

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 September 2002.

INCH-POUND

MIL-DTL-19491H
28 June 2002
SUPERSEDING
MIL-S-19491G
26 June 1992

DETAIL SPECIFICATION

SEMICONDUCTOR DEVICES, PACKAGING OF

This specification is approved for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 Scope. This specification covers the requirements for the preservation, packing, and container marking of semiconductor devices such as transistors and diodes (FSC 5961) (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

- A-A-59135 - Packaging Material, Sheet.
- A-A-59136 - Cushioning Material, Packaging, Closed Cell Foam Plank.
- A-A-55485 - Mounting Pads, Electrical-Electronic Component, General Requirements for.

DEPARTMENT OF DEFENSE

- MIL-DTL-117 - Bags, Heat-Sealable.
- MIL-PRF-19500 - Semiconductor Devices, General Specification for.
- MIL-PRF-81705 - Barrier Materials, Flexible, Electrostatic Protective, Heat-Sealable.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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STANDARDS

FEDERAL

FED-STD-123 - Marking for Shipment (Civil Agencies).

DEPARTMENT OF DEFENSE

MIL-STD-129 - Military Marking, Standard Practice for.

MIL-STD-750 - Test Methods for Semiconductor Devices.

MIL-STD-1686 - Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices).

MIL-STD-2073-1 - DOD Standard Practice for Military Packaging.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents, which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

ASTM INTERNATIONAL

ASTM D3951 - Standard Practice for Commercial Packaging.

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NSCL Z540.1 - Laboratories, Calibration, and Measuring and Test Equipment.

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO10012-1 - Equipment, Quality Assurance Requirements for Measuring - Part 1: Metrological Confirmation System for Measuring Equipment.

(Application for copies should be addressed to American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. REQUIREMENTS

3.1 General. The packaging terms used herein shall be in accordance with the definitions listed in MIL-STD-129, MIL-STD-1686, MIL-STD-2073-1. The following general requirements apply, as applicable, to military or commercial packaging.

3.1.1 Shipments to Government activities.

3.1.1.1 Pairs and sets. Semiconductor devices furnished in pairs or sets under one national stock number (NSN) shall be unit packaged as one pair or one set, as applicable. When specified in a detail specification, matched diodes shall be packaged with a statement to that effect. Unless otherwise specified, unit of issue (each pair, set) shall be individually unit packed.

3.1.1.2 Hardware. Hardware accompanying semiconductor devices shall be protected and enclosed within the unit pack in a manner that will not damage the device or pack. When practical or when the semiconductor devices are not otherwise protected, the hardware should be mounted on each device.

3.1.1.3 Physical protection. Semiconductor devices and accessories shall be packaged in a manner that will ensure compliance with the applicable requirements of MIL-STD-2073-1 as well as those specified herein.

3.1.1.4 Wrapping and cushioning and lead protection for semiconductor devices. Leads and terminals, excluding axial leaded devices, shall be protected by container design, die-cut inserts, vials, or non-corrosive supporting materials or devices to prevent damage to the item or packaging. Leads or terminals shall extend outward and be maintained in a configuration as manufactured without causing undue loads or stresses capable of causing damage to the devices. Materials used to maintain item position and lead configuration shall permit item removal and replacement without bending the leads. All semiconductor devices shall be wrapped or cushioned with non-corrosive materials, which shall not crumble, flake, powder, or shed. In addition, no static generating materials shall be used for semiconductor devices susceptible to electric field force damage. For these susceptible devices, materials conforming to type II or III of MIL-PRF-81705 or bags conforming to MIL-DTL-117, type 1, class A, style 2 shall be used as wraps or pouches, respectively. Alternatively, cushioning materials conforming to CID (Commercial Item Description) A-A-59135 for sheet material and A-A-59136 for plank material may be used. Any materials used shall be in accordance with MIL-STD-2073-1 for wrapping materials and for cushioning materials. No special protection is required for axial leaded devices that are not electrostatic discharge sensitive (ESDS).

3.1.1.5 Electrostatic and electromagnetic shielding and corrosion protection. Electrostatic and electromagnetic shielding (as well as protection from corrosion, and contamination) shall be provided by placing the wrapped or cushioned semiconductor device in heat sealed bags fabricated with material conforming to MIL-DTL-117, type 1, class F, style 1. For immediate use applications and for those instances where no exposure to electrostatic or electromagnetic fields are anticipated, barrier material conforming to type II or III of MIL-PRF-81705 may be used. Electrostatic and electromagnetic shielding protection shall be mandatory for all:

- a. Mixer diodes (microwave diodes).
- b. MOSFET transistors (insulated gate field effect).
- c. Junction field-effect transistors.
- d. Silicon controlled rectifiers (SCR).
- e. Small signal Schottky diodes (Schottky barrier).
- f. RF (semiconductor devices not otherwise named which operate at a frequency above 1 gigahertz).

