

The documentation and process conversion measures necessary to comply with this revision shall be completed by 13 April 2015.

INCH-POUND

MIL-PRF-19500/263B  
12 January 2015  
SUPERSEDING  
MIL-S-19500/263A(ER)  
15 May 1963

## PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, NPN, SILICON, HIGH POWER,  
THROUGH-HOLE MOUNT, TYPES 2N1714 THROUGH 2N1717,  
QUALITY LEVEL JAN

Inactive for new design after 7 June 1999.

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 NPN, silicon, transistors for relatively high-power applications. One level of product assurance (JAN) is provided for all encapsulated devices.

1.2 Package outlines. The device package outlines is a modified TO-5 (without a suffix symbol) or a modified TO-39 (with suffix S, see [1.5.3](#)) in accordance with [figure 1](#) for all encapsulated device types.

1.3 Maximum ratings. Unless otherwise specified,  $T_A = +25^\circ\text{C}$ .

Types	$P_C$ (1) $T_A = +25^\circ\text{C}$	$P_C$ (2) $T_C = +100^\circ\text{C}$	$V_{EB}$	$I_C$	$R_{\theta JX}$	$T_J$	$T_{STG}$	Alt.
	mW	W	V dc	A dc	$^\circ\text{C}/\text{W}$	$^\circ\text{C}$	$^\circ\text{C}$	Ft.
All	0.8	10	6.0	0.75	7.5	+175	-65 to +200	100,000

- (1) This power dissipation at ambient, free-air temperature of  $+25^\circ\text{C}$ . For ambient, free-air temperatures between  $+25^\circ\text{C}$  and  $+175^\circ\text{C}$ , derate linearly at rate of  $5.33 \text{ mW}/^\circ\text{C}$ .
- (2) This power dissipation at case temperature of  $+100^\circ\text{C}$ . For case temperatures between  $+100^\circ\text{C}$  and  $+175^\circ\text{C}$ , derate linearly at rate of  $134 \text{ mW}/^\circ\text{C}$ .

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](mailto: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>.

AMSC N/A

FSC 5961



1.4 Primary electrical characteristics. Unless otherwise specified,  $T_A = +25^\circ\text{C}$ .

Limits	$h_{FE}$ (1) $V_{CE} = 5\text{ V dc}$ $I_C = 10\text{ mA dc}$		$h_{FE}$ (1) $V_{CE} = 5\text{ V dc}$ $I_C = 200\text{ mA dc}$		$V_{EBF}$ $V_{CB} = 60\text{ V dc}$	$V_{EBF}$ $V_{CB} = 100\text{ V dc}$	$V_{(BR)CEO}$ (1) $I_C = 30\text{ mA dc}, I_B = 0$	
	2N1714 2N1715	2N1716 2N1717	2N1714 2N1715	2N1716 2N1717	2N1714 2N1716	2N1715 2N1717	2N1714 2N1716	2N1715 2N1717
Minimum	10	20	20	40	V dc	V dc	V dc	V dc
Maximum			60	120	---	---	60	100
					1.0	2.0		

Limits	$I_{CES}$ $V_{CE} = 60\text{ V dc}$ $V_{BE} = 0$		$I_{CES}$ $V_{CE} = 90\text{ V dc}$ $V_{BE} = 0$		$I_{CES}$ $V_{CE} = 150\text{ V dc}$ $V_{BE} = 0$	
	2N1714 2N1715	2N1716 2N1717	2N1714 2N1715	2N1716 2N1717	2N1714 2N1715	2N1716 2N1717
Minimum	$\mu\text{A dc}$	$\mu\text{A dc}$	$\mu\text{A dc}$	$\mu\text{A dc}$	$\mu\text{A dc}$	$\mu\text{A dc}$
Maximum	2.0	2.0	50	50	50	50

(1) Pulsed (see 4.5.1).

1.5 Part or Identifying Number (PIN). The PIN is in accordance with MIL-PRF-19500, and as specified herein. See 6.4 for PIN construction example and 6.5 for a list of available PINs.

1.5.1 JAN certification mark and quality level. The only quality level designator for encapsulated devices that is applicable for this specification sheet is the base quality level "JAN" that uses no modifiers.

1.5.2 Device type. The designation system for the device types of transistors covered by this specification sheet are as follows.

1.5.2.1 First number and first letter symbols. The transistors of this specification sheet use the first number and letter symbols "2N".

1.5.2.2 Second number symbols. The second number symbols for the transistors covered by this specification sheet are as follows: "1714", "1715", "1716", and "1717".

