

9 December 1966

SUPERSEDING
MIL-S-19500/207B(EL)

13 October 1966

MILITARY SPECIFICATION

TRANSISTOR, NPN, SILICON
TYPES 2N1479, 2N1480, 2N1481, 2N1482

1. SCOPE

1.1 Scope.- This specification covers the detail requirements for silicon, NPN, medium-power transistors for use in compatible equipment circuits. (See 3.4 and 6.2 herein.)

1.2 Outline and dimensions.- See Figure 1 herein. (TO-5)

1.3 Maximum ratings.-

	P_T ^{1/}	V_{CBO}	V_{CEO}	V_{CEX}	V_{EBO}	I_B	I_C	T_J	θ_{J-C}	T_{stg}
	W	Vdc	Vdc	Vdc	Vdc	Adc	Adc	°C	°C/W	°C
2N1479	1	60	40	60	12	1.0	1.5	+200	35	-65to+200
2N1480	1	100	55	100	12	1.0	1.5	+200	35	-65to+200
2N1481	1	60	40	60	12	1.0	1.5	+200	35	-65to+200
2N1482	1	100	55	100	12	1.0	1.5	+200	35	-65to+200

^{1/}

This power dissipation is for 1000 hours expected life at $T_A = +25^\circ\text{C}$.

1.4 Particular electrical characteristics.- (at $T_A = +25^\circ\text{C}$, unless otherwise specified):

	h_{FE}		$V_{CE(sat)}$		V_{BE}		I_{CBO}		I_{EBO}		f_{ab}	
	at: $I_C = 200 \text{ mAdc}$ $V_{CE} = 4 \text{ Vdc}$		at: ^{1/} $I_C = 200 \text{ mAdc}$		at: $I_C = 200 \text{ mAdc}$ $V_{CE} = 4 \text{ Vdc}$		at: $V_{CB} = 30 \text{ Vdc}$		at: $V_{EB} = 12 \text{ Vdc}$		at: $V_{CB} = 28 \text{ Vdc}$ $I_C = 5 \text{ mAdc}$	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2N1479	20	60	---	0.75	---	1.5	---	5	---	10	800	---
2N1480	20	60	---	0.75	---	1.5	---	5	---	10	800	---
2N1481	35	100	---	0.75	---	1.5	---	5	---	10	800	---
2N1482	35	100	---	0.75	---	1.5	---	5	---	10	800	---

^{1/}

At $I_B = 20 \text{ mAdc}$ for 2N1479, 2N1480; at $I_B = 10 \text{ mAdc}$ for 2N1481, 2N1482.

FSC-5961

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 this specification to the extent specified herein:

SPECIFICATIONS

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 contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer. Both the title and number or symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 Requirements.- Requirements for the transistors shall be in accordance with Specification MIL-S-19500 and as otherwise specified herein.

3.2 Abbreviations and symbols.- The abbreviations and symbols used herein are defined in Specification MIL-S-19500, and as follows:

$t_{on} \dots \dots \dots (t_r + t_d)$

$t_{off} \dots \dots \dots (t_s + t_f)$

⊕- 3.3 Design and construction.- The transistor shall be of the design, construction, and physical dimensions specified on Figure 1. (See 3.3.2 herein.)

3.3.1 Terminal arrangement.- The terminal arrangement on the transistor shall be as indicated in Figure 1.

3.3.2 Terminal-lead length.- Terminal-lead length(s) other than that specified in Figure 1 may be furnished under contract or order (see 6.3 herein) when the devices covered herein are required directly for particular equipment-circuit installation or for automatic-assembly-technique programs. Where such longer leads are required and provided, it shall not be construed as affecting adversely the Qualified-product status of the device, or applicable JAN marking.

3.3.3 Operating position.- The transistor shall be capable of proper operation in any position.

3.4 Performance characteristics.- The transistor performance characteristics shall be as specified in Tables I, II, and III herein. Except where specifically differentiated for respective transistor types (see 1.3, 1.4, and Tables I, II, and III herein), the performance requirements, including characteristics, ratings, and test conditions, apply equally to all transistor types covered herein.

3.5 Marking.- Except as otherwise specified herein, marking shall be in accordance with Specification MIL-S-19500. If any specification-requirements waiver has been granted, the product-identification marking shall consist of the 'classification' type designation only. The 'manufacturer's identification' and 'country or origin' may, at option of the manufacturer, be omitted from being marked directly on the semiconductor device covered herein. (See 3.3.2 and 4.3.4 herein.)

