MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, POWER
TYPES 2N1039, 2N1041, 2N2553, 2N2555, 2N2557 AND 2N2559

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for PNP, germanium, power, transistors.

1.2 Physical dimensions.

2N1039 and 2N1041 - See figure 1
2N2553 and 2N2555 - See figure 3
2N2557 and 2N2559 - See figure 4

1.3 Maximum ratings.

P_T 1/ T_C = 25°C	P_T T_A = 25°C			V_{CB}		V_{CE}		V_{EB}	T_{stg}
	2N1039 2/ 2N1041	2N2553 3/ 2N2555	2N2557 4/ 2N2559	2N1039 2N2553 2N2557	2N1041 2N2555 2N2559	2N1039 2N2553 2N2557	2N1041 2N2555 2N2559		
W	mW	mW	mW	Vdc	Vdc	Vdc	Vdc	Vdc	°C
20	400	900	1100	-60	-100	-40	-60	-20	-65 to +100

1/ Derate 267 mW/°C for T_C > 25°C.
2/ Derate 5.33 mW/°C for T_A > 25°C.
3/ Derate 12.0 mW/°C for T_A > 25°C.
4/ Derate 14.67 mW/°C for T_A > 25°C.

1.4 Primary electrical characteristics.

Limits	h_{FE} V_{CE} = -0.5 Vdc I_C = -1 Adc	h_{FE} V_{CE} = -0.5 Vdc I_C = -50 mAdc	$V_{CE}(sat)$ I_C = -1 Adc I_B = -0.1 Adc	$\|h_{fe}\|$ V_{CE} = -1.5 Vdc I_C = -0.5 Adc f = 112.5 kHz	h_{IE} V_{CE} = -0.5 Vdc I_C = -1 Adc
			Vdc		ohms
Min	20	33	---	2	---
Max	60	---	-0.25	12	60

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

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

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500.

3.3 Design, construction, and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figures 1, 3, and 4.

3.3.1 Lead material and finish. Lead material shall be Kovar or alloy 52. Lead finish shall be gold-plated. (Leads may be tin-plated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2).

3.3.2 Terminal-lead length. Terminal-lead length (s) other than that specified in figures 1, 3, and 4 may be furnished when so stipulated in the contract or order (see 6.2) where the devices covered herein are required directly for particular equipment-circuit installation or for automatic-assembly-technique programs. Where other lead lengths are required and provided, it shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking.

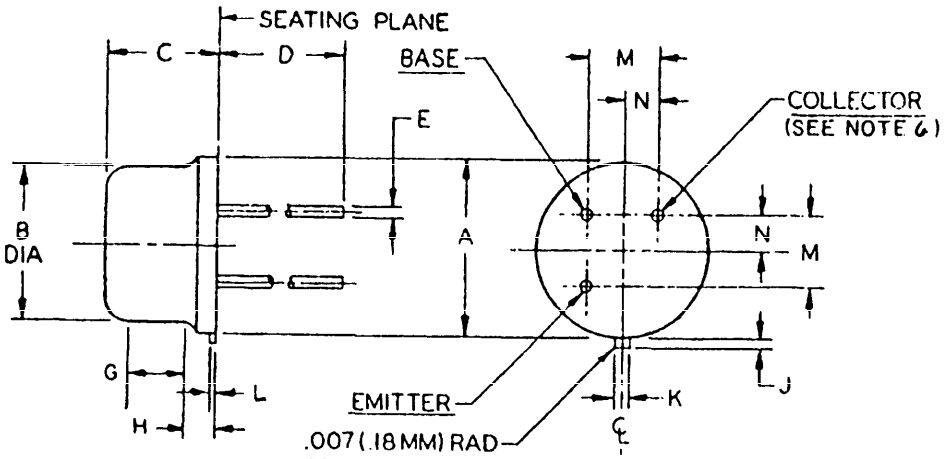
3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(a) Country of origin.
(b) Manufacturer's identification.

