United States Department of Defense
Suppliers' Passive RFID Information Guide

Version 7.0

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What's New in this Version

Date of Change	Version	Reason for Change	Summary of Change
3/05	7.0	Policy Update	Updated policy information to detail our phased implementation approach
3/05	7.0	Completed Milestones	Removed items in the "Upcoming Milestones" section that have already passed.
3/05	7.0	EPC update	Updated the definition of EPC Technology to reflect the approval of Gen 2 and note that this type of technology still needs to become readily available.
3/05	7.0	Additional Information	Added the section entitled "Number Formats and Representations".
3/05	7.0	Data Construct Update	Changed the binary header that specifies that the tag is encoded as a DoD-96 Tag Data Construct
3/05	7.0	Additional Information	Updated terminology in the graphic for the example encoding of a 96-bit tag to focus more on binary elements.

DoD Suppliers' Passive RFID Information Guide

1. Introduction

1.1 Background

The United States Department of Defense (DoD) is dedicated to becoming an early adopter of passive Radio Frequency Identification (RFID) technology. Passive RFID tags reflect and modulate a carrier signal received by an interrogator. Passive RFID requires strong RF signals from a reader/interrogator, and the RF signal strength returned from the tag is constrained to very low levels by the limited energy.

RFID is a truly transformational technology and will play a vital role in achieving the DoD vision for implementing knowledge-enabled logistic support to the warfighter through fully automated visibility and management of assets. Our goal is to employ mature and emerging supply chain technologies to optimize the supply chain – use of RFID as an integral part of a comprehensive suite of AIT technology will facilitate accurate, hands-free data capture in support of DoD business processes in an integrated end-to-end supply chain enterprise.

In order to achieve this goal, we will require cooperation and concerted efforts from many entities, including our suppliers and the diverse U.S. military community. The final policy, released in July 2004, requires passive RFID tagging at the case, pallet and the item packaging (unit pack) level, with appropriate contract clause, in accordance with the implementation plan, which may be downloaded from http://www.dodrfid.org/supplierimplementationplan.htm. The DoD policy requiring RFID implementation has a starting date of January 2005. The effective date for suppliers to implement RFID will be the date a supplier's contract contains language regarding the requirement. That could be any date in January 2005 or beyond. The DoD has many contracts with its suppliers that are renewed and recompeted regularly. As these new contracts are effective the requirement for RFID will be included according to the supplier implementation plan (www.dodrfid.org).

DoD has been actively delivering RFID related information and requirements to its supplier community. Throughout this effort, we have been drafting a DFAR clause to include RFID relevant information, held two supplier summits to discuss RFID concepts and concerns, and established open channels of communication with our vendor community.

This document serves as a summary of the Department of Defense's requirements and guidelines related to passive RFID implementation for our supplier community. This guide will be updated as necessary as the technology and supporting business processes evolve.

1.2 Potential Benefits of RFID technology

The benefits associated with RFID technology are numerous for both the Department of Defense and our suppliers. The incorporation of passive RFID technology will allow the DoD to have hands-free data capture enabling the efficient recording of material transactions as well as gaining

increased efficiencies within our supply chain by streamlining our supply chain, improving business functions, and better supporting global war-fighting requirements.

Typically, RFID benefits can be seen in the areas of inventory management and visibility, operational improvements, shrinkage, and asset tracking. Within each area, there are substantial benefits for the DoD as well as our suppliers, including collaborative benefits. Highlighted benefits include:

Supplier Benefits:

- Improve planning
- Produce faster demand responses
- Reduce the Bull Whip Effect
- Streamline Business Processes
- Improve efficiency in the recall of defective items
- Increase your ability to make sure that your products are always on our shelves.
- Receive faster payments for your supplied goods.

DoD Benefits:

- Improve inventory management
- Improve labor productivity
- Eliminate duplicate orders
- Replace manual procedures
- Automate receipt and acceptance
- Improve inventory and shipment visibility and management
- Reduce shrinkage
- Enhance business processes within the DoD
- Improve asset tracking

We expect that each supplier will explore your own possible benefits, and determine the most cost effective way to incorporate RFID technology into your organization.

1.3 Upcoming Milestones

The Department of Defense is committed to supporting our suppliers throughout the integration process. We will keep the supplier community informed of upcoming milestones, as well as changes to our related policies.

2. Implementation

The DoD vision for RFID is to utilize RFID to facilitate accurate, hands free data capture in support of business processes in an integrated DoD supply chain enterprise as an integral part of a comprehensive suite of AIT technology. The key to future functionality of the unique item data in the DoD Supply Chain will be the ability to temporarily associate "conditional state" information about the item – whether for transportation, supply management, maintenance, distribution, or disposal. In order to accomplish this goal, and as the available technology matures, the DoD expects to fully embrace the use of EPC technology as well as approved EPC tag data constructs in a supporting DoD data environment. The efficiencies RFID creates are quickly being realized as a valuable component of the suite of Automatic Identification Technology (AIT) technologies. Active RFID has already improved the ability to track and trace materiel through the supply chain. Combining the passive RFID technology will create greater efficiencies and data accuracy. Leveraging RFID to the fullest extent possible will improve the ability to get the warfighter the right materiel, at the right place, at the right time, and in the right condition.

Our combined efforts by January 2005 will lay the foundation for improving supply chain efficiencies. The DoD is working with various industry associations to ensure that their suppliers' implementation approach aligns with the requirements of the policy.

2.1 Definitions

For clarification, the following definitions apply to passive RFID technology and tags in support of the DoD requirement to mark/tag material shipments to DoD activities in accordance with the DoD RFID policy:

EPC Technology: Passive RFID technology (readers, tags, printers, etc.) that is built to the most current published EPCglobal Class 0 and Class 1 specifications and that meets interoperability test requirements as prescribed by EPCglobal™. EPC Technology will include Ultra High Frequency Generation 2 (UHF Gen 2) technology when equipment based on this specification is readily available commercially.

UID (Unique Identification) Unit Pack A MIL-STD-129 defined unit pack, specifically, the first tie, wrap, or container applied to a single item, or to a group of items, of a single stock number, preserved or unpreserved, which constitutes a complete or identifiable package.

Bulk Commodities: These items shall not be tagged in accordance with passive RFID tagging requirements. Bulk commodities are products carried or shipped in rail tank cars; tanker trucks; other bulk, wheeled conveyances; or pipelines.

Examples of bulk commodities are:

- Sand

- Gravel
- Bulk liquids (water, chemicals, or petroleum products)
- Ready-mix concrete or similar construction materials
- Coal or combustibles such as firewood
- Agricultural products – seeds, grains, animal feeds, and the like

In addition, Munitions and explosives shall not be tagged until the following certification requirements are met for the passive RFID tag: electromagnetic effects on the environment (E3), Hazards of Electromagnetic Radiation to Ordnance (HERO), Hazards of Electromagnetic Radiation to Fuel (HERF), and Hazards of Electromagnetic Radiation to Personnel (HERP).

