MIL-S-19500/436(USAF)
AMENDMENT 5
9 JANUARY 1984
SUPERSEDING
AMENDMENT 4
13 July 1972

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE-VARIABLE CAPACITOR
TYPES 1N5461B THRU 1N5476B AND 1N5461C THRU 1N5476C
JAN, JANTX, AND JANTXV

This amendment forms a part of Military Specification MIL-S-19500/436(USAF), dated 28 August 1970, and is approved for use by Rome Air Development Center, Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

PAGE 1

* TITLE: Delete and substitute as printed above.

1.3: C column, Capacitance ratio column, and Q column: Delete "(See table IV)" and substitute "(See tables IV and V)".

PAGE 2

3.2: Delete "C_C --- Case Capacitance" and "L_S ---- Series inductance".

PAGE 3

4.2, line 7, LTPD: Delete "5" and substitute "7".

4.3, line 4: Delete "subgroups 6 and 7" and substitute subgroups 5 and 6". Also line 5, delete "subgroup 1" and substitute "subgroups 1, 3 and 4".

PAGE 4

4.4.2, equation: Delete "10^6" and substitute "10^2".

PAGE 5

4.4.3 and 4.4.4: Delete in their entirety.

4.5.2, line 2: Delete "lease" and substitute "least".

4.5.3, line 5: Delete "in 15 minutes" and substitute "15 minutes minimum".

PAGE 7

Figure 1, Title: Delete "Semiconductor Device, diode, silicon, voltage regulator types TX and non-TX types IN5518B thru IN5546B" and substitute "Semiconductor Device, diode, silicon, voltage regulator types, TX and non-TX, IN5461B thru IN5476B and IN5461C thru IN5476C".

PAGE 8

TABLE I, Group A inspection, Subgroup 3, "Case, capacitance" and "Series, inductance": Delete.

PAGE 9

TABLE II, Group B inspection, Subgroup 2, Hermetic seal, Method 1071, Details column: Delete "Test cond. 'E' for gross leaks" and substitute "Test cond. 'D' or 'E' for gross leaks." Following Hermetic seal, Method 1071, add "Moisture resistance, Method 1021".

PAGE 10

TABLE II, Group B inspection - Continued, Subgroup 6, Steady-state operation life, Method 1027, Details column: Delete "T_A = +150°C" and substitute "T_A = 150°C".

PAGE 11

TABLE III, Group C inspection:

a. Subgroup 3, End points: Delete "(Same as subgroup 3)" and replace with the following: "Reverse current, Method 4016, DC method; V_R = 25 V dc I_R, 20 nA dc amd Capacitance, Method 4001, V = 4 V dc, f = 1 MHz, C, Col. 3, Tables IV and V, Col. 4, Tables IV and V, pF.".

b. Subgroup 5, End points: Delete entries for Reverse current and Capacitance in their entirety and substitute "(Same as subgroup 3)".

Capacitance, Method 4001, V = 4 V dc, f = 1 MHz, C, Col. 3, Table IV, Col. 4, Table IV, pF," and substitute "(Same as subgroup 3)".

c. Subgroup 6, End points: Delete "(Same as subgroup 5)" and substitute "(Same as subgroup 3)".

PAGE 12

TABLE IV, device 1N5463B, Capacitance, Min. Limit, Col. 3: Delete "9.95" and substitute "9.5".

Add the following new table:

TABLE V

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Type	Capacitance V_R = 4 V dc			Capacitance ratio From V_R = 2 V dc To V_R = 30 V dc		Q V_R = 4 V dc f = 50 MHz
	Nom	Min	Max	Min	Max	Min
	pF	pF	pF			
1N5461C	6.8	6.66	6.94	2.7	3.1	600
1N5462C	8.2	8.04	8.36	2.8	3.1	600
1N5463C	10.0	9.8	10.2	2.8	3.1	550
1N5464C	12.0	11.76	12.24	2.8	3.1	550
1N5465C	15.0	14.7	15.3	2.8	3.1	550
1N5466C	18.0	17.64	18.36	2.9	3.1	500
1N5467C	20.0	19.60	20.4	2.9	3.1	500
1N5468C	22.0	21.56	22.44	2.9	3.2	500
1N5469C	27.0	26.46	27.54	2.9	3.2	500
1N5470C	33.0	32.34	33.66	2.9	3.2	500
1N5471C	39.0	38.22	39.78	2.9	3.2	450
1N5472C	47.0	46.06	47.94	2.9	3.2	400
1N5473C	56.0	54.88	57.12	2.9	3.3	300
1N5474C	68.0	66.64	69.36	2.9	3.3	250
1N5475C	82.0	80.36	83.64	2.9	3.3	225
1N5476C	100.0	98.0	102.00	2.9	3.3	200

PAGE 13

TABLE V, paragraphs 4.5.7, 4.5.7.2 and 4.5.7.3: Renumber "TABLE V" to read "TABLE VI" wherever it appears.

