Send to
R. Ulmer

DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON, OHIO—45420

IN REPLY REFER TO: DESC-EC

24 January 1964

SUBJECT: Meeting of Power and Gas Tube Working Group #5

TO: Distribution to Military and Manufacturers of Power and Gas Tubes

1. Information pertinent to subject meeting is as follows:

   a. Agenda: See Attachment (1)

   b. Location: Defense Electronics Supply Center
   1507 Wilmington Pike
   Building 5, Conference Room #1
   Dayton, Ohio 45420

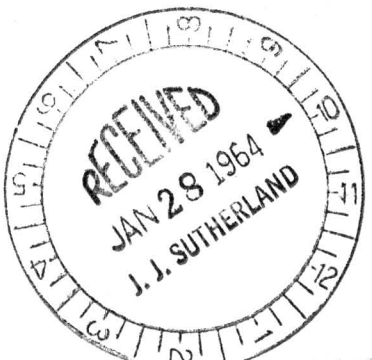
   c. Date: 25-26 February 1964

   d. Time: 1300 EST on 25 February 1964
   0930 EST on 26 February 1964

2. Discussion will be limited to the technical comments on the case material unless time permits consideration of additional technical comments which may be presented at the meeting. Such additional technical comments will be discussed only if they are of a non-controversial nature; otherwise, they will be placed on the Agenda for consideration during a future meeting of the Working Group. Comments on policy will not be considered during a future meeting of the Working Group. Comments on policy will not be considered during subject meeting.

3. It is imperative that all Departmental Representatives who attend the meeting come fully prepared to discuss all aspects of each case on the agenda and express firm Departmental positions Industry Representatives are also requested to come to the meeting fully prepared. Complete preparation by all attendees should yield realistic procurement documents.

4. It is requested of each Department of the Military services that receives an information copy of the agenda to please forward their comments to the action activity early enough to be utilized at the subject meeting.



5. Whenever a service or manufacturer is requested to submit or submits a proposal to DESC-E, it must be received by this Center not more than forty-five (45) days after the 25-26 February 1964 Working Group meeting, to insure that it will be included on the next agenda.

FOR THE COMMANDER

ROBERT C. HADELOFF
Chief, Circuit Devices Division

2 Atchs
1. Mil. Dist. List
2. Agenda for Subj. Mtg.

MILITARY DISTRIBUTION FSC 5960

Custodians:

Army: Commanding Officer
USAEMSA (SELMS-PS)
Ft. Monmouth, N.J. 17B, 6C

Navy: Ch, Bu of Ships
Specs & Stdzn Br
Code 621
Dept of the Navy
Washington 25, D. C. 12B, 3C

USAF: Commander
Systems Engineering Group
(SEPSD) 25B, 5C
Wright-Patterson AFB, Ohio

Army Activities:

Commanding Officer
Frankford Arsenal
Attn: SMUFA-5500
Phila. 37, Pa. 25B, 4C

Commanding General
U.S.A. Missile Command
Attn: AMSMI-IES 15B, 3C
Redstone Arsenal, Ala.

Commanding General
U.S. Army Tank Automotive Center
Attn: SMOTA-RSS
Detroit Arsenal
Warren, Mich. 43B, 4C

Navy Activities:

Chief, BuMedical & Surgery
Bldg. 5, Potomac Annex
Dept of the Navy 2B
Washington 25, D. C.

Commandant of the Marine Corps
Code CSL
Headquarters, USMC 4B, 4C
Washington 25, D. C.

Commandant, U. S. Coast Guard Hqs.
Station 6-19, Room 6020 2B, 2C
1300 E. Street, N. W.
Washington 25, D. C.

USAF ACTIVITIES:

Commander
Directorate of Air Force Support
Attn: SGEES 20B, 10C
Wright-Patterson AFB, Ohio

Surgeon General
Hq, USAF
Attn: AFMSHB
Bldg. T-8
Washington 25, D. C. 2B, 2C

Commander
Hq, AFSC (SCSND)
Andrews Air Force Base 25B, 5C
Washington 25, D. C.

Other DOD Activities:

Commander
Defense Medical Supply Center
Attn: Tech Dept
3rd Ave & 29th St.
Brooklyn 32, N. Y. 10B, 3C

Director
National Security Agency
Attn: M2112
Ft. George G. Meade, Md. 3B, 3C

Defense Electronics Supply Center
Directorate of Engineering Stdzn.
Attn: DESC-EP
1507 Wilmington Pike
Dayton, Ohio 45420 10B, 2C

B = Copies required, drafts of specs (Agenda, Minutes, etc.)
C = Copies required, circulation letters for spec drafts

Army, Navy, and USAF activities must submit comments through the appropriate Departmental Custodian to insure proper disposition.

AGENDA FOR MEETING OF
WORKING GROUP ON POWER AND GAS TUBES
TO BE HELD 25-26 FEBRUARY 1964
AT 1300 ON 25 FEBRUARY AND 0930 ON 26 FEBRUARY

I. REVIEW OF MINUTES OF MEETING HELD 8 OCTOBER 1963.

II. CASES FOR DISCUSSION:

Note: For cases where the Working Group agrees to the initiation of projects for replacing limited coordination (LC) specifications with coordinated specifications; and further, agrees that partial or no re-evaluation testing will be required on manufacturers' products in order for DESC to continue the listing of such products on the governing qualified products list (QPL), DESC will require of manufacturers only the specific amount of re-evaluation testing recommended by the Working Group provided that:

1. DESC receives copies of the test reports which formed the basis for products being listed on the QPL under the LC document; and

2. Evaluation by DESC of test results in the above referenced test reports gives evidence that products concerned have satisfactorily met all of the qualification testing requirements of the LC document.

   a. Otherwise, manufacturers may be required to have more re-evaluation testing performed on their products than was agreed to by the Working Group. In all instances where qualification problems develop which prevent DESC from operating in accordance with the agreements of the Working Group, DESC will discuss such problems first, with the Military Department concerned and then, with the Preparing Activity, prior to taking required action.

Page	Case	Title	MIL-Number
3	2.1.125	JAN-C1K/B	1217A
8	2.1.131	Coordination of Tube Types in 4X150 and 4X250 Family	
9	2.1.139	4CX300Y (Y-260) Coordination of	
14	2.1.141	Proposed NATO Draft on Pulse Modulators and Clipper Tubes	
16	2.1.142	JAN-8438/4-400A	887A
21	2.1.143	JAN-7322	1371B

Page	Case	Title	MIL-Number
23	2.1.144	Specification requirements for Tube Types 8168/4CX1000A, 4CX5000A, 6895, and 5682	
24	2.1.145	JAN-4E27A	1038B
25	2.1.146	JAN-8172/4X150G	302J
27	2.1.147	Salt Spray Change	MIL-E-1E
28	2.1.148	Shock test	MIL-E-1E
30	2.1.149	Revisions to MIL-E-1E	
33	2.1.150	Life Test Sampling (Group S)	

III. NEW BUSINESS:

Industry and Service representatives are requested to submit:

A. New proposals concerning coordination of limited coordination (LC) documents.

B. New proposals concerning the Preferred and Guidance Lists.

C. New proposals and problem areas for consideration at a future meeting of the Working Group. (Other than those in categories A and B.)

IV. CLOSED SESSION (SERVICES ONLY).

A. Review of LC documents to determine Service interest.

B. Review of Preferred and Guidance Lists.

1. Case Material.

2. Proposals presented at meeting under III B above.

A. Case Number 2.1.125: Coordination of MIL-E-1/1217A, JAN-C1k/B.

B. Purpose of Case: To make the LC specification MIL-E-1/1217 (Navy) into a coordinated document.

C. Reference Material:

1. Agenda and minutes of 19 March, 18 June, and 8 October 1963 meetings.

2. DESC-E letter to Bureau of Ships dated 31 October 1963.

3. Proposed MIL-E-1/1217A.

D. Summary of Case: In accordance with the agreements reached during the above listed meetings, the Navy TSS is presented for coordination. However, before coordination is approved, a determination as to which tube type, the C1k or C1kB, will be the preferred JAN type. When this is determined, one of the TSS's should be cancelled.

E. DESC-E recommends that the C1kB TSS be coordinated and that the C1k TSS be cancelled.

F. Additional information required.

1. Preparing Activity

2. Agent

3. Qualification

4. User and Review Activities

Note: This initial draft prepared by the Defense Electronics Supply Center, (DESC-E), has not been approved and is subject to modification. DO NOT USE FOR PROCUREMENT PURPOSES.