Case: Either an exterior container within a palletized unit load or an individual shipping container.

> Exterior Container: A MIL-STD-129 defined container, bundle, or assembly that is sufficient by reason of material, design, and construction to protect unit packs and intermediate containers and their contents during shipment and storage. It can be a unit pack or a container with a combination of unit packs or intermediate containers. An exterior container may or may not be used as a shipping container.
>
> Shipping Container: A MIL-STD-129 defined exterior container which meets carrier regulations and is of sufficient strength, by reason of material, design, and construction, to be shipped safely without further packing (e.g., wooden boxes or crates, fiber and metal drums, and corrugated and solid fiberboard boxes).

Palletized Unit Load: A MIL-STD-129 defined quantity of items, packed or unpacked, arranged on a pallet in a specified manner and secured, strapped, or fastened on the pallet so that the whole palletized load is handled as a single unit. A palletized or skidded load is not considered to be a shipping container.

2.2 Implementation Approach

Considering the volume of contracts and the variety of commodities managed, the DoD has developed a plan for passive RFID tagging that delivers best value to the warfighting customer. This implementation plan provides a roadmap that targets critical distribution functions within the defense distribution depots, depot maintenance operations and strategic aerial ports.

RFID technology will be implemented through a phased approach, applied both to supplier requirements and DoD sites. Shipments of goods and materials will be phased in by procurement methods, classes/commodities, location and layers of packaging for passive RFID.

For DoD suppliers, the following implementation approach will be followed:

Commencing January 1st, 2005

RFID tagging will be required for all DoD manufacturers and suppliers who have new contracts, issued with the appropriate contract clause, according to the following implementation guidelines:

The following Classes of Supply will require RFID tags to be placed on all individual cases, all cases packaged within palletized unit loads, and all palletized unit loads:

- Class I Subclass – Packaged Operational Rations
- Class II – Clothing, Individual Equipment, and Tools.
- Class VI – Personal Demand Items
- Class IX – Weapon Systems Repair Parts & Components

When these commodities are being shipped to the following locations:

- Defense Distribution Depot, Susquehanna, PA (DDSP)
- Defense Distribution Depot, San Joaquin, CA (DDJC)

Commencing January 1st, 2006

In addition to the requirements above, RFID tagging will be required for all DoD manufacturers and suppliers who have new contracts, issued with the appropriate contract clause, according to the following implementation guidelines:

The following Classes of Supply will require RFID tags to be placed on all individual cases, all cases packaged within palletized unit loads, and all palletized unit loads (pending appropriate safety certification):

- Class I – Subsistence and Comfort Items
- Class III – Packaged Petroleum, Lubricants, Oils, Preservatives, Chemicals & Additives
- Class IV – Construction & Barrier Equipment
- Class V – Ammunition of all types
- Class VII – Major End Items
- Class VIII – Pharmaceuticals and Medical Materials

When these commodities are shipped to DDSP, DDJC and the following:

USMC
Marine Corps Maintenance Depot, Albany, GA
Marine Corps Maintenance Depot, Barstow, CA

USA
Army Maintenance Depot, Anniston, AL
Army Maintenance Depot, Corpus Christi, TX
Army Maintenance Depot, Red River, TX
Army Maintenance Depot, Tobyhanna, PA

USTRANSCOM
Air Mobility Command Terminal, Charleston Air Force Base, Charleston, SC
Air Mobility Command Terminal, Dover Air Force Base, Dover, DE
Air Mobility Command Terminal, Naval Air Station Norfolk, Norfolk, VA
Air Mobility Command Terminal, Travis Air Force Base, Fairfield, CA

USAF
Air Logistics Center, Hill Air Force Base, Ogden, UT
Air Logistics Center, Tinker Air Force Base, Oklahoma City, OK
Air Logistics Center, Warner Robbins, GA

USN
Naval Aviation Depot, Cherry Point, NC
Naval Aviation Depot, Jacksonville, FL
Naval Aviation Depot North Island, San Diego, CA

DLA
Defense Distribution Depot, Albany, GA
Defense Distribution Depot, Anniston, AL
Defense Distribution Depot, Barstow, CA
Defense Distribution Depot, Cherry Point, NC
Defense Distribution Depot, Columbus, OH
Defense Distribution Depot, Corpus Christi, TX
Defense Distribution Depot, Hill Air Force Base, Ogden, UT
Defense Distribution Depot, Jacksonville, FL
Defense Distribution Depot, Tinker Air Force Base, Oklahoma City, OK
Defense Distribution Depot, Norfolk, VA
Defense Distribution Depot, Puget Sound, WA
Defense Distribution Depot, Red River, TX
Defense Distribution Depot, Richmond, VA
Defense Distribution Depot North Island, San Diego, CA
Defense Distribution Depot, Tobyhanna, PA
Defense Distribution Depot, Warner Robbins, GA

Commencing January 1st, 2007

RFID tagging will be required for all DoD manufacturers and suppliers who have new contracts, issued with the appropriate contract clause, according to the following implementation guidelines:

All classes of supply will require RFID tags on all individual cases, all cases packaged within palletized unit loads, all pallets, and all unit packs for unique identification (UID) items.

RFID tagging will be required on commodities shipped to any DoD location.

3. Guidelines and Requirements

The cost of implementing and operating RFID technology is considered a normal cost of business.

Per current DoD regulations, DoD Purchase Cards may be used to acquire items on existing government contracts as well as acquire items directly from suppliers that are not on a specific government contract. If the DoD Purchase Card is used to acquire items that are on a government contract that includes a requirement for RFID tagging of material per the appropriate DFARS Rule, any items purchased via the DoD Purchase Card shall be RFID tagged in accordance with the policy. If DoD customers desire the inclusion of a passive RFID tag on shipments for these type purchases, this requirement must be specifically requested of the shipping supplier/vendor and the shipment must be accompanied by an appropriate Advanced Shipment Notification (ASN) containing the shipment information associated to the appropriate RFID tag.

The DoD will not endorse any technology or software provider. Suppliers should evaluate available technology and software.

3.1 Contract/Solicitation Requirements

All solicitations awarded with the appropriate contract clause, will require that passive RFID tags be affixed at the case, pallet, and UID item packaging level for material delivered to the Department of Defense, in accordance with the implementation plan, which is located above in the section entitled: "*Implementation Approach."* The plan can also be found at: http://www.dodrfid.org/supplierimplementationplan.htm

3.2 Case and Pallet Tagging

Cases and pallets of material (except bulk commodities as defined in the Definitions section of this document) will be tagged at the point of origin (manufacturer/vendor) with passive RFID tags beginning on January 1, 2005 for those contracts that contain the appropriate clause. The RFID tag and data written to the tag must meet the published DoD standards as outlined in the following sections.

