TECHNICAL MANUAL

METHODS AND PROCEDURES MANUAL

UNIQUE IDENTIFICATION ASSET MARKING AND TRACKING

(ATOS-HILL)

This manual supersedes TO 00-25-260 dated 15 October 2013.

This Technical Manual (TM) applies to Department of the Air Force organizations responsible for the use, maintenance, servicing, and/or storage of legacy assets that require Unique Identification (UID). This TM only applies to legacy assets owned/repaired by the Department of the Air Force and does not authorize the marking of legacy assets owned by other government organizations. The guidance provided by this document may be referenced or incorporated into detailed maintenance guides as approved by the item manager(s) responsible for the legacy items to be marked.

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INTRODUCTION

1 PURPOSE.

This technical manual provides guidance and information for the following: Air Force (AF) Item Unique Identification (IUID) program asset marking and tracking; basics of IUID, Unique Item Identifier (UII) characteristics, surface preparation and IUID label application, indirect part marking, Direct Part Marking (DPM), verification, validation, and inspection. It is not intended to be used as a technical guide to manufacture Unique Identification (UID) labels. Instructions for safe and proper storage, handling, inspection, testing, maintenance, and preparation for use are also provided.

1.1 This methods and procedures manual applies to the Department of the AF depot level organizations responsible for the use, maintenance, servicing, and/or storage of legacy assets that require UID. This manual does not authorize the marking of legacy assets owned by other government organizations. The guidance provided by this document may be referenced or incorporated into maintenance guides as approved by the Engineering Source Authority (ESA) responsible for the legacy items to be marked.

2 USE OF THIS MANUAL.

The table of contents indicates chapter, paragraph, title, and page numbers to facilitate location of information. Illustrations, tables, and diagrams, when applicable, are located throughout the publication to supplement the text material. A list of illustrations and a list of tables indicate the number, title, and location. Abbreviations, phrases, and words which are on a decal, a placard or an engraving are set forth in the text exactly as they appear on the decal, the placard or the engraving.

3 SCOPE.

This manual is intended to be used in conjunction with item specific Technical Orders (TOs) for depot and contractual level repairs. When a conflict occurs between this manual and the item specific TO, the item specific TO will take precedence.

4 DEFINITIONS.

The word SHALL is used to express a provision that is binding. The words SHOULD and MAY are used when it is necessary to express nonmandatory provisions. WILL may be used to express a mandatory declaration of purpose or when it is necessary to express a future event.

5 ABBREVIATIONS.

All abbreviations used in this manual are in accordance with JCS Pub 1-02, ASME Y14.38M, and the GPO Styleguide for use on drawings, specifications, standards, and in technical documents, except as follows:

AC	Alternating Current
ADC	Automatic Data Capture
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFMCI	Air Force Material Command Instruction
AI	Application Identifier
AIM	Association for Automatic Identification and Mobility
AIMT	Asset Inventory Management Tool
AF	Air Force
AFTO	Air Force Technical Order
AIS	Automated Information System
AIT	Automatic Identification Technology
AL	Aluminum
AMT	Asset Marking and Tracking
ASCII	American Standard Code for Information Interchange

CAD	Computer Aided Design
CAFDEx	Centralized Access for Data Exchange
CAGE	Commercial and Government Entity
CEMS	Central Engine Management System
CO_2	Carbon Dioxide
CSA	Canadian Standards Association
°C	Degrees Celsius
°F	Degrees Fahrenheit
DC	Direct Current
DFARS	Defense Acquisition Regulations System
DLIS	Defense Logistics Information System
DoD	Department of Defense
DoDI	Department of Defense Instruction
DPI	Dots Per Inch
DPM	Direct Part Marking
DRILS	Defense Repair Information Logistics System (G200)
DRMS	Defense Reutilization and Marketing Service
DRU	Direct Reporting Unit
DUNS	Dunn and Bradstreet Data Universal Numbering System
ECC	Error Correction Code
ECE	Electrochemical Etching
ECM	Electrochemical Marking
EDCL	Enterprise Data Collection Layer
EDM	Electrical Discharge Machining
EID	Enterprise Identifier
ESA	Engineering Source Authority
ESD	Electrostatic Discharge
ESDS	Electrostatic Discharge Sensitive
FAR	Federal Acquisition Regulation
FOC	Full Operational Capability
FOD	Foreign Object Damage
FOM	Facilitate Other Maintenance
GFP	Government Furnished Property
GIAI	Global Individual Asset Identifier
GSA	General Services Administration
GTIN	Global Trade Identification Number
HRC	Rockwell Hardness C Scale
HAF	Headquarters Air Force
HAZ	Heat Affected Zone
HRI	Human Readable Information
IAC	Issuing Agency Code
IAW	In Accordance With
ID	Identification
IEC	International Electrotechnical Commission
IET	Industrial Engineer Technician
IMM	Intrusive Marking Method
IMPRESA	Depot Maintenance Repair Overhaul System
ISO	International Organization for Standardization
IUID	Item Unique Identification
JEDMICS	Joint Engineering Data Management Information and Control System
LASER	Light Amplification by Stimulated Emission of Radiation
LCD	Liquid Crystal Display

LDMS	Lean Depot Management System
LENS	Laser Engineered Net Shaping
LIVD	Laser Induced Vapor Deposition
LMJ	Liquid Metal Jet
LPM	Label Part Marking
MAJCOM	Major Command
MIL-STD	Military Standard
MPTO	Methods and Procedures Technical Order
MRI	Machine-Readable Information
ND:YAG	Neodymium-Doped Yttrium Aluminum Garnet
NIMM	Non-Intrusive Marking Method
NWRM	Nuclear War Readiness Material
OI	Operating Instruction
OPM	Opportunistic Parts Marking
OSD	Office of Secretary of Defense
OSHA	Occupational Safety and Health Administration
OSS&E	Operational Safety Sustainment and Effectiveness
PCB	Printed Circuit Board
PMO	Program Management Office
PN	Part Number
PPE	Personal Protective Equipment
PP&E	Property, Plant, and Equipment
PVC	Polyvinyl Chloride
PVF	Polyvinyl Fluoride
PWB	Printed Wiring Board
RFID	Radio Frequency Identification
SAM	Serialized Asset Management
SCR	Sequence Control Register
SDS	Safety Data Sheet
SIM	Serialized Item Management
SMR	Source, Maintenance, and Recoverability
SNT	Serial Number Tracking
SPO	System Program Office
TCTO	Time Compliance Technical Order
TM	Technical Manual
TO	Technical Order
TRIAD	Three tier IUID marking software: Template, MIL-STD Compliance, Data Capture and Migration
UID	Unique Identification
UII	Unique Item Identifier
UL	Underwriters Laboratory, Inc
UV	Ultraviolet
VII	Virtual Item Identification
WCD	Work Control Document
YAG	Yttrium Aluminum Garnet
2-D	Two Dimensional

6 LIST OF RELATED PUBLICATIONS.

These publications contain information in support of this technical manual and are required to accomplish the prescribed maintenance.

List of Related Publications

Number	Title
A-A-208	Ink, Marking Stencil, Opaque (Porous and Nonporous Surfaces)
A-A-50271	(MIL-P-514D) Commercial Item Description, Plate, Identification
A-A-56032	Ink, Marking, Epoxy Base
AF IUID Class IX	Repairables Legacy Marking Plan April 2012
AFI 63-101	Acquisitions and Sustainment Life Cycle Management
AFI 90-821	Hazard Communication (HAZCOM) Program
AFI 91-301	Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program
AFMAN 91-203	Air Force Occupational Safety, Fire and Health Standards
AFMCI 63-XXX	Supporting document to AFI 63-101, when published
AFOSH STD 91-501	Air Force Consolidated Occupational Safety Standard
AIM-BC1	Uniform Symbology Specification Code 39
AIM DPM-1-2006	Direct Part Mark Quality Guidance
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
ANSI MH10.8.2	American National Standard Data Identifier and Application Identifier Standard
ANSI MH10.8.7	Labeling and Direct Product Marking with Linear Bar Code and Two Dimensional Symbols
ASME Y14.38M	Abbreviations and Acronyms Revision and Redesignation of ASME Y1.1
ASTM D 3330	Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape
ASTM D 3951	Standard Practice for Commercial Packaging
ASTM D 5181	Standard Test Method for Abrasion Resistance of Printed Matter by the GA-CAT Compression Abrasion Tester
AS9132A	Data Matrix Quality Requirements for Parts Marking
	Department of Defense Acquisition Guidebook
Department of Defense Directive 4140.1	Material Management Policy
Department of Defense Directive 5000.1	Defense Acquisition Systems
	Department of Defense Guidelines for the Virtual Unique Item Identifier (UII)
Department of Defense Instruction 5000.64	Accountability and Management of DoD- Owned Equipment and Other Accountable Property
Department of Defense Instruction 7000.14	Defense Financial Management Regulation
DFARS 252-211-7003	Item Identification and Valuation DoD Guide to Uniquely Identifying Items; Assuring Valuation, Accountability and Control of Government Property (latest revision)
DOD-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
DODI 8320.04	Item Unique Identification (IUID) Standards for Tangible Personal Property
DRMS-R 5000.6	Compliance With Environmental Laws and Regulations
FAR, Part 45	Federal Acquisition Requisition for Government Property
ISO/IEC 15415	Information Technology - Automatic Identification and Data Capture Techniques - Bar Code Print Quality Test Specification - Two-dimensional Symbols
ISO/IEC 15416	Information Technology - Automatic Identification and Data Capture Techniques - Bar Code Print Quality Test Specification - Linear Symbols
ISO/IEC 15417	Information Technology - Automatic Identification and Data Capture Techniques - Code 128 Bar Code SymbologySpecification

List of Related Publications - Continued

Number	Title
ISO/IEC 15418	Information Technology - Automatic Identification and Data Capture Techniques - GS1 Application Identifiers and ASC MH10 Data Identifiers
ISO/IEC 15434	Information Technology - Transfer Syntax for High Capacity ADC Media
ISO/IEC 16022	Information Technology - Automatic Identification and Data Capture Techniques - Data Matrix Bar Code Symbology Specification
LIA Z136.1	Safe Use of Lasers
MIL-DTL-15024F Type L	Detail Specification Plates, Tags, and Bands for Identification of Equipment, General Specification
MIL-DTL-31000	Technical Data Package, General Specification for
MIL-HDBK-1812	Type Designation, Assignment and Method for Obtaining
MIL-PRF-131	Barrier Material, Water Vaporproof, Greaseproof, Flexible, Heat-Sealable
MIL-PRF-61002	Pressure-sensitive Adhesive Labels for Bar Codes, Performance Specification
MIL-PRF-87937 Type III	Qualified Product List, Cleaning Compound, Aerospace Equipment
MIL-STD-129	Military Marking for Shipment and Storage
MIL-STD-130	DoD Standard Practice Identification Marking of U.S. Military Property
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically United Explosive Devices)
MIL-STD-202	Electronic and Electrical Component Parts Test Method Standard
MIL-STD-889B	Military Standard Dissimilar Metals
NASA-HDBK-6003	Application of Data Matrix
NASA-STD-6002	Applying Data Matrix Identification Symbols on Aerospace Parts
TT-I-735	Isopropyl Alcohol Specification
00-25-195	Source, Maintenance, and Recoverability Coding of Air Force Weapons, Systems, and Equipment
00-25-234	General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment
00-5-1	AF Technical Order System
1-1-169	Aircraft Weapons Systems Cleaning and Corrosion Control
1-1-691	Cleaning and Corrosion Prevention and Control, Aerospace and Nonaerospace Equipment
1-1-8	Technical Manual Application and Removal of Organic Coatings, Aerospace and Nonaerospace Equipment

7 LIST OF APPLICABLE TIME COMPLIANCE TECHNICAL ORDERS (TCTO).

None.

8 IMPROVEMENT REPORTS.

NOTE

As used in this TO, MAJCOM includes Field Operating Agencies (FOAs) and Direct Reporting Units (DRUs).

HQ USAF/A4LX is responsible for establishing basic TCTO policy and for approving policy and procedure changes. Recommended changes to this manual shall be submitted in accordance with TO 00-05-01, Technical Manual (TM) Change Recommendation and Reply or the Joint Computer-aided Acquisition and Logistics Support (JCALS) system Recommend a TM Change process In Accordance With (IAW) TO 00-5-1, AF Technical Order System, to the TO Manager, 416 SCMS/GUBAB, 6071 Gum Lane, Bldg 1223, Hill AFB, Utah 84056.

SAFETY SUMMARY

1 GENERAL SAFETY INSTRUCTIONS.

This manual describes physical and chemical processes which may cause injury or death to personnel or damage to equipment if not properly followed. This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment. Prior to performing any task, the WARNINGs, CAUTIONs, and NOTEs included in that task shall be reviewed and understood.

2 WARNINGS, CAUTIONS, AND NOTES.

WARNINGs and CAUTIONs are used in this manual to highlight operating or maintenance procedures, practices, conditions or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGs and CAUTIONs immediately precede the step or procedure to which they apply. WARNINGs and CAUTIONs consist of four parts: heading (WARNING or CAUTION), a statement of the hazard, minimum precautions, and possible result if disregarded. NOTEs are used in the manual to highlight operating or maintenance procedures, practices, conditions or statements which are not essential to protection of personnel or equipment. NOTEs may precede or follow the step or procedure, depending upon the information to be highlighted. The headings used and their definitions are as follows:

WARNING

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to or death of personnel or long-term health hazards.

CAUTION

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to or destruction of equipment or loss of mission effectiveness.

NOTE

Highlights an essential operating condition or maintenance procedure, condition or statement.

3 SAFETY PRECAUTIONS.

Some general equipment may be outlined in this technical order. Follow all safety precautions and guidelines as outlined in the instruction manuals for each individual pieces of equipment. In addition, operators should be thoroughly familiar with applicable safety regulations as stated in AFI 91-301.

