MILITARY SPECIFICATION

TRANSISTOR, TYPES 2N1173 AND 2N1174

1. SCOPE

1.1 Scope.- This specification covers the detail requirements for germanium, NPN type 2N1173 and PNP type 2N1174 transistors, the general requirements which are in accordance with Specification MIL-S-19500, unless otherwise specified herein. The transistors have the following salient characteristics 1/:

	h_{FE} I_E = 10 mA	h_{FE} i_e=200ma(pulse)	h_{fe} I_E = 0.5 mA	V_{CE}(sat) I = 10 mA
Min.	50	25	50	---
Max.	200	---	200	-75 mVdc

	C_{ob} V_{CB} = -10 V	NF at 0.5 mA	t_d+t_r See table III	t_s+t_f See table III
Min.	---	---	---	---
Max.	25 $\mu\mu$f	10 db	0.5 μsec	2.0 μsec

1.2 Absolute maximum ratings 1/

P_C 2/ W	T_{stg} °C	V_{CEV} 3/ Vdc	V_{CEO} 3/ Vdc	V_{CBO} 3/ Vdc	V_{EBO} 3/ Vdc	I_E mAdc	I_C mAdc
.25	-65 to +100	-35	-20	-35	-35	200	-200

1/ Polarities specified are for PNP type 2N1174; for NPN type 2N1173, reverse polarities apply.

2/ Collector power ratings at temperatures higher than 25°C, P_C is derated at 3.33 mW/°C.

3/ These voltage ratings may be exceeded (without permanently impairing the serviceability of the transistor) provided the power is limited to 10 mW.

2. APPLICABLE DOCUMENTS

2.1 The following document, of the issue in effect on the date of invitation for bids, forms a part of this specification to the extent specified herein:

SPECIFICATION

MILITARY

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

(Copies of specifications, standards, drawings, and publications required by contractors 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. - Transistors shall be in accordance with Specification MIL-S-19500 and as specified herein.

3.2 Design and construction. - Transistors shall be of the design, construction and physical dimensions shown on figure 1.

3.3 Abbreviations and symbols. - The following abbreviation and symbol shall also apply:

BV_{CEV} . . . . . Collector to emitter breakdown voltage, reverse bias.

3.4 Performance characteristics. - Performance characteristics shall be as specified in 4.5, 4.6 and 4.7.

3.5 Marking. Transistors shall be marked with the manufacturer's identification, "USN" prefix, type designation, acceptance date, and lot identification suffix letter.

3.5.1 Lot identification suffix letter. - Each inspection lot shall be identified by a capital Gothic letter. The suffix letter shall be marked on each transistor immediately following the coded acceptance date. A different letter shall be used for each acceptance lot in any 1 week.

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification tests. - Qualification tests shall be conducted at a laboratory satisfactory to the Bureau of Ships. Qualification tests shall consist of the tests specified in 4.5, 4.6 and 4.7. (Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.1)).

4.2 Delayed delivery. - Devices held for a period exceeding 6 months following source inspection acceptance shall be reinspected for all Group A requirements prior to shipment.

4.3 Inspection conditions. - Unless otherwise specified, electrical measurements shall be taken within 3 seconds of application of bias and the ambient temperature shall be maintained at 25 ± 3°C.

4.4 Acceptance inspection. - Acceptance inspection shall consist of examinations and tests specified in 4.5, 4.6 and 4.7. Sampling shall be in accordance with 4.4.1 except for life tests which shall be in accordance with method B of Specification MIL-S-19500.

4.4.1 Acceptance sampling. - The acceptance sample size shall be chosen by the manufacturer and shall be adequate to assure, with a 90 percent confidence, the specified Lot Tolerance Percent Defective (LTPD). At the discretion of the manufacturer, 100 percent testing of the inspection lot to the specified LTPD shall be allowed.

4.4.2 Acceptance number. - The acceptance number associated with the selected sample size shall be determined using a suitable acceptance sampling plan which will assure the specified LTPD with a 90 percent confidence.

