

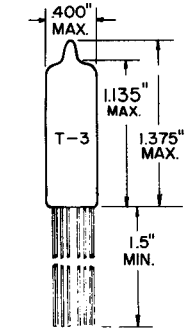
TUNG-SOL

TWIN TRIODE

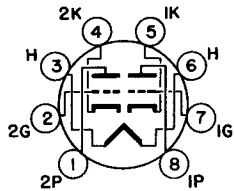
SUBMINIATURE TYPE

HEATER

ANY MOUNTING POSITION



GLASS BULB
SUBMINIATURE BUTTON
8 PIN BASE E8-10
0.17" TINNED
FLEXIBLE LEADS
OUTLINE DRAWING
JEDEC 3-1



BOTTOM VIEW
BASING DIAGRAM
JEDEC 80G

THE 6111WA IS A HEATER-CATHODE TYPE MEDIUM-MU TWIN TRIODE CAPABLE OF OPERATION IN THE UHF REGION. IT IS OF SUBMINIATURE CONSTRUCTION AND DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED.

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS

AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDI- TIONS NOTE 7	NORM. OPER- ATION NOTE 6	DES. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	250	Vdc
PEAK PLATE VOLTAGE	eb:	---	---	---	360	v
GRID #1 VOLTAGE	Ec1:	-55	0	0	---	Vdc
PLATE DISSIPATION (PER PL.)	Pp/p:	---	---	0.85	0.95	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	v
PLATE CURRENT (PER PLATE)	Ip/p:	0.5	---	8.5	22	mAdc
GRID CURRENT (PER GRID)	Ic/c:	---	---	---	5.5	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	220	220	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	5000	---	μMHOS
AMPLIFICATION FACTOR	Mu/p:	---	---	20	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS¹ IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1									
COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES.									
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA
HEATER-CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.4	Ihk(1):	---	---	---	---	3.5	---	μ Adc
Ehk=-100 Vdc		Ihk(1):	---	---	---	---	3.5	---	μ Adc
GRID CURRENT:									
Rg=1.0 MEG.	0.4	Ic(1):	---	---	---	---	-0.3	---	μ Adc
PLATE CURRENT (1):	0.4	Ib(1):	6.0	7.5	8.5	9.5	11.0	2.8	mAdc
PLATE CURRENT (2):									
Ec1=-9.0 Vdc	0.4	Ib(2):	---	---	---	---	100	---	μ Adc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	4100	4650	→ 5000	5350	5900	1000	μ MHOS
CONTINUITY AND SHORTS (INOPERATIVES):									
(NOTE 11)	0.4	---	---	---	---	---	---	---	---
MECHANICAL:									
ENVELOPE (B-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3V									
Eg-all=-100 Vdc	2.5	Rg1-all:	250	---	---	---	---	---	MEG.
Ep-all=-300Vdc		Rp-all:	250	---	---	---	---	---	MEG.
PLATE CURRENT (1)									
DIFFERENCE BETWEEN SECTIONS:	2.5	ΔIb :	---	---	---	---	1.5	---	mAdc
TRANSCONDUCTANCE (2):									
Ef=5.7 V (NOTE 9)	2.5	$\Delta Ef Sm(2)$:	---	---	---	---	10	---	PERCENT
GRID EMISSION:									
Ef=7.5 V; Rg/g=1.0 MEG.;									
Eb=250 Vdc; Rk/k=2900									
OHMS PREHEAT 5 MIN.									
AT Ec1=0, TEST AT									
Ec1=-20 Vdc	6.5	Isc1:	---	---	---	---	-0.5	---	μ Adc
AF NOISE:									
Esig=65 mVac; Rg1=									
0.1 MEG.; Rp=0.01 MEG.;									
Rk=100 OHMS; Ck=1000 μ f									
UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
AMPLIFICATION FACTOR:	6.5	Mu:	17	---	20	---	23	---	---
PULSE EMISSION (1):									
Eb=150 Vdc; Ec1=-25 Vdc;									
tp=10 μ sec; DUTY CYCLE=									
1%; egk=+30 V; Rk/k=1.0		ik:	320	---	---	---	---	---	ma
OHM; (NOTE 12)	2.5	$\Delta_{tp} ik$:	---	---	---	---	10	---	PERCENT
PULSE EMISSION (2):									
Ef=5.9 V; Eb=150 Vdc; Ec1=-									
25 Vdc; tp=10 μ sec DUTY									
CYCLE=1%; egk=+30 V; Rk/k									
=1.0 OHM; (NOTE 12)	6.5	ik:	300	---	---	---	---	---	ma

→ INDICATES A CHANGE.