MIL-E-1/1217A

SUPERSEDING
MIL-E-1/1217 (Navy)
21 November 1958

MILITARY SPECIFICATION SHEET

ELECTRON TUBE, THYRATRON

JAN-C1K/B

(Preamble to be inserted after approval)

DESCRIPTION: Inert Gas

PIN CONNECTIONS AND DIMENSIONS: See figure 1

CATHODE: Coated Filament

ABSOLUTE-MAXIMUM RATINGS:

Parameter:	Ef	epx	epy	Ib	ib	tk	TA	F	i surge	0.1 sec	ALT
Unit:	Vac	v	v	Adc	a	sec	°C	cps	a		ft
	2.5±5%	2000	2000	1.0	8.0	20 minimum	-60 +75	125	77		10,000
TEST CONDITIONS:											
	2.5	2000	2000	---	---	---	---	60	---		---

PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS		UNIT
						Min	Max	
	General							
3.1	Qualification	Required	---	---	---	---	---	---
3.6	Performance	(See note 1)	---	---	---	---	---	---
4.9.2	Dimensions	(See figure 1)	---	---	---	---	---	---
4.5	Holding period	t = 176 hours	---	---	---	---	---	---
3.4.3	Base connections	---	---	---	---	---	---	---
	Qualification inspection (See note 2)							
4.10.21	Thyratron grid current	epx=epy=-750v; F=500; Ib=1.0 Adc	---	---	ic	---	25	uAdc
	Acceptance inspection part 1 (production)							
4.10.17.1	Critical grid voltage for conduction	Ebb=2000 Vdc; Rg=1000; Rp=750 to 5000	0.65	II	Ecc	-4	-10	Vdc
4.10.17.2	Critical anode voltage for conduction	Ec=4Vdc; Rg=1000; Rp=750 to 5000	0.65	II	Eb	---	75	Vdc
4.10.18	Tube voltage drop	Ib=1.0Adc; Epp=130 Vac maximum; Rg=10,000; Grid connected to anode (see note 3)	0.65	II	Etd	---	12	Vdc
4.10.19	Thyratron high-voltage operation	Ib=1.0 Adc; Rg=10,000	0.65	II	Ecc	-4	-10	Vdc
4.10.21	Thyratron grid current	Rg=1 Meg, and 10,000 (see note 4)	0.65	II	ic	---	5	uAdc
4.10.1.7	Thyratron emission	ib=8a (see note 5)	0.65	II	etd	---	45	v
---	Stabilization	Epp=130 Vac maximum; Ib=1.2 Adc ± 10%; Rg =10,000; Grid connected to anode (see note 6)	0.65	II	t	16	---	hours
	Acceptance inspection, part 2 (design)							
4.10.8	Filament current	---	6.5	L6	If	5.5	7.1	Aac
4.9.19.1	Low-frequency vibration	No voltages	---	---	---	---	---	---
4.9.19.3	Bump	Hammer angle = 20°	---	---	---	---	---	---
---	Filament cycling no load	Eb=Ec=0 (see note 7)	6.5	L6	t	1000	---	cycles

PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS		UNIT
						Min	Max	
	Acceptance inspection, part 3 (life or periodic check							
4.11	Life test	Operation; Group D; ib=8a; Ib=1.0 Adc; Resistance load	---	---	t	500	---	hours
4.11.4	Life-test end point	Operation	---	---	Ecc	-4	-10	Vdc
		Grid current	---	---	ic	---	5	uAdc
		emission	---	---	etd	---	55	v
4.9.18 and 4.9.18.1.6.1	Container drop	Required						
Section 5	Preparation for delivery	(See note 8)						

NOTES:

1. In addition to the paragraphs specified hereon, the following tests and requirements listed in 3.6 shall apply: 3.3, 3.3.1, 3.4.2, 3.7, 3.7.7, 3.8, 4.1, 4.3, 4.4, 4.6, 4.7, 4.8, 4.9, 4.9.1, 4.9.3, 4.9.4, 4.9.5, and 4.9.21.

2. All tests listed hereon shall be performed during qualification, however, this test is normally performed during qualification inspection only.

3. Wattmeter method: - With an alternating current source and resistive load, measure the power loss in the tube with a wattmeter so that the current coil is in series with, and the voltage coil across the tube. The tube voltage drop (Etd) is the total power loss minus the coil loss under load, divided by the average, or d. c. current (Ib).

4. Operate tube at least 5 minutes before the test. Operation may be at optional Epp, but Ib shall be 1.0 Adc minimum. To test, switch to the test voltage and Ib=1.0Adc in less than 2 seconds.

5. Connect grid to anode through 10,000-ohm resistor. Adjust Epp and Rp to give the required current.

6. Thirty-six hours minimum stabilization is required for all tubes before characteristic testing. Since stabilization is performed on 100 percent of the product, it is considered to be a part of the regular processing procedure during manufacture. Hence, after all of the tubes in any lot have been stabilized once, no further stabilization on these tubes will be required.

   Voltages as specified on the TSS shall be applied continuously during stabilization.

7. A cycle shall consist of a 3-minute period with filament voltage applied followed by a 3-minute period with filament voltage removed. After cycling test, the tubes shall be within the limits of this specification for Operation and Grid Current Test.

8. Tubes shall be packaged and packed, as specified in the contract or order, in accordance with Specification MIL-E-75 and appendix thereto.

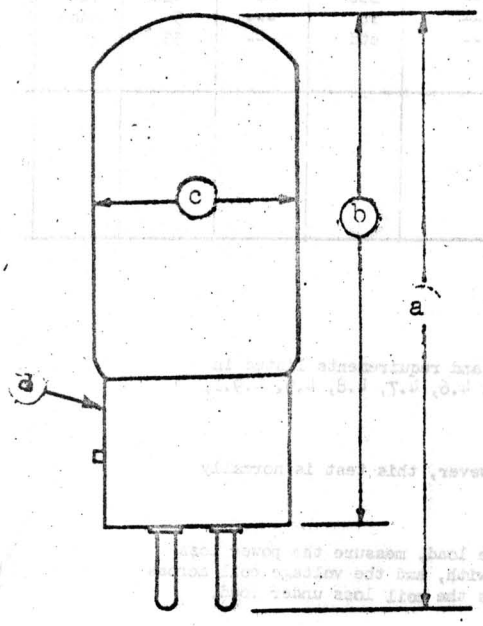
9. Referenced documents shall be of the issue in effect on the date of invitation for bids.

Custodians:
Army - EL
Navy - Ships
Air Force - ASD

Preparing Activity:
Navy - Ships

Pin Connections

Pin No.	Element
1 & 4	f
2	p
3	g



Dim.	AQL Percent Defective	Inspection Level	Limits Min	Limits Max
QUALIFICATION INSPECTION				
D	Base: A4-10, metal shell, ceramic (insert (see note b)			
QUALIFICATION INSPECTION, PART 2 (Design)				
A	6.5	L6	---	4.375 (110.85)
B	6.5	L6	---	3.781 (96.044)
C	6.5	L6	---	1.563 (39.69)

Notes:

a. All dimensions in inches and millimeters (in parentheses).
b. JEDEC designation.

Figure 1. Outline drawing.

A. Case Number 2.1.131: Consolidation of the tube types in the 4X150 and 4X250 family.

B. Reference Material:

1. Minutes of the 18 June 1963 working group meeting.

2. Agenda of the 8 October 1963 working group meeting.

3. Minutes of the 8 October 1963 working group meeting.

C. Summary of Case: In accordance with the 8 October 1963 working group meeting, several of the listed tube types were deleted, however, the following types still require review for possible deletion or consolidation:

4X150 Class	4X150A, 7034W, 8296 4X150D, 7035W, 8297, 7609 8172/4X150G
4X250 Class	7203/4CX250B, 7203W 7204/4CX250F, 7204W 7580, 7580W/4CX250R 8245/4CX250K

D. DESC-E Recommendations: DESC-E recommends that the above listed tubes be reviewed by each of the Military Services and inturn submit their recommendations to the committee for further action.

A. Case Number 2.1.139: Proposed Specification for EIMAC tube type 4CX300Y (Y-260).

B. Purpose of Case: To coordinate a tube specification sheet for the 4CX300Y.

C. Reference Material:

1. Proposed TSS MIL-E-1/

2. Paragraph Number 4.2 and 4.3 of MIL-T-5422E

D. Summary of Case: The 4CX300Y, formerly the Y-260, is used extensively by the Air Force in the AN/ALT-15 System. This system is made by Hallicrafters in which their drawing number 090-001483 applies to the subject tube. In this drawing, the environmental tests (Vibration and Shock) are in accordance with MIL-T-5422E, paragraphs 4.2 and 4.3 on equipment specification.

This drawing is not adequate for competitive procurement from other electron tube manufacturers due to the lack of adequate tests and limits that are required in order to adequately describe the performance requirements of any electron tube. One obvious lack in the drawing is any reference to power output capabilities of this tube.

Eimac's proposed specification for the 4CX300Y does not include any Acceptance Inspection, Part 3 data, therefore, it is imperative that sufficient data be obtained to fulfill these parameters.

E. DESC-E recommends that Acceptance Inspection, Part 3 information be provided for inclusion into the proposed EIMAC specification and that the specification be coordinated.