4.4.3 Table I shows the minimum sample size necessary to assure a maximum LTPD, with a confidence level of 90 percent for various failure acceptance numbers (a). (Rejection number, r, equals a + 1).

4.4.4 Selection of samples. - The selection of a sample size shall be at the option of the manufacturer. The minimum quality (actual percent defective of the manufactured lot necessary to accept 95 percent (19 out of 20)) of the lots submitted is shown, for information, in table II; the values shown are equivalent to AQL's for the respective sample sizes and acceptance numbers shown in table I.

4.4.5 Additional samples. - The manufacturer may add an additional quantity to the initial sample, but this may be done only once for any subgroup and the added samples shall be subjected to all the tests within

the subgroup. The total sample (initial and added samples) shall determine the new acceptance number. The total defectives of the intial and second sample shall be additive and shall comply with the specified LTPD requirement.

4.4.6 Tightened inspection. Tightened inspection on resubmitted lots is obtained by testing to an LTPD equal to the next-lower number in the series 1, 1.5, 2, 3, 5 and 7 x 10^n from the specified initial LTPD.

4.4.7 Reduced inspection. Eligibility for reduced inspection shall be achieved when the following criteria have been met:

(a) The immediately preceding five lots have met the acceptance requirements.
(b) The average percent defective over the preceding five lots has not exceeded one-tenth of the specified LTPD.
(c) There has been no unusual discontinuity in production in the immediately preceding five lots.

4.4.7.1 The manufacturer shall lose eligibility for reduced inspection whenever two of five consecutive lots have failed the acceptance requirements or the percentage defective over the preceding five lots exceeds two-tenths of the specified LTPD. (In case of a single lot failure, the sample for inspection shall have been completely tested to determine the total number of defectives for percentage defective calculation.)

4.4.7.2 Reduced inspection is performed by testing to an LTPD equal to the next higher number in the series 1, 1.5, 2, 3, 5 and 7 x 10^n from the specified initial LTPD.

4.4.8 Acceptance-inspection information. One copy of the acceptance-inspection information pertinent to the transistor inspection lot shall be furnished by the transistor supplier and shall accompany each transistor shipment from the inspection lot to the equipment manufacturer.

4.5 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table III. A device having one or more defects shall be counted as one defective.

4.6 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table IV.

4.6.1 Disposition of sample units. Sample units which have been subjected to and passed subgroups 1 and 5 of group B and subgroups 1 and 3 of group C inspection may be delivered on the contract or order provided that these sample units are subjected to and pass group A inspection. Units found defective in the course of inspection shall not be delivered on the contract or order.

4.7 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table V.

4.7.1 Salt atmosphere. The device shall be examined for destructive corrosion and illegible marking.

4.8 Samples for destructive tests. Sample devices for the tests in subgroups 2 and 3 of group B inspection and subgroup 2 of group C inspection may be units which are outside the group A requirements by less than 20 percent on the following parameters: BV_{CEO}, $V_{CE}(sat)$, $V_{BE}(sat)$, h_{fe}, C_{ob}, t_d+t_r and t_s+t_f.

5. PREPARATION FOR DELIVERY

5.1 See Specification MIL-S-19500.

6. NOTES

6.1 The activity responsible for the qualified products list is the Bureau of Ships, Department of the Navy, Washington 25, D. C., and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests shall be made in accordance with "Provisions Governing Qualification". (Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pa.).

Notice. - When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation or conveying any rights or permission to manufacture, use or sell any patented invention that may be in any way related thereto.

Preparing activity:
Navy - Ships
(Project 5961-N173(NAVY))

Table I - *Minimum size of sample to be tested to assure, with a 90 percent confidence, a lot* percent defective no greater than the LTPD specified.