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- Except as otherwise specified herein, the responsibility for inspection, general procedures for acceptance, classification of inspection, and inspection conditions and methods of test shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions.

4.1.1 Procedure for lots held more than 1 year.- The requirements in Specification MIL-S-19500, paragraph 4.2, applicable to "lots held more than 6 months" shall apply, herewith, only to lots held more than 1 year.

4.2 Qualification and acceptance inspection.- Qualification and Quality Conformance inspection shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions, and as otherwise specified herein (see 4.2.2 herein). Groups A, B, and C inspection shall consist of the examinations and tests specified in Table I, II and III, respectively, herein. Quality Conformance inspection shall include inspection of Preparation for Delivery (see 5.1 herein).

4.2.1 Specified LTPD for subgroups.- The LTPD specified for a subgroup in Table I, II, and III herein shall apply for all of the tests, combined, in the subgroup.

4.2.2 Group B-Group C life test samples.- Samples that have been subjected to Group B, 340-hour life test may be continued on test for 1000 hours in order to satisfy Group C life test requirements. These samples shall be predesignated, and shall remain subjected to the Group C 1000-hour evaluation after they have passed the Group B, 340-hour acceptance criteria. The cumulative total of failures found during the subsequent interval up to 1000 hours shall be computed for 1000-hour acceptance criteria. (See 4.2.3 herein.)

4.2.3 Group C testing.- Unless otherwise specified, Group C tests shall be performed on the initial lot and thereafter on a lot every 6 months. (See Table III herein.) The contractor shall, throughout the course of a contract or order, permit the Government representative to scrutinize all test data and findings covering manufacturer's test program on Group C characteristics and parameters for the product concerned. Upon determination by the Government inspector (in advance of Group C, 6-month, test results) that Group C parameters are not being adequately met, the Government inspector may require lot-by-lot inspection, normally for a minimum of 3 consecutive lots, to be performed for required Group C tests.

4.2.4 Disposition of sample units.- Sample units that have been subjected to Group B, Subgroup 2, 4, and 5 tests shall not be delivered on the contract or order. Sample units that have been subjected to and have passed Group B, Subgroups 1, 3, 6, 7 and 8 tests and all Group C tests, (these tests to be considered non-destructive) may be delivered on the contract or order provided that, after Group B inspection is terminated, those sample units are subjected to and pass Group A inspection. Defective units from any sample group that may have passed group inspection shall not be delivered on the contract or order until the defect(s) has been remedied to the satisfaction of the Government.

4.3 Particular examination and test requirements.-

4.3.1 Interval for End-Point Test measurements.- All applicable End-Point Test measurements shall be performed after sample units have been subjected to required physical-mechanical or environmental test(s), in accordance with the following time-delay limitations:

- (a) For Qualification inspection: within 24 hours.
- (b) For Quality Conformance inspection: within 96 hours; however, at discretion of the Government inspector, a more protracted interval may be allowed.

4.3.2 Shock.- The shock testing apparatus shall be capable of providing shock pulses of the specified peak acceleration, waveform, and pulse duration to the body of the device. The acceleration pulse, as determined from the unfiltered output of a transducer with a natural frequency greater than 10,000 cycles per second, shall be a half-sine waveform with an allowable distortion not greater than ± 20 percent of the specified peak acceleration. The pulse duration shall be measured between the points at 10 percent of the peak acceleration during rise and at 10 percent of the peak acceleration during decay. Absolute tolerance of the pulse duration shall be ± 30 percent of the specified duration.

4.3.5 Mechanical damage resulting from tests.- Except for intentionally deforming, mutilating, or dismembering mechanical-stress tests to which samples are subjected, there shall be no evidence of mechanical damage to any sample unit as a result of any of the Groups A, B, or C tests.

4.3.4 Marking legibility.- Marking shall be legible before and after all tests.

Table I. Group A inspection.

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
<u>Subgroup 1</u>			10			
2071	Visual and mechanical examination	---	---	---	---	---
<u>Subgroup 2</u>			5			
3036	Collector-base cutoff current:	Bias Cond. D				
	2N1479, 2N1481	$V_{CB} = 30 \text{ Vdc}$	I_{CBO}	---	5	μAdc
	2N1480, 2N1482	$V_{CB} = 50 \text{ Vdc}$	I_{CBO}	---	5	μAdc
3061	Emitter-base cutoff current	Bias Cond. D $V_{EB} = 12 \text{ Vdc}$	I_{EBO}	---	10	μAdc
3011	Collector-emitter breakdown voltage:	Bias Cond. D $I_C = 50 \text{ mAdc}$				
	2N1479, 2N1481		BV_{CEO}	40	---	Vdc
	2N1480, 2N1482		BV_{CEO}	55	---	Vdc
3011	Collector-emitter breakdown voltage, emitter-to-base reversed biased:	Bias Cond. A $I_C = 0.25 \text{ mAdc}$ $V_{EB} = 1.5 \text{ Vdc}$				
	2N1479, 2N1481		BV_{CEX}	60	---	Vdc
	2N1480, 2N1482		BV_{CEX}	100	---	Vdc

