

MINISTRY OF SUPPLY D.L.R.D./R.A.E.

SPECIFICATION MOS/CV.2698 incorporating MIL-S-1/174C. ISSUE No. 1. DATED 1.2.58. To be read in conjunction with K1006 and BS.448.	<u>SECURITY</u>	
	<u>SPECIFICATION</u> Unclassified	<u>VALVE</u> Unclassified

TYPE OF VALVE:- Sub-miniature Double Diode with flying leads. CATHODE:- Indirectly heated. ENVELOPE:- Glass PROTOTYPE:- 5896	<u>MARKING</u> See K1001/4. Additional Marking 5896.		
<u>RATINGS</u> (All limiting values are absolute)	<u>BASE</u> BS.448/B8D/F.		
Heater Volts (V) 6.3 Heater Current (mA) 300 Max. Peak Inverse Voltage (V) 460 Max. Mean Anode Current (mA) 10 Max. Peak Anode Current (mA) 60 Max. Surge Anode Current (mA) 350 Max. Heater Cathode Voltage (V) 360 Max. Bulb Temperature (°C) 220	NOTES B B B	<u>CONNECTORS</u>	
		<u>PIN</u>	<u>ELECTRODE</u>
		1	Anode 2 a"
		2	Cathode 2 k"
		3	Heater h
		4	Internal shield
		5	Anode 1 a'
		6	Heater h
		7	Cathode k'
		8	No connection
<u>CAPACITANCES (pF) Note A.</u>		<u>DIMENSIONS (mm)</u>	
Ca'a" (max.) 0.026 Ca-h+k+sh. 3.0 Ck-h+a+sh. 4.2	B B	<u>DIMENSIONS</u>	
		<u>"A" Seated Height</u>	<u>MIN.</u> <u>MAX.</u>
		"C" Diam.	-    34.92 9.3    10.16
<u>NOTES</u>			
A. Measured with screen.			
B. Each section.			

Z.16367.R.

# CV2698

MIL-E-1/174C  
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SUPERSEDED  
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INDIVIDUAL MILITARY SPECIFICATION SHEET  
ELECTRON TUBE, RECEIVING, DOUBLE DIODE, SUBMINIATURE

JAN-5886

This specification sheet forms a part of the latest issue of Military Specification MIL-E-1.

Description: Double diode, 400 Mc

Ratings:	Ef	Epp/p	epx	Ehk	RL	CL	Io/p	ib/p	i surge/p	T Envelope	Alt
Absolute	V	Vac	v	v	chms	uf	mA	ma	ma	°C	ft
Maximum:	6.6	—	460	360	—	—	10	60	350	+220	60,000
Minimum:	6.0	—	Note 1	Note 1	—	—	—	—	—	—	Note 2
Test Cond.:	6.3	165	—	0	11,000	8	—	—	—	—	—

Cathode: Coated Unipotential  
Base: Subminiature - 8 Pin with long leads

Height: 1.375 in. max.  
Diameter: 0.400 in. max.

Pin No.: 1 2 3 4 5 6 7 8  
Element: 2p 2k h sd lp h lk uc

Envelope: T-3

The following tests shall be performed:

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.  
For miscellaneous requirements, see Paragraph 3.2, Inspection Instructions for Electron Tubes.

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS					Units
						Min.	LAL	Bogie	UAL	Max.	
<u>Qualification Approval Tests</u>											
3.1	Qualification Approval:	Required for JAN Marking	—	—							
—	Resonant Frequency:	F=900Mc; Note 22	—	—	Length:	14.65	—	—	—	—	cm
—	Cathode:	Coated Unipotential	—	—							
3.4.3	Base Connections:		—	—							
<u>Measurements Acceptance Tests, Part 1 Note 2</u>											
4.10.8	Heater Current:	Note 4	—	—	If:	—	288	300	312	—	24 mA
4.10.8	Heater Current:		0.65	II	If:	280	—	—	—	320	mA
4.10.15	Heater-Cathode Leakage:	Note 6 Ehk=+360Vdc Ehk=-360Vdc	0.65	II	Ihk: Ihk:	—	—	—	—	40 40	uAdc uAdc
4.10.13	Operation:	Note 23	0.65	II	Ic:	16	—	—	—	—	mA
4.7.5	Continuity and Shorts (Inoperatives):		0.4	II		—	—	—	—	—	
4.9.1	Mechanical:	Envelope: (8-1)									
<u>Measurements Acceptance Tests, Part 2</u>											
4.8.2	Insulation of Electrodes:	p-all; Note 6	2.5	I	R:	100	—	—	—	—	Meg
4.10.1.1	Emission:	Eb=10Vdc; Note 6	2.5	I	Is:	30	—	—	—	—	mA
4.10.4.1	Plate Current:	Ebb=0; Ip=40,000; Note 6	2.5	I	Ib:	5.0	—	—	—	25	mA
4.10.4.1	Plate Current Difference Between Sections:		2.5	I	Ib:	—	—	—	—	5.0	uAdc
4.10.14	Capacitance:	0.405 in. dia. shield lp to 2p lp to h+lk+sd 2p to h+2k+sd lk to h+lp+sd 2k to h+2p+sd	6.5	Code F	C: C: C: C: C:	— 2.5 2.5 3.5 3.5	— — — — —	— — — — —	— — — — —	0.026 3.5 3.5 4.9 4.9	uuf uuf uuf uuf uuf

