Department Of Navy (DoN)

Automatic Identification Technology (AIT) Instructional Guide

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MEMORANDUM FOR DISTRIBUTION

Subj: DEPARTMENT OF NAVY (DON) AUTOMATIC IDENTIFICATION TECHNOLOGY (AIT) INSTRUCTIONAL GUIDE

1. The Navy is implementing AIT in support of Total Asset Visibility (TAV) in accordance with applicable Commercial and Department of Defense (DOD) policy, plans, standards, and regulations. This AIT Instructional Guide was developed to assist Navy Program Executive Officers (PEOs), Program Managers (PMs), and Systems Integrators in the integration of AIT into Navy business processes And the DOD Supply Chain pipeline.

2. The Navy Logistics AIT Implementation Plan requires all Navy Command sot use Linear and Two dimensional bar coding on all part and packaging to accurately capture source data for transmission to an AIS. This guide has been developed to provide assistance in achieving this goal and to facilitate other AIT media use within the Navy.

3. The Naval Sea Systems Command (NAVSEA), Naval Air Systems Command (NAVAIR), Naval Special Warfare Command (NAVSPECWAR), and Naval Supply Systems Command (NAVSUP) all believe AIT has significant cost avoidance/savings potential for the Navy. The AIT program is accomplishing a goal that has existed since the beginning of logistics management – tracking individual components through the supply chain. The insertion of AIT supports asset visibility and provides automated access to supply, transportation, maintenance, medical, HAZMAT, and usage history.

4. The AIT Instructional Guide is a living document that will be updated on an as required basis. Please provide comments or updates to the instruction guide point of contact Ms. Lorrey Bentzel, NAVSUP 4C1B, Commercial (717) 605-6724, DSN: 430-6724, and e-mail, Lorrey_J_Bentzel@navsup.navy.mil

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Foreword

The purpose of the Navy AIT Instructional Guide is to identify goals and specific steps required for the Navy to revolutionize its policies and business processes for automating source data capture and integrating information into Logistics decision-making processes.

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1. Purpose

This document is prepared as a road map for program, project and functional managers, process owners, and other technical and support staff to be used when initiating an Automatic Identification Technology (AIT) Project. This information is designed to support those individuals in preparing contract and project design requirements documents. Recommend the Navy AIT Project Office be contacted by anyone that is considering an AIT implementation; thoroughly review this guide and the selection process criteria.

2. Background

AIT is not a system; AIT automates collection and transmission of data to Automated Information Systems (AIS). Automation works. There are many examples in government and private industry that shows automation is a crucial cost and time saving tool. Today, we witness the use of automation at grocery, warehouse, distribution, and retail stores. There are numerous Navy prototyped and implemented projects that have prove the efficiencies of logistics business process automation and reengineering.

These projects show:

- Substantial reduction in time to inventory items (45% or greater)
- Advanced AIT is capable of operating on Naval vessels (e.g. Radio Frequency (RF) technologies) without interference to or from the ship systems.
- Reduction in effort to process receipt, pick, pack, ship, stow or move materials afloat and ashore (in excess of 50%)
- Significant time savings in processing materials through the use of RF systems

DOD agencies realize the benefits of AIT within many system designs, several are:

- DLA, using RF Data Communication (RFDC) with DSS.
- US Army, using RF Identification (RFID) throughout Europe and parts of Asia for trans-shipment.
- US Marines, using two-dimensional bar codes and RFDC with Asset Tracking Logistics and Supply System (ATLASS) II+.
- Navy, NAVAIR implementing Contact Memory Buttons (CMB) on selected aircraft.

More information on AIT projects can be obtained at the Navy AIT Project Office Internet web site (www.Navy-AIT.com) that catalogs lessons learned and performance benefits from organizations implementing AIT; also refer to the

contact information provided in Appendix D and the DOD Logistics AIT office (www.DODAIT.com).

3. Scope

This guidebook describes the necessary an AIT selection process and suggests issues that should be considered and resolved before proceeding with a project. We have identified potential problems AIS owners can encounter when developing a reengineered process with AIT.

Chapter 1: AIT Framework

The AIT framework is a structure for supporting the integration of data collection hardware and AIT software for the rapid identification, sorting, and maintenance history of any product or commodity. This framework supports asset visibility by capturing and transferring data from initial manufacture to its ultimate consumption or disposal.

1-1. Framework Qualifiers

This section identifies combined components that make-up an AIT Framework. Strive for interoperability, compatibility, maintainability, and interchangeability goals Joint Visions 2010/2020. In an AIT Framework, we will identify policy, standards, implementation plans, and short and long-term goals.

1-1.1. Policy before Standards

The DOD Logistics AIT Office located at the Defense Logistics Agency (DLA) is the executive agent of the Logistics AIT program office responsible for developing a DOD Logistics AIT Framework. This Framework will identify the data, technology, compliance, conformance, and application standards adopted by DOD that will allow the Military Services to implement an infrastructure to support the Long-Term Goals identified below. The Navy is participating in the development of this Framework and will be required to implement this policy, in support of Joint Logistics Operations.

1-1.2. Standards before Implementation

As DOD adopts and incorporates the Logistics AIT Framework into policy it is paramount for the Navy to review existing requirements documents for the various business processes (strategic) and AISs (operational) to integrate AIT (tactical). Immediate focus must be placed on the processes and systems to accept data seamlessly and not only on the capabilities of recent AIT technological advances. Compounding this issue is the Navy's implementation of large-scale process/system reengineering efforts such as Enterprise Resource Planning (ERP)

simultaneously with DLA instituting ERP. DLA and the Navy must ensure processes and data are standardized to assure interoperability and compatibility between logistics systems.

1-2. Long-Term Goal (5 years and greater)

Providing the war-fighter Information Interoperability across all logistic functional areas to enhance decision-making.

This is accomplished by providing the war-fighter:

- Joint Asset Visibility in the following areas:
  - Mobility
  - Transportation
  - Movement
  - Logistics (Supply, Maintenance, Engineering, etc.)
  - Personnel and Force Health Protection
  - Acquisition and Finance and
- Joint Decision Support Tools (i.e., Collaborative Planning, Course of Action Development and Course of Action Analysis)

AIT devices collect data and feed that data to the end user/Global Combat Support System (GCSS)-Global Command and Control System (GCCS) war-fighter. The user's display consists of a single picture - the combat support logistics picture fused and integrated with the command & control picture. This becomes a decision-making tool, providing Real-Time Situational Awareness of the battlefield.

1-3. Short-Term Goal (3-5 years)

Develop a process to accept standardized data to commercial industry allowing this seamless data into AISs. Institutionalize the Information Integration Process outlined above through adherence to DOD and Navy policy.

One objective is to support identifying requirements to design and develop DOD Logistics AIT Framework to be enacted into policy (i.e., directives, instructions, regulations, etc.).

This AIT environment will include the proper mix of technologies that enables users to efficiently and effectively capture, aggregate, and transfer data (i.e., acquisition, supply, maintenance, transportation, etc.). The environment includes AIT hardware/software and, AISs with supporting databases, interfaces connectivity, and the architectural infrastructure (i.e., networks, power, security, etc.) that effectively integrates these elements.

Chapter 2: AIT Selection Process

The Navy AIT Project Office has developed a process to AIT projects. The decision to implement AIT is essentially a decision to evaluate or perform process reengineering to achieve economic benefits. For this reason it is imperative that a valid business process and cost analysis be completed before ascertaining as a viable project direction.

The remainder of this section details the process flow diagram illustrated in Figure 2-1 on the following page. This evaluation method is designed to establish the necessary documentation and knowledge base to facilitate an informed decision in pursuing an AIT project and the ability to support the project with current and estimated future improved performance measurements.

To assist in understanding exactly how the organization can benefit from this process, every step in the flow chart has a detailed description of the effort and product derived.

It should be noted preliminary Hazards to Electro-magnetic Radiation to Ordnance (HERO) releases for use onboard ship or in proximity of ordnance **are required** for all projects using RF equipment.

AIT Implementation Process Flow Diagram

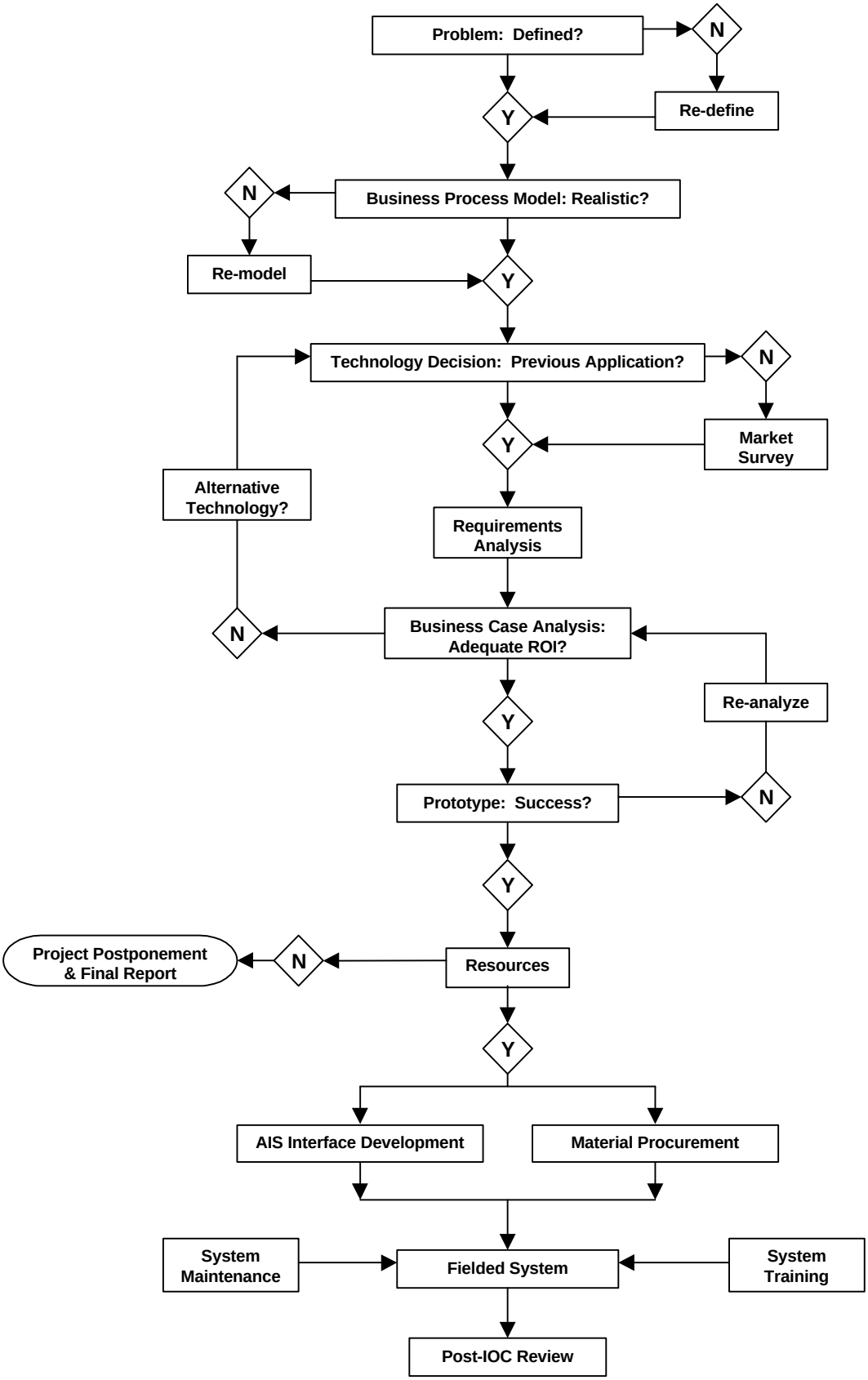


Figure 2-1: Decision tree process for AIT projects.

2-1. Problem definition

Identify specific problems associated with current system or process that could be improved with accurate and timely data capture, transfer, AIS data that could aid the decision making process for movement of material. Be specific and use examples when possible. Take care not to describe symptoms of a larger or hidden problem. Drill down until you define the problem itself. Proper definition may indicate that an AIT solution is not the best solution.

As an example:

- An internal audit shows a greater than 4% of exceptions generated when processing material or,
- It has become evident that, including birth record data could elevate 20% of the maintenance processing time at the depot.

2-1.1. Define/Develop a Business Process Model

Definition of the current business process is essential to developing a process model. The process analysis should document every step, all the information, and how it's used. Source data for the process analysis can be policy documents, work instructions, and physical sight analysis. This process analysis will be the entry data used for the process model and will assist in identifying those areas where automation could help.

The business process model is a blueprint depicting how your system or process should ideally operate. This is the "vision" that the proposed process will achieve. AIT is not a system alone, but an enabler to an AIS. Automation may be employed to realize specific benefits but shouldn't be looked upon as the only change required to meet the goal.

2-1.2. Select Appropriate Technology

The different families of AIT are suited for different applications and the costs associated with their benefits can vary greatly. Evaluate existing DOD and other service AIT/AIS capabilities to eliminate duplication of work effort assure solution does not already exist for the problem or improvement your system has. Once its been determined an existing capability does not exist, the Navy AIT Project Office can help with conducting a thorough market survey to assess current technology and any emergent technology that is applicable to your defined problem. Pay close attention to industry case studies and past or ongoing service projects that may apply to your system.

Pay close attention to the AIT impact on the scalability of the AIS. The automation technology should not become a factor when future enhancements are required. Refer to Appendix A for more information on what to consider when selecting an AIT.

As an example:

- Why choose a linear symbol for processing a key document (which could not support additional data elements given the size constraints of the document), when a two-dimensional symbol could accommodate numerous expansions, or
- Why choose a contact memory button to record maintenance data on a DLR to support field activity repair, when the reprogramming and hardware costs could web enable the system to provide a more economical access to the data.

2-1.3. Develop Requirements

Requirements development is based on thorough analysis of the process model. Requirements can be explained as the minimum process or technology achievements that must be incorporated to meet the desired goal. Functional requirement analysis to capture the process flow, associated cost for specific components of the process. The findings of the functional requirements are the source data to initiate a business case analysis.

As a requirements example:

- End user training and refresher training on AIT hardware and software.
- A requirement to have the AIS sort received material by its storage location in the warehouse and having the user scan the material and the location number to validate its stowed position.
- HERO, Frequency Allocation, and Host Nation Approval (HNA) for RF equipped AIT.
- Site Survey of the warehouse to determine RF access point mounting locations and eliminate possible dead zones.

2-1.4. Conduct Initial Business Case Analysis (BCA)

It is important to note that an effective BCA is neither long nor detailed; the logic applied to the BCA is more important than its length. The BCA is key for the following reasons:

- Documenting the current requirements and constraints that influence a decision, and providing the key historical perspective when performing a return on investment.
- Effectively communicates and justifies the need for changes in business process.

Appendix B is an example of a BCA format.

2-1.5. Develop software interfaces as required

The requirement analysis should identify any new or existing software applications and legacy system databases that the proposed system must interface. Care must be taken to identify all proprietary software, as this will affect system scalability and life cycle costs. Ensure those AIS owners, network security, and user stakeholders are involved in the interface development process. If possible, conduct prototypes (if new application of technology), procure and integrate the minimum amount of hardware and the required

software to conduct a valid, limited system prototype in a controlled setting. Although not mandatory, prototypes help mitigate risks associated with operating Commercial Off the Shelf (COTS) AIT products in the Navy. Develop and adhere to a detailed test plan and document test results. Update the BCA to reflect the results obtained in the limited prototype demonstration. Close attention should be paid to prevent overly optimistic performance estimates that create false return on investment forecast.

2-1.6. Identify and Obtain Resources

At this time, funding for fielding AIT implementations for operational use remains the responsibility of the sponsoring command. The Navy AIT Steering Group (SG) maintains a small budget to assist AIS owners with proof-of-concept projects to validate new or innovative uses of AIT. Persons interested in submitting a proposal for the Navy AIT SG should first view the Navy AIT Project Office website for specific procedures and point of contact. Upon completion of the BCA and prior to developing software or conducting a prototype, the originator will need to obtain or have assured a sponsor for the intended project before proceeding.

2-1.7. Procurement

Preliminary Hazards to Electro-magnetic Radiation to Ordnance (HERO) releases for use onboard ship or in proximity of ordnance **are required** for all projects using RF equipment. The Navy AIT Project Office does assist organizations with preparation of hardware and software orders. The Navy AIT Project Office recommends programs begin the procurement based on a limited prototype demonstration. Whenever possible and the requirements are fitting, AIT hardware/software should be obtained using the AIT contracts available through the Army's Product Manager (PM) AIT (www.eis.army.mil/ait/home.htm) who provides centralized procurement and management services for AIT. Consideration to the level of effort with adapting legacy systems to AIT hardware must thoroughly be assessed and performed in a partnership with the Central Design Agency (CDA).
The Navy AIT Project Office contains information on the use and reutilization of AIT equipment through the Navy AIT Support Plan (visit the Navy AIT web site for more information).

2-1.8. Training

Any AIT project will have to account for the costs associated with operator and maintenance training. Successful AIT implementations will account for familiarization training at the time of implementation complemented by sustainment or follow-on training in the appropriate form (Computer Based Training (CBT), internet, schoolhouse, training teams, train-the-trainer, etc.). The requirement analysis must identify the appropriate training required.

2-1.9. Installation (full implementation)

Other than frequency allocation, HERO certification, and Host Nation Approval (HNA) approvals for RF systems, Navy Marine Corp Intranet (NMCI) and Information Technology for the 21st Century (IT21) programs must be consulted for implications on the installation of AIT on both afloat and ashore systems. Planning for the installation must account for schedule impact to operational units, a fail-safe mechanism to mitigate risk of AIT non-performance, and transitional impacts from one process to another.

2-1.10. Systems Maintenance

AIT hardware/software maintenance requirements for the life cycle of the system need to be incorporated in the planned implementation and, most importantly, consolidated within the system that the AIT is integrated. AIT maintenance should not be considered a stand-alone requirement but inclusive of the overall system life cycle effort. Such life cycle support costs that are frequently overlooked are consumable materials (such as bar code label stock, printer ribbons, print-head cleaning, and battery maintenance for hand-held devices).

2-1.11. Post Initial Operating Capability BCA Review

At a pre-determined interval identified within the original BCA, an assessment of the actual results obtained with the AIT as compared with the business process model will be conducted. The purpose of this is two-fold, first to provide feedback on the AIT implementation that will serve to foster process-oriented “lessons learned” for future implementations and, secondly, to provide an archive of empirical data to improve the analysis of costs/payback for AISs that use AIT.