3.3 Item Level (UID) Tagging

All items that require a Unique Identification (UID) will be tagged on the item packaging (UID Pack) at origin (manufacturer/vendor) with a passive RFID tag commencing January 1st, 2007 for those contracts that contain the appropriate clause.

Please note that this requirement for RFID tagging of UID items does not replace or affect the current process of assigning and placing unique identification on these items.

3.4 Advance Ship Notice (ASN) Transactions

For all shipments that are tagged with an RFID tag, a Receiving Report or Advanced Ship Notice (ASN) must be submitted through an electronic commerce capability developed for DoD called Wide Area Work Flow (WAWF). The receiving reports can be submitted to WAWF using three approved electronic transmission methods (EDI, web-based, or user defined format). Additional information, registration procedures for vendors, and a web-based training course for WAWF are available at https://wawf.eb.mil.

The intent of the transaction requirement is to pre-populate an association of RFID tag data with the appropriate shipment and materiel data in the DoD data environment. The transaction facilitates the identification of materiel based solely on reading the RFID tag. For this process to work, the receiving report must be received by the DoD receiving point before receiving the tagged materiel. This transaction must be initiated for all tag types and encoding schemes.

RFID Event Type	RFID Tag Data Construct	ASN Required	ASN Type
Shipment from Supplier	SGTIN-64 / SGTIN-96	Yes	856/WAWF Web or UDF
	GRAI-64 / GRAI-96	Yes	856/WAWF Web or UDF
	GIAI-64 / GIAI-96	Yes	856/WAWF Web or UDF
	SSCC-64 / SSCC-96	Yes	856/WAWF Web or UDF
	DoD-64 / DoD-96	Yes	856/WAWF Web or UDF

Table 1 - ASN Requirements for Supplier Shipments

3.5 Tag Classes and Sizes

The RFID tags listed in **Table 2** will be utilized for initial shipments from suppliers in compliance with appropriate contractual requirements to tag items shipped to DoD receiving points commencing January 1, 2005.

When the UHF Gen 2 EPC technology is approved and has completed any required compliance and/or interoperability testing, the DoD will establish firm tag acceptance expiration dates (sunset dates) for EPC Version 1 (class 0 and 1) tags and will accept only UHF Gen 2 EPC tags thereafter. The DoD goal is to migrate to use of an open standard UHF Gen 2 EPC tag, Class 1 or higher, that will support DoD end-to-end supply chain integration.

Class	User Memory Size (bits)	Sunset Date
0	64	At a minimum, 2 years from the general commercial availability and product maturity of EPCglobal certified UHF Gen 2 tags.
0	96	At a minimum, 2 years from the general commercial availability and product maturity of EPCglobal certified UHF Gen 2 tags.
1	64	At a minimum, 6 months from the general commercial availability and product maturity of Class 1 96 bit tags.
1	96	At a minimum, 2 years from the general commercial availability and product maturity of EPCglobal certified UHF Gen 2 tags.

Table 2 - Acceptable RFID tags and Anticipated Sunset Dates

3.6 Number Formats and Representations

The following sections of this document discuss the specific details of generating the unique number or id that must be programmed in each RFID tag, either by a manufacturer in the case of Class 0 read-only tags, or by anyone possessing the appropriate equipment in the case of Class 1 read-write tags. In this guide, numbers may be represented in binary, decimal or hexadecimal format as indicated in the surrounding text. It should be noted that the RFID tag stores its id in electronic memory which stores data in binary format. Generating the id to be programmed to the tag involves the setting of specific bit patterns in specific positions of the tag memory and thus the contents of the RFID tag are often represented in binary format. However, once determined by the encoding process, this id can be represented in any base (e.g. 1110 (binary) = 14 (decimal) = E (hexadecimal)).

After the contents of the tag have been determined by the encoding process, suppliers may either order a tag pre-programmed with this id or program the tag themselves. If ordering a pre-programmed tag, you will provide this id to the tag supplier in the format specified by the supplier. If programming the tag yourself, the specific software that is used to write the id to the tag will determine the required number format, often hexadecimal. If you are uncertain of the required number representation required by your software, contact the software provider for details.

Regardless of how you procure the RFID tag, when it is applied to goods you are supplying to the DoD, you must transmit an ASN indicating the relationship of this id to a specific shipment as previously discussed. Within this ASN, you must provide the id of every RFID tag in a shipment and you must represent this id in hexadecimal format.

3.7 Tag Data Constructs

Suppliers to DoD must encode an approved RFID tag using one of two options:

- EPCglobal tag data construct
- DoD tag data construct

Suppliers that are EPCglobal™ subscribers and possess a unique EPC company prefix may choose to use an EPC tag data construct to encode tags per the rules that follow. Suppliers that choose to employ the DoD tag data construct will use the Commercial and Government Entity (CAGE) code previously assigned to them and encode the tags per the rules that follow. Regardless of the selected encoding scheme, suppliers are responsible for ensuring that each tag contains a unique identifier.

Table 3 indicates the acceptable tag data constructs and the relationships between the various combinations of tag class, size, data construct and the organization that controls the data construct.

Class	User Memory Size (bits)	Tag Data Construct	Controlling Organization	Requires EPCglobal membership to use construct?
0	64	SGTIN-64 GRAI-64 GIAI-64 SSCC-64	EPC	Yes
0	64	DoD-64	DoD	No
1	64	SGTIN-64 GRAI-64 GIAI-64 SSCC-64	EPC	Yes
1	64	DoD-64	DoD	No
0	96	SGTIN-64 GRAI-64 GIAI-64 SSCC-64	EPC	Yes
0	96	DoD-96	DoD	No
1	96	SGTIN-64 GRAI-64 GIAI-64 SSCC-64	EPC	Yes
1	96	DoD-96	DoD	No

Table 3 - Acceptable RFID Tag Data Constructs for Supplier Originated shipments

Based on your membership in EPCglobal, select either an EPCglobal tag data construct option or a DoD tag data construct option and proceed to the corresponding following section for details on how to encode RFID tags using the selected option.

3.7.1 EPCglobal Tag Data Construct Option

This option should be selected by a DoD supplier that is:

- already a member of EPCglobal and has an assigned company prefix
- intends to join EPCglobal and obtain a company prefix

This company prefix is required for encoding of all RFID tag classes and sizes. **Table 4** summarizes the selection of an encoding scheme for either 64 or 96 bit tags based on the type of object being tagged and its usage. From these criteria, select an encoding scheme from **Table 4** and then use **Table 5** or **Table 6** to encode the tag.