Maximum percent *defective* (LTPD)	20	15	10	7	5	3	2	1.5	1	0.7
Acceptance number (a) (r = a + 1)	Minimum sample sizes									
0	11	15	22	32	45	76	116	153	231	328
1	18	25	38	55	77	129	195	258	390	555
2	25	34	52	75	105	176	266	354	533	759
3	32	43	65	94	132	221	333	444	668	953
4	38	52	78	113	158	265	398	531	798	1140
5	45	60	91	131	184	308	462	617	927	1323
6	51	68	104	149	209	349	528	700	1054	1503
7	57	77	116	166	234	390	589	783	1178	1680
8	63	85	128	184	258	431	648	864	1300	1854
9	69	93	140	201	282	471	709	945	1421	2027
10	75	100	152	218	306	511	770	1025	1541	2199

Table II - Minimum quality required to accept (on the average) 19 of 20 lots.

Maximum percent *defective* (LTPD)	20	15	10	7	5	3	2	1.5	1	0.7
Acceptance number (a) (r = a + 1)	Minimum quality (percent defective) (equivalent to AQL)									
0	0.46	0.34	0.23	0.16	0.11	0.07	0.04	0.03	0.02	0.02
1	2.0	1.4	.94	.65	.46	.28	.18	.14	.09	.06
2	3.4	2.4	1.6	1.1	.78	.47	.31	.23	.15	.11
3	4.4	3.2	2.1	1.5	1.0	.62	.41	.31	.20	.14
4	5.3	3.9	2.6	1.8	1.3	.75	.50	.37	.25	.17
5	6.0	4.4	2.9	2.0	1.4	.85	.57	.42	.28	.20
6	6.6	4.9	3.2	2.2	1.6	.94	.62	.47	.31	.22
7	7.2	5.3	3.5	2.4	1.7	1.0	.67	.51	.34	.24
8	7.7	5.6	3.7	2.6	1.8	1.1	.72	.54	.36	.25
9	8.1	6.0	3.9	2.7	1.9	1.2	.77	.58	.38	.27
10	8.4	6.3	4.1	2.9	2.0	1.2	.80	.60	.40	.28

TABLE III - Group A inspection

Examination or test	Conditions 1/	LTPD	Symbol	Limits 1/		Units
				Min.	Max.	
Subgroup 1						
Visual and mechanical examination	---	5	---	---	---	---
Subgroup 2						
Collector to emitter breakdown voltage back biased base	I_C = -100 μAdc V_{BE} = 1 Vdc	3	BV_{CEV}	-35	---	Vdc
Collector to emitter breakdown voltage, open base	i_c = -5 ma(pulse) $t_p \leq$ 1 msec. duty cycle ≤ 15%		BV_{CEO}	-20	---	Vdc
Emitter to base breakdown voltage, open collector	I_E = -100 μAdc		BV_{EBO}	-35	---	Vdc
Collector cutoff current, open emitter	V_{CB} = -20 Vdc		I_{CBO}	---	-10	μAdc
Emitter cutoff current, open emitter	V_{EB} = -20 Vdc		I_{EBO}	---	-10	μAdc
Collector cutoff current, open emitter	V_{CB} = -20 Vdc T_A = +70°C		I_{CBO}	---	-100 (+150 for 2N1173)	μAdc
Subgroup 3						
Static forward current transfer ratio	I_E = 10 mAdc V_{CE} = -1 Vdc	3	h_{FE}	50	200	---
Saturation voltage (collector to emitter)	I_C = -10 mAdc I_B = -0.4 mAdc		V_{CE}(sat)	---	-75	mVdc
Saturation voltage (base to emitter)	I_C = -10 mAdc I_B = -0.4 mAdc		V_{BE}(sat)	-125	-300	mVdc
Static forward current transfer ratio	V_{CE} = -1 Vdc i_e = 200 ma (pulse) duty cycle ≤ 15% $t_p \leq$ 1 msec		h_{FE}	25	---	---
Saturation voltage (collector to emitter)	I_C = -50 mAdc I_B = -2 mAdc		V_{CE}(sat)	---	-200	mVdc
Saturation voltage (base to emitter)	I_C = -50 mAdc I_B = -2 mAdc		V_{BE}(sat)	---	-500	mVdc

See footnote at end of table.

TABLE III - Group A inspection (Cont'd.)

