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

VALVE ELECTRONIC **CV4029**

Specification M.O.S./CV.4029 incorporating MIL-E-1/175C.
Issue No.1 Dated 21.5.58
To be read in conjunction with BS.1409 and K.1006.

SECURITY	
Specification	Valve
UNCLASSIFIED	UNCLASSIFIED

TYPE OF VALVE: Sub miniature Power Amplifier pentode with flying leads.

CATHODE: Indirectly heated.

ENVELOPE: Glass.

PROTOTYPE: 5902

MARKING

See K.1001/4

Additional Marking 5902.

BASE

B8D
(Sub miniature 8 pin with flying leads.)

RATINGS
(All limiting values are absolute)

Heater Voltage	(V)	6.3
Heater Current	(mA)	450
Max. Operating Anode Voltage	(V)	165
Max. Operating Screen Voltage	(V)	155
Max. Anode Dissipation	(W)	3.7
Max. Screen Dissipation	(W)	0.4
Max. Cathode Current	(mA)	50
Max. Heater Cathode Voltage	(V)	200
Max. Bulb Temperature	(°C)	220

Typical Operating Conditions

Anode Volts	(V)	110
Screen Volts	(V)	110
Cathode Resistance	(Ω)	270
Anode Current	(mA)	30
Screen Current	(mA)	2
Mutual Conductance	(mA/V)	4.2

Capacitances (Note A)

Cag (max.)	(pF)	0.2
Cin (nom.)	(pF)	6.5
Cout (nom.)	(pF)	7.5

CONNECTIONS

Lead		
1	Control Grid	g
2	Cathode + Suppressor	k+g3
3	Heater	h
4	Cathode + Suppressor	k+g3
5	Anode	a
6	Heater	h
7	Screen Grid	g2
8	Cathode + Suppressor	k+g3

DIMENSIONS

See K.1006. T3
Outline 8-4.

DIMENSIONS	MIN.	MAX.
A	-	1.75"
B	1.39"	1.51"
C		0.4"

MOUNTING POSITION

Any.

NOTES

A. Measured with a close fitting metal screen.

CV 4029

MIL-E-1/175C
14 May 1956
SUPERSEDING
MIL-E-1/175B
26 October 1954

INDIVIDUAL MILITARY SPECIFICATION SHEET

ELECTRON TUBE, RECEIVING, PENTODE, SUBMINIATURE

JAN-5902

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

Description: Pentode, Beam Power

Ratings:	Ef	Eb	Ecl	Ec2	Ehk	Rk	Rgl	Ik	Pp	Pg2	T Envelope	Alt
Absolute	V	Vdc	Vdc	Vdc	v	ohms	Meg	mAdc	W	W	oC	ft
Maximum:	6.6	165	0	155	200	---	0.55	50	3.7	0.4	220	60,000 Note 2
Minimum:	6.0	---	-55	---	---	---	---	---	---	---	---	---
Test Cond.:	6.3	110	0	110	0 Note 1	270 Note 1	---	---	---	---	---	---

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

Diameter: 0.400 in. max.
Height: 1.75 in. max.

Envelope: T-3

Pin No.:	1	2	3	4	5	6	7	8
Element:	gl	k g3	h	k g3	p	h	g2	k g3

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 3.3, Inspection Instructions for Electron Tubes.

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS Min.	LAL	Bogie	UAL	Max.	ALD	Units
	Qualification Approval Tests											
3.1	Qualification Approval:	Required for JAN Marking	---	---								
---	Cathode:	Coated Unipotential	---	---								
3.4.3	Base Connections:		---	---								
	Measurements Acceptance Tests, Part 1, Note 3											
4.10.8	Heater Current:	Note 4	---	---	If:	---	432	450	468	---	36	mA
4.10.8	Heater Current:		0.65	II	If:	420	---	---	---	480	---	mA
4.10.15	Heater-Cathode Leakage:	Ehk=+100Vdc Ehk=-100Vdc	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	15 15	--- ---	uAdc uAdc
4.10.6.1	Grid Current:	Rgl=1.0Meg	0.65	II	Icl:	0	---	---	---	-1.0	---	uAdc
4.10.4.1	Plate Current(1):	Note 4	---	---	Ib:	---	27.0	30.0	33.0	---	8.0	mAdc
4.10.4.1	Plate Current(1):		0.65	II	Ib:	23.0	---	---	---	37.0	---	mAdc
4.10.4.1	Plate Current(2):	Ecl=-40Vdc; Ek=0	0.65	II	Ib:	---	---	---	---	100	---	uAdc
4.10.16.1	Power Output(1):	Esig=6.4Vac; Rp=3000	0.65	II	Po:	0.75	---	---	---	---	---	W
4.7.5	Continuity and Shorts: (Inoperatives)		0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical:	Envelope: (8-4)	---	---		---	---	---	---	---	---	
	Measurements Acceptance Tests Part 2											
4.8	Insulation of Electrodes:	gl-all p-all	2.5	I	R: R:	50 50	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.4.3	Screen Grid Current:		2.5	I	Ic2:	0	---	---	---	4.0	---	mAdc
4.10.9	Transconductance:	Note 4	---	---	Sm:	---	3850	4200	4550	---	950	umhos
4.10.9	Transconductance:		2.5	I	Sm:	3500	---	---	---	4900	---	umhos