Tag Requirement	EPC Data Construct	When Used
UID Unit Pack	SGTIN-64 SGTIN-96	On item packaging for items meeting the DoD criteria for assignment of UID where a serial number is used to augment a GTIN which is used for the unique identification of trade items worldwide within the EAN.UCC System.
	GRAI-64 GRAI-96	On item packaging for items meeting the DoD criteria for assignment of UID (reusable package or transport equipment of specific or certain value).
	GIAI-64 GIAI-96	On item packaging for items meeting the DoD criteria for assignment of UID (used to uniquely identify an entity that is part of the fixed inventory of a company – GIAI can be used to identify any fixed asset of an organization).
Case, Transport Package, Palletized Unit Load	SGTIN-64 SGTIN-96	Items shipped as either pure case or pallet (see above)
	SSCC-64 SSCC-96	Items shipped as either pure or mixed case, or pallet. (SSCC can be used by all parties in the supply chain as a reference number to the relevant information held in computer database or file).

Table 4 - Selecting the proper tag data construct

The EPCglobal tag data constructs are included in this document solely for information purposes; please consult http://www.epcglobalinc.org for the latest updates and corrections.

Tag Construct	Header	Filter Value	Company Prefix Index	Item Reference	Serial Number
SGTIN-64	2	3	14	20	25
				Asset Type	**Serial Number**
GRAI-64	8	3	14	20	19
				Individual Asset Reference	
GIAI-64	8	3	14	39	
				Serial Reference	
SSCC-64	8	3	14	39	

Table 5 - 64 bit EPCglobal tag encoding

Tag Construct	Header	Filter Value	Partition	Company Prefix	Item Reference	Serial Number
SGTIN-96	8	3	3	20-40	24-4	38
					Asset Type	**Serial Number**
GRAI-96	8	3	3	20-40	24-4	38
					Individual Asset Reference	
GIAI-96	8	3	3	20-40	62-42	
					Serial Reference	**Unallocated**
SSCC-96	8	3	3	20-40	38-18	24

Table 6 - 96 bit EPCglobal tag encoding

3.7.2 DoD Tag Data Construct Option

This option should be selected by any DoD supplier that is:

- not a member of EPCglobal and doesn't intend to join
- has already been assigned a CAGE (Commercial Government Entity) code

Similar to the unique company prefix assigned to EPCglobal member/subscribers, the CAGE code is a unique identifier assigned and managed by the DoD. It is a sequence of five alphanumeric characters used to uniquely identify the supplier amongst all other suppliers. It is used to ensure that the RFID tag from a given supplier can not contain the same identifier as those from another supplier.

The suppliers' CAGE code is required for encoding of all RFID tag classes and sizes. **Table 7** summarizes the selection of an encoding scheme for either 64 or 96 bit tags based on the type of

object being tagged and its usage. From these criteria, select an encoding scheme from **Table 7** and then use the appropriate following section to properly encode the tag.

Tag Requirement	Tag Data Construct	When Used
UID Pack	**DoD-64 DoD-96**	**On item packaging for items meeting the DoD criteria for assignment of UID**
Case, Transport Package, Palletized Unit Load	**DoD-64 DoD-96**	**Items shipped as either pure or mixed case, pallet**

Table 7 - Selecting the proper tag data construct

3.7.3 DoD-64 Tag Data Construct

This tag data construct should be used to encode 64-bit Class 0 and Class 1 tags for shipping goods to the DoD. The 64-bit tag is broken into a number of fields as indicated in **Table 8**. The details of what information to encode into these fields is explained below. After all the field values have been determined, the entire contents of the tag can be viewed as a single unique number used to identify a shipment to DoD.

Header	Filter	Government Managed Identifier	Serial Number
8 bits	**2 bits**	**30 bits**	**24 bits**

Table 8 – DoD-64 Tag Data Construct encoding

Fields:

Header – specifies that the tag data is encoded as a DoD 64-bit tag construct, use binary number 1100 1110.

Filter – identifies a pallet, case, or UID item associated with tag, represented in binary number format using the following values:

- 00 = pallet
- 01 = case
- 10 = UID item
- 11 = reserved for future use

Government Managed Identifier – For suppliers, this field will be encoded with their CAGE code. This code identifies the supplier and ensures uniqueness of serial number across all suppliers, and is represented in truncated ASCII format. In order to properly fit the CAGE code within the allocated 30 bit Government Managed Identifier field of the DoD-64 Tag Data Construct, it is necessary to compress the CAGE code using a simple algorithm involving the truncation of the two most significant bits of the standard 8-bit ASCII representation of the characters of the CAGE code. Once truncated, the remaining 6 bits still uniquely identify the original

ASCII characters and can be properly decoded after the encoding scheme. **Table 9** details the mapping scheme for this compression.

Serial Number – uniquely identifies up to 2^{24} = 16,777,216 tagged items, represented in binary number format. After the serial number is converted into binary format, it must be left padded with zeros to 24 bits total. It is the responsibility of the supplier to insure that this is a unique number across all shipments to DoD.

CAGE code character	Truncated binary value
A	00 0001
B	00 0010
C	00 0011
D	00 0100
E	00 0101
F	00 0110
G	00 0111
H	00 1000
I	Invalid CAGE character
J	00 1010
K	00 1011
L	00 1100
M	00 1101
N	00 1110
O	Invalid CAGE character
P	01 0000
Q	01 0001
R	01 0010
S	01 0011
T	01 0100
U	01 0101
V	01 0110
W	01 0111
X	01 1000
Y	01 1001
Z	01 1010
0	11 0000
1	11 0001
2	11 0010
3	11 0011
4	11 0100
5	11 0101
6	11 0110
7	11 0111
8	11 1000
9	11 1001
SPACE	10 0000

Table 9 - Truncated ASCII character to CAGE code character mappings

In order to clarify the steps required to encode a tag using the DoD-64 tag data construct, an example follows. Refer to **Table 12** for hexadecimal conversion assistance.