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CHARACTERISTICS AND QUALITY CONTROL TESTS¹ cont'd.
 IN THE FOLLOWING TEST EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 - CONT'D.									
HEATER-CATHODE LEAKAGE (2): E _f =6.7 V(PIN 6 NEG.); E _{hk} =+100 Vdc;(CATHODE NEGATIVE); t=16 SEC. (NOTE 13)									
	6.5	I _{hk} (2):	---	---	---	---	1.0	---	μAdc
CAPACITANCE:		C _{gp} :	1.2	---	1.5	---	1.8	---	μf
CAPACITANCE:		C _{in} :	1.4	---	1.9	---	2.4	---	μf
CAPACITANCE (NOTE2)	6.5	C _{out}	0.20	---	0.28	---	0.36	---	μf
(UNIT #1)									
CAPACITANCE		C _{out}	0.22	---	0.32	---	0.42	---	μf
(UNIT #2)									
CAPACITANCE		C _{gg} :	---	---	---	---	0.011	---	μf
CAPACITANCE:		C _{pp} :	---	---	---	---	0.50	---	μf
MEASUREMENTS ACCEPTANCE TESTS, PART 2 cont'd.									
		ALLOWABLE DEF. PER CHARAC.	AQL %	MIL-E-1 SYMBOL					MIL-E-1 UNITS
		1st SAMP.	COMB. SAMP.				MIN.	MAX.	
OPERATION TIME: (NOTE 10)		---	---	4.0	t:		---	20	SEC.
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE =21 ±3 mmHg; VOLTAGE = 300 Vac.									
	---	---	6.5	---			---	---	---
VIBRATION (2): F=40 cps; G=15; R _p =10,000 OHMS									
	---	---	2.5	Ep:			---	20	mVac
VIBRATION (3): F=70-2000cps G=10; R _p =10,000 OHMS. POSITIONS X ₁ AND X ₂ ONLY.									
	---	---	6.5	ep:			---	125	mv.
DEGRADATION RATE ACCEPTANCE TESTS									
SUBMINIATURE LEAD FATIGUE:									
	---	---	2.5	---			4.0	---	arcs
SHOCK (1): E _{hk} =+100 Vdc; R _g =0.1 MEG.; HAMMER ANGLE = 30°; (NOTE 3)									
	---	---	20	---			---	---	---
FATIGUE (1): 96 HOURS; G=2.5; FIXED FREQUENCY; F=25 MIN., 60 MAX. (NOTE 5)									
	---	---	6.5	---			---	---	---
SHOCK (2): E _{hk} =100 Vdc; R _g =0.1 MEG.; HAMMER ANGLE=120°+RUBBER PAD; t=10 MILLISECONDS; G=75; (NOTE 15)									
	---	---	20	---			---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 14)									
	---	---	6.5	---			---	---	---
POST SHOCK TESTS (1) & (2) AND FATIGUE TESTS (1) & (2) END POINTS:									
VIBRATION (2): F=40cps; G=15; R _p =10,000 OHMS									
			---	Ep:			---	80	mVac

