

The documentation and process conversion measures necessary to comply with this document shall be completed by 10 September 2021.

INCH-POUND

MIL-PRF-19500/270K
w/AMENDMENT 1
10 June 2021
SUPERSEDING
MIL-PRF-19500/270K
27 January 2016

PERFORMANCE SPECIFICATION SHEET

TRANSISTOR, UNITIZED, DUAL, NPN, SILICON
THROUGH HOLE MOUNT PACKAGE, TYPE 2N2060
QUALITY LEVELS JAN, JANTX, JANTXV, AND JANS

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 two electrically isolated, matched NPN, silicon transistors as one dual unit. Four levels of product assurance (JAN, JANTX, JANTXV, and JANS) are provided for each device type as specified in [MIL-PRF-19500](#).

1.2 Physical dimensions. The device package outline is 6 terminal metal can similar to a modified TO-77 or TO-99 in accordance with [figure 1](#) for all device types.

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

P _{T1} T _A = +25°C		P _{T2} T _C = +25°C		I _C	V _{CBO}	V _{CEO}	V _{EBO}	T _{STG} and T _J
One section (1)	Both sections (2)	One section (1)	Both sections (2)					
<u>mW</u> 540	<u>mW</u> 600	<u>W</u> 1.5	<u>W</u> 2.12	<u>mA dc</u> 500	<u>V dc</u> 100	<u>V dc</u> 60	<u>V dc</u> 7	<u>°C</u> -65 to +200

- (1) For $T_A > +25^\circ\text{C}$, derate linearly 3.08 mW/°C one section, 3.48 mW/°C both sections.
(2) For $T_C > +25^\circ\text{C}$, derate linearly 8.6 mW/°C one section, 12.1 mW/°C both sections.

1.4 Primary electrical characteristics of each individual section. Unless otherwise specified, $T_C = +25^\circ\text{C}$.

Limit	h _{FE1} V _{CE} = 5 V dc I _C = 10 μA dc	h _{FE2} V _{CE} = 5 V dc I _C = 100 μA dc	h _{FE3} V _{CE} = 5 V dc I _C = 1 mA dc	h _{FE4} (1) V _{CE} = 5 V dc I _C = 10 mA dc	h _{FE} V _{CE} = 10 V dc I _C = 50 mA dc f = 20 MHz	V _{CE(sat)} I _C = 50 mA dc I _B = 5 mA dc	V _{BE(sat)} I _C = 50 mA dc I _B = 5 mA dc
Min	25	30	40	50	3	<u>V dc</u>	<u>V dc</u>
Max	75	90	120	150	25	0.3	0.9

- (1) Pulsed (see [4.5.1](#)).

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>.



MIL-PRF-19500/270K
w/AMENDMENT 1

1.4.1 Primary electrical matching characteristics of each individual section.

Limit	$\frac{h_{FE2-1}}{h_{FE2-2}} (1)$	$ V_{BE1} - V_{BE2} $	$ \Delta(V_{BE1} - V_{BE2}) \Delta T_A 1$	$ \Delta(V_{BE1} - V_{BE2}) \Delta T_A 2$
	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ <u>1/</u>	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ $T_A = +25^\circ\text{C and } -55^\circ\text{C}$	$V_{CE} = 5 \text{ V dc};$ $I_C = 100 \mu\text{A dc}$ $T_A = +125^\circ\text{C and } +25^\circ\text{C}$
Min	0.9	<u>mV dc</u>	<u>mV dc</u>	<u>mV</u>
Max	1.0	5	0.8	1.0

(1) The larger number will be placed in the denominator.

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 quality level designators for encapsulated devices that are applicable for this specification sheet are "JAN", "JANTX", "JANTXV", and "JANS".