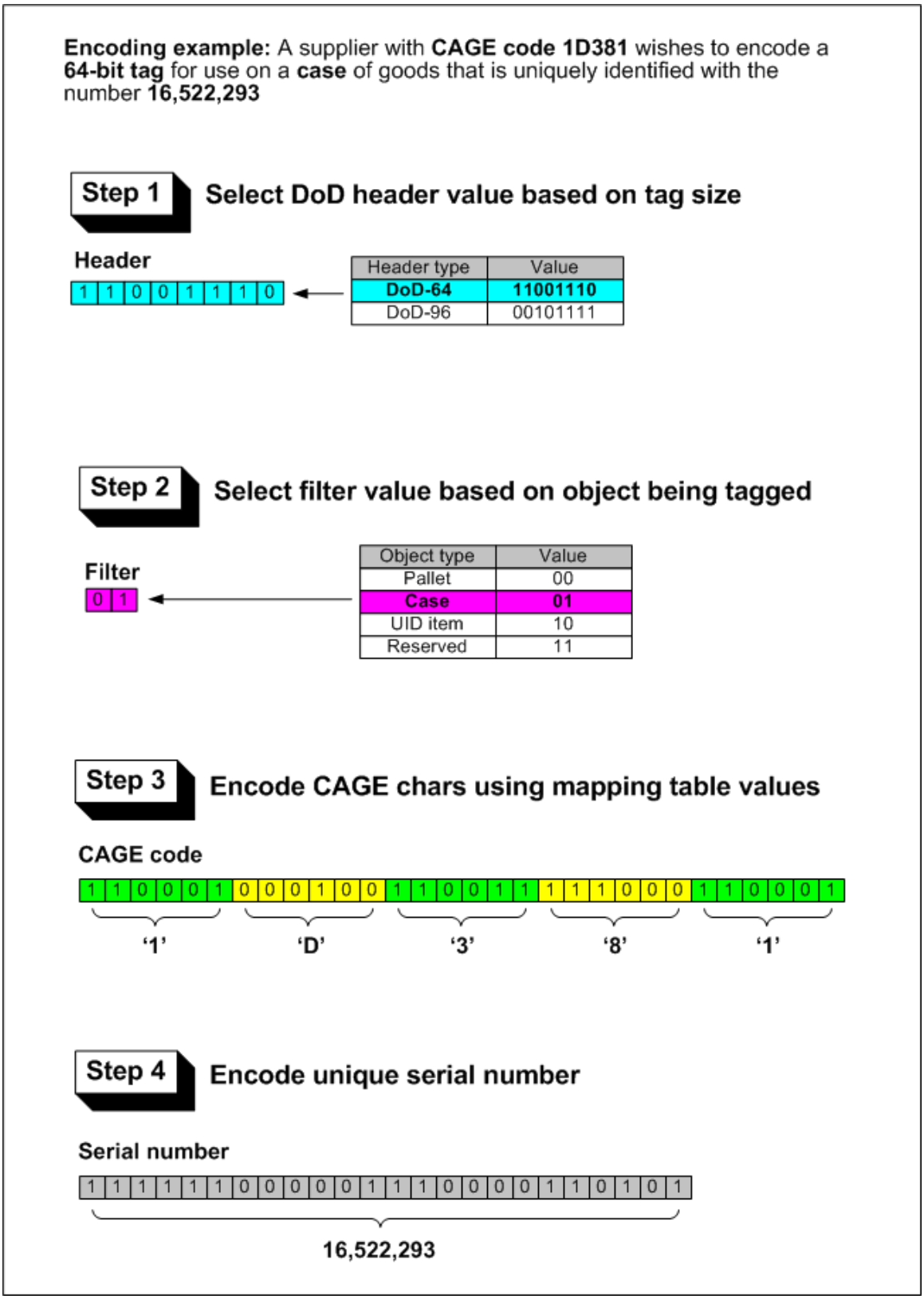

Figure 1 - Example encoding of a 64-bit tag (Steps 1-4)

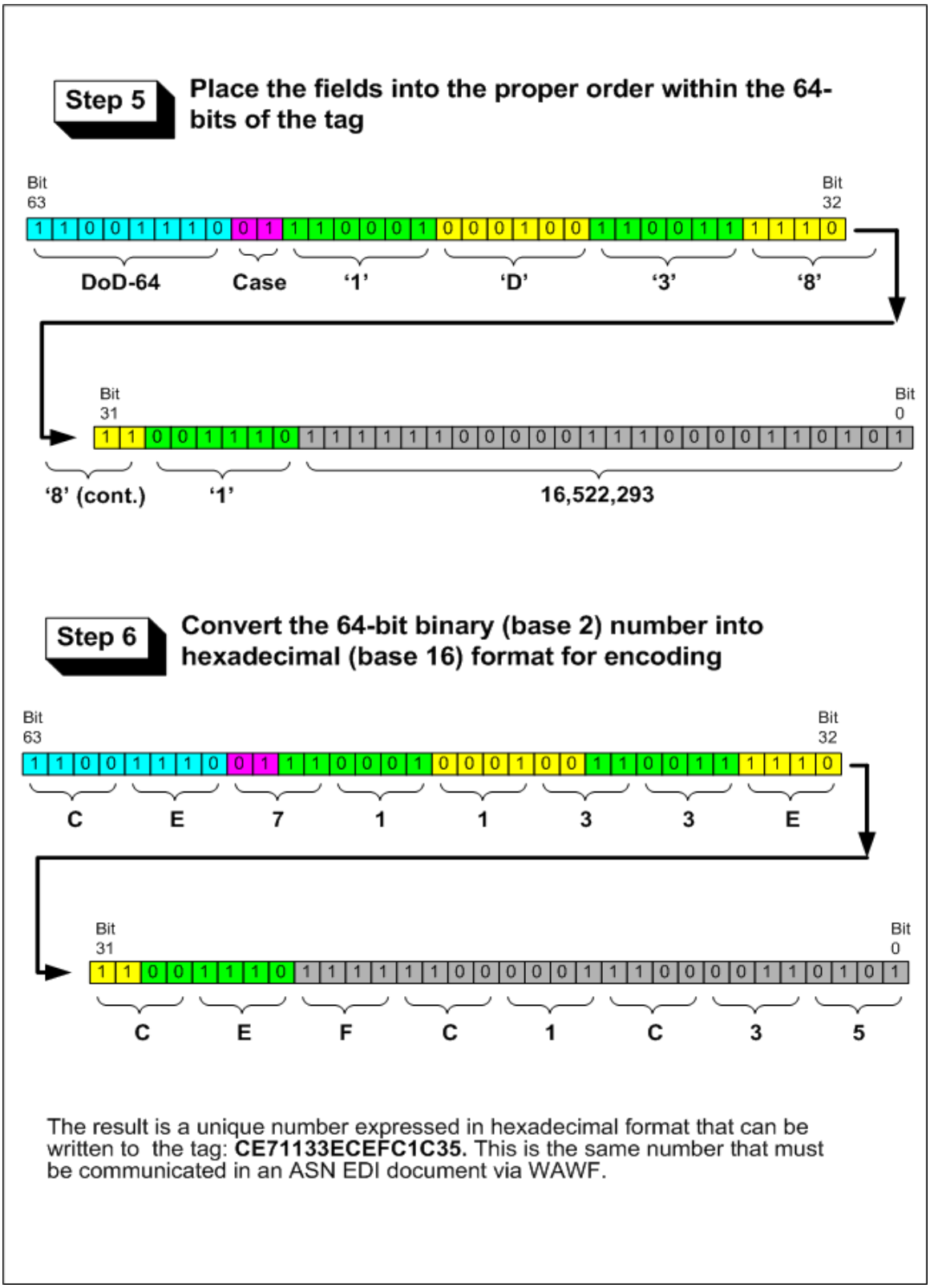

Figure 2 - Example encoding of a 64-bit tag (Steps 5-6)

3.7.4 DoD-96 Tag Data Construct

This tag data construct should be used to encode 96-bit Class 0 and Class 1 tags for shipping goods to the DoD. The 96-bit tag is broken into a number of fields as indicated in **Table 10**. The details of what information to encode into these fields is explained below. After all the field values have been determined, the entire contents of the tag can be viewed as a single unique number used to identify a shipment to DoD.