Table I. Group A inspection.-(Cont'd)

Test Method per MIL-STD-750	Examination or test <u>1/</u>	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
<u>Subgroup 3</u>			5			
3076	Static forward-current transfer ratio:	$I_C = 200 \text{ mA dc}$ $V_{CE} = 4 \text{ V dc}$				
	2N1479, 2N1480 2N1481, 2N1482		h_{FE} h_{FE}	20 35	60 100	--- ---
3071	Collector-emitter saturation voltage:	$I_C = 200 \text{ mA dc}$				
	2N1479, 2N1480 2N1481, 2N1482	$I_B = 20 \text{ mA dc}$ $I_B = 10 \text{ mA dc}$	$V_{CE(sat)}$ $V_{CE(sat)}$	--- ---	0.75 0.75	Vdc Vdc
3066	Base-to-emitter voltage	Test Cond. B $I_C = 200 \text{ mA dc}$ $V_{CE} = 4 \text{ V dc}$	V_{BE}	---	1.5	Vdc
<u>Subgroup 4</u>			5			
3301	Small-signal short-circuit forward-current transfer-ratio cutoff frequency	$I_C = 5 \text{ mA dc}$ $V_{CB} = 28 \text{ V dc}$	f_{ab}	800	---	KHz
3251	Total switching time	$R_C = 59 \text{ ohms}$ $V_{CC} = 12 \text{ V dc}$ $I_{B(o)} = I_{B(2)} = 8.5 \text{ mA dc}$ $I_{B(1)} = 20 \text{ mA dc}$	t_{on+} t_{off}	---	25	usec

^{1/}
See 3.4 herein.

Table II. Group B inspection.

Test Method per MIL-STD-750	Examination or test <u>1/</u>	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
	<u>Subgroup 1</u>		20			
2066	Physical dimensions	---	---	---	---	---
	<u>Subgroup 2</u>		10			
*- 2026	Solderability	Omit aging	---	---	---	---
1051	Temperature cycling	Test Cond. C 10 cycles	---	---	---	---
1056	Thermal shock (glass strain)	Test Cond. A	---	---	---	---
<u>2/</u>	Seal (leak rate)	Test Cond. C, procedure III; Test Cond. A for gross leaks	---	---	10 ⁻⁷	atm cc/sec
1021	Moisture resistance	---	---	---	---	---
	<u>End-point tests:</u>					
3036	<u>Collector-base cutoff current:</u>	Bias Cond. D				
	2N1479, 2N1481	V _{CB} = 30 Vdc	I _{CBO}	---	5	uAdc
	2N1480, 2N1482	V _{CB} = 50 Vdc	I _{CBO}	---	5	uAdc
3076	<u>Static forward-current transfer ratio:</u>	I _C = 200 mAdc V _{CE} = 4 Vdc				
	2N1479, 2N1480		h _{FE}	20	60	---
	2N1481, 2N1482		h _{FE}	35	100	---

Table II. Group B inspection-(Cont'd)

Test Method per MIL-STD-750	Examination or test <u>1/</u>	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
<u>Subgroup 3</u>			10			
2016	Shock	<u>3/</u> Non-operating G = 500 5 blows of 1.0 msec ea. in orientations X1, Y1, Y2, Z1 (total = 20 blows)	---	---	---	---
2046	Vibration fatigue	Non-operating	---	---	---	---
2056	Vibration, variable frequency	---	---	---	---	---
2006	Constant acceleration (centrifugal)	10,000G Orientations X1, Y1, Y2, Z1	---	---	---	---
<u>End-point tests:</u> Same as for Subgroup 2 above						
<u>Subgroup 4</u>			20			
2036	Terminal strength (lead fatigue)	Test Cond. E	---	---	---	---
<u>End-point tests:</u> Same as for Subgroup 2 above						
<u>Subgroup 5</u>			20			
1041	Salt atmosphere (corrosion)	---	---	---	---	---
<u>End-point tests:</u> Same as for Subgroup 2 above						
<u>Subgroup 6</u> ^{4/}						
<u>5/</u> 3036	High-temperature operation: Collector-base cutoff current: 2N1479, 2N1481 2N1480, 2N1482	T _A = +175° +5° C -0° C Bias Cond. D V _{CB} = 30 Vdc V _{CB} = 50 Vdc	15	I _{CBO} I _{CBO}	---	0.75 mAdc 0.75 mAdc