2-1.12. Navy AIT Project Office Data Requirements

As the executive agency for Navy AIT, The Navy AIT Project Office requires programs implementing AIT into new or legacy systems to complete a monthly report of progress. This report is intended to be completed and submitted in electronic format, the file can be downloaded from the Navy AIT website. Points of contact for questions are also listed on the website or in appendix G. In addition the Navy AIT Project office provides support tools for first-time AIT programs to use in getting started (such as the Implementing an AIT Project file (in MS Project 2000)) can also be downloaded via the Navy AIT website.

Chapter 3: Automatic Identification Technology

3-1. Identification Technology

3-1.1. Bar Code

Bar codes are by far the most familiar use of AIT. As cited earlier, few things in our personal lives don't contain a linear Universal Product Code (UPC) bar code. There are currently several dozen different bar code symbols used in commercial industry. Many of these symbologies are industry specific, developed by, and used for certain processes to meet a technological requirement. As more industries realized the cost and time benefits of bar coding, formats and data capacities have evolved. Currently there are linear and two-dimensional (or 2D) bar codes the DOD has selected as "DOD Standard" in this section. Table 3-1 illustrates some of the typical business areas bar coding might be used.

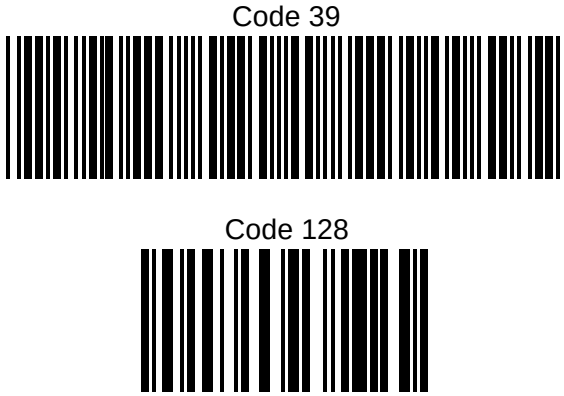
Transportation	Manufacturing	Security	Financial	Other
Retail	Process Control	Access Control	University Cards	Animal Identification
Container ID	Assembly Line ID	Auto Immobilizer	Automated fueling	Gas Cylinder ID
Airline Transponder	Configuration Management	Baggage Tag	Ski Tickets	Medical Device ID
Pallet ID	Factory Automation	Boarding Pass		Membership Cards
Parking Control	Paint Shop	Fleet Management		Patient ID (Infants)
Rental Car	Inventory Control	Security Areas		Time & Attendance
	Maintenance Logs	Vehicle Access		
	Tool Marking			

Table 3-1: Typical Bar Coding Application Areas.

3-1.1.1. Linear Bar Code

The most basic form of part and package marking and identification is a linear bar code. Linear bar codes are a series of bars and spaces to create a bar code symbol. Linear bar codes have limited data storage capacity and rely on the existence of a flat surface. Linear bar code applications require the existence and availability of an external database to support business processes. The bar code usually identifies a data element, such as a document number or transportation control number (TCN), and serves as an automated key to information pre-positioned in an AIS database. DOD recognizes the two standard linear bar codes shown below. Code 39 bar code, in use since the mid 1970s, is the principal DOD bar code. MILSTAMP requires its use on all Military Shipping Labels (MSL).

There is a second DOD standard linear barcode, Code 128. This code was developed in 1981 and is becoming increasingly popular with commercial users. While similar to a Code 39 bar code, it is significantly different. It is a double density code, meaning it encodes two numeric digits as a single character, allowing the encoding of more data in the same space. Numeric Code 128 is 47% smaller than Code 39 while alphanumeric Code 128 is 23% smaller. Although DOD accepts Code 128 as standard, there are currently few applications. Currently in the DOD, no linear bar codes have imbedded data identification or Data Identifiers (DI) (more on "DIs" in chapter 4). The DOD bar codes are commonly referred as being "naked" because they cannot tell if 17 Characters represents a Transportation Control Number (TCN) or a serial number. Currently when DOD scans linear bar codes, the linear bar codes must be scanned in sequence for the information to go seamlessly into the AIS.

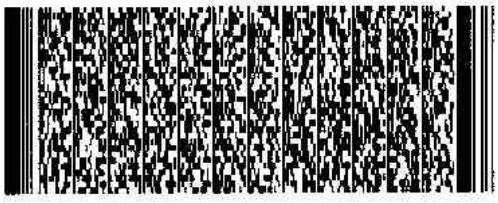


Linear Bar Codes –Encoding 1234567890

3-1.1.2. Two-Dimensional Bar Code

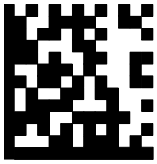
Two-dimensional, High Capacity symbols get their name from the fact that they store data in two directions—vertically and horizontally. They store significantly more data than linear bar codes, thus facilitating applications that are more complex. While most linear bar code applications require the existence and availability of an external database to support business processes as discussed above, 2D High Capacity symbols may function as a portable data file that travels with an item. They have error correction features. They can sustain considerable damage and still be read.

Currently the most commonly used 2D high capacity symbology within DOD is the PDF417 symbol and it is composed of a stack of bar-code rows, ranging from a minimum of 3 rows to a maximum of 90 rows. A symbol can encode approximately 1850 alphanumeric characters and approximately 960 numeric. This symbology was initially used by DLA in 1998 to store and transfer Transportation Control and Movement Document (TCMD) and Issue Receipt Release Document (IRRD) data on MSLs for individual shipments and for consolidated shipments involving eight or less line items. All DOD shippers were required to use 2D MSLs by the second quarter of FY02. The PDF417 symbol requires a 2D bar code scanner.



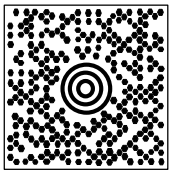
PDF417 Two-dimensional high capacity symbology

Data Matrix is a high capacity matrix symbology popular for marking small items such as integrated circuits, printed circuit boards, and parts. A Data Matrix symbol can encode up to 2,000 characters. There are currently no DOD applications for Data Matrix, but it is being evaluated as the standard symbol for product marking of parts and components. The consumer electronics industry and the automotive industry started using this symbology to identify specific vendor, part number, and trace ability codes in mid 2001. The Consumer Electronics Association (CEA), Telecommunication Industry Forum (TCIF), Automotive Industry Action Group (AIAG), and Air Transportation Association (ATA) industries use the Data Matrix symbology. The Data Matrix Bar Code requires a special image scanner.



Data Matrix

Maxi code is a medium capacity matrix symbology especially designed for high-speed scanning package sorting and tracking. A symbol can encode up to 93 characters. United Parcel Service (UPS) initially introduced it in 1992. Although DOD accepts Maxi code as the standard for logistics sorting applications, there are currently no DOD applications other than by DLA for UPS shipping. The Maxi code bar code requires a special image scanner.



Maxicode

3-1.2. Contact Memory Button (CMB)

Contact memory buttons (CMB) are being used in both military and commercial applications. These are high capacity AIT. They are used to track high value maintenance items throughout their life cycle recording and maintaining inventory as well as maintenance management information. CMBs are high capacity storage devices that are made to be extremely durable. They range in physical size and memory capacity. Typical CMB specifications are listed in table 2.

	Height	Diameter	Weight	Memory
Micro	2.2 mm	5.6 mm	0.17g	4KB
Mini	2.8 mm	14.3 mm	0.77g	128 B, 256 B, 2 KB, 8KB, 32KB
Standard	5.3 mm	24.7 mm	4.0g	128 B, 256 B, 2 KB, 8KB, 32KB
Mega	5.3 mm	28.6 mm	5.0g	1 MB, 2MB

Table 3-2: Navy Contact Memory Button characteristics

There are a number of mechanical and adhesive products that can be used to attach a CMB to an item. Numerous vendors make collars, clips, fobs, and brackets for mechanical attachment. One adhesive product currently in use on Navy helicopters is HYSOL: EA 9394 LOCTITE CORPORATION: Ultra Copper RTV Silicone Gasket Maker, an approved epoxy to bond the contact memory buttons to the surface part. The following table illustrates common business areas CMB's might be used.

Transportation	Manufacturing	Security	Financial	Other
Container ID (HazMat)	Assembly Line ID	Access Control	Electronic Cash	Animal Identification
Pallet ID	Management	Electronic Keys	Payphone token	Gas Cylinder ID
	Configuration	Security Areas		Time & Attendance
	Inventory Control			
	Maintenance Logs			

Table 3-3: Typical Contact Memory Button Application Areas.

3-1.3. Radio Frequency Identification (RFID)

Basic RFID systems consist of three components: an antenna (or coil), a transceiver (with decoder), and a transponder (commonly called an RF tag) that is electronically programmed with unique information.

The antenna emits radio signals to activate the tag and read and write data. Antennas are the conduits between the tag and the transceiver, which controls the system's communication. Antennas are available in a variety of shapes and sizes. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected. If constant interrogation is not required, a sensor device can activate the field.

Often the antenna is packaged with the transceiver and decoder to become a reader (a.k.a. interrogator), which can be configured either as a handheld or as a fixed-mount device. The reader emits radio waves in ranges of anywhere from one inch to hundreds of feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing.

RFID tags come in a wide variety of shapes and sizes. Passive RFID tags operate without a separate external power source and obtain operating power generated from the reader. Passive tags are consequently much lighter than active tags, less expensive, and offer a virtually unlimited operational lifetime. The trade off is that they have shorter read ranges than active tags, require a higher-powered reader, and usually have less memory. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) or "license plate" information that cannot be modified.
Active tags operate with an integral power source and can achieve ranges to several hundred feet. The trade off for these systems is size, cost, and infrastructure. Other influencing factors are Hazards of Electro-Magnetic Radiation to Ordnance (HERO), Personnel (HERP), and Fuels (HERF). Active RFID systems have the ability to store large amounts of information. Both of these types of RF systems require business process

reengineering to accommodate the automated data reading and writing. Table 4 illustrates some of the business areas RFID might be used.

Transportation	Manufacturing	Security	Financial	Other
Airline Transponder	AGV Control	Access Control	Electronic Cash	Animal ID
Container ID	Assembly Line ID	Auto Immobilizer	Automated Fueling	Finish Line
Global Positioning	Configuration Management	Baggage Tag	Payphone Token	Gambling Token
Pallet ID	Factory Automation	Boarding Pass	Ski Tickets	Gas Cylinder ID
Parking Control	Forklift Positioning	Electronic Article Surveillance	University Cards	Laundry Tracking
Toll Collection	Inventory Control	Electronic Keys		Loyalty Programs
Traffic Management	Maintenance Logs	Fleet management		Medical Device ID
Truck Fleet Tracking	Paint Shop	People Locating		Membership Cards
	Process Control Security Areas	Security Areas		Mining
		Theft prevention		Patient ID (Infants)
		Vehicle Access		Rail Car ID
		Vehicle Movement		Time & Attendance

Table 3-4: Typical RFID Application Areas.

3-1.4. Optical Memory Card (OMC)

The credit card sized OMC uses Write Once Read Many (WORM) optical recording technology. This allows data to be added or updated, but never deleted or erased. The optical media is encapsulated between transparent, protective layers of polycarbonate plastic. To record data, an optical card drive uses a laser to 'burn' physical spots on the reflective optical media, similar to CD-ROM recording technology, but with the ability to add more data at any time until the card capacity is reached. DLA uses the cards with material shipping. The 4.1 megabyte data capacity is reduced to 2.8 megabytes due to the Error Detection And Correction (EDAC) model. Optical card reader/writer is an external device that can add cost in both procurement and integration. Currently OMCs are provided by DLA to organizations requesting them. These devices are populated with shipping information identical to that found on the DD1387 (Military Shipping Label). Users of this technology must establish a system to return the cards back to DLA for

reuse. The following table illustrates some typical OMC application areas. There are currently no applications within the Navy that use OMC.

Transportation	Other
Container ID	Inside the Box Visibility
Pallet ID	

Table 3-5: Typical OMC Application Areas.

3-1.5. Radio Frequency Data Communication (RFDC)

RFDC is not an AIT, rather a form of wireless networking. Many AIT handheld devices are enabled with RF functionality and for that reason a brief description is provided. RFDC utilizes a Radio Frequency medium to transmit and receive application data from a data collection or handheld device (HHD) (the client) to a host computer (the server). This technology is offered in different frequency ranges, either of which has benefits and tradeoffs. Most RF capable handheld devices have the RF circuitry built into the unit. The network or server side requires an RF Access Point (AP) to facilitate the RF signal between the HHDs and the server. Between the server and AP utilizes standard TCP/IP technology capable of managing several dozen HHDs. However, the communication between the AP and HHD is proprietary, where two manufacturers' handheld units are not capable of sharing information on the same wireless network. Numerous security and network issues must be considered when integrating an RFDC solution to any business process. No RF project should be attempted without a through business case analysis and a clear cost benefit and return on investment.

3-2. Part and Package Marking Technology

Modification to current part marking is appropriate to reduce Navy and DOD reliance on standards that are unique to the military and adopt standards commercial manufacturing and service industries already use in their operations. Adoption of the ANSI MH10.8.2 and 8.3 standards will achieve economies in the expenditure of resources and improve the timeliness and accuracy of information flow.

3-2.1. Part Marking

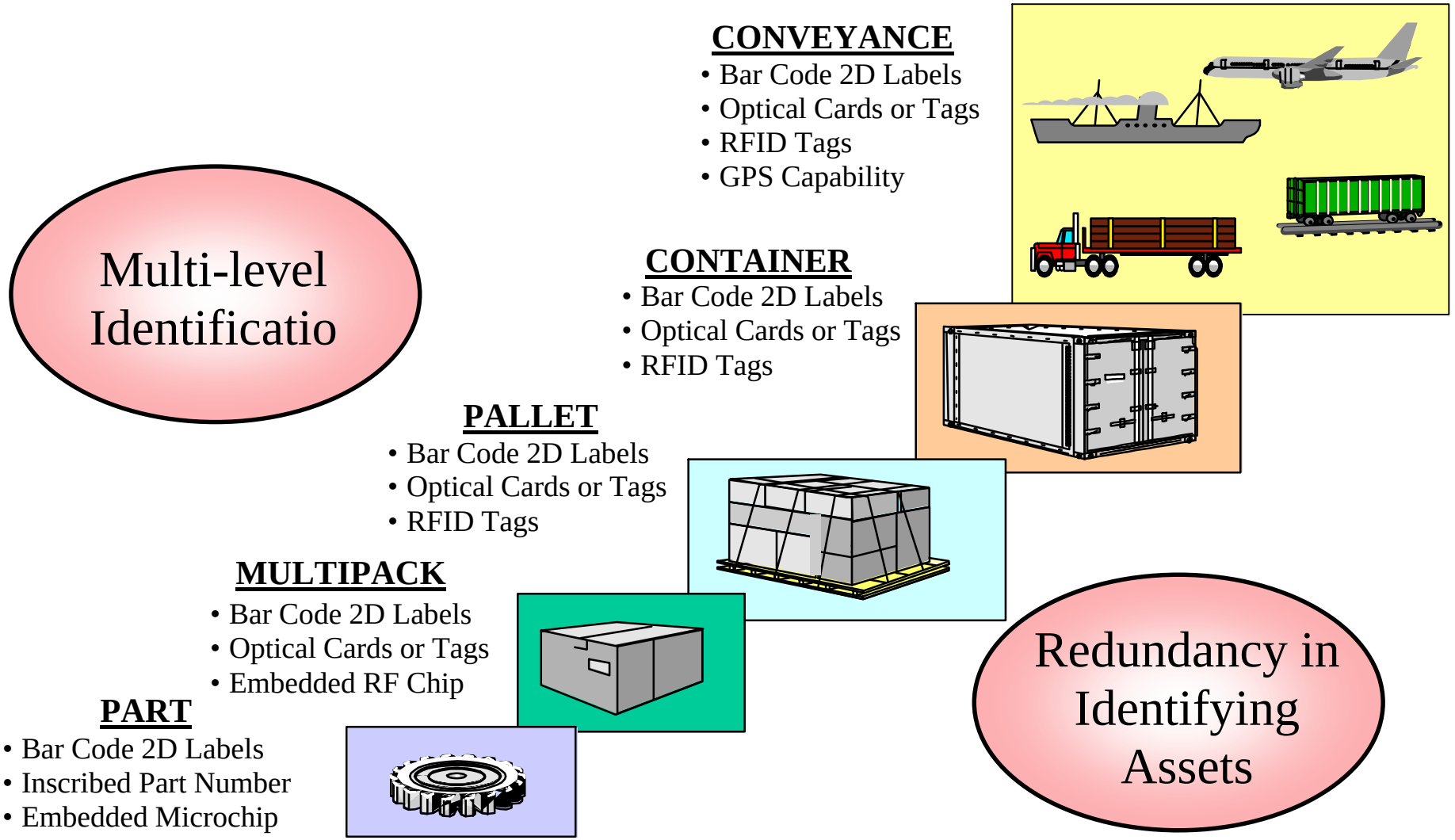
The Navy AIT Project Office has produced a Navy Standard Practice for Park Marking; this document is available for download from the Internet at the Navy AIT Project Office website (www.navy-ait.com). This standard practice was prepared based on the current modifications to the MIL-STD-130.

3-2.2. Package Marking

The Navy Standard Practice for Package Marking (also available on the Navy AIT website) is proposed to establish the machine-readable (e.g., bar code) and human readable data content of labels applied to product packages, using the ANSI data

standards. This standard practice was prepared based on the current modifications to the MIL-STD-129.

*Supply Supports Maintenance Actions by Using Many Types of AIT**



* Requires further policy and standards definition.

Figure 3-1: Types of AIT used in maintenance actions

Chapter 4: Standards

4-1. Data Standards

Commonality and standardization of technology and data elements is essential to achieving any benefits from process automation. Current Navy processes are specifically engineered to make up for the lack of data standardization. Every bar code produced by Navy systems today is "naked." A good example of naked bar codes are the three linear bar codes on the DD 1348-1A. Users processing material with the DD 1348-1A must scan the bar codes in a specific order; first as document number, second as stock number, and third as unit of issue. If the bar codes contained an imbedded code to identify each data element, this could eliminate many unnecessary errors. Additionally if we used 2D bar codes with the same imbedded codes, someone scanning the 900 (plus) characters could immediately find the data they were looking for. This can be done regardless of the data's physical location or order within the AIT medium.