Header	Filter	Government Managed Identifier	Serial Number
8 bits	4 bits	48 bits	36 bits

Table 10 – DoD-96 Tag Data Construct format

Fields:

Header – specifies that the tag data is encoded as a DoD 96-bit tag construct, use binary number 0010 1111

Filter – identifies a pallet, case, or UID item associated with tag, represented in binary number format using the following values

- 0000 = pallet
- 0001 = case
- 0010 = UID item
- all other combinations = reserved for future use

Government Managed Identifier – For suppliers, this field will be encoded with their CAGE code. This code identifies the supplier and ensures uniqueness of serial number across all suppliers, and is represented in standard 8-bit ASCII format. For the DoD-96 tag data construct, an ASCII space char must be prepended to the CAGE code to make the code a total of 6 ASCII chars. **Table 11** can be used to determine the correct binary value of any valid CAGE code character.

Serial Number – uniquely identifies up to 2^{36} = 68,719,476,736 tagged items, represented in binary number format. After the serial number is converted into binary format, it must be left padded with zeros to 36 bits total.

CAGE code character	Binary value
A	0100 0001
B	0100 0010
C	0100 0011
D	0100 0100
E	0100 0101
F	0100 0110
G	0100 0111
H	0100 1000
I	Invalid CAGE character
J	0100 1010
K	0100 1011
L	0100 1100
M	0100 1101
N	0100 1110
O	Invalid CAGE character
P	0101 0000
Q	0101 0001
R	0101 0010
S	0101 0011
T	0101 0100
U	0101 0101
V	0101 0110
W	0101 0111
X	0101 1000
Y	0101 1001
Z	0101 1010
0	0011 0000
1	0011 0001
2	0011 0010
3	0011 0011
4	0011 0100
5	0011 0101
6	0011 0110
7	0011 0111
8	0011 1000
9	0011 1001
SPACE	0010 0000

Table 11 - ASCII character to CAGE code character mappings

The following figures outline the steps of encoding a 96-bit tag using the DoD-96 tag data construct. Refer to **Table 12** for hexadecimal conversion assistance.

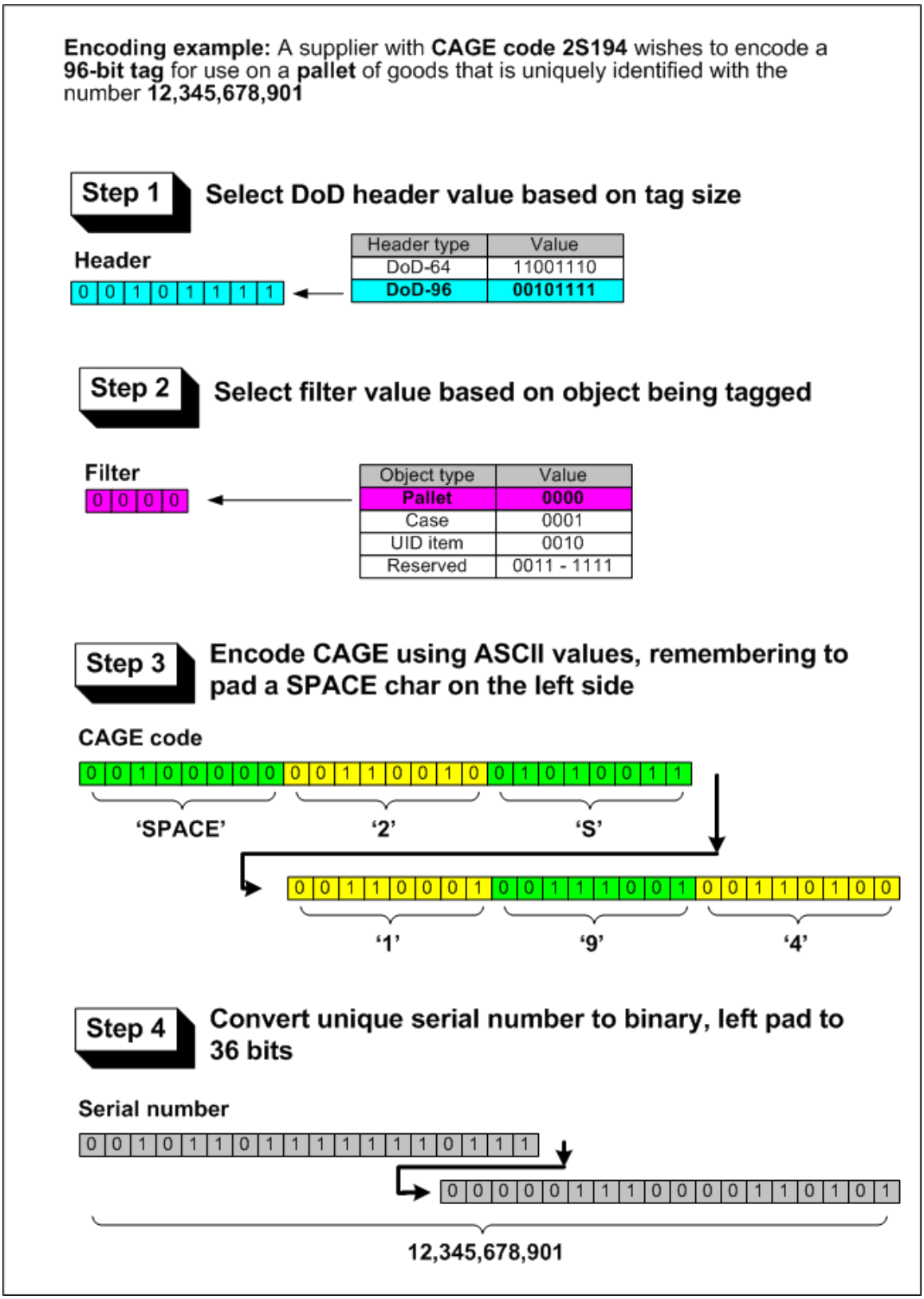

Figure 3 - Example encoding of a 96-bit tag (Steps 1-4)