4. QUALITY ASSURANCE PROVISIONS

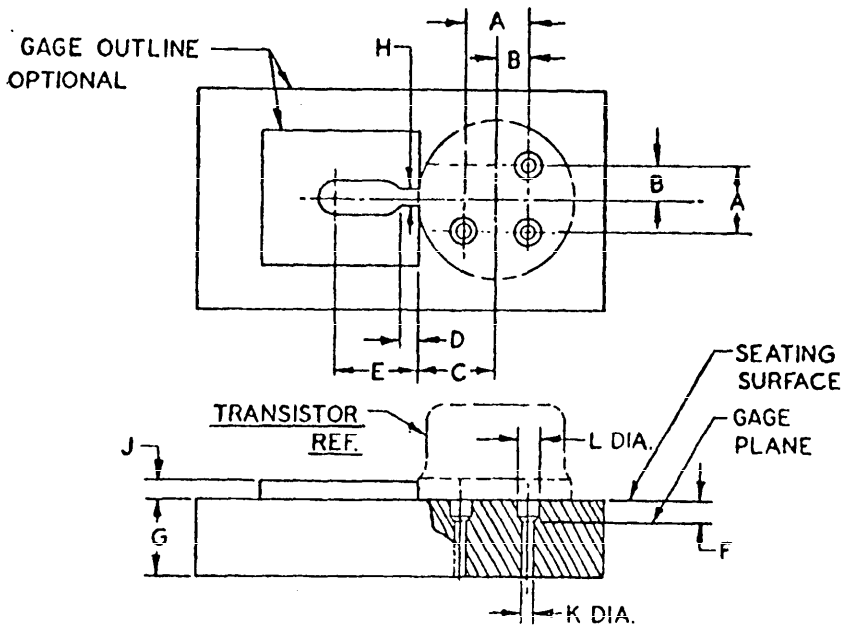
4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.335	.370	8.51	9.40	
B	.310	.340	7.87	8.64	
C	.240	.390	6.10	9.91	
D	1.500	1.750	38.10	44.45	8
E	.022	.028	.56	.71	2,8
F					
G	.080	---	2.03	---	3
H	---	---	---	---	4
J	.029	.045	0.74	1.14	7
K	.025	.035	.64	.89	
L	.009	.125	0.23	3.18	
M	.1414 Nom		3.59 Nom		5
N	.0707 Nom		1.80 Nom		5

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .250(6.35 mm) from the seating plane.
3. Variations on dimension B in this zone shall not exceed .010(.25 mm).
4. Outline in this zone is not controlled.
5. When measured in a gaging plane .054+.001,-.000(1.37+.03,-.00 mm) below the seating plane of the transistor, maximum diameter leads shall be within .007(.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 2 shows the preferred measured method.
6. Collector shall be electrically connected to the case.
7. Measured from the maximum diameter of the actual device.
8. All 3 leads.

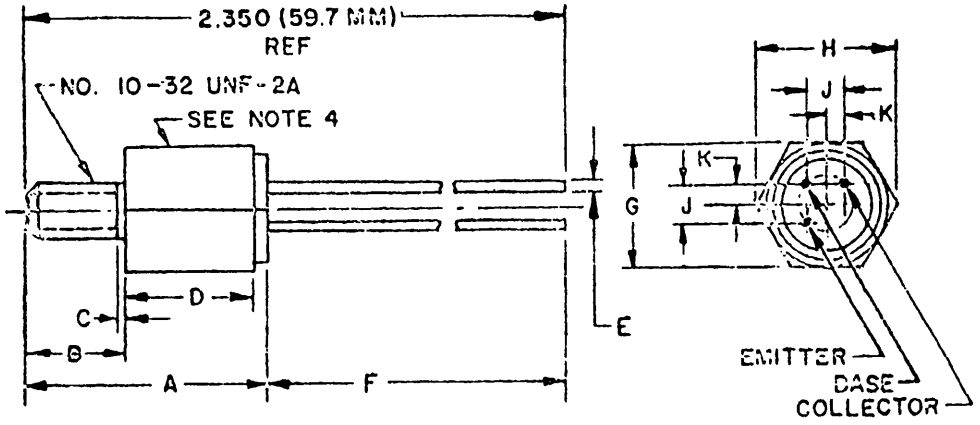
FIGURE 1. Physical dimensions of transistor types 2N1039 and 2N1041.



DIMENSIONS				
LTR	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.1409	.1419	3.58	3.60
B	.0702	.0712	1.78	1.81
C	.182	.199	4.62	5.05
D	.009	.011	.23	.28
E	.125 Nom		3.18 Nom	
F	.054	.055	1.37	1.40
G	.372	.378	9.45	9.60
H	.0350	.0355	.89	.90
J	.150 Nom		3.81 Nom	
K	.0415	.0425	1.05	1.08
L	.0595	.0605	1.51	1.54

NOTES:
1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is .125±.010 (3.18±.25 mm) from the seating surface of the gage. A spacer may be used to obtain the .125 (3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.05 oz shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.
2. The location of the tab locator, within the limits of dim C, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