3.1 The following are general safety precautions that are not related to any specific procedure and, therefore, do not appear elsewhere in this technical manual. These are general safety precautions and instructions that personnel must understand and apply during many phases of operation and maintenance to ensure personal safety and health and the protection of Air Force property.

- WEAR PROTECTIVE CLOTHING. Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.
- USE OF SAFETY APPROVED EQUIPMENT. When cleaners are being applied, approved explosion-proof lights, blowers, and other equipment shall be used. Ensure fire-fighting equipment is readily available and in working order.

- GIVE CLEANERS SPECIAL CARE. Keep cleaners in approved safety containers and in minimum quantities. Discard soiled cleaning cloths into safety containers.

- KEEP AWAY FROM LIVE CIRCUITS. Maintenance personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high-voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

- DO NOT SERVICE OR ADJUST ALONE. Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

- RESUSCITATION. Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Cardiopulmonary resuscitation training requirements are outlined in AFMAN 91-203. Information and training sources may be obtained by the installation Medical Group, American Red Cross or other appropriate organization.

- USE OF CHEMICALS. Multiple chemicals may be used in various IUID marking procedures as called out in this TO. Read all SDS forms prior to their use. Strict adherence to the guidelines of the SDS and local shop safety procedures are mandatory.

CHAPTER 1
INTRODUCTION AND GENERAL INFORMATION

1.1 INTRODUCTION.

Item Unique Identification (IUID) marking is a Department of Defense (DoD) mandate requiring compliance with numerous published directions and guidance. IUID marking quality and process standards are in accordance with MIL-STD-130( ). Other governing publications examples are, DODI 8320.04, AFI 63-101. In addition, AFMCI XX- XXX will support above governance when published.

1.1.1 The Air Force (AF) IUID Program Management Office (PMO) has issued the AF IUID Class IX Repairables Legacy Marking Plan (April 2012). This plan identifies the criteria for determination of which types of AF items require IUID marking. Many additional AF items will require marking as determined by the responsible Engineering Source Authority (ESA). Changes to applicable technical data will direct that marking.

1.1.2 The Office of Secretary of Defense (OSD) and DoD has mandated all AF depot repair centers to be programmatic Full Operational Capability (FOC) by 31 December 2015. Programmatic FOC as defined is all unmarked legacy items entering a maintenance facility and requiring IUID and will exit with a qualifying Unique Item Identifier (UII) if the level of maintenance facilitates that marking opportunity. Within the AFMC depot complexes, FOC is defined as IUID marking maturity has been achieved to include the following elements:

a. AF Program Offices and engineering have processed technical marking requirement data and it is in place.

b. Maintenance documents such as Work Control Documents (WCDs), process orders, or other depot technical documents have been updated to reflect the marking requirement.

c. Marking and verification equipment and floor space are available to meet IUID requirements, or outsourcing processes have been established.

d. Marking technician and equipment maintenance technician training has been completed.

e. All bioenvironmental and safety requirements have been met.

f. Marking materials have been identified and are available per depot practices.

g. MIL-STD-130( ) and DoD IUID registration compliance processes are ensured.

1.1.2.1 Policy further states no items require removal from service or inventory for the sole purpose of IUID marking. In order to meet the 31 December 2015 FOC date, the AF will have all requirements, processes, and capabilities for IUID marking in place to ensure all required AF items will be marked at depot trigger events. Unique identification is intended as a means for the Air Force's logistics to have tracking capability for use in the DoD.

1.2 ASSET MARKING AND TRACKING.

The Asset Marking and Tracking (AMT) Program Office defines AMT as the capability to track assets individually throughout the supply chain and capture significant lifecycle events which have the potential to significantly improve the AF asset management process.

1.2.1 This cradle-to-grave AF logistics vision for system repairables, elected consumables, engines, equipment, and other designated properties is to provide visibility, accountability, and status of high value parts at any given time.

1.2.2 Advantages of AMT. AF logistics and supply chain processes have not evolved to leverage modern automated capabilities over the past few decades. While areas of traceability have been developed, poor visibility and numerous gaps still exist within the AF supply chain. The need for a functioning enterprise capability for asset visibility still remains.

1.2.2.1 AMT will revolutionize the ability to maintain system configuration control. AMT enables the AF to have total asset visibility through the acquisition, transportation, supply, maintenance, and disposal processes. Component level visibility provides valuable data such as part history, maintenance usage, repair dates, overhaul, and operational locations. This consolidated asset history will greatly enhance lifecycle management for AF items.

1.2.2.2 Current information such as asset location will be beneficial for numerous AF functional users. A prime use case is Time Compliance Technical Order (TCTO) compliance on a part that was manufactured or designed incorrectly. TCTOs may easily be tracked by the System Program Office (SPO) through the Unique Identification (UID) system to ensure all applicable items have complied with TCTO requirements.

1.2.2.3 Transportation and delivery are often a concern with Nuclear War Readiness Material (NWRM). Through the use of the AMT and UID markings, critical material can be shipped and tracked with up-to-date information about the current location of unique items. Significant benefits associated with complete and accurate item visibility are critical to the future of the Air Force. Some of these benefits may include system and supply chain program office operations, engineering analysis efforts, configuration management, counterfeit part control, maintenance data collection, requirements forecasting, budgeting, and item warranty.

1.3 WAY FORWARD.

AF established technical data compliance authorization identifies the level of organizational entities authorized and mandated for the level of repair to be accomplished. An example of this level of repair may be called out by the Source, Maintenance, and Recoverability (SMR) code. The SMR authorizes intermediate, organizational, or depot level removal and repair actions. IUID marking requirements should only be accomplished by the authorized level of repair specified per the applicable Technical Order (TO). Intermediate and organizational levels of repair are not authorized to apply depot level marking without direct guidance specifically approved by the configuration manager or cognizant engineering authority to that entity. An item removed to Facilitate Other Maintenance (FOM) is not authorization for IUID marking.

1.3.1 IUID and UII data association, data capture, integrity, and migration to AF databases and the DoD IUID Registry are critical to the concepts and benefits of the UID program. Use of AF approved portfolio managed systems may be utilized to accomplish and secure the IUID/UII data. Systems such as Asset Inventory Management Tool (AIMT), Centralized Access for Data Exchange (CAFDEx), Central Engine Management System (CEMS), Defense Repair Information Logistics System (G200) (DRILS), Enterprise Data Collection Layer (EDCL), Depot Maintenance Repair Overhaul System (IMPRESA), Lean Depot Management System (LDMS), and Three tier IUID marking software: Template, MIL-STD Compliance, Data Capture and Migration (TRIAD) are examples.

1.3.2 IUID association and registration data are required and all data are provided to the AF IUID Program Management Office (PMO) through one of the previously stated systems or any other AF approved system to associate marking data to the item being marked and sent to the DoD IUID Registry.

1.3.3 MIL-STD-130 referenced guidance will define the data matrix standards for IUID marking. This standard identifies applicable International Organization for Standardization (ISO) specifications to produce compliant syntax and symbology for 2-D data matrices.

1.3.4 Validation and Verification needs to be addressed and is a critical onetime requirement following the production of a compliant 2-D bar code. Additional information on this topic is covered in subsequent chapters.

1.3.5 MIL-STD-130, DoD Guidance, Department of Defense Instruction (DoDI), Air Force Instruction (AFI), AF guidance, and applicable technical data govern the majority of IUID compliance direction. There will be specific cases where locally developed, Operational Instructions (OIs), or local process orders will be utilized to facilitate IUID compliance.

CHAPTER 2
INTRODUCTION TO ITEM UNIQUE IDENTIFICATION

2.1 INTRODUCTION.

Item Unique Identification (IUID) is accomplished by marking each qualifying item with a 2-D data matrix symbol and registering the Unique Item Identifier (UII) and asset pedigree data in the Department of Defense (DoD) IUID Registry. Because the data matrix symbol is machine- readable, IUID marking greatly reduces data entry error and improves the accuracy of inventory and acquisition records. Ensure item data is correct so machine-readability can maintain the correct data throughout the item's lifecycle.

2.1.1 The data matrix is encoded with data element(s) necessary to construct a UII, which is the globally unique alpha-numeric code assigned to every qualifying item in DoD inventory. See Chapter 3 for details.

2.1.2 UIIs, along with a set of select item identification data, are stored in the DoD IUID Registry, which allows controlled access to information such as acquisition cost and lifecycle support data. The DoD IUID Registry is hosted and operated by the Defense Logistics Information Service (DLIS) and serves as the authoritative source for item acquisition cost and required acquisition-based pedigree data.

2.2 IUID BENEFITS.

DoD services must uniquely identify qualifying items to provide for better asset accountability, valuation, and lifecycle management. IUID provides the DoD with the source data to facilitate and accomplish the following:

- Provide item visibility.
- Supply item data necessary for top-level logistics and engineering analysis.
- Provide an accurate source for property and equipment valuation/accountability.
- Improve access to historical data for use during systems design and throughout the life of an item.
- Provide better item intelligence for the warfighter in operational planning.
- Reduce workforce burden through increased productivity and efficiency.
- Assist in the identification, segregation, and ultimate reduction of counterfeit items and parts.

2.3 IUID BASICS.

The UII is supplemental to prior markings on an item and as a minimum needs only to replicate UII-related information. The chosen UII construct format will determine what information will be encoded. All qualified legacy items shall be marked in accordance with approved IUID marking policies set forth by DoD Guide to Uniquely Identifying Items and other DoD directives, MIL-STD-130, item specific technical orders, and the guidance outlined in this manual.

2.3.1 Items and their embedded components (circuit card assemblies, power supplies, transducers, etc.) may be marked with a supplemental Unique Identification (UID) label placed on or adjacent to the existing means of identification (plate, tag or other marking method). Do not cover any prior pertinent markings. If this is not possible, a suitable location on the item must be determined that does not detract from its form, fit, or function.

2.3.2 Engineering analysis of operating environmental conditions such as air-stream, chaffing, fluid contamination, high-pressure wash, repetitive impact, temperature, Foreign Object Damage (FOD), etc., must be taken into consideration when determining marking methods, materials, and need of protective coatings that are best suited for each UID candidate. The

use of supplemental, nonintrusive, additive marking of self-adhesive, nonmetallic polyacrylic labels or other forms of thermal transfer materials is highly encouraged whenever possible. This reduces the depth of engineering analysis and eliminates metallurgical testing, and the need to design and fabricate individual holding fixtures required for intrusive UII applications.

2.3.2.1 UID requirements are reflected in the Joint Engineering Data Management Information and Control System (JEDMICS) drawings and/or original equipment drawings, if available, for legacy items. Item specific Technical Orders (TOs) will have detailed information for the application/creation of the UID label.

2.4 IUID DATA MATRIX DEFINITIONS.

2.4.1 Data Matrix. (Figure 2-2) A data matrix is 2-D, machine-readable barcode for encoding data. Many types of data matrices exist and are used in various applications. The ECC 200 data matrix described in ISO/IEC 16022 is the only one required in DoD UID program. The ECC 200 matrix is well suited for IUID due to its unique properties. The matrix has a higher information density than 1-D barcodes and most other 2-D matrices, with up to 2,335 alphanumeric characters. It can be scaled up or down to fit within available marking space. The UID matrix can be applied using adhesive label, rigid plate, or directly on the surface using any one of multiple marking methods and technologies. The ECC 200 data matrix consists of uniform rows and columns of light and dark cells. The matrix is commonly square, but may be rectangular in shape in cases where there is little room on the item, or the item is unusually shaped. The matrix can range in size from 10x10 to 144x144 cells and can be scaled to be very small to extremely large.

2.4.1.1 Primary characteristics are as follows:

a. **Cells** are individual small squares or dots contained in the data matrix. Cells represent bits or binary digits of encoded information that contain the matrices machine-readable data. Contrasting cells are turned ON or OFF.

b. **Clocking Pattern.** A broken L-shaped pattern consisting of one row and one column of alternating dark and light cells. The clocking pattern is used by verifiers and readers to determine the size of the data matrix and its orientation.

c. **Data Region.** The area framed by the clocking pattern and finder pattern that contains dark or light cells. These cells are used to encrypt the UII data.

d. **Finder Pattern.** A solid L-shaped pattern consisting of one column and one row of contrasting cells. The finder pattern is used by both verifiers and readers to locate, identify orientation, and measure the data matrix.

e. **Quiet Zone.** An area kept free from all markings or interfering obstructions. The quiet zone must be at least one cell width wide around the entire data matrix. The quiet zone isolates the data matrix.

2.4.2 Enterprise Identifier. The Enterprise Identifier (EID) is a unique identification code assigned to an activity or organization by registered issuing agencies such as Commercial and Government Entity (CAGE) code, Department of Defense Activity Address Code (DoDAAC), or Dun & Bradstreet's Data Universal Numbering System (DUNS). An enterprise can be an entity such as manufacture, design activity, depot, supplier, program management office, or third party. Typically within the depot complexes, the EID will be that depot's cage code and will be encoded in the generated UII. In commercial applications, DoDAACs and DUNS, etc., are acceptable to be encoded in the generated UII and will not necessarily conform to the 5-character CAGE code. The entity generating the UII is responsible for guaranteeing the uniqueness of that UII, as produced under its authority, by using its EID. No entity is authorized to use another's EID unless given written permission in a Memorandum of Agreement (MOA) or called out in the item's technical data package(s).

2.4.2.1 Item. An item is an asset in the AF inventory consisting of a group of subassemblies, components, or constituent part(s).

2.4.2.2 IUID. IUID is the system of globally and unambiguously distinguishing one item from all other items the DoD buys or owns. This allows the DoD to track identically made items individually throughout their lifecycles. With IUID, the DoD can consistently capture the value of all individual items it buys, trace these items during their use, combat counterfeiting of parts, and associate valuable business intelligence to an item throughout its lifecycle.