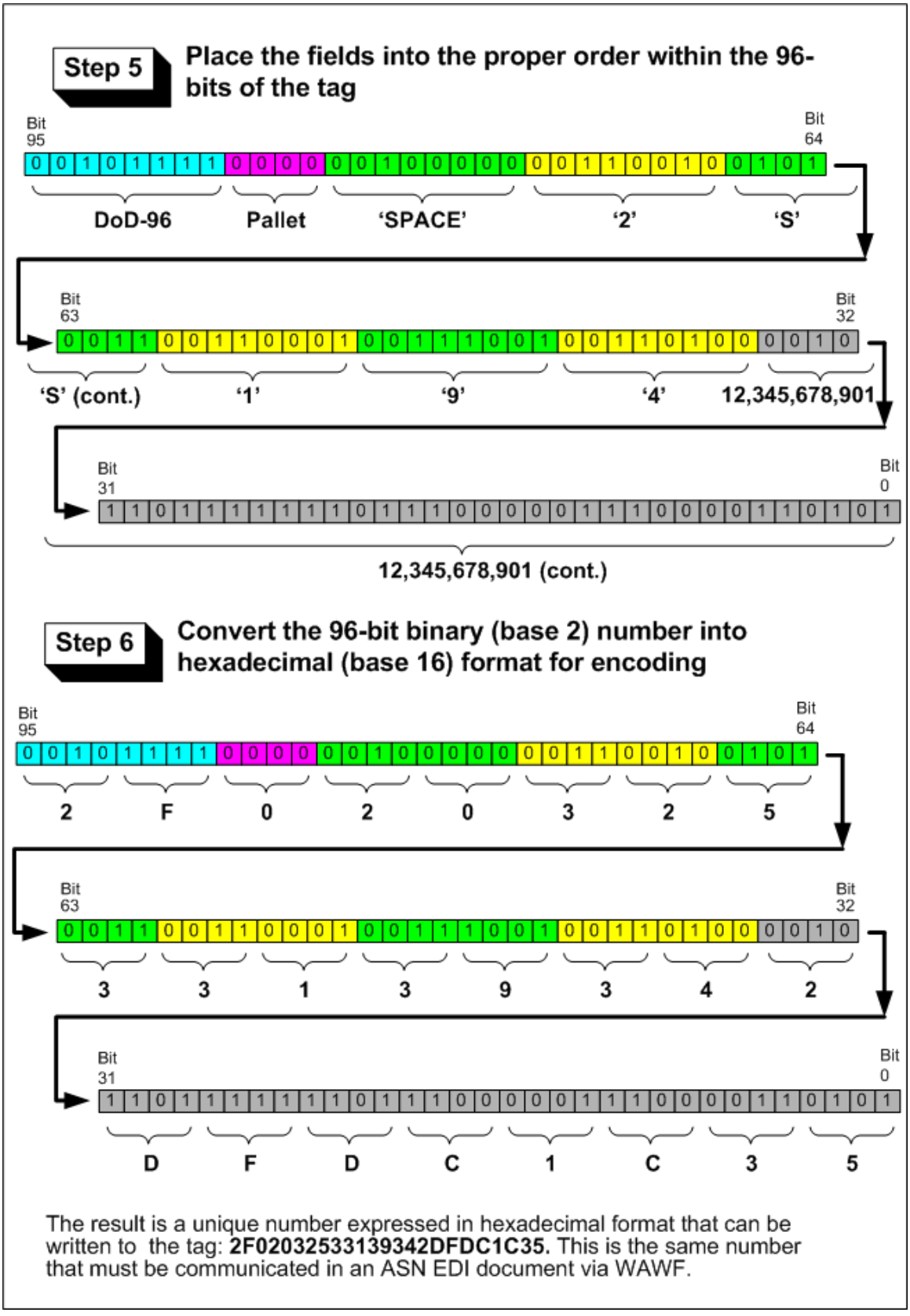

Figure 4 - Example encoding of a 96-bit tag (Steps 5-6)

3.7 Tag Placement

The transponder (RF tag) may be integrated with the shipping label (RFID-enabled labels), or may be an independent entity (where a separate shipping label would also be necessary).

All address labels and RF tags should be affixed at a suitable location where there is a minimum risk of damage and highest potential for successful interrogation.

The bottom edge of the address label containing the unit load information should be within the range of 81 cm to 122 cm (32 to 48 in) from the bottom of the pallet. If the loaded pallet is less than 51 cm (20 in) in height, the label should be placed as high as possible on the pallet, but not closer than 5 cm (2 in) to the natural top of the unit load.

Each unit load shall have one RF tag, independent or part of an address label, which contains the unit load information. Additionally, if the pallet is reusable, there may be a RF tag containing a unique returnable asset identifier.

RFID-enabled labels shall be applied to shipping containers or palletized unit loads as per the standards presented in MIL-STD-129.

- The address label shall be placed on the identification-marked side and right of center on a vertical face, allowing a minimum of 5 cm (2 in) from all edges. An additional address label may be placed on the identification-marked end for styles which, because of their configuration, allow access by materials handling equipment only to the end of the container.

- The RFID-enabled label should not be placed over a seam nor should sealing tape or bands be placed over the label in a manner that interferes with the scanning of the label bar codes or reading the transponder data.

- The RFID-enabled label should not be placed in a manner that overlaps any other existing RF transponder. There should be at least a 10 cm (4 in) separation.

- The RFID-enabled label on a palletized unit load should not be attached to an exterior container if the cargo within the exterior container will not be removed for receipt processing and storage.

- If RFID-enabled address labels are not used, then attach a separate passive RFID tag and a separate address label(s).

- The passive RFID tag should be placed on the identification-marked side and right of center on a vertical face, allowing a minimum of 5 cm (2 in) from all edges.

- A passive RFID tag should not be placed in a manner that overlaps any other existing radio frequency (RF) transponder. There should be at least a 10 cm (4 in) separation.

- The passive RFID tag on a palletized unit load should not be attached to an exterior container if the cargo within the exterior container will not be removed for receipt processing and storage.

