

The documentation and process conversion measures necessary to comply with this revision shall be completed by 2 January 1990

INCH-POUND

MIL-S-19500/260D  
21 April 1989  
SUPERSEDING  
MIL-S-19500/260C  
28 April 1983

### MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, SILICON, POWER RECTIFIER  
TYPES 1N1202A, 1N1204A, 1N1206A, 1N3671A AND 1N3673A AND AR  
JAN, JANTX, JANTXV, AND JANS

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 detail requirements for silicon semiconductor, power rectifier diodes. Four levels of product assurance are provided for each device type as specified in MIL-S-19500.

1.2 Normal and reverse (AR suffix) types. 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 (D0-203AA, formerly D0-4).

1.4 Maximum ratings.

Types	$V_{RSM}$	$V_{RWM}$	$I_0$ 1/ $T_C = 150^\circ\text{C}$	$I_{FSM}$ $T_C = 150^\circ\text{C}$ $t = 1/120$ s	$T_J$ and $T_{STG}$	Barometric pressure (reduced)	$t_{rr}$
	V(pk)	V(pk)	A dc	A	$^\circ\text{C}$	mmHg	$\mu\text{s}$
1N1202A	240	200	12	240	-65 to +200	N/A	10
1N1204A	480	400	12	240	-65 to +200	8	10
1N1206A	720	600	12	240	-65 to +200	16	10
1N3671A	960	800	12	240	-65 to +200	30	10
1N3673A	1200	1000	12	240	-65 to +200	54	10

1/ Derate linearly 2 percent of  $I_0$  per  $^\circ\text{C}$  for  $T_C = 150^\circ\text{C}$  to  $T_C = 200^\circ\text{C}$ .

1.5 Primary electrical characteristics.  $R_{\theta JC} = 2.0^\circ\text{C/W}$  maximum.

#### 2. APPLICABLE DOCUMENTS

2.1 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Space and Naval Warfare Systems Command, ATTN: SPAWAR 003-114, Washington, DC 20363 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

## MIL-S-19500/260D

2.1.1 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).

## SPECIFICATION

## MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

## STANDARDS

## FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.

## MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein. Lot accumulation period shall be three months in lieu of six weeks.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500, and figure 1 herein.

3.4 Marking. Marking shall be in accordance with MIL-S-19500, except at the option of the manufacturer, the following marking may be omitted from the body of the device:

- a. Country of origin.
- b. Manufacturer's identification.

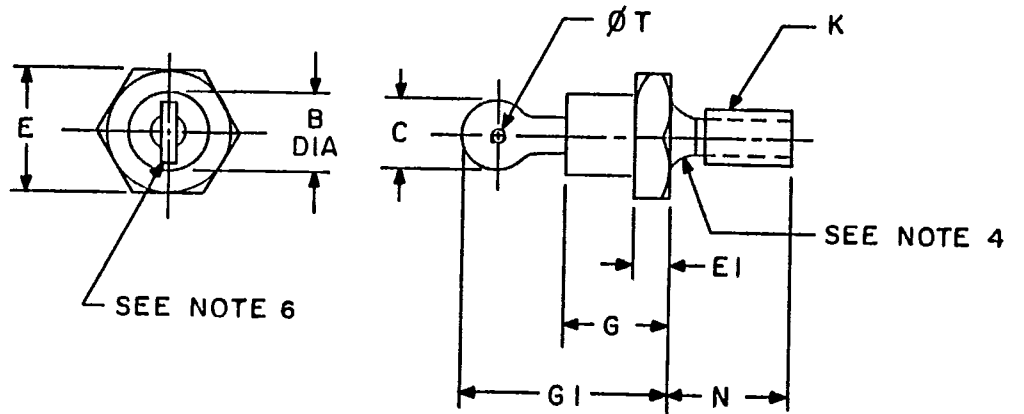
3.5 Polarity. The polarity shall be indicated by a graphic symbol with the arrow pointing toward the negative end for forward bias. The reversed units shall also be marked with an R following the last digit in the type number.

## 4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500, and as specified herein. Tests in either polarity shall be sufficient to obtain qualification approval of both polarities.