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CHARACTERISTICS AND QUALITY CONTROL TESTS¹ cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	COMB. SAMP.	AQL MIL-E-1 %	MIN	MAX	MIL-E-1
DEGRADATION RATE						
ACCEPTANCE TESTS (CONT'D).						
HEATER-CATHODE LEAKAGE (1):						
Ehk=+100 Vdc	---	---	---	lhk(1): ---	7	μ Adc
Ehk=-100 Vdc	---	---	---	lhk(1): ---	7	μ Adc
CHANGE IN TRANSDUC- DUCTANCE (1) OF INDIVIDUAL TUBES:						
Ef=6.3 V	---	---	---	Δ_t Sm(1). ---	15	PERCENT
GRID CURRENT (1):	---	---	---	lc(1): ---	-1.0	μ Adc
GLASS STRAIN (THERMAL SHOCK).	---	---	6.5	---	---	---
ACCEPTANCE LIFE TEST						
HEATER CYCLING LIFE TEST:						
Ef=7.0V; Eb=Ec=0V;						
Ehk=140 Vac; 1 MIN.						
ON, 4 MIN. OFF	---	---	1.0	2000	---	CYCLES
HEATER CYCLING LIFE TEST						
END POINTS:						
HEATER-CATHODE						
LEAKAGE (1):						
Ehk=+100 Vdc	---	---	---	lhk(1): ---	7	μ Adc
Ehk=-100 Vdc	---	---	---	lhk(1): ---	7	μ Adc
2 & 20 HOUR STABILITY						
LIFE TEST:						
TA=ROOM; Ehk=+200 Vdc;						
Rg/g= 1.0 MEG.	---	---	---	---	---	---
2 & 20 HOUR STABILITY						
LIFE TEST END POINTS:						
(TYPICAL SAMPLE SIZE=						
50 TUBES)	---	---	---	---	---	---
CHANGE IN TRANSDUC- DUCTANCE (1) OF INDIVIDUAL TUBES:	---	---	1.0	Δ_t Sm(1): ---	10	PERCENT
100 HOUR SURVIVAL RATE						
LIFE TEST:						
TA = ROOM; Ehk=+200 Vdc;						
Rg/g =1.0 MEG.	---	---	---	---	---	---
100 HOUR SURVIVAL RATE						
LIFE TEST END POINTS:						
(TYPICAL SAMPLE SIZE=						
200 TUBES)	---	---	---	---	---	---
CONTINUITY AND SHORTS						
(INOPERATIVES:	---	---	0.65	---	---	---
TRANSDUCTANCE (1):	---	---	1.0	Sm(1): 3750	---	μ MHOS
200 HOUR INTERMITTENT						
LIFE TEST (1):						
Eb=250 Vdc Ec=0 Vdc;						
Ehk=+200 Vdc; Rg/g=1.0						
MEG.; Rk/k= 2900 OHMS;						
TA = ROOM						
200 INTERMITTENT LIFE						
TEST (1) END POINTS:						
(TYPICAL SAMPLE SIZE=						
20 TUBES 1st SAMPLE;						
40 TUBES 2nd SAMPLE)						
INOPERATIVES:	1	3	---	---	---	---
GRID CURRENT (1):	1	3	---	lc1: ---	-0.9	μ Adc
HEATER CURRENT:	1	3	---	lf: 276	328	mA
CHANGE IN TRANSDUC- DUCTANCE (1) OF INDIVIDUAL TUBES:	1	3	---	Δ_t Sm(1): ---	25	PERCENT

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CHARACTERISTICS AND QUALITY CONTROL TESTS cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC.		AQL	MIL-E-1			MIL-E-1
ACCEPTANCE LIFE TESTS (cont'd.)	1st COMB.	COMB. SAMP.	%	SYMBOL	MIN.	MAX.	UNITS
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{E_f} S_m(2)$	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1): Ehk=+100 Vdc Ehk=-100 Vdc	1	3	---	lhk(1): lhk(1):	---	10 10	μA_{dc} μA_{dc}
INSULATION OF ELECTRODES: g-all p-all	1	3	---	Rg-all: Rp-all:	100 100	---	MEG. MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
500 HOUR INTERMITTENT PULSE LIFE TEST: Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; Rl/p=330 OHMS; tp=10 μsec ; DUTY CYCLE = 1.0 %; egk=+ 30 $\pm$ 1 VOLTS; TA = ROOM							
500 HOUR INTERMITTENT PULSE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE) INOPERATIVES: PULSE EMISSION: CHANGE IN PULSE EMISSION OF INDIVIDUAL TUBES FROM INITIAL:	1 1 1	3 3 3	---	---	---	---	---
				ik:	300	---	mA
	1	3	---	Δik :	---	-35	PERCENT
				Δik :	---	+50	PERCENT
TOTAL DEFECTIVES:	2	5	---	---	---	---	---
INTERMITTENT HIGH TEMPERATURE LIFE TEST (2): T BULB =220° C; Ehk=+200 Vdc; Rg/g=1.0 MEG.	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE) INOPERATIVES: GRID CURRENT (1): HEATER CURRENT: TRANSCONDUCTANCE (1) CHANGE IN INDIVIDUAL TUBES FROM INITIAL: TRANSCONDUCTANCE (2): (NOTE 9) HEATER-CATHODE LEAKAGE (1): Ehk=+100 Vdc Ehk=-100 Vdc	---	---	---	---	---	---	---
	1	3	---	lc(1):	---	-0.7	μA_{dc}
	1	3	---	If:	276	328	mA
	1	3	---	$\Delta_t S_m(1)$:	---	20	PERCENT
	1	3	---	$\Delta_{E_f} S_m(2)$:	---	15	PERCENT
	1	3	---	lhk(1):	---	10	μA_{dc}
				lhk(1):	---	10	μA_{dc}