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

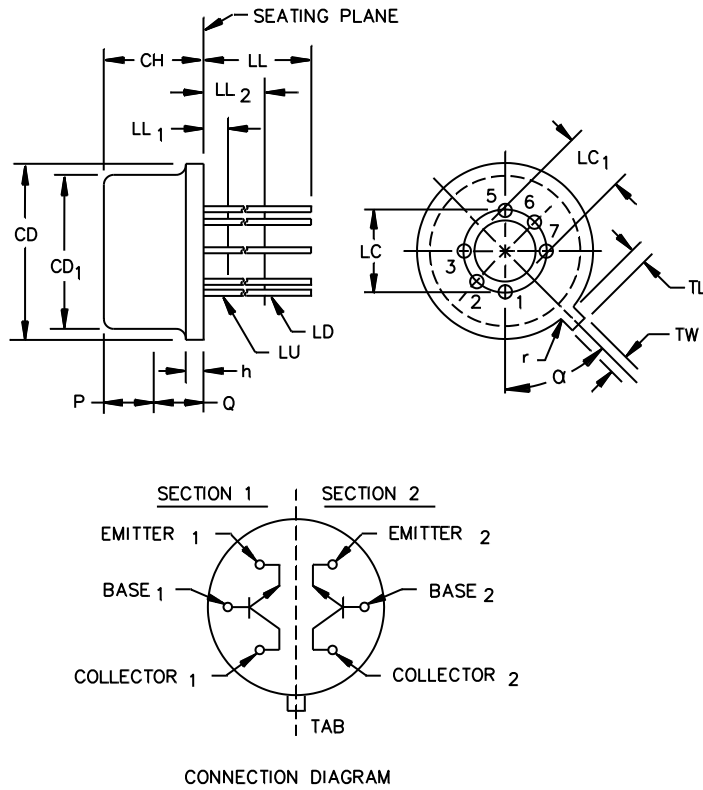
1.5.2.1 First number and first letter symbols. The transistors of this specification sheet use the first number and letter symbols "2N".

1.5.2.2 Second number symbols. The second number symbols for the transistors covered by this specification sheet are "2060".

1.5.3 Suffix symbols. The suffix symbol "L" is used on devices that have a longer lead length than standard: 1.500 inches (38.10 mm) minimum to 1.750 inches (44.45 mm) maximum. Devices with standard length leads use no suffix (see [figure 1](#)).

1.5.4 Lead finish. The lead finishes applicable to this specification sheet are listed on [QPDSIS-19500](#).

MIL-PRF-19500/270K
w/AMENDMENT 1



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.335	.370	8.51	9.40	
CD ₁	.305	.335	7.75	8.51	
CH		.260		6.60	
LC	.200 TP		5.08 TP		4
LC ₁	.140	.160	3.56	4.06	
LD	.016	.021	0.41	0.53	5
LL	See notes 5, 6, and 7				
LL ₁		.050		1.27	5
LL ₂	.250		6.35		5
LU	.016	.019	0.41	0.48	5
P	.100		2.54		8
Q		.050		1.27	9
TL	.029	.045	0.74	1.14	11
TW	.028	.034	0.71	0.86	9, 10
h	.009	.041	0.23	1.04	
r		.010		0.25	12
α	45°TP		45°TP		4

NOTES:

1. Dimensions are in inches. Metric equivalents are given for general information only.
2. Refer to rules for dimensioning semiconductor product outlines included in JEDEC Publication No. 95.
3. Lead number 4 and 8 omitted on this variation.
4. Leads at gauge plane .054 - .055 inch (1.37 - 1.40 mm) below seating plane shall be within .007 inch (.18 mm) radius of true position (TP) at a maximum material condition (MMC) relative to the tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure described on gauge drawing GS-1.
5. LU applies between LL₁ and LL₂ LD applies between LL₂ and LL minimum. Diameter is uncontrolled in LL₁ and beyond minimum.
- * 6. For transistor types 2N2060, LL is .500 inch (12.70 mm) minimum, and .750 inch (19.05 mm) maximum.
7. For transistor types 2N2060L, LL is 1.500 inches (38.10 mm) minimum, and 1.750 inches (44.45 mm) maximum.
8. CD₁ shall not vary more than .010 inch (.25 mm) in zone P. This zone is controlled for automatic handling.
9. Details of outline in this zone optional.
10. Beyond r, TW must be held to a minimum length of .021 inch (.53 mm).
11. TL measured from maximum CD.
12. r (radius) applies to both inside corners of tab.