4-1.1. ANSI Standard

The American National Standards Institute (ANSI) established ANSI MH10.8.3 *Data Syntax and Semantics for High Capacity AIT Technologies*. Historically, AIS systems are engineered to specifically decoded and parse data on individual cases. The ANSI standard defines a single mapping method regardless of which high capacity AIT media is employed. Once the mapping is defined within the AIS, it can be used on all AIT media and able to parse specific data elements. This method is defined by syntax and semantics. The decision to recommend these commercial standards is based on several guiding principles. They are:

- Published governmental policy to adopt commercial standards
- Achieving future economies through adopting technologies that DOD vendors and contractors use in their systems
- It is a practical technology to ensure the greatest benefit to the greatest number of Navy stakeholders
- A technology is applicable regardless of the storage mediums that host it.

4-1.1.1. Data Semantics

Data semantics are handled and processed in much the same way we process mail. The data is encapsulated with a message envelope. The envelope format stipulates the data semantics. The message is processed in stages; first, the message envelope is processed, second, the message format is determined and third, the message is parsed. The data semantics are built on a library of formats. Each format contains specific list of Data Identifiers (DIs). See Figure 4-1 for an illustration.

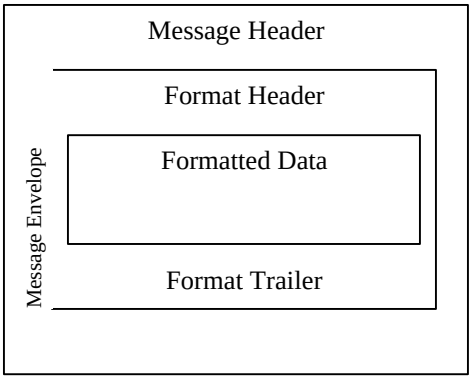


Figure 4-1: Example enveloping of data formatting using data

4-1.1.2. Data Syntax

As stated previously data formatted in accordance with the ANSI MH10.8.3 standard is encapsulated within a format header and trailer indicators. The standard identifies 100 data format indicators, of which only ten are currently used. Table 6 reflects the format indicator structure.

Format Indicator	Format Description
00	Reserved for future use
01	Transportation
02	Complete EDI message / transaction
03	Structured data using ANSI ASC X12 Segments
04	Structured data using UN/EDIFACT Segments
05	Data using EAN/UCC Application Identifiers
06	Data using FACT Data Identifiers
07	Free form text
08	Structured data using CII Syntax Rules
09	Binary data (file type) (compression technique) (number of bytes)
10	Reserved for future use
11	Structured data using ASN.1
12-99	Reserved for future use

Table 4-1: Format Structure of the ANSI MH10.8.3 Standard.

Primarily, DOD utilizes formats 06 and 07. Format 07 is used for DOD-specific data identifiers that are DIs not part of the commercial standard. Those DIs can be found on the DOD Logistics AIT Office web site (www.DODait.com) under the *Documents – Reference* link (titled: *DOD Non-Commercial Data Identifier Document*). The applicable format 06 and 07 DIs are listed in Appendix D. For more information on specific DIs or these standards, contact the Navy AIT Project office (www.navy-ait.com) or ANSI (www.ansi.org).

4-1.2. DOD Unique Data Identifiers

Although the DOD is vigorously pursuing commercial AIT standards, several data elements required for DOD's non-commercial business processes do not exist in the commercial standards. The DOD Non-Commercial Data Identifier Document lists these data elements for use in DOD AIT data formats. This is a dynamic document requiring periodic update as users receive new or modified Data Identifiers. A process flow describing the process users may use to obtain new or modified data identifiers is in the coordination process within the AIT Project Office. The latest version of the document can be obtained via the Internet at the DOD Logistics AIT Office website (www.dod-ait.com).

4-1.3. Navy Supply Data

Current guidance establishes the three code 39 linear and one 2D bar codes as the standard symbologies for the automated marking and reading of items of supply, equipment, material packs, and containers in logistics operations throughout the DOD. The symbology is to be applied in accordance with MIL-STD-129. Figure 4-2 illustrates the Issue Release Document (IRD) DD 1348-1A with its linear and 2D bar codes. The information coded within the 2D label is provided in the table 4-2.

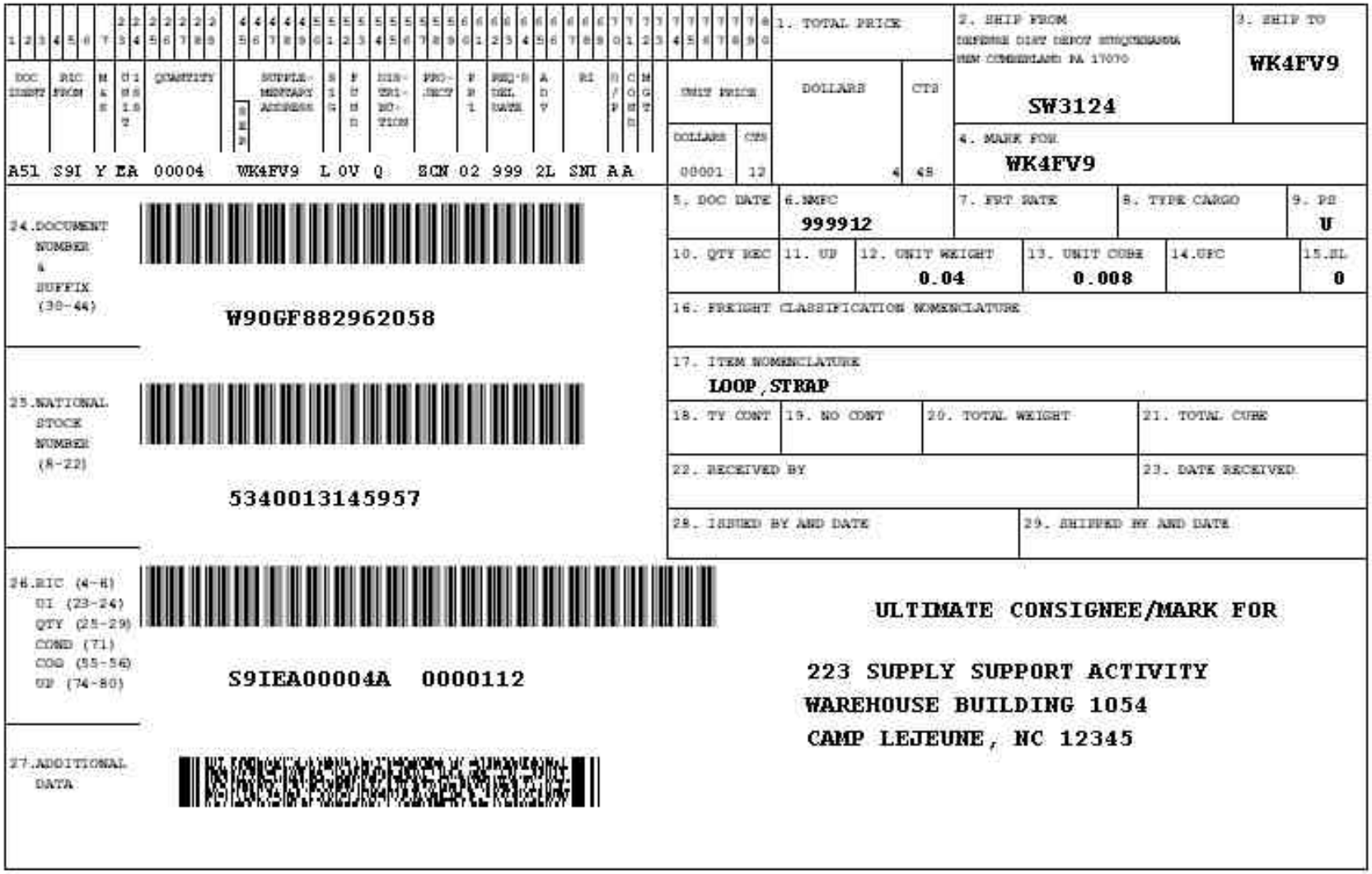


Figure 4-2: DD1348-1A

Compliance Character	Data Identifier/ Data Element Identifier [1/]	Data Field (DOD Usage)	Data Format (Type/Length)	Sample Data (Identifier and Data Field)	Element Separators	Total Characters [2/]
[]>		Format Header Text	a3	[]>	RS	4
06		**Data Identifier Format** (ANSI Standard)	n2	06	GS	3
	12S	**Document Number** Includes Suffix Code when applicable	an14..an15	12SM1200120010001A	GS	19
	N	**National/NATO Stock Number (NSN) or Stock Identification Elements** May reflect NSN, CAGE Code/part number, FSC, etc., as applicable. May also include associated coding, e.g., Type of Pack, USN Special Material Identification Code (SMIC) or USAF Materiel Management Aggregation Code (MMAC)	an..15	N7420014522690	GS	17
	7Q	**Quantity and Unit of Issue** Do not include leading zeros	An..5+an2	7Q1EA	GS	10
	V	**Routing Identifier Code**	an3	VML1	GS	5
	2R	**Condition Code**	an1	2RA	GS	4
	12Q	**Unit Price** Configured as ***5*** digits whole dollars, decimal, and 2 digits cents followed by "USD" indicating U.S. dollars. Do not include leading blanks.	n..5.n2+an3	12Q1234567.90USD	GS	14
	5P	**National Motor Freight Classification Commodity Number**	n6	5P999912	RS	9
07		**Data Identifier Format** (ANSI Free Text)	n2	07	GS	3
	03	**Project Code**	an3	031CF	GS	6
	B6	**DOD Distribution Code**	an3	B6_7V	GS	6

[1/] "**Data Identifiers**" (Compliance Character 06) pertain to American National Standards Institute (ANSI) authorized data elements. Refer to ANSI MH10.8.2, American National Standard for Material Handling, for additional information. "**Data Element Identifiers**" (Compliance Character 07) pertain to DOD authorized data elements. Refer to www.DODait.com for additional information.

[2/] "**Total Characters**" reflects length of data identifier/data element identifier + data field + element separator.

		Three-position field must reflect blanks as applicable. Blanks may be located in any position.				
	27	**Consignee DODAAC** Reflects ship-to DODAAC (Block 3)	an6	27M12001	$^{G}_{S}$	9
	38	**Nomenclature**	an..20	38Oil_Filter	$^{G}_{S}$	23
	32	**Required Delivery Date (RDD)** May reflect RDD in DDD format or special codes, e.g., expedited shipment and handling (Code 999), Not Mission Capable Supply (NMCS) (Code N__), etc.	an..3	32999	$^{G}_{S}$	6
	B7	**Requisition Priority Designator (PD)**	n2	B703	$^{G}_{S}$	5
	B8	**Partial Shipment Indicator**	a1	B8P	$^{G}_{S}$	4
	81	**Supplementary Address** Derived from rp 45-50 of the requisition	an6	81M12003	$^{R}_{S}$ **EOT**	10
Total Characters Required Including Formatting						157

Table 4-2: Data elements within the DD 1348-1A 2D bar code.

All data identifiers are alphanumeric characters.
a = Alphabetic Data
an = Alphanumeric Data
n = Numeric Data
.. = Variable Length (up to maximum shown)
$^{R}_{S}$ = Nonprintable hexadecimal code indicating next entry is a new compliance character indicating a new data identifier format follows
$^{R}_{S}$ **EOT** = Nonprintable hexadecimal code indicating end of transmission
_ = Denotes a blank in sample data above

Sample data stream:
[)>$^{R}_{S}$06$^{G}_{S}$12SM1200120010001A$^{G}_{S}$N7420014522690$^{G}_{S}$7Q1EA$^{G}_{S}$VML1$^{G}_{S}$2RA$^{G}_{S}$ 12Q1234567.90USD
$^{G}_{S}$5P999912 $^{R}_{S}$ 07$^{G}_{S}$031CF$^{G}_{S}$B6 7V$^{G}_{S}$27M12001$^{G}_{S}$38Oil Filter$^{G}_{S}$32999$^{G}_{S}$B703$^{G}_{S}$B8P$^{G}_{S}$ 81M12003 $^{R}_{S}$ **EOT**

Sample PDF 417 symbol (contents do not match above data stream - for illustrative purpose only):

(Estimated Size)

4-1.3.1. Navy Transportation Data

The following minimum human readable data requirements and 3-of-9 linear bar code will be placed on each Military Shipping Label (MSL) DD Form 1387, see Figure 4-3 for example.

Figure 4-3: Example MSL for Generic Shipment.

- Transportation Control Number (TCN)
- Postage Data or Transportation Account Code (TAC) applicable to shipments moving by the DTS from Point of Entry (POE) to Point of Departure (POD), otherwise leave blank
- Consignor
- Ship to/POE/CCP three-digit air/water POE code or CCP code, and enough space for 5 lines of up to 35 characters for the in-the-clear address
- Transportation Priority
- POD: Three-digit air/water POD code
- Ultimate Consignee/Mark For and Department Of Defense Activity Address Code (DODAAC)
- DODAAC

- Actual Weight (this piece)
- Required Delivery Date (RDD)
- Cube (this piece)
- Date Shipped/four-position date
- Foreign Military Sales (FMS) Case Number
- Piece Number (of Total Pieces)
- Total Number of Pieces

Compliance Character	Format 06	Data Field	Data Format type/Length	Sample Data	Element Separators	Total Characters
[]>		**Compliance Indicator**	an3	[]>	R_S	4
Format06		**Data Identifier Format Header** (ANSI Standard)	an2	06	G_S	3
	JKUSM	**Transport Control Number (TCN)**	an5+an17	JKUSMW3123801E221XXX	G_S	23
	9K	**TAC**	AN+2AN4	9KF8WR	G_S	7
	13Q	**Piece number**	an3+n..4/n..4	13Q1/4	G_S	12
	4V	**Carrier Code**	an2+an4	4VSEAU	G_S	7
	3D	**Ship Date**	an2+an4	3D8077	G_S	7
	2Q	**Weight**	an2+an..5	2Q3870	G_S	8
	10P	**CommoditySpecail/HandlingCode**	an3+an2	10PAZ	R_S	6
Format 07		**Free Text Format Header**	an2	07	G_S	3
	34	**Document Identifier Code**	an2+an3	34TXI	G_S	6
	03	**Project Code**	an2+an3	039EV	G_S	6
	12	**Cube**	an2+n..4	120035	G_S	7
	15	**Compatibility Code**	an2+an5	15AB000	G_S	8
	21	**Pallet Identification**	an2+an6	21DOVARC	G_S	9
	23	**Air Dimension Code**	an2+an1	23A	G_S	4
	24	**Container Number**	an2+n5	2413579	G_S	8
	25	**POE**	an2+an3	25JFG	G_S	6
	26	**POD**	an2+an3	26IN4	G_S	6

	27	**Consignee**	an2+an6	27W23QLL	GS	9
	28	**Transportation Priority**	an2+n1	281	GS	4
	29	**Consignor**	an2+an6	29W62N2A	GS	9
	30	**Mode of shipment**	an2+an1	30A	GS	4
	32	**Required Delivery Date**	an2+n4	328234	GS	7
	33	**Special Priority**	an2+an1	339	GS	4
	35	**Free Text Content**	an2+an..60	35free text up to 60 Characters	GS	63
Format 06		**Data Identifier Format Header**	an2	06	GS	3
	12S	**Document Number**	an3+15	12SWK4GEY80110232	GS	19
	N	**NSN/NATO Stock Number**	an1+an..15	N53100198785	GS	17
	7Q	**Quantity with Unit of Issue**	an2+n..5+an2	7Q5EA	GS	10
	V	**Routing Identifier Code**	an1+an3	VS91	GS	5
	2R	**Condition Code**	an2+an2	2RA	GS	4
	8V	**Distribution Code**	an2+an2	8V7V	GS	5
	12Q	**Unit Price**	an3+n..7+an3	12Q12345.9OUSD	RS EOT	15

Table 4-3: Data elements and identifiers used in the DD1387 Military Shipping Label (MSL).

4-2. Conformance Standards

4-2.1. Technology

The following sections are the technology standards that are applicable to the common AIT used within DOD and Navy. The Navy AIT Project Office maintains a library of these applicable standards. Contact the Navy AIT Project Office or visit the web site at www.navy-ait.com for more information regarding current AIT standards. AIT with less technology and application standards represents a higher risk to the implementing organization.

4-2.1.1. Bar Code

The following standards should be applied and considered when integrating any bar code technology.

4-2.1.1.1. Code 39

ISO/IEC 16388, Bar Code Symbology Specification - Code 39
ISO/IEC 15426-1, Bar Code Verifier Conformance Specification - Part 1: Linear
ISO/IEC 15423-1, Bar Code Scanner and Decoder Performance Testing - Part 1: Linear
ISO/IEC 15425, International Conformance Specification - Bar Code Printing Software

ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.1.2. Code 128

ISO/IEC 15417, Bar Code Symbology Specification - Code 128
ISO/IEC 15426-1, Bar Code Verifier Conformance Specification - Part 1: Linear
ISO/IEC 15423-1, Bar Code Scanner and Decoder Performance Testing - Part 1: Linear
ISO/IEC 15425, International Conformance Specification - Bar Code Printing Software
ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.1.3. Code PDF417

ISO/IEC 15438, Bar Code Symbology Specification - PDF417
ISO/IEC 15426-2, Bar Code Verifier Conformance Specification - Part 2: Two Dimensional
ISO/IEC 15423-2, Bar Code Scanner and Decoder Performance Testing - Part 1: Two Dimensional
ISO/IEC 15425, International Conformance Specification - Bar Code Printing Software
ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.1.4. Code Data Matrix

ISO/IEC 16022, Bar Code Symbology Specification - Data Matrix
ISO/IEC 15426-2, Bar Code Verifier Conformance Specification - Part 2: Two Dimensional
ISO/IEC 15423-2, Bar Code Scanner and Decoder Performance Testing - Part 1: Two Dimensional
ISO/IEC 15425, International Conformance Specification - Bar Code Printing Software
ISO/IEC 15419, Bar Code Digital Imaging and Printing Performance Testing
ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.1.5. Code Maxi code

ISO/IEC 16023, Bar Code Symbology Specification – Maxi code
ISO/IEC 15426-2, Bar Code Verifier Conformance Specification - Part 2: Two Dimensional
ISO/IEC 15423-2, Bar Code Scanner and Decoder Performance Testing - Part 1: Two Dimensional
ISO/IEC 15425, International Conformance Specification - Bar Code Printing Software
ISO/IEC 15419, Bar Code Digital Imaging and Printing Performance Testing
ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.2. Contact Memory Button (CMB)

ANSI MH10.8.2, Data Application Identifier Standard
ANSI MH10.8.3, Syntax for High Capacity ADC Media

4-2.1.3. Radio Frequency Identification (RFID)

ANSI MH10.8.2, Data Application Identifier Standard (as applicable)
ANSI MH10.8.3, Syntax for High Capacity ADC Media (as applicable)

4-2.1.4. Optical Memory Card (OMC)

Currently there are no standards specific to OMC's. Additionally the Navy AIT Project Office has been unsuccessful at identifying a business case within the Navy for use of this technology.

