

Specification MOS/CV4013 incorporating MIL-E-1/5A				<u>SECURITY</u>	
Issue 1 Dated 29.8.1956.				<u>Specification</u> <u>Valve</u>	
To be read in conjunction with K1006.				UNCLASSIFIED UNCLASSIFIED	

TYPE OF VALVE - Reliable Double Triode				<u>MARKING</u>	
CATHODE - Indirectly heated				See K1001/4.	
ENVELOPE - Glass				<u>Additional marking</u>	
PROTOTYPE - 5670 (REIMA DESIGNATION)				5670	

<u>RATINGS</u>				<u>BASE</u>	
<u>All limiting values are absolute</u>				See BS448/B9A/1.1	
Heater Voltage	(V)	6.3	Note		
Heater Current	(A)	0.35			
Max Anode Voltage	(V)	330	A		
Max Anode Dissipation	(W)	1.35	A		
Max Heater - Cathode Voltage	(V)	100	A		
Max Negative Grid Voltage	(V)	55	A		
Max Series Grid Resistance	(M)	0.5	A		
Max Cathode Current	(mA)	18	A		
Max Grid Current	(mA)	3	A		
Max Bulb Temperature	(°C)	165			
Max Altitude for full ratings	(ft)	60,000			
<u>Typical Operating Conditions</u> Note A.					
Anode Voltage	(V)	150			
Anode Current	(mA)	8.2			
Mutual Conductance	(mA/V)	5.5			
Amplification Factor		35			

<u>CONNECTIONS</u>		
Pin	Electrode	
1	Heater	h
2	Cathode (2)	k*
3	Grid (2)	g*
4	Anode (2)	a*
5	Shield	s
6	Anode (1)	a†
7	Grid (1)	g†
8	Cathode	k†
9	Heater	h

<u>DIMENSIONS</u>		
See BS448/B9A/2.1		
Size ref. No.1.		
Dimension (mm)	Min.	Max.
A seated height	-	38.0
C Diameter	19.0	22.2
D Overall length	-	45.0

<u>MOUNTING POSITION</u>		
ANY		

<u>NOTES</u>		
A. Each section		

CV4013

MIL-E-1/5A
 5 December 1955
 SUPERSEDING
 MIL-E-1/5
 13 Jan 53

INDIVIDUAL MILITARY SPECIFICATION SHEET
 ELECTRON TUBE, RECEIVING, TWIN TRIODE, MINIATURE

JAN-5670

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

Description: Twin Triode, Medium Mu

Ratings:	E _f	E _b	E _c	E _{hk}	R _{k/k}	R _{g/g}	I _{k/k}	I _{c/g}	P _{p/p}	T	Envelope	Alt
Absolute	V	V _{dc}	V _{dc}	V	ohms	Meg	mAdc	mAdc	W	°C	A65	ft
Maximum:	6.9	330	0	100	—	0.5	18	3.0	1.35	—	—	60,000 Note 2
Minimum:	5.7	—	-55	—	—	—	—	—	—	—	—	—
Test Cond.:	6.3	150	0	0	240 Note 1	—	—	—	—	—	—	—

Cathode: Coated Unipotential
 Base: Miniature Button 9-Pin

Diameter: 7/8 in. max.
 Height: 1-3/4 in. max.

Pin No.: 1 2 3 4 5 6 7 8 9
 Element: h 2k 2g 2p sd lp lg lk h

Envelope: T-6 1/2

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.

For miscellaneous requirements, see Paragraph 3.3, Inspection Instructions for Electron Tubes.												
Ref.	Test	Conditions	A.C.L.(%)	Insp. Level or Code	Sym.	LIMITS						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
<u>Qualification Approval Tests</u>												
3.1	Qualification Approval:	Required for JAN Marking	—	—								
—	Cathode:	Coated Unipotential	—	—								
3.4.3	Base Connections:	E9-1	—	—								
4.9.20.3	Vibration(1):	E _c =-3Vdc;R _p =2000; R _k =0;Notes 7,9	—	—	E _p :	—	—	—	—	100	—	mVac
<u>Measurements Acceptance Tests Part 1 Note 3</u>												
4.10.8	Heater Current:	Note 4	—	—	If:	—	337	330	363	—	26	mA
4.10.8	Heater Current:		0.65	II	If:	330	—	—	—	370	—	mA
4.10.15	Heater-Cathode Leakage:	Note 21 E _{hk} =-100Vdc E _{hk} =-100Vdc	0.65	II	I _{hk} : I _{hk} :	— —	— —	— —	— —	7 7	— —	uAdc uAdc
4.10.6.1	Grid Current:	R _g =0.5Meg Max; Note 21	0.65	II	I _c :	0	—	—	—	-0.3	—	uAdc
4.10.4.1	Plate Current(1):	Notes 4,21	—	—	I _b :	—	7.3	8.2	9.1	—	2.0	mAdc
4.10.4.1	Plate Current(1):	Note 21	0.65	II	I _b :	5.9	—	—	—	10.5	—	mAdc
4.10.4.1	Plate Current(2):	E _c =-10Vdc;R _p =0.25 Meg;Note 21	0.65	II	I _b :	—	—	—	—	45	—	uAdc
4.10.9	Transconductance(1):	Notes 4,21	—	—	S _m :	—	5000	5500	6000	—	1000	umhos
4.10.9	Transconductance(1):	Note 21	0.65	II	S _m :	4500	—	—	—	6500	—	umhos
4.7.5	Continuity and Short: (Inoperatives)		0.4	II		—	—	—	—	—	—	
4.9.1	Mechanical:	Envelope Outline No. (6-6)	—	—		—	—	—	—	—	—	
<u>Measurements Acceptance Tests Part 2</u>												
4.8	Insulation of Electrodes:	Note 21 E _g -all=-100Vdc E _p -all=-300Vdc	2.5	IA	R: R:	100 100	— —	— —	— —	— —	— —	Meg Meg
4.10.4.1	Plate Current(1) Difference Between Sections:		2.5	I	I _b :	—	—	—	—	1.8	—	mAdc