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3.1.2 Preservation. Preservation shall be military or commercial as specified herein (see 6.2).

3.1.2.1 Military.

3.1.2.1.1 Cleaning. Semiconductor devices and accessories shall be clean or be cleaned in accordance with MIL-STD-2073-1, if applicable.

3.1.2.1.2 Drying. Semiconductor devices and accessories shall be dry or be dried in accordance with MIL-STD-2073-1, if applicable.

3.1.2.1.3 Preservatives. Contact preservatives shall not be used.

3.1.2.1.4 Unit packs. Semiconductor devices shall be unit packed one each and protected in accordance with the requirements contained herein and in MIL-DTL-117, for bags conforming to MIL-DTL-117, type I, class E, style I or II.

3.1.2.1.5 Intermediate containers. The use of intermediate containers shall be in accordance with MIL-STD-2073-1.

3.1.2.2 Commercial. Commercial packaging shall be in accordance with ASTM-D3951.

3.1.3 Packing. Packing shall be level A, B, or minimal as specified in MIL-STD-2073-1 (see 6.2).

3.1.4 Marking.

3.1.4.1 Military. In addition to any special marking required by the contract or order, marking for military or commercial levels shall be in accordance with MIL-STD-129 and, when applicable, as specified in 3.1.4.1.1.

3.1.4.1.1 Special requirements. When required by the contract or order, containers shall be marked as specified in 3.1.4.1.1.1 and 3.1.4.1.1.2.

3.1.4.1.1.1 ESDS electronic devices. Unit, intermediate, and exterior packs containing ESDS devices susceptible to damage from electric field forces (see MIL-HDBK-263 for definition of electric field) shall be marked in accordance with MIL-STD-129 requirements.

3.1.4.1.1.2 MIL-PRF-19500 semiconductor devices, additional marking. The unit packs of those semiconductor devices acquired in conformance with MIL-PRF-19500, shall be additionally marked with the following:

- a. JAN prefix.
- b. Type designation.
- c. Manufacturer's designating symbol.
- d. Assembly plant code.
- e. Lot identification code.
- f. Inspection date.
- g. Reinspection date (if reinspection is applicable).
- h. Country of origin.
- J. Serialization may be included as a serialization range of individual serialized devices.

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3.1.5 Civil agencies. When specified in the contract or order (see 6.2), the marking of domestic shipments for civil agencies shall be in accordance with FED-STD-123.

3.1.6 First article and conformance inspections. First article and conformance inspections and tests shall be required as specified in 4.4 and 4.5, respectively. Samples for these tests shall be furnished in accordance with the procedures outlined in 4.4 and 4.5. The performance of the visual and dimensional inspections, rough handling tests, and leakage tests shall conform to the inspections and tests outlined in 4.6.1, 4.6.2.1, and 4.6.2.2, respectively.

3.1.6.1 Functional requirements.

3.1.6.1.1 Rough handling test (when specified (see 6.2)). When packs have been tested in accordance with 4.6.2.1, all material and components comprising each pack shall be free from damage or evidence of displacement, which might affect the use of the preservation method or pack. The semiconductor devices and associated accessories within the tested packs shall show no visible signs of damage. When specified in the contract or order (see 6.2), functional tests in accordance with the group A inspection requirements of the commodity specification shall be conducted on those semiconductor devices subjected to the rough handling test to determine freedom from operational malfunction. The examination of the devices tested under this group A inspection shall be in accordance with the visual and mechanical inspection requirements specified in test method 2071 of MIL-STD-750 or the commodity specification.

3.1.6.1.2 Leakage test (when applicable). When a barrier enclosed unit pack has been tested in accordance with 4.6.2.2, there shall be no evidence of moisture within the unit pack.

3.2 Shipments to non-Government activities.

3.2.1 Non-ESDS semiconductor devices. Shipments to original equipment manufacturers (OEM) and packaging distributors shall be in accordance with ASTM-D3951.

3.2.2 ESDS semiconductor devices. Shipments of ESDS semiconductor devices to OEM's and packaging distributors shall conform to the requirements specified 3.1.1.5.

3.2.2.1 Packaging material surface resistivity. Tape and reel, waffle pack, and other type carriers used in packaging shall have a surface resistivity of less than 10^{12} ohms per square.

3.2.2.2 Container. Tape and reel, waffle pack, and other type carriers used in packaging, if required, shall be placed in a bag conforming to MIL-DTL-117, type I, class A, style 2 or class F, style 1 using barrier material conforming to MIL-PRF-81705 type I, II, or III as specified (see 6.2.2).

3.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Workmanship. The quality of workmanship shall assure acceptance of the completed preservation, packing, and marking requirements in accordance with the inspections specified in section 4 herein.

