

The documentation and process conversion measures necessary to comply with this revision shall be completed by 20 October 2012.

INCH POUND

MIL-PRF-19500/246K
 20 July 2012
 SUPERSEDING
 MIL-PRF-19500/246J
 w/AMENDMENT 1
 8 March 2012

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER,
 TYPES 1N3289, 1N3291, 1N3293, 1N3294, 1N3295, AND R TYPES,
 JAN, JANTX, AND JANTXV

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

The requirements for acquiring the product described herein shall consist of this specification sheet and [MIL-PRF-19500](#).

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon power rectifiers. Three levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#).

1.2 Normal and reverse types (reverse types, suffix R). Reverse and normal types are identical except the normal types have the cathode connected to the stud and the reverse types have the anode connected to the stud. Designated values are applicable to both types.

1.3 Physical dimensions. See [figure 1](#) (DO-205AA - formerly DO-8).

1.4 Ratings and characteristics.

Type	V _{RSM}	V _{RWM}	I _O T _C = 150°C	I _O T _C = 134°C (1)	I _{FSM} 1/120 s	Barometric pressure (reduced)	T _J and T _{STG}
	<u>V (pk)</u>	<u>V (pk)</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>mm Hg</u>	<u>°C</u>
1N3289, R	240	200	75	100	1,600		-65 to +200
1N3291, R	480	400	75	100	1,600	8	-65 to +200
1N3293, R	720	600	75	100	1,600	16	-65 to +200
1N3294, R	960	800	75	100	1,600	30	-65 to +200
1N3295, R	1,200	1,000	75	100	1,600	54	-65 to +200

(1) Derate linearly 1.5 A dc/°C for T_C ≥ 134°C.

1.5 Thermal resistance characteristic: R_{θJC} = 0.4°C/W, see [figure 2](#).

* 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>.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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, 4, or 5 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at <https://assist.dla.mil/quicksearch> or <https://assist.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 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.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in [MIL-PRF-19500](#) and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see [4.2](#) and [6.3](#)).

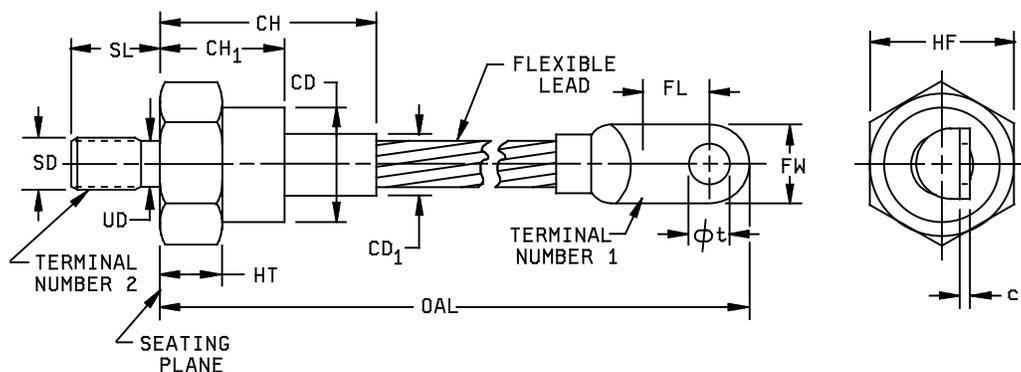
3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in [MIL-PRF-19500](#).

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in [MIL-PRF-19500](#) and on [figure 1](#) (DO-205AA) herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with [MIL-PRF-19500](#), and as specified herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see [6.2](#)).

3.5 Marking. Devices shall be marked as specified in [MIL-PRF-19500](#).

3.6 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end or the use of other techniques considered commercial practice.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.625	1.000	15.88	25.40	8
CD ₁		.500		12.70	
CH		1.750		44.45	
CH ₁		1.140		28.96	
c	.050	.120	1.27	3.05	
FL	.300	.450	7.62	11.43	6
FW		.670		17.02	
HF	1.031	1.063	26.19	27.00	
HT	.125	.500	3.18	12.70	5
OAL	4.300	5.065	109.22	128.65	
SD					4
SL	.605	.645	15.37	16.38	
UD	.343	.373	8.71	9.47	
φt	.250	.310	6.35	7.87	4

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for general information only.
3. Complete threads to extend to within 2.5 threads of seating plane.
4. 375-24 UNF-2A. Maximum pitch diameter of plated threads shall be basic pitch diameter (.3479 inch (8.837 mm) reference).
5. A chamfer or undercut on one or both ends of hexagonal portions is optional.
6. Minimum flat.
7. For marking (see 3.5).
8. The body of the device, with the exception of the hexagon and flexible lead extensions, lies within cylinder defined by CD₁ and CH, CD₁ not to exceed actual HF.
9. Terminal shape is optional.
10. In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.