2.4.2.3 IUID Lifecycle. If it is not realistic for the UID label to survive the entire lifecycle of the item or the rebuild process, the item will be marked in such a way that the UID label will survive its expected lifecycle up to the next maintenance event. The item can then be remarked using the original UII data.

2.4.3 Unique Identification. UID is a program for establishing globally unique and unambiguous identifiers within the DoD, which serves to distinguish a discrete entity or relationship from other like and unlike entities or relationships.

2.4.3.1 UII is the unique and unambiguous identification data encoded within an ECC 200 data matrix. The UII is associated only once to an item and the data within remains unique to that item for the entire lifecycle of the item. See Table 2-1 for the characteristics of a UII, Figure 2-1 for an illustration of the UII lifecycle, and Figure 2-2 for the ECC 200 data matrix.

2.4.3.2 Validation is the process for determining that the machine-readable symbol contains the required information and is encoded with the correct semantics and syntax. IUID validation is performed using an electronic/optical imaging device capable of reading 2-D data matrix information.

2.4.3.3 Verification combines validation of the semantics and syntax in addition to the quality of a machine-readable symbol. Verification assigns a grade to the results indicating acceptance in accordance with the applicable MRI- protocol quality control document. It is performed using an electronic/optical verification device and includes methods that are largely visual in nature.

2.4.3.4 Data string is the machine-readable encoded data. At a minimum, it contains the UII, but may contain additional pertinent data in the data matrices.

Table 2-1. Characteristics of a UII

A UII Is:	A UII Is Not:
A globally unique unambiguous item identifier	A physical method of communicating data, such as Radio Frequency Identification (RFID) tags, contact memory buttons, linear bar codes, or 2-D data matrices
Permanent through life	A replacement for the national stock number
Created by concatenating a string of specific data elements	Intelligent standalone data that contains information about an item
A means of capturing and utilizing lifecycle data	Independent
Stored within a 2-D matrix - acts as an access key to other information	A storage for an item’s total history

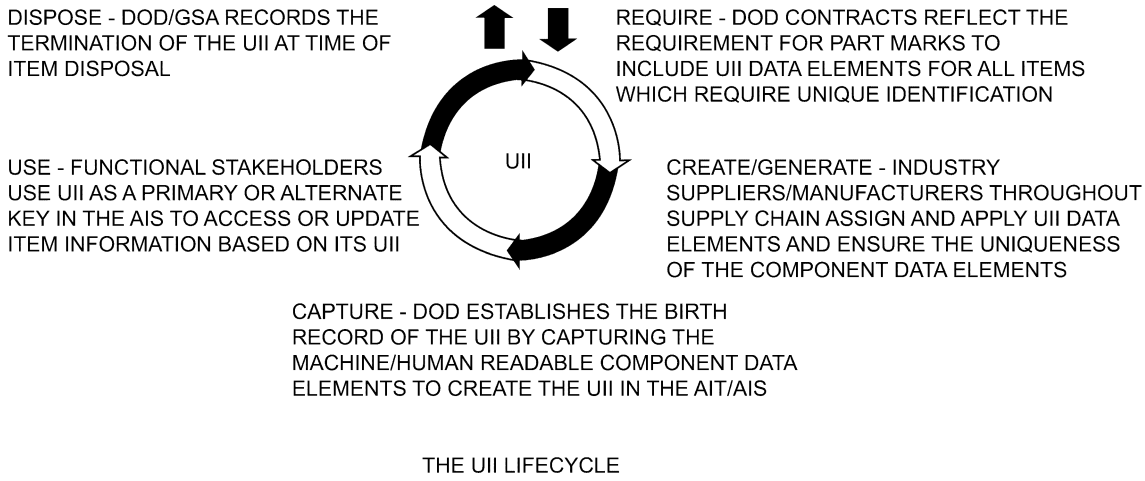


Figure 2-1. The UII Lifecycle

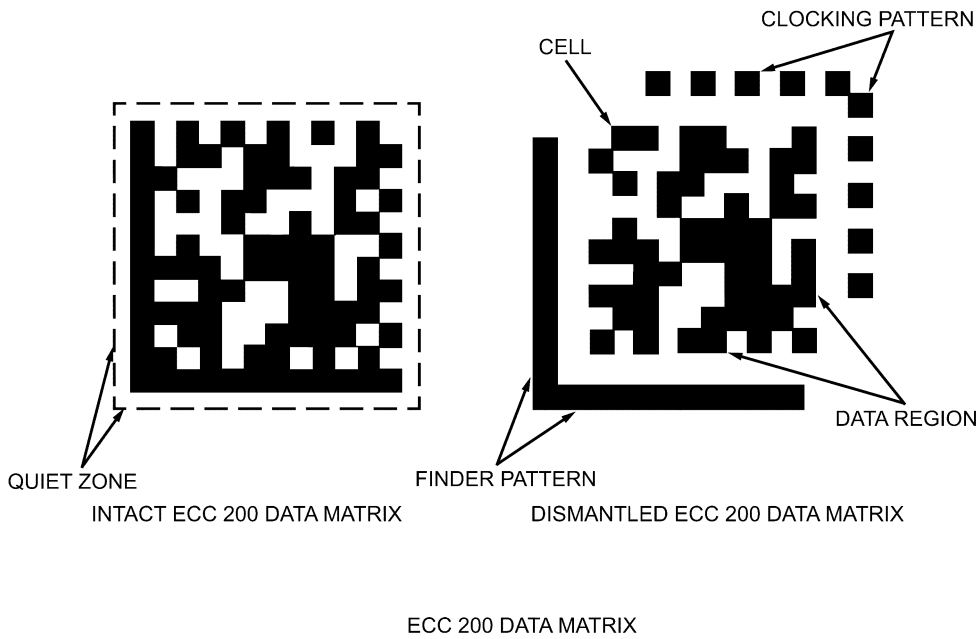


Figure 2-2. ECC 200 Data Matrix

CHAPTER 3
UNIQUE ITEM IDENTIFICATION AND ENCODED DATA CHARACTERISTICS

3.1 SCOPE.

Due to Department of Defense (DoD) policy and guidance, as well as MIL-STD-130, much more latitude is given to private industry for creation of Unique Item Identifier (UII) formats. This chapter defines most formats expected to enter Air Force (AF) legacy inventory from private industry.

3.2 CONSTRUCTS.

MIL-STD-130 governs UII constructs 1 and 2 as well as the various formats that may be used when creating an ECC 200 data matrix. The UII constructs and formats covered in this manual are DoD recognized and are commonly used by DoD contractors, vendors, manufacturers, and repair depots. The following illustrated examples are not an all-inclusive list of DoD recognized UII formats or accepted equivalents.

3.2.1 Determining Construct Format. Before producing Item Unique Identification (IUID) labels, reference the proper technical data to ensure there is an IUID requirement for the asset. If no construct or format has been specified in the technical data, use Figure 3-1 to determine which UII construct best applies. Keep in mind, asset accountability and traceability should be at the forefront when selecting which UII construct is appropriate.

3.2.1.1 Construct 1. A construct 1 UII is derived from the combination of the issuing agency code, enterprise identifier, and a unique sequential alphanumeric string or item serial number. It is the responsibility of the enterprise producing a construct 1 UII to ensure the serial/sequence number assigned is unique within the enterprise. This single data set will provide the permanent identification for the lifecycle of the item it is assigned to. See Figure 3-2 through Figure 3-5 for examples of various formats of construct 1 UIIs.

3.2.1.1.1 Construct 1 Advantages. The advantage of using construct 1 IUID labels for marking legacy items is it allows for the printing of mass-produced batches of nonpedigree data specific labels. The labels can be pre- produced and used as needed on any asset without prior knowledge of specific asset pedigree data. This type of marking can be especially useful for organizations that do not have the resources to produce their own IUID labels. Because there is no direct association between the label and the assets being marked, the UII will need to be associated to the asset by using an asset tracking database (see asset tracking section of this TO). This association shall be established at the time, or prior to, the label is being applied to its assigned asset.

3.2.1.1.2 Construct 1 Disadvantages. The disadvantages of using construct 1 IUID labels are as follows: other than the EID, they contain ambiguous data, in that there is no item specific identification encoded in the data matrix. Supply points or other agencies will not be able to glean any useful information from the data matrix. To have value, users need access to the asset tracking database where the UII and its associated specific data is stored.

3.2.1.1.2.1 Another disadvantage is when a data matrix is damaged beyond readability or when missing, and the items lack a serial number, it is virtually impossible to identify the original UII even with a tracking database.

3.2.1.1.3 Construct 1 With Supplemental Information. A construct 1 UII with supplemental information is derived the same way as the construct 1 described in Paragraph 3.2.1.1. It contains the combination of the issuing agency code, enterprise identifier, and a unique sequential alphanumeric string or item serial number with additional supplemental information. This supplemental information must have a data identifier assigned in order to be properly encoded in the data matrix. Examples of supplemental information may include manufacturer CAGE code, current part number, and item serial number. These data elements are encoded in the data matrix but remain separate from the UII. It is the responsibility of the enterprise producing a construct 1 UII with supplemental information to ensure the UII is unique within the enterprise. See Figure 3-3 for an example of a construct 1 with supplemental data.

3.2.1.1.3.1 Construct 1 With Supplemental Information Advantages. This format allows the label to be scanned where the readout will identify the association to a specific item independent of an asset tracking database. This is due to the availability of the supplemental data. See Figure 3-3 for an example of a construct 1 with supplemental data.

3.2.1.2 Construct 2 UII. A construct 2 UII is derived from a combination of issuing agency code, enterprise identifier original part number (part number at the time UII was created), and the asset's unique serial number. The enterprise producing the construct 2 UII is responsible for guaranteeing the accuracy and uniqueness of the UII. See Figure 3-6 through Figure 3-10 for examples of various formats of construct 2 UIIs.

3.2.1.2.1 The advantage in using this IUID format is the matrix can be scanned and the asset identified independent of an asset tracking database.

3.2.1.3 25S for Remarks of Constructs 1 and 2. In a 25S construct, a UID label had already been created but may need to be recreated (remarked) because it is damaged or missing. Remarking an asset is required when a label is worn beyond MIL-STD-130 readability standards. This generally involves a maintenance event when the label is removed for maintenance activity, found to be worn or missing, and therefore there is a need to recreate a new label with the same UII. It is recommended when such events occur, and when possible, to recreate the original UII using a 25S formatted IUID data string. However, the 25S format can accommodate all UII formats regardless of original construct. Examples of remarked UIIs using the 25S formatted data string are shown in Figure 3-2 through Figure 3-10.

3.2.1.4 Other Constructs. Other constructs do exist and may be used in areas of the DoD. If these other constructs are required, refer to MIL-STD-130 (N) for the appropriate formatting.