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Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS Min.	LAL	Bogie	UAL	Max.	ALT	Units
	Measurements Acceptance Tests Part 2(Contd)											
4.10.6.1	Grid Current(2):	Ef=7.5V;Ec1=-40Vdc; Rg1=1.0Meg;Ek=0;Note 20	2.5	I	Ic1:	0	---	---	---	-2.0	---	uAdc
4.10.16.1	Power Output(2):	Ef=5.7V;Esig=6.4Vac; Rp=3000;Note 23			Δ Po; Ef	---	---	---	---	15	---	%
4.10.3.2	AF Noise:	Esig=150Vac;Ec2=110Vdc; Ec1=-8.7Vdc;Ek=0;Rp=2000; Rg1=0.5Meg;Rg2=10,000; Cg2=4.0uf	2.5	I	NB:	---	---	---	---	17	---	VU
4.10.14	Capacitance:	0.405 in. dia. Shield 0.405 in. dia. Shield 0.405 in. dia. Shield	6.5	Code F	Cgp: Cin: Cout:	--- 5.5 6.5	--- --- ---	--- --- ---	--- --- ---	0.20 7.5 8.5	--- --- ---	uuf uuf uuf
4.10.10	Plate Resistance:		6.5	IA	rp:	0.01	---	---	---	---	---	Meg
---	Low Pressure Voltage Breakdown:	Pressure=55±5mm Hg.; Voltage=300Vac;Note 6	6.5	Note 5	---	---	---	---	---	---	---	---
4.9.20.3	Vibration(1):	No Voltages;Post Shock and Fatigue Test End Points apply	10.0	Note 5		---	---	---	---	---	---	
4.9.19.1	Vibration(2):	Ep=2000;Ck=1000uf; F=40cps;G=15;Note 7	2.5	I	Ep:	---	---	---	---	100	---	mVac
	Degradation Rate Acceptance Tests Note 8											
4.9.5.3	Subminiature Lead Fatigue:	Note 9	2.5	Code F	---	4	---	---	---	---	---	arcs
4.9.20.5	Shock:	Hammer angle=30°; Ehk=±100Vdc;Rg1=0.1Meg; 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:	Vibration(2) Heater-Cathode Leakage Ehk=±100Vdc Ehk=-100Vdc Change in Power Output(1) of individual tubes	--- --- --- --- ---	--- --- --- --- ---	Ep: Ihk: Ihk: Δ Po; t	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	300 40 40 20	--- --- --- --- ---	mVac uAdc uAdc %
---	Glass Strain:	Note 11	6.5	I	---	---	---	---	---	---	---	

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic 1st Sample	Allowable Defectives per Characteristic Combined Samples	Sym.	LIMITS Min.	LIMITS Max.	Units
	Acceptance Life Tests Note 8									
---	Stability Life Test: (1 hour)	Eb=Ec2=100Vdc;Ehk=±200Vdc;Rg1=0.47meg; Ek=220;TA=Room;Note 13	1.0	Code I	---	---		---	---	
---	Stability Life Test End Points:	Change in Power Output (1) of individual tubes	---	---	---	---	Δ Po; t	---	10.0	%
---	Survival Rate Life Test:	Stability Life Test Conditions or equivalent;TA=Room;Notes 14,15	---	II	---		---	---	---	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives) Power Output(1)	0.65 1.0	--- ---	--- ---	--- ---	--- Po:	--- 0.65	--- ---	 W
4.11.7	Heater Cycling Life Test:	Ef=7.0V; 1 min. on; 4 min. off;Ehk=140Vac; Ec1=Ec2=Eb=0;Note 12	2.5	Code H	---	---		---	---	