Table II: Group B inspection-(Cont'd)

Test Method per MIL-STD-750	Examination or test <u>1/</u>	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
<u>Subgroup 6</u> <u>4/</u> - (Cont'd)						
<u>5/</u>	Low-temperature operation:	$T_A = -55^{\circ} \text{ to } +3^{\circ} \text{ C}$				
3076	Static forward-current transfer ratio:	$I_C = 200 \text{ mA dc}$ $V_{CE} = 4 \text{ V dc}$				
	2N1479, 2N1480 2N1481, 2N1482		h_{FE} h_{FE}	10 17	---	---
			10			
<u>Subgroup 7</u>						
1031	High-temperature life (non-operating)	$T_{stg} = +200^{\circ} \text{ C}$ $t = 340 \text{ hours}$ <u>6/</u>				
	<u>End-point tests:</u>					
3036	<u>Collector-base cutoff current:</u>	Bias Cond. D				
	2N1479, 2N1481 2N1480, 2N1482	$V_{CB} = 30 \text{ V dc}$ $V_{CB} = 50 \text{ V dc}$	I_{CBO} I_{CBO}	---	10	$\mu\text{A dc}$ $\mu\text{A dc}$
3076	Static forward-current transfer ratio:	$I_C = 200 \text{ mA dc}$ $V_{CE} = 4 \text{ V dc}$				
	2N1479, 2N1480 2N1481, 2N1482		h_{FE} h_{FE}	15 25	75 125	---
			10			
<u>Subgroup 8</u>						
1026	Steady-state operation life:	$T_A = +25^{\circ} \text{ C}$ $V_{CE} = 28 \text{ V dc}$ $P_T = 1.0 \text{ W}$ $t = 340 \text{ hours}$ <u>6/</u>				
	<u>End-point tests:</u>					
	Same as for Subgroup 7 above					

1/ See 3.4 and 4.3.1 herein.

2/ Per Method 112 in Standard MIL-STD-202.

3/ See 4.3.2 herein.

4/ For this Subgroup, the sample units subjected to the High-Temp. Oper. test shall be permitted to return to and be stabilized at room ambient temperature prior to their being subjected to the Low-Temp. Oper. test.

5/ Measurement(s) shall be made after thermal equilibrium has been reached at the temperature specified.

6/ See 4.2.2 herein.

Table III. Group C inspection. ^{1/}

Test Method per MIL-STD-750	Examination or test <u>2/</u>	Conditions	LTPD Symbol	Limit		Unit
				Min	Max	
<u>Subgroup 1</u>			20			
1001	Barometric pressure, reduced (altitude operation):	Pressure=8±2 mmHg Normal mounting t = 1 minute, minimum	---	---	---	---
3036	<u>Measurement during test:</u> Collector-to-base cutoff current:	Bias Cond. D				
	2N1479, 2N1481	V _{CB} = 60 Vdc	I _{CBO}	---	100	uAdc
	2N1480, 2N1482	V _{CB} = 100 Vdc	I _{CBO}	---	100	uAdc
* 3151	Thermal resistance (junction-to-case)	---	e _{J-C}	---	35	°C/W
<u>Subgroup 2</u>			λ=10			
1031	High-temperature life (non-operating)	T _{stg} = +200°C t = 1000 hours <u>3/</u>	---	---	---	---
3036	<u>End-point tests:</u> Collector-base cutoff current:	Bias Cond. D				
	2N1479, 2N1481	V _{CB} =30 Vdc	I _{CBO}	---	10	uAdc
	2N1480, 2N1482	V _{CB} =50 Vdc	I _{CBO}	---	10	uAdc
3076	Static forward-current transfer ratio:	I _C =200 mAdc V _{CE} =4 Vdc				
	2N1479, 2N1480		h _{FE}	15	75	---
	2N1481, 2N1482		h _{FE}	25	125	---