F. Additional information required.

1. Preparing Activity

2. Agent

3. Qualification

4. User and Review Activities

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TEST SPECIFICATION

5 November, 1963
Superseding
type Y-260
20 July, 1962

ELECTRON TUBE, TETRODE, EXTERNAL ANODE, INTEGRAL-FINNED

4CX300Y

Fl = 110 Mc

ABSOLUTE MAXIMUM RATINGS:

Parameter:	Ef	Eb	Ec1	Ec2	Ib	Ehk	Pg1	Pg2	Pp	Anode Core & Seal T	Cooling	Altitude
Units:	Vac	Vdc	Vdc	Vdc	mAdc	Vdc	W	W	W	°C		Ft
	Note 1										Note 2	
C Teleg :	6.0±5%	2000	-250	300	400	±150	1	8	400	250	---	20,000
C Telep :	6.0±5%	1500	-250	300	300	±150	1	8	250	250	---	20,000
A or AB :	6.0±5%	2000	---	400	400	±150	1	8	400	Note 3 250	---	20,000
Test Cond:	6.0	1000	adj	300	240	---	---	---	---	---	Note 4	---

MIL-E-1 PAR.No.	TEST	CONDITIONS	AQL%	INSP. LEVEL	SYMBOL	LIMITS Min	LIMITS Max	UNITS
	General							
4.5	Holding Period		---	---	t:	72	---	hrs
4.9.2	Dimensions	Per Figure 1: See Note 5	---	---	---	---	---	---
---	Cathode	Oxide-coated, unipotential	---	---	---	---	---	---
	Acceptance Inspection Part 1 (Production) Note 6							
4.9.1	Mechanical Production Tests		---	---	---	---	---	---
4.10.8	Heater Current		0.65	II	If:	3.00	3.85	Aac
4.10.5.2	Grid Voltage		0.65	II	Ec1:	-32	-45	Vdc
4.10.4.3	Screen Grid Current		0.65	II	Ic2:	-8.0	+2.0	mAdc
4.10.6.1	†Total Grid Current	Eb = 2000 Vdc; Ib = 150 mAdc	0.65	II	Ic1:	---	-15	µAdc
4.10.6.6	Primary Control Grid Emission	Pg1=1 W; t = 15; Anode & screen grid floating	0.65	II	Isg1:	---	-25	µAdc

MIL-E-1 PAR.NO.	TEST	CONDITIONS	AQL%	INSP. LEVEL	SYMBOL	LIMITS Min	LIMITS Max	UNITS
	Acceptance Inspection Part 1 (Production) Note 6 Cont'd							
4.10.6.6	Primary Screen Grid Emission	Ec1 = 0 Vdc; Pg2 = 8 W; t = 15; anode floating	0.65	II	Isg2:	---	-250	µAdc
---	Pulse Emission	Eb = Ec2 = 250 Vdc; Ec1 = -100 Vdc; prr = 11 ± 1 pps; tp = 4500 µs minimum; ec1/ik = 2.4 a; Ef = 5.4 Vac; Note 7	0.65	II	Δik:	---	300	ma
---	Positive Grid Current Division	Eb = Ec2 = 250 Vdc; Ec1 = -100 Vdc; prr = 11 ± 1 pps; tp = 4500 µs minimum; ec1/ib = 1.6 a; Note 8	0.65	II	ec1:	8.0	18.0	v
					ic1:	---	400	ma
					ic2:	---	400	ma
	Acceptance Inspection Part 2 (Design) Note 9							
4.10.14	Direct Interelectrode Capacitance (grounded cathode connection)		6.5	L6	Cgp:	---	0.07	µµf
					Cin:	30.0	38.0	µµf
					Cout:	3.9	5.0	µµf
4.10.15	Heater-Cathode Leakage	Ehk = +250 Vdc	6.5	L6	Ihk:	---	150	µAdc
		Ehk = -250 Vdc			Ihk:	---	150	µAdc

NOTES

Note 1: When long life and consistent performance are factors, the applied heater voltage should be maintained within plus or minus five percent. Heater voltage should be measured directly at the tube base or socket with an accurate meter.

Note 2: When the tube is operated at 100 percent of maximum rated plate dissipation at an incoming air temperature of 25°C maximum at sea level, a minimum air flow of 7.4 cfm must pass through the anode cooler. If the socket SK-700, or equivalent, is used, an incoming air flow of 7.4 cfm to the lower end of the socket is required. At this flow of 7.4 cfm, the static pressure drop directly across the tube and socket is approximately 0.7 inch of water. This pressure drop varies with the amount of escaping air and with the shape and construction of the air director. Air cooling of the tube should be increased with increased incoming air temperature. In all cases of operation a socket which provides for forced-air cooling of the base must be used. The air flow should be applied before or simultaneously with application of electrode voltages and may be removed simultaneously with them. In all cases of operation sufficient cooling must be provided to prevent seal and anode core temperatures in excess of the specified maximum values, and where long life and consistent performance are factors, cooling in excess of the minimum requirements will prove beneficial.

Note 3: Applies to carrier-only condition.

Note 4: In all electrical tests involving application of heater voltage, forced-air cooling of the tube is allowed at the rate of 7.4 cfm maximum for the base and anode. A separate source may be used for the base and anode but neither shall exceed 7.4 cfm. The tube may be operated in an air-system socket (SK-700, with SK-606 chimney, or equivalents). The cooling air shall not have a temperature of less than 20°C nor an absolute pressure greater than 32 inches of mercury.

Note 5: The following dimensions shall be considered Acceptance Inspection part 2 (Design), AQL 6.5, Inspection Level L6: A, D, F, G, H, J, K, L, and M. The following dimensions shall be checked on the first production lot of each year, using a sample of 10 tubes with one failure allowed: B, C, E, N, Q, and R; in case of a sample failure, that dimension shall become Acceptance Inspection part 2 (Design) for three consecutive successful submissions, at which time it will revert to a once-a-year periodic basis.

Note 6: These tests shall be carried out as standard production tests. Sampling as in MIL-STD-105 may be used. The AQL for the combined defectives for attributes, excluding mechanical, shall be one percent. A tube having one or more defects shall be counted as one defective.

Note 7: The Pulse Emission test is taken at the voltage conditions specified. The grid voltage pulse is essentially a square wave, and the magnitude is adjusted to produce a total cathode current of 2.4 amperes at the leading edge of the pulse. The difference in cathode current (Δik) from the leading to the falling edge of the pulse shall not exceed the specified limit. The input wave shape shall have a tr and a tf of 25 µs maximum each, and the slope of the top of the pulse may not be greater than 0.5% with a ripple not to exceed 0.1% .

Note 8: Positive Grid Current Division is taken with the voltage conditions as specified. The grid voltage pulse is essentially a square wave and its magnitude is adjusted to produce a plate current of 1.6 amperes at the leading edge of the pulse. The magnitude of ec1, ic1, and ic2 are recorded and shall be within the specified limits. The input wave shape shall have a tr and a tf of 25 µs maximum each, and the slope of the top of the pulse may be not greater than 0.5% with a ripple not to exceed 0.1% .

Note 9: Sampling shall be in accordance with MIL-STD-105.

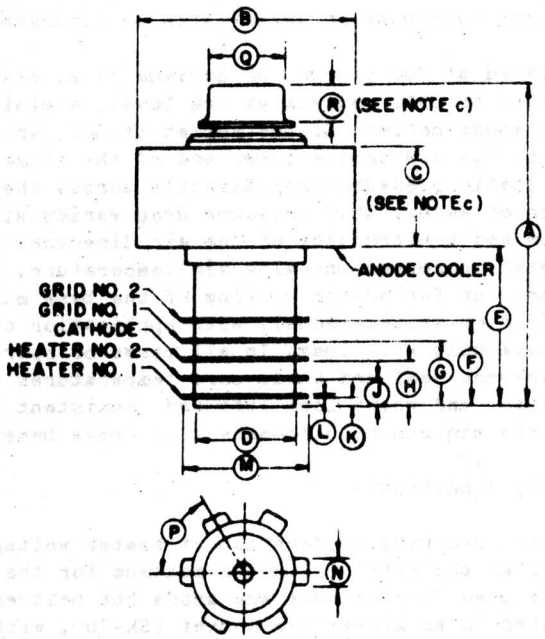


Figure 1 - Outline Drawing

DIM.	LIMITS	
	Min	Max
A	2.300	2.500
B	1.610 dia	1.640 dia
C	0.710	0.790
D	0.740 dia	0.770 dia
E	1.133	1.195
F	0.602	0.642
G	0.470	0.500
H	0.329	0.359
J	0.193	0.213
K	0.050	0.072
L	0.010	0.020
M	0.936 dia	0.956 dia
N	0.170	0.185
P	NOMINAL 60°	
Q	0.559 dia	0.573 dia
R	0.240	0.280

NOTES

a. All dimensions in inches unless otherwise specified.

b. Nominal dimensions are for information and are not required for inspection purposes.

c. Available anode contact surface.

A. Case Number 2.1.141: Proposed NATO Draft on Pulse Modulators and Clipper Tubes.

B. Purpose of Case: To review the attached draft for possible inclusion into MIL-E-1E.

C. Reference Material:

1. Agenda and minutes of 7 May 1963 Special meeting.

2. Proposed draft (see attachment).

D. Summary of Case: In accordance with the agreements of the 7 May 1963 meeting, the Army has re-submitted their revised proposal for review and approval. (See attachment.)

E. DESC-E recommends that the NATO proposal be approved as submitted by EL.

A. Case Number 2.1.142: Revision of MIL-E-1/887, for tube type JAN-4-400A.

B. Purpose of Case: To revise and up-date the subject specification.

C. Reference Material:

1. Bureau of Ships letter dated 29 November 1963.

2. Proposed MIL-E-1/887A for tube type JAN 8438/4-400A.

D. Summary of Case: The subject specification is being revised and up-dated to the latest MIL-E-1E format per Bureau of Ships request.

E. DESC-E recommends that the proposed tube specification be accepted.

F. Additional information required:

1. Preparing Activity.

2. Agent.

3. Qualification.

4. User and Review Activities.

SUPERSEDING
MIL-E-1/887
25 July 1956

PROPOSED

MILITARY SPECIFICATION SHEET

ELECTRON TUBE, TRANSMITTING

JAN-8438/4-400A

Preamble to be inserted after approval.