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Ltr	Dimensions in inches with metric equivalents (mm) in parentheses (see note 2)		Notes
	Minimum	Maximum	
G		.405 (10.29)	
B		.424 (10.77)	
E	.424 (10.77)	.437 (11.10)	
E 1	.075 (1.90)	.175 (4.44)	
G 1		.800 (20.32)	
C		.250 (6.35)	9
ØT	.060 (1.52)		
N	.422 (10.72)	.453 (11.51)	
K			3,5,7

## NOTES:

- Dimensions are in inches.
- Metric equivalents are given for general information.
- Units must not be damaged by torque of 15 inch-pounds applied to 10-32NF2B nut assembled on thread.
- Diameter of unthreaded portion .189 (4.80 mm) max and .163 (4.14 mm) min.
- Complete threads shall extend to within 2-1/2 threads of the seating plane.
- Angular orientation of this terminal is undefined.
- Maximum pitch diameter of plated threads shall be basic pitch diameter .169 inch (4.31 mm) reference FED-STD-H28 (Screw Thread Standards for Federal Services).
- The A.S.A. thread reference is 10-32UNF2A.
- Terminal end shape is unrestricted.
- Reversed (anode to stud) units shall be marked with an R following the last digit in the type number.

FIGURE 1. Physical dimensions.

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4.3 Screening (JANS, JANTXV, and JANTX levels only). Screening shall be in accordance with MIL-S-19500 (table II) 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.

Screen (see table II of MIL-S-19500)	Measurements	
	JANS level	JANTX and JANTXV levels
<u>1</u> /	Surge, see 4.3.1; Thermal response, see 4.3.2	Surge, see 4.3.1; Thermal response, see 4.3.2
4	Not applicable	Not applicable
9	$V_{F2}$ and $I_{R1}$ <u>2</u> /	$V_{F2}$ and $I_{R1}$ <u>2</u> /
10	MIL-STD-750, method 1038, test condition A, t = 96 hrs.	MIL-STD-750, method 1038, test condition A, t = 48 hrs.
11	$V_{F2}$ and $I_{R1}$ ; $\Delta V_{F2} = \pm 0.1$ V(pk); $\Delta I_{R1} = 5$ $\mu$ A dc or 100% from the initial value, whichever is greater. Subgroup 2 of table I herein.	Subgroup 2 of table I herein, $V_{F2}$ and $I_{R1}$ ; $\Delta V_{F2} = \pm 0.1$ V(pk); $\Delta I_{R1} = 5$ $\mu$ A dc or 100% from the initial value, whichever is greater. <u>3</u> /
12	Burn-in, see 4.3.3 and 4.5.1. MIL-STD-750, method 1038, test condition B.	Not applicable
13	Subgroups 2 and 3 of table I herein; $\Delta V_{F2} = \pm 0.1$ V(pk); $\Delta I_{R1} = 5$ $\mu$ A dc or 100% from the initial value, whichever is greater.	Not applicable

1/ Surge shall precede thermal response. These tests shall be performed anytime after screen 3 and before screen 9.

2/  $I_{R1}$  measurement shall not be indicative of an open condition.

3/ PDA of 13 shall apply to screen 11 for JANTX and JANTXV.

4.3.1 Surge current. Surge current, see MIL-STD-750, method 4066.  $I_0 = 0$ ;  $V_{RM(W)} = 0$ ;  $I_{FSM} = 325$ ; six surges;  $T_A = 25^\circ$  C. One surge per minute maximum.  $t_p = 8.3$  ms.

4.3.2 Thermal response ( $\Delta V_F$  measurements). The  $\Delta V_F$  measurements shall be performed in accordance with MIL-STD-750, method 3101. The  $\Delta V_F$  conditions and maximum  $V_F$  limit shall be derived by each vendor. The chosen  $\Delta V_F$  measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal response curve shall be plotted. The chosen  $\Delta V_F$  value shall be considered final after the manufacturer has had the opportunity to test five consecutive lots.  $t_p = 250$  ms. Heating current ( $I_H$ )  $\geq$  rated  $I_0$ .

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**4.3.3 Power burn-in.** Power burn-in conditions are as follows:

MIL-STD-750, method 1038, test condition B.  $T_C = 150^\circ\text{C}$ ,  $f = 60\text{ Hz}$ ;  $I_O = 12\text{ A dc}$  (see 4.5.1);  $V_R = \text{Rated } V_R(\text{pk})$  (see 1.4).