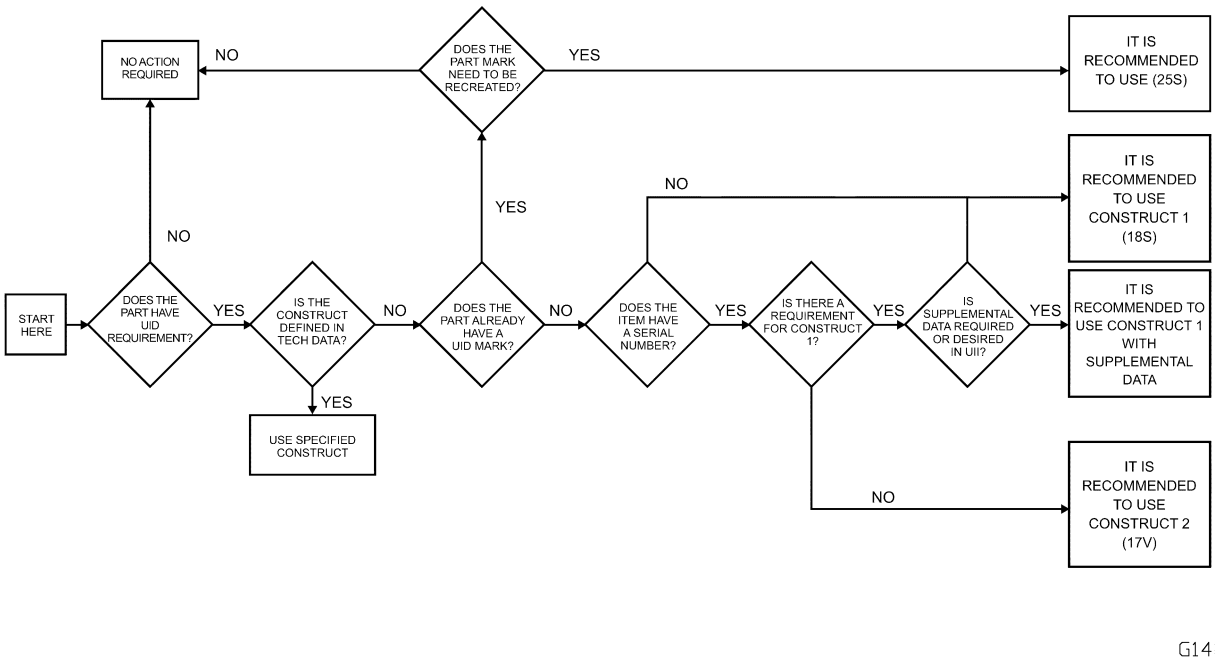


Figure 3-1. Flowchart for Choosing Constructs

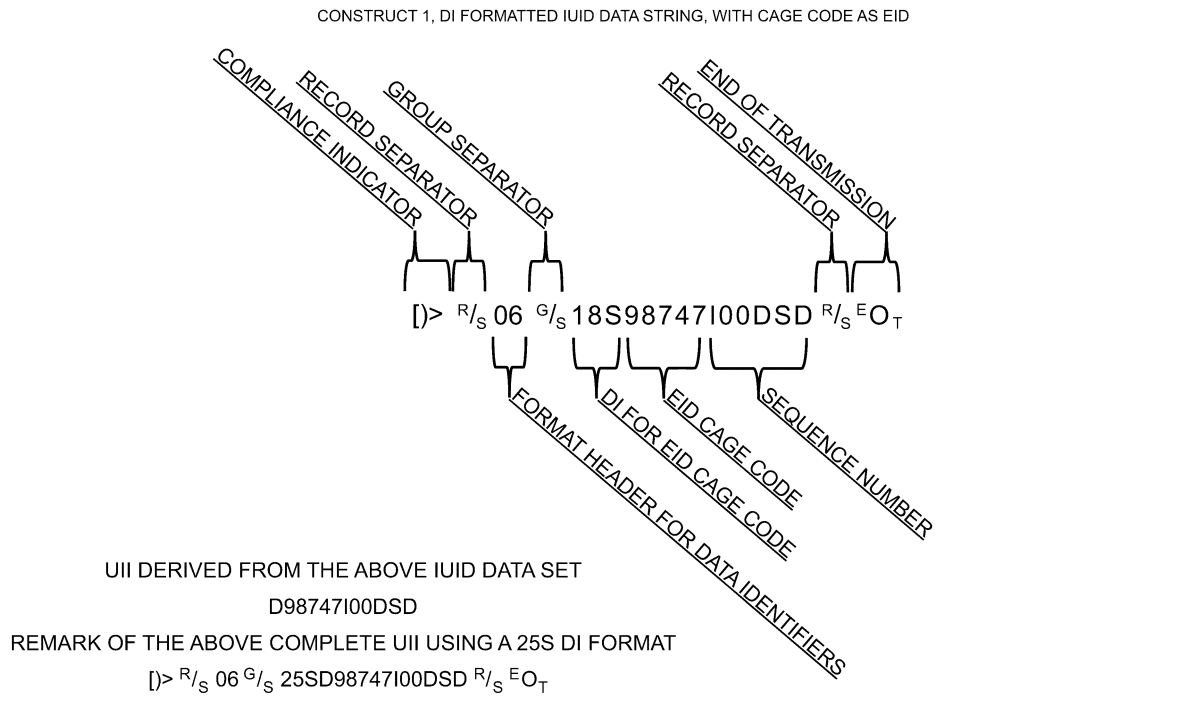


Figure 3-2. Illustration of Construct 1

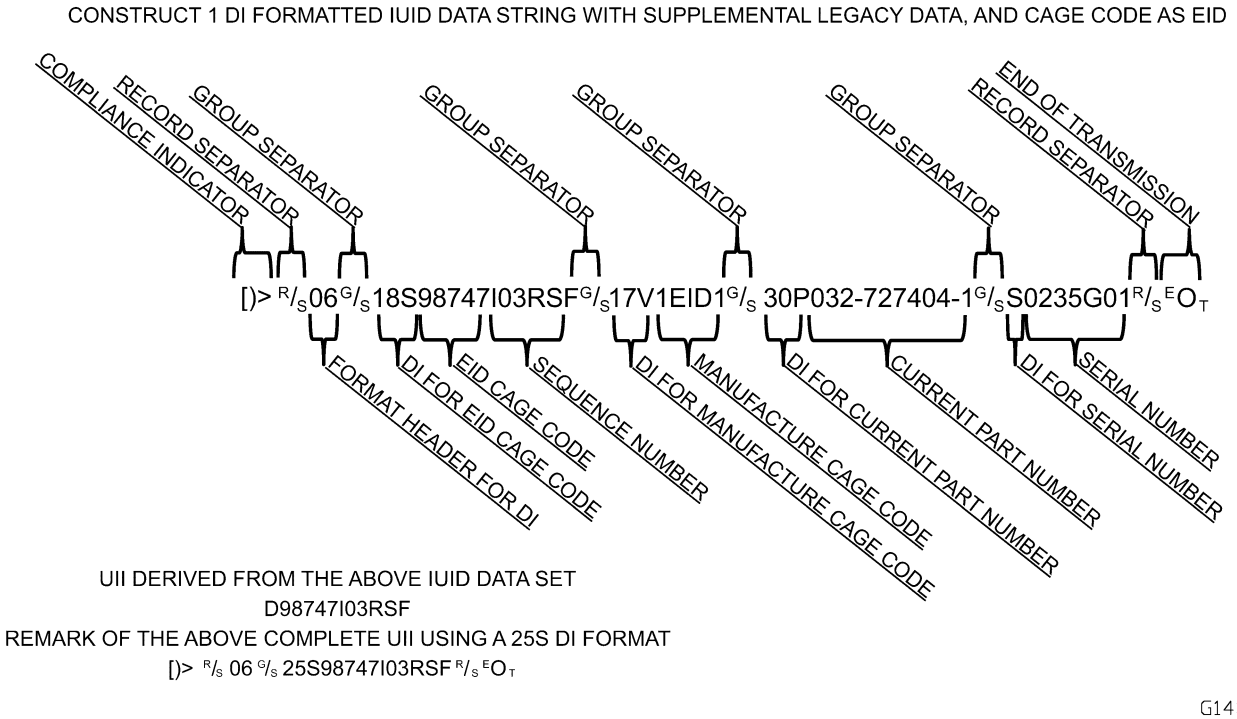


Figure 3-3. Illustration of Construct 1 With Supplemental Data Format

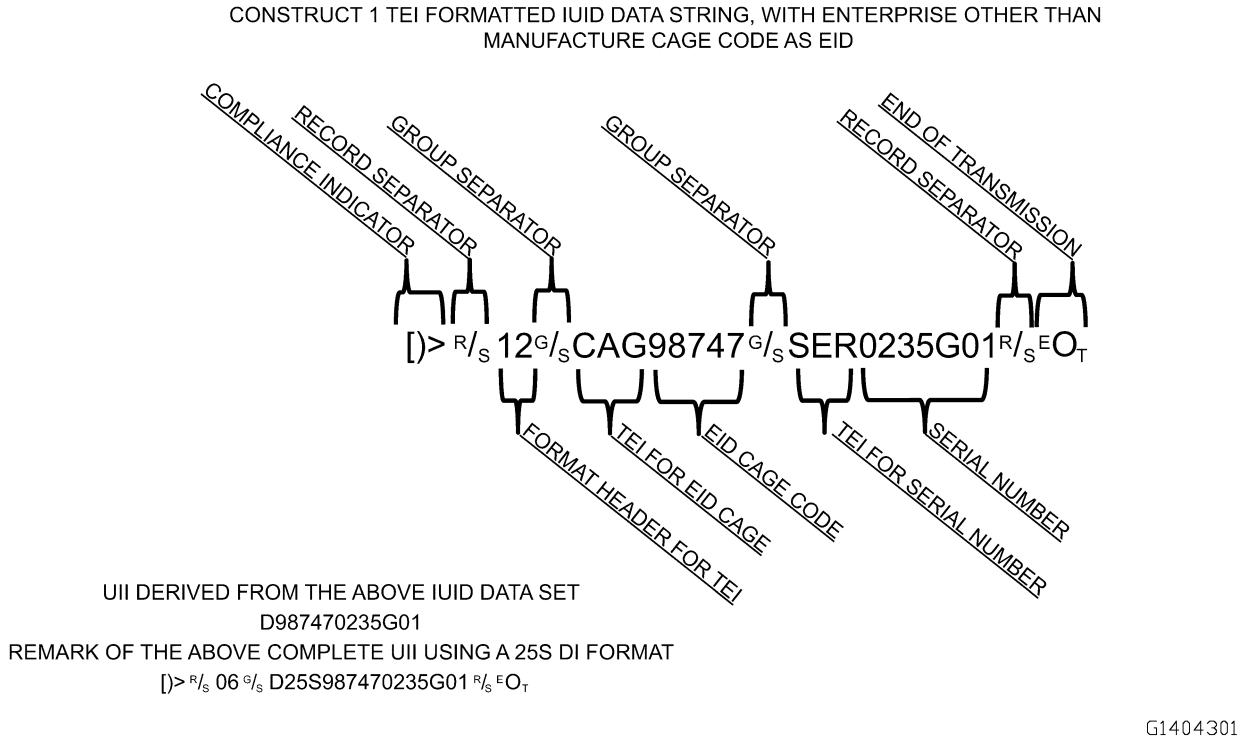


Figure 3-4. Construct 1 With TEI Format

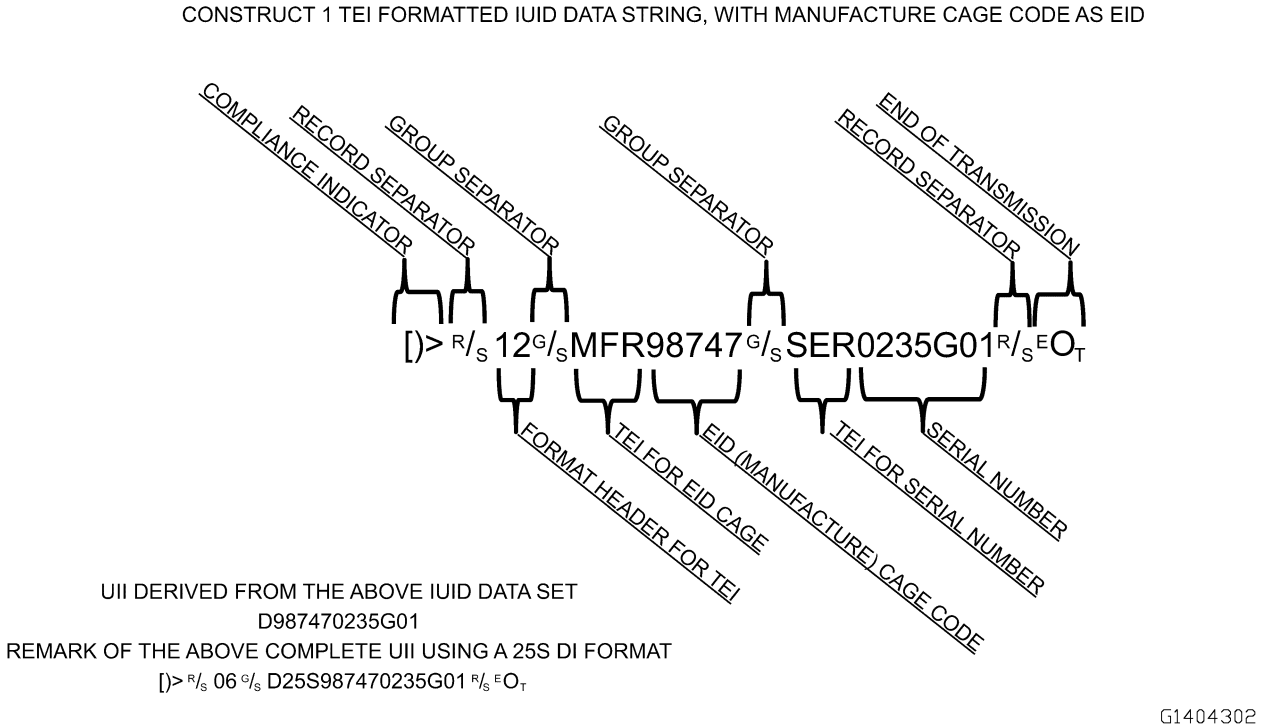


Figure 3-5. Construct 1 With TEI Format