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Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS						Units
						Min.	LAL	Bogle	UAL	Max.	AID	
<u>Measurements Acceptance Tests, Part 2(Contd)</u>												
	Low Pressure Voltage Breakdown:	Pressure=55±5mm Hg.; Voltage=330Vac; Note 7	6.5	Note 5								
4.9.20.3	Vibration(1):	No Voltages; Post Shock and Fatigue Test End Points apply	10.0	Note 5								
<u>Degradation Rate Acceptance Tests, Note 8</u>												
4.9.5.3	Subminiature Lead Fatigue:	Note 9	2.5	Code F		4						arcs
4.9.20.5	Shock:	Hammer angle=30°; Etk=+100Vdc; Note 10	20									
4.9.20.6	Fatigue:	G=2.5; Fixed Frequency; F=25 min., 60 max.	6.5	Note 5								
	Post Shock and Fatigue Test End Points:	Heater-Cathode Leakage Etk=+360Vdc Etk=+360Vdc Operation			Ink: — Ink: — Io: 14				80 80			uadc uadc madc
	Glass Strain:	Note 11	6.5	I								
Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units		
					1st Sample	Combined Samples		Min.	Max.			
<u>Acceptance Life Tests Note 8</u>												
4.11.7	Heater Cycling Life Test:	Ef=7.0V; 1 min. on, 4 min. off; Etk=140Vac; Etk=+2b=0; Note 12	2.5	Code H								
	Stability Life Test: (1 Hour)	TA=Room; Notes 13,24	1.0	Code I								
4.11.4	Stability Life Test End Points:	Change in Operation of individual tubes					$\Delta I_o$		10.0		%	
	Survival Rate Life Test:	Stability Life Test Conditions or equivalent; TA=Room; Notes 14,15		II								
	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives) Operation	0.65 1.0									
							Io:	14.0			madc	
4.11.5	Intermittent Life Test:	Stability Life Test Conditions; T Envelope=+220°C min; Notes 16,17; 1000 hour requirements do not apply										
4.11.4	Intermittent Life Test End Points: (500 Hours): Note 16	Note 18 Inoperatives; Note 19 Heater Current Operation Change in Operation of individual tubes Heater-Cathode Leakage Etk=+360Vdc Etk=+360Vdc Insulation of Electrodes p-all			1 2 1 1	3 5 3 3						
							If: Io: $\Delta I_o$	276 14	328 15		mA madc %	
					2	5	Ink: Ink:		80 80		uadc uadc	
					2	5	R:	25			Meg	
		Total Defectives			4	8						

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Ref.	Test	Conditions
4.11.5	Information Life Test: (1000 Hours)	Intermittent Life Test Conditions; Notes 17, 20, 21
	<u>Packaging Information</u>	
4.9.18.1.3	Carton Drop:	(d) Package Group 1; Carton Size C

**Caution to Electron Equipment Design Engineers.** Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

Note 1: The maximum voltage appearing between any pair of leads shall be no greater than the maximum peak inverse plate voltage.

Note 2: If altitude rating is exceeded, reduction of instantaneous voltages (EF, excluded) may be required.

Note 3: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding inoperatives and mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, inspection Level II shall apply.

Note 4: Variables Sampling Procedure:

Test for Lot-Average Acceptance:

Select a 35 tube sample at random from the lot. Number these tubes consecutively.

Determine the numerical average value of the characteristic as specified on the specification sheet of the 35 tube sample. If this value is on or above the LAL and on or below the UAL, accept for Lot Average.

Test for Lot Dispersion Acceptance:

Divide the 35 tube sample into seven (7) consecutive sub-groups of five (5) tubes each. Determine the range, R, of each sub-group for the measured characteristic specified on the Specification Sheet.

Compute the numerical average of the R values which is equal to  $\bar{R}$ . If  $\bar{R}$  is equal to or less than the ALD, accept for Lot Dispersion.

Note 5: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. MIL-STD-105, sample size code letter F shall apply.

Note 6: Test each section separately.