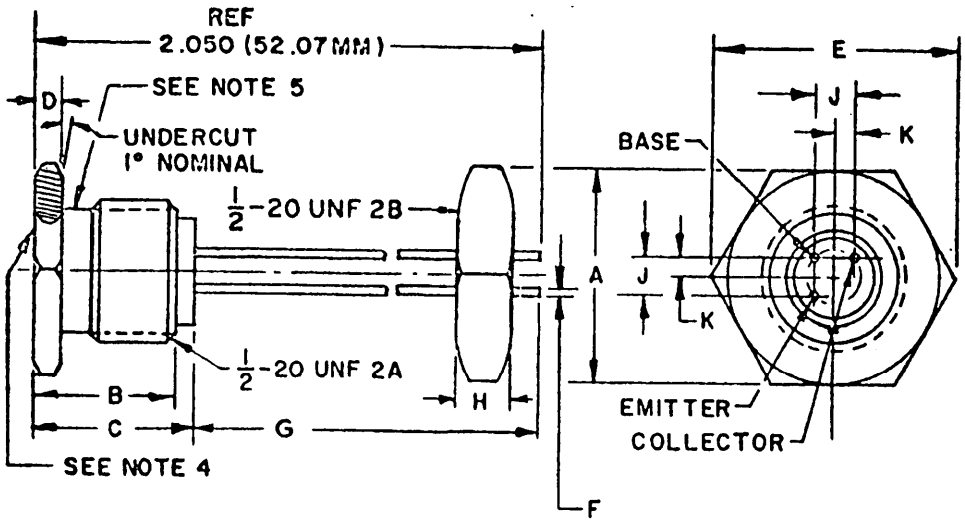
FIGURE 2. Gage for lead and tab location for transistor types 2N1039 and 2N1041.



DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	---	.850	---	21.59	
B	.345	.365	8.76	9.27	
C	---	.035	---	.89	
D	.435	.455	11.05	11.56	
E	.022	.028	.56	.71	6
F	1.500	1.750	38.10	44.45	6
G	.427	.447	10.85	11.35	5
H	---	.510	---	12.95	5
J	.1314	.1514	3.34	3.85	
K	.0707 Nom		1.80 Nom		

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. The orientation of the leads in relation to the hex flats is not controlled.
3. The collector shall be electrically connected to the case.
4. Temperature measurement point 0.060(1.52 mm) nominal from seat of heat sink.
5. Three places.
6. Three leads.

FIGURE 3. Physical dimensions of transistor types 2N2553 and 2N2555.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.740	.760	18.80	19.30	
B	.485	.515	12.32	13.08	
C	---	.550	---	13.97	
D	.083	.103	2.11	2.62	
E	---	.875	---	22.23	6
F	.022	.028	.56	.71	7
G	1.500	1.750	38.10	44.45	7
H	.177	.197	4.50	5.00	
J	.1314	.1514	3.34	3.85	
K	.0707 Nom		1.80 Nom		

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. The orientation of the leads in relation to the hex flats is not controlled.
3. The collector shall be electrically connected to the case.
4. Temperature measurement point 0.160(4.06 mm) nominal from center of heat sink.
5. Thread relief is 0.090 (2.29 mm) max. by 0.430(10.94 mm) dia. nominal.
6. Three places.
7. Three leads.

FIGURE 4. Physical dimensions of transistor types 2N2557 and 2N2559.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750 Method	MIL-STD-750 Details (See 4.4.2)	LTPD	Symbol	Limits Min	Limits Max	Unit
Subgroup 1			10				
Visual and mechanical examination	2071			---	---	---	---
Subgroup 2			5				
Breakdown voltage, collector to base	3001	Bias cond. D					
2N1039		I_C = -750 μAdc		BV_{CBO}	-60	---	Vdc
2N2553					-60	---	Vdc
2N2557					-60	---	Vdc
2N1041		I_C = -750 μAdc		BV_{CBO}	-100	---	Vdc
2N2555					-100	---	Vdc
2N2559					-100	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. D					
2N1039		I_C = -100 mAdc		BV_{CEO}	-40	---	Vdc
2N2553					-40	---	Vdc
2N2557					-40	---	Vdc
2N1041		I_C = -100 mAdc		BV_{CEO}	-60	---	Vdc
2N2555					-60	---	Vdc
2N2559					-60	---	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; I_E = -750 μAdc		BV_{EBO}	-20	---	Vdc
Collector to emitter cutoff current	3041	Bias cond. A					
2N1039		V_{CE} = -30 Vdc; V_{BE} = +0.2 Vdc		I_{CEX}	---	-750	μAdc
2N2553					---	-750	μAdc
2N2557					---	-750	μAdc
2N1041		V_{CE} = -50 Vdc; V_{BE} = +0.2 Vdc		I_{CEX}	---	-750	μAdc
2N2555					---	-750	μAdc
2N2559					---	-750	μAdc
Collector to base cutoff current	3036	Bias cond. D					
2N1039		V_{CB} = -30 Vdc		I_{CBO}	---	-70	μAdc
2N2553					---	-70	μAdc
2N2557					---	-70	μAdc
2N1041		V_{CB} = -50 Vdc		I_{CBO}	---	-70	μAdc
2N2555					---	-70	μAdc
2N2559					---	-70	μAdc
Subgroup 3			5				
Forward-current transfer ratio	3076	V_{CE} = -0.5 Vdc; I_C = -1 Adc		h_{FE}	20	60	---
Forward-current transfer ratio	3076	V_{CE} = -0.5 Vdc; I_C = -50 mAdc		h_{FE}	33	---	---
Collector to emitter voltage (saturated)	3071	I_C = -1 Adc; I_B = -0.1 Adc		$V_{CE}(sat)$	---	-0.25	Vdc