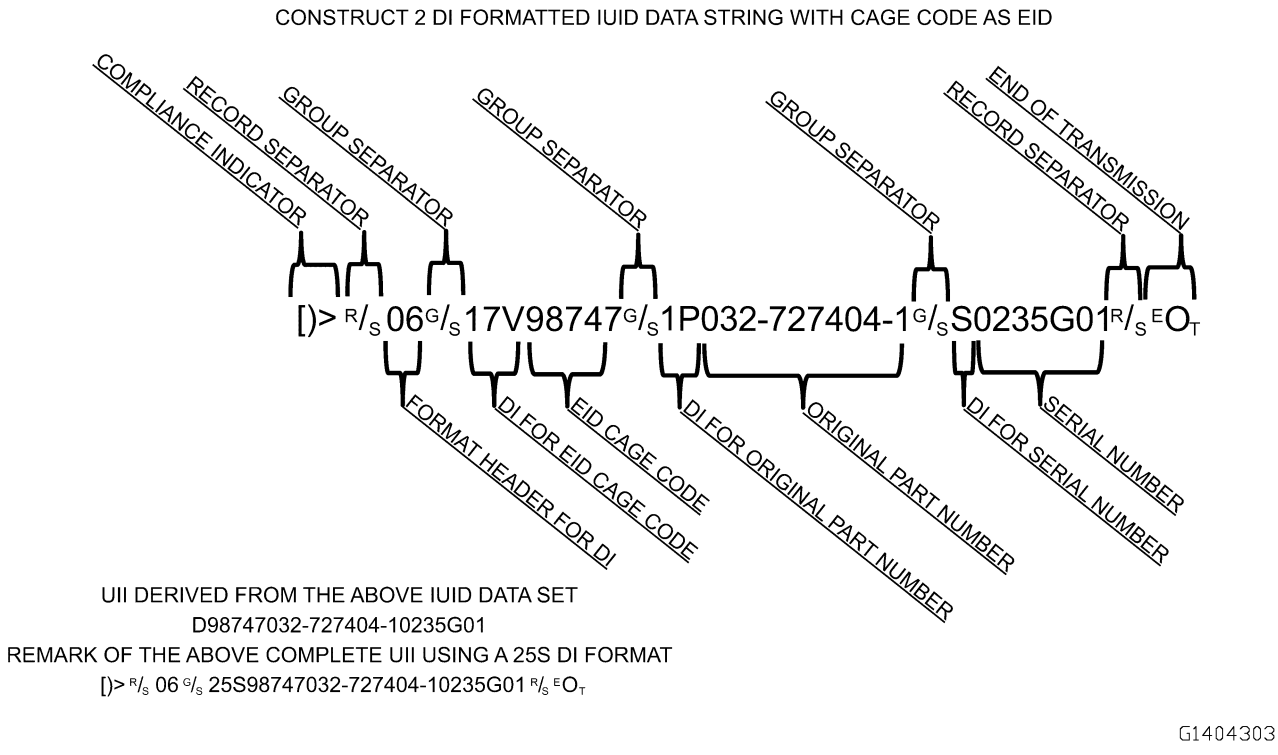


Figure 3-6. Illustration of Construct 2 Formatting

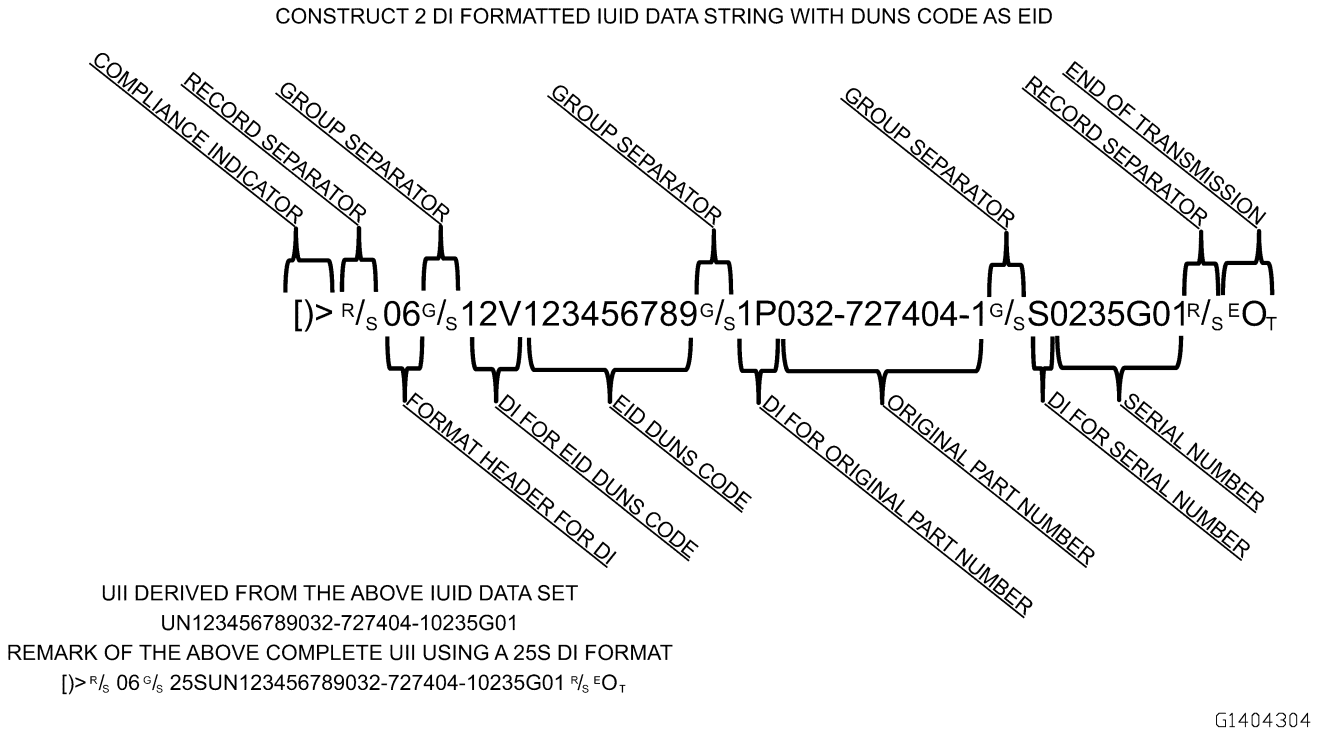


Figure 3-7. Illustration of Construct 2 With DUNS as EID

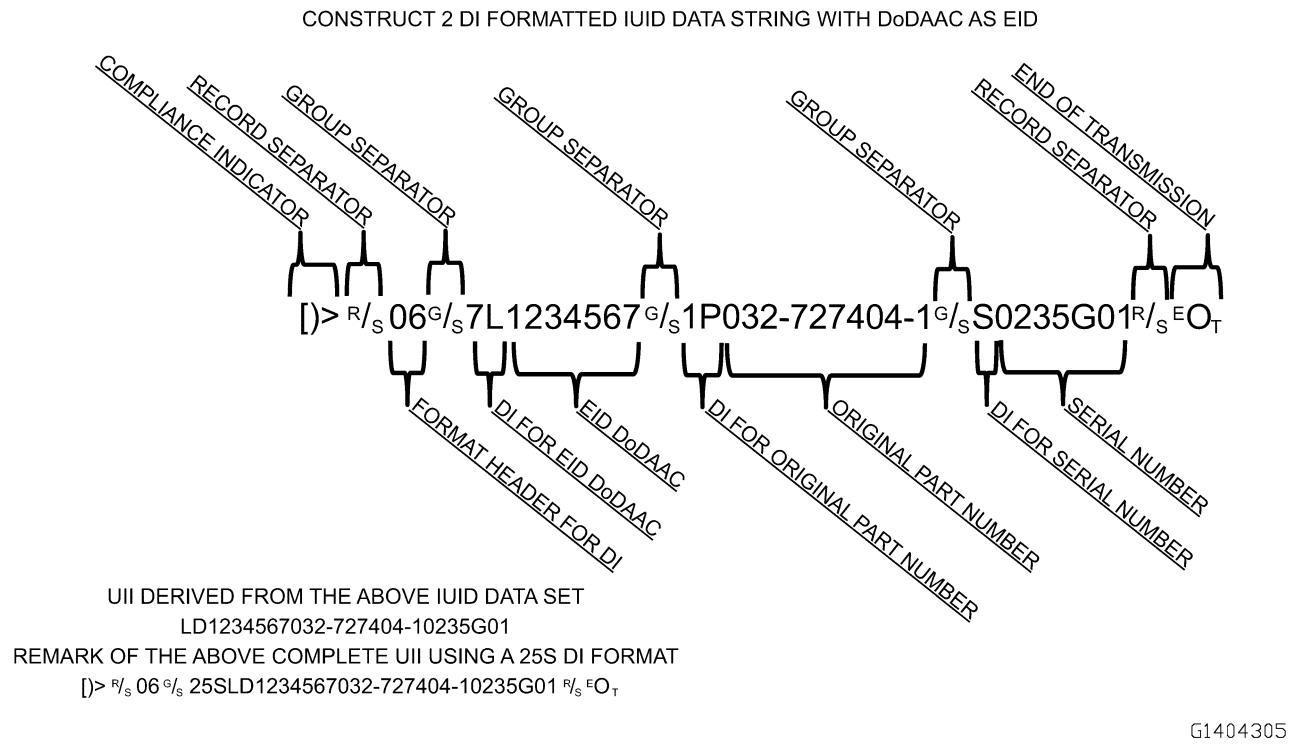


Figure 3-8. Illustration of Construct 2 With DoDAAC as EID

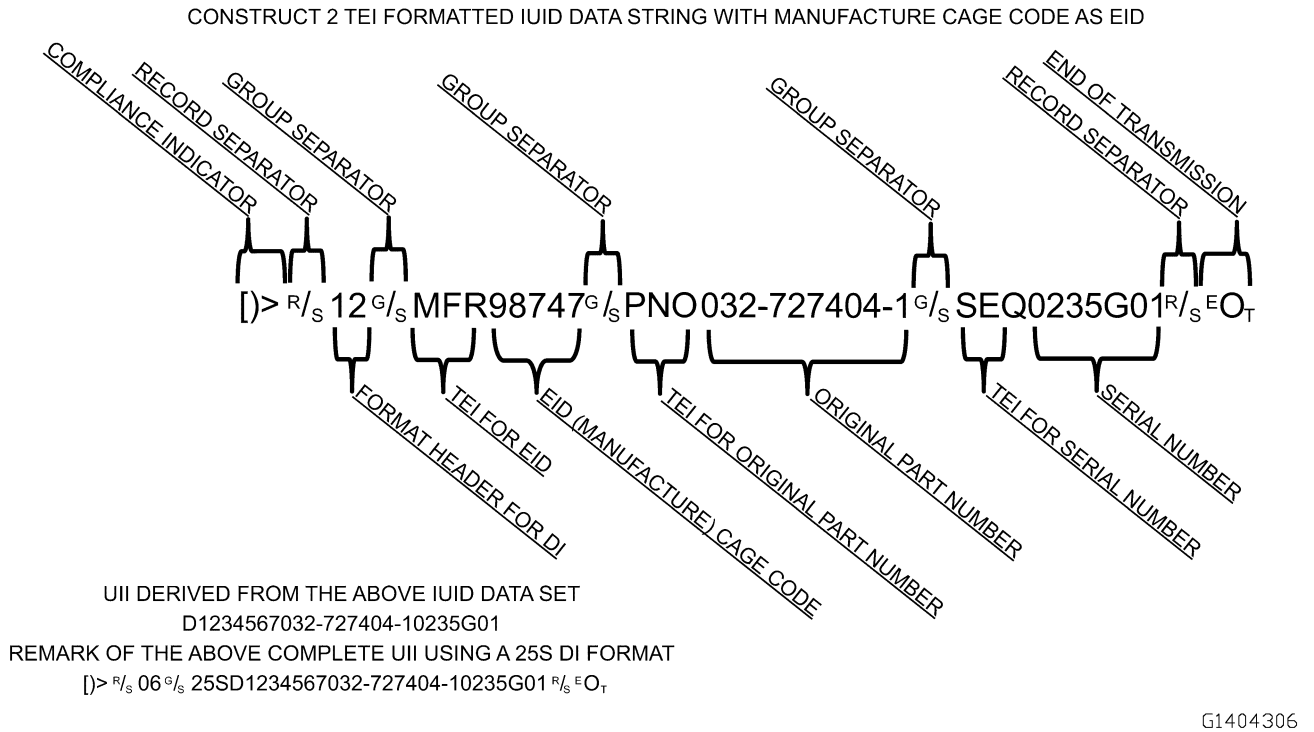


Figure 3-9. Illustration of Construct 2 With TEI Format

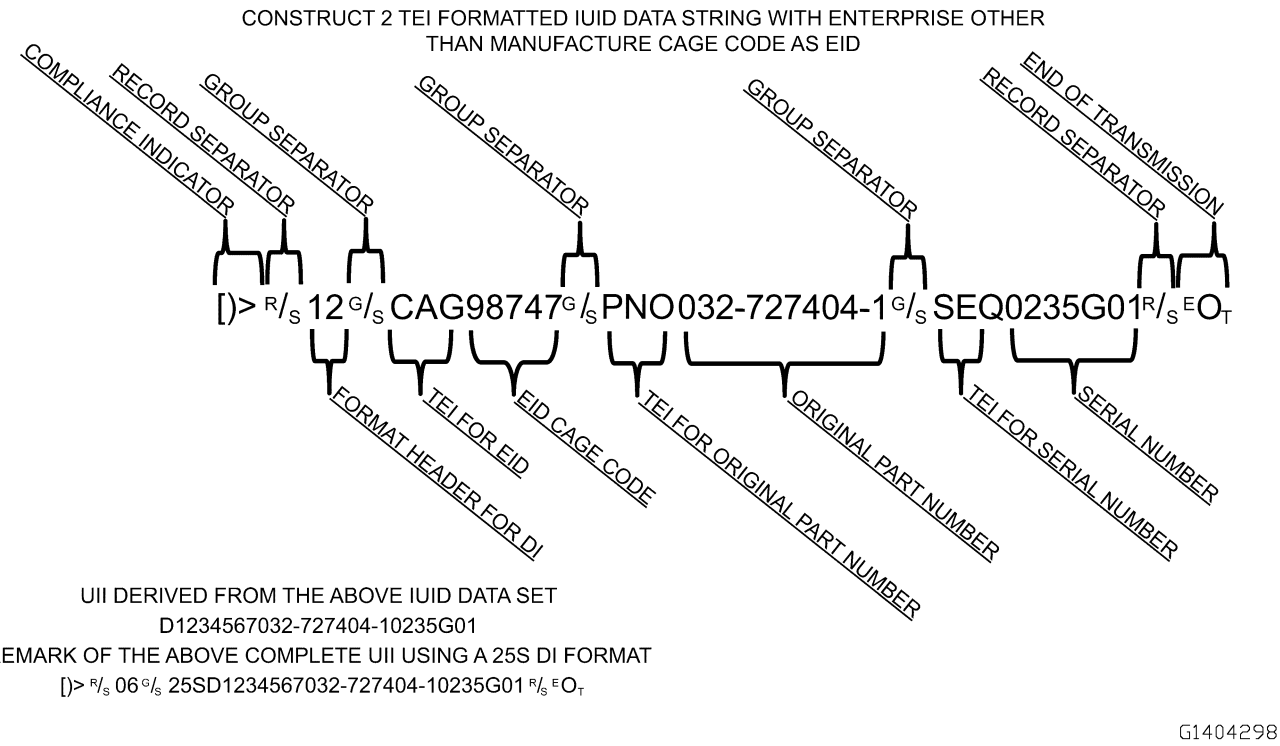
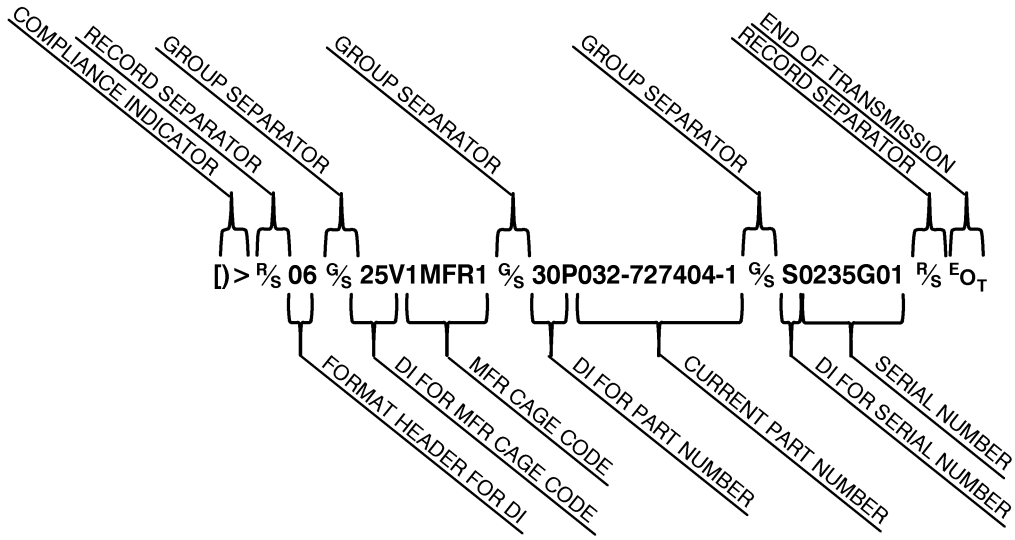