CV4013

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
<u>Measurements Acceptance Tests Part 2(Contd)</u>												
4.10.4.1	Plate Current(3):	E _c =-4Vdc; Note 21	2.5	I	I _b :	5	—	—	—	—	—	uAde
4.10.9	Transconductance(2):	E _f =5.7V; Notes 21,22	2.5	I	Δ S _m : E _f	—	—	—	—	15	—	%
4.10.6.2	Grid Emission:	E _f =7.5V; E _c =-10Vdc; Notes 20,21	2.5	I	I _{sc} :	0	—	—	—	-0.5	—	uAde
4.10.3.1	RF Noise:	E _b =250Vdc; E _{cal} =1.1mVac; C _k =0.2uF; R _g =0.5Meg; R _k =240; Notes 9,23	2.5	I	—	—	—	—	—	—	—	—
4.10.3.5	Noise and Microphonics:	E _f =6.3Vac; E _{hk} =0; E _{bb} =250 Vdc; E _c =0; E _{cal} =200mVac; R _p =10,000; R _g =0; R _k =240; C _k =1000uF min; Notes 9, 24	2.5	I	—	—	—	—	—	—	—	—
4.10.11.1	Amplification Factor:	Notes 4,21	—	—	M _u :	—	30.8	35	39.2	—	11.0	—
4.10.11.1	Amplification Factor:	Note 21	6.5	IA	M _u :	26	—	—	—	44	—	—
4.10.14	Capacitance:	No Shield; Note 21 No Shield; Note 21 No Shield; Note 21 No Shield	6.5	Code E	C _{gp} : C _{in} : C _{out} : C _{pp} :	0.8 1.7 0.7 —	— — — —	— — — —	— — — —	1.4 2.7 1.3 0.10	— — — —	unf unf unf unf
—	Low Pressure Voltage Breakdown:	Pressure=55/5mm Hg.; Voltage=500mVac; Note 6	6.5	Note 5	—	—	—	—	—	—	—	—
4.9.19.1	Vibration(2):	E _c =-3Vdc; R _p =2000; R _k =0; Notes 7,9	6.5	Code I	E _p :	—	—	—	—	100	—	mVac
<u>Degradation Rate Acceptance Tests Note 8</u>												
4.9.20.5	Shock:	Hammer angle=42°; E _{hk} =100Vdc; C _k =0; Note 10	20	—	—	—	—	—	—	—	—	—
4.9.20.5	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 E _{hk} =100Vdc E _{hk} =100Vdc Transconductance(1): Grid Current	—	—	E _p : I _{hk} : I _{hk} : S _m (1): I _o :	— — — 380 0	— — — — —	— — — — —	— — — — —	200 20 20 — -0.6	— — — — —	mVac uAde uAde umhos uAde
4.9.6.1	Min. Tube Base Strain:	—	—	—	—	—	—	—	—	—	—	—
—	Glass Strain:	Note 11	2.5	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	E _f =7.5V; E _{hk} =135Vdc; R _k =0; E _c =E _b =0; Note 12	—	—	—	—	—	—	—	—		
4.11.4	Heater Cycling Life Test End Points:	Heater-Cathode Leakage E _{hk} =100Vdc E _{hk} =100Vdc	—	—	—	—	I _{hk} : I _{hk} :	— —	15 15	uAde uAde		
—	Stability Life Test: (1 hour)	E _{hk} =135Vdc; R _g =0.5Meg; T _A =Room; Notes 13,21	1.0	Code I	—	—	—	—	—	—		
—	Stability Life Test End Points:	Change in Transconductance(1) of individual tubes	—	—	—	—	Δ S _m : t:	—	10	%		

