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Engineering Specification AD 2

L-2078

21" Rectangular Glass Color Tube

Copy No. 22

Issue 1
June 1, 1956

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SUBJECT: Engineering Specification AD-2 (Apple Tube) Issue 1

Attached herewith is one copy of a first draft of the specification. The primary purposes of this draft are to establish what items shall be specified, and to assemble the information in a logical format.

All items pertinent to the current tube design have been carried over from previous developmental specifications to preserve continuity. We have, however, indicated by an asterisk (*) several items which appear to be properly the internal responsibility of the tube supplier. We suggest their deletion from the next revision of this specification.

Some of the nominal values and limits that have been entered are well established. Others are purely tentative and will require experience before they can be considered realistic.

The attached specification does not yet include Appendix A - Definitions and Test Methods or Appendix B - Drawings. These sections are now being put in draft form. The present material is distributed now to promote early discussion of its completeness, clarity, general format and basic intent.

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FIRST DRAFT

Engineering Specification AD-2
L 2078
21" Rectangular Glass Color Tube

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Appendix A - Definitions and Test Methods	
Appendix B - Drawings	} In preparation

FIRST DRAFT

Engineering Specification AD-2

L 2078

21" Rectangular Glass Color Tube

I – General

Notes

1. Electron Gun	Dual beam	
2. Screen		
a. Type	Phosphor line	
b. Phosphor (Three separate phosphors collectively)		
c. Color Line Order	R,G,B	
d. Triplet Pitch (center)	0.061	inches
e. Nominal Area	260	sq. inches
f. Center width	19 1/8	inches
g. Center height	14 5/16	inches
3. Face Plate Light Transmission (center)	73.5	%
4. Focusing Method	Magnetic	
5. Deflection Method	Magnetic	
6. Deflection Angles		
a. Diagonal	74	degrees
b. Horizontal		degrees
c. Vertical		degrees
7. Overall Length	25 1/2	inches

Notes

8. Direct Interelectrode capacitances:

a. Grid #1A to all other electrodes	11±2		μμf
b. Grid #1B to all other electrodes	11±2		μμf
c. Grid #1A to Grid #1B other electrodes grounded	0.5	max.	μμf
d. Cathode to all other electrodes	8	max.	μμf
e. External grid #4 coating to internal grid #4		Min.	μμf
f. External anode coating to internal anode coating		min.	μμf
9. Grid #4 Terminal (nearest base)		JETEC	#J1-21 + Corona Shield
10. Anode Terminal (nearest screen)		JETEC	#J1-21 + Corona Shield
11. Base		RETMA	12-43
12. Base connections			

Pin

1 - Heater	7 - Cathode
2 - Grid #2 (Beam shield convergence)	8 - Cathode
3 - N.C.	
4 - Grid #1A (Writing)	9 - Grid #1B (Pilot)
5 - N.C.	10 - N.C.
6 - Grid #2	11 - Grid #2
	12 - Heater

II - Maximum Ratings (Design Center)

The tube shall be capable of operating continuously without breakdown, corona or leakage when the following voltages are applied between designated element and cathode. For maximum operation a 10% increase is assumed.

1. Grid #4	30	max.	KV
2. Anode	30	max.	KV
3. Anode to Grid #4			
a. Negative	6	max.	KV
b. Positive	0	max.	KV
4. Grid #2	1	max.	KV
5. Grid #2 Current		max.	μ a
6. Grid #1A and Grid #1B			
a. Negative bias	350	max.	volts
b. Negative peak	500	max.	volts
c. Positive bias	0	max.	volts
d. Positive peak	2	max.	volts
7. Heater - Cathode Voltage			
a. Heater negative during 15 sec. warmup.	410	max.	volts
b. Heater negative after 15 sec. warmup.	175	max.	volts
c. Heater Positive	175	max.	volts

Notes

III - Typical Operating Voltages

1. Grid #4	30	KV
2. Anode	27	KV
3. Grid #2	600	Volts
4. Grid 1A	See Section IV	
5. Grid 1B	See Section IV	
6 Heater		
a. Voltage	6.3	volts
b. Current	.6 ±10%	amps.

IV - Static Characteristics

A - Gun

1. Cathode Emission		
a. Zero bias current		
Grid #1A	$2.35 (E_{co})^{3/2}$	μa
Grid #1B	$2.35 (E_{co})^{3/2}$	μa
b. Uniformity		
2. Cut-off Limits		
a. Grid #1A	-125 to -175	volts
b. Grid #1B	-45 to -75	volts
3. Spot Size (focused)	30 max.	mils
4. Astigmatism	1.3 max.	