4. VERIFICATION

4.1 Classification of inspections. The inspections specified herein are classified as follows:

- a. Materials inspection (see 4.3).
- b. First article inspection (see 4.4).
- c. Conformance inspection (see 4.5).

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4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy and quality to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ISO10012-1 or ANSI/NSCL Z540-1 or equivalent.

4.2.1 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the general requirements of MIL-STD-750.

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials used are in accordance with the applicable requirements specified herein.

4.4. First article inspection. When specified (see 6.2), first article inspection shall be performed by the contractor, after award of contract and prior to production at a time and location acceptable to the Government. First article inspection shall not be required:

- a. When there have been no changes in material, processes, or packaging design that will adversely affect the item protection since the last recorded inspection.
- b. When the acquisition activity waives requirements for first article inspection.
- c. When commercial level protection is specified.
- d. When prior successful inspection was conducted on a like item and pack (subject to approval of the administrative contracting officer).

4.4.1 Sample size. One sample unit consisting of military preservation as applicable, a fully packed shipping container shall be submitted for first article inspection. The sample for the rough handling test shall consist of the pack selected for the first article inspection. The sample for the leakage test shall be five unit packs selected at random for the first article exterior (shipping container).

4.4.2 Inspection routine. The sample shall be subjected to the inspections specified in tables I and II. The leakage test, when applicable, shall be performed directly after the rough-handling test.

4.4.3 Failures. One or more failures shall be cause for refusal to grant first article approval.

4.4.4 Resubmission of first article sample. If the sample fails to pass first article inspection, the contractor shall change the preservation and packing processes to correct the cause of the deficiency. First article inspection shall be performed on a corrected sample to prove that the corrective action is acceptable.

4.5 Conformance inspection. This inspection shall consist of the inspections and tests specified in tables I and II, respectively.

4.5.1 Shipments to Government activities.

4.5.1.1 Inspection lot. An inspection lot, as far as practicable, shall consist of unit or exterior (shipping) packs produced under essentially the same conditions and offered for inspection at one time. For the purpose of selecting samples to be inspected and tested for compliance with the requirements of this specification, either items in process or completed packs, except as stated herein, may be combined into lots without regard to individual items, contracts, or the quantities therein. Unit packs of the same size and made from the same packaging materials may be grouped together except when item complexity, item value, or the complexity of the preservation method warrants that the inspection of such items be performed on a separate basis. A separate application of the sampling or inspection procedure shall be made on these items. The combination of the items to be subjected to inspection shall be determined by either the Government or the contractor, subject to the approval of the Government.

4.5.1.2 Visual and dimensional inspection. Visual and dimensional inspection shall consist of those inspections specified in table I.

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4.5.1.3 Sample plan. A sample of five packages shall be randomly selected. If one or more defects are found, the inspection lot shall be screened and the defective packages removed. A new sample of five packages shall be randomly selected. If any of the defects are found in the second sample, the inspection lot shall be rejected and shall not be supplied as in compliance with this specification.

TABLE I. Visual and dimensional inspections.

Major defects	Requirement paragraphs	Method paragraph
Packaging materials not conforming to referenced specification requirements	3.1.1.4, 3.1.1.5, and 3.2.2	4.6.1
Insufficient field force protection (shielding)	3.1.1.4, 3.1.1.5, and 3.2.2	4.6.1
Punctured or improperly fabricated barrier bag	3.1.1.4, 3.1.1.5, and 3.2.2	4.6.1
Unclean or improperly cleaned items	3.1.2.1.1	4.6.1
Incorrect preservation method	3.1.2	4.6.1
Wrong quantity per unit pack	3.1.2.1.4 and 3.1.2.1.5	4.6.1
Non-usable or incorrect applications of intermediate containers	3.1.2.1.6	4.6.1
Improper box closures	3.1.3	4.6.1
Omitted, incorrect, or illegible marking	3.1.4	4.6.1

TABLE II. Functional inspections.

Major defects	Requirement paragraph	Method paragraph
Rough handling (when specified)	3.1.6.1.1	4.6.2.1
Leakage (when applicable)	3.1.6.1.2	4.6.2.2

4.5.1.4 Rejected lots. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.5.1.5 Disposition of sample units. Sample units, which have passed all the inspections specified in table I may be delivered on the contract, provided the lot is accepted.

4.5.2 Shipments to non-Government facilities. Shipments to non-Government facilities shall be for visual and dimensional inspections specified in table I.

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4.5.3 Functional inspection. Functional inspection shall consist of the tests specified in table II.