TABLE I. Group A inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (See 4.4.2)			Min	Max	
Subgroup 3 - Continued							
Base emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = -0.5 Vdc; I_C = -1 Adc		V_{BE}	---	-0.8	Vdc
Base emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = -0.5 Vdc; I_C = -50 mAdc		V_{BE}	---	-0.35	Vdc
Subgroup 4			5				
Magnitude of small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = -1.5 Vdc; I_C = -0.5 Adc; f = 112.5 kHz		$\lvert h_{fe} \rvert$	2	12	---
Static input resistance	3086	V_{CE} = -0.5 Vdc; I_C = -1 Adc		h_{IE}	---	60	ohms
Subgroup 5			10				
High-temperature operation:		T_A = +71°C					
Collector to base cutoff current	3036	Bias cond. D					
2N1039		V_{CB} = -30 Vdc		I_{CBO}	---	-2	mAdc
2N2553					---	-2	mAdc
2N2557					---	-2	mAdc
2N1041		V_{CB} = -50 Vdc		I_{CBO}	---	-2	mAdc
2N2555					---	-2	mAdc
2N2559					---	-2	mAdc
Low-temperature operation:		T_A = -65°C					
Forward-current transfer ratio	3076	V_{CE} = -0.5 Vdc; I_C = -50 mAdc		h_{FE}	15	---	---

TABLE II. Group B inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (See 4.4.2)			Min	Max	
Subgroup 1			20				
Physical dimensions	2066	(See figures 1, 3, and 4)		---	---	---	---
Subgroup 2			15				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. B, except in step 3, T_A = 100° + 0, -5°C		---	---	---	---

TABLE II Group B inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (See 4.4.2)			Min	Max	
Subgroup 2 - Continued							
Thermal shock (glass strain)	1056	Test cond. A		---	---	---	---
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D					
2N1039		V_{CB} = -30 Vdc		I_{CBO}	---	-70	μAdc
2N2553					---	-70	μAdc
2N2557					---	-70	μAdc
2N1041		V_{CB} = -50 Vdc			---	-70	μAdc
2N2555					---	-70	μAdc
2N2559					---	-70	μAdc
Forward-current transfer ratio	3076	V_{CE} = -0.5 Vdc; I_C = -1 Adc		h_{FE}	20	60	---
Subgroup 3			10				
Shock	2016	Nonoperating; 1,500 G; 0.5 ms; 5 blows in each orientation: X_1, Y_1, Y_2 and Z_1		---	---	---	---
Vibration, variable frequency	2056			---	---	---	---
Constant acceleration	2006	10,000 G in each orientation: X_1, Y_1, Y_2 and Z_1		---	---	---	---
End points: (Same as subgroup 2)							
Subgroup 4			10				
Terminal strength (lead fatigue)	2036	Test cond. E		---	---	---	---
End points:							
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks		---	---	$1x10^{-7}$	atm cc/s
Subgroup 5			20				
Salt atmosphere (corrosion)	1041			---	---	---	---
Subgroup 6			5				
High-temperature life (nonoperating)	1032	T_{stg} = +100°C time = 340 hours (see 4.3.4)		---	---	---	---