Examination or test	Conditions 1/	LTPD	Symbol	Limits 1/		Units
				Min.	Max.	
Subgroup 4						
Small-signal short-circuit forward-current transfer ratio	V_{CE} = -10 Vdc I_E = 0.5 mAdc		h_{fe}	50	200	---
Output capacitance	V_{CB} = -10 Vdc		C_{ob}	---	25	$\mu\mu f$
Noise figure	V_{CE} = -5 Vdc I_E = 0.5 mAdc f = 1 kc		NF	---	10	db
Delay and rise time	Method A $V_{BE(0)}$ = 1 Vdc $I_{B(1)}$ = -5 mAdc V_{CC} = -10 Vdc R_C = 300 ohms	3	t_d+t_r	---	0.5	μsec
Storage and fall time	Method A $I_{B(1)}$ = -1 mAdc $I_{B(2)}$ = 1 mAdc V_{CC} = -10 Vdc R_C = 1000 ohms		t_s+t_f	---	2.0	μsec

1/ Conditions and limits specified are for PNP type 2N1174; for NPN type 2N1173, reverse polarities apply.

TABLE IV - Group B inspection

Examination or test	Conditions 1/	LTPD	Symbol	Limits 1/		Units
				Min.	Max.	
Subgroup 1						
Physical dimensions	---	15	---	---	---	---
Subgroup 2						
Soldering	---		---	---	---	---
Temperature cycling	5 cycles $T_{(high)} = +100^{\circ}{}^{+0^{\circ}}_{-5^{\circ}}$C.		---	---	---	---

See footnote at end of table.

TABLE IV - Group B inspection (Cont'd.)

Examination or test	Conditions 1/	LTPD	Symbol	Limits 1/		Units
				Min.	Max.	
Subgroup 2 (Cont'd.)						
Thermal shock (glass strain)	$T_{(high)}$ = +85° ± 5°C. $T_{(low)}$ = 0° ± 2°C.		---	---	---	---
Moisture resistance	---		---	---	---	---
End points:		10				
Collector to emitter breakdown voltage, back biased base	I_C = -150 μ Adc V_{BE} = 1 Vdc		BV_{CEV}	-35	---	Vdc
Emitter breakdown voltage open collector	I_E = -150 μ Adc		BV_{EBO}	-35	---	Vdc
Static forward current transfer ratio	V_{CE} = -1.0 Vdc I_E = 10 mAdc		h_{FE}	35	---	---
Subgroup 3						
Shock	5 blows X_1, Y_1, Y_2 & Z_1		---	---	---	---
Constant acceleration	15,000 G		---	---	---	---
Vibration, variable frequency	---	10	---	---	---	---
Vibration fatigue	---		---	---	---	---
End points: (Same as for subgroup 2)						
Subgroup 4						
Lead fatigue	8 ± 0.5 oz No lead restriction	10	---	---	---	---
Subgroup 5						
Storage life	Method B $T_A = 100^{\circ}{}^{+0^{\circ}}_{-5^{\circ}}$C	λ = 5	---	---	---	---
End points:						
Collector cutoff current, open emitter	V_{CB} = -20 Vdc		I_{CBO}	---	-20	μ Adc
Emitter cutoff current, open collector	V_{EB} = -20 Vdc		I_{EBO}	---	-20	μ Adc
Collector to emitter breakdown voltage, back biased base	I_C = -150 μ Adc V_{BE} = 1 Vdc		BV_{CEV}	-35	---	Vdc

See footnote at end of table.