4-2.1.5. Radio Frequency Data Communication (RFDC)

IEEE 802.11b
FIPS 140-2

Chapter 5: Bar Code Print Quality

This chapter provides guidelines for creating and evaluating printed labels to satisfy Navy and DOD bar code print quality requirements. Evaluation parameters are geared toward printing two-dimensional (2D) and linear symbologies on labels as defined in U.S. Department of Defense specifications and guidelines. This includes initial and ongoing evaluation of the following issues:

- 2D and linear symbol print quality
- Overall label format
- Bar code orientation
- Orient the item / orient the scanner
- Bar code replacement
- Human-readable text and graphics
- Selection of hardware, software, and supplies
- The process of applying labels (physical application, equipment)
- Matching labels with material (adhesive, location)
- Human resources to establish and maintain the labeling program

5-1. Compliance Requirements

5-1.1. Understanding DOD's Requirements

Navy and DOD's labeling requirements are based upon the needs of *their systems*. Some Navy and DOD systems are highly sophisticated mainframe applications designed to capture data for downloading to other business systems. Others may use systems that are less sophisticated. Because of various Navy and DOD applications, it is important to understand there may be different labeling requirements from one application to another.

5-1.2. Navy and DOD Guidelines

Any supplier who prints Navy and DOD labels must have the Navy and DOD specifications.

5-1.3. Pre-production Approval

Pre-production sampling helps ensure that your investment in bar code labeling hardware, software, and time meets Navy and DOD requirements. It is recommended that the Navy AIT Project Office review pre-production label samples. If your AIS owners do not have a pre-production approval process, some alternatives are:

- Use an outside evaluation source for verification of label quality. It is important to understand that print quality is a simple verification process. That a label at one point in time provided a high grade does not mean that the high grade will continue throughout the supply chain. Some third party sources are available through the Navy Project Office.
- Obtain and use a verification device (Navy AIT Project Office can perform bar code verification).

Meeting AIS owner specifications Navy and DOD labels are centered around four major requirements. These are the *label format,* the *label data*, the *bar code specifications,* and the *symbol content.* All must work together to meet the Navy and DOD's print quality.

The figures 5-1, 5-2, and 5-3 are examples of the Military Shipping Label with both Linear (Code 39) and 2D Symbology (PDF417) Bar Codes.

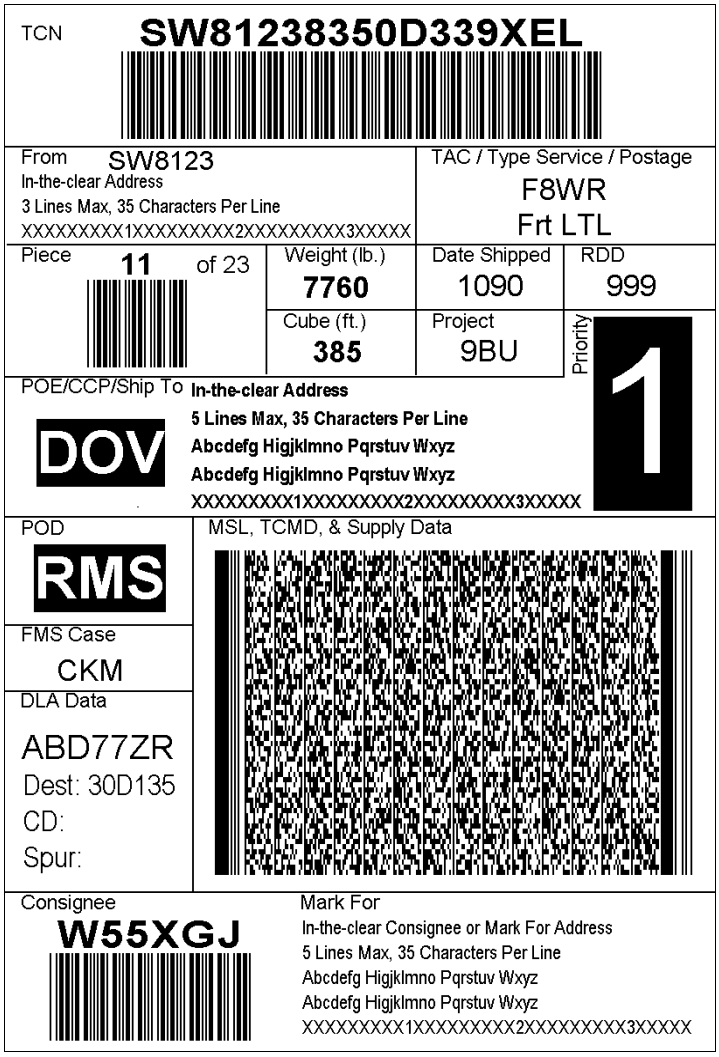


Figure 5- 1: Military Shipping Label, Generic Cargo

Figure 5-2: Military Shipping Label, Personal Property

Figure 5-2 is an example of the "New" Household Goods Linear Code 39 and 2D Symbology (PDF417) Bar Codes.

Figure 5- 3: Military Shipping Label, Unit Move

Figure 5-3 is used with "unit moves" as outlined in the Defense Transportation Regulation, specifically Chapter 208 (produced by TRANSCOM).

5-1.4. Label Data

Having incorrect, incomplete, or missing bar code data on a label Frustrates material, complicates processes, and costs organizations significant labor hours each year to correct. Each piece of data is important to the process. As an example, incorrect data could cause receipts to be accumulated against the wrong supplier or part number, material to be delivered to the wrong location, inventory quantities to be posted incorrectly, and traceability to be lost.
Incomplete data could cause:

- Production shutdowns
- Manual data entry
- Longer processing times
- Late payments
- Premium freight charges
- Unnecessary maintenance are material recalls

To build trading partner confidence, audit your labels, and scan the bar codes and/or 2D symbols for correct and complete AIS owner human-readable data.

5-1.5. Bar Code Specifications for Linear (Code 39)

Because your bar code labels will be used in open system environments, some basic bar code specifications must be met during the printing process. Compliance with the specifications will ensure that most scanning devices used can perform acceptably. To an AIS owner, performance is instant decoding when a scanner is pointed at a bar code. Listed below are linear specific items requiring attention during the initial installation of the printing process. The AIS owner will be expecting these to be correct.

5-1.5.1. Linear X-Dimension

The width of the narrow bars and spaces in Symbologies such as Code 39 is known as the X-Dimension. The X-Dimension is usually defined in a unit of measure called 'mils,' which is 1/1,000 (0.001) inch. The X-Dimension must be within the parameter range as specified. The parameter range was developed to ensure acceptable performance of scanning devices in AIS owner applications. Be sure you have selected and are printing within the X-Dimension range specified by your AIS label specifications.

5-1.5.2. Linear Wide-to-Narrow Bar Ratio (WNBR)

In Code 39, each bar and space is called an element. Element widths can be wide or narrow. The relationship of the wide elements to the narrow elements is expressed as a ratio. (For example: 3:1) If the ratio is too small, the bars and spaces look the same width to the scanner and the symbol will not decode. Refer to ISO / IEC 15416 Bar Code Print Quality Test Specification – Linear Symbols.

5-1.5.3. Linear Print Contrast

Print contrast is the difference between the light and dark printed bars and spaces. For best scanner performance, bar codes should be black on white. For DOD label applications, the label stock is required to be white with black printing. The higher the contrast, the better the scanner can differentiate a bar from a space, or a wide element from a narrow element. When the label's bars begin to fade, it is difficult for a scanner to find them. When printing, symbol bars should be sharp, dark, and free of voids. Symbol spaces should be clean and free from ink spots. In order to obtain optimum performance when using thermal printing technology, the printers burn time may need to be adjusted. It is a common error to try to

make the bars as dark as possible by increasing the burn time. This results in wider bars and narrower spaces, which may decrease scannability. A verification device is recommended to determine the actual X-Dimension, wide-to-narrow bar ratio, and label print contrast.

5-1.5.4. Linear Symbol Bar Height

Bar code label specifications usually specify a minimum bar height. Meeting or exceeding bar height specifications will ensure greater scannability. DOD Shipping Label Specifications require a symbol height of 0.5 inches. *Do not violate the minimum bar height requirements in order to print larger human-readable data or to use smaller label stock.*

5-1.5.5. Linear Quiet Zones

Bar code symbols need clear areas, known as quiet zones, on both sides of the symbol. Bar code label specification will specify a particular quiet zone size. DOD Label Specifications require a quiet zone of 0.25 inches on both ends of the bar code symbol. Most quiet zone problems occur from the bar code symbol being too near the label's edge or building block separator line. Human-readable information placed too close to the symbol can also hinder scan performance.

5-1.5.6. Linear Data Identifiers

As stated previously, DIs ensures that a bar code label works in an open system. DOD standards require the use of DIs. These are defined in the *Data Application Identifier Standard* ANSI MH10.8.2.

DIs specifies to the host computer the type of data that is being transmitted. The DI may also be shown in parenthesis in the data title for each bar coded data area. It is important to audit for missing or incorrect data identifiers. Data identifiers should always be placed immediately after the start character in the Code 39 symbol and should not include the parentheses found in the data title. *Improperly used or missing DIs will cause problems within AIS.*

5-1.5.7. Human-Readable Interpretation (HRI) for Linear

Human-readable interpretation is the text that is printed above or below the bar code. The human-readable interpretation is not exactly what is encoded in the bar code since the start, stop, and data identifier characters are not printed. The human-readable text should be printed at the correct measurable size or lines-per-block as specified by the bar code label specification. The printing of non-significant zeros, start and stop characters, and the encoding of embedded spaces on labels should be avoided whenever possible. Sometimes the data from a label must be manually entered into a collection device for processing. Therefore, care should be taken to clearly distinguish the human-readable number “0” from the human-readable letter “O” and the number “1” from the letter “l”.

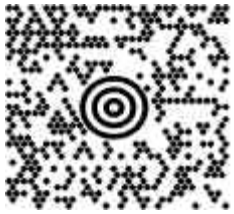
Some AIS owners require the use of specific data formatting – spaces and/or dashes – in the human-readable interpretation that is not reflected in the encoded data. These spaces or dashes are used in the human-readable interpretation to enhance HRI readability. Be sure to use the HRI formatting specified by the bar code label specification.

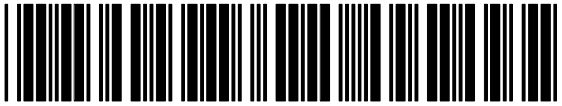
Make sure your bar code label application is capable of applying specific formatting into the HRI without actually encoding the spaces or dashes into the bar code.

5-1.6. Specifications for 2D

Because your labels will be used in open system environments, some basic specifications should be met during the printing process. Compliance to the specifications will ensure that most reading devices used will have acceptable performance.
Listed below are specific items requiring attention during the initial installation of the printing process intended to print labels with 2D symbols.


PDF417


MaxiCode


Code 39


0 3
U.P.C. Version A


Data Matrix

5-1.6.1. 2D X-Dimension

The minimum value is set to ensure acceptable reading whereas the maximum value is set to ensure that the symbol will fit within the space allocated. Choose an X-Dimension that is consistent with the resolution of your printer and closest to the middle of the DOD's specification range.

PDF417: The X-dimension for PDF417 is the widths of the narrow bars, usually measured in mils. The DOD as part of the specification provides an acceptable range. For example, if the DOD allows 10 to 15 mils (0.010 to 0.015 inch) and you have a 300-dpi printer, choose 13 mils (0.013 inch). ISO 15415 is used for PDF417 2d symbology.
Data Matrix: The X-Dimension for Data Matrix is the width (and height) of the individual cell forming the data. The same example from PDF417 applies.
MaxiCode: The X-dimension (hexagon width) for MaxiCode is fixed at 35 mils, and generally is outside the control of the party printing the label.

5-1.6.2. 2D Element Height

Increasing this value improves readability but increases the symbol size proportionately.

PDF417: For PDF417 the value is expressed as a multiple of the X-dimension (3 times the X-dimension is the minimum for DOD applications). Always print PDF417 symbols with a bar height within the range specified label specification, but choose a value that best fits the label space allocated.
Data Matrix: This value for Data Matrix is equal to that selected for the X-Dimension. Always print Data Matrix symbols with an element height within the range specified by bar code label specification, but choose a value that best fits the space allocated
MaxiCode: For MaxiCode the value is fixed at 40 mils (0.040 inch).

5-1.6.3. 2D Print Contrast

PDF417, Data Matrix, and MaxiCode: Print contrast is the difference between light and dark elements. For best scanner performance, symbols should be black on white. For DOD label applications, the label stock is required to be white with black printing. The higher the contrast, the better the scanner can differentiate dark elements from light and, in the case of PDF417, wide bars from narrow. When printing, dark elements should be sharp, dark, and free of voids. Light elements should be clean and free from ink spots.

5-1.6.4. 2D Error Correction Level

All 2D symbologies recommended by DOD have embedded levels of error correction. All of the symbols contain additional information that allows data recovery, even when part of the symbol is damaged or missing. Increasing the level of error correction provides a more robust symbol by adding to the symbol size while reducing the total data capacity. Be sure to select the error correction level specified by the DOD.
PDF417: symbols must use error correction level 5.
Data Matrix: symbols must use ECC 200
MaxiCode: Selecting modes 2, 3, and 4 yields Standard Error Correction (SEC)

5-1.6.5. 2D Symbol Size

PDF417: Bar code label specification may specify the overall symbol width and/or an aspect ratio for the symbol's height to width. In the case of PDF417 the tables found in Annex B, of ISO 15394 - *Bar Code and Two-dimensional Symbols for Shipping, Transport, and Receiving Labels* can be useful for selecting. In all cases, if there appears to be an incompatibility among the X-Dimension, Element Height, Error Correction Level, Symbol Size, or Label Size, discuss it with the AIS owner or Navy AIT Project Office. Do not make a decision to deviate from the specifications without prior approval.
Data Matrix: When the DOD application for Data Matrix is defined this section will be expanded.
MaxiCode: the symbol height and width are fixed.

5-1.6.6. 2D Quiet Zones

PDF417: As stated previously, symbols need clear areas, known as quiet zones, surrounding the symbol. Bar code label specification will specify a particular quiet zone

size. ISO/IEC 15438 – *Symbology Specification - PDF417* requires a quiet zone of 2X on all four sides of PDF417 symbols. Most quiet zone problems occur when a symbol is printed too near the label's edge or building block separator line. Human-readable information placed too close to the symbol can also interfere with the quiet zone.
Data Matrix: ISO/IEC 16022 – *Symbology Specification - Data Matrix* requires a quiet zone of 1 X-Dimension on all four sides of a Data Matrix symbol. Most quiet zone problems occur when a symbol is printed too near the label's edge or building block separator line. Human-readable information placed too close to the symbol can also interfere with the quiet zone.
MaxiCode: ISO/IEC 16023 – Symbology Specification - MaxiCode requires a quiet zone of 0.04 inches on all four sides of MaxiCode symbols. Most quiet zone problems occur when a symbol is printed too near the label's edge or a separator line. Human-readable information placed too close to the symbol can also interfere with the quiet zone.

5-1.6.7. 2D Data Format

PDF417, DataMatrix, and MaxiCode: 2D Symbols are used when larger amounts of information need to be stored on the label. As a result, many data elements are encoded in a single symbol. In order to ensure that the application reading the symbol can find all of those data elements, they must be stored in a format understood by all trading partners. When a DOD application for Data Matrix is defined, that section will be expanded.
These PDF417 formats are detailed in ANSI MH10.8.3 (Clause 4.3.2 applies to MaxiCode)/ISO 15434 – *Transfer Syntax for High Capacity ADC Media*, MIL-STD-129 and MIL-STD-130. Several formats are available depending on the application; be sure to follow the format outlined in the AIS owner's guideline. These formats must be followed exactly; failure to do so will make a perfectly readable symbol useless to the AIS owner.

5-1.6.8. 2D Human-readable Interpretation (HRI) for 2D

In shipping label applications, 2D symbols encode large amounts of information. Consequently, the Human-readable Interpretation (HRI) of the symbol is not printed. Instead, the block containing the symbol is labeled with one or more of the following:

- **PDF417;** CUST (AIS owner), SPLR (supplier), CARR (carrier), depending on the user(s) of the symbols.
- **MaxiCode;** CARR (carrier)
- **DataMatrix:** When the DOD application for Data Matrix is defined this section will be expanded.

These titles should be printed using the same font as other block titles. Be sure to follow the AIS owner's instructions when adding titles to these blocks. The title indicates which symbol to scan for a particular application.

5-2. Maintenance and Continuous Improvement

As with any project, ongoing maintenance is as important as the initial setup. Assigning a coordinator to be responsible to filter all questions and concerns is equally important.

Conduct audits and surveys of bar code labels, the best time to do this is several months after a system has been stabilized.
Detailed record keeping is the key to success. The following list represents some of the things you should be tracking:

- Regular bar code Printing Maintenance
- Keep dust away from Printers (or encase printers in a more dust free environment-ensure if you have an enclosure, that air can circulate).
- Bar Code Verification

5-2.1. Checklist for Success

Three major steps in determining label quality are:

- Visually inspecting the label
- Scanning each bar code field
- Verifying the bar code with a verification device

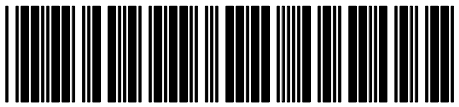
Use the following checklist for evaluating bar code symbols and their human-readable text.