1.5.3 Suffix symbols. The suffix letter "S" is used on devices that have a shortened lead length: 0.5 inch (12.7 mm) minimum to .75 inch (19.1 mm) maximum. Devices with standard length leads (see figure 1) use no suffix symbol.

1.5.4 Lead finish. The lead finishes applicable to this specification sheet are listed on QML-19500.

## 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.

### 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 <http://quicksearch.dla.mil>.)

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 for the transistor shall be as specified in [MIL-PRF-19500](#) and as specified 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. The abbreviations, symbols, and definitions used herein shall be as specified in [MIL-PRF-19500](#) and as follows:

$I_{BC}$	Forward biased, base-collector current, dc, emitter open (current flow in forward direction).
$P_C$	Collector power dissipation.

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in [MIL-PRF-19500](#) and herein. The device package style is either a modified TO-5 or a modified TO-39 in accordance with [figure 1](#) for all device types.

3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with [MIL-STD-750](#), [MIL-PRF-19500](#), and herein. Where a choice of lead finish or formation is desired, it shall be specified in the acquisition document (see [6.2](#)).

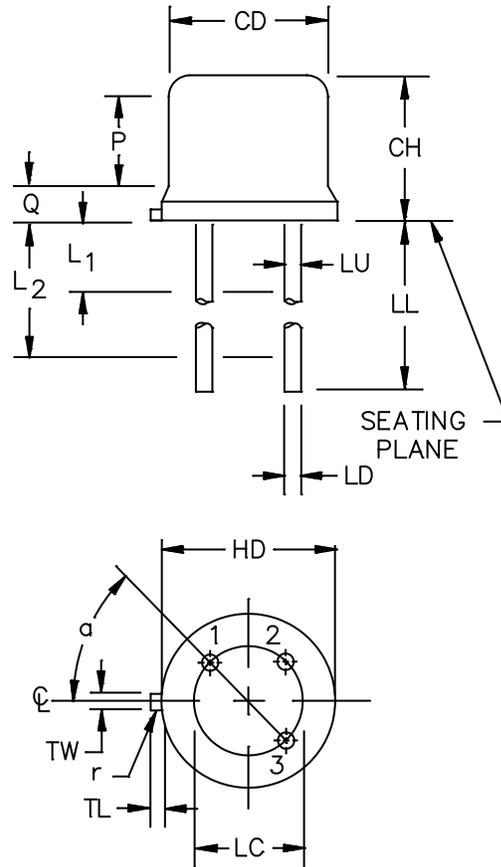
3.4.2 Pin-out. The pin-out of the device types shall be as shown on [figure 1](#). Terminal 1 is the emitter, terminal 2 is the base, and terminal 3 is the collector. The collector shall be electrically connected to the case.

3.5 Marking. Marking shall be in accordance with [MIL-PRF-19500](#).

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics shall be as specified in [1.3](#), [1.4](#), and [table I](#) herein.

3.7 Workmanship. Transistors 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.

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	3
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		TP		4
LD	.016	.021	0.41	0.53	5, 6
LL	See notes 6, 7, and 8				
LU	.016	.019	0.41	0.48	5, 6
L <sub>1</sub>		.050		1.27	5, 6
L <sub>2</sub>	.250		6.35		5, 6
P	.100		2.54		9
Q		.030		0.76	
TL	.029	.045	0.74	1.14	10, 11
TW	.028	.034	0.71	0.86	10
r		.010		0.25	12
$\alpha$	45° TP		45° TP		4



## NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Lead 1 = emitter, lead 2 = base, lead 3 = collector. The collector shall be internally connected to the case.
3. Dimension CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
4. Leads at gauge plane  $.054 + .001 - .000$  inch ( $1.37 + 0.03 - 0.00$  mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
5. Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between dimensions L<sub>2</sub> and LL minimum. Diameter is uncontrolled in and beyond dimension LL minimum.
6. All three leads.
7. For the modified TO-5 package (PINs without the S suffix), dimension LL is 1.500 inch (38.10 mm) minimum and 1.750 inch (44.45 mm) maximum.
8. For the modified TO-39 package (PINs with the S suffix), dimension LL is .500 inch (12.70 mm) minimum and .750 inch (19.05 mm) maximum.
9. Body contour optional within zone defined by dimensions HD, CD, and Q.
10. Beyond dimension r (radius) maximum, dimension TW shall be held for a minimum length of .011 (0.28 mm).
11. Dimension TL measured from maximum dimension HD.
12. Dimension r (radius) applies to both inside corners of tab.
13. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.