NOTE: The margins of this amendment are marked with an asterisk to indicate where changes from the previous amendment 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 amendment.

Custodian:
Air Force - 17

Review activities:
Air Force - 11, 99

User activity:
Air Force - 19

Agent:
DLA - ES

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(Project 5961-F877)

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MIL-S-19500/436(USAF)
28 August 1970

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE-VARIABLE CAPACITOR
TYPES 1N5461B THRU 1N5476B AND TX1N5461B THRU TX1N5476B

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a silicon, voltage-variable-capacitor diode for use in tuning and harmonic generator applications. The prefix "TX" is used on devices submitted to and passing the special process-conditioning, testing, and screening specified in 4.5 through 4.5.7.3.

1.2 Physical dimensions. See figure 1 (DO-7).

1.3 Ratings and characteristics.

P_T 1/		vRM(wkg)	BV I_R - 10u Adc	C V_R = 4 Vdc f = 1 MHz	Capacitance ratio	Q V_R = 4 Vdc f = 50 MHz
	mW	V(pk)	Vdc	pf		
Min.	---	---	30	(See table IV)	(See table IV)	(See table IV)
Max.	400	30	---	(See table IV)	---	---

1/Derate linearly 2.67 mW/°C above 25°C.

OPERATING AMBIENT TEMPERATURE: -65°C to +175°C.

STORAGE TEMPERATURE: -65° to +200°C.

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.

MIL-S-19500/436(USAF)

STANDARD

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, and as follows:

Q--------Quality factor (ratio of reactance to effective resistance).
C_C--------Case Capacitance
TC_C------Temperature coefficient of capacitance.
L_s-------Series inductance.

3.3 Design, construction, and physical dimensions. Diodes shall be of the design, construction, and physical dimensions specified on figure 1.

3.3.1 Lead finish. Leads shall be tinned or gold plated and maybe specified in the contract or order (see 6.2) without affecting the qualified product status of the device, or applicable JAN marking.

3.3.1.1 Lead material. If lead material need be specified, it shall be specified in the contract or order (see 6.2).

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

3.4.1 Process-conditioning, testing, and screening for "TX" types. Process-conditioning, testing, and screening for the "TX" types shall be as specified in 4.5.

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

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

3.5.1 Type designation. It is permissible to have the type designation on more than one line; however, if this is done, the break in the type number shall be as follows:

J1N - - - - - -XXXX or JTX1N - - - - - -XXX

3.5.2 "TX" marking. Devices in accordance with the "TX" requirements shall be marked with a "TX" immediately following the "JAN" or "J" prefix.

3.5.3 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end. (No color coding shall be permitted.)

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III. Qualification for a particular group of capacitances requires the testing of the lowest- and highest-nominal-capacitance units in the group. The manufacturer has the option of submitting samples individually to subgroups 5 and 6 of group B and subgroups 5 and 6 of Group C inspection or of submitting to the tightened combination of these tests, using a sample size under the LTPD = 5 column and a test duration of 1,000 hours.

The number of specimens to be inspected in the group, the determination of defectives, and the number of defectives shall be as specified in the qualification inspection procedure of MIL-S-19500 with the exception that the inspection routine for structurally similar devices does not apply. Ten samples of all other types shall be subjected to subgroup 2 of group A inspection and subgroup 2 of group C inspection.

4.2.1 Qualification testing. The non-TX types shall be used for qualification testing. At the manufacturer's request to the qualifying activity, qualification will be extended to include the "TX" type of the device.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in groups A, B, and C. Group A inspection and subgroup 2 of group C inspection shall be performed on a sublot basis. Group B inspection (with the exception of subgroups 6 and 7) and subgroup 1 of group C shall be performed on a lot basis in accordance with MIL-S-19500. Subgroups 5 and 6 of group B and subgroups 5 and 6 of group C inspection shall be performed on a lot basis with 50 percent of the sample being the highest capacitance type present in the lot and 50 percent of the sample being the highest-volume type present in the lot. Subsequent acceptance of capacitance types which are higher capacitance than those previously subjected to 1,000-hours life testing within the current six-month period (see 4.3.4.) requires retesting of subgroups 5 and 6 of group C inspection for a lot which includes the higher capacitance type. (Provisions of MIL-S-19500 early-acceptance procedures do not apply to this specification.)