5-2.1.1. Visual Inspection

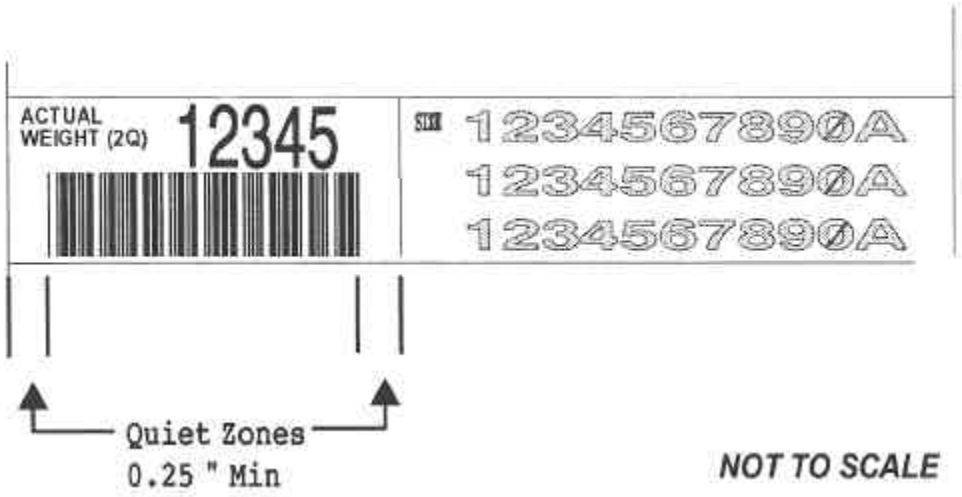
Obtain a sample format from your AIS owner and compare your label.

- Have you test-printed with maximum data characters specified by the AIS owner?
- Do all the fields fit on the label?
- Do the bars look “squashed” together?

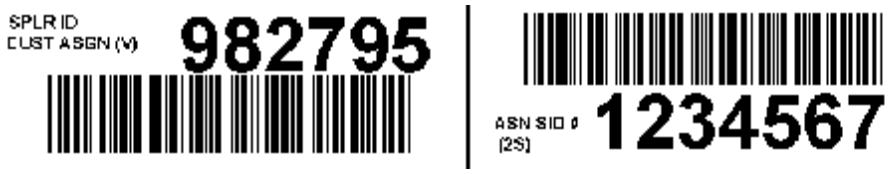
 (sqashed)

 (normal)

- Are quiet zones a minimum of 0.25”?



- Are side-by-side bar codes printed properly?

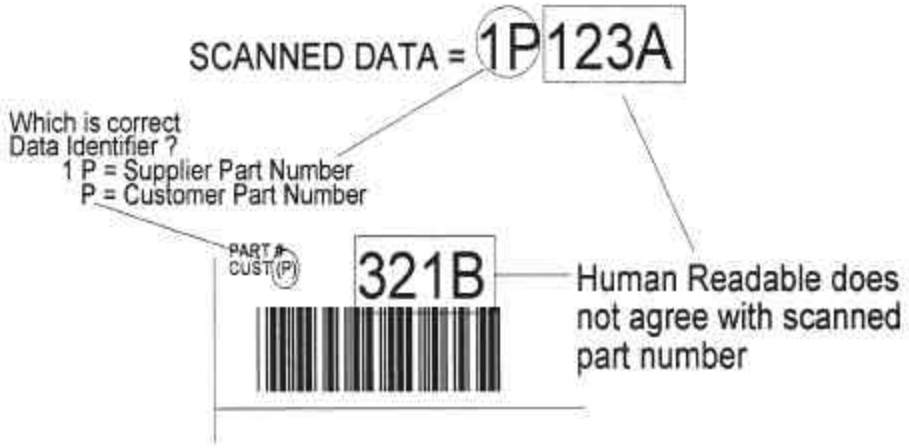


- Are the label stock white and the printing black?
- Is the print quality consistent throughout the label?

- Do the bar codes comply with height specifications in the label specification?
- Are Data Identifiers used correctly according to the ANSI and DOD specifications?
- Is the number “zero” easily distinguishable from the letter “O”?

5-2.1.2. Scanning

- Can you scan the bar codes and decode the proper data, including Data Identifiers?
- Are Data Identifiers present in the human-readable information and encoded in the bar code?
- Do the bar codes and the human-readable information correspond?



5-2.1.3. Verification

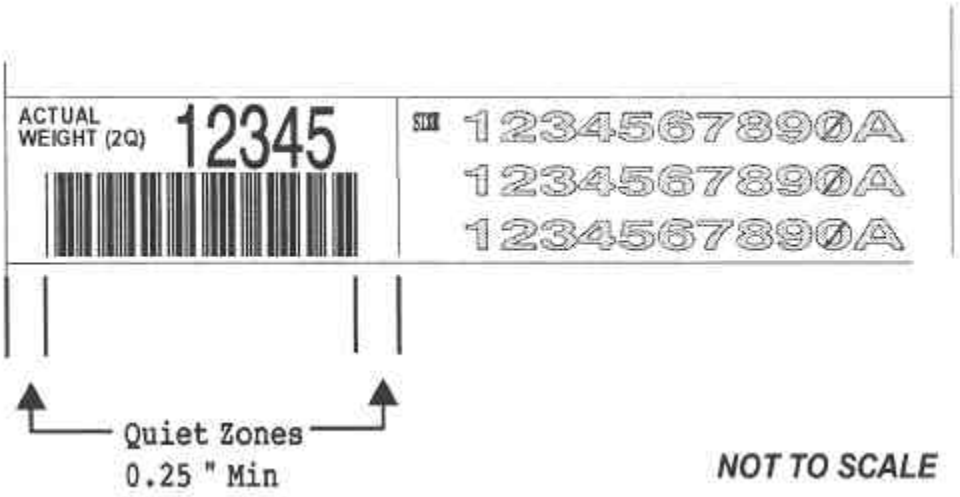
You should verify your bar code labels:

- When using new ribbon or label stock
- After any adjustments to your printer, such as burn time or feed speed.
- After printer maintenance or repair.
- After any new variable has been introduced.

5-3. Troubleshooting

When there's an unreadable bar code label, it is necessary to determine what is causing the problem. Troubleshooting is a controlled process of elimination where only one variable is checked at a time. The following process is recommended:

Visually inspect the label for damage, dirt, tears, and ink marks. If any of these defects exists, then reprint the label and verify or scan it. Look for quiet zones at each end of the bar code. There should be approximately 0.25 inch of white space at the beginning and end of the bar code. If this space is not available, you must change the parameters of the bar code or increase the width of the label stock.



If the label passes a visual inspection, validate that the scanner you are using is a visible laser diode scanner (which can be found on the label with FCC compliance data). Validate that the scanner you are using is working by trying to read another label. If your scanner does not read the other label, then read either label with another scanner. If neither scanner reads the label, make sure the scanner/decoder you are using is set for the symbology used to encode the bar code. If you still cannot read the bar code on the label, you should now use a verifier to determine what is wrong with the bar code. First, make sure your verifier is calibrated. If the verifier cannot decode the bar code, check the printer for print head defects, motor speed variations, label stock feed, toner, ribbon, and heat settings. Remember to check each item individually and validate its performance before going on to the next item.

If all those check out, it is possible that the software printing the bar code has not encoded the bar code correctly. This may happen if you are using a new software package or if your coding was written in-house. Missing start and stop characters are a common problem. When the verifier decodes the bar code, it will identify the parameters that are causing the problem. Once you know which parameters have failed, you need to correct the problem(s).
The verifier will report on the following parameters: Contrast, modulation, and decodability. These parameters are related to bar and space reflectance (how black the bars are and how white the spaces are to the scanner) and can be improved by checking the following:
For thermal printers – burn time and heat settings, printing (feed) speed, label stock per manufacturer requirements, thermal transfer ribbon per manufacturer requirements.

(high heat, excessive burn time)

(ribbon/print head malfunction)

For laser printers – Toner, density setting, selected X-dimension not less than .010 inch, label stock. For dot matrix printers – Ribbon, print head/ribbon spacing (adjustable) must be set for the thickness of the label stock. For multi-part forms, the bar codes are expected to be read on the original only, not the copies.

(ribbon fade)

(print head alignment)

5-4. Influencing Factors:

The following paragraphs are influencing factors that, with proper planning and consideration, can mitigate project risk. Appendix A contains the questions you should ask when your agency/activity begins the process of defining an AIT project. This is by no means a comprehensive list, but it points to issues that affect the design specification of the labeling system. Commercial system integrators are available to help you further understand the requirements, the process, and the required equipment

5-4.1 Organizing for Success

Proper organization is critical to the success of any bar code compliance labeling process. In this section, we will discuss evaluating, acquiring, and installing equipment, software, and supplies.

5-4.2. Bar Code Print Software

In most cases, the corporate AIS will be modified to accommodate the printing of bar code labels. Current commercial grade bar code printers have all the ISO bar code symbols embedded within the printer firmware. They perform printing and formatting operations from a vendor specific scripting language. This scripting language allows the users host system or send the bar code label print data (formatted with the necessary script) to the printer. This enables the user to focus on what data in the database to include on the label, and not worry about coding the actual bar code symbol.

However, it may be necessary for some organizations to purchase a COTS bar code printing application (when cost, application size and functionality are constraints). Selecting a software package that meets the requirements can make labeling much easier. Items to consider include:

- Does the software support the ANSI MH10.8.1M/ISO 15394 (International Shipping Label), ANSI MH10.8.3/ISO 15434 (Transfer Syntax for High Capacity ADC Media), ANSI MH10.8.2/ISO 15418 (Data Identifiers), MIL-STD-129, MIL-STD-130 standards?
- Will it handle all of DOD's formats?

- Is the software capable of producing graphics?
- Make sure the bar code label application is capable of custom formatting of the human-readable information, without embedding characters such as spaces or dashes into the bar code.
- Does the software have its own database or can you pull information from other computer systems, and if so, how?
- What printers does the software work with?
- What computer operating system does the software work with?
- Does the software support printers attached to a network?
- Is the software capable of supporting multiple print stations?
- Does the software have separate label design and production printing capabilities?
- What level of technical support is provided for the software?
- Is training available for the software product? How extensive and in what format(s) is that training?
- What is the software upgrade policy?

5-4.3. Consumables/Supplies

Now that the printer, computer, and software have been selected, consider the consumables needed. Some things to consider when selecting the media and printer supplies include:

- Media – consider shelf life, storage temperature, humidity, face stock, and adhesive.
- Are labels/tags and ribbons/toners matched to your application and printer to ensure quality output?
- Using consumables other than those recommended by your printer manufacturer may void your printer's print head warranty.

Media for laser printers require adhesives that won't melt at high temperatures. Non-water soluble inks should be used.
Print heads on thermal transfer or thermal direct printers must be cleaned regularly.

5-4.4. Installation

Installation of your printing system may be a service provided by a vendor. All printers and software should come with a complete set of documentation.
Once you have your equipment installed, print several test labels using the AIS format. Now is a good time to use a verifier to adjust your printer for optimum performance. You are ready for production when you are satisfied that the labels comply with your AIS owner requirements. A recommended practice is to send a sample label to your AIS owner to ensure that you are in compliance.

5-5. Sign-off on Equipment / Software / Supplies

During the selection of your equipment, software, and supplies, it is important to make sure your vendors are aware of your compliance requirements. Items to consider include:

- Will the vendor provide assistance to meet conformance?
- Will the vendor provide support if any non-conforming issues arise?
- Do you have a sign-off document that includes:
- Installation?
- Training?
- Compliance Acceptance?

Before signing off on your system, be sure you and your AIS owner agree that the labels are acceptable

5-6. ANSI Verification Print Quality Parameters

When you use a verifier, it gives you a grade based on ANSI X3.182 Quality Parameters. The following explains those parameters and provides some suggestions on what to do if you have a problem.

5-6.1. ANSI Pass/Fail Quality Parameters

Edge Determination
A Global Threshold line drawn halfway between the highest and lowest reflectance value. The correct numbers of elements crossing the Global Threshold line are counted to check if the count conforms to legitimate Bar Code Symbology.
Minimum Reflectance
The reflectance value of at least one bar must be half or less than the highest reflectance value for a space.
Suggestions to improve Minimum Reflectance: Make the bars darker; that is, use darker ink or, for thermal transfer printing, increase heat.
Edge Contrast Minimum
The reflectance difference in the transition from an adjacent bar to a space, or a space to a bar. The worst pair must have a minimum Edge Contrast of 15% or higher to pass the test.
Suggestions to improve Edge Contrast Minimum: Use a whiter substrate and darker ink or increase the X-Dimension, assuming the appropriate aperture size is used.
Decode
The test is passed when the established bar and space widths can be converted into the correct series of valid characters for a given symbology.

5-6.2. ANSI Graded Quality Parameters

Symbol Contrast
This is the difference between the highest and lowest reflectance value in the scan profile. The higher the value, the better the grade.
Suggestions to improve Symbol Contrast: Make the bars darker and the spaces lighter or less shiny.
Modulation

This is how the scanner “sees” wide elements (bars and spaces) in relationship to narrow elements. Scanners usually “see” spaces narrower than bars and narrow spaces as less reflective than wide spaces.

Suggestion to improve Modulation: Making narrow spaces wider than narrow bars usually will increase the Modulation grade.

Defects

Defects are voids found in bars and spots found in spaces and quiet zones of the code. Each element is individually evaluated for its reflectance non-uniformity.

Decodability

This measures the accuracy of the printed bar code against the appropriate reference decode algorithm. It also measures the amount of margin left for the reading process after printing the bar code.

Figures 5-1 and 5-2 are samples of Poor Quality Bar Code Labels found during a recent "walk the line" performed by the Navy AIT Project Office.

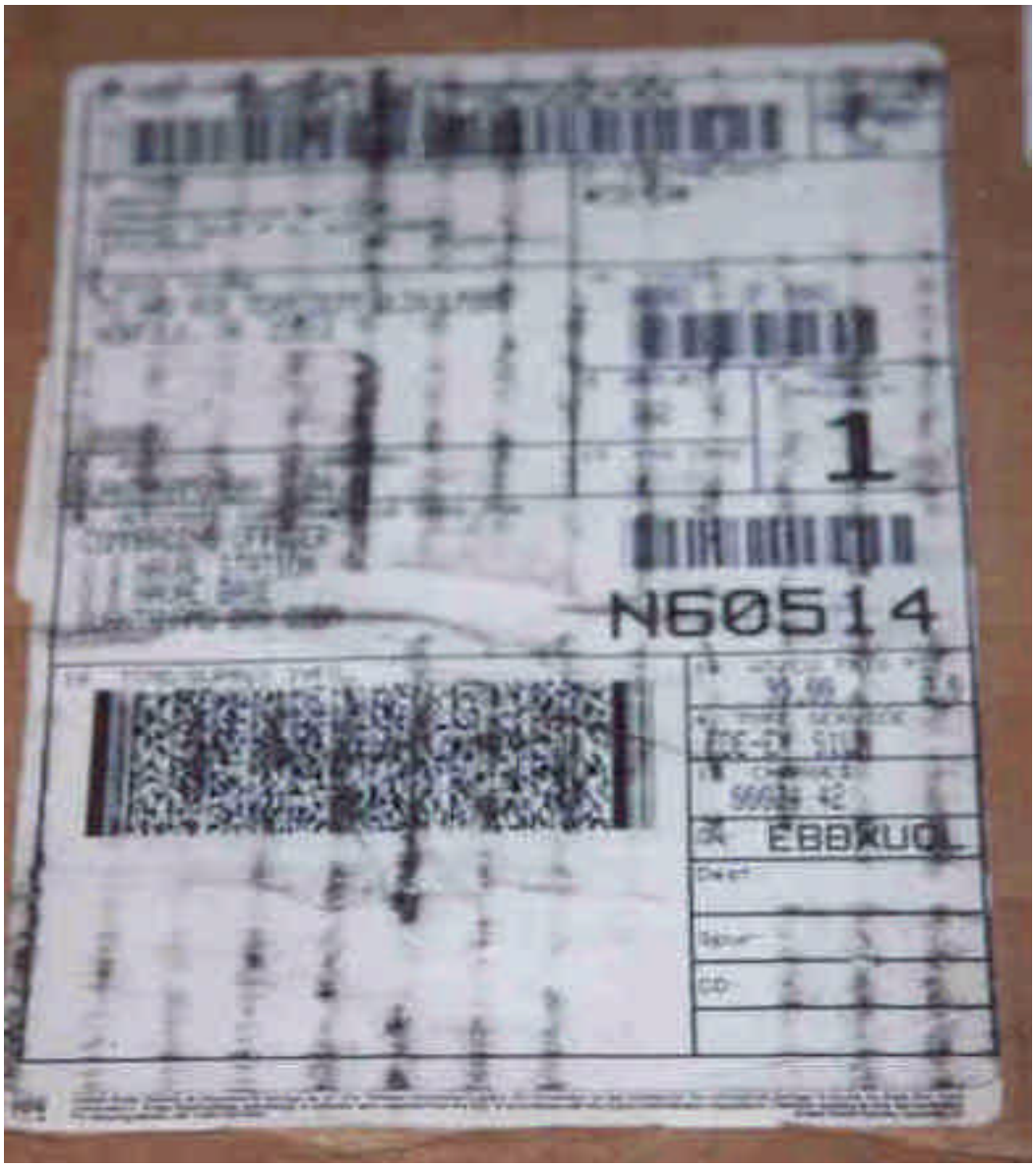


Figure 5-1: Bar Code with Oil Stains causing streaks

Figure 5-2: Tape across TCN Bar code

Appendix A
Questions You Might Want To Ask

Defining the requirements and understanding the process

The following list highlights the questions you should ask when your agency/activity begins the process of defining a Navy and DOD labeling program. This is by no means a comprehensive list, but it points to issues that affect the design specification of the labeling system. Commercial system integrators are available to help you further understand the requirements, the process, and the required equipment.

Logistics

- Where will the labeling system be physically located relative to where the labels are applied?
- Are there any response time problems that could impact the ability to print?
- Who will actually print the labels?
- What are the environment considerations for the labels?
- Will you need to run power and a communication cables to the printer?
- Is the bar code brought to the scanner?
- Is the scanner brought to the bar code?
- Cost of labeling hardware, software, and process changes?
- Impact on workforce (changes imposed on training, shifts, and expertise to operate or maintain)?
- Cost to sustain?
- Maintainability and any warranty considerations?
- How scalable is the system, can it grow as your needs change?

Hardware/Software

- Where do you want the label generation software to reside?
- Who should have design access to label formats?
- What is the source of label information?
- Who will maintain the format library?
- What type of print technology do you wish to use?
- What type of scanning technology do you need to accommodate?