FIGURE 1. Physical dimensions and configuration of modified TO-5 or TO-39 package.

#### 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 and tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet 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 of this revision to maintain qualification.

4.2.2 Transient thermal impedance. The transient thermal impedance measurements shall be performed in accordance with test method 3131 of MIL-STD-750 using the guidelines in that test method for determining  $I_M$ ,  $I_H$ ,  $t_H$ ,  $t_{sw}$ , (and  $V_H$  where appropriate). See table II, subgroup 4 herein.

4.3 Screening. Screening is not applicable for devices compliant to this specification sheet.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VIB of MIL-PRF-19500 and herein.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B2	1056	Test condition A
B3	2046	

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500 and as follows herein.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	3005	$T_C = 100^\circ\text{C}$ Pre-pulse condition: $I_{BC} = 0$ , $I_E = 0$ . Pulse condition: $I_{BC} = 750$ mA dc, $I_E = 0$ , $t_p = 30 \pm 5$ second for 1 cycle; $T_C \leq 100^\circ\text{C}$

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 as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

4.5.1 Pulse response measurements. The conditions for pulse response measurement shall be as specified in section 4 of MIL-STD-750.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Transient thermal impedance	3131	See 4.2.2	$R_{\theta JX}$		7.5	$^{\circ}\text{C/W}$
Collector to emitter cutoff current	3041	Bias condition C, $V_{CE} = 60 \text{ V dc}$ , $V_{EB} = 0$	$I_{CES}$		2.0	$\mu\text{A dc}$
Collector to emitter cutoff current 2N1714, 2N1716 2N1715, 2N1717	3041	Bias condition C, $V_{EB} = 0$  $V_{CE} = 90 \text{ V dc}$ , $V_{CE} = 150 \text{ V dc}$ ,	$I_{CES}$ $I_{CES}$		50 50	$\mu\text{A dc}$ $\mu\text{A dc}$
Collector to emitter cutoff current 2N1714, 2N1716 2N1715, 2N1717	3041	Bias condition D, $I_B = 0$  $V_{CE} = 50 \text{ V dc}$ $V_{CE} = 90 \text{ V dc}$	$I_{CEO}$ $I_{CEO}$		50 50	$\mu\text{A dc}$ $\mu\text{A dc}$
Collector to base, cutoff current	3036	Bias condition D, $V_{CB} = 3 \text{ V dc}$ , $I_E = 0$	$I_{CBO}$		1.0	$\mu\text{A dc}$
Emitter to base, cutoff current	3061	Bias condition D, $V_{EB} = 3 \text{ V dc}$ , $I_C = 0$	$I_{EBO}$		10	$\mu\text{A dc}$
Emitter to base, cutoff current	3061	Bias condition D, $V_{EB} = 6 \text{ V dc}$ , $I_C = 0$	$I_{EBO}$		10	$\mu\text{A dc}$
Collector to emitter breakdown voltage 2N1714, 2N1716 2N1715, 2N1717	3011	Bias condition D, $I_C = 30 \text{ mA dc}$ , $I_B = 0$	$V_{(BR)CEO}$ $V_{(BR)CEO}$		60 100	$\text{V dc}$ $\text{V dc}$
Floating potential  2N1714, 2N1716 2N1715, 2N1717	3020	Voltmeter input resistance $\geq 10$ Meg.  $V_{CB} = 60 \text{ V dc}$ $V_{CB} = 100 \text{ V dc}$	$V_{EBF}$ $V_{EBF}$		1.0 2.0	$\text{V dc}$ $\text{V dc}$

See footnotes at end of table.