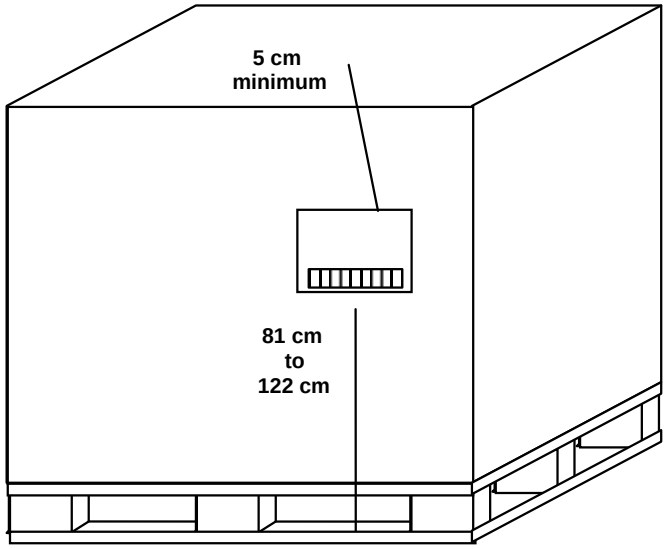

Figure 5 - RFID-enabled label placement on palletized unit load

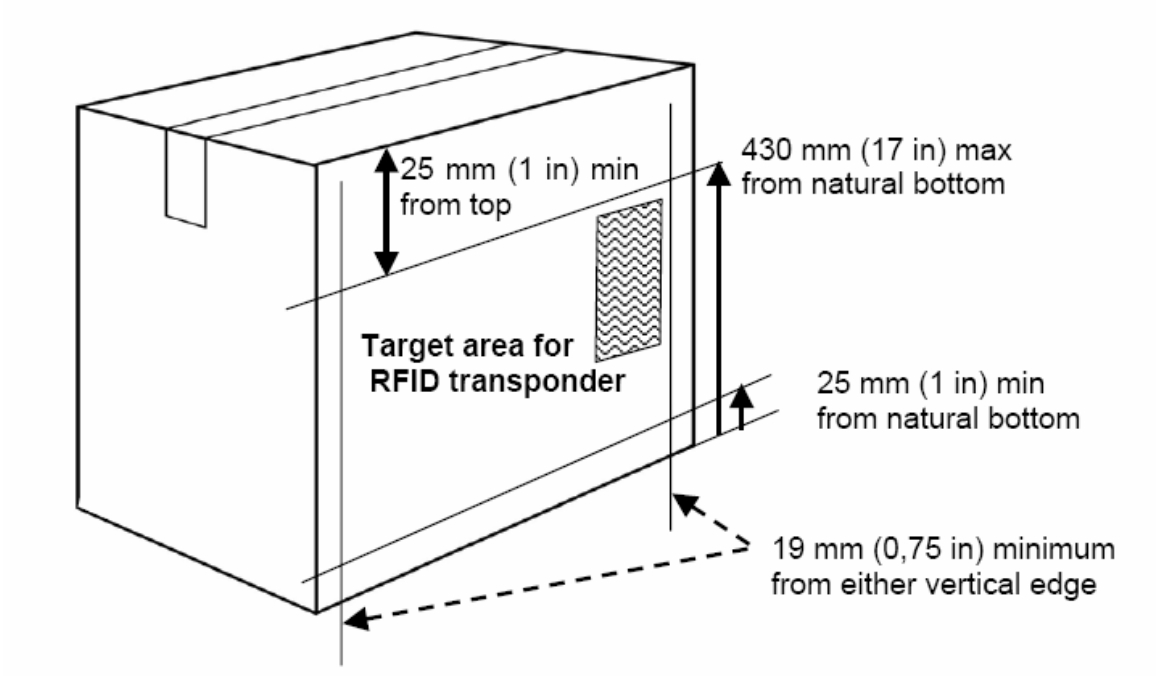

Figure 6 - RFID-enabled label placement on case

3.8 Performance Requirements

For reference, below are our minimum readability performance requirements:

RF tags are expected to meet the Department of Defense's user requirements for:

> Portal: For the palletized unit load passive RFID tag, the passive RFID tags on the shipping containers and exterior containers within the palletized unit load, and the UID item unit pack passive RFID tags that are passing through a portal, the read distance shall be at least 3 meters (3.3 yards), reading passive RFID tags at 10 miles per hour (e.g., forklift).
>
> Conveyor: For an individual shipping container passive RFID tag, an individual exterior container passive RFID tag, and the UID item pack passive RFID tag moving on a conveyor, the read distance shall be at least 1 meter (1.1 yards), reading passive RFID tags at 600 feet per minute.

RFID tags may either be permanent or temporary. It is up to the supplier to determine which tag type is best for your organization. Please keep in mind that both of these tag types have their own benefits and possible drawbacks. However, all tags must be durable (properly attached to item/case/pallet) and secure enough to make it through the DoD supply chain without jeopardizing usability.

4. Commonly Asked Questions

For the answers to commonly asked questions as well as additional information regarding the RFID mandate and policy please refer to the Department of Defense website http://www.dodrfid.org. The website contains FAQs, background information, and Policy to assist your efforts in being RFID compliant.

5. Future Amendments

Future policy amendments may be needed, in order to keep up with evolving RFID standards, technology, and the business environments. DoD RFID policies and business rules will continue to be refined as passive RFID capabilities are implemented over the next few months.

Please check for updates to the Supplier Implementation Plan (http://www.dodrfid.org/supplierimplementationplan.htm) and this Supplier Passive RFID Information Guide (http://www/.dodrfid.org/supplierguide.htm), for implementation dates and details as well as detailed information concerning the applicable commodities.

6. Contacts

If you have yet to do so, we strongly encourage you, our supplier, to investigate RFID benefits and applications within your organization as soon as possible. Below are contacts that will help you in the effort.

- Visit EPCglobal on the internet: http://www.epcglobalinc.org/
- Create an RFID team/manager within your organization.

Additional information and RFID FAQs are available at http://www.dodrfid.org

Please note: This guide is subject to updates and information contained in this guide is subject to change. Please use http://www.dodrfid.org to keep abreast of the most current requirements.

7. Acronyms

ASN	Advance Ship Notice
CAGE	Commercial and Government Entity
EPC	Electronic Product Code
GIAI	Global Individual Asset Identifier
GRAI	Global Returnable Asset Identifier
RFID	Radio Frequency Identification
SGTIN	Serialized Global Trade Item Number
SSCC	Serialized Shipment Container Code
UID	Unique Identification

8. Number Conversion Table

The following table is included as a convenience to the user. It can be used to determine the hexadecimal and binary representations of the decimal numbers 0-15 inclusive.

Decimal	Hex	Binary		Decimal	Hex	Binary
0	0	0000		8	8	1000
1	1	0001		9	9	1001
2	2	0010		10	A	1010
3	3	0011		11	B	1011
4	4	0100		12	C	1100
5	5	0101		13	D	1101
6	6	0110		14	E	1110
7	7	0111		15	F	1111

Table 12 - Numeric conversion