**4.4 Quality conformance inspection.** Quality conformance inspection shall be in accordance with MIL-S-19500.

**4.4.1 Group A inspection.** Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein. End-point electrical measurements shall be in accordance with the applicable steps of table V herein.

**4.4.2 Group B inspection.** Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVa (JANS) and table IVb (JANTX and JANTXV) of MIL-S-19500, and tables IIa and IIb herein. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table V herein.

**4.4.3 Group C inspection.** Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500, and table III herein. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table V herein.

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

**4.5.1 Burn-in and steady-state operation life tests.** These tests shall be conducted with a half-sine waveform of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine waveform of the specified average rectifier current. The forward conduction angle of the rectified current not be greater than 180 degrees nor less than 150 degrees.

**4.5.2 DC intermittent operation life.** A cycle shall consist of an "on" period, when power is applied suddenly, not gradually, to the device for the time necessary to achieve a delta case temperature of  $85^\circ\text{C} +15^\circ\text{C}$ ,  $-5^\circ\text{C}$ , followed by an "off" period, when the power is suddenly removed, for cooling. Auxiliary (forced) cooling is permitted during the off period only.  $30\text{ s} \leq t_{\text{heating}} \leq 60\text{ s}$ .  $P = V_F \times I_F$  or  $P = V_{FPK} \times I_{AV}$  if using sine wave current. DC full wave current (or equivalent half sine wave current) shall be used for the power required during the on period. Within the time interval of 50 cycles before to 500 cycles after the termination of the test, the sample units shall be removed from the specified test conditions and allowed to reach room ambient conditions. Specified end-point measurements for qualification and quality conformance inspection shall be completed within 96 hours after removal of sample units from the specified test conditions. Additional readings may be taken at the discretion of the manufacturer.

## MIL-S-19500/2600

TABLE I. Group A inspection.

Inspection	MIL-STD-750		LTPD 1/	Symbol	Limits		Unit
	Method	Conditions			Min	Max	
<u>Subgroup 1</u>							
Visual and mechanical inspection	2071						
<u>Subgroup 2</u>							
Forward voltage	4011	$I_F = \text{rated } I_{FSM}$		$V_{F1}$	---	2.5	V dc
Forward voltage	4011	$i_f = 38 \text{ A(pk)}$ pulse, pulse width = 8.5 ms, duty cycle = 2% maximum		$V_{F2}$	---	1.35	V(pk)
Reverse current	4016	DC method, $V_R = \text{Rated } V_R \text{ (dc)}$ (see 1.4)		$I_{R1}$	---	5	$\mu\text{A dc}$
<u>Subgroup 3</u>							
High temperature operation		$T_C = 150^\circ\text{C}$					
Reverse current	4016	DC method, $V_R = \text{Rated } V_R$ (see 1.4)		$I_{R2}$	---	1	mA dc
Low temperature operation		$T_C = -65^\circ\text{C}$					
Reverse current	4026	DC method, $V_R = \text{Rated } V_R$ (see 1.4)		$I_{R3}$	---	1	mA dc
<u>Subgroups 4 and 5</u>							
Not applicable							
<u>Subgroup 6</u>							
Not applicable							

1/ For LTPD numbers, see MIL-S-19500.

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TABLE IIa. Group B inspection for JANS devices.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD <u>1/</u>	Small lot quality conformance inspection n/c <u>1/</u>
	Method	Conditions		
<u>Subgroup 1</u>				
Physical dimensions	2066	See figure 1		
<u>Subgroup 2</u> <u>2/</u>				
Solderability	2026			
Resistance to solvents	1022			
<u>Subgroup 3</u>				
Thermal shock (temperature cycling)	1051			
Surge current	4066	$T_C = 150^\circ\text{C}$ ; $V_R = \text{Rated } V_R \text{ (see 1.4)}$ $i_f(\text{surge}) = 240 \text{ A}$ ; $I_0 = 12 \text{ A dc}$ ; six 1/120 s surges; 1 surge per minute maximum; $t_p = 8.3 \text{ ms}$		
Hermetic seal	1071			
Fine leak Gross leak				
Electrical measurements		See table V, steps 1, 2, 4, and 5		
Decap-internal visual (design verification)	2075			
Die shear	2017			
<u>Subgroup 4</u>				
DC intermittent operation life	1037	.25 rated $I_0 \leq I_0$ applied $<$ rated $I_0$ (see 4.5.2); 2,000 cycles	5	12/0
Electrical measurements		See table V, steps 1, 2, 4, and 5		

See footnotes at end of table.