TABLE II. Group B inspection. - Continued

Examination or test	MIL-STD-750 Method	MIL-STD-750 Details (See 4.4.2)	LTPD	Symbol	Limits Min	Limits Max	Unit
Subgroup 6 - Continued							
End points:							
Collector to base cutoff current	3036						
2N1039		V_{CB} = -30 Vdc		I_{CBO}	---	-90	µAdc
2N2553					---	-90	µAdc
2N2557					---	-90	µAdc
2N1041		V_{CB} = -50 Vdc		I_{CBO}	---	-90	µAdc
2N2555					---	-90	µAdc
2N2559					---	-90	µAdc
Forward-current transfer ratio	3076	V_{CE} = -0.5 Vdc; I_C = -1 Adc		h_{FE}	16	72	---
Subgroup 7			5				
Steady-state operation life	1027	T_C = +55°C V_{CE} = -20 Vdc I_C = -600 mAdc time = 340 hours (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6)							

TABLE III. Group C inspection.

Examination or test	MIL-STD-750 Method	MIL-STD-750 Details (See 4.4.2)	LTPD	Symbol	Limits Min	Limits Max	Unit
Subgroup 1			10				
Barometric pressure, reduced (altitude operation)	1001	Normal mounting pressure = 8 mm Hg for 60 s minimum		---	---	---	---
Measurement during test:							
Collector to base cutoff current	3036	Bias cond. D					
2N1039		V_{CB} = -60 Vdc		I_{CBO}	---	-750	µAdc
2N2553					---	-750	µAdc
2N2557					---	-750	µAdc
2N1041		V_{CB} = -100 Vdc		I_{CBO}	---	-750	µAdc
2N2555					---	-750	µAdc
2N2559					---	-750	µAdc

TABLE III. Group C inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (See 4.4.2)			Min	Max	
Subgroup 1 - Continued							
Thermal resistance	3151						
2N1039				θ_{J-A}	---	0.188	°C/mW
2N1041					---	0.188	°C/mW
2N2553				θ_{J-A}	---	0.083	°C/mW
2N2555					---	0.083	°C/mW
2N2557				θ_{J-A}	---	0.068	°C/mW
2N2559					---	0.068	°C/mW
Subgroup 2			10				
Resistance to solvents	---	MIL-STD-202, Method 215 (see 4.4.1)		---	---	---	---
Subgroup 3			$\lambda = 7$				
High-temperature life (nonoperating)	1031	$T_{stg} = +100°C$ (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							
Subgroup 4			$\lambda = 7$				
Steady-state operation life	1026	$T_C = +55°C$; $V_{CE} = -20$ Vdc; $I_C = -600$ mAdc (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III. Qualification of the devices shall be as follows:

(a) Qualification inspection may be conducted on any one or more types by individually sampling each as required, or

(b) The manufacturer has the option of qualifying the entire family by the following sampling procedure: One of the three types 2N1039, 2N2553 or 2N2557 and one of the three types 2N1041, 2N2555 or 2N2559 shall be subjected to complete qualification inspection. The required sample size for subgroups 1, 2, 3, 4 and 5 of group B inspection and subgroup 1 of group C inspection may be made up of equal quantities of each of the two types selected provided that they are both in the same case outlines. One transistor type in each case outline (see figures 1, 3 and 4) shall be subjected to the examinations and tests of subgroups 1 and 5 of group B inspection and the thermal resistance test of subgroup 1 of group C inspection. A full required sample of each type (six types) shall be subjected to subgroups 6 and 7 of group B inspection after being subjected to and passing all examinations and tests of group A inspection.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every six months during production.

4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hours life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria, see 4.3.3.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

4.4.1 Resistance to solvents. Transistors shall be subjected to tests in accordance with method 215 of MIL-STD-202. The following details shall apply:

(a) All areas of the transistor body where marking has been applied shall be brushed.

(b) After subjection to the tests there shall be no evidence of mechanical damage to the device and markings shall have remained legible.

4.4.2 Inspection conditions. Unless otherwise specified herein, all inspections shall be conducted at a case temperature (T_C) of 25°C.

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES

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

6.2 Ordering data.

(a) Lead finish if other than gold-plated (see 3.3.1).

(b) Terminal-lead length if other than specified in figures 1, 3, and 4 (see 3.3.2).

Custodians:
Army - EL
Navy - EC
Air Force - 17

Review activities:
Army - MU, MI
Air Force - 11, 80
DSA - ES

User activities:
Army - AV, SM
Navy - AS, CG, MC, OS, SH
Air Force - 13, 15, 19

Preparing activity:
Navy - EC

Agent:
DSA - ES

(Project 5961-0225)