E712A

DIRECT VIEW STORAGE TUBE

The data should be read in conjunction with the Storage Tube Preamble.

INTRODUCTION

The E712A is an 11 inch (279mm) direct view storage tube designed to provide very bright displays of information ranging from single transients and recurrent waveforms to half tone pictures. The useful viewing screen diameter is 9 inches (228.6mm), making the tube particularly suitable for the daylight-viewing of displays in radar, medical, television and tabular display applications.

The tube has two electron guns, one for writing the signal on to the storage surface and the other, the flood gun, for displaying written information on the viewing screen. The writing gun is similar to that in a conventional cathode ray tube, except that it need only be operative for a single trace, and is coaxial with the viewing screen so that relatively simple deflection circuits may be used. In writing, a charge pattern is deposited on the storage surface, which consists of an insulator coating on a metal mesh (the backing electrode). Low velocity electrons from the flood gun approach the storage mesh normally and at constant current density over the useful area. They penetrate the mesh in those areas where a charge pattern has been written, the number doing so being determined by the amount of charge deposited, and are then accelerated to the viewing screen where they produce an image.

Since the flood gun is normally continuously operative, the image on the viewing screen persists without deterioration for one to two minutes, and is visible for periods up to ten minutes. Extended storage periods may be obtained by switching off the flood beam until viewing is required, provided that no writing takes place while the flood gun is inoperative. The image can be completely erased in a fraction of a second by applying a small positive pulse to the backing electrode and controlled persistence can be obtained by varying the duration of shorter repetitive pulses.

Selective erasure is possible by electronic switching of appropriate electrode voltages.

GENERAL DATA

Electrical

	Writing Gun	Flood Gun	
Cathodes, indirectly heated, oxide coated	one	one	
Heater voltage (see note 1)	6.3	32	V
Heater current	0.3	1.2	A
Cathode heating time (minimum) (see note 2)	45	120	s
Inter-electrode capacitances:			
cathode to all other electrodes	8.0	—	pF
grid 1 to all other electrodes	10	—	pF
grid 1A to all other electrodes	—	90	pF
grid 1 to cathode, all other electrodes earthed	5.0	—	pF
backing electrode to all other electrodes	—	250	pF
screen to all other electrodes	—	110	pF
Focus method	electrostatic	electrostatic	
Deflection method	magnetic	none	
Phosphor		aluminized P20	
Fluorescent colour (see spectral output characteristic on page 12)		yellow	

Mechanical

Overall length	575mm (22.64 inches) max
Overall diameter	284mm (11.18 inches) max
Useful viewing screen diameter	228.6mm (9 inches) min
Net weight	11 pounds (5kg) approx
Mounting position	any, except with base up and with tube axis at an angle less than 20° from vertical
Base	B.S.448-B12A
Bulb connectors	12 B.S.448-CT8 cavity caps (JEDEC no. J1-21) and 2 special caps (see page 14)

MAXIMUM AND MINIMUM RATINGS (Absolute values)

No individual rating should be exceeded

All voltages are with respect to the flood gun cathode unless otherwise stated

Writing Gun

	Min	Max	
Heater voltage	6.0	6.6	V
Grid 4 voltage			see note 3
Grid 3 voltage (negative value)	—	6.0	kV
Grid 2 voltage			see note 3
Grid 1 voltage:			
negative bias*	0	250	V
positive peak*	—	2.0	V
Cathode voltage (negative value)	—	6.0	kV
Peak heater to cathode voltage	—	125	V
Cathode current (peak)	—	1.0	mA
Grid to cathode circuit impedance	—	1.0	MΩ

Flood Gun

	Min	Max	
Heater voltage	28	32	V
Viewing screen voltage (see note 4)	—	12	kV
Backing electrode voltage (peak) (see note 5)	—	20	V
Grid 4 (collector mesh) voltage	—	300	V
Grid 3 voltage	—	300	V
Grid 3A voltage	—	300	V
Grid 2 voltage	—	200	V
Grid 2A voltage	—	200	V
Grid 1 voltage	—	50	V
Grid 1A voltage	—	10	V
Grid shield voltage (negative value)	—	75	V
Heater to cathode voltage (see note 1)	—	0	V

* With respect to Writing Gun Cathode.

TYPICAL OPERATION

All voltages are with respect to flood gun cathode unless otherwise stated.

WRITING GUN

Operational Conditions

Grid 4 voltage (see note 3)	0	V
Grid 3 voltage (normal range for focus)*	200 to 600	V
Grid 2 voltage (see note 3)	0	V
Grid 1 voltage (normal range for writing beam cut-off)*	−85 to −150	V
Cathode voltage	−5000	V max

Typical Performance

Writing beam current	see curves on page 9
Cathode current	see curves on page 9
Stored writing speed	see curves on page 10 and 11

FLOOD GUN

Operational Conditions

Screen voltage (see note 4)	10	kV max
Backing electrode d.c. voltage	5.0	V
Erase pulse amplitude for screen cut-off (normal range)	3.0 to 5.0	V
Grid 4 (collector mesh) voltage	250	V
Grid 3A voltage (normal range, see note 6)	200 to 250	V
Grid 3 voltage (normal range, see note 6)	70 to 120	V
Grid 2A voltage (normal range, see note 6)	20 to 60	V
Grid 2 voltage (normal range, see note 6)	60 to 140	V
Grid 1A voltage (normal range, see note 6)	0 to 10	V
Grid 1 voltage (normal range, see note 6)	0 to 10	V
Shield voltage (normal range, see note 6)	0 to −60	V
Cathode voltage	0	V
Backing electrode supply impedance	1500	Ω max

* With respect to Writing Gun Cathode.