4.3.1 Inspection lot. Inspection lot shall be defined in MIL-S-19500 except that the lot accumulation period requirements shall be 6 months in lieu of 6 weeks. Manufacturers who employ two or more processes shall establish a new inspection lot for each process.

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

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

4.3.4 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.3.4.1 Group C life-test samples. Samples that have been subjected to subgroup 6, group B, 500-hour life test may be continued on test for 1,000-hours in order to satisfy group C life-test requirements. These samples shall be predesignated and shall remain subject to the group C 1,000-hour acceptance evaluation after they have passed the group B 500-hour acceptance criteria. The cumulative total of failures found during the 500-hour test and during the subsequent interval up to 1,000-hours shall be computed for the 1,000-hour acceptance criteria.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, the referenced methods of MIL-STD-750 and the figures herein. Section 4 of MIL-STD-750 is applicable.

4.4.1 Terminal strength and salt atmosphere. Electrical rejects or structurally similar devices may be used for subgroup 4 of group B inspection and subgroup 1 of group C inspection.

4.4.2 Temperature coefficient of capacitance. Throughout the temperature range specified the capacitance shall not change by more than the amount specified relative to the capacitance value measured at $T_A = 25^\circ C$. The temperature coefficient of capacitance may be computed by the following formula:

$$TC_C = \frac{C_T\ (+85^\circ C) - C_T\ (-65^\circ C)}{85 + 65} \times \frac{10^6}{C_T\ (25^\circ C)}$$

(Accuracy is limited by the C_T measurement to ± 0.1 pF.)

4.4.3 Case, Capacitance, C_c, is measured on an open package at 1.0 MHz using a capacitance bridge, Boonton Electronics Model 75A or equivalent.

4.4.4 Series inductance, Ls is measured on a shorted package at 250 MHz using an impedance bridge, Boonton Radio Model 250A RX Meter or equivalent.

4.4.5 Resistance to solvents. Diodes shall be subjected to tests in accordance with Method 215 of MIL-STD-202. The following details shall apply:

(a) All areas of the diode 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.

4.5 Process-conditioning, testing, and screening for "TX" types. The procedure for process-conditioning, testing, and screening the "TX" types shall be in accordance with 4.5.1 through 4.5.7.3 and figure 2. The process-conditioning shall be conducted on 100 percent of the lot, prior to submission of the lot to the tests specified in tables I, II, and III. (At the option of the manufacturer, the non "TX" types may be subjected to process-conditioning and testing.)

4.5.1 Quality assurance (lot verification). Quality assurance shall keep lot records, monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these devices. The records shall be available for review by the customer at all times. The quality assurance monitoring shall include, but not be limited to: process-conditioning, testing, and screening. (The conditioning and screening tests performed as standard production tests need not be repeated when these are acceptable to the Government beforehand as being equal to or more severe than specified herein and the relative process-conditioning sequence is maintained.)

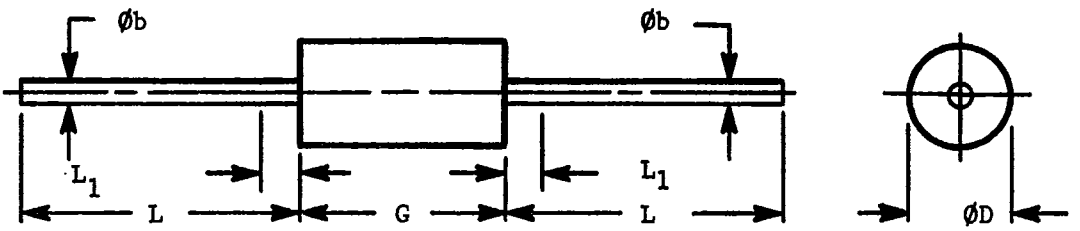
4.5.2 High-temperature storage. All devices shall be stored for at lease 48 hours at a minimum temperature (T_A) of 200° C.

4.5.3 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) and shall be performed in accordance with MIL-STD-750, method 1051, test condition C, except that 10 cycles shall be continuously performed and the time at the temperature extremes shall be in 15 minutes.