FIGURE 1. Physical dimensions of a modified TO-77 or TO-99 package.

MIL-PRF-19500/270K
w/AMENDMENT 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 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://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 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-19500) 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 and as follows.

$\frac{h_{FE-1}}{h_{FE-2}}$	Static forward-current-gain-ratio. The matching ratio of the static forward-current transfer ratios of each section.
$ V_{BE1} - V_{BE2} $	Absolute value of base-emitter-voltage differential between the individual sections.
$ \Delta(V_{BE1} - V_{BE2}) \Delta T_A $	Absolute value of the algebraic difference between the base-emitter-voltage differentials between the individual sections at two different temperatures.
$ \Delta V_{BE1-2}(T1) - \Delta V_{BE1-2}(T2) $	Absolute value of the algebraic difference between the base-emitter- voltage differentials between the individual sections at two different temperatures.

MIL-PRF-19500/270K
w/AMENDMENT 1

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and herein. The device package style is a 6 terminal metal can similar to a modified TO-77 or TO-99 in accordance with figure 1 for all device types.

3.4.1 Lead finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition requirements (see 6.2).

3.5 Electrical performance characteristics. Unless otherwise specified, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.6 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.7 Workmanship. 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 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.

MIL-PRF-19500/270K
w/AMENDMENT 1

4.3 Screening (quality levels JANS, JANTX, and JANTXV only). Screening shall be in accordance with 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.

Screen	Measurement	
	Quality level JANS	Quality levels JANTX and JANTXV
3c (1)	Thermal impedance (see 4.5.9)	Thermal impedance (see 4.5.9)
9	I_{CB02} , $\frac{h_{FE2-1}}{h_{FE2-2}}$, and h_{FE3}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CB02} , $\frac{h_{FE2-1}}{h_{FE2-2}}$, and h_{FE3} I_{CB02} = 100 percent of initial value or 2 nA dc, whichever is greater. Δh_{FE3} = ± 15 percent	I_{CB02} and h_{FE3}
12	See 4.3.1, 240 hours minimum	See 4.3.1, 80 hours minimum
13	Subgroups 2 and 3 of table I herein; ΔI_{CB02} = 100 percent of initial value or 2 nA dc, whichever is greater. Δh_{FE3} = ± 15 percent	Subgroup 2 of table I herein; ΔI_{CB02} = 100 percent of initial value or 2 nA dc, whichever is greater. Δh_{FE3} = ± 15 percent
13a	Method 1016 of MIL-STD-750, test condition A (collector to collector) R_{c1-c2} = 10^9 ohms minimum	Not applicable
14	Required	Required

(1) Shall be performed anytime after temperature cycling (screen 3a) and does not need to be repeated in screening requirements for JANTX and JANTXV level devices.

4.3.1 Power burn-in conditions. Power burn-in conditions for quality levels shall be as follows:

V_{CB} = 10 to 40 V dc, P_T = 300 mW (each section) at T_A = $+25^\circ\text{C} \pm 3^\circ\text{C}$.

V_{CB} = 10 to 40 V dc, P_T = 600 mW (both sections) at T_A = $+25^\circ\text{C} \pm 3^\circ\text{C}$.

NOTE: No heat sink or forced air-cooling on the devices shall be permitted.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table E-VIB, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

MIL-PRF-19500/270K
w/AMENDMENT 1

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with 4.4.2.1 for quality level JANS and 4.4.2.2 for quality levels JAN, JANTX, and JANTXV.

4.4.2.1 Quality level JANS. Group B inspection for quality level JANS shall be conducted in accordance with the conditions specified for subgroup testing in table E–VIA of MIL-PRF-19500 and herein. Delta measurements for JANS shall be in accordance with 4.6 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B4	1037	$V_{CB} = 10 \text{ V dc.}$
B5	1027	$V_{CB} = 10 \text{ V dc; } P_D \geq 100 \text{ percent of maximum rated } P_T \text{ (see 1.3).}$ (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.) Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table E–VIA, adjust T_A or P_D to achieve $T_J = +275^\circ\text{C}$ minimum. Option 2: 216 hours minimum, sample size = 45, $c = 0$; adjust T_A or P_D to achieve a $T_J = +225^\circ\text{C}$ minimum.