Typical Performance

Viewing screen current for full brightness all over screen	2.0	mA max
Grid 4 current	3.5	mA max
Grid 3A current	1.5	mA max
Grid 3 current	0.5	mA max
Grid 2A current	2.0	mA max
Grid 2 current	2.0	mA max
Grid 1A current	10	mA max
Grid 1 current	0.5	mA max
Shield current	0.1	mA max
Cathode current	15	mA max
Maximum screen luminance (at the centre)	1000	ft-lambert
	3430	cd/m^2
Viewing time (see note 7)	60	s min
Stored line width	see note 8 and curves on page 10	
Peak line brightness	see note 8 and curves on page 11	

NOTES

1. The writing gun cathode is operated at a potential of −5.0kV; the writing gun heater supply should therefore be adequately insulated.

   A d.c. supply should be used for the flood gun heater, with the negative side connected externally to the flood gun cathode via a 4.7kΩ resistor.

2. To prevent the possibility of runaway charging of the storage mesh surface, flood gun operation must be established before the writing gun e.h.t. is applied.

   The flood gun heater is a relatively massive structure and the gradual application of the full heater voltage is recommended, via a thermistor for example.

   Care must be taken when switching the tube on and off to ensure that the writing gun is so biassed that heavy writing, which might damage the storage mesh or the screen, cannot occur.

3. Grid 4 and grid 2 (writing gun) are connected internally to flood gun cathode.

4. The viewing screen supply impedance must lie between 0.3 and 1.0MΩ.

5. Except when the Clearance Procedure is being used; see General Instructions, Pulse Erasure Part (c) on pages 7 and 8.

6. The 'Normal Ranges' given are the specification limits. Each tube is accompanied by a sheet specifying the voltages required to give optimum performance on test for the particular tube. These voltages will be within the specification limits shown. The test values supplied should be used when setting up the tube initially, but some slight adjustment may be necessary to optimize the display uniformity for a particular application.

7. The viewing time is the time taken for any area of the screen of 6cm minimum diameter to reach an average brightness of 10% of the maximum light output for that area, immediately after the tube has been erased to just black.

   The specification limit for viewing time is 60 seconds minimum. Longer viewing times can be obtained by erasing beyond black or pulsing the flood gun above flicker frequency, but with a reduction in writing speed and brightness respectively.

8. The typical stored line width and peak line brightness characteristics given on pages 10 and 11 were measured at the centre of the display area after erasing to just black and writing a single field of a raster of widely spaced lines at the stated modulator drives and writing speeds.

GENERAL INSTRUCTIONS

Handling

The tube should be transported screen upwards to prevent particles falling on the storage elements. It should be handled with care to avoid damage to the metal seals.

Magnetic Shielding

Because of the low voltage of the flood gun beam, it is essential to shield the whole of the viewing section from magnetic fields; shielding of the writing gun is also advisable. Details of suitable Mumetal shields are available from English Electric Valve Company Ltd.

Demagnetization

Although the carrying pack contains magnetic shielding, the tube may become magnetized during transportation and this will cause severe non-uniformity of the display. In this event English Electric Valve Company should be consulted.

Pulse Erasure

(a) The speed of erasure is controlled by the adjustment of the pulse width in conjunction with the pulse repetition rate, which should be sufficiently high to prevent flicker, and preferably in the range between 200 and 1000 pulses per second. By increasing the pulse length or the pulse repetition rate, the erasure time may be reduced proportionately. The pulse amplitude also alters the erase rate but primarily determines the final potential to which the storage mesh is driven in the absence of writing. Normally a pulse amplitude two to three times the manual erase value is applied, which gives an approximately uniform rate of erasure for visible signals but tends to suppress small non-integrating signals such as noise. A much lower pulse amplitude must be used if the grey scale is to be preserved with no loss of information.

(b) If it can be conveniently arranged for the screen h.t. to be switched off simultaneously with either manual or pulse train erase then two advantages will ensue:

(i) Contrast during pulse train erase will improve.
(ii) The time taken for erasure will decrease.

(c) The normal erasure procedure may be inadequate or ineffective under the following conditions:

(i) When writing beam electrons have penetrated the surface of the storage insulator and have built up charges within it. Low velocity beam electrons cannot neutralize these charges and after the normal erasure procedure has been carried out the original screen image may still be faintly visible as the background illumination increases.