4.5.4 Acceleration. All devices shall be subjected to acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the Y_1 orientation only, at a peak level of 20,000 G, minimum. The 1-minute hold-time requirement shall not apply.

4.5.5 Hermetic seal (fine leak) test. All devices shall be fine-leak tested in accordance with MIL-STD-750, method 1071, test condition G or H.

4.5.6 Hermetic seal (gross-leak) test. All devices shall be tested for gross-leaks in accordance with MIL-STD-750, method 1071, test condition D or E.



SYMBOL	VARIATIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
Øb	.018	.022	.46	.56	
ØD	.078	.107	1.98	2.72	2
G	.195	.300	4.95	7.62	2
L	1.000	1.500	25.40	38.10	
L_1	---	.050	---	1.27	3

NOTES:
1. Refer to rules for dimensioning semiconductor product outlines included in Publication No. 76.
2. Package contour optional within ØD and length G. Heat slugs, if any, shall be included within this cylinder but shall not be subject to the minimum limit of ØD.
3. Lead diameter not controlled in zones L_1 to allow for flash lead finish build-up and minor irregularities other than heat slugs.

Figure 1. Semiconductor Device, diode, silicon, voltage regulator types TX and non-TX types 1N5518B thru 1N5546B. (DO-7).

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TABLE I. Group A inspection

Examination or Test	MIL-STD-750		LTPD		Symbol	Limits		Unit
	Method	Details	Non TX	TX		Min	Max	
Subgroup 1			10	5				
Visual and mechanical examination	2071				---	---	---	---
Subgroup 2			7	5				
Breakdown voltage	4021	I_R = 10 μAdc			BV_R	30	---	Vdc
Reverse current	4016	DC method; V_R = 25 Vdc			I_R	---	20	nAdc
Reverse current	4016	DC method; V_R = 25 Vdc T_A = 150°C			I_R	---	20	μAdc
Subgroup 3			7	5				
Capacitance	4001	V_R=4 Vdc; f = 1 MHz			C	Col.3 table IV	Col.4 table IV	pf
Capacitance ratio	4001	From V_R = 2 Vdc to V_R = 30 Vdc; f = 1 MHz			---	Col.5 table IV	Col.6 table IV	---
Quality factor	4036	V_R = 4 Vdc; f = 50 MHz			Q	Col.7 table IV	---	---
Case, capacitance		f = 1.0 MHz Lead length 1/16 inch (See 4.4.3)			C_c	0.1	0.35	pf
Series, inductance		f = 250 MHz Lead length 1/16 inch (See 4.4.4)			L_S	3.0	8.0	mH

TABLE II. Group B inspection

Examination or Test	MIL-STD-750		LTPD		Symbol	Limits		Unit
	Method	Details	Non TX	TX		Min	Max	
Subgroup 1			15	15				
Physical dimensions	2066	(See figure 1)			---	---	---	---
Subgroup 2			10	10				
Solderability	2026				---	---	---	---
Thermal shock (temperature cycling)	1051	Test condition C; T (high) = 175°C 10 cycles			---	---	---	---
Thermal shock (glass strain)	1056	Test condition A			---	---	---	---
Terminal strength (tension)	2036	Test condition A; 4 lbs; t = 15 sec.			---	---	---	---
Hermetic seal	1071	Test cond. "G or H" for fine leaks; Test cond. "E" for gross leaks			---	---	---	---
End points:								
Reverse current	4016	DC method; V = 25 Vdc			I_R	---	20	nAdc
Capacitance	4001	V_R = 4 Vdc f_R = 1 MHz			C	Col.3 table IV	Col.4 table IV	pf
Subgroup 3			10	10				
Shock (nonoperating)	2016	1500 G; 0.5 msec: 5 blows in each orientation: X_1, Y_1 and Y_2			---	---	---	---
Vibration, variable frequency	2056	Nonoperating			---	---	---	---

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TABLE II. Group B inspection - Continued

Examination or Test	MIL-STD-750		LTPD		Symbol	Limits		Unit
	Method	Details	Non TX	TX		Min	Max	
Subgroup 3 - Cont'd.								
Constant acceleration	2006	20,000 G, in X_1, Y_1, and Y_2 orientations			---	---	---	---
End points: (Same as subgroup 2)								
Subgroup 4			10	10				
Terminal strength (lead fatigue)	2036	Test cond. E (See 4.4.1)			---	---	---	---
Subgroup 5			10	7				
High-temperature life (nonoperating)	1032	T_A = 200°C; t^A= 500 hours			---	---	---	---
End points: (Same as subgroup 2)								
Subgroup 6			10	7				
Steady-state operation life	1027	V_R = 25 Vdc T^R = +150°C t^A= 500 hours (See 4.3.4.1)			---	---	---	---
End points: (Same as subgroup 2)								