Notes

5. Beam Divergence (Grid #1A)		max.	degrees
? 6. Spot Centering			
* 7. Grid Aperture Separation (center to center)			inches
* 8. Grid Aperture Alignment			degrees
* 9. Convergence			
*10. Skew			
11. Tranamu			
a. Grid 1A	300	min.	
b. Grid 1B	300	min.	
12. Deflection Modulation			
a. Grid 1A		max.	inches
b. Grid 1B		max.	inches

Maximum Circuit Values:

13. Grid Circuit Resistance	1.5	max.	meg.
14. Other Leakages			

* - To be deleted when specification VB-2 is approved.

B. Phosphor Line Structure

1. Primary Chromaticity

a. The nominal primary coordinates (CIE) of a finished tube shall be as follows:

	X	Y
Red		
Green		
Blue		

b. Deviations permitted from the above are shown in Drawing

2. Center Pitch 61 ± mils

3. Phosphor Line and Guard Space
 Widths (center)

Red	Guard	Green	Guard	Blue	Guard	±	mils
10	10	10	10	10	10		

4. Phosphor Line Geometry

The phosphor line pitch (in the reference plane) shall conform to the following relation:

$$P = P_0(1 + J_x X + K_x X^2 + M_x X^3 + K_y Y^2 + R_y Y^4 + M_{xy} X^2 X^2)$$

Where:

J _x =	K _x =	N _x =
K _y =	R _y =	M _{xy} =

Notes

- a. Maximum pitch error ± 0.25 %
- b. Maximum slope error degrees

5. Screen Alignment Error

- Phosphor lines perpendicular to principal horizontal plane ± 2 degrees

C. Index Line Structure

- 1. The index lines shall be displaced from the color line structure in accordance with drawing Registry error

color
 max. degrees

- 2. Index phase (at center)

Green

- 3. Index extension beyond picture area:

- a. Left center 7 min. lines
- b. Bottom left corner 1/4 min. inches

- 4. Index Yield

- a. Minimum 40 %
- b. Maximum %
- c. Yield Ratio (excluding blemishes) 3:1 max.

- 5. Secondary Emission Ratio

max.

- 6. Index Signal Blemishes (greatest dimensions)

- a. No Yield 1/16 max. inches
- b. 10% Yield 1/4 max. inches
- c. 25% Yield 1/2 max. inches

Notes

- | | | |
|--|--|-----------|
| 7. Internal Grid #4 coating resistance | | max. ohms |
| 8. External Grid #4 coating resistance | | max. ohms |
| 9. External anode coating resistance | | max. ohms |

V - Dynamic Characteristics

A. White Field Properties

- | | | |
|--|------|-------------|
| 1. Luminance (center) | | min. Ft. l. |
| 2. Luminance uniformity
(any corner relative to center) | | max.% |
| 3. White Point
(see drawing for limits) | 8000 | degrees K |
| 4. White Uniformity
Maximum departure of any area
relative to center
(see drawing for limits) | | MPCD |

B. Color Field Properties

1. Color Phase Equality

At the tube face center the phase separation of the three primary colors (or the three complementary colors) shall be:

120 ± 5 color degrees

2. Flat Field Uniformity

In any solid color field, primary or complements the contribution of the tube to variations in hue over the visible screen area shall not exceed the equivalent of:

± 10 color degrees

Notes

(The following item must eventually appear in a final performance specification and could thereby supplant several tube design items listed here. Existing test equipment, however, is not adequate for pilot sun use and it is therefore meaningless to specify saturation on a performance basis now. The item is shown in this draft in its nodal place but is not to be considered a part of the formal specification).

3. Saturation

Under the test condition stated the relative saturation for any hue shall not be less than:
85 min.%

VI - Glassware and Coatings

A. Drawings

The tube supplier shall submit for approval drawings of the finished tube assembly showing the following information:

	<u>Present Lansdale Equivalent *</u>	
1. External dimensions and tolerances, contact locations, etc.	959-9103 917-9805	12-9-55 8-11-55
2. External coatings	959-9103	12-9-55
3. Internal coatings	917-9806	11-25-55
4. Neck contour and diameter, (after sealing)	017-9668	3-31-55
5. External and internal neck gauges	217-0010-A 217-0010	11-3-50 11-3-50

* Revisions are required in all cases to meet current practice.

B. Specific Requirements

1. Neck length Reference line to Grid #1	8 ± 1/8	inches
2. Neck alignment		
3. Beam alignment		
4. Beam clearance		
5. Center of Projection		
a. Location from reference line		inches
b. Offset for earth's field		inches

6. Anode contact alignment

7. Grid #4 contact alignment

C. Screen and Glass Quality Limits

To be specified

VII - Life

The life expectancy of the tube when operated within ratings shall not be less than 2000 hours.