Figure 3-10. Illustration of Construct 2 With TEI Format and Enterprise Other Than Manufacturer CAGE as EID

NEXT GEN SERIALIZATION (NGS) DATA IDENTIFIER (DI) CONSTRUCT, USING ONLY CURRENT PART NUMBER (30P)



NGS UII DERIVED FROM THE ABOVE NGS DATA SET
1MFR1032-727404-10235G01

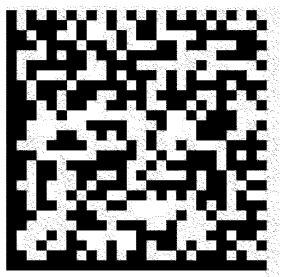
REPRINT OF THE ABOVE NGS
[)>RS 06 GS 25V1MFR1 GS 30P032-727404-1 GS S0235G01 RS EOT
NOTE: NGS FORMATTING REMAINS THE SAME. NO REFORMATTING TO 25S.

IF PART NUMBER ROLLS THEN

NGS UII WITH PART NUMBER ROLL TO 032-727404-2
[)>RS 06 GS 25V1MFR1 GS 30P032-727404-2 GS S0235G01 RS EOT
NOTE: AN UPDATED NGS UII IS CREATED AND ROLLS WITH THE PN.

NGS DERIVED AFTER PART NUMBER ROLL TO 032-727404-2
1MFR1032-727404-20235G01
NOTE: NEW NGS UII REFLECTS PN ROLL.

EXAMPLE OF RESPECTIVE 2D USING ECC 200 DATA MATRIX:



T□00-25-260-001

Figure 3-11. Illustration of Next Generation Serialization for 25V Department of Defense Construct

CHAPTER 4
UID LABEL SURFACE PREPARATION AND APPLICATION

4.1 INTRODUCTION.

NOTE

A label may be made of either a metallic or nonmetallic material and may be similar or dissimilar to the material of the item being marked. Unique Identification (UID) labels can be affixed to the identified item by any approved means found in applicable technical data.

The term label is used to describe various types of UID marking materials and can be interchanged with the term plate (i.e. tags, tape, data plate, name plate, ID plate, etc.).

NOTE

The following cleaning procedures for the surface where the label will be applied are recommendations only and may not apply to all materials. For the uncommon or unusual cases where these guidelines do not apply, consult the applicable technical data and/or contact appropriate engineering source authority for specific guidance.

4.1.1 Properly cleaning the surface will help prevent the onset of corrosion and contamination on the surface. Unclean or contaminated surfaces may lead to premature label adhesive/mechanical fastener failures. In addition, these guidelines will ensure the longest possible service life of the UID labels.

4.1.2 These procedures are for, but not limited to, the application of UID labels onto various components utilizing self-adhesive labels. Label material covered includes polyacrylic film, polyimide film, and other forms of thermal transfer label materials. These procedures can also be used to perform surface preparation for application of metallic labels. The procedures will be applicable for various surfaces including anodized and/or alodined aluminum, electrical equipment, and phenolic surfaces.

4.1.3 Unless otherwise specified by technical data, all cleaning and surface preparation of surfaces should be done in accordance with TO 1-1-169 and local shop procedures. For cleaning and surface preparation of electrical equipment, reference TO 00-25-234.

4.1.4 For most metallic surfaces, apply Isopropyl Alcohol, TT-I-735, or MIL-PRF-87937 Type III cleaning solution liberally to surface, wipe surface until surface is free from visible contaminants, dirt, hydraulic fluid, etc., and dry with cheesecloth. Allow area to dry before applying UID label.

4.2 UID DIRECT PART MARKING SURFACE PREPARATION.

Ensure marking surfaces are cleaned and free of all contaminants. When available, follow surface cleaning instructions per applicable technical data and/or guidance from the Engineering Source Authority (ESA).

4.2.1 When preparing a surface for electrochemical etching, ensure surface does not have nonconductive coatings that would prevent proper etching, such as anodized, painted, or corrosion-treated surfaces.

4.2.2 When preparing a surface for laser marking, ensure surface is clean of debris, dirt, and oil. Follow cleaning procedures outlined in appropriate technical data prior to laser marking. Failure to properly clean item may cause mark to be unverifiable or may potentially ignite oil, causing a safety hazard.

4.2.3 When dot peening components, ensure all parts are clean of debris or dirt. Follow all cleaning and surface preparations contained in the technical data to ensure that a good verifiable mark is achieved.

4.2.4 If specific surface cleaning instructions are not available, see MIL-PRF-87937 Type III for approved cleaning solutions. Follow pre-cleaning instructions; removal of grease, oil, and other organic soils can be accomplished with virtually any solvent.

4.2.5

CAUTION

Mechanical preparation is not appropriate on all metal surfaces. Check applicable technical data or contact the ESA for authorization of methods. Damage could result and failure or scrapping out of components. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

Mechanical preparation methods such as wire brushing or rubbing with metal wool/Scotch Brite may be used to prepare metal surfaces. Exercise care to ensure all abrasive materials (grit, sand, cloth, sand paper, or brushes) are free from contaminants that may be spread or rubbed onto surface. Exercise care in using any mechanical method to prevent deep gouges or rough surfaces which are not conducive to good bonding. Abrasives and debris should be wiped or water rinsed from surface.

4.3 UID LABEL APPLICATION.

NOTE

See UID label surface preparation instructions in Paragraph 4.1.1 prior to UID label application.

UID label placement is dictated by the applicable technical order or engineering drawing and in most cases will show the proper UID label number to be applied and its placement location. When initially determining where the label is to be placed, the following guidelines will strongly influence the labels durability and usefulness. The following are general considerations when determining placement:

a. Apply labels in protected areas when possible.

b. The labels should be readable when the marked item is in service.

c. The labels should be readable when the marked item is stowed.

d. Apply labels on flat areas when possible.

4.3.1 Unless otherwise directed by applicable technical order(s) or engineering drawing(s), do not place labels (list not all inclusive):

a. Over vents and/or air intakes.

b. Over other information.

c. Over fastener holes.

d. Over seams between separable pieces of the item.

e. On sealing surfaces.

f. On wearing or mating surfaces.

g. Near high heat sources.

h. Over lenses, optics, or sensors.

i. On surfaces with dimensional tolerance requirements.

j. In direct air streams (for example, leading edge of wings, helicopter rotors, exposed portions of turbine blades, and so forth).

k. On balance grinding surfaces

NOTE

Other placement considerations become important in specialized circumstances, such as when marking curved, rough, shiny surfaces, and items that are sensitive to electrostatic discharge.

4.4 UID LABELS WITH ADHESIVE BACKING APPLICATION PROCEDURES (TAPE).

Clean hands before handling materials to ensure they are free from any dirt, oil, hydraulic fluids, grease, etc.

4.4.1 Peel label from backing by bending and lifting at the corners and/or edges; avoid touching adhesive surface. Affix label to component in area specified in the applicable technical order and apply pressure by rubbing label surface to thoroughly activate adhesive and to work out any air bubbles between label and surface. If possible, allow label to set for a minimum of 1 hour prior to any use of labeled/plate item. Maximum adhesion occurs approximately 24-48 hours after applying the label for most adhesives.

NOTE

Ensure label is in correct position prior to allowing adhesive to touch component surface. Once adhesive has made contact, it will be very difficult to remove without damaging or destroying it.

4.5 UID LABEL WITH RIVET/SCREW APPLICATION PROCEDURES.

Ensure all materials are the same if using rivets/screws to attach ID plates. Follow installation instructions in applicable technical data when available. If materials are different, follow existing standards and guidance for dissimilar metals. See MIL-STD-889( ).

4.6 PROTECTIVE COATINGS AND COVERS.

Protective coatings and covers can add resilience to UID labels by protecting the label, substrate, and adhesive from damage. Coatings and covers should have a matte finish to minimize unwanted reflection off surface. If coatings are not applied in accordance with applicable technical data, readability of the UID label may be affected. This includes validation/verification as required by MIL-STD-130( ).

4.7 UID LABEL REMOVAL.

If UID label is unreadable or damaged and needs to be replaced, the following removal method is suggested.

4.7.1 The least damaging method for removing labels applied with adhesive is with the use of dry ice. Applying dry ice to label for 4-5 minutes causes adhesive to become brittle. The label is then tapped on the edge with a blunt object, preferably a plastic scraper, to free it from item. Use care not to damage item. Any surface exposed after label removal should be restored to its original condition before new label is applied.

CHAPTER 5
INDIRECT PART MARKING

5.1 INDIRECT PART MARKING USING DATA PLATES AND LABELS.

Indirect part marking for this Technical Order (TO) is defined as a nonintrusive Item Unique Identification (IUID) marking method that will not adversely affect form, fit, or function of item to be marked. Indirect part marking generally includes metal plates and adhesive-backed printed labels applied directly to surface of item. Indirect part marking also includes labels applied directly to existing identification plates/label where space permits. Two other forms of indirect part marking are bag and tag and virtual marking that can be used as a last resort.

5.1.1 Foreign Object Damage.

CAUTION

It is not recommended to use a data plate in locations where engine/air intakes have the potential to ingest the data plate and/or any bolts or screws attaching the data plate to the item. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

Foreign Object Damage (FOD) is always a concern.

5.1.2 Environment. Consider the numerous factors in various environments when selecting material for a data plate. Some of these may include temperature, dissimilar metals, and surrounding conditions (weather, sea water, etc.).

5.1.3 Dissimilar Metals. Corrosion is a concern when selecting metals for data plates. It is possible that when two dissimilar metals are interfaced and subjected to certain environmental conditions for a period of time, galvanic corrosion bonding or other adverse chemical reaction may occur. The Engineering Source Authority (ESA) must also consider the material of the interfacing component when selecting data plate material. Refer to MIL-STD-889() when selecting data plate material or considering other options to minimize corrosion.

5.1.4 Wear Resistance. In many environments, durability is often an issue when selecting the correct material for data plates. At a minimum, the data plate should be able to withstand wear until the next maintenance activity. Ideally, the design and placement of the data plate should last the entire lifecycle of item.

5.1.5 Location and Size of Data Plate. It is imperative that the design of a data plate does not adversely affect form, fit, or function of item. A location should be selected where no damage to data plate and/or item occurs.

5.1.6 Attaching Data Plate. Plates may be attached using adhesives, mechanical fasteners, or other means as specified in technical data. The ESA must specify the method for attaching a data plate to item.

5.2 PLATE MANUFACTURING.

NOTE

The terms plate and label may be used interchangeably.

Onsite manufacturing of plates and labels can be an efficient way to ensure timeliness, quality, and control of design, printing, application, and Unique Item Identifier (UII) data integrity. Various materials and methods may be used when manufacturing a plate or label for identifying an item. A number of factors must be taken into consideration during the engineering analysis phase when selecting marking method, type of material, and label dimensions. Some of these factors include dissimilar metals, wear resistance, location of data plate, and environment in which data plate resides.

5.2.1 Aluminum Foil Labels. Aluminum foil labels are pliable, durable, versatile, and tamper proof. They are also resistant to abrasion, chemicals, and solvents. Typically, they will withstand harsh environments including a wide range of temperatures and Ultraviolet (UV) rays. The labels easily conform to curved surfaces and are lightweight. Aluminum foil labels can be used in many different UID application scenarios if approved by the ESA. Aluminum foil labels can be produced using a laser or photo-imaging process.

5.2.2 Aluminum ID Plates. Aluminum ID plates are rigid, durable, versatile, and tamper proof, and resistant to abrasion, chemicals, and solvents. Typically, they will withstand harsh environments including a wide range of temperatures and UV rays. Aluminum ID plates can be used in many different Unique Identification (UID) application scenarios if approved by the ESA. Aluminum ID plates can be engraved in one step using a laser or photo- imaging process.

5.2.3 Photosensitive Anodized Aluminum ID Plates (Metal Photo). Photosensitive anodized aluminum ID plates combine durability in harsh environments with a high-quality, long-lasting appearance. Photosensitive ID plates will function for several years, maintaining their original appearance under an array of conditions including extreme heat, humidity, long-term exposure to weather, UV, salt spray, abrasion, industrial solvents, and chemicals. The durability for which photosensitivity is known is the result of a manufacturing process in which a silver halide image is embedded within the sapphire-hard, anodic layer of aluminum. The ID plate is resistant to chemicals, heat, abrasion, salt spray, and sunlight. Photosensitive ID plates are considered to be the most durable aluminum ID plate and can be used in many different UID application scenarios if approved by the ESA.