Ref.	Test	Conditions	AQL(%)	Insp. Level Or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units
					1st Sample	Combined Samples		Min.	Max.	
	Acceptance Life Tests Note 8(Contd)									
4.11.4	Heater Cycling Life Test End Points:	Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	---	---	Ihk:	---	40	uAdc
		Ehk=-100Vdc	---	---	---	---	Ihk:	---	40	uAdc
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	---	---	1	3		---	---	
		Heater Current	---	---	2	5	If:	414	492	mA
		Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	2	5	Ihk:	---	60	uAdc
		Ehk=-100Vdc	---	---			Ihk:	---	60	uAdc
		Grid Current	---	---	1	3	Icl:	0	-2.0	uAdc
		Change in Power Output(1) of individual tubes from initial	---	---	1	3	ΔP_{o_t}:	---	20	%
		Power Output(1) average change	---	---	---	---	Avg ΔP_{o_t}:	---	15	%
		Insulation of Electrodes								
		g1-all	---	---	2	5	R:	25	---	Meg
		p-all	---	---			R:	25	---	Meg
		Power Output(2)	---	---	2	5	$\Delta P_{o_{Ef}}$:	---	15	%
		Total Defectives	---	---	4	8		---	---	
4.11.5	Information Life Test: (1000 Hours)	Intermittent Life Test Conditions; Notes 17, 21, 22								
	Packaging Requirements									
4.9.18.1.1	Carton Drop:	(d) Package Group 1; Carton Size D								

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 reference point for heater-cathode potential shall be the positive terminal of the cathode resistor.

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: Tubes shall be tested in a chamber under the conditions of pressure specified on the specification sheet. The specified voltage shall be applied between the leads of elements carrying B+ voltage and the adjacent leads. Voltage shall be of simusoidal wave form with F = 60 cycles. Tubes showing evidence of corona or arcing shall be considered defective.

Note 7: The impedance of the plate and screen voltage supplies shall not exceed that of a 40 uf capacitor at 10 cps.

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 subjected to this test shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperature immediately prior to beginning this test. The entire tube shall be immersed in water at not less than 97°C for 15 seconds and immediately thereafter immersed in water at 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 so placed in the water that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period at 5°C, the tubes shall be removed and allowed to return to 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 (Parag. 5.3.6.1, Inspection Instructions for Electron Tubes). Electrical rejects, other than inoperatives, may be used in the performance of this test.

Note 12: The no load to steady state full load 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, heater-cathode short, or heater-cathode leakage in excess of the specified Heater-Cycling Life Test End Point limit.

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 under 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, 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 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 shall be 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 shall have 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 shall 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 50 and 200 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 may 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 that 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 samples as described in Note 13, paragraph (a).

d. Regular life test shall be conducted for 500 hours and acceptance shall be on the basis of the requirements indicated on the Specification Sheet.

e. The life test sample shall be read at the following times:

0 hours
500 hours (plus 48 hours; minus 24 hours)

Additional reading periods may be used at the discretion of the electron tube manufacturer.

f. 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.

g. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown.

h. Not more than one (1) accidental breakage shall be allowed in the life test sample. If 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 in contact with the envelope. Envelope Temperature requirement will be satisfied if a tube, having bogie Ib (±5%) under normal test conditions, is determined to operate at minimum specified temperature at any position on the life test rack.

Note 18: Order for evaluation of life test defects:- If a tube is defective for more than one attribute characteristic, the lowest numbered characteristic in this table, for which the tube failed, shall constitute the failure.

(1) Inoperative
(2) Heater Current
(3) Grid Current
(4) Change in Power Output(1) ΔP_o
(5) Power Output(2) $\Delta \frac{P_o}{E_f}$
(6) Heater-Cathode Leakage
(7) Insulation of Electrodes

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 (Ref. Inspection Instructions for Electron Tubes, par. 5.3.6.1).

Note 20: Prior to this test, the tube shall be preheated a minimum of five minutes at the conditions indicated below. Three minute test is not permitted. Test at preheat conditions within 3 seconds after preheating. Grid Current(2) shall be the last test performed on the sample selected for the Grid Current(2) test.

Ef	Ec1	Ec2	Ec3	Eb	Rk	Rgl
V	Vdc	Vdc	Vdc	Vdc	ohms	Meg
7.5	0	100	0	100	220	0.47

Note 21: On Information Life Tests, read same characteristics as for Intermittent Life Test. Limits do not apply. Six (6) copies of these data shall be forwarded to the Armed Services Electron Tube Committee for their information and file.

Note 22: 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 operative tubes from a completed Intermittent Life Test sample. This life test shall be classified as a destructive test. Read at 1000 hours.

Note 23: Power Output (2) is the percent change in Power Output (1) of an individual tube resulting in the change in Ef.

Note 24: Reference specification shall be of the issue in effect on the date of invitation for bid.