* 4.4.2.2 Quality levels JAN, JANTX, and JANTXV. Group B inspection for quality levels JAN, JANTX, and JANTXV shall be conducted in accordance with the conditions specified in table E–VIC (small die flow) of MIL-PRF-19500 and herein. Delta measurements for JAN, JANTX, and JANTXV shall be after each step listed below and shall be in accordance with 4.6 herein.

<u>Step</u>	<u>Method</u>	<u>Condition</u>
1	1026	Steady-state operation life: 1,000 hours, $V_{CB} = 10 \text{ V dc}$, power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum using a minimum of $P_D = 75 \text{ percent of maximum rated } P_T$ as defined in 1.3. $n = 45 \text{ devices, } c = 0$. The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.
2	1048	Blocking life: $T_A = +150^\circ\text{C}$, $V_{CB} = 80 \text{ percent of rated}$, 48 hours minimum. $n = 45 \text{ devices, } c = 0$.
3	1032	High-temperature (nonoperating) life: 340 hours, $T_A = +200^\circ\text{C}$. $n = 22, c = 0$.

4.4.2.2.1 Sample selection and usage. Samples selected for small die flow group B inspection shall comply with the following:

- a. Samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot (see MIL-PRF-19500).
- b. Samples must be selected from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test may be tested prior to the application of final lead finish.
- c. Separate samples may be used for each step.

MIL-PRF-19500/270K
w/AMENDMENT 1

4.4.2.2.2 Failures. In the event of a lot failure, the resubmission requirements of MIL-PRF-19500 shall apply. In addition, all catastrophic failures during small die flow group B inspection shall be analyzed to the extent possible to identify root cause and corrective action.

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 in 4.4.3.1 (for quality level JANS), and 4.4.3.2 (for quality levels JAN, JANTX, and JANTXV) herein. Delta measurements shall be in accordance with 4.6 herein.

4.4.3.1 Quality level JANS.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C6	1026	Steady-state operation life: 1,000 hours, $V_{CB} = 10$ dc, power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum using a minimum of $P_D = 75$ percent of maximum rated P_r as defined in 1.3; $n = 45$ devices, $c = 0$. The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.

4.4.3.2 Quality levels JAN, JANTX, and JANTXV.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E.
C6		Not applicable.

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests for conformance inspection. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.4.4 Group E Inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table II herein.

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

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

4.5.2 Testing of units. All specified electrical tests, including end-point electrical measurements and delta measurement tests, shall be performed equally on both sections of the transistor types covered herein, except where the electrical characteristic being evaluated applies to the transistor as a device entity.

4.5.3 Disposition of leads when testing characteristics of each section. During the measurement of the characteristic of each section, the leads of the section not under test shall be open-circuited.

4.5.4 Forward-current-gain ratio. The value for the forward-current-gain ratio for each individual section of a dual unit shall be measured using method 3076 of MIL-STD-750. The forward-current-gain ratio shall be calculated by dividing one of the values by the other. If possible, this ratio shall be measured directly to improve accuracy.

MIL-PRF-19500/270K
w/AMENDMENT 1

4.5.5 Base-emitter-voltage differential. The base-emitter-voltage differential shall be determined by connecting the emitters of the individual sections together, applying specified electrical test conditions to each individual section in accordance with method 3066 of MIL-STD-750, test condition B, and measuring the absolute value of the voltage between the bases of the individual sections of a dual unit.

4.5.6 Base-emitter-voltage differential change with temperature. The value of the base-emitter-voltage differential shall be measured at the two specified temperatures in accordance with 4.5.5 except that the identities of the individual sections shall be maintained. The absolute value of the algebraic difference between the values at the two temperature extremes shall be calculated. A mathematical formula for this parameter is:

$$| (V_{BE1} - V_{BE2})_{T1} - (V_{BE1} - V_{BE2})_{T2} |$$

4.5.7 Noise figure test. Noise figure shall be measured using a model No. 2173C/2181 Quan Tech Laboratories test set, or equivalent. Conditions shall be as specified in table I.