DESCRIPTION: Tetrode
Pin connections and dimensions: See figure 1.
Cathode: Thoriated Tungsten Filament
Cap: See figure 1. See note 3

ABSOLUTE-MAXIMUM RATINGS

Parameter:	Ef	Eb	Ec1	Ec2	Ib	Pp	Pg1	Pg2	Altitude	Cooling
Unit:	Vac	Vdc	Vdc	Vdc	mAdc	W	W	W	ft	Note 1
C Teleg:	5.0±5%	3200	-500	600	275	270	10	35	10,000	---
C Telep:	5.0±5%	4000	-500	600	350	400	10	35	10,000	---
AB Audio:	5.0±5%	4000	-500	800	350	400	10	35	10,000	---
TEST CONDITIONS:	5.0	2500	Adj.	500	160	---	---	---	---	Note 2

REQUIREMENTS AND TESTS

GENERAL:

Qualification
Materials
Conductors
Seal-off tip
Marking
Workmanship
Holding period
Preheating
Short and discontinuity detection
Preparation for delivery (See note 5)
Container drop, Method 1136

QUALIFICATION:

Cathode
Base connections
Salt spray

SECTION OR METHOD NO.	REQUIREMENT OR TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS		UNIT
						Min	Max	
	Quality Conformance Inspection, Part 1							
1301	Filament current	---	0.65	II	If	13.5	14.7	Aac
1266	Total grid current	---	0.65	II	Ic1	---	10	uAdc
1266	Primary control grid emission	Ef=6.0Vac; Ic1=200 mAdc; t=12; Anode and screen grid floating.	0.65	II	Isg1	---	-500	uAdc
1266	Primary screen grid emission	Ef=6.0Vac;Ic2=170 mAdc;Ec1=0Vdc;t=15 plate floating.	0.65	II	Isg2	---	-500	uAdc
1261	Grid voltage	---	0.65	II	Ec1	-55	-80	Vdc
1231	Peak emission	eb=ec1=ec2=2500V	0.65	II	is	7.0	---	a
D-20	Mechanical	---	---	---	---	---	---	---
	Quality Conformance Inspection, Part 2							
1031	Low frequency vibration	No voltages	6.5	1A	---	---	---	---
1036	Bump	Angle = 15°	6.5	1A	---	---	---	---
1036	Bump and short	Angle = 5°	6.5	1A	---	---	---	---
1316	Amplification Factor	g1=g2;Ic2=70mAdc; Eb=0Vdc	6.5	1A	Mu	4.5	6.0	---
1236	Power oscillation	Ebb=3Kvdc; Ib=350 mAdc; Pp=400W; Ec2=500Vdc; F=110 Mc	6.5	1A	Po	500	---	W
1331	Direct-interelectrode capacitance	---	6.5	1A	Cgp Cin Cout	--- 10.70 4.20	0.17 14.50 5.60	pf pf pf
	Quality Conformance Inspection, Part 3							
4.7	Life test	Group C; Power Oscillation	---	---	t	500	---	hours
4.7.3	Life test end points	Peak emission	---	---	is	5.6	---	a
		Primary control grid emission	---	---	Isg1	---	-500	uAdc
		Primary screen grid emission	---	---	Isg2	---	-500	uAdc

NOTES:

1. Forced-air cooling must be provided for the base-pin and anode-lead seals. This air should be applied simultaneously with filament power, using the 259-JAN sock or equivalent. A minimum air flow of 14 cu. ft./minute shall be used. The pressure drop as measured in the socket at this flow equals 0.25 inches of water. The air requirements stated above are based on operation at sea level and on ambient temperature of 20°C. Operation at high altitude or at high temperature requires a greater volume of air flow.

2. Forced-air cooling of the anode and base seals to an extent not to exceed the minimum values specified in Note 1 is permitted.

3. It is recommended that a heat-radiating type of connector be used on the anode terminal in all RF applications.

4. The AQL for the combined defectives for attributes in Quality Conformance Inspection, Part 1, excluding mechanical, shall be one percent. A tube having one or more defects shall be counted as one defective. MIL-STD-105, Inspection Level II, shall apply.

5. Tubes shall be packaged and packed, as specified in the contract or order, in accordance with specification MIL-E-75 and appendix thereto.

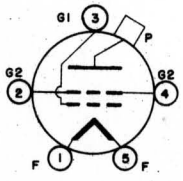
Custodians:
Army - EL
Navy - Ships
Air Force - ASD

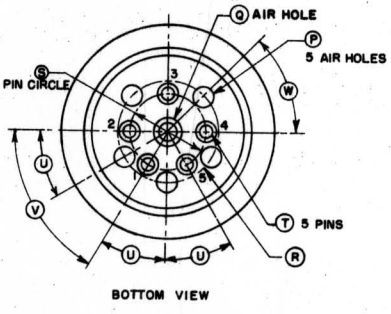
User:

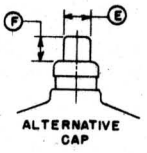
Review:

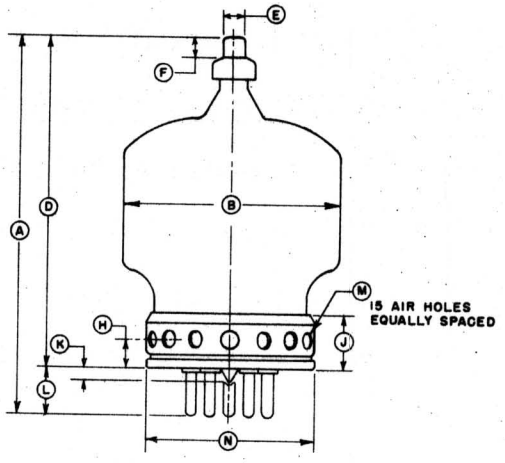
Preparing Activity:
Navy - Ships

DIM.	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	LIMITS			
			INCHES		MILLIMETERS	
			MIN.	MAX.	MIN.	MAX.
QUALIFICATION INSPECTION						
D	---	---	5.125	5.625	130.18	142.88
E	---	---	0.350	0.365	8.89	9.27
F	---	---	0.328	---	8.33	---
J	---	---	---	0.969	---	24.61
K	---	---	---	0.250 (Note a)	---	6.35 (Note a)
N	---	---	---	2.750	---	69.85
T	---	---	0.185	0.191 (Note a)	4.70	4.85 (Note a)
S	---	---	1.250 (Note a)		(31.75)	
U	---	---	30° (Note a)			
V	---	---	60° (Note a)			
W	---	---	45° (Note a)			
QUALITY CONFORMANCE INSPECTION, PART 2						
A	6.5	S3	5.875	6.375	149.23	161.93
B	6.5	S3	---	3.563	---	90.50
NOMINAL DIMENSIONS (See note b)						
H	0.438 (11.13)					
L	0.750 (19.05)					
M	0.250 (6.35)					
P	0.312 (7.92)					
Q	0.500 (12.70)					
R	1.625 (41.28)					









Note a. Base pins T and tubulation K are so alined that they can be freely inserted in a gage 1/4 thick with hole diameters of .204 and .500 respectively located on the true centers by the given dimensions S U V.

Note b. Dimensions without tolerances are for information and are not required for inspection purposes.

A. Case Number 2.1.143: JAN 7322, MIL-E-1/1371B

B. Purpose of Case: To incorporate industry recommendations in a revised tube specification sheet.

C. Reference Material:

1. 19 March 1963 Agenda and minutes of meeting.

2. 8 October 1963 Agenda and minutes of meeting.

3. DESC-EC letter to Bureau of Ships dated 31 October 1963.

4. Bureau of Ships letter to DESC-E dated 6 December 1963.

5. Proposed Figure 1 - Outline drawing.

D. Summary of Case: In accordance with the agreements of the 8 October 1963 meeting and Bureau of Ships recommendations, the only item open for discussion on this TSS will be on the outline drawing. The Navy recommendation is that the outline drawing of the JAN-7322 should be changed to one of a more definitive nature and should be the same or similar to the outline drawing shown in MIL-E-1/1426A (Navy) for tube type 8354. The Navy is presently conducting an investigation to determine whether Note 1, which concerns the mounting assemblies, can be deleted from the JAN-7322 TSS. Results of this investigation will be presented at this meeting.