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(Contd)</u>									
—	Survival Rate Life Tests: (500 hours)	Stability Life Test Conditions or equivalent; Notes 14, 15, 21	—	II	—	—		—	—	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives) Transconductance(1)	0.65	—	—	—	—	—	—	
			1.0	—	—	—	Sm	3850	—	umho
4.11.5	Intermittent Life Test:	Stability Life Test Conditions; T Envelope = $\Delta 65^{\circ}\text{C}$ min.; Notes 16, 17, 21	—	—	—	—		—	—	
4.11.4	Intermittent Life Test End Points:	Note 18 Inoperatives; Note 19 Grid Current Heater Current Change in Transconductance(1) of individual tubes Transconductance(2) Heater-Cathode Leakage $\text{Ehk} \sim 100\text{Vdc}$ $\text{Ehk} \sim 100\text{Vdc}$ Insulation of Electrodes g-all p-all Transconductance(1) average change Total Defectives	—	—	1	3	Ic: 0 If: 330 ΔSm_t	—	—	uAdc mA %
			—	—	1	3		—	20	%
			—	—	2	5	Sm Et	—	15	%
			—	—	1	3	Ihk: Ihk_1	—	7	uAdc uAdc
			—	—	2	5	R: 50 R: 50 $\text{Avg} \Delta \text{Sm}_t$	—	—	Neg Neg %
			—	—	—	—		15		%
			—	—	4	8		—	—	
4.11.4	Intermittent Life Test End Points: (1000 Hours)	Note 18 Inoperatives; Note 19 Grid Current Heater Current Change in Transconductance(1) of individual tubes Heater-Cathode Leakage $\text{Ehk} \sim 100\text{Vdc}$ $\text{Ehk} \sim 100\text{Vdc}$ Total Defectives	—	—	2	5	Ic: 0 If: 330 ΔSm_t	—	—	uAdc mA %
			—	—	2	5		—	25	%
			—	—	2	5	Ihk: Ihk_1	—	7	uAdc uAdc
			—	—	5	10		—	—	
<u>Packaging Information</u>										
4.9.18.1.1	Carton Drop:	(d) Package Group 1; Carton Size E								

- 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 (E_f , 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 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.

CV4013

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 base pins of elements carrying B+ voltage and their adjacent pins. Voltage shall be of sinusoidal wave form with $F = 60$ cycles. Tubes showing evidence of corona or arcing shall be considered defective.

Note 7: The impedance of the plate voltage supply 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

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

Note 9: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 10: $R_g = 0.1$ meg; R_g not to be used when thyratron-type short indicator is used.

Note 11: Glass strain procedures - All tubes submitted to this test 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 97° 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 so 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 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 current in excess of the specified heater cycling life test end point limit.

Note 13: Stability Life Test:

- 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.
- Serially mark all tubes from the sample.
- Record referenced characteristic measurements after a maximum operation of 15 minutes under specified voltage and current conditions on the entire sample.
- 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.
- 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 voltages and current conditions, and immediately measured. The 15 minutes preheat shall be considered as part of the test time.
- A defective shall be defined as a tube having a change in referenced characteristic greater than that specified on the specification sheet.
- 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

- Select sample in accordance with Note 13, Paragraph (a).
- 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.
- Determine the number of defective tubes at the 100 hour period.

Note 14:
(Contd)

- 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 (E_h) and heater-cathode voltage (E_{hc}) 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 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 10 tubes which meet the measurements acceptance test limits for those characteristics specified as Intermittent Life Test End Points.
Subject these 10 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).
- d. 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 the Specification Sheet.
 - 3. Regular life test shall be in effect initially and shall continue in effect until the eligibility criteria for the Reduced Hours Life Test have been met.
- e. 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 Tests: Two (2) or more 500 hour life test lot failures occurring in the last three (3) consecutive lots.
- f. The life test sample shall be read at the following times:
 - 0 hours
 - 500 hours (plus 1/8 hours; minus 2 1/2 hours)
 - 1000 hours (plus 1/8 hours; minus 2 1/2 hours; when in force)

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

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

CV4013

Note 20: Prior to this test, tubes shall be preheated a minimum of five minutes with all sections operating at the conditions indicated below. Three minute test is not permitted. Test within three seconds after preheating. Grid Emission shall be the last test performed on the sample selected for the Grid Emission test.

Ef	Ec	Eb	Rk	Rg
V	Vdc	Vdc	ohms	Meg
7.5	0	150	240	0.5

Note 21: Test each unit separately.

Note 22: Transconductance (2) is the percent change in Transconductance (1) of an individual tube resulting from the change in Ef.

Note 23: In addition to the rejection criteria of Par. 4.10.3.1, MIL-E-1, the output shall be read on a VU meter using a rejection limit of five (5) VU. Five (5) VU is the meter deflection obtained with a steady state output of 3 mW from the amplifier.

Note 24: The rejection level shall be set at the VU meter reading obtained during calibration.

Note 25: Reference specification shall be of the issue in effect on the date of invitation for bid.