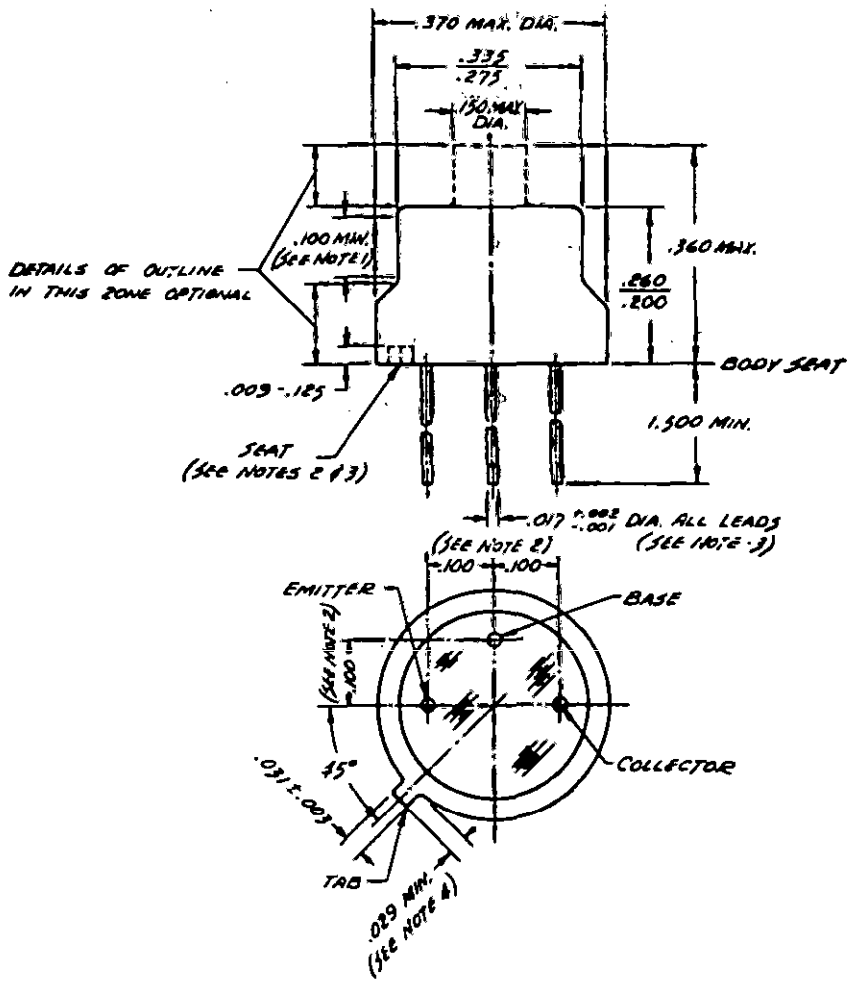
TABLE IV - Group B inspection (Cont'd.)

Examination or test	Conditions 1/	LTPD	Symbol	Limits 1/		Units
				Min.	Max.	
Subgroup 5 (Cont'd.)						
Static forward current transfer ratio	I_E = 10 mAdc V_{CE} = -1 Vdc		h_{FE}	35	---	---

1/ Conditions and limits specified are for PNP type 2N1174; for NPN type 2N1173, reverse polarities apply.

TABLE V - Group C inspection

Examination or test	Conditions	LTPD	Symbol	Limits		Units
				Min.	Max.	
Subgroup 1						
Thermal resistance	Period = 6 months	5	θ_{J-A}	---	0.3	°C/mW
Subgroup 2						
Salt atmosphere (corrosion)	Period = 6 months See 4.7.1	15	---	---	---	---
End points:						
(Same as for subgroup 5 of table IV)						
Subgroup 3						
Operation life	Period = 1 month	n = 10	---	---	---	---
	Method B T_A = 25° ± 3°C					
	V_{CB} = -25 ± 2.5 Vdc $P_C = 250^{+0}_{-25}$ mW					
End points:						
(Same as for subgroup 5 of table IV)						



NOTES:

1:- The variation in diameter within this zone shall not exceed 0.010.

2:- Maximum diameter leads measured at a gaging plane 0.054 $^{+.001}_{-.000}$ below the body seat shall be within 0.007 of their true location relative to the maximum width tab.

3:- The specified lead diameter applies in the zone between 0.050 and 0.250 from the body seat. Between 0.250 and 1.500 the diameter shall not exceed 0.021. Outside of these zones the diameter is not controlled.

4:- Measured from maximum diameter of the actual device.

5:- All dimensions are in inches.

Figure 1 - Dimensions of transistor, types 2N1173 and 2N1174.

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