E. DESC-E recommends that the proposed changes be accepted.

F. Additional information required:

1. Preparing Activity

2. Agent

3. Qualification.

4. User and Reviewer Activities

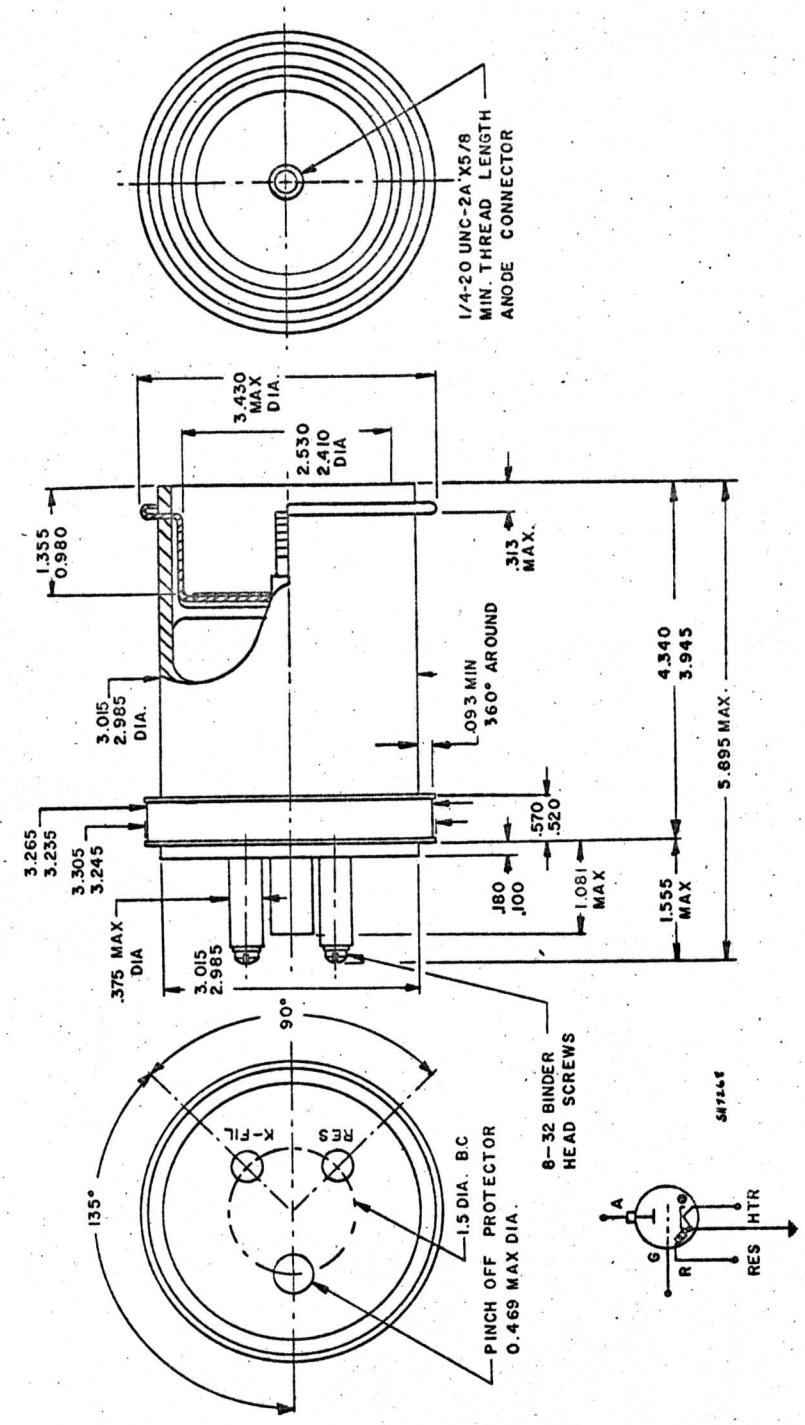

1/4-20 UNC-2A X5/8
MIN. THREAD LENGTH
ANODE CONNECTOR
3.430
MAX
DIA.
2.530
2.410
DIA
1.355
0.980
.313
MAX.
3.015
2.985
DIA.
.093 MIN
360° AROUND
4.340
3.945
5.695 MAX.
3.265
3.235
3.305
3.245
.570
.520
.180
.100
1.081
MAX
1.555
MAX
.375 MAX
DIA
3.015
2.985
90°
135°
K-FIL
RES
1.5 DIA. B.C
PINCH OFF PROTECTOR
0.469 MAX DIA.
8-32 BINDER
HEAD SCREWS
A
G
R
RES
HTR

Figure 1 -

7

A. Case Number 2.1.144: Specification Requirements for Tube Type 8168/4CX1000A, 4CX5000A, 6895, and 5682.

B. Purpose of Case: To obtain and coordinate specifications on the subject tube types.

C. Summary of Case: DESC as a procuring agency is presently buying several tube types to commercial specifications, due to the lack of approved JAN specifications being available. The subject tubes are in the volume procurement class, in which it is desirous to have approved military specifications on.

D. DESC-E recommends that specification sheets be obtained and approved on each of the above listed tubes.

A. Case Number 2.1.145: Proposed revision of MIL-E-1/1038A, JAN 4E27A.

B. Purpose of Case: To revise MIL-E-1/1038A to include the 14 day humidity test and up-date to the latest MIL-E-1E format.

C. Reference Material:

1. Minutes of 8 October 1963 Working Group Meeting.

2. Proposed changes to MIL-E-1/1038A.

D. Summary of Case: The Army (EL) Command requested that the 4E27A TSS be revised to include the 14 day humidity test.

E. DESC-E recommends that the subject TSS be revised and up-dated to the latest MIL-E-1E format.

F. Additional information required:

1. Preparing Activity

2. Agent

3. Qualification

4. User and Review Activities

Proposed Changes to MIL-E-1/1038A

In Acceptance Inspection, Part 3, add the following humidity test:

PAR. NO.	TEST	CONDITIONS	AQL	INSP. LEVEL	SYMBOL	LIMITS		UNIT
						Min.	Max.	
---	Humidity Test	(See note 4)	---	---	---	---	---	----
---	Post humidity test end point	Total grid current (see note 5)	---	---	Icl	---	-20	uAdc

4. The sample of tubes under test shall be subjected at an atmosphere of 95 to 100 percent relative humidity at a temperature of 95° to 100°C for a period of 14 days. A sample of tubes shall be tested monthly. Sampling shall be per MIL-STD-105, inspection level L6. Single-sampling table IV-A shall be used for reduced sampling. The sample size shall be based on the estimated production lot size, except that only Codes F through Q shall be used for normal or reduced sampling, while only Codes G through Q shall be used for tightened sampling, and in no case shall the actual monthly submission exceed the estimate upon which the sample size was based. Allowable failures shall be per 6.5 percent AQL.

5. Upon satisfactory compliance to this plan for three successive months of production, lots may be pre-released upon the following conditions.
There shall be no defects at the end of the first 7 days; however, the sample shall continue to 14 days or sample failure (seven-day failure criteria shall be Icl = -15 uAdc maximum). In the event the sample fails the 14-day criteria, normal inspection without pre-release consideration must be resumed until the next three lots comply with the specification requirements. In the event of failure of a pre-release sample, the manufacturer shall immediately notify the cognizant Government Inspector, and the Contracting Officer, of the failure.

A. Case Number 2.1.146: Proposed revision of MIL-E-1/302J, JAN 8172/4X150G.

B. Purpose of Case: To revise MIL-E-1/302J to include the 14 day humidity test and up-date to the latest MIL-E-1E format.

C. Reference Material:

1. Minutes of 8 October 1963 working group meeting.

2. Proposed revision to MIL-E-1/302J.

D. Summary of Case: The Army (EL) Command requested that the 8172/4X150G TSS be revised to include the 14 day humidity test.

E. DESC-E recommends that the subject TSS be revised and up-dated to the latest MIL-E-1E format.

F. Additional information required:

1. Preparing Activity.

2. Agent

3. Qualification.

4. User and Review Activities.

Proposed Humidity Test Change

1. In Acceptance Inspection, Part 3: Change the maximum limit of Icl from -15 to -20 uAdc in the Post Humidity Test end point.

2. Delete Notes 13 and 14 and add the following notes:

13. The sample of tubes under test shall be subjected at an atmosphere of 95 to 100 percent relative humidity at a temperature of 95° to 100°C for a period of 14 days. A sample of tubes shall be tested monthly. Sampling shall be per MIL-STD-105, inspection level L6. Single-sampling table IV-A shall be used for normal and tightened sampling, and table V shall be used for reduced sampling. The sample size shall be based on the estimated production lot size, except that only Code F through Q shall be used for normal or reduced sampling, while only Codes G through Q shall be used for tightened sampling, and in no case shall the actual monthly submission exceed the estimate upon which the sample size was based. Allowable failures shall be per 6.5 percent AQL.

14. Upon satisfactory compliance to this plan for three successive months of production, lots may be pre-released upon the following conditions.

There shall be no defects at the end of the first 7 days; however, the sample shall continue to 14 days or sample failure (seven-day failure criteria shall be Icl =-15 uAdc maximum). In the event the sample fails the 14-day criteria, normal inspection without pre-release consideration must be resumed until the next three lots comply with the specification requirements. In the event of failure of a pre-release sample, the manufacturer shall immediately notify the cognizant Government Inspector, and the Contracting Officer, of the failure.

A. Case Number 2.1.147: Salt Spray change to MIL-E-1E.

B. Purpose of Case: To revise Salt Spray Test Method 1006.

C. Summary of Case: Salt Spray testing of tubes when applicable, should be changed from 96 hours to 48 hours. This would be consistent with the requirement of MIL-S-12883A which covers tube sockets. It would also equal the Salt Spray requirement of "ER" specifications covering more valnerable components.

D. DESC-E recommends that MIL-E-1E be amended as follows:

Test Method 1006, Salt Spray: In the first sentence, delete test condition "A" and substitute "B". Add new last sentence: "Defects shall be classified in accordance with the applicable criteria of Appendix D".

A. Case Number 2.1.148: Proposed revision of MIL-E-1 Shock Test.

B. Purpose of Case: To clarify the Shock Test requirements.

C. Reference Material:

1. CAMESA letter dated 17 October 1963.

D. Summary of Case: In accordance with CAMESA letter neither paragraph 4.9.20.5 of MIL-E-1D nor Method 1041 of MIL-E-1E indicates that the manufacturer does not have a free choice to use either condition (a) with the specified voltage applied or condition (b) with a thyratron short-indicator. Actually, by the provisions of paragraph 4.3 of MIL-E-1E, or E.30.7 of MIL-E-1E, he must apply the voltages specified in the general condition of the TSS unless the TSS specifies otherwise in the particular conditions of that test. CAMESA letter also stated that certain European user of MIL-E-1, unaware of the requirements of 4.3 has inferred that he had a free choice to use either condition and was shock-testing receiving tube types with no voltages applied.