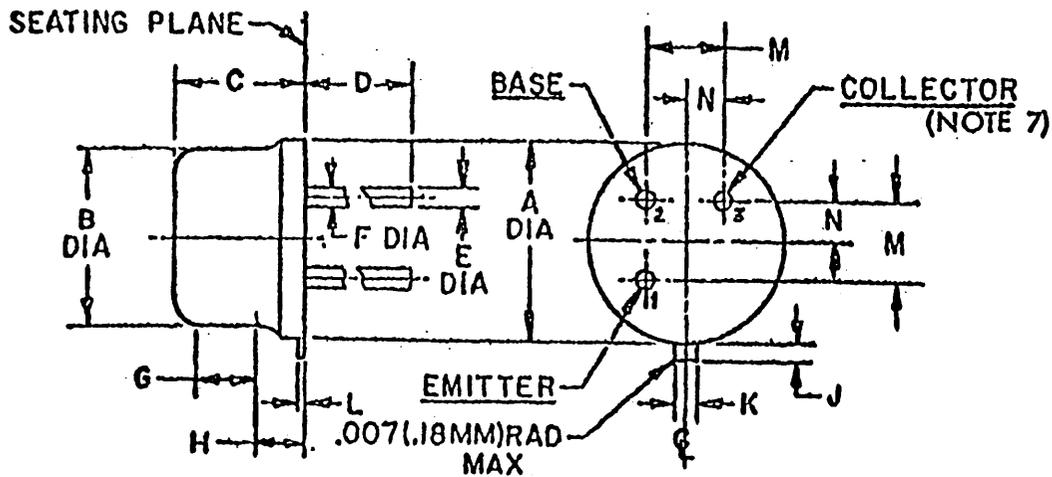
Table III. Group C inspection, ^{1/}-(Cont'd)

Test Method per MIL-STD-750	Examination or test ^{2/}	Conditions	LTPD Symbol	Limits		Unit
				Min	Max	
	<u>Subgroup 3</u>		$\lambda=10$			
1026	Steady-state operation life	$T_A = +25^\circ\text{C}$ $V_{CE} = 28 \text{ Vdc}$ $P_T = 1.0 \text{ W}$ $t = 1000 \text{ hrs}$ ^{3/}	---	---	---	---
	<u>End-point tests</u> Same as for Subgroup 2 above					
	<u>Subgroup 4</u>		10			
1026	Steady-state operation life:	$T_C = +125^{+5}_{-0} \text{ }^\circ\text{C}$ $V_{CE} = 24 \text{ Vdc}$ $P_T = 2.15 \text{ W}$ With heat sink $t = 250 \text{ hours}$	---	---	---	---
	<u>End-point tests:</u> Same as for Subgroup 2 above					

^{1/} Periodicity: See 4.2.3 herein.

^{2/} See 3.4 and 4.3.1 herein.

^{3/} See 4.2.2 herein.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.335	.370	8.51	9.40	
B	.305	.335	7.75	8.51	
C	.240	.260	6.10	6.60	
D	1.500	1.750	3.81	4.45	9
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100	---	2.54	---	4
H	---	---	---	---	5
J	.029	.045	.74	1.14	8
K	.028	.034	.71	.86	
L	.009	.125	.23	3.18	
M	.1414 Nom		3.59 Nom		6
N	.0707 Nom		1.80 Nom		6

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. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on Dim B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054+.001 (1.37 mm+.03 mm) below the seating plane of the transistor max dia leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller dia leads shall fall within the outline of the max dia lead tolerance.
7. Collector internally connected to case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.

Figure 1. Outline and dimensions.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery.- Preparation for delivery, and the inspection of preparation for delivery, shall be in accordance with Specification MIL-S-19500.

6. NOTES

6.1 Notes.- The notes included in Specification MIL-S-19500, with the following additions or exceptions, are applicable to this document.

6.2 Application guidance.-

- a. The revised requirements in this document issue do not impair ready, bilateral replaceability between the transistor covered herein and the transistors, respectively, as covered in the previous issue(s) of this document.
- b. To insure proper circuit application, particular attention should be given to the differential voltage-and-current requirements, ratings, and performance characteristics pertinent to the individual transistor types covered herein.

6.3 Ordering data.-

- a. Terminal-lead length (if other than as show. in Fig. 1 herein): See 3.3.2 herein.

6.4 Qualification.- With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in Qualified Products List (QPL)-19500, whether or not such products have actually been so listed by that date. Information pertaining to qualification of Products covered by this specification should be requested from the Commanding General, U. S. Army Electronics Command, Fort Monmouth, New Jersey 07703, attention: AMSEL-PP-EM-2.

6.5 Changes from previous issue.- The margins of this document are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. 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 and relationship to the last previous issue.

Custodians:
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Preparing activity:
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Project No. 5961-A083

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

ORGANIZATION	CITY AND STATE
--------------	----------------

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		\$

MATERIAL PROCURED UNDER A

DIRECT GOVERNMENT CONTRACT
 SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

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