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CHARACTERISTICS AND QUALITY CONTROL TEST cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC.		AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
	1st SAMP.	COMB. SAMP.					
ACCEPTANCE LIFE TESTS (cont'd.)							
INSULATION OF ELECTRODES:							
g-all:	1	3	---	Rg-all:	50	---	MEG.
p-all:			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1)							
AVERAGE CHANGE:	---	---	---	Avg Δ_{tSm} :	---	15	PERCENT
TOTAL DEFECTIVES	3	6	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE LIFE TEST END POINTS:							
(TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-1.0	μ Adc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1)							
CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_{tSm}(1)$:	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{EtSm}(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μ Adc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μ Adc
INSULATION OF ELECTRODES:							
g-all:	2	5	---	Rg-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES

- CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1, "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES," AND MIL-STD-105A.
- WITHOUT SHIELD.
- TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.
- CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.
- TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

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NOTES CONT'D.

6. THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.
7. THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.
8. FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY $\pm 5\%$ HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.
9. CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT $E_f=6.3$ V TO THAT VALUE MEASURED AT $E_f=5.7$ V.
10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN $\pm 10\%$ OF THE THREE (3) MINUTE PLATE CURRENT (1) VALUE MEASURED AT PLATE CURRENT (1) TEST CONDITIONS. NO PREHEATING BEFORE THIS TEST IS ALLOWED. A COLD TUBE MUST BE USED.
11. DURING BOTH CONTINUITY AND SHORT TESTING, THE TUBE UNDER TEST SHALL BE TAPPED AT LEAST THREE TIMES IN EACH OF TWO PLANES 90° APART WITH A TAPPER WHICH SHALL BE ADJUSTED TO GIVE AN IMPULSE OF APPROXIMATELY ONE HALF SINE WAVE OF 300 ± 50 MICROSECONDS DURATION AND HAVING A MINIMUM AVERAGE AMPLITUDE OF 80 G'S PEAK ACCELERATION AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DEVICE CAPABLE OF DETECTING AS SHORTS, THE FOLLOWING INTERELEMENT RESISTANCES OF THE GIVEN TIME DURATION.

DURATION	SENSITIVITY
PERMANENT	600,000 OHMS
500 MICRO SECONDS	500,000 OHMS
100 MICRO SECONDS	100,000 OHMS
60 MICRO SECONDS	1,000 OHMS

TUBES WHICH GIVE AN INDICATION OF ONE OR MORE OF THE FOLLOWING SHALL BE REJECTED AS INOPERABLE:

- A. EITHER A PERMANENT OR TAP SHORT AT ANY TIME DURING THE TAPPING PROCEDURE
 - B. ANY OPEN CIRCUIT
 - C. ANY LEAKS
12. PEAK CATHODE CURRENT SHALL BE MEASURED BY MEANS OF A HIGH IMPEDANCE OSCILLOSCOPE OR EQUIPMENT DEVICE CONNECTED ACROSS A $1.0 \pm 1\%$ CATHODE RESISTOR. THE SPECIFIED LIMIT REFERS TO THE MAXIMUMS OF THE PULSE COMPLITUDE. THE VARIATION OF THE OUTPUT PULSE AMPLITUDE BETWEEN $20\% t_p$ AND $80\% t_p$ SHALL NOT EXCEED THE SPECIFIED LIMIT.
 13. HEATER-CATHODE LEAKAGE (2) IS PERFORMED AS FOLLOWS:
 - A. PREHEAT TUBES FOR 10 SECONDS WITH $E_f=10.5$ V
 - B. TEST IMMEDIATELY BY THE APPLICATIONS OF THE SPECIFIED TEST CONDITIONS OF THIS TEST
 - C. AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTION.
 14. THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2 AND Y1. ONLY RATED HEATED VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED FAILURES.
 - A. TUBES WHICH SHOW PERMANENT OR TAP SHORTS OR OPEN CIRCUITS FOLLOWING FATIGUE TEST, WHEN TESTED AS SPECIFIED IN 4.7.2 AND 4.7.3
 - B. TUBES WHICH DO NOT COMPLY WITH POST FATIGUE LIMITS, THIS IS A DESTRUCTIVE TEST
 15. THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).