E. DESC-E recommends that Test Method 1040 be revised as follows: Delete paragraph 2 and substitute;

"2. Unless otherwise specified, tubes shall be tested with voltages applied. When the conditions on the TSS indicates "No voltage", the tubes shall be tested with a thyratron - controlled short-circuit indicator with the circuit constants, as shown in Figure 1041-1 or its equivalent, connected to indicate interelectrode shorts. In all cases, tubes shall have rated filament or heater voltage applied."

Our file ref. 25-12-1 (CAMESA)

21 OCT REC'D

CANADA

DEPARTMENT OF NATIONAL DEFENCE

CANADIAN MILITARY ELECTRONICS STANDARDS AGENCY

OTTAWA, ONTARIO,

17 October 1963.

AGENDA MIT'L

Defense Electronics Supply Center,
1507 Wilmington Pike,
Dayton, Ohio (45420), U.S.A.

Attn: DESC-E

MIL-E-1 Shock Test

1. Neither paragraph 4.9.20.5 of MIL-E-1D nor Method 1041 of MIL-E/1E indicates that the manufacturer does not have a free choice to use either condition (a) with the specified voltage applied or condition (b) with a thyratron short-indicator. Actually, by the provisions of para 4.3 of MIL-E-1D, or E.30.7 of MIL-E/1E, he must apply the voltages specified in the general condition on the TSS unless the TSS specifies otherwise in the particular conditions for that test.

2. It has come to our attention that a certain European user of MIL-E-1, unaware of the requirements of 4.3 has inferred that he had a free choice to use either condition and was shock-testing receiving type tubes with no voltages applied.

3. To clarify the intent of the requirement we would propose that para 2 should be rewritten as follows:

"2. Except as may be otherwise specified in the particular test conditions on the TSS, all tubes shall be tested with the voltages which are specified on the tube specification sheet applied to the tube. When the test specification sheet specifies "No Voltages", the tubes shall be tested with a thyratron-controlled short-circuit indicator with the circuit constants as shown in Fig. 1041-1 or its equivalent, connected to indicate interelectrode shorts. In all cases tubes shall have rated filament or heater voltage applied".

(G.A. Armstrong) P.Eng.
for Director
Canadian Military Electronics Standards Agency

A. Case Number 2.1.149: Proposed revisions to MIL-E-1E.

B. Purpose of Case: To review and recommend for adoption the proposed revisions to MIL-E-1E.

C. Reference Material:

1. Section 5, Preparation for Delivery

2. Appendix E

3. Paragraph 4.5

4. Test Method 1136

D. Summary of Case: Since approval of MIL-E-1E, the above listed proposed revisions have been received.

E. DESC-E recommends that the above listed proposals be accepted.

AGENDA MATERIAL

Add the following to Appendix E, Page 225:

"70. Destructive tests. The following tests are designated as destructive. Tubes used for conducting these tests shall be in addition to the quantity to be delivered:

Test	Method Number
Vibration fatigue	1031
Shock	1041
Lead Fatigue	1116
Intermittent Life	1501
Heater-cycling Life	1506

PACKAGING COMMENTS TO PROPOSED SPECIFICATION MIL-E-1E

1. Delete Section 5 in its entirety and replace with the following:

5. Preparation for Delivery

5.1 Unless otherwise specified in the contract or order (see 6.1), each tube shall be packaged, packed and container marked in accordance with Specification MIL-E-75.

5.2 The required rough handling test, package group and package size (when applicable) shall be specified in the CONDITIONS column of the TSS.

5.2.1 In the event no package group is suitable or special instructions are required, detailed packaging, packing, and marking instructions shall be shown in a note of the TSS.

1. The following changes are proposed in order to eliminate redundance and conflict between MIL-E-75 and MIL-E-1.

2. Proposal:

a. MIL-E-1(E), paragraph 4.5; delete and substitute:

4.5 Rough handling test, quality conformance inspection sampling: This test shall be performed at least three times (at four month intervals) each year for continuous production, or at least three times during any one production run. It shall also be required whenever the tube design, or container design or material is changed. When required during qualification inspection, compliance at two additional intervals shall be acceptable.

4.5.1 The number of samples and the acceptance criteria shall be determined as specified in Test Method 1136 and specification MIL-E-75.

b. Table V. Delete.

c. Test Method 1136: Change title to: "Rough Handling Test". Method 1136, delete first paragraph and substitute:

Tubes packaged and packed in accordance with Specification MIL-E-75 shall have met all applicable provisions of this specification prior to the performance of the applicable rough handling test.

Following the MIL-E-75 testing, mechanical defects and initial acceptance provisions of the TSS, shall be within the levels specified. The tubes shall also comply with the following acceptance criteria, as applicable.

Delete 1. and substitute:

d. 1. Receiving Tubes. Tubes which have been subjected to the applicable tests specified in MIL-E-75 shall be within the limits of the following tests when specified as Quality Conformance Inspection, Part 1; heater-cathode leakage, anode current, power output, transconductance, anode resistance, ac amplification, and conversion transconductance.

A. Case Number 2.1.150: Life Test Sampling (Group S).

B. Purpose of Case: To review and approve proposed changes to Group S for inclusion into MIL-E-1E.

C. Reference Material:

1. DESC - JT11.1 proposed Group S Life Test Plan; Revision to.

2. CAMESA comments on the Group S Life Test Plan; Revision 6.

D. Summary of Case: In February 1963, JEDEC 11.1 proposed a Group S Life Test Plan for inclusion in MIL-E-1E. This plan seemed unsatisfactory and DESC and JT11.1 jointly prepared Revision 6 to the plan. CAMESA feels that Revision 6 to the plan is overly lax and their comments are included as part of the Agenda.

Notes and Explanation of Changes:

1. Production line may still be run: Life test only controls acceptance of the product. Per JT-11.1.

2. Per P.J. Hogan.

3. Per P.J. Hogan and JT-11.1.

4. Per P.J. Hogan.

5. Per P.J. Hogan.

6. Per J.J. Aiello and JT-11.1.

7. Per CAMESA; equivalent to Hogan's equation (2) within $\pm\frac{1}{2}$ unit for K = 1 to 10, but simpler. Also equivalent to Group D "80% rule".

8. Per P.J. Hogan.

9. The whole of this paragraph attempts to reconcile the views of JT-11.1 and P.J. Hogan. The letter J.R.M. Vaughan--P.J. Hogan of 8/28/63 is relevant.

10. Rewritten to accomodate the intention of Note 1 above.

11. Per P.J. Hogan.

12. New paragraph to provide protection equal to Group D at start of production, when not immediately preceded by Initial Life Test. Per J.R.M. Vaughan.

13. Per P.J. Hogan, JT-11.1 and J.R.M. Vaughan.

Notes

4.9.5.5 Group S - This group letter may be referenced in the tube specification sheet, or may be used in place of Group B, C or D at the manufacturer's option. For use in place of Group B, the Multiple Short Life Test (4.9.5.5.3) shall be performed weekly instead of monthly. A Group B or C tube should not be assigned to Group S unless it is one to which Paragraph 4.9.5.5.1 applies.

Group S Life Test consists of three parts: Initial Life Test (4.9.5.5.2) to be completed before any delivery is made; Multiple Short Life Test (4.9.5.5.3), which determines the acceptability of each monthly lot; and Sequential Life Test (4.9.5.5.4), which provides information on the ultimate capability of the tube, and stops shipments of the tube in the event of a significant deterioration in life, but is not related to any particular lot.

1.

4.9.5.5.1 Application of Life Test Group S - This group is applicable when the mean life of the tube type is of prime interest, rather than the failure rate in early life.

4.9.5.5.2 Initial Life Test - Three tubes shall be life tested under the specified conditions. The average of the sample shall be not less than the specified life, and no tube shall fail at less than half the specified life. The life to be credited to each tube shall be determined as follows:

a. When the time of failure is known exactly, the number of credit hours shall be equal to the actual operating hours before failure.

Notes

b. When the time of failure is not known exactly, the number of credit hours shall be equal to either the number of hours up to the last successful reading plus 10% of the specified life, or the number of hours up to a time midway between the last successful and the first unsuccessful reading, whichever is the less.

The credit hours for any one tube are not limited to the specified life.

This test shall be waived if the manufacturer has successfully completed Qualification Approval Life Tests for the tube type, or if the current production run follows within twelve months an earlier run, and no significant change in design or production has been made. The test shall be completed (or waived) before any delivery of tubes is made. This is a destructive test.

4.9.5.5.3 Multiple Short Life Test - Tubes shall be selected from current production according to the double sampling plan below, and placed on life test for a period equal to 10% of the specified life, but not less than 24 hours nor more than 100 hours each. At the end of this period, those parameters listed under Life Test End Points shall be measured, but the limit values shall be the Acceptance Test values, not the End-of-Life values. Passing this Test qualifies the monthly lot from which the tubes were drawn, unless shipments have been halted in accordance with paragraph 4.9.5.5.4, Sequential Life Test.

2.

This test is non-destructive, except for any tube which fails to pass. Tubes which pass shall be returned to the lot from which they were drawn.