5.2.4 AlumaMark ID Plates. AlumaMark ID plates are made from a specially treated aluminum that yields rich black graphics when marked with a laser, resulting in high contrast, easy to read marks. AlumaMark ID plates are durable, versatile, and tamper proof, and resistant to abrasion, chemicals, and solvents. Typically, they are most suitable for indoor use but can be used outside if a protective coating is used. AlumaMark ID plates can be used in many different UID application scenarios if approved by the ESA.

5.2.5 Anodized Aluminum ID Plates. Anodized ID plates are very similar to aluminum ID plates but go through a process that forms a hard layer of oxide on the surface of the material. Anodized ID plates are durable, versatile, and tamper proof, and moderately resistant to abrasion, chemicals, and solvents. Typically, they will withstand mild to moderate environments. Black anodized aluminum ID plates, when exposed to direct sunlight and high UV levels for extended periods, have experienced fading and lose readability in relatively short periods of exposure. This should be taken into consideration when plate application is to be on exterior surfaces subjected to these environmental conditions. Anodized ID plates can be used for in many different UID application scenarios if approved by the ESA. Anodized ID plates come in many different colors and can be engraved in one step using a laser or photo-imaging process.

5.2.6 DuraBlack Aluminum ID Plates. DuraBlack ID plates are composed of multilevel coatings on an aluminum base. DuraBlack ID plates are durable, versatile, and tamper proof, and resistant to abrasion, chemicals, and solvents. Typically, they will withstand harsh environments including a wide range of temperatures and UV rays. In side-by-side tests, DuraBlack outperforms black anodized aluminum in most applications. DuraBlack ID plates can be used in many different UID application scenarios if approved by the ESA. DuraBlack ID plates can be engraved in one step using a CO_2 laser providing a high resolution mark.

5.2.7 Stainless Steel ID Plates. Stainless steel ID plates are durable, versatile, and tamper proof, and resistant to abrasion, chemicals, and solvents. They will withstand the harshest environments including a wide range of temperatures and UV rays. In environments where exposure to corrosive atmosphere or high heat is likely, stainless steel is, in most cases, the material of choice. Stainless steel ID plates can be used in many different UID application scenarios if approved by the ESA. It offers an unsurpassed clean, sharp, and detailed appearance that stands out in many applications. Stainless steel ID plates can be chemically etched, dot peened, or laser etched. Stainless steel ID plates come in a variety of thicknesses and may be attached using adhesive backing or mechanical fasteners.

5.2.8 Polyacrylic Labels. Polyacrylic labels consist of double-layered, highly cross-linked acrylic film with modified acrylic adhesive and a dimensionally stable release paper. They are durable, versatile, and tamper proof, and resistant to abrasion, chemicals, and solvents. The labels are suitable for use in temperatures ranging from -58 to +392 °F. Polyacrylic labels can be used in many different UID application scenarios if approved by the ESA and are the most common marking media for IUID. The labels can be formed into custom sizes and shapes. Polyacrylic labels can be engraved using Nd:YAG or CO_2 lasers. Polyacrylic labels have adhesive backing, which adheres to most plastic, metal, glass, painted, and ceramic surfaces. A standard tamper evident design feature prevents the label from being removed in one piece once it is applied.

5.2.9 Polyimide Labels. Polyimide is a polymeric plastic material, engineered for long-term performance at very high temperatures in excess of 250 °C for prolonged periods of time. At extreme temperatures, the quality of mark and label survivability are at risk. It is thermally very stable and is widely used in aerospace, electronics, and electrical industries when high-temperature material is required. Because of its thermal stability, properly engineered polyimide films do not shrink or decompose at temperatures encountered in the circuit board industry. Polyimide labels can be used in many different UID application scenarios if approved by the ESA. Polyimide labels may be printed using a thermal transfer or dot matrix printer.

5.2.10 Thermal Transfer Printed Labels. Thermal transfer printed labels are easily identified by the crisp, often glossy, printed surface. The clarity is achieved by using a thin ribbon roll that when heated by the print head melts onto the label to form the image. When matched with suitable media, thermal transfer technology is resistant to heat and moisture, and the image cannot be rubbed off, making the printed labels one of the most durable available. An additional benefit of this technology is the continuity of the printed image. Because the color and density of the printed image is determined by the ribbon and resolution of the printer, thermal transfer printing produces consistent, reliable printing on every label. Thermal transfer labels can be used in many different UID application scenarios if approved by the ESA. Thermal transfer labels come in rolls in a variety of widths and thicknesses and have adhesive backing.

5.3 ALTERNATIVE MARKING METHODS.

5.3.1 Bag and Tag. Bag and tag is the process of creating and registering an IUID mark and placing it on the packaging or container rather than on the item itself. There are some instances where bag and tag is the only possible solution: item is too small for a verifiable IUID mark or environmental/operational conditions of item make other forms of marking unfeasible. Bag and tag must be approved by the ESA.

5.3.2 Virtual Marking. Virtual marking is the process of creating the UII for an item and registering the pedigree data within the DoD IUID Registry. No IUID label is actually created and registry is annotated as such, but virtual marking means that physical marking needs to occur at the next available opportunity. When item is physically marked, the registry will be updated to reflect the status change.

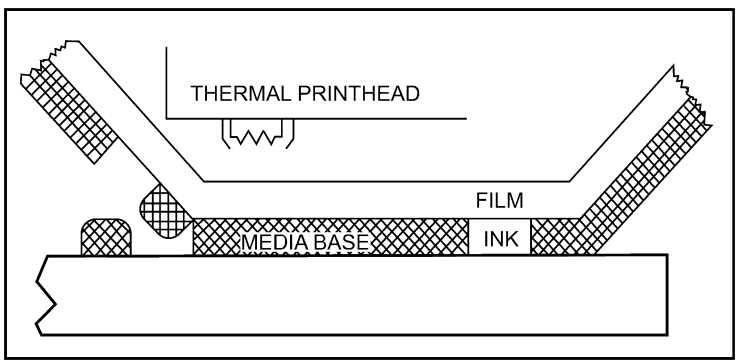


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Figure 5-1. Illustration of Thermal Printer

CHAPTER 6
DIRECT PART MARKING

6.1 INTRODUCTION.

Direct Part Marking (DPM) is the application of a Unique Identification (UID) data matrix mark directly onto the base material of an item. DPM is often used when environmental conditions such as high temperatures, fluids, airstream, etc., would prohibit the use of a label. DPM can be applied to the item and is often intrusive; therefore, safety precautions need to be followed. It is the responsibility of the Engineering Source Authority (ESA) to conduct a thorough analysis to ensure DPM is the viable alternative to mark the item.

6.1.1 There are some marking methods that are considered to be DPM, such as ink jet, silk screen, and stencil. Even though they are not intrusive, they are less accepted and unproven IUID marking methods. These methods can be used if no other form of DPM is viable. Consider the more common and proven methods first.

6.2 DOT PEEN MARKING.

WARNING

Most dot peening equipment is considered as either semi-automated or fully automated. Follow all safety guidelines outlined by the equipment manufacturer and item specific Technical Orders (TOs) or locally developed procedures as applicable to prevent injury to personnel and damage to equipment and Department of Defense (DoD) assets. Do not modify or alter safety equipment. Failure to do so could cause injury to personnel.

(Figure 6-1) Dot peen part marking is a process for marking an item using a stylus. The stylus is used on an X-Y coordinate machine to indent the item, producing a data matrix and/or Human Readable Information (HRI). Dot peen marking technology typically produces round indentations on a part's surface with a pneumatically or electromechanically driven pin. The dot's shape, size, and spacing are critical to the readability of mark. The matrix created should be suitable to trap or reflect light and large enough to be distinguishable from the item's surface finish.

6.2.1 Special Considerations.

NOTE

Before selecting this method for use on DoD assets, take special consideration of the implications of the effects of work hardening.

As a dot peen mark is created on an item, the stylus deforms the substrate causing an indentation on the item. During the process, it causes a deformed region around the mark where the material has been cold worked (becomes more brittle). Because of this, undesirable residual stresses may occur and the ductility of the part may be lost. See Figure 6-1.

6.2.2 The dot peen process should not be used under the following conditions:

a. Materials less than 0.02 inch (0.51 mm) thick.

b. Surfaces that are Electrical Discharge Machined (EDM).

c. Nonductile materials.

d. Assets where the mark may be potentially on an edge, around a hole, or on uneven surfaces.

e. Any highly stressed items.

f. Highly fatigued items.

g. Marking preheated items that do not lend themselves to annealing.

6.2.2.1 When dot peening is not appropriate for use for a particular component, use an alternate method.

6.2.3 The basic steps in creating a dot peen UID data matrix are as follows:

a. For detailed step-by-step dot peen procedures, consult the OEM user manual, item specific TO, and locally developed procedures, if applicable.

b. Set up item to correct angle and minimize any movement during marking process. To produce the data matrix per MIL-STD-130, use appropriate fixtures as necessary to prevent injury to personnel and/or damage to assets. Appropriate fixturing is necessary to properly secure item during dot peening process to prevent movement and comply with MIL-STD-130.

c. Apply mark to component.

d. Verify and validate that mark is compliant with MIL-STD-130.

e. After item is marked, apply specified coating to prevent corrosion, if required.

6.3 ELECTROCHEMICAL ETCHING.

Electrochemical Etching (ECE) is a process used to etch away base material of an item by using an electrolyte and electrical current. The basic theory behind electrochemical etching is that the base material reacts with the electrolyte and current. This removes a very small amount of base material and redeposits it, causing discoloration. See Figure 6-2.

6.3.1 Equipment. ECE marking equipment can consist of a power unit, electrode (wand), mask/stencil, ground cable, grounding plate, and electrolytes. Additional tooling and fixturing may be required to properly hold the component in position and to potentially automate the process as needed.

6.3.2 Methodology.

WARNING

- Electrochemical etching uses electrical current. Follow all safety guidelines outlined in manufacturer's instruction manual, item specific TOs, or locally developed procedures, if applicable. Ensure component and equipment are properly grounded prior to electrochemical etching any item. Wear proper safety equipment when using electrochemical etching equipment.
- Electrolytes used in the electrochemical etching process may be hazardous. Follow all Safety Data Sheet (SDS) safety guidelines when using electrolytes. Failure to comply could result in injury to, or death of, personnel or long term health hazards.

CAUTION

Wipe off and clean all excess electrolytes from items as they may cause corrosion. Failure to comply could result in damage to, or destruction of, equipment or loss of mission effectiveness.

This methodology for part marking using the electrochemical etching process is a general guideline. When a conflict occurs between this TO and the instructions for a specific item, the specific item's information takes precedence. When electrochemical etching is allowed on a component, the type of electrolyte, surface preparation method, voltage, number of cycles, dwell time, and neutralizer must be specified.

6.3.3 The basic steps for creating an ECE UID data matrix are as follows:

a. Set up equipment per the instructions specified in the owner's manual.

b. Create a mask/stencil of the information (data matrix, any HRI, if applicable) to be applied to the part.

c. Apply appropriate electrolyte to sponge or cloth.

d. Apply mask/stencil to part.

e. Activate electrical current and monitor the time and cycles of current.

f. Turn off electrical current.

g. Wipe off and neutralize remaining electrolyte on part.

h. Verify and validate that mark is compliant with MIL-STD-130.

i. After item is marked, apply specified coating to prevent corrosion, if required.

6.3.4 AC vs. DC Current. There are two separate currents that may be used when electrochemical etching items. Alternating Current (AC) is generally used to extract material from marking surface and redeposit it back on the item in the form of a metallic oxide. Electrolytes used in this process cause the IUID mark to become discolored or darkened. AC and Direct Current (DC) are often used together to form a deep-etched mark. See Figure 6-3.

6.3.5 Advantages. ECE is a viable option for components under high stress because the process does not affect the surrounding grain structure like other DPM processes. The depth of the mark can easily be controlled due to electrolyte used, dwell time, and voltage applied.

6.3.6 Disadvantages. Electrochemical etching cannot be used in the following scenarios:

a. Nonconductive materials

b. Any coated components:

- Anodized parts
- Painted surfaces
- Tagnite, etc

c. Electrochemical etching (nondeep etch) typically affects shallower areas of the part. This means that the mark is not very good for high wear areas.

d. Like most DPM, ECE can be difficult to verify. Refer to verification work package in this TO for ways to assist in the verification of a direct part mark.

6.4 LASER MARKING.

WARNING

Use extreme caution when being exposed to lasers. Lasers emit and reflect intense energy beams, which could cause severe burns or eye damage. Ensure proper protective barriers and/or safety equipment are in place. Do not alter or disable protective barriers or equipment. Failure to comply could result in injury to, or death of, personnel or long term health hazards.

Laser DPM uses amplified high intensity light to scribe the matrix on item and is generally very precise and accurate. This method of IUID marking is more durable than many other DPM methods. The depth of the IUID mark can be determined by the speed and intensity of the laser.

6.4.1 Laser Types. There are numerous laser types that can be used when marking items. Carefully select the laser type that would work best for the application.

6.4.1.1 Femto Lasers. Femto lasers are high-precision lasers that use a high power, amplified light beam and marks at very high speeds. Thermal effects on the substrate are minimal due to an intense beam that removes material quickly, thus reducing the Heat Affected Zone (HAZ) on the item.

6.4.1.2 YAG.

WARNING

Most Yttrium Aluminum Garnet (YAG) lasers are considered to be a class I (reference LIA Z136.1) type laser; therefore, appropriate protective safety gear must be worn or proper protective equipment interlocks must be in place to protect personnel. Failure to comply could result in injury to, or death of, personnel or long term health hazards.