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TABLE IIa. Group B inspection for JANS devices - Continued.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD <u>1/</u>	Small lot quality conformance inspection n/c <u>1/</u>
	Method	Conditions		
<u>Subgroup 5</u>				
Accelerated steady-state operation life	1027	$I_F = 4 \text{ A dc};$ $V_R = \text{Rated } V_R \text{ (see 1.4),}$ $T_A = 125^\circ\text{C};$ or adjusted as required by the chosen $T_A$ to give an average lot $T_J = 275^\circ\text{C}$ (see 4.5.1), $f = 60 \text{ Hz}$		
Electrical measurements		See table V, steps 3, 6, and 7		
<u>Subgroup 6</u>				
Thermal resistance	3101	See 1.5		

1/ For LTPD numbers, see MIL-S-19500.



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TABLE IIb. Group B inspection for JANTX and JANTXV devices.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD <u>1/</u>	Small lot quality conformance inspection n/c <u>1/</u>
	Method	Conditions		
<u>Subgroup 1</u> <u>2/</u>				
Solderability	2026			
Resistance to solvents	1022			
<u>Subgroup 2</u>				
Thermal shock (temperature cycling)	1051			
Surge current	4066	$T_C = 150^\circ\text{C};$ $i_f(\text{surge}) = 240 \text{ A};$ $I_0 = 12 \text{ A dc};$ six surges; 1 surge per minute maximum $V_R = \text{Rated } V_R \text{ (see 1.4)}$ $t_p = 8.3 \text{ ms}$		
Hermetic seal	1071			
Fine leak Gross leak				
Electrical measurements		See table V, steps 1, 2, and 4		
<u>Subgroup 3</u> <u>2/</u>				
DC intermittent operation life	1037	.25 rated $I_0 \leq I_0$ applied $<$ rated $I_0$ (see 4.5.2); 2,000 cycles		
Electrical measurements		See table V, steps 1, 2, and 4		
Steady-state DC blocking life	1038 or 1049	Condition A; 340 hrs		
Electrical measurements		See table V, steps, 1 and 2		
<u>Subgroup 4</u>				
Decap internal visual (design verification)	2075			
<u>Subgroup 5</u>				
Not applicable				
<u>Subgroup 6</u>				
High temperature (nonoperating)	1032	$T_A = 200^\circ\text{C}$ minimum		
Electrical measurements		See table V, steps 1 and 2		

1/ For LTPD numbers, see MIL-S-19500.

2/ A separate sample may be pulled for each test.

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TABLE III. Group C inspection.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD <u>1/</u>	Small lot quality conformance inspection n/c <u>1/</u>
	Method	Conditions		
<u>Subgroup 1</u>				
Physical dimensions	2066	See figure 1		
<u>Subgroup 2</u>				
Thermal shock (glass strain)	1056	Test condition B		
Terminal strength (tension)	2036	Test condition A, Weight = 10 lbs, t = 15 s		
Bending stress		Test condition F, method B, Weight = 5 lbs, t = 15 s		
Seal torque		Test condition D1, Torque = 10 oz-in, t = 15 s		
Stud torque		Test condition D2, Torque = 15 lb-in, t = 15 s		
Hermetic seal	1071			
Fine leak Gross leak				
Moisture resistance	1021			
Electrical measurements		See table V, steps 1, 2, and 4 (JANTX and JANTXV), Steps 1, 2, 4, and 5 (JANS)		
<u>Subgroup 3</u>				
Shock	2016			
Vibration, variable frequency	2056			
Constant acceleration	2006			
Electrical measurements		See table V, steps 1 and 2		
<u>Subgroup 4</u>				
Salt atmosphere (corrosion)	1041			

See footnote at end of table.