FIGURE 1. Physical dimensions.

* 3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.4, 1.5, and table I.

* 3.8 Electrical test requirements. The electrical test requirements shall be as specified in table I.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.1 Group E qualification. Group E qualification shall be performed herein for qualification or re-qualification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot to this revision to maintain qualification.

4.3 Screening (JANTX and JANTXV levels only). Screening shall be in accordance with appendix E, table E-IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screening (see appendix E, table E-IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
1	Method 2073 of MIL-STD-750 may be used in lieu of method 2074 for compression bonded devices only.
3c	Thermal impedance (see 4.3.1) and figure 2.
4	5,000 G; performed prior to installation of external lead.
10	Not applicable.
11	I_{RM1} and V_{FM} of subgroup 2 of table I herein.
12	Method 1038, condition A; $V_{RM} = V_{RWM}$ rated (see 1.4), $T_C = 150^\circ\text{C}$; $f = 60$ Hz.
13	Subgroup 2 of table I herein: $\Delta I_{RM1} = \pm 0.5$ mA (pk) or 100 percent of initial value, whichever is greater. $\Delta V_{FM} = \pm 0.1$ V (pk).

4.3.1 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 of MIL-STD-750 using the guidelines in that method for determining I_M , I_H , t_H , t_{sw} , (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μs max. See table II, group E, subgroup 4 and figure 2 herein.

4.4 Conformance inspection. Conformance inspection shall be in accordance with [MIL-PRF-19500](#).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table E-V of [MIL-PRF-19500](#), [table I](#) herein, and as specified herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of [table II](#) herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-VIB (JAN, JANTX, and JANTXV) of [MIL-PRF-19500](#) and [table III](#) herein. Electrical measurements (end-points) and delta requirements shall be in accordance with applicable steps of [table III](#) herein.

4.4.2.1 Group B inspection, appendix E, table E-VIB (JAN, JANTX, and JANTXV of [MIL-PRF-19500](#)).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	1071	Gross leak. Test condition C, step 2 or test condition D.
B3	1048	Blocking life. $T_C = +150^\circ\text{C}, -10, +0$; $V_{RWM} = V_{RM}$ (see 1.4); $t = 340$ hours.
B3	1037	See 4.5.1 , $\Delta T = 85^\circ\text{C}$ minimum; $I_O = \geq 75$ A, 5,000 cycles. (Separate samples may be used.)
B5	3151	$R_{\theta JC} = 0.4^\circ\text{C/W}$.
B6	1031	$T_C = +185^\circ\text{C}$.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-VII of [MIL-PRF-19500](#). Electrical measurements (end-points) and delta limits shall be in accordance with [table III](#) herein.

4.4.3.1 Group C inspection, appendix E, table E-VII of [MIL-PRF-19500](#).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	1051	-55°C to $+175^\circ\text{C}$, 25 cycles.
C2	2036	Tension (lead): Test condition A; weight = 100 pounds; $t = 15 \pm 3$ seconds. Torque (terminal): Test condition D1; 10 inch-pounds; $t = 15 \pm 3$ seconds. Torque (stud): Test condition D2; 125 inch-pounds; $t = 15 \pm 3$ seconds.
C2	1071	Gross leak. Test condition C, step 2 or test condition D.
C5	1001	(For qualification only) (1N3291, 1N3293, 1N3294, 1N3295); $t = 60$ s, see 1.4 for test conditions.
C6	1048	Blocking life. $T_C = +150^\circ\text{C}, -10, +0$; $V_{RWM} = V_{RM}$ (see 1.4), $t = 1,000$ hours

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-IX of [MIL-PRF-19500](#) and [table II](#) herein. Electrical measurements (end-points) shall be in accordance with the applicable inspections of [table I](#), subgroup 2 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables as follows.

4.5.1 Power cycling. One complete test shall be as follows: First, heat the case to the maximum temperature specified by passing the specified amount of forward current through the diode under test. Then, remove the applied current and allow the case temperature to cool to the minimum case temperature specified. No time limit is applicable to any one cycle, but the cycling shall be continuous until the required number of cycles have been completed. Sample size = 12, c = 0.