4.5.8 Noise figure (wideband) test. Wideband noise figure shall be measured using a model No. 512 Quan Tech Laboratories test set, or equivalent. Conditions shall be as specified in table I.

4.5.9 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3131, of MIL-PRF-19500. The following conditions shall apply:

- a. I_M measurement current ----- 5 mA.
- b. I_H forward heating current ----- 200 mA (min).
- c. t_H heating time ----- 25 - 30 ms.
- d. t_{md} measurement delay time ----- 60 μ s max.
- e. V_{CE} collector-emitter voltage ----- 10 V dc minimum

The maximum limit for $Z_{\theta JX}$ under these test conditions is $Z_{\theta JX} (\text{max}) = 72^\circ\text{C/W}$.

MIL-PRF-19500/270K
w/AMENDMENT 1

4.6 Delta measurements. Delta measurements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1.	Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$; $I_C = 1 \text{ mA dc}$	Δh_{FE3}	± 25 percent change from initial reading.
2.	Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 80 \text{ V dc}$	ΔI_{CBO2} (1)	100 percent or 2 nA dc, whichever is greater.
3.	Saturation voltage and resistance (collector to emitter voltage)	3071	$I_C = 50 \text{ mA dc}$, $I_B = 5 \text{ mA dc}$	$\Delta V_{CE(sat)}$ (2)	$\pm 50 \text{ mV dc}$ from initial reading.
4.	Base emitter voltage (nonsaturated) (absolute value of differential - change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc}$, $I_C = 100 \mu\text{A dc}$, $T_A = +25^\circ\text{C}$ and -55°C (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A 1$ (2)	0.80 mV dc maximum
5.	Base emitter voltage (nonsaturated) (absolute value of differential - change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc}$, $I_C = 100 \mu\text{A dc}$, $T_A = +25^\circ\text{C}$ and $+125^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A 2$ (2)	1.0 mV dc maximum

(1) Devices which exceed the group A limits for this test shall not be accepted.

(2) JANS only.

MIL-PRF-19500/270K
w/AMENDMENT 1

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> 2/						
Visual and mechanical examination 3/	2071					
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Salt atmosphere	1041	n = 6, c = 0 (for laser marked devices only)				
Temp cycling 3/ 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal 4/ Fine leak Gross leak	1071	n = 22 devices, c = 0				
End-point electrical measurements 4/		Table I, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T _A = +250°C at t = 24 hrs or T _A = 300°C at t = 2 hrs n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Thermal impedance 6/	3131	See 4.5.9	Z _{θJX}			°C/W
Collector to base cutoff current	3036	Bias condition D, V _{CB} = 100 V dc	I _{CBO1}		10	μA dc
Breakdown voltage, collector to emitter	3011	Bias condition B, I _C = 10 mA dc, R _{BE} ≤ 10 ohms, pulsed (see 4.5.1)	V _{(BR)CE R}	80		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D, I _C = 30 mA dc, pulsed (see 4.5.1)	V _{(BR)CE O}	60		V dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 7 V dc	I _{EBO1}		10	μA dc
Collector to base cutoff current	3036	Bias condition D; V _{CB} = 80 V dc	I _{CBO2}		2	nA dc
Emitter to base cutoff current	3061	Bias condition D, V _{EB} = 5 V dc	I _{EBO2}		2	nA dc
Saturation voltage and resistance	3071	I _C = 50 mA dc; I _B = 5 mA dc	V _{CE(sat)}		0.3	V dc

See footnotes at end of table.