Notes

3. The sample size, acceptance and rejection numbers depend on the lot size N.

	N	Sample Sizes	Acceptance Numbers	
a.	Under 10	$n_1 = 1$ n_2 = remainder of lot	$C_1 = 0$ $C_2 = 1$	
b.	10 to 50	$n_1 = 5$ $n_2 = 5$	$C_1 = 0$ $C_2 = 1$	except C_1=1, C_2=2 if there was no failure in the previous first sample.
c.	51 to 250	$n_1 = 7$ $n_2 = 7$	$C_1 = 0$ $C_2 = 1$	except C_1=1, C_2=2 if there was no failure in the previous first sample.
d.	251 up	$n_1 = 10$ $n_2 = 10$	$C_1 = 1$ $C_2 = 2$	

This test shall be run concurrently with production.

4. (sentence deleted) Pre-release is allowed when there was no failure on this test in the previous month and there has been no failure so far during the current month.

4.9.5.5.4 Sequential Life Test - The number of Sequential Life Test Sockets is determined by the monthly rate of production as follows:

	m.r.p.:	Number of Sockets:
a.	up to 250	1
b.	251 to 500	2
c.	501 up	3

Notes

5. The specified sockets shall be filled with tubes from the first month's production, and are then run sequentially; i.e., each tube is operated at the specified Life Test conditions until it fails to meet one or more of the Life Test End Points (end-of-life values). It is then replaced with a tube drawn from the current month's production. It shall also be replaced if it reaches 2½ times the specified Life; a tube removed under this clause shall be plotted (see below) as though it had failed at that time. Tubes shall be selected in a random manner from those which have met the requirements of the Multiple Short Life Test. Credit hours shall be determined as in 4.9.5.5.2.(a) and (b).

6. The time spent on Multiple Short Life Test shall not be included.

The results of this test shall be plotted in the normal manner of Sequential Life Tests; it is convenient to plot as ordinate, not the actual aggregate hours, but the ratio of aggregate hours T to specified life t; this axis then represents the number of "nominal tube life-times". The number of failures (or tubes taken off at 2½ times the specified Life), denoted by K, is plotted as abscissa. See Fig. X.

The Reject Line shall be defined by

7. $$K = 1.25 \frac{T}{t} \qquad (1)$$

The area below the Reject Line is denoted as Zone A. The area above the Reject Line is denoted as Zone B. There shall also be a line plotted as defined by

8. $$K = \frac{T}{t} - 1.64\sqrt{\frac{T}{t}} \qquad (2)$$

Notes

The area above this line is denoted as Zone C. Initial Life Test tubes (including re-run Initial Life Tests following a rejection on this test) are never included in the Sequential Life Test Plot.

9. The Plot must be brought up-to-date when any failure occurs, and may be completed more frequently at the manufacturer's option. A convenient interval is the same as is used for checking the tube(s) on test for conformity to the End of Life parameters. Aggregate Life T includes the accumulated hours on all tubes, running or failed, except those excluded under the replotting rules (below). The "head" of the plot moves along a vertical line as long as hours are being accumulated without failure, and moves 1 unit horizontally to the right each time a failure occurs.

10. In the event that the plotted "staircase" enters Zone A, shipments shall be halted, and the cause of deterioration shall be investigated. Shipments may be resumed either on satisfactory evidence that the cause has been found and corrected, or on successfully re-running the Initial Life Test (without waivers). After a stoppage, the Sequential Life Test Plot is started over at zero.

As long as the plotted "staircase" remains in Zone B or C, shipment of lots qualified under 4.9.5.5.3 is continued.

11. In the event that the plotted staircase enters Zone C, there is high confidence that the product is equal to or better than the specified life.

Notes

12. When the Initial Life Test (4.9.5.5.2) is waived, shipments shall not be made before the aggregate hours on the Sequential Life Test Sockets show a combined average equal to 80% of the Specified Life.

13. After 6 months or 10 failures, whichever occurs first, the data shall be replotted. The origin of coordinates shall be moved up to the starting point of either the vertical line on which the chart stood 3 months before, or of the fifth tube back, as the case may be. The Reject Line moves up with the coordinate axes. The chart then shows data on the last 3 months or 5 tubes.

Data continue to be added to the new chart until it again reaches either 6 months or 10 tubes, when the replotting cycle is repeated.

When the tubes contracted for are built in a single batch in a short period, the Sequential Life Test shall be continued if necessary after production is complete, until the aggregate hours on each Socket are at least equal to the specified Life. A rejection in this "post production" period shall preclude any waiver of Paragraph 4.9.5.5.2 for the next production run of the same tube type.

In other cases, the Sequential Life Test shall be terminated when the Multiple Short Life Test on the final lot of tubes is completed.

This is a destructive test.

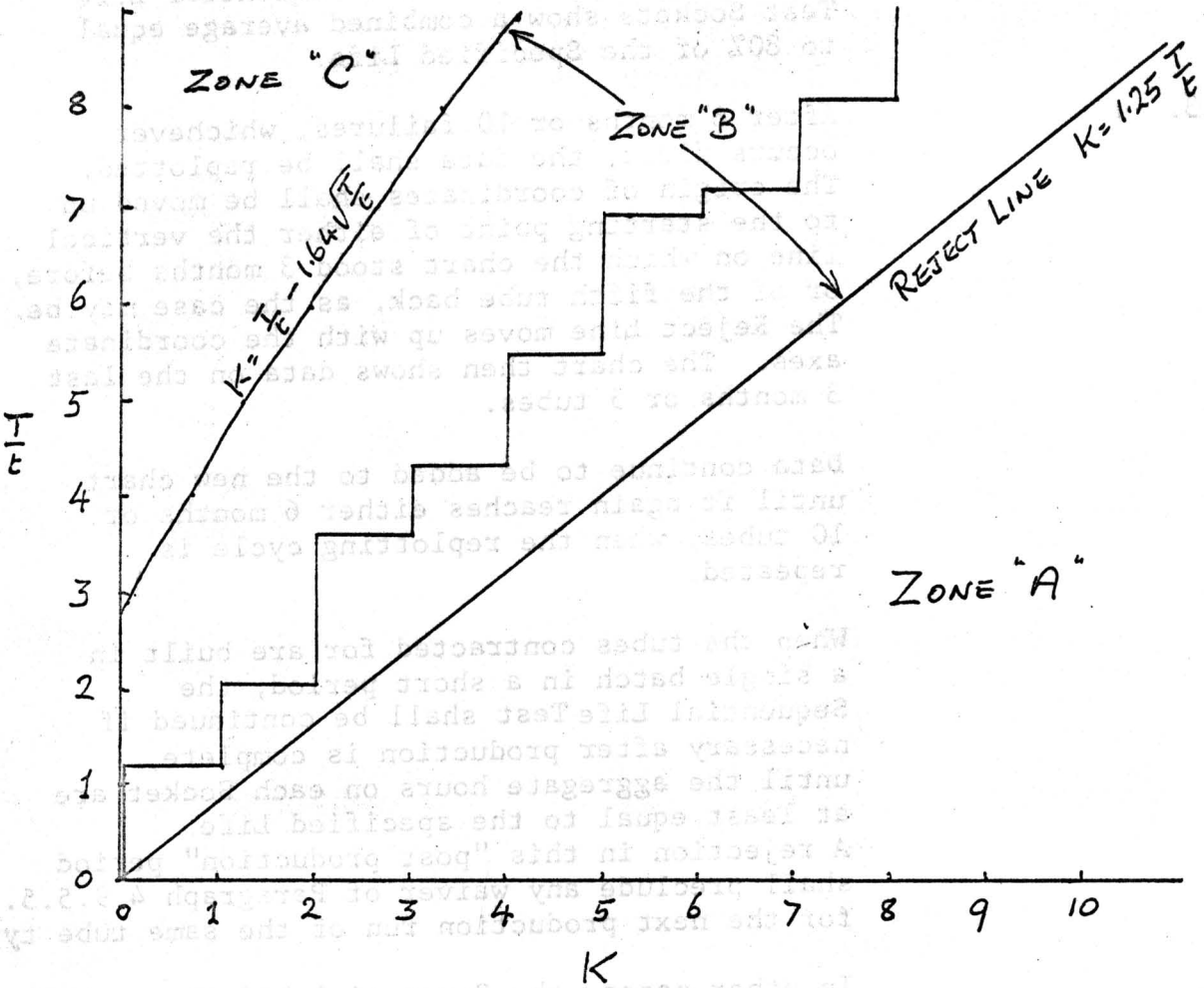


FIG. 'X': SEQUENTIAL LIFE TEST PLOT (ILLUSTRATIVE).

JTC-11 SEQUENTIAL LIFE TEST SCHEME VERSUS GROUP "D" REQUIREMENTS

In commenting on the JEDEC proposal for Life Test Group "S", CAMESA has stated that the details were such as to make the proposed scheme an unacceptable optional alternate to the present Group D life test because it would significantly relax the minimum average life requirement. An acceptance table was prepared to present, in terms of the sequential test scheme, the equivalent minimum quality now demanded by the Group D provisions. It is a first requirement of specifications that no scheme is acceptable as an optional alternate unless it is truly equivalent.