Note 7: There shall be no evidence of arcing or corona between anode pins and adjacent pins with no other voltages applied.

Note 8: Destructive tests:

Tubes subjected to the following destructive tests are not to be accepted under this specification

- 4.9.5.3 Subminiature Lead Fatigue.
- 4.9.20.5 Shock.
- 4.9.20.6 Fatigue.
- 4.11.7 Heater Cycling Life Test.
- 4.11.5 Intermittent Life Test.

Note 9: When a manufacturer submits tubes for qualification approval, five extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 10: Leads may be clipped for application of voltages during impact.

Note 11: Glass strain procedures - All tubes submitted to this shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperature. The entire tube shall be immersed in water not less than 85°C for 15 seconds and immediately thereafter immersed in water not more than 5°C for 5 seconds. The volume of water shall be large enough that the temperature will not be appreciably affected by the test. The method of submersion shall be in accordance with Drawing #245 JAN, and such that a minimum of heat is conducted away by the holder used. The tubes shall be placed in the water so that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period, the tubes shall be removed and allowed to dry at room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks. Electrical rejects other than inoperatives may be used in the performance of this test.

Note 12: The regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, or a heater-cathode short.

Note 13: Stability Life Test:

- a. Life test samples shall be selected from a lot at random in such a manner as to be representative of the lot. If such selection results in a sample containing tubes which are outside the initial specification sheet limits for the relevant life test end point characteristics, such tubes shall be replaced by randomly selected acceptable tubes.
- b. Serially mark all tubes from the sample.
- c. Record referenced characteristic measurements after a maximum operation of 15 minutes at specified voltage and current conditions on the entire sample.
- d. Operate at life test conditions for one (1) hour (plus 30 minutes, minus 0 minutes). Life test shall be conducted as per paragraphs 4.11 and 4.11.5, MIL-E-1, except that the following shall be substituted for the third sentence of 4.11: The mean electrode potentials, except heater or filament, may be established at values differing by not more than 5% from the specified values provided the same average electrode dissipation are obtained that occur with the specified voltages. Fluctuations of all voltages including heater or filament voltage shall be as small as practical.
- e. Record referenced characteristic measurements at the end of this test period. Referenced characteristic measurements shall be taken immediately following the test or tubes shall be preheated 15 minutes under specified test voltage and current conditions, and immediately measured. The 15 minutes preheat shall be considered as part of the test time.
- f. A defective is defined as a tube having a change in referenced characteristic greater than that specified on the specification sheet.
- g. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown tests.

Note 14: MEANS OF ASSURING SURVIVAL RATE- The procedure for assuring the maintenance of a desirable quality level in terms of early life survival consists of a series of normal, reduced, and tightened inspection plans for use at 100 hours. The sample size is dependent upon lot size, and the transfer between normal, reduced, and tightened inspection is dependent upon quality history.

The selection of inspection scheme and sampling plan shall be in accordance with Inspection Instructions for Electron Tubes paragraph 5.3.4.2 through 5.3.4.3.1.3 inclusive except that paragraph 5.3.4.2.2 shall be modified by deleting the last part of the first sentence which states "...or if no lot in the last 20 lots inspected shall have been declared nonconforming for life test qualities." At the manufacturer's option, reduced inspection may be used if no lot in the last ten (10) lots inspected has been declared nonconforming.

INSPECTION PROCEDURE

- a. Select sample in accordance with Note 13, paragraph (a).
- b. Tubes to be tested at 100 hours as provided in MIL-E-1(4.7.5). When any tap-short indication is obtained, the test shall be repeated. When any short indication is again obtained the tube will be rejected as an inoperative.
- c. Determine the number of defective tubes at the 100 hour period.
- d. If more than the allowable number of defectives occur, declare the lot nonconforming.
- e. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown tests.

Note 15: For Survival Rate Life Test, the equivalent Stability Life Test conditions shall be interpreted as having the same heater voltage (Ef) and heater-cathode voltage (Ehk) as the Stability Life Test; and the same interruptions of MIL-E-1 paragraph 4.11.5 as the Intermittent Life Test. The electrode voltages shall be such that the element dissipations are not less than 80 percent, nor more than 100 percent of Stability Life Test plate dissipation. These voltages are to be maintained within the limits of plus 200, minus 50 percent of the Stability Life Test voltages.