Equipment, Software and Supplies Procurement

Before you purchase a printer, software, or even change your supplies, you should request a sample from your vendor that meets your AIS owner's specification. This pre-purchase verification ensures compliance.

Printers

Not all printers are created equal. Some printers do not have the graphics capability to produce *acceptable symbol print quality*. Some of the common types of printers available today for bar code printing include thermal transfer, direct thermal, laser, and dot matrix (least desirable). Other types of printers exist but may not be easily adapted to print symbols, which meet current industry standards. Questions to consider as you go through the process of selecting a printer include:

- Can the printer produce the type of symbol(s) your AIS owner requires?
- Can the printer handle all the types of label media your AIS owner requires?
- Are you using consumables recommended by the printer manufacturer?
- Does the printer you want to use meet the AIS owner's quality specifications?
- Does your AIS owner require that the labels be scanable by an infrared device?
- How many labels will you need to produce per hour? Per shift? Per day?
- Is the printer capable of meeting your peak production requirements?
- Are local service and support available for the printer?
- Is a backup printer available?
- Can the printer produce graphics if they are required?
- Can the printer handle the overall size of the label required for the application?
- Are the printer and the bar code printing software compatible?
- Does the printer have the connectivity your system requires?
- Do the printer and the media match your production environment?

The large majority of scanners sold today use visible light. These scanners can read symbols printed on all types of labeling media. Scanners using infrared light may not be able read symbols printed with dye-based inks. Printers that use these types of inks include direct thermal, dot matrix, and ink jet printers. With thermal printers, make sure that the correct temperature setting is used to avoid bar codes that have bars or spaces that are either too narrow or too wide, or that have rough instead of sharp edges. Additional points to remember are:

- Thermal direct printers provide quality symbols, but most thermal label stocks cannot be read with infrared light. Thermal direct material may also degrade with exposure to excessive heat and bright light.
- Will the printer produce symbols that meet Navy and DOD Standards?
- Dot Matrix print quality is highly dependent on the quality of the ribbon and substrate used.
- Be cautious of ink spread with an inkjet printer. Do not use water-soluble inks.

Scanners

A thorough understanding of the environment and equipment used by the AIS owner is required to scan the labels you make. Some things to consider when selecting a scanner:

- What is the distance between the scanner and the label?
- Is your scanner compatible with the "X" dimension of your bar codes?

- Does your scanner have auto-discrimination capability?
- If yes, it is recommended to turn off unused symbologies (for faster scanning).
- Does the scanner interface match that of your host system?
- Do the characteristics of the scanner meet your production environment?
- Does the scanner fit a fixed-position application or a hand-held application?
- Do you need to send and/or receive data in real time?
- A specific point to remember for 2D:
    - 2D symbols have specific requirements;
    - Make sure your scanner is capable of reading your symbology.

Scanner Selection

You can chose from the following types of scanners based on the needs of your application:

- Wands
- CCD scanners
- Laser scanners

Most of these come in either hand-held and/or fixed-mount (position) versions. Some, such as presentation scanners (mounted on a fork lift), fixed-mount (conveyor scanners), and CCD (imagers) will be able to scan the bar code in any orientation, identifying Linear (code 39 and UPC) and 2D Symbologies (PDF417, Data Matrix, Maxicode).
Each of these different types of scanners has capabilities that can satisfy, enhance, or potentially limit the usefulness of your application.

The following considerations will help you select the best scanner for your application.

- Which symbologies will you be reading? The first major choice is between a 2D capable scanner and one that only reads 1D or linear symbols.

Today, the DOD standard for 2D symbols is PDF417. Maxicode may be used in carrier sortation and tracking applications where applications support Maxicode. Data Matrix is being considered for some direct marking applications. Today, the DOD standard for linear symbols is Code 39. U.P.C. may be used in point-of-sale applications where the applications support U.P.C., e.g., commissary.
The PDF417 2D Symbology and linear symbols can be read by all contemporary bar code scanning devices, e.g., laser scanners and imagers. Maxicode and Data Matrix require CCD (imagers) as reading devices.

Select Resolution

After you determine which symbologies you need to read, the next step is to select the resolution of the scanner. No scanner can read every possible resolution, but all of them can read the range of resolutions allowed within an application standard. In order to pick the correct resolution you need to know the following:

- Determine the minimum and maximum "X" dimensions for the bar code used in the application
- For the Navy and DOD, the acceptable symbologies are Code 39 and PDF417. The “X” dimension range within Navy and DOD applications are within a range of 0.010 inch and 0.020 inch.
- Determine the minimum and maximum number of characters encoded
- For the Navy and DOD, a maximum of 19 characters can be encoded in Code 39 and a maximum number of 969 characters can be encoded in PDF417.
- Determine the minimum and maximum scanning distances.

The Navy and DOD users should work with the Navy’s AIT Project Office Help Desk to determine which scanner should be used for the minimum and maximum scanning distances required by the application

Determine Through-put

The next step is to determine your throughput.

- How often will you be scanning the bar codes in the application?
- Likewise, determine if you require unattended or attended scanning, and whether the scanning devices are hand-held or fixed-position.

Typically, a low throughput application uses a hand-held scanner and an extremely high throughput application requires an unattended fixed-position
Scanner. Ask yourself the following questions:

- What is the maximum number of scans per hour?
- Do you need to take the scanner to the bar code?
- Will the item be delivered to the scanner?
- What are the minimum and maximum dimensions of the packaging?
- If this is a conveyor application, what is the conveyor speed?
- Does the height of the packaging vary?
- Do variations in the dimensions of the packaging make hand-held or fixed-position scanning difficult?

Consider Ergonomics

It is also very important to consider the ergonomics of a hand-held scanner. Your application will not succeed if your workforce can’t operate the scanner productively.

- Is the scanner comfortable to use?
- How heavy is the scanner?
- Will you require accessories such as shoulder straps, holster, etc.?
- How well does it balance in the hand?
- Is the trigger (if available) easy to use?

- If it is tethered to a portable terminal, is the combination easy to use?

Consider the Environment

The environment also plays an important role when selecting a scanner. Some scanners function differently in sunlight and in certain types of factory or warehouse lighting. You may also need a weatherproof scanner for outdoor applications or an intrinsically safe scanner or a HERO certified device (around ammunition). Make a list of all the environmental factors that will play a role in your application. Some of the more common factors are temperature, sunlight, rain, dirt, dust, and audible noise. You may need an intrinsically safe scanner for static-free operation. Environmental features to consider include:

- Watertight for wet
- Loud beep for noisy
- Ability to handle extreme cold or heat
- Bright indicator lights for dimly lit areas
- Long range scanner for distance scanning
- Bright light for outdoor (sunlight) scanning
- Industrialized for harsh environment

Verifiers

To verify a bar code means to check the quality of the printed symbol against bar code standards. Verification is critical because unscannable bar codes reduce the efficiency of data exchange between you and the DOD. You may want to perform a quality test using a verifier to check the print quality of your symbol. Verifiers look at many parameters of the printed bar code including print contrast, bar width, defects, and decodability. In addition, 2D verifiers look at the parameter of unused error correction. A visual inspection of the label is important to check for errors like misspelled words, incorrect formats, and poor alignment of the symbols and text. It should be remembered that 2D symbologies have complex data formats that must be checked for compliance. Some questions to consider when selecting a verifier:

- Choose a verifier that supports your application standard.
- Can additional label application standards be programmed into your verifier?
- Can your verifier be calibrated?
- Is there a test to ensure your verifier is working properly?
- The symbologies used by the DOD are Code 39 and PDF417. In certain circumstances, Maxicode and U.P.C. may be used. Data Matrix is being considered for specific applications.
- Will the verifier recognize these symbologies?

Bar code print quality is not always obvious to the human eye. Just because a bar code looks good does not mean it was printed properly or that it will be read correctly by the wide variety of scanners on the market today. Bar code verifiers have been designed to

check the quality of the printed bar code against key parameters as defined by bar code specifications (industry-specific standards and guidelines such as MIL-STD-129 and MIL-STD-130). Verifiers also check the bar code against traditional and American National Standards Institute (ANSI) print quality parameters.

The Navy endorses the DOD's policies to use the ANSI "Guideline for Bar Code Print Quality" (X3.182). This guideline is the product of extensive testing to evaluate how a bar code scanner 'sees' a printed bar code. ANSI print quality parameters are based on bar and space reflectance values and provide a letter grade of A, B, C, D, or F. According to the ANSI guideline, the aperture size and the illumination wavelength used to verify printed bar codes can have a significant impact on the ANSI grade. The *lowest* ANSI grade achieved after the calculation of all the test parameters is the *scan grad*e. For example, if there is just one C grade and all other grades are A, the scan grade will be a C. Since quality can vary throughout a bar code, ANSI suggests that a complete scan be performed at 10 different locations between the top and the bottom of the bar code. The *average of the scan grades* of these multiple scans will be the overall *symbol grade.* Today, most industry-specific bar code applications require conformance to the "ANSI Bar Code Print Quality Guideline" (X3.182). These applications specify the aperture size and the illumination wavelength, as well as the minimum passing ANSI grade. This should ensure scanability under a wide variety of conditions.

The following list should be considered when choosing a bar code verification device: All the industry-specific application standards should be pre-programmed into the verifier. The verifier should check against the ANSI X3.182 "Guideline for Bar Code Print Quality." International standards are in the works. These emerging standards will provide backwards compatibility with X3.182. The aperture diameter should match the required bar and space 'X' dimension or the size stated in the DOD application. When implementing a bar code program, a consistent verification process is necessary to ensure continuous bar code print quality. Regular calibration of the verifier is required to ensure a valid verification process. The verification process must start at the time of printing and continue through the transportation shipment. Printed bar codes from suppliers should be verified to ensure that they meet established quality standards. As a practical guideline, bar codes should always be verified after changing the ribbon, toner, or ink; when label stock is changed; and after maintenance is performed on the printing equipment. In addition, bar codes should be verified at the beginning, middle, and end of each print run. It is very important to verify your bar codes to ensure that they can be read correctly by all types of scanners the first time and every time thereafter.

Bar Code Print Software

Selecting a software package that meets your needs can make labeling much easier. Items to consider include:

- Does the software support the ANSI MH10.8.1M/ISO 15394 (International Shipping Label), ANSI MH10.8.3/ISO 15434 (Transfer Syntax for High Capacity

ADC Media), ANSI MH10.8.2/ISO 15418 (Data Identifiers), MIL-STD-129, MIL-STD-130 standards?

- Will it handle all of DOD's formats?
- Is the software capable of producing graphics?
- Do you have to re-key all the information that will go on the label or can the data be pulled from a file in the computer?
- Make sure your software doesn't require re-keying of the bar code data for human-readable interpretation.
- Make sure the bar code label application is capable of custom formatting of the human-readable information, without embedding characters such as spaces or dashes into the bar code.
- Does the software have its own database or can you pull information from other computer systems, and if so, how?
- What printers does the software work with?
- What computer operating system does the software work with?
- Does the software support printers attached to a network?
- Is the software capable of supporting multiple print stations?
- Does the software have separate label design and production printing capabilities?
- What level of technical support is provided for the software?
- Is training available for the software product? How extensive and in what format(s) is that training?
- What is the software upgrade policy?
- Which symbologies are available with this software?
- Does the software support ANSI MH 10.8.2 Data Identifiers (DIs)?
- Is the software flexible enough to support new DIs?
- Does the software provide security for setup parameters (password protected or read only)?
- Is the software key protected (only runs if a key, typically installed on the printer port, is in place)?
- Does your software support DOD's recommended 2D symbology (PDF-417)?

Consumables/Supplies

Now that you have selected your printer, computer, and software, consider the consumables you will need. Some things to consider when selecting the media (such as label/shoe tag stock) and printer supplies (such as ribbon/toner) include:

- Media – consider shelf life, storage temperature, humidity, face stock, and adhesive.
- Are labels/tags and ribbons/toners matched to your application and printer to ensure quality output?
- Using consumables other than those recommended by your printer manufacturer may void your printer's print head warranty.
- Media for laser printers require adhesives that won't melt at high temperatures.
- If using infrared scanner, make sure the bar code is scannable. Not all ribbons for dot matrix printers will work for infrared printing.

- Non-water soluble inks should be used.
- Print heads on thermal transfer or thermal direct printers must be cleaned regularly.

Sign-off on Equipment / Software / Supplies

During the selection of your equipment, software, and supplies, it is important to make sure your vendors are aware of your compliance requirements. Items to consider include:

- Will the vendor provide assistance to meet conformance?
- Will the vendor provide support if any non-conforming issues arise?
- Do you have a sign-off document that includes?
- Installation?
- Training?
- Compliance Acceptance?

Before signing off on your system, be sure you and your AIS owner agree that the labels are acceptable.

Appendix B
Business Case Analysis Format Outline

This appendix provides a recommended format for preparation of an AIT BCA. An effective BCA is not long or detailed: its logical analysis is more important than its length.

I. Program Management Information

A. Project Title
B. Current Phase
C. Business Champion

- Name
- Activity or office
- Voice and fax numbers
- E-mail address

II. Background

A. Brief Summary of the initiative (in bullet format) that describes:

- The initiative itself
- The initiative's support for strategic plans and operational requirements
- The initiative's contribution qualitatively and quantitatively to user's goals and objectives

B. Brief discussion of risks and risk reduction strategy.
C. Classification of the initiative (use one of the following).

- ***Mission essential*** – Describe how the initiative is critical to current mission performance, directly supports essential initiatives, or is mandated by higher authority or law
- ***Business practice change*** – Describe how the initiative provides a capability to achieve process improvements, assists in establishing new capabilities, or eliminates non-value-added processes
- ***Enabler*** – Describe how the initiative assists as a tool, technique, or technology (including AIT) to achieve strategic or operational objectives

III. Alternatives

A. List alternatives (usually 2 or 3) and summarize each one briefly.
B. List any assumptions used to analyze alternatives and their justifications (such as inflation rates, discount rates, and estimates).
C. Provide cost profiles, funding requirements, and sources.
1. Use these cost elements in each profile

- *Personnel* – Civilian and military labor
- *Information technology* – investments in new systems, costs to modify current systems, and costs to prepare metrics to monitor alternative's progress
- *Facilities* - New facilities, modifications to existing facilities, or the possibility of closing facilities

- *Material* - Changes in stock age levels, purchases of capital equipment, sustainment material
- *Other* - Items such as transportation costs, income generated by the alternative, and user savings

2. Show a cost profile of the baseline using the above cost elements in constant dollars for the current and the next 5 fiscal years.

3. Show a cost profile of the alternatives using the above elements in constant dollars for the current and next 5 fiscal years.

4. For each alternative, identify known or anticipated funding requirements and their sources (Defense Working Capital Fund, O&MN, and APN) for the years of the Program Objective Memorandum (POM).

IV. Discussion and Evaluation of Alternatives

A. Rank the alternatives.

B. Explain and illustrate each initiative's return on investment (ROI) and payback period.

C. Specify consequences to customer's current operations (such as reduction in inventory levels and reduced logistics response time).

D. For each initiative, identify risks that could adversely affect it and assess the possibility that the initiative can be successful; specify a risk reduction strategy for each risk.

V. Recommendation

A. Recommend one alternative based on the following criteria.

- Return on Investment (ROI)
- Criticality to mission performance and readiness
- Support of DOD's strategic objectives
- Fulfillment of users requests and objectives

B. Describe metrics to measure initiative progress.

C. Discuss risk in implementing selected initiative and risk reduction strategies.

Appendix C
Sample Contract Language for Packaging, Packing, and Marking for Basic Ordering Agreements

PACKAGING, PACKING, AND MARKING FOR BASIC ORDERING AGREEMENTS (BOAS) AND LONG TERM CONTRACTS (LTCS) (AUG 2001)

The contractor shall package, pack and mark all items as cited below.

1. PACKAGING REQUIREMENTS -

a. IMMEDIATE USE/INSTALLATION AND PART NUMBER BUY SHIPMENTS -

Any national stock numbered (NSN) item or Interim Supply Support (ISS) item **required for immediate use and/or direct installation** or part number item (authority granted to ship without NSN) shall be packaged and packed in accordance with MIL-STD-2073-1B, Level C criteria or ASTM 3951, Standard Practice for Commercial Packaging, for all shipments to a continental United States (CONUS) government activity or contractor-owned facility. NAVICP will determine if procurement is an immediate use requirement. All buys destined for overseas shipment shall be packaged in accordance with MIL-STD-2073-1B, Level A criteria and packed in accordance with paragraph 2 "Packing Levels for Shipment" herein.

b. SYSTEM STOCK SHIPMENTS - The contractor shall package all items intended to **enter the military distribution system (stock)** in accordance with MIL-STD-2073-1B, DOD Material Procedures for "Development and Application of Packaging Requirements" and the Level A requirements of MIL-STD-2073-2C, "Packaging Requirement Codes (PRCs)".

2. PACKING LEVELS FOR SHIPMENT – After the Level A Packaging requirements are completed, the contractor shall pack as follows (Note: Reusable containers, fast pack containers or wood containers are shipping containers and DO NOT require overpacking for shipment). Exterior shipping containers are referenced in MIL-STD-2073-1B, Standard Navy Practice for Part Marking, Table VII, Page 51:

Domestic Shipments (CONUS): Level C
Overseas Shipments (OCONUS) (including Navy ships at sea):
Via air, FPO, APO Level B
Via freight forwarder Level B
Via surface Level A

3. PACKAGED AND PACKING MARKING REQUIREMENTS - All unit containers, intermediate containers and shipping containers shall be marked in accordance with MIL-STD-129M, Marking for Shipment and Storage. In addition, the following specific requirements apply:

a. BAR CODED SERIAL NUMBER MARKING

1.) All unit containers and intermediate containers shall be marked with the bar coded serial number, as referenced in MIL-STD-129M, paragraph 4.5.2.2.

b. DEPOT LEVEL REPAIRABLE (DLR) LABELS

1.) A National Stock Number (NSN) starting with a number 7 (seven) or an even number is a Depot Level Repairable (DLR). Depot Level Repairable items **intended for stock (other than immediate use and/or direct installation)** in the Naval supply system require a DLR packing label to be placed on the unit containers and shipping containers for accountability and control. Each unit container and shipping container shall be affixed with the applicable label as close to the bar code label as possible.

EXCEPTION: For any item packaged in a reusable shipping and storage container (excluding wood and fiberboard), the inner container shall be affixed with a DLR label. DLR labels shall not be placed on the reusable container.