4.5.3.1 Sampling plan. Sampling plan shall be as follows:

- a. One sample unit for the rough-handling test shall be selected whenever the design of the item or package is changed.
- b. For unit packs requiring waterproof or water-vapor proof barriers, five sample units for the leakage test shall be selected daily at random from the first lot processed each day. Five additional samples shall be selected at random from the day's total production.
- c. The leakage test shall be performed following the rough-handling test on unit packs requiring waterproof or water-vapor proof barriers. Five sample units or the number of units contained within the shipping container (if less than five) shall be selected.

4.5.3.2 Failures. One or more failures shall be cause for rejection of the lot.

4.5.3.3 Disposition of sample units. Sample units which have passed the inspections specified in table II may be delivered on the contract if the lot is accepted and opened packs have been reprocessed.

4.5.3.4 Noncompliance. If a sample fails to pass the inspections specified in table II, the contractor shall take corrective action on the materials or processes or both, as warranted, on all unit, intermediate, and exterior (shipping) packs which can be corrected and which were processed under essentially the same conditions, with essentially the same materials, and which are considered subject to the same failure. Acceptance of the unit, intermediate, and exterior packs shall be discontinued until corrective action has been taken and the applicable inspections specified in table II have been repeated on additional sample units. All inspections or the inspection, which the original sample failed, shall be at the option of the Government. Inspections specified in table II may be reinstated; however, final acceptance shall be withheld until the reinspection, in accordance with table II, has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the administrative contracting officer.

4.6 Methods of inspection and tests.

4.6.1 Visual and dimensional inspections. Unit, intermediate, and exterior packs shall be examined to verify that the materials, designs, methods, physical limitations, marking, and workmanship are in accordance with the applicable requirements (see 3.1 through 3.4).

4.6.2 Functional tests.

4.6.2.1 Rough handling. Packs shall be subject to the applicable rough handling tests and the interpretation of results or cause for rejection as specified in 3.1.6.1.1 and MIL-STD-2073-1.

4.6.2.2 Leakage. When a waterproof or water-vapor proof barrier is required, the unit pack shall be subjected to the applicable leakage test and interpretation of results specified in 3.1.6.1.2 and MIL-STD-2073-1.

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5. PACKAGING

This section is not applicable to this specification.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The preservation, packing, and marking specified herein are intended for direct shipments to the Government and to OEMs and packaging distributors. Unless otherwise designated, the general requirements (3.1) and marking requirements (3.1.4) are applicable for the shipment of semiconductors and accessories to Government activities only.

6.2 Acquisition requirements.

6.2.1 Shipments to Government activities. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2 and 2.3).
- c. Military preservation and packing (see 3.1.2 and 3.1.3).
- d. Quantity per unit pack, if other than specified (see 3.1.2.1.4 and 3.1.2.1.5).
- e. Method of preservation if other than that specified (see 3.1.2).
- f. If a unitized load is not required for shipment to one destination when total quantities are equal to 40 cubic feet (1.1328 cubic meters) or more (see 3.1).
- g. Whether any other standard or special marking is required (see 3.1.4).
- h. If FED-STD-123 is required for civil agency marking (see 3.1.5).
- i. If a rough handling test is required (see 3.1.6.1.1).
- j. If semiconductor devices functional tests are required (see 3.1.6.1.1).
- k. If the contractor is not responsible for the performance of all inspection requirements (see 4.2).
- l. If first article inspection is not required (see 4.4).

6.2.2 Shipments to non-Government activities. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2 and 2.3).
- c. Military preservation and packing and specify the packaging material to be used if the item is an ESDS device (see 3.2.2.2 and MIL-STD-2073-1).
- d. Whether any standard or special markings are required (see 3.1.4.1.1)
- e. Quantity per unit pack (see 3.1.2.1.4 and 3.1.2.1.5).

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6.3 Inspection for first article. The sample pack submitted for first article inspection (when satisfactorily performed as specified in 4.4) will serve as the production standard for subsequent packaging operations. The contractor should inform the acquisition activity or the activity administering the contract of the time and location of the inspection so that the Government representative will have an opportunity to witness the tests.

6.4 Definition. A hermetic seal is a fusion of metal to metal, glass to glass, or metal to glass.

6.5 Subject term (key word) listing.

- Diode
- Electrostatic discharge protection
- Environmental field force protection
- Packing
- Physical protection
- Semiconductor device
- Shielding
- Special marking
- Transistor

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project PACK - 1113)

Review activities:
Army - AR, AV, MI, SM
Navy - AS, CG, MC, OS, SA, SH
Air Force - 71, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-DTL-19491H	2. DOCUMENT DATE 28 June 2002
3. DOCUMENT TITLE SEMICONDUCTOR DEVICES, PACKAGING OF		
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)		
5. REASON FOR RECOMMENDATION		
6. SUBMITTER		
a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED
8. PREPARING ACTIVITY		
a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan.barone@dsc.dla.mil	
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888	