MIL-PRF-19500/270K
w/AMENDMENT 1

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued						
Base emitter voltage (saturated)	3066	Test condition A, $I_C = 50 \text{ mA dc}$, $I_B = 5 \text{ mA dc}$	$V_{BE(sat)}$		0.9	V dc
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 10 \text{ }\mu\text{A dc}$	h_{FE1}	25	75	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$	h_{FE2}	30	90	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$	h_{FE3}	40	120	
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 10 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE4}	50	150	
Forward-current transfer ratio (gain ratio)	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$, pulsed (see 4.5.1)	$\frac{h_{FE2-1}}{h_{FE2-2}}$ 7/	0.9	1.0	
Forward-current transfer ratio (gain ratio)	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 1.0 \text{ mA dc}$, pulsed (see 4.5.1)	$\frac{h_{FE3-1}}{h_{FE3-2}}$ 7/	0.9	1.0	
Absolute value of base emitter-voltage differential	3066	Test condition B, $V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$ (see 4.5.5)	$ V_{BE} - V_{BE2} 1$		5	mV dc
Absolute value of base emitter-voltage differential	3066	Test condition B, $V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$ (see 4.5.5)	$ V_{BE} - V_{BE2} 2$		5	mV dc
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Base-emitter-voltage (nonsaturated) (absolute value of differential change with temperature)	3066	Test condition B; $V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$ (see 4.5.5), $T_A = +125^\circ\text{C}$ and $+25^\circ\text{C}$ (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A 2$		1	mV dc
Collector to base cutoff current	3036	Bias condition D, $V_{CB} = 80 \text{ V dc}$ $T_A = -55^\circ\text{C}$	I_{CBO3}		10	$\mu\text{A dc}$
Low temperature operation:						
Forward-current transfer ratio	3076	$V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$	h_{FE5}	10		
Base-emitter-voltage (nonsaturated) (absolute value of differential change with temperature)	3066	Test condition B, $V_{CE} = 5 \text{ V dc}$, $I_C = 100 \text{ }\mu\text{A dc}$, (see 4.5.5), $T_A = +25^\circ\text{C}$ and -55°C (see 4.5.6)	$ \Delta(V_{BE1} - V_{BE2})\Delta T_A 1$		.8	mV dc

See footnotes at end of table.

MIL-PRF-19500/270K
w/AMENDMENT 1

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 4						
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$; $f = 1 \text{ kHz}$	h_{fe}	50	150	
Common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}$, $I_C = 50 \text{ mA dc}$; $f = 20 \text{ MHz}$	$ h_{fe} $	3	25	
Small-signal short-circuit input impedance	3201	$V_{CB} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$; $f = 1 \text{ kHz}$	h_{ib}	20	30	Ω
Small-signal short-circuit input impedance	3201	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$; $f = 1 \text{ kHz}$	h_{ie}	1,000	4,000	Ω
Small-signal open-circuit output admittance	3216	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$; $f = 1 \text{ kHz}$	h_{oe}	0	16	μMho
Output capacitance (input open circuited)	3236	$V_{CB} = 10 \text{ V dc}$, $I_E = 0$; $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{obo}		15	pF
Input capacitance (output open circuited)	3240	$V_{EB} = 0.5 \text{ V dc}$, $I_E = 0$; $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{ibo}		85	pF
Noise figure	3246	$V_{CE} = 10 \text{ V dc}$, $I_C = 300 \mu\text{A dc}$; $R_g = 510 \Omega$; $f = 1 \text{ kHz}$ (see 4.5.7)	F1		8	dB
Noise figure	3246	$V_{CE} = 10 \text{ V dc}$, $I_C = 300 \mu\text{A dc}$; $R_g = 1 \text{ k}\Omega$; $f = 10 \text{ kHz}$ (see 4.5.7)	F2		8	dB
Collector to collector leakage		Test condition (see 4.5.3) $V_{(\text{collector 1 to collector 2})} = 100 \text{ V dc}$	$I_{(\text{collector 1 to collector 2})}$		100	nA dc

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

2/ For resubmission of failed subgroup 1, double the sample size of the failed test or sequence of tests. A failure in subgroup 1 of table I shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.

3/ Separate samples may be used.

4/ Not required for JANS devices.

5/ Not required for laser marked devices.

6/ For end-point measurements, this test is required for the following subgroups:

Group B, subgroups 3, 4 and 5 for quality level JANS.