* TABLE I. Group A inspection. 1/

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Forward voltage	4011	Pulse method: $I_{FM} = 310 \text{ A (pk)}$; pulse width = 8.3 ms max; duty cycle = 2 percent max	V_{FM1}		1.55	V (pk)
Reverse current	4016	AC method:	I_{RM1}			
1N3289, R		$V_{RM} = 200 \text{ V (pk)}$			10	mA (pk)
1N3291, R		$V_{RM} = 400 \text{ V (pk)}$			10	mA (pk)
1N3293, R		$V_{RM} = 600 \text{ V (pk)}$			10	mA (pk)
1N3294, R		$V_{RM} = 800 \text{ V (pk)}$			10	mA (pk)
1N3295, R		$V_{RM} = 1,000 \text{ V (pk)}$			10	mA (pk)
Reverse current at peak reverse voltage	4016	AC method:	I_{RM2}			
1N3289, R		$V_{RM} = 240 \text{ V (pk)}$			40	mA (pk)
1N3291, R		$V_{RM} = 480 \text{ V (pk)}$			40	mA (pk)
1N3293, R		$V_{RM} = 720 \text{ V (pk)}$			40	mA (pk)
1N3294, R		$V_{RM} = 960 \text{ V (pk)}$			40	mA (pk)
1N3295, R		$V_{RM} = 1,200 \text{ V (pk)}$			40	mA (pk)
Thermal impedance	3101	See 4.3.1 and figure 2	$Z_{\theta JX}$			$^{\circ}\text{C/W}$
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +200^{\circ}\text{C}$				
Reverse current	4016	AC method:	I_{RM3}			
1N3289, R		$V_{RM} = 200 \text{ V (pk)}$			30	mA (pk)
1N3291, R		$V_{RM} = 400 \text{ V (pk)}$			30	mA (pk)
1N3293, R		$V_{RM} = 600 \text{ V (pk)}$			30	mA (pk)
1N3294, R		$V_{RM} = 800 \text{ V (pk)}$			30	mA (pk)
1N3295, R		$V_{RM} = 1,000 \text{ V (pk)}$			30	mA (pk)

See footnote at end of table.

* TABLE I. Group A inspection - Continued. 1/

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u> - Continued						
Low temperature operation:		$T_C = -65^\circ\text{C}$				
Forward voltage	4011	Pulse method: $I_{FM} = 310 \text{ A (pk)}$; pulse width = 8.3 ms max; duty cycle = 2 percent maximum	V_{FM2}		1.60	V (pk)
Reverse current:	4016	AC method:	I_{RM4}			
1N3289, R		$V_{RM} = 200 \text{ V (pk)}$			40	mA (pk)
1N3291, R		$V_{RM} = 400 \text{ V (pk)}$			40	mA (pk)
1N3293, R		$V_{RM} = 600 \text{ V (pk)}$			40	mA (pk)
1N3294, R		$V_{RM} = 800 \text{ V (pk)}$			40	mA (pk)
1N3295, R		$V_{RM} = 1,000 \text{ V (pk)}$			40	mA (pk)
<u>Subgroups 4 and 5</u>						
Not applicable						
<u>Subgroup 6</u>						
* Surge current	4066	$T_C = +150^\circ\text{C}$; $I_{FSM} = 1,600 \text{ A (pk)}$ $I_O = 75 \text{ A dc}$; ten 1/120 s surges; 1 surge/minute $V_{RM} = V_{RWM}$ (see 1.4)				
Electrical measurements		See table III , steps 1 and 2				
<u>Subgroup 7</u>						
Not applicable						

1/ For sample plan, see [MIL-PRF-19500](#).

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* TABLE II. Group E inspection (all quality levels) for qualification and requalification only.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Thermal shock	1056	100 cycles, 0°C to 100°C.	
Hermetic seal	1071		
Electrical measurement		See table I , group A, subgroup 2.	
<u>Subgroup 2</u>			45 devices c = 0
Steady-state reverse bias	1038	Test condition A, 1,000 hours.	
Electrical measurement		See table I , subgroup 2.	
<u>Subgroup 4</u>			Sample size = N/A
Thermal impedance curves		See MIL-PRF-19500 .	
<u>Subgroup 5</u>			3 devices c = 0
Barometric pressure	1001	V_{RWM} = rated V_{RWM} (see 1.4), pressure = rated pressure (see 1.4), t = 1 minute.	

TABLE III. Groups A, B, C, D, and E electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	Pulse method: $I_{FM} = 310$ A (pk) pulse width = 8.3 ms maximum; duty cycle = 2 percent maximum	V_{FM}		1.55	V (pk)
2.	Reverse current	4016	AC method:	I_{RM1}			
	1N3289, R		$V_{RM} = 200$ V (pk)			10	mA (pk)
	1N3291, R		$V_{RM} = 400$ V (pk)			10	mA (pk)
	1N3293, R		$V_{RM} = 600$ V (pk)			10	mA (pk)
	1N3294, R		$V_{RM} = 800$ V (pk)			10	mA (pk)
	1N3295, R		$V_{RM} = 1,000$ V (pk)			10	mA (pk)
3.	Forward voltage (change)	4011	$I_{FM} = 310$ A (pk)	ΔV_{FM}		+0.1	V (pk)