YAG lasers are one of the most common types of lasers used. They use a flashtube or laser diode to amplify the light and can be operated in pulsing or continuous mode. The YAG laser is ideally suited to be absorbed in most metals; however, it has a small wavelength which inhibits its ability to be absorbed by many other materials such as wood, acrylics, plastics, fabrics, etc.

6.4.1.3 CO_2 Lasers. CO_2 lasers operate at a much higher wavelength than YAG lasers. This makes them ideal for marking organic materials such as wood, acrylics, rubber, etc. However, when using CO_2 on metal, a bonding agent for contrast is needed to make verifiable and readable marks due to the inability of laser to penetrate the substrate. Generally, CO_2 lasers are not the best option for DPM.

6.4.2 Laser Schedules. When called out by technical data, the laser schedule will indicate power settings, location, depth of mark, and speed required to generate a safe and verifiable mark. It is often recommended that a laser setting schedule be tested on a coupon of the same material. This testing confirms a safe depth of the HAZ to validate part integrity is not compromised.

6.4.3 Considerations. When laser marking parts, there are a few factors that need to be considered to ensure a good, verifiable mark is going to be produced.

6.4.3.1 The first consideration is the type of material being marked followed by its thickness. This will affect the laser selected and power setting and speed necessary to produce a robust mark.

6.4.3.2 HAZ is often a factor. Refer to Paragraph 6.4.4 for heat considerations.

6.4.3.3 Stress on the component is also a big consideration when considering whether or not to use laser marking on a part. Consider the amount of HAZ on a part and how much is permissible given the amount of stress on the component.

6.4.4 Heat Affected Zone. Figure 6-4) HAZ is defined as the region around the marking area that has had its microstructure altered due to the intense heat. In laser marking, heat affected zones can be detrimental when the part is highly stressed.

6.4.4.1 Occasionally, the HAZ may be minimized by stress relieving the part or by carefully grinding away the affected zone. The cognizant engineering authority should decide whether the item is acceptable for laser welding or stress relieving to ensure that no detrimental effects occur to the item.

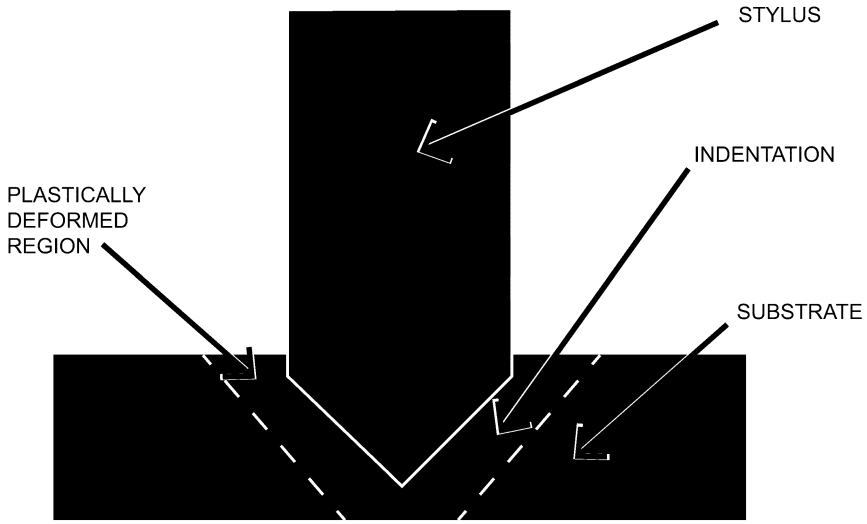

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Figure 6-1. Dot Peening

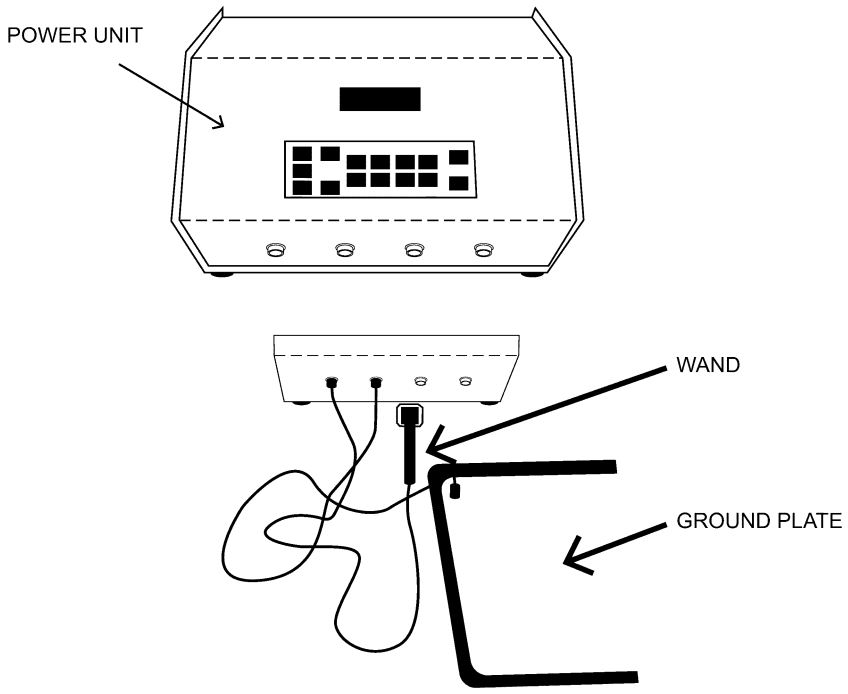

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Figure 6-2. Electrochemical Etching Equipment

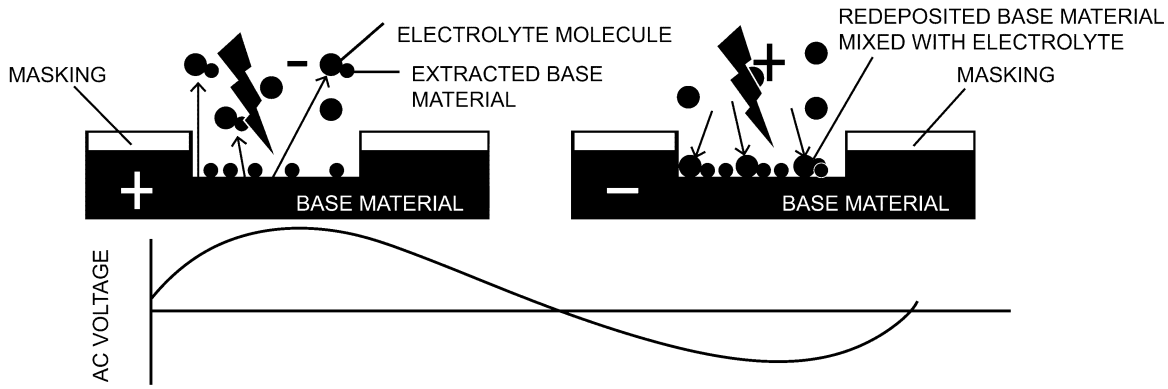

Figure 6-3. Illustrations of AC Current on a Ferrous Parent Material Type

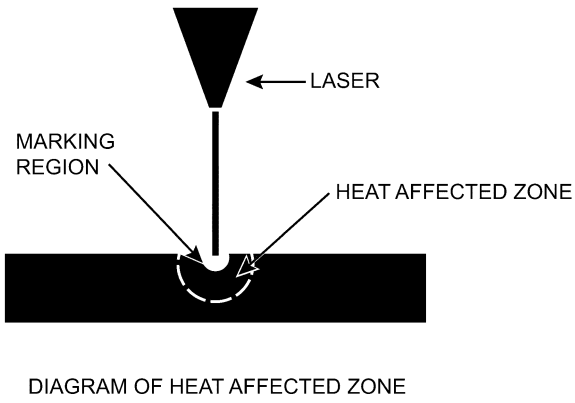

Figure 6-4. Diagram of Heat Affected Zone

CHAPTER 7
VERIFICATION, VALIDATION, AND INSPECTION

7.1 VERIFICATION AND VALIDATION.

Verification of data matrix quality and validation of Machine-Readable Information (MRI) encoded in the Unique Item Identifier (UII) data matrix are requirements for the production of MIL-STD-130 compliant UII labels. Imaging equipment with correctly configured lighting and compliant ISO/IEC 15416 and AIM DPM-1-2006 software are required to accomplish this function. Validation and verification work in conjunction to produce a letter grade for the data matrix.

7.1.1 For Direct Part Marking (DPM), a letter grade of C or better must be achieved. For indirect part marks, a letter grade of B or better must be achieved.

7.1.2 Data matrix symbol quality can be determined using any of the following standards: ISO/IEC 15415, AIM DPM-1-2006, or SAE AS9132.

7.1.3 Verification/Validation Batch Sampling. When large quantities of marks are needed, verifying every mark can be very time consuming. MIL-STD-130 allows for the adoption of a lot acceptance sampling plan as a method to test the integrity of a batch of barcodes without having to verify every barcode. Lot acceptance sampling is an inspection procedure where a random sample is taken from a lot. Upon the results of the samples, the lot is either rejected or accepted.

7.2 NEWLY MANUFACTURED UID LABEL AND DATA PLATE INSPECTION.

The following inspection activities will apply to indirect part marking Unique Identification (UID) labels. Magnifying loops and other optical magnification enhancement tools may be useful when performing the following inspections.

7.2.1 Inspection of newly manufactured UID labels prior to application:

a. Ensure all Human Readable Information (HRI) is legible, spelled correctly, and applicable to the item on which label will be applied.

b. Check for debris, corrosion, cracks, tears, holes, or scratches that may interfere with label application on item.

c. Reference item specific applicable TO to confirm location of the UID label on item. Ensure surface preparation and label application procedures are followed prior to application. See Chapter 4 on surface preparation.

d. Configure lighting to support verification/validation of data matrix.

e. Scan the UID data matrix to confirm encoded data is applicable to item being marked.

7.3 NEWLY MARKED DPM UID INSPECTIONS REQUIREMENTS.

The following inspection activities will apply to DPM. Magnifying loops and other optical magnification enhancement tools may be useful when performing the following inspection activities.

7.3.1 Inspect DPM Marked Assets. Ensure all HRI is legible, spelled correctly, and applicable to item on which DPM is applied.

a. Check DPM marked area for debris, corrosion, cracks, tears, holes, or scratches that may interfere with or impede the readability of the HRI data.

b. Reference item specific applicable TO to confirm location of UID on item prior to application. Ensure surface preparation application procedures are followed. See Chapter 4 on surface preparation.

c. Configure lighting to support verification/validation of data matrix.

d. Scan DPM UII to confirm encoded data is applicable to item being marked.

7.3.1.1 Incorrect or Nonconforming DPM Marked Items. If DPM items do not pass inspection process, refer to applicable TO and MIL-STD-130 for instructions on how to obliterate a bad mark, find an alternate DPM location, and remark the item.

7.4 INSPECTION OF EXISTING UID LABELS ON ITEMS RETURNING FOR MAINTENANCE.

The following inspection activities will apply to existing indirect UID labels. Magnifying loops and other optical magnification enhancement tools may be useful when performing the following inspection activities.

a. Visually inspect incoming item for existing UID labels and data plates. Incoming items should be inspected for existing UID labels and data plates prior to producing new labels for item assets that may already have them. When trying to locate small or hard to find UID labels or data plates, it may be helpful to reference applicable technical data to confirm the correct location of UID label or data plate on the item.

b. If UID label exists:

(1) Remove any accumulated debris, dust, and dirt from UID label. Reference applicable technical data for proper cleaning procedures as required.

(2) Check UID label for corrosion, cracks, holes, peeling, tears, scratches, or any other damage that may interfere with or impede readability of the UII.

(3) Scan UII data matrix symbol to confirm encoded data is applicable to item. MIL-STD- 130 requires a minimum of 60% readability, also referred to as a minimum of 40% of unused error correction. Remark all noncompliant labels per applicable technical data using construct 25S. It is recommended that remarking occur if lifecycle wear of the data matrix is nearing minimum readability.

c. If UID label or data plate passes inspection:

(1) If label or data plate is not damaged and HRI/MRI data is readable and has been confirmed to be correct, do not make replacement label unless repair process will destroy existing UID label.

(2) If existing label must be removed, ensure MRI data has been captured and is used when replacement label is produced.

d. If UID label does not exist and item requires Item Unique Identification (IUID), check legacy systems (if item legacy data is known) to determine if item was previously marked. Legacy systems may include Depot Maintenance Repair Overhaul System (IMPRESA), Defense Repair Information Logistics System (G200) (DRILS), Lean Depot Management System (LDMS), Central Engine Management System (CEMS), and Centralized Access for Data Exchange (CAFDEx), or systems not identified here, to determine if an item was previously marked. This will aid in not assigning a new UII to a previously marked item.

7.5 INSPECTION OF EXISTING DPM DATA MATRIX AND UII ON ITEMS RETURNING FOR MAINTENANCE.

The following inspection activities will apply to existing DPM symbol. Magnifying loops and other optical magnification enhancement tools may be useful when performing the following inspection activities. For difficult to locate DPM UIIs, it may be useful to reference applicable technical data to confirm the correct location.

7.5.1 Visually Inspect Incoming Item for Existing IUID Data Matrix.

a. Ensure all HRI is legible, spelled correctly, and applicable to item on which the DPM is applied.

b. Check DPM marked area for debris, corrosion, cracks, tears, holes, or scratches that may interfere with or impede readability of HRI data.

c. Reference item specific applicable TO to confirm location of UID on item prior to application. Ensure surface preparation application procedures are followed. See Chapter 4 on surface preparation.

d. Scan DPM UII to confirm readability. It is recommended to capture the UII for potential remarking items if UII will be destroyed during maintenance process.

e. If DPM marked item does not pass inspection process, reference item specific TO for detailed instructions on remarking.