Note 16: Intermittent Life Tests:

- a. The first 20 tubes of the Stability Life Test sample which meet the measurements acceptance test limits for those characteristics specified as Intermittent Life Test End Points shall be used for the Intermittent Life Test sample. In the event that a second Stability Life Test sample is used, the first 20 tubes from the sample which meet the above conditions shall be used.
- b. In the event of failure of the first sample on Intermittent Life Test, take a completely fresh sample (MIL-STD-105 sample size code letter I) and stabilize it in accordance with the conditions of the Stability Life Test. Then select from it the first 40 tubes which meet the measurements acceptance test limits for those characteristics specified as Intermittent Life Test End Points. Subject these 40 tubes to the Intermittent Life Test. Acceptance shall then be based on combined results from the first and second samples.
- c. As an alternate method, the manufacturer may select his life test sample as described in Note 13, paragraph (a).

- Note 16: (Contd)
- d. Life test shall be conducted as per paragraphs 4.11, and 4.11.5, MIL-E-1, except that the following shall be substituted for the third sentence of 4.11: The mean electrode potentials, except heater or filament may be established at values differing by not more than 5% from the specified values provided the same average electrode dissipations are obtained that occur with the specified voltages. Fluctuations of all voltages including heater or filament voltage shall be as small as practical.
- e. Regular Life Test
1. Regular Life test shall be conducted for 1000 hours.
  2. Regular life test acceptance shall be on the basis of the 500 and 1000 hours requirements as indicated on Specification Sheet.
  3. Regular life test shall be in effect initially and shall continue in effect until the eligibility criteria for Reduced Hours Life Test have been met.
- f. Reduced Hours Life Test:
1. Reduced Hours Life Test shall be conducted for 500 hours and acceptance shall be based on the 500 hour end point limits.
  2. Eligibility for Reduced Hours Life Tests: No lot failure due to the 1000 hour life test has occurred in the preceding three (3) consecutive lots.
  3. Loss of eligibility for Reduced Hours Life Test: Two (2) or more 500 hour life test lot failures occurring in the last three (3) consecutive lots.
- g. The life test sample shall be read at the following times:
- 0 hours  
500 hours (plus 48 hours; minus 24 hours)  
1000 hours (plus 48 hours; minus 24 hours; when in force)
- Additional reading periods may be used at the discretion of the electron tube manufacturer.
- h. Acceptance Criteria: The lot shall be considered satisfactory for acceptance provided that the specified allowable defects are not exceeded and the change of the average of any characteristic in the life test sample specified for life test control of averages is not exceeded. The average percentage change shall be ascertained from the determination of the individual changes for each tube in the life test sample from the zero (0) hour value for the referenced characteristic or characteristics. For purposes of computation of this average percentage change, the absolute values of the individual changes for each tube in the life test sample shall be used. Any tube found inoperative during life testing shall not be considered in the calculation of this average.
- i. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown.
- j. Not more than one (1) accidental breakage shall be allowed in the life test sample. In the event that one (1) life test tube is accidentally broken, acceptability of the life test sample shall be based upon the remaining tubes in the sample provided that the broken tube was not known to be a defective.
- Note 17: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of .025 inch diameter phosphor bronze placed in contact with the envelope.
- Note 18: Order for evaluation of life test defects.- In the event a tube is defective for more than one attribute characteristic, the characteristic appearing first in the Life Test End Points shall constitute the failure.
- Note 19: An inoperative as referenced in Life Test is defined as a tube having one (1) or more of the following defects: discontinuity (Ref. MIL-E-1, par. 4.7.1), shorts (Ref. MIL-E-1, par. 4.7.2), air leaks.
- Note 20: On Information Life Tests, read same characteristic as Intermittent Life Test. Limits do not apply. Six copies of these data shall be forwarded to the Armed Services Electron Tube Committee upon request.
- Note 21: This life test shall be conducted on a minimum of one sample of ten tubes each month of production. This sample shall be selected as the first ten serially marked, noninoperative tubes from a completed Intermittent Life Test sample. This life test shall be classified as a destructive test. Read at 1000 hours.
- Note 22: This test shall be performed by testing a cold tube in a parallel line circuit per Dwg. 244 JAN. Each diode section shall be tested independently. The line shall be connected to the plate and cathode. All other leads shall be bent at right angles to the axis of the tube and left floating. The length of L shall not be less than that specified herein.
- Note 23: In a full wave circuit, adjust  $Z_p/p$  so that a bogie tube gives  $I_o = 18 \text{ mdc}$ . A bogie tube has a tube drop  $E_{td} = 10 \text{ Vdc}$  at  $I_s = 50 \text{ mdc}$  per plate.  $E_{hk} = E_o + 117 \text{ Vac}$ .
- Note 24: In a full wave life test circuit, the values specified for RL and CL may be considered approximate and shall be adjusted initially to give not less than  $I_o = 18 \text{ mdc}$  and  $i_b = 50 \text{ ma}$  with a bogie tube.  $E_{hk} = E_o + 117 \text{ Vac}$ .
- Note 25: Reference specification shall be of the issue in effect on the date of invitation for bid.