2.) Labels are available via the Document Automation & Production Service (DAPS) website: http://forms.daps.mil. The website will advise the procedures for ordering and establishing an account. When searching for the DLR label, the following procedure should be followed:

1. Click on "Order/Search Forms"

2. Under "Search Criteria", type in the either of the following NSNs:

NSN	DESCRIPTION	QUANTITY PER UNIT PACKAGE	APPLICATION	FORM NUMBER
0108LF5055300	DEPOT LEVEL REPAIRABLE (DLR) LABEL 2 X 3	100	Unit Container	NAVSUP 1397-1
0108LF5055000	DEPOT LEVEL REPAIRABLE (DLR) LABEL 3 X 5	100	Shipping Container	NAVSUP 1397

c. SPECIAL MATERIAL IDENTIFICATION CODE (SMIC) IDENTIFICATION **(UNIQUE TO NAVICP-MECHANICSBURG)**

1.) Nuclear POC - Nuclear Reactor items are identified with an X2, X3, X4 or X5 following the National Stock Number (e.g. 7H1240-01-234-5678 **X2**). Any inquiry regarding these items should be addressed to NAVICP-Mech, Code 872, telephone (717)605-1140.
2.) Certain Program-related items are identified by a two-position Special Material Identification Code (SMIC), which appears as a suffix to the NSN (e.g. 1H4730-00-900-1317 **L1**), and require special markings. Containers shall be marked with letters, maximum two inches high on two (2) sides and two ends as follows:

SMIC	MARKINGS	COLOR	TYPE CONTAINER
L1	LEVEL 1	RED	Unit, intermediate and shipping (size permitting)
S1	SURFACE LEVEL 1	RED	Unit, intermediate and shipping (size permitting)
SS	SUBSAFE	RED	Unit, intermediate and shipping (size permitting)
C1/SB	LEVEL 1/ SUBSAFE SPECIAL CLEAN 02-N2	GREEN	Intermediate and shipping
CP/DO/ DG/VG	SPECIAL CLEAN 02-N2	GREEN	Intermediate and shipping

d. ASBESTOS MARKINGS

In accordance with 29 CFR, the following caution label shall be placed on all unit containers, intermediate containers and shipping containers for all items containing asbestos in a form that can be inhaled:

CAUTION

CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM

4. EUROPEAN UNION RESTRICTIONS REGARDING NON-MANUFACTURED WOOD PACKAGING AND PALLETS

All European shipments with wood pallets and wood containers produced of non-manufactured wood shall be constructed from Heat Treated (HT to 56 degrees Centigrade for 30 minutes) material and certified by an accredited agency recognized by the American Lumber Standards Committee (ALSC) in accordance with Non-manufactured Wood Packing Policy and Non-manufactured Wood Packing Enforcement Regulations both dated May 30, 2001.

Refer to http://www.aphis.usda.gov/ppq/swp/eunmwp.html for information and material sources.

5. NAVY SHELF LIFE PROGRAM

Navy shelf-life requirements are listed under the item description in a 3-digit alpha/numeric code. Position one (1) is the DOD shelf-life code, defining the type of shelf-life for an item (Type I, non-extendible or Type II, extendible), and the number of months an item can remain ready for issue in a Navy specified package. Positions two (2) and three (3) combined form the Navy-unique shelf-life action codes used by storage activities, and do not impose any requirements on the contractor. The contractor shall use the applicable shelf-life paragraphs and table in MIL-STD-129M, "Marking for Shipment and Storage", to apply either Type I or Type II shelf-life markings for an

item's unit, intermediate and shipping containers. Contractors will ensure that at least eighty-five percent (85%) of the Navy shelf-life requirement is remaining when received by the first government activity.

6. ACO AUTHORITY TO CHANGE PACKAGING, PACKING OR MARKING

The ACO may order a change in preservation, packaging, packing or marking upon specific request of the NAVICP PCO. The contractor shall submit to the ACO a price reduction proposal, whenever such a change in packaging and/or packing levels has been made.

7. REUSABLE NATIONAL STOCK NUMBERED (NSN) CONTAINERS FOR NAVY PROCUREMENTS

a. A Repairable item that has an NSN assigned in the "Container NSN" field (e.g . 8145_____) requires shipment in a metal or plastic reusable shipping and storage container. Unless otherwise specified, reusable NSN containers (EXCLUDING WOOD AND FIBERBOARD), shall be provided as Government Furnished Material (GFM). Fast Pack Containers **are not** provided by NAVICP. To obtain reusable containers, Contractor may:

Request containers online via the Container Request Form (CRF) NAVICP 4030/2, available under website: http://www.nll.navsup.navy.mil/navicp. Under "Document Type" click on down arrow to "Contract Support Documentation". Under "Keywords", type in "CSD011", then "Search". Click on the form title; fill out the appropriate information and click "Submit", which will automatically send the form to the NAVICP Container Manager.

The contractor shall request GFM containers from the Container Management Area, Code 03333.60, telephone (215)697-2673 or Code 03333.63, telephone (215)697-2237, telefax (215)697-3725, at least 90 days prior to the anticipated shipping date (monthly for repair contracts).

b. GFM reusable containers shall be reused, when the contractor and ACO consider the containers adequate to protect the items in shipment and extended storage. Containers not new in appearance or that have minor surface defects shall not be discarded. Minor refurbishment, such as replacement of foam cushioning, shall be accomplished at no additional cost to the Government. Regardless of the condition of the container, information regarding disposition of excess containers shall be obtained from the NAVICP Container Management Area, Code 03333.63, (215)697-2237, if necessary.

c. In the event reusable containers are unavailable, the contractor shall package the items in accordance with the alternate packaging requirements specified below. Under no circumstances will the unavailability of reusable containers be an excusable delivery delay. Unit packs shall be designed to conserve weight and cube while retaining the protection required and enhancing standardization.

8. REUSABLE NATIONAL STOCK NUMBERED (NSN) CONTAINERS FOR FOREIGN MILITARY SALES (FMS) PROCUREMENTS

1.) For all FMS, JPO-Italy, JPO-Spain and other acquisitions for foreign end-users, reusable shipping and storage containers shall be provided as Contractor Furnished Material (CFM), unless otherwise specified.

2.) For FMS and other foreign end-use acquisitions requiring CFM containers, contractors may tender offers including alternate, non-reusable, packaging methods and be considered responsive.

9. ALTERNATE PACKAGING AUTHORIZATION

1.) The contractor shall request containers as stated in paragraphs 7. a.) or 7. b.) above. If the NAVICP Container Management Area (CMA) informs the contractor that containers are unavailable, then the NAVICP CMA will confirm that the contractor is permitted to use this clause. For the following commonly used containers (listed in NSN order), the contractor is authorized to use the following alternate packaging requirements:

ALTERNATE PACKAGING REQUIREMENTS FOR
ITEMS ASSIGNED THE FOLLOWING CONTAINERS:

Container NSN 6KD8145-	Container Part Number	Alternate Packaging Code IAW MIL-STD-2073 (QUP = 001)
00-288-1396	13414-018	DW100K3GHMEDA00
00-288-1397	13414-024	DW100K3GHMEDA00
00-301-2987	13414-017	DW100K3GHMEDA00
00-449-8424	13414-090	DW100K3GHMEDA00
00-449-8427	13414-083	DW100K3GHMEDA00
00-485-8250	13414-077	DW100K3GHMDRA00
00-485-8256	13414-038	DW100K3GHMEDA00
00-499-9808	13414-125	DW100K3GHMDRA00
00-501-9138	13414-110	DW100K3GHMEDA00
00-514-2798	13414-102	DW100K3GHMDRA00
00-519-6384	13414-029	DW100K3GHMEDA00
00-522-6907	13414-033	DW100K3GHMEDA00
00-529-8585	13414-124	DW100K3GHMDRA00
00-536-4925	13414-101	DW100K3GHMEDA00
00-540-1762	13414-046	DW100K3GHMEDA00
00-549-6647	13414-078	DW100K3GHMEDA00
00-553-1539	13414-025	DW100K3GHMEDA00
01-008-3683	13414-502	DW100K3GHMF2A00
01-010-3776	13414-501	DW100K3GHMF2A00
01-026-2369	13414-170	DW100K3GHMDRA00
01-044-3289	13414-095	DW100K3GHMEDA00

ALTERNATE PACKAGING REQUIREMENTS FOR
ITEMS ASSIGNED THE FOLLOWING CONTAINERS:

Container NSN 6KD8145-	Container Part Number	Alternate Packaging Code IAW MIL-STD-2073 (QUP = 001)
01-262-2982	15450-100	DW100K3GHMEDA00
01-262-2983	15450-200	DW100K3GHMEDA00
01-262-2984	15450-300	DW100K3GHMEDA00
01-262-2985	15450-400	DW100K3GHMEDA00
01-262-2986	15450-500	DW100K3GHMEDA00
01-262-2987	15450-600	DW100K3GHMEDA00
01-262-2988	15450-700	DW100K3GHMDRA00

ALTERNATE PACKAGING REQUIREMENTS FOR
ITEMS ASSIGNED THE FOLLOWING CONTAINERS:

Container NSN 1RM8145-	Container Part Number	Alternate Packaging Code IAW MIL-STD-2073 (QUP = 001)
00-260-9548	P069-2	GX100ZZBGBECA00 ZZ = MIL-P-81997, Type I Pouch
00-260-9556	P069-1	Same as above
00-260-9559	P069-3	Same as above
00-260-9562	P069-4	Same as above
01-012-4088	P069-6	Same as above
01-014-0440	P069-5	Same as above
01-164-4073	P069-7	Same as above

10. NAVICP-Phila. DRAWING (80132)15450 - MULTI-APPLICATION REUSABLE CONTAINER (45 G MAXIMUM)

a. The inner package shall be centrally located on the platform of the reusable container. Package shall be snugly strapped in place.

b. Both the inner package (barrier bag) and outer container shall be marked/re-marked with the use of labels and/or tags in accordance with MIL-STD-129M, including bar code labels. A tag shall be used for bar code labeling of the outer container.

c. The NAVICP container manager for the containers listed in the below table is Code 03333.61, telephone (215)697-2063 or telefax (215)697-3725.

NSN 6KD8145-	NAVY P/N 15450-	MAXIMUM SHELL OUTSIDE DIMENSIONS (INCHES)	CONTAINER TARE WT. (LBS.)	ITEM SIZE (INCHES)	ITEM WT. (LBS.)

01-262-2982	100	20.4 X 16.0 X 14.5	23	Min. 8 X 4 X 4 Max. 12.6 X 8.6 X 7	3 - 10
01-262-2983	200	22.0X 20.0 X 17.2	30	Min. 12 X 8 X 6 Max. 14.6 X 12.6 X 9	10 - 20
01-262-2984	300	24.3 X 22.9 X 17	36	Min. 14 X 12 X 7 Max. 16.5 X 15 X 9.5	15 – 30
01-262-2985	400	35.6 X 20.7 X 19.5	51	Min.14 X 12 X 9 Max. 28 X 13 X 12	20 – 40
01-262-2986	500	24.4 X 24.3 X 22.5	45	Min. 14 X 14 X 10 Max.16.5 X 16.5 X 15	30 – 60
01-262-2987	600	35.8 X 28.9 X 22	66	Min. 14 X 14 X 10 Max. 28 X 21 X 14.5	30 – 60
01-262-2988	700	41.7 X 22.6 X 22.0	77	Min. 25 X 14 X 10 Max. 34 X 21 X 14	45 – 75

Appendix D
Navy AIT Points of Contact

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Appendix E
Navy AIT Vision

Automatic Identification Technology (AIT)
Vision Paper

Purpose

The purpose of this vision paper is to identify goals and specific steps required for Navy to revolutionize its policies for automating source data capture and integrating information into Logistics decision-making processes.

Background

In a fully integrated Automatic Identification and Data Capture/Collection (AIDC)/AIT environment Navy Configuration Management (CM), Damage Control, Financial, Food Service, Hazardous Material (HAZMAT), Maintenance, Medical, Ordnance, Personnel, Safety, Security, Ship Service, Supply, or Transportation must create and use accurate, timely information about their activities and the products they maintain. Near real-time information is available on demand and is updated easily by the maintainer in this automated environment. The information provides the logistician specific product genealogy, supply, transport, repair and performance histories, links to appropriate technical data and troubleshooting guides, and tracks comprehensive configuration information. Other Navy materiel managers have access to the information to support their management activities.

Focused Logistics, the Joint Staff's systematic approach for developing full spectrum supportability across the range of possible missions envisioned in support of Joint Vision 2020, defines six tenets. The tenets are the framework for designing a logistics template in joint war fighting technology. One of the six tenets is information fusion - the timely and accurate accessing and integrating of logistics data across units and combat support agencies throughout the world that provides reliable asset visibility and access to logistics resources in support of the warfighter. Focused Logistics specifically identifies AIT as a vital component of information fusion because it ensures the capturing of current and accurate source data for existing and future Service, Agency, and Commander-In-Chief (CINC) automated information systems (AISs).

Because of the potential benefits to Department of Defense's (DODs) logistics community, the Office of the Secretary of Defense (OSD) is focusing on AIT in a number of ways. OSD has published the Logistics Automatic Identification Technology Concept of Operations (CONOPS), established a DOD Logistics AIT Office, assigned a program manager for AIT, activated the Maintenance Technology Senior Steering Group, and developed a DOD Logistics AIT Implementation Plan. These actions, in turn, have placed a number of requirements on the Services, as well as the Joint Staff and Defense Agencies. These requirements include developing and adopting AIT standards, ensuring interoperability and compatibility, improving business practices, and developing a strategy for funding AIT applications.

The Navy's current vision, as stated in the United States Navy Logistics Automatic Identification Technology Implementation Plan - September 2000, is

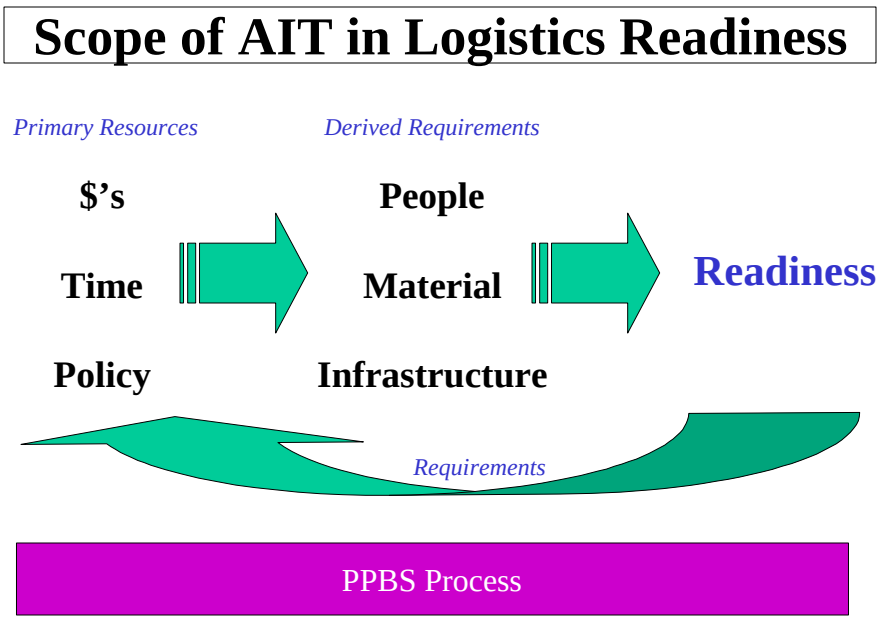
> Navy AIT will provide the proper mix of technologies that allows users to efficiently and effectively capture, aggregate, and transfer data and information, and share the data among AISs by using the optimum technology for a particular application. AIT will facilitate data collection and flow to all AISs to better achieves asset visibility with minimal personnel intervention, both afloat and ashore. The Navy vision for AIT is applicable throughout the Navy, though the initial emphasis is on the supply and transportation functions.

This vision:

- ONLY applies to machine-readable data
- maximizes use of commercial standards - minimizes use of DOD unique marking
- utilizes a license plate philosophy - touch data once, move it, capture it
- comprises rules written for normal environments
- utilizes AIT media meeting conformance standards
- requires a sunset date for naked bar codes
- excludes true closed-loop systems
- encompasses commodity unique modifications to basic AIT
    - HazMat
    - Shelf Life
    - Explosives
    - Postal, etc.

SCOPE

The Navy has an aspiration to optimize manning on ships as wells as at the logistics shore nodes while improving readiness. In order to meet the optimized manning mandates by the Chief of Naval Operation (CNO), this will require technology insertion, systems modernization, and business process reengineering (BPR). The requirements for AIT technology insertion are derived from the "Readiness" objectives. The three major components of "readiness" are impacted by the availability of personnel, the operational availability of the material, and the infrastructure to support the personnel responsible for the logistics pipeline. The primary resources required to identify the correct number of personnel, the proper amount of operational material and infrastructure are dollars for the technology insertion balanced with the time saving, the cost avoidance, and policy. The Navy is undertaking a number of proofs-of-concept/prototypes to prove the technology will meet the requirements, can be integrated to a fully compliant data environment, and identify the total cost for full implementation. As in any business process, policy changes will be required to take full advantage of the technology insertion. The Navy AIT Project Office will provide support to the Navy for technology, data, and compliance and conformance standards. The scope of AIT in logistics readiness is depicted in the following graphic.



AIT is not a System, AIT automates Management Information Systems

Qualifiers

Policy before Standards. The DOD Logistics AIT Office located at the Defense Logistics Agency (DLA) is the executive agent for Logistics AIT and is responsible for developing the DOD Logistics AIT Architecture. This Architecture will identify the data, technology, compliance and conformance, and application standards adopted by DOD that will allow the Military Services to implement an infrastructure to support the Long-Term Goals identified below. The Navy has been participating in the development of this Architecture and will be required to implement this policy, once signed, in support of Joint Logistics Operations.

Application Standards before Technology Insertion. As DOD adopts Logistics AIT Architecture and incorporates this Architecture into policy, it is paramount for the Navy to review existing requirement documents for the various business processes (strategic) and AISs (operational) to integrate AIT (tactical). Immediate focus must be placed on the processes and systems to accept data seamlessly and not on the technology. Compounding this issue it the Navy's implementation of large-scale process/system reengineering efforts such as Enterprise Resource planning (ERP) at the same time DLA is instituting ERP. DLA and the Navy must ensure processes and data are standardized otherwise Integrated Data Environments (IDEs) will be required to extend support for these interfaces.