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TABLE III. Group C inspection - Continued.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD <u>1/</u>	Small lot quality conformance inspection n/c <u>1/</u>
	Method	Conditions		
<u>Subgroup 5</u> N/A <u>Subgroup 6</u>			5	12/0
DC intermittent operation life	1037	.25 rated $I_0 \leq I_0$ applied $<$ rated $I_0$ (see 4.5.2); 6,000 cycles		
Electrical measurements		See table V, steps 3, 4, 5, and 7 (JANS), and steps 3, 4, and 7 (JANTX, JANTXV)		

1/ For LTPD numbers, see MIL-S-19500.

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TABLE IV. Group E inspection (all quality levels) for qualification only.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection LTPD	Small lot quality conformance inspection n/c
	Method	Conditions		
<u>Subgroup 1</u>			10	6/0
Thermal shock (glass strain)	1056	0°C to 100°C, 100 cycles		
Hermetic seal	1071			
Electrical measurements		See table V, steps 2, 3, and 4		
<u>Subgroup 2</u>			5	12/0
Steady-state DC blocking life	1038 or 1049	Condition A; 1,000 hrs		
Electrical measurements		See table V, steps 3, 6, and 7		
<u>Subgroup 3</u>				
DPA		Photos of cross sections shall be submitted in the qualification report. Vendors shall retain duplicate photos.	3/0	1/0
<u>Subgroup 4</u>			10	6/0
Thermal resistance	3101	See 1.5		
<u>Subgroup 5</u>				
Barometric pressure (reduced)	1001	Hg = rated Hg; t = 60 s,		
		<u>Voltage during test</u>		
		---		
		400 V dc		
		600 V dc		
		800 V dc		
		1000 V dc		
1N1202A				
1N1204A				
1N1206A				
1N3671A				
1N3673A				
		While the test is being performed, $I_p$ shall be monitored and shall not exceed group A limits.		

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TABLE V. Groups A, B, and C electrical end-point measurements.

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	$i_f = 38$ A(pk) (pulse); pulse width = 8.5 ms duty cycle = 2% maximum	$V_{F2}$	---	1.35	V(pk)
2.	Reverse current	4016	DC method $V_R =$ Rated $V_R$ (dc) (see 1.4)	$I_{R1}$	---	5	$\mu$ A dc
3.	Forward voltage	4011	$i_f = 38$ A(pk) (pulse); pulse width = 8.5 ms duty cycle = 2% maximum	$V_{F2}$	---	1.4	V(pk)
4.	Thermal response	3101	See 4.3.2	$\Delta V_F$			mV dc
5.	Forward voltage	4011	$I_F = 50$ mA dc	$\Delta V_{F3}$	+50 mV dc maximum change from previous to post intermittent life and thermal shock measurement tests (JANS only)		
6.	Reverse current	4016	DC method, $V_R =$ Rated $V_R$ (dc) (see 1.4)	$\Delta I_{R1}$ 1/	100% or 5 $\mu$ A, (whichever is greater) change from initial group A reading		
7.	Reverse current	4016	DC method, $V_R =$ Rated $V_R$ (dc) (see 1.4)	$I_{R4}$		10	$\mu$ A dc

1/ Devices which exceed the group A limits for this test shall be rejected.

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## 5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

## 6. NOTES

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

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Acquisition requirements. 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 2.1.1).
- c. Lead finish may be specified (see 3.3.1).

6.3 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's part numbers. This information in no way implies that manufacturer's part numbers are suitable as a substitute for the military Part or Identifying Number (PIN).

Military Part or Identifying Number	Manufacturer's CAGE code	Manufacturer's and user's part number
1N1204A	CDKF	S13001 935A486-1
1N1204RA	CDKF	S13002 935A486-2

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6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

## CONCLUDING MATERIAL

## Custodians:

Army - ER  
Navy - EC  
Air Force - 17  
NASA - NA

## Review activities:

Army - AR, MI  
NASA - MSFC - EGO2  
Air Force - 11, 19, 85, 99  
DLA - ES

## User activities:

Army - SM  
Navy - AS, CG, MC, OS, SH

## Preparing activity:

Navy - EC

## Agent:

DLA - ES

(Project 5961-1066)