In attempting to draw a compromise between the JTC-11 proposal and the CAMESA counter-proposal, DESC has apparently failed to recognize that the CAMESA figures represent a hold-the-line policy and DESC has suggested a scheme which constitutes almost as great a relaxation of the minimum requirement as does the JTC-11 proposal. At the present time Group D represents by quite a margin the lowest life test quality level in MIL-E-1. The JTC-11 proposal would cut that level in half. This Agency regards such a matter with considerable concern. Because of the importance of this one question of equivalence, we should like to present in some detail the basis for our argument.

As an introduction to the picture, let us consider exactly what the Group D paragraph in MIL-E-1 says (para 4.11.3.6):

> ".....at the conclusion of the time specified for the life test, the average life of the sample shall be not less than 80% of the duration of the test."

It should be noted that the figure by which the lot is accepted or rejected is the average life of the sample as calculated at the conclusion of the time specified, regardless of how many tubes in the sample may or may not have failed. Now the time specified for the duration of the test is usually 500 hours; it follows from the 80% "average life" requirement that the sample tested must average 400 hours or better. Since, in general, many tubes will still be going strong at the end of the test period, it follows that the calculated "average" life of the sample cannot be the true average life, which would be recorded if the samples were allowed to run until failure.

Turning our attention now to the sequential life test scheme, we find that here the samples tested are allowed to run out their full life (up to two and a half times the "specified average life"). The reject line for this scheme is so formulated that if the specified average life is taken to be 500 hours any product having an average life of 400 hours would still have a high probability of never dropping below the reject line. Here again then, the reject line assumes a minimum average life of 400 hours.

To the casual observer the two schemes appear to be equivalent. The figures are in fact the same in each instance. However, the statistical meaning of the limit specified is completely different. Under the Group D scheme, 400 hours is the absolute minimum average for any sample which may be tested. In the sequential life test scheme the 400 hour figure is subtly transformed to mean the average of the parent lot or population from which samples are drawn. For true equivalence the same figure could never appear in each sense.

Let us suppose that a given product does indeed have a 400 hour average life. One of the first principles of statistics is that 50% of samples randomly selected from such a lot would average less than 400 hours. This same product then, readily accepted by the sequential life scheme, would fail under the Group D scheme on half the tests run.

It is obvious that in order to pass the Group D requirement a reasonable percentage of the time, (usually 95% confidence), any product must have a true average life which is appreciably in excess of 400 hours. On the basis of calculations which are shown later, we consider that the true average life must be of the order of 1000 hours. If this figure were specified as the minimum acceptable average life as denoted by the symbol "t" in the JTC-11 formula, then either scheme would accept with the same probability any product having this minimum acceptable value. In other words, the sequential life scheme would then be a satisfactory optional alternate to the Group D scheme.

The reject line which has been proposed by DESC would require that the true average life of the product would have to be a little higher than that required by the JTC-11 formula for the same probability of acceptance. It must be said of the DESC proposal, however, that, like the JTC-11 scheme, it fails to recognize the difference in statistical meaning of the "time specified for the life test" in the Group D scheme and the "specified minimum acceptable life" in the sequential life test scheme. Both would regard four to five hundred hours as an acceptable minimum true average life for any of the tube types involved. As we have shown, tubes of such low average life would be in real trouble with the Group D requirement. If the specified minimum average life "t", is accepted to mean 500 hours, the effective true average life implied in the Group D scheme would be reduced by hundreds of hours. This is the one area in the proposed scheme where no compromise can be accepted.

DETERMINATION OF THE EQUIVALENT AVERAGE LIFE FOR THE SEQUENTIAL LIFE TEST

It has been demonstrated in general terms that, for any product to have a reasonable probability of passing the Group D test, it must have a true average life which is in excess of the specified duration of the test. How much in excess this actual life must be depends firstly on the degree of assurance required that any sample selected for test will be successful, and secondly on the typical life characteristic or survival pattern of the product during life. For normal operation of business, 95% assurance of success is usually provided for. If the failure characteristic is known to the extent that it can be stated as a mathematical function of time, the precise equivalent true life may be calculated. However, different tube types will differ considerably in their characteristic life patterns. Since the scheme under consideration is intended to be applicable to all these tube types, the figure to be specified must be selected as the best average condition. Let us therefore consider a few of the possible general failure patterns.

The only requirement of the Group D paragraph is that the sample tested must score at least 80% of the maximum possible tube-hours of operation during the test. Thus the scheme would accept with equal validity any of the four general failure patterns illustrated below.

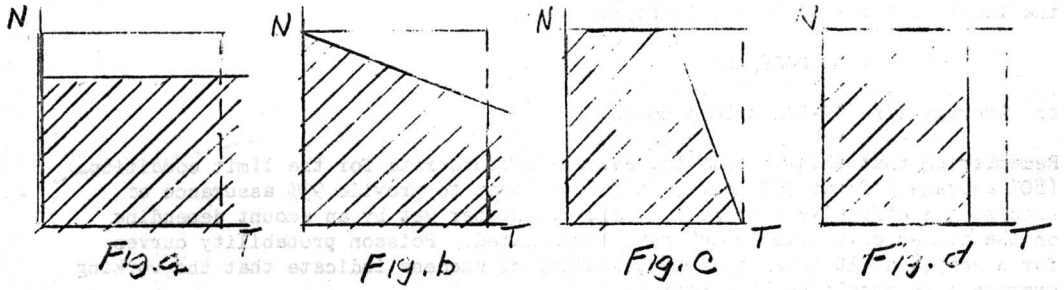


Fig. a Fig. b Fig. c Fig. d

The patterns illustrate the general range of shapes which might be encountered. They have this in common that they all represent 80% "average" life during the test period. Figure "a" represents a product having 20% "infant mortality" followed by a long failure-free period. The surviving samples would only need to last to the 500 hour mark to pass the Group D requirement but would have an indeterminate true average life, theoretically approaching infinity. Such a failure pattern may be dismissed as purely hypothetical. Figure "d" represents the opposite extreme, the "one-hoss-shay" pattern, where no failures whatever occur until all samples are suddenly worn out. In this pattern all samples have exactly the same life. In this way the pattern represents the only conceivable condition where the true average life could be as low as 400 hours and still meet the Group D requirement. However such a pattern never occurs in nature so it also must be dismissed as hypothetical.

Figures "b" and "c" representing intermediate patterns closely resemble two standard distribution patterns, the exponential or constant probability distribution, and the Gaussian or centralized probability distribution. Combinations of these patterns are characteristic of electron tube mortality curves. Since these patterns can each be dealt with mathematically, let us determine the average life for each distribution which is equivalent to the 80% average life requirement of Group D.

In the exponential distribution the number of samples surviving at time "t" is given by the expression

$$N = N_o e^{-at} \qquad (1)$$

The area under this curve represents tube-hours, from which it may be concluded that the accumulated tube-hours at time "t" is given by the expression

$$\text{Accumulated tube-hours} = N_o \int_0^t e^{-at} dt$$

$$= \frac{N_o(1 - e^{-at})}{a} \qquad (2)$$

From the above may be derived the familiar fact that the average life of the samples in such a distribution is given by

$$\text{Average life} = 1/a \text{ hours} \qquad (3)$$

Also from equation (2) may be derived the not-so-familiar relation that the percentage average life at any time is given by

$$\% \text{ Average life, } P = \frac{(1 - e^{-at})}{at} \qquad (4)$$

For 80% average life, as in Group D, equation (4) may be written

$$.8at = 1 - e^{-at} \qquad (4a)$$

The above equation is balanced at the condition that

$$at = .465$$

Remembering that in the Group D scheme the 80% average life condition is to be the limit at t = -500 hours, it follows that

$$a = .00093/\text{hr.}$$

or Average life = -1/a = 1075 hours

Remembering that this is only the average failure rate for the limit condition (80% average life at 500 hours) it follows that to provide 95% assurance of success the effective average life must be higher yet by an amount depending on the number of samples which have accumulated. Poisson probability curves for a sample of 10 tubes and 95% certainty of success indicate that the working average life should be 1800 hours.

In the case of the Gaussian distribution, let us assume to begin with, that the distribution has the widest possible normal spread. This means, in effect, that the wear-out begins almost immediately at the origin. Now, for the Gaussian distribution, 99.7% of the population lies within three sigma limits of the mean value. This means in this particular case that the lot average life will be just over three standard deviations, say 3.2. It is known from standard statistical theory that 95% of the readings in the distribution lie above the point 1.64 standard deviations below the population mean. Therefore, for 95% confidence that any sample selected will survive 400 hours or better, it follows that the 1.64 sigma point must coincide with 400 hours on the time scale. Consequently the lot average life will be $\frac{3.2}{1.64} \times 400$ hours or 800 hours. It must be noted in considering this type of failure pattern that if the distribution covers a narrower range about the mean, the average life may be somewhat less than 800 hours. However, this is contingent upon there being no infant mortality or early life failures before the wear-out distribution commences. Since tubes in general do not show much uniformity about the mean value, i.e. have a wide "variance", and since premature failures are a fairly frequent occurrence, the possibility of an acceptable lot average less than 800 hours is rather remote.

We have seen that for 95% probability of passing the 400-hour sample average limit of the Group D test, a product having a pure exponential distribution must average about 1800 hours; those having a normal or Gaussian distribution should have an average of about 800 hours. As pointed out earlier any actual distribution will most likely be some hybrid pattern combining both these standard patterns. Considering the foregoing facts, it seems entirely reasonable that a minimum acceptable average life of 1000 hours in the JTC-11 sequential life test scheme should be specified, if equivalence of the two schemes is to be assured.

31 October 1963

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