Group B, step 1 for quality levels JAN, JANTX, JANTXV.

Group C, subgroups 2 and 6 for all quality levels.

Group E, subgroup 1 for all quality levels.

7/ The larger number will be placed in the denominator.

MIL-PRF-19500/270K
w/AMENDMENT 1

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

Inspection	MIL-STD-750		Qualification
	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 subgroup 2 of table I and 4.6 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10 \text{ V dc}$, 6000 cycles.	
End-point electrical measurements		See subgroup 2 of table I and 4.6 herein.	
<u>Subgroup 4</u>			
Thermal impedance curves		Each supplier shall submit their qual-lot average and design thermal impedance curves. In addition, optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	Sample size N/A
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			11 devices
ESD	1020		
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B for devices < 400 V.	

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MIL-PRF-19500/270K
w/AMENDMENT 1

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual 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.)

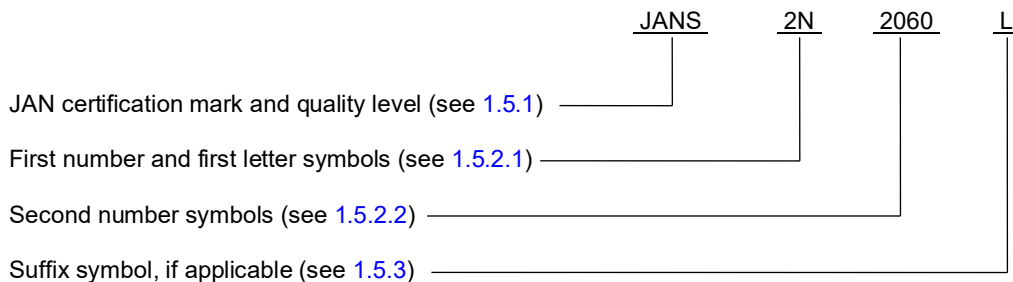
6.1 Intended use. Devices conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish ([3.4.1](#)).
- d. The complete PIN, see [1.5](#) and 6.4.

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 43216-5000 or e-mail vqe.chief@dla.mil.

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



MIL-PRF-19500/270K
w/AMENDMENT 1

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

PINs for devices of the base quality level	PINs for devices of quality level "TX"	PINs for devices of quality level "TXV"	PINs for devices of quality level "S"
JAN2N2060	JANTX2N2060	JANTXV2N2060	JANS2N2060
JAN2N2060L	JANTX2N2060L	JANTXV2N2060L	JANS2N2060L

6.6 Supersession information and superseded PINs.

6.6.1 Lead finish. The original issue of this specification through MIL-S-19500/270(NAVY) (1 October 1963) did not specify a lead finish. MIL-S-19500/270C (15 April 1970) specified that the lead finish as "gold (as specified in MIL-STD-1276)". That same revision also allowed for "tin-coated over gold". MIL-S-19500/270D with amendment 2 (21 May 1981) changed the lead finish to "gold or tin plated or solder dipped". MIL-S-19500/270E (14 August 1992) through MIL-PRF-19500/270G (10 August 1998) modified the lead finish to "gold, silver, tin, or solder plated". The last change to the lead finish requirements were made in MIL-PRF-19500/270H (24 July 2003) in which no lead finish was specified. Tin is no longer acceptable as a lead finish.

6.6.2 Lead material. Because of the performance format of this document, the lead materials specified in earlier issues are no longer specified.

6.7 Request for new types and configurations. Requests for new device types or configurations for inclusions in this specification sheet should be submitted to: DLA Land and Maritime, ATTN: VAC, Post Office Box 3990, Columbus, OH 43218-3990 or by electronic mail at "Semiconductor@dla.mil" or by facsimile (614) 693-1642 or DSN 850-6939.

MIL-PRF-19500/270K
w/AMENDMENT 1

* 6.8 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. 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.

Custodians:

- Army - CR
- * Navy - SH
- Air Force - 85
- * NASA - NA
- DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2021-042)

Review activities:

- Army - AR, AV, MI, SM
- Navy - AS, MC, OS
- * Air Force - 19

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>.