

The documentation and process conversion measures necessary to comply with this revision shall be completed by 18 December 2014.

INCH-POUND

MIL-DTL-19491J
 19 August 2014
 SUPERSEDING
 MIL-DTL-19491H
 28 June 2002

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 of 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 cited in the solicitation or contract (see 6.2).

FEDERAL STANDARDS

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

COMMERCIAL ITEM DESCRIPTIONS

A-A-59135 – Packaging Material, Sheet.
 A-A-59136 – Cushioning Material, Packaging, Closed Cell Foam Plank.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-129	-	Military Marking For Shipment And Storage.
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	-	Standard Practice for Military Packaging.

DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-263	-	Electrostatic Discharge Control Handbook For Protection Of Electrical And Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)
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(Copies of these documents are available online at <http://quicksearch.dla.mil>.)

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)

ASTM D3951	-	Standard Practice for Commercial Packaging.
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(Copies of these documents are available online at <http://www.astm.org>.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 10012	-	Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment.
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(Copies of these documents are available online at <http://www.iso.ch>.)

NCSL INTERNATIONAL (NCSL)

NSCL Z540.3	-	Requirements for the Calibration of Measuring and Test Equipment.
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(Copies of these documents are available online at <http://www.ncsli.org>.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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](#). 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 I or III of [MIL-PRF-81705](#) or bags conforming to [MIL-DTL-117](#), type I, class F, style 1 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 I, 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 I 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.

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 3.1.4.2.

3.1.4.2 Special requirements. When required by the contract or order, containers shall be marked as specified in 3.1.4.2.1 and 3.1.4.2.2.

3.1.4.2.1 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.

3.1.4.2.2 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. Part or Identifying Number (PIN).
- 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.
- i. 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 F, style 1 using barrier material conforming to type I or III of [MIL-PRF-81705](#) as specified (see 6.2.2).

3.3 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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 [ISO 10012](#) or [NSCL Z540.3](#) 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.

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4.5.1.2 Visual and dimensional inspection. Visual and dimensional inspection shall consist of those inspections specified in [table I](#).

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	4.6.1
Non-usable or incorrect applications of intermediate containers	3.1.2.1.5	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.

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4.5.2 Shipments to non-Government facilities. Shipments to non-Government facilities shall be for visual and dimensional inspections specified in [table I](#).

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](#).

5. PACKAGING

This section is not applicable to this specification.

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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 should specify the following:

- a. Title, number, and date of this specification.
- b. Levels of preservation and packing (see 3.1.2 and 3.1.3).
- c. Quantity per unit pack, if other than specified (see 3.1.2.1.4).
- d. Method of preservation if other than that specified (see 3.1.2).
- e. Whether any other standard or special marking is required (see 3.1.4).
- f. If FED-STD-123 is required for civil agency marking (see 3.1.5).
- g. If semiconductor devices functional tests are required (see 3.1.6.1).
- h. If a rough handling test is required (see 3.1.6.1.1).
- i. If the contractor is not responsible for the performance of all inspection requirements (see 4.2).
- j. 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 this specification.
- b. Levels of preservation and packing (see 3.1.2 and 3.1.3) and specify the packaging material to be used if the item is an ESDS device (see 3.2.2 and MIL-STD-2073-1).
- c. Quantity per unit pack (see 3.1.2.1.4).
- d. Whether any standard or special markings are required (see 3.1.4)

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.

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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. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

Custodians:

Army – CR
Navy – EC
Air Force – 85
DLA – CC

Preparing activity:

DLA – CC

(Project PACK-2014-002)

Review activities:

Army – AR, AV, MI, SM
Navy – AS, CG, MC, OS, SA, SH
Air Force – 71, 99
DLA – DH

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.