TABLE I. Group A inspection – Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2 – continued</u>						
Forward-current transfer ratio 2N1714, 2N1716 2N1715, 2N1717	3076	$V_{CE} = 5 \text{ V dc}, I_C = 10 \text{ mA dc};$	$h_{FE}$ $h_{FE}$	10 20		
Forward-current transfer ratio <u>3/</u> 2N1714, 2N1716 2N1715, 2N1717	3076	$V_{CE} = 5 \text{ V dc}, I_C = 200 \text{ mA dc};$	$h_{FE}$ $h_{FE}$	20 40	60 120	
Base to emitter voltage		$I_C = 200 \text{ mA dc}, I_B = 20 \text{ mA dc}$	$V_{BE}$		1.6	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 200 \text{ mA dc}, I_B = 20 \text{ mA dc}$	$V_{CE(sat)}$	---	2.0	V dc
<u>Subgroup 3</u>						
High temperature operation		$T_A = +175^\circ\text{C}, +5^\circ\text{C}, -0^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition C; $V_{CE} = 60 \text{ V dc}, V_{EB} = 0$	$I_{CES}$		500	$\mu\text{A dc}$
Low temperature operation		$T_A = -55^\circ\text{C}, +5^\circ\text{C}, -0^\circ\text{C}$				
Forward-current transfer ratio  2N1714, 2N1715 2N1716, 2N1717	3076	$V_{CE} = 5 \text{ V dc}, I_C = 200 \text{ mA dc}$	$h_{FE}$ $h_{FE}$	10 20		
<u>Subgroup 4</u>						
Magnitude of common emitter small-signal, short-circuit forward-current transfer ratio	3306	$f = 16 \text{ MHz}, V_{CE} = 10 \text{ V dc}, I_C = 100 \text{ mA dc}$	$ h_{FE} $		1.0	
Output capacitance (open circuit, common base)	3236	$f = 1 \text{ MHz}, V_{CB} = 10 \text{ V dc}, I_E = 0$	$C_{ob}$		50	pf
<u>Subgroups 5, 6 and 7</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

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

Inspection	MIL-STD-750		Sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	
Hermetic seal Fine leak Gross leak	1071		
End-point electrical measurements		See <a href="#">table I</a> , subgroup 2 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Steady-state operating life	1026	$T_A = 25^\circ\text{C}$ , $P_T = 0.8 \text{ W}$ , $V_{CE} = 40 \text{ V dc}$ , $t = 340 \text{ hours}$ .	
End-point electrical measurements		See <a href="#">table I</a> , subgroup 2 herein.	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See <a href="#">MIL-PRF-19500</a> .	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B.	
<u>Subgroup 9</u>			
Burnout by pulsing	3005	Pre-pulse condition: $T_C = 100^\circ\text{C}$ , $I_{BC} = 0$ , $I_E = 0$ . Pulse condition: $T_C \leq 100^\circ\text{C}$ , $I_{BC} = 750 \text{ mA dc}$ , $I_E = 0$ , $t_p = 30 \pm 5 \text{ seconds}$ , 1 cycle.	

## 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.)

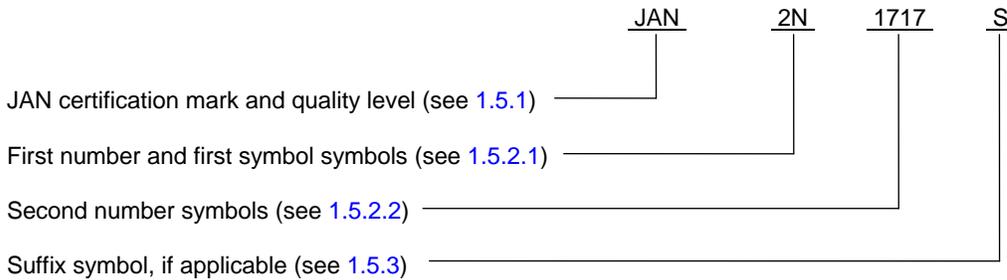
6.1 Intended use. Transistors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

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. The complete PIN, see 1.5, 6.4, and 6.5.

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](mailto:vqe.chief@dla.mil).

6.4 PIN construction example. The PINs for encapsulated devices are constructed using the following form.



6.5 List of PINs. The following is a list of possible PINs available on this specification sheet.

PINs for devices in a modified TO-5 package (standard lead lengths)	PINs for devices in a modified TO-39 package (short lead lengths)
JAN2N1714	JAN2N1714S
JAN2N1715	JAN2N1715S
JAN2N1716	JAN2N1716S
JAN2N1717	JAN2N1717S

6.6 Supersession information and superseded PINs.

6.6.1 Lead length. The original issue of this specification through MIL-S-19500/263(EL) with amendment 3 (26 June 1978) did not contain a suffix to designate lead length. MIL-S-19500/263(ER) with amendment 4 (5 May 1980) introduced the "S" suffix option with the associated TO-39 package. When applicable, PINs covering devices with a shortened lead length now shall include a suffix "S" to designate this package configuration (see 1.2, 1.5, and figure 1.)

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

Custodians:  
Army – CR  
Air Force – 85  
DLA – CC

Preparing activity:  
DLA – CC

(Project 5961-2014-004)

Review activities:  
Army – EA, MI  
Air Force – 70, 99

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