TABLE III. Group C inspection

Examination or Test	MIL-STD-750		LTPD		Symbol	Limits		Unit
	Method	Details	Non TX	TX		Min	Max	
Subgroup 1			10	10				
Salt atmosphere	1041	(See 4.4.1)			---	---	---	---
Subgroup 2			10	10				
Temperature coefficient of capacitance	---	T_A = -65°C to +85°C V_R = 4 Vdc (see 4.4.2)			TC_C	---	0.04	%/°C
Subgroup 3			10	10				
Thermal shock (temperature cycling)	1051	Test cond. C-1; T(high) = 175°C time at temperature extremes=15 minutes min, total test time= 72 hours (maximum)			---	---	---	---
End points: (Same as subgroup 3)								
Subgroup 4			10	10				
Resistance to solvents		MIL-STD-202, Method 215 (See 4.4.5)			---	---	---	---
Subgroup 5			λ= 10	λ= 7				
High-temperature life (nonoperating)	1031	T_A = 200°C			---	---	---	---
End points:								
Reverse current	4016	DC method; V_R = 25 Vdc			I_R	---	20	nAdc
Capacitance	4001	V = 4 Vdc; f = 1 MHz			C	Col.3 table IV	Col.4 table IV	pf
Subgroup 6			λ= 10	λ= 7				
Steady-state operation life	1026	V_R=25Vdc T_A=150°C			---	---	---	---
End points: (Same as subgroup 5)		(See 4.3.4.1)						

TABLE IV

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Type	Capacitance V_R = 4 Vdc			Capacitance ratio From V_R =2Vdc To V_R =30 Vdc		Q V_R = 4Vdc f=50 MHz
	Nom.	Min.	Max.	Min.	Max.	Min.
	pf	pf	pf			
1N5461B	6.8	6.46	7.14	2.7	3.1	600
1N5462B	8.2	7.79	8.61	2.8	3.1	600
1N5463B	10.0	9.95	10.5	2.8	3.1	550
1N5464B	12.0	11.4	12.6	2.8	3.1	550
1N5465B	15.0	14.25	15.75	2.8	3.1	550
1N5466B	18.0	17.1	18.9	2.9	3.1	500
1N5467B	20.0	19.0	21.0	2.9	3.1	500
1N5468B	22.0	20.9	23.1	2.9	3.2	500
1N5469B	27.0	25.65	28.35	2.9	3.2	500
1N5470B	33.0	31.35	34.65	2.9	3.2	500
1N5471B	39.0	37.05	40.95	2.9	3.2	450
1N5472B	47.0	44.65	49.35	2.9	3.2	400
1N5473B	56.0	53.2	58.8	2.9	3.3	300
1N5474B	68.0	64.6	71.4	2.9	3.3	250
1N5475B	82.0	77.9	86.1	2.9	3.3	225
1N5476B	100.0	95.0	105.0	2.9	3.3	200

4.5.7 Preburn-in tests. The parameter I_R of table V shall be measured and the data recorded for all devices in the lot. All devices shall be handled or identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet these requirements initially will be removed from the inspection lot and the quantity removed noted on the lot history.

TABLE V. Burn-in test measurements

Examination or test	MIL-STD-750		Symbol	Limits		Unit
	Method	Details		Min	Max	
Reverse current	4016	DC method; V_R =25 Vdc	I_R	---	20	nAdc

4.5.7.1 Burn-in test. All devices shall be operated for 96 hours minimum under the following conditions:

T_A = + 150°C
V_R = 25 Vdc

4.5.7.2 Post burn-in tests. The parameter I_R of table V shall be retested after burn-in and the data recorded for all devices in the lot. The parameter measured shall not have changed during the burn-in test from the initial value by more than the specified amount as follows:

ΔI_R = 100% or 10 nanoamperes, whichever is greater

4.5.7.3 Burn-in test failure (screening). All devices that exceed the delta (Δ) limit of 4.5.7.2 or the limit of table V after burn-in, shall be removed from the inspection lot and the quantity removed shall be noted on the lot history. Where the quantity removed after burn-in exceeds 10 percent of the total inspection lot on burn-in test, the entire lot shall be unacceptable as "TX" types.