- 1/ The electrical measurements for appendix E, table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
- Subgroup 2, see table III herein, steps 1 and 2.
 - Subgroup 3, see table III herein, steps 1 and 2.
 - Subgroup 6, see table III herein, steps 1 and 2.
- 2/ The electrical measurements for appendix E, table E-VII (all quality levels) of MIL-PRF-19500 are as follows:
- Subgroup 2, see table III herein, steps 1 and 2.
 - Subgroup 5, see table III herein, step 2 during test.
 - Subgroup 6, see table III herein, steps 1 and 2.
- 3/ The electrical measurements for appendix E, table E-IX of MIL-PRF-19500 are as follows:
- Subgroup 1, see table III herein, steps 1, 2, and 3.
 - Subgroup 2, see table III herein, steps 1, 2, and 3.

Maximum Thermal Impedance

JAN1N3293R DO-8

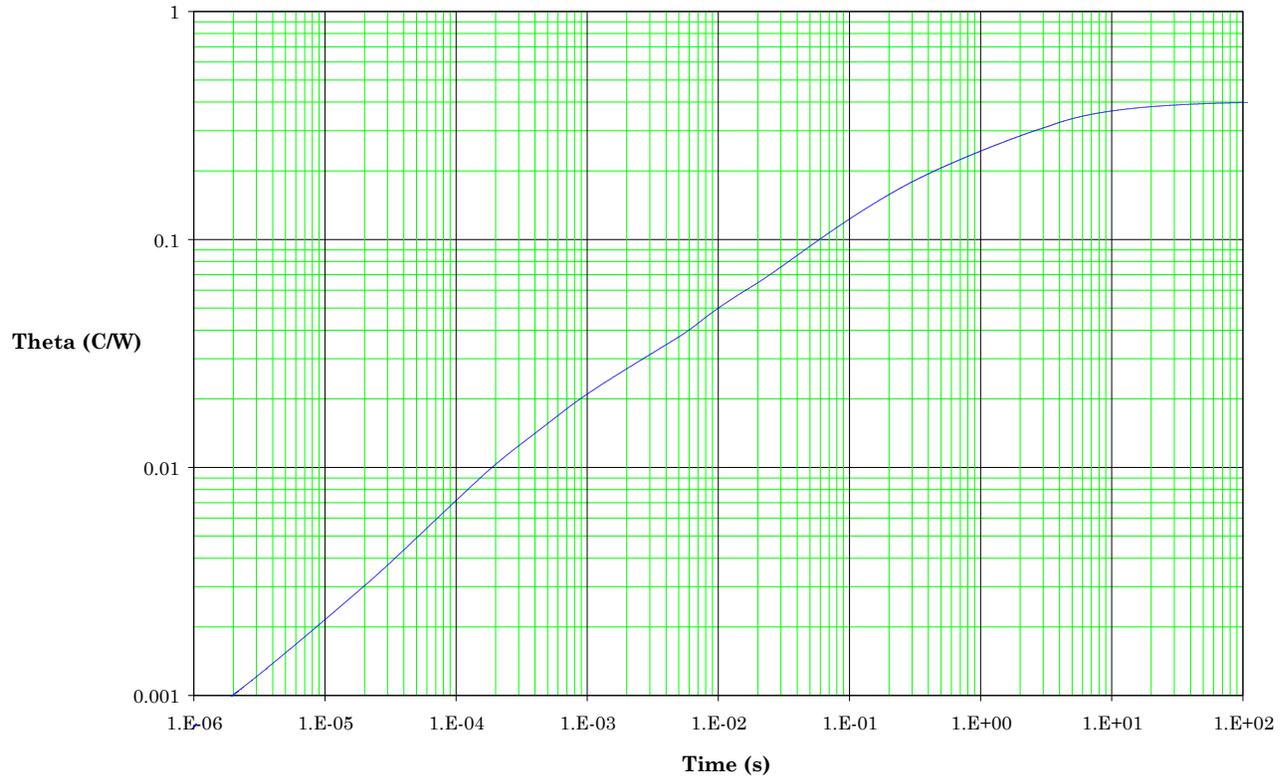


FIGURE 2. Thermal impedance graph ($R_{\theta JC}$) for DO205AA = .4°C/W, this curve takes into account both standard and reverse polarity.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in [MIL-PRF-19500](#) are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

* 6.4 Changes from previous issue. The margins of this specification are marked with asterisks 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 last previous issue.

Custodians:

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

Preparing activity:

DLA - CC

(Project 5961-2012-074)

Review activities:

Army - AR, MI
Navy - AS, MC
Air Force - 19, 99

* 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>.