Controlling Directives

In simplistic terms the following directives support the Information Integration Process outlined in the next section by requiring a basic AIT infrastructure (linear and 2D bar codes) at DOD Supply and Transportation nodes worldwide by mid FY02, AIT/AIS integration by FY04 and TAV by FY07.

DUSD(L) Logistics Automatic Identification Technology Concept of Operations Memorandum of 12 November 1997
DOD Logistics Automatic Identification Technology Implementation Plan of 17 March 2000
DOD Reform Initiative Directive (DRID) #54 - Logistics Transformation Plans of 23 March 2000
Navy Congressional Plan for Inventory Management of In-Transit Items of April 2000
Navy High Yield Logistics Transformation Plan for FY00 of 21 August 2000
Navy Logistics Automatic Identification Technology Implementation Plan of 5 October 2000

Long-Term Goal (5 years and greater)

GOAL: To provide the warfighter Information Interoperability across all Logistic Functional Areas to enhance decision-making.

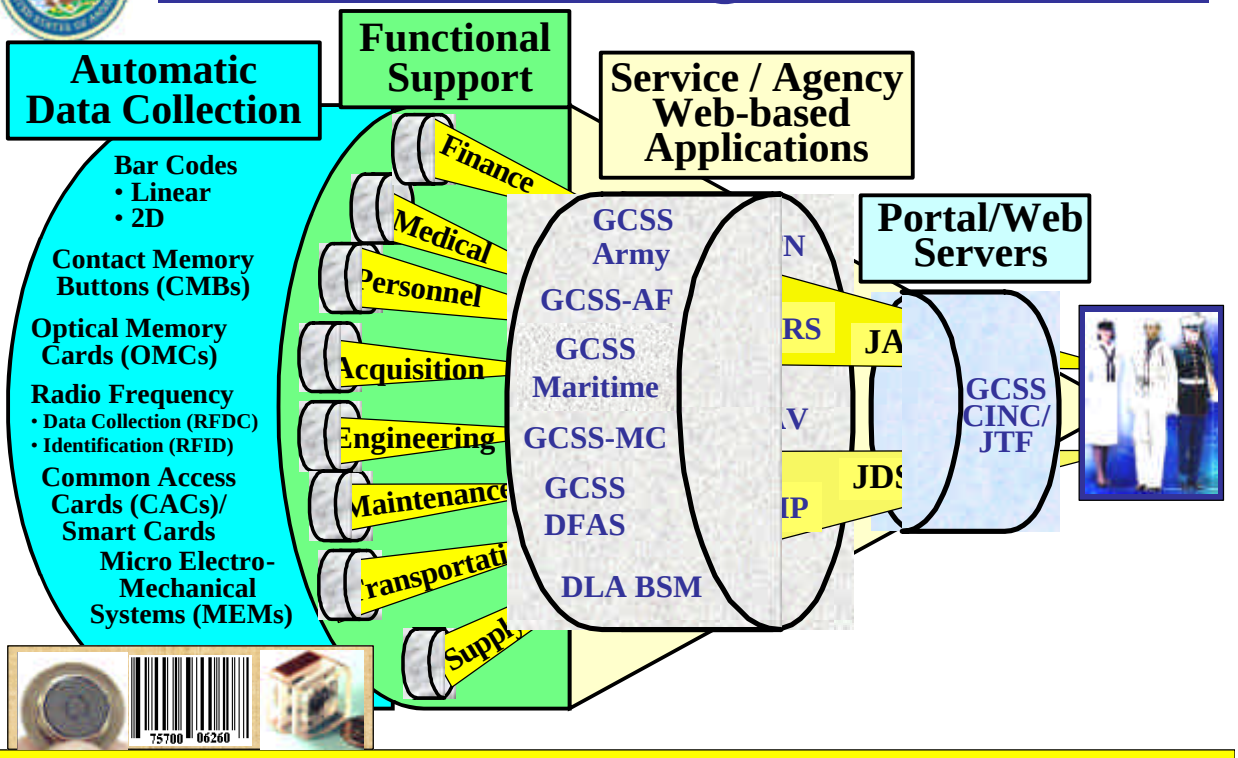
This is accomplished by providing the warfighter:

(1) Joint Asset Visibility in the following areas: Mobility, Transportation, Movement, Logistics (Supply, Maintenance, Engineering, etc.), Personnel and Force Health Protection, Acquisition and Finance, and
(2) Joint Decision Support Tools (i.e., Collaborative Planning, Course of Action Development and Course of Action Analysis)

AIT devices collect timely and accurate data and feed that data to the End User/GCSS-GCCS warfighter. This data is feed through the AIS. The user's infrastructure is a fully web-enabled end state, one that allows any authorized user using any authorized computer-like box, anywhere in the world in a near real-time environment. The user's display consists of a single picture - the COMBAT SUPPORT logistics picture fused and integrated with the COMMAND & CONTROL picture. This becomes a decision-making tool, providing Real-Time Situational Awareness of the battlefield.

This process is depicted in the following chart.

Information Integration Process



It's NOT about Technology, it's about Process

Short-Term Goal (3-5 years)

GOAL: Develop a process to accept standardized data from commercial industry and pass this data seamlessly into AISs. Institutionalize the Information Integration Process outlined above through policy.

To support our short-term goal and our qualifier of Process before Technology, our current objective is to support identifying requirements to design and develop a DOD Logistics AIT Architecture to be enacted into policy (i.e., directives, instructions, regulations, etc.).

This AIT environment will include the proper mix of technologies that enables users to efficiently and effectively capture, aggregate, and transfer data (i.e., acquisition, supply, maintenance, transportation, etc.). The environment includes AIT equipment, AISs with supporting databases, and the architectural infrastructure (i.e., networks, power, security, etc.) that effectively integrates these elements.

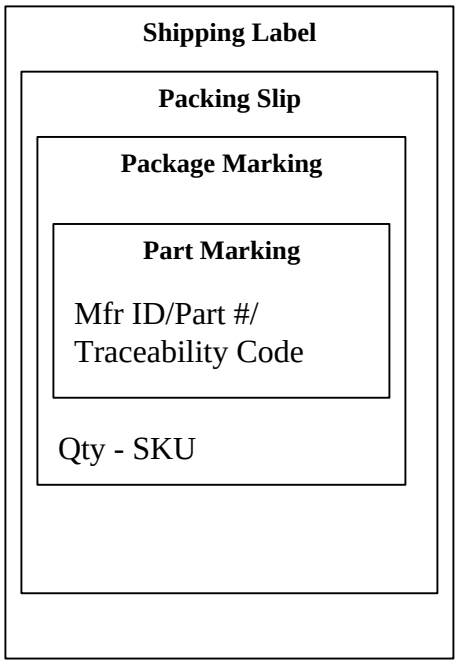
Using AIT and related AIS capabilities in the integrated environment, Navy functional business processes easily record accurate information about the procedures they carry out. The products they maintain are digitally characterized in the environment; data requirements, such as receipt, store, issue, and work-order forms are pre-populated according to AIT identification and interface with appropriate AISs. Information is created in near real-time.

Logistics process tracking, such as troubleshooting, inspection, removal, repair, and overhaul are easily and accurately documented. Uniquely identified products, whether they are end items, LRUs, or SRUs, are the central point around which information is focused. AIT provides instant, automatic identification of every discrete product for accurately accumulating and retrieving all related information.

Information (e.g., required technical data, maintenance or performance histories, and configuration relationships) is available when demanded. AISs are properly constructed and linked in an architecture that brings all related information together for the maintainer or other user. AIT and unique product markings are the instantaneous key into the information environment.

Other materiel management personnel have access to the information created by acquisition, supply, maintenance, transportation, medical, etc. functions, such as item management, product engineering, production planning, and reliability analysis, are supported with comprehensive, accurate information from a single IDE.

The DOD Logistics AIT Office's vision is to maximize the use of commercial standards as they apply to machine-readable data only. The data hierarchy envisioned by the DOD Logistics AIT Office is depicted in the following figure.



The Navy AIT Project Office is a strong advocate and key participator in the development of this basic building block for the DOD Logistics AIT Architecture.

Business Transaction Requirements

To support our Vision, Scope, and Process basic business transaction requirements will be identified to allow for seamless AIT/AIS integration. These include identification of the following basic elements:

- Material ⇒ ***What***
- Transaction (process) ⇒ ***How***
- Characteristics
  - Time ⇒ ***When***
  - Place ⇒ ***Where***
  - Person ⇒ ***Who***

Functional areas that directly benefit from using the transaction characteristics identified for AIT include the following and will be discussed in greater detail:

- Information
- Acquisition
- Manufacture
- Storage
- Transportation
- Operations
- Repair/Maintenance
- Disposal
- Performance Measurement
- Personnel

AIT =
Data accuracy
Timeliness
Efficiency

There are three primary stages of a product's life cycle, from its "birth" (procurement), throughout its "life" (in-use), to its "death" (reutilization).

- **Procurement** includes actions taken to acquire a product required to meet initial or replenishment requirements. The life cycle of a product begins with its purchase from a vendor, original equipment manufacturer (OEM), or re-manufacturer. Specific product information, such as part number, traceability code, and manufacturer, is recorded on the item at birth.
- **In-Use** describes the operational history of a product. Operational history is defined by its time spent in four conditions: in-maintenance, in-storage, in-transit, and on-hand in unit. A product can move through the four conditions many times through its life cycle. A significant amount of information could be recorded during its use, including modifications, repairs, operational history, overhauls, configuration changes, and warranty criteria.
- **Reutilization** describes the end of a product's useful Navy life, and includes disposing of a repairable product or repair part (including reutilization, disposal, discard, resale, or destruction). Depending on its attributes, characteristics, condition, or operational history, certain information is recorded indicating a product's final disposition, such as its status as a flight-critical part or as HazMat.

Information can be broken down into four major characteristics. The more centralized the data, the greater the risk of data being corrupted. This is why at the first point along the supply chain (acquisition, receipt, store, issue, maintenance, overhaul etc.), the creation and capture of AIT is critical.

- In-Use
- In-Process
- In-Storage
- In-Transit

Acquisition Phase allows for the Navy to adequately mark material supplies, aircraft, ships and components with an AIT/ADC capability. Cost savings originate at the acquisition phase. The acquisition phase is broken into three major categories and the Vision incorporates including AIT into contract language for material contracts, services, and small contract purchases.

- Material Contract
  - Direct Vendor Delivery
  - Prime Vendor
  - Major Acquisition
- Service and Support Contract
  - GOCO
  - Outsourcing
- Small Contracts
  - Impact Cards
  - Local Purchase
  - Blanket Purchase Agreement's (BPAs)

Manufacture and the maintenance genealogy can be broken down from the very smallest bit to the largest ship or aircraft. AIT requires a suite of technology (bar codes, contact memory buttons, optical memory cards, smart cards, RFDC/RFID etc.) to create, collect, capture, and transmit the data to a database.

- Bit and piece
- Sub Assembly
- Assembly
- Component
- Equipment
- Major System

Storage provides an excellent use of AIT/ADC if the material comes from the vendors directly. Simple bar codes can more accurately record the process and infuse the information into a warehouse management systems or transportation tracking.

- Receipt/Store/Issue/Transfer to end user
- General Storage

- Cross Dock/Transit Point
- Special Requirement
  - HazMat
  - Shelf Life
  - Medical
  - Biological/Chemical
  - Nuclear

Transportation functions can be improved dramatically in time required to process documents, reduced workload manning, and providing more timely and accurate data. Using AIT will assist the Navy in its ability to have ITV during the transportation phase.

- Distribution
  - Consolidation
  - Single
  - De-aggregation
- Packaging
  - Wood
  - Fiber
  - Rubber
  - Metal
- Containerization
  - Open
  - Closed

Operations are the readiness component of the Navy's mission. The use of AIT can greatly improve on the knowledge of weapon systems with more timely and accurate data. AIT can provide the Navy's leadership with the most current status and genealogy of a system down to the bit level.

- In-Use
- Configuration
- Consumption
- Tracking

Repair/Maintenance is a relatively new use for AIT and has excellent potential for cost avoidance. The Navy will continue to implement and use AIT for tracking the maintenance cycle and providing the combat components with operational systems.

- Unit (O Level)
- Outsource
- Intermediate (I)/Depot (D)
- Configuration Maintenance
- Usage - Consumption

Disposal will be a new use of AIT once the acquisition community provides policy guidance and ensure vendors start implementing the vision of marking material at the source. The Navy needs the ability to track and trace sub safe and aviation components due to the critical nature of the product and its future possible use.

- General (Sales)
- Special – Demilitarization
- Reutilization
- Recycling/Reclamation

Performance Measurement ultimately is improved by the use of AIT. A fully integrated AIT architecture will enhance the following:

- Readiness
- Weapon System Predictive Analysis
- Continuous Process Improvement
- Business Case Analysis (BCA)

Personnel can be integrated into the business process of receipt, store, and issue by identifying the person accomplishing the task. Manifesting and personnel accountability can be greatly increased through the use of AIT. Electronic signature on AIT devices will support the Navy in moving to a paperless environment.

- Identification (accountability)
- Manifesting

Historical Perspective

According to several studies, at least one error must be expected in every 200 to 400 keystrokes. If a typical computer entry involves 15 keystrokes, the result is a five percent error from this source alone. As a consequence, AIS data accuracy is far less effective than it could be simply because the original source data from manual input will be flawed if not corrected. The more centralized the data, the greater the risk of the data being corrupted.

Several studies have shown:

- a positive cash flow and a complete return on investment (ROI) in six months after implementing a bar code solution. As for every business process or functional application, the bar code may not be the correct solution based on the requirement.
- contact memory buttons (CMBs) will be used where ruggedness and the ability to have a dynamic portable data file (PDF) is required. It is cheaper to use CMBs where you have to replace five or more bar codes (labor costs, time required, removing the label, re-printing, and then re-marking).

- a positive cash flow for a radio frequency identification (RFID) implementation will take place in three years and the complete ROI could be as long as 6 years.

Every AIT media has its strengths and weakness and the most appropriate solution will be determined by a thorough examination of the requirement and existing logistic business process. The Vision supports the design, development, and implementation of an AIT decision-tree matrix to support Navy functional users to determine the optimum solution for a requirement.

Logistics Processes

As discussed above, the transaction data elements (create data) using AIT (collect/pass data) integrated with an AIS (view data) cross several functional applications and business processes. Identifying specific examples where AIT will have the most immediate impact is based on several qualifying factors previously identified in this paper. Estimates of savings will be more closely associated with cost avoidance than cost reduction since it is the responsibility of theater commanders, platform/weapon system managers, etc. to effect cost reductions.

The goal is to standardize and automate the process of moving commercial data into DOD AISs. Given the magnitude and diversity of the Supply, Transportation, and Maintenance segments, DOD has three overarching requirements for AIT devices.

- They should be integrated into the AISs supporting its logistics functions,
- be used to maximize the use of pre-positioned data in these AISs, and
- be compatible throughout those functions.

Furthermore, they should support the following requirements:

- For materiel received at a storage site, maintenance facility, shipping activity, port, destination receiving activity, or consignee, AIT devices should be capable of transferring item identification data (such as manufacturers ID, part number, traceability code, quantity, SKU) and transaction controlling data (such as document numbers) to the supporting AIS. The data transfer process should facilitate the receipt, disposition, and documentation processes.

- If pre-positioned data is not available when a shipment is received, AIT devices should be capable of transferring the stored information to the AIS that supports the particular logistics process. The AIS can use this information to create a record for the item and complete the required transaction.

- AIT devices should be an integral part of DOD's logistics processes. They should be used to convey item or transaction identification information, access and update specific records through AIS interfaces, and permit logistics personnel to enter only new or updated information. Examples of specific functions and processes that AIT can enhance include the following:

    - **Storage sites** are responsible for receiving materiel from vendors, reconciling purchase orders and contract commitments, stocking materiel in bins or on shelves, conducting physical inventories, and issuing materiel from storage. AIT support

should facilitate the transfer of information to AISs and confirm the accuracy of specific item data with information in the AISs.

- **Maintenance facilities** are responsible for tracking materiel through work-in-progress by collecting identification data, time, and location of materiel in every step of the repair process. The AIT devices should collect information on materiel consumed in the repair process and carry comprehensive maintenance history data for sequential logistics processes to use.

- **Shipping and receiving activities and ports** are responsible for confirming materiel has been received, preparing shipment documentation, combining items into consolidated shipment units, dividing shipment units into individual items, and updating shipment status.

- **Logistics management** is responsible for assisting in locating and identifying materiel, shipments, and containers. AIT devices should be capable of supporting the transfer of items among maintenance facilities, storage sites, and shipping activities. AIT devices, in concert with associated AISs, should be capable of supporting the reconstitution of DOD shipments.

Critical Success Factors

Several factors are critical to the success of the Vision. The following factors are outside the control of the Navy AIT Project Office and require cooperative support by the Navy:

- **Communications**. The Vision concept rests on assured and reliable communications. Success will be constrained by the quality and capacity of communications lines.
- **Integration**. The Vision is primarily the integration of data, AISs, standards, and communications networks. This Vision can facilitate the integration of functional, operational, and business processes that have operated independently.
- **Security**. Maximizing capabilities requires supporting a wide range of information exchange needs. To support the needs, several security issues need to be addressed. The exchange of unclassified information from highly classified systems to ones with lower classifications, access controls, encryption, and data aggregation are key security issues that need to be resolved.
- **Data quality**. The Vision's success depends on the quality and timeliness of the data provided to users. Data availability and data accuracy are constrained by quality controls of source system data. Because data is readily available and consequently widely used, data providers should feel a heightened sense of responsibility to provide data that are as timely and accurate as possible.
- **Business rules**. The following two types of business rules are relevant to the Vision:
  - **Visibility business rules**. Visibility rules govern what information is exchanged, how it is exchanged, and who has access to it. Although DOD policy considers data to be a corporate, shared asset and DOD 4140.1-R prescribes logistics policy, the data providers and users are responsible for implementation. Accessibility to required

logistics data necessitates cooperation of service and agency owners of logistics AISs. The DOD JTAV Office serves as a facilitator.

- **Functional business rules**. Functional rules determine how business processes are performed and how the information is used. Business processes may be improved by taking advantage of improved visibility capabilities. Although these rules are the responsibility of the applicable functional offices, the Navy AIT Project Office can facilitate a revision of the rules.

Appendix F

Reference Materials and Further AIT Reading

This area reserved for listing books, periodicals, pertinent articles, and Internet web sites that offer information on AIT integration, ROI, technology, and standards.