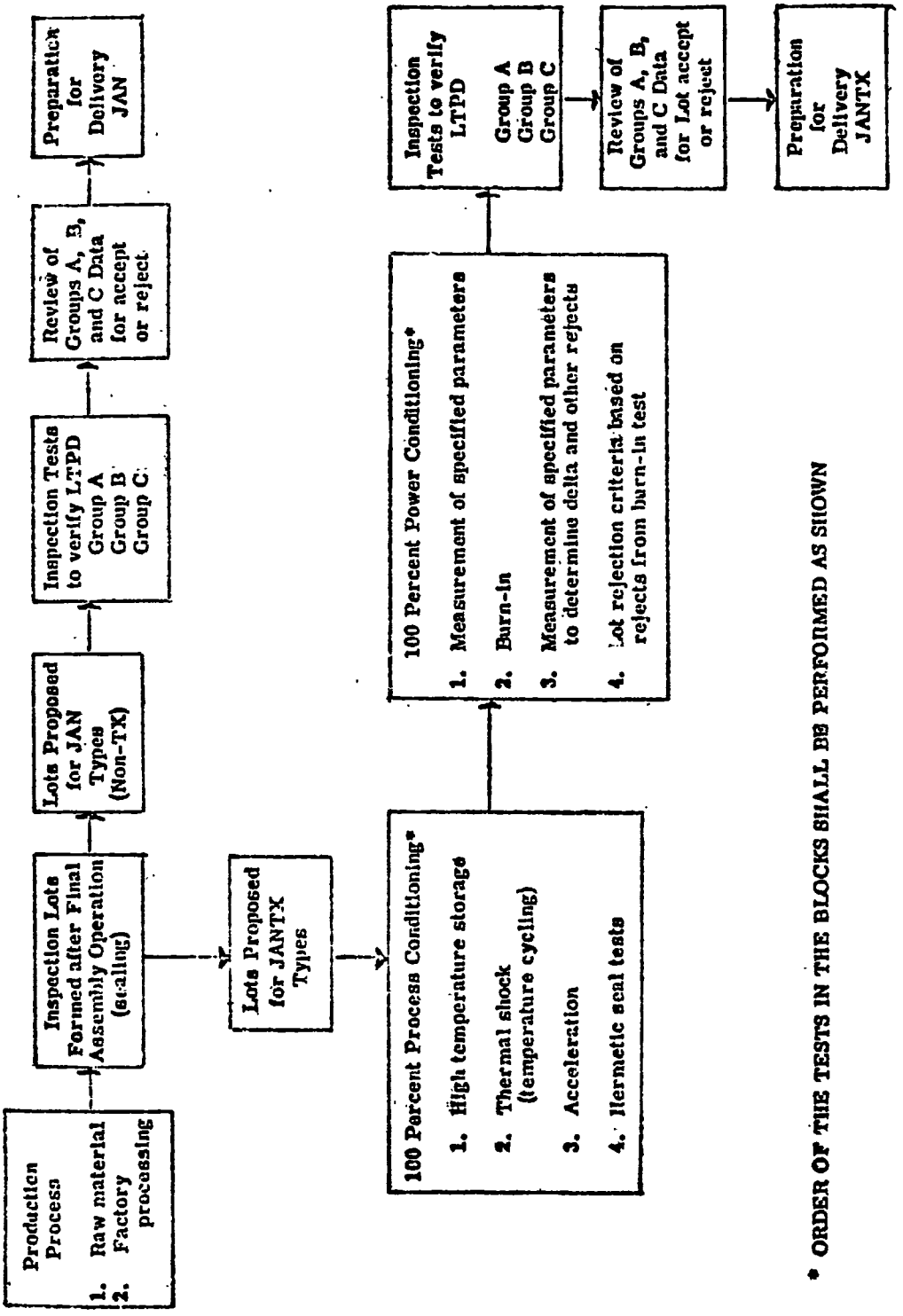

FIGURE 2. Order of procedure diagram for JAN (Non-TX) and JANTX types.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

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

6.2 Ordering data. Procurement documents should specify the following:

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

(b) Lead material (see 3.3.1.1).

(c) Inspection data (see 4.3).

Custodian:

Air Force - 17

Review activities:

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User activities:

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