(ii) When parts of the storage mesh surface are driven so positive that the number of secondary electrons produced by the flood beam exceeds those arriving at the surface. This condition is known as runaway charging and can occur when a pulse exceeding 20 volts in amplitude

is applied to the backing electrode. It can also occur when an excessively high writing charge is deposited, e.g. with a stationary spot or line and particularly when writing takes place in the absence of flood beam current. Damage may be done to the storage mesh if this fault is not quickly corrected.

Both faults can be corrected by operating a switch to disconnect the backing electrode from its supply and connecting it to the flood gun grid 4 through a protective resistor; this switch must make and break quickly and need be operated once only. The screen should then be at uniform full brightness and normal erasure will prepare the tube for operation. Care should be taken to ensure that this switch cannot be left in the 'on' condition. This procedure is known as clearance.

The clearance procedure may be carried out automatically prior to each complete erasure if required.

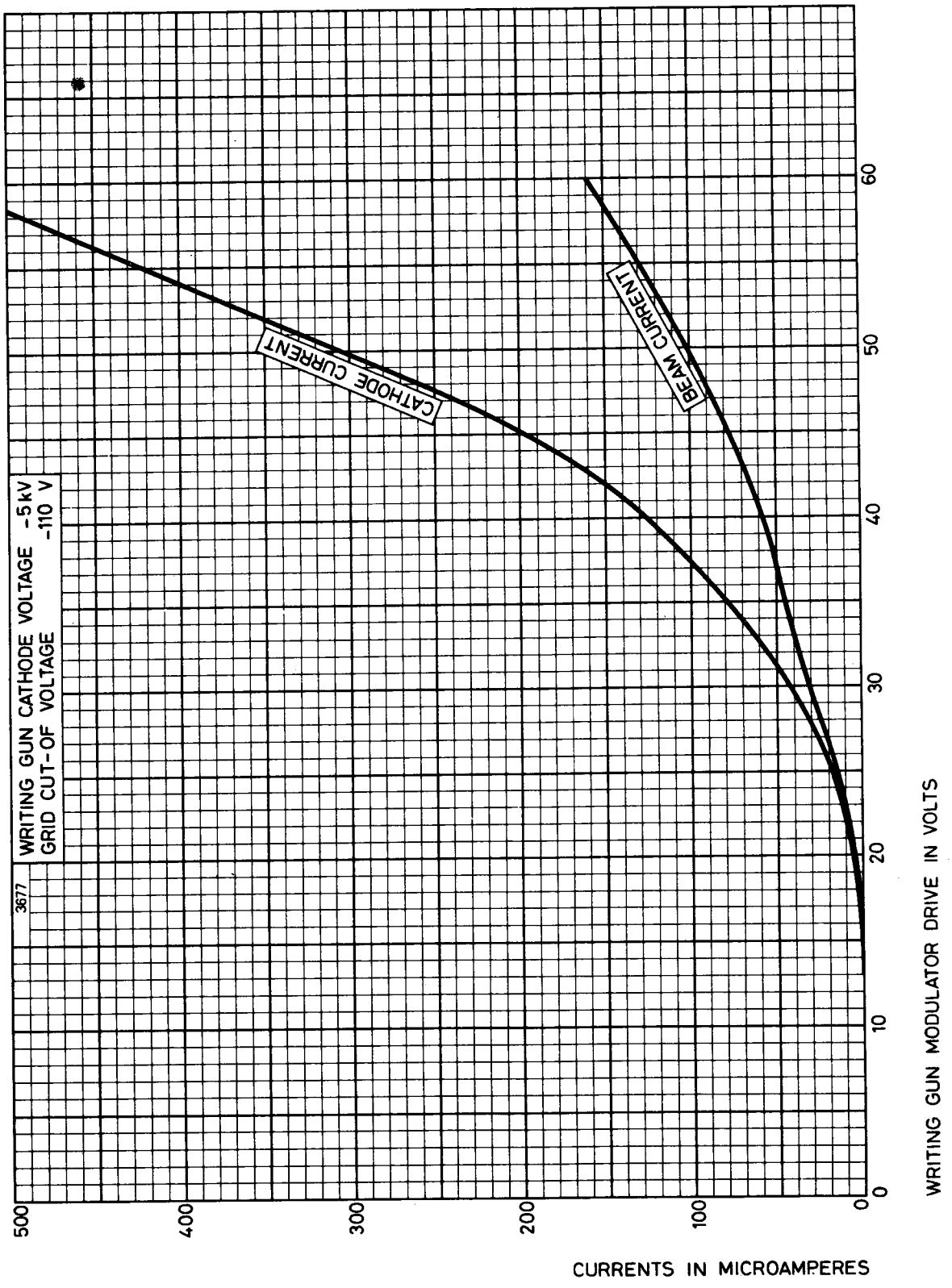
Deflection Supplies

Any failure of the deflection drive that may result in the production of a stationary spot or line may cause runaway charging, even with the flood beam on. Provision should be made for automatically cutting off the writing gun beam in the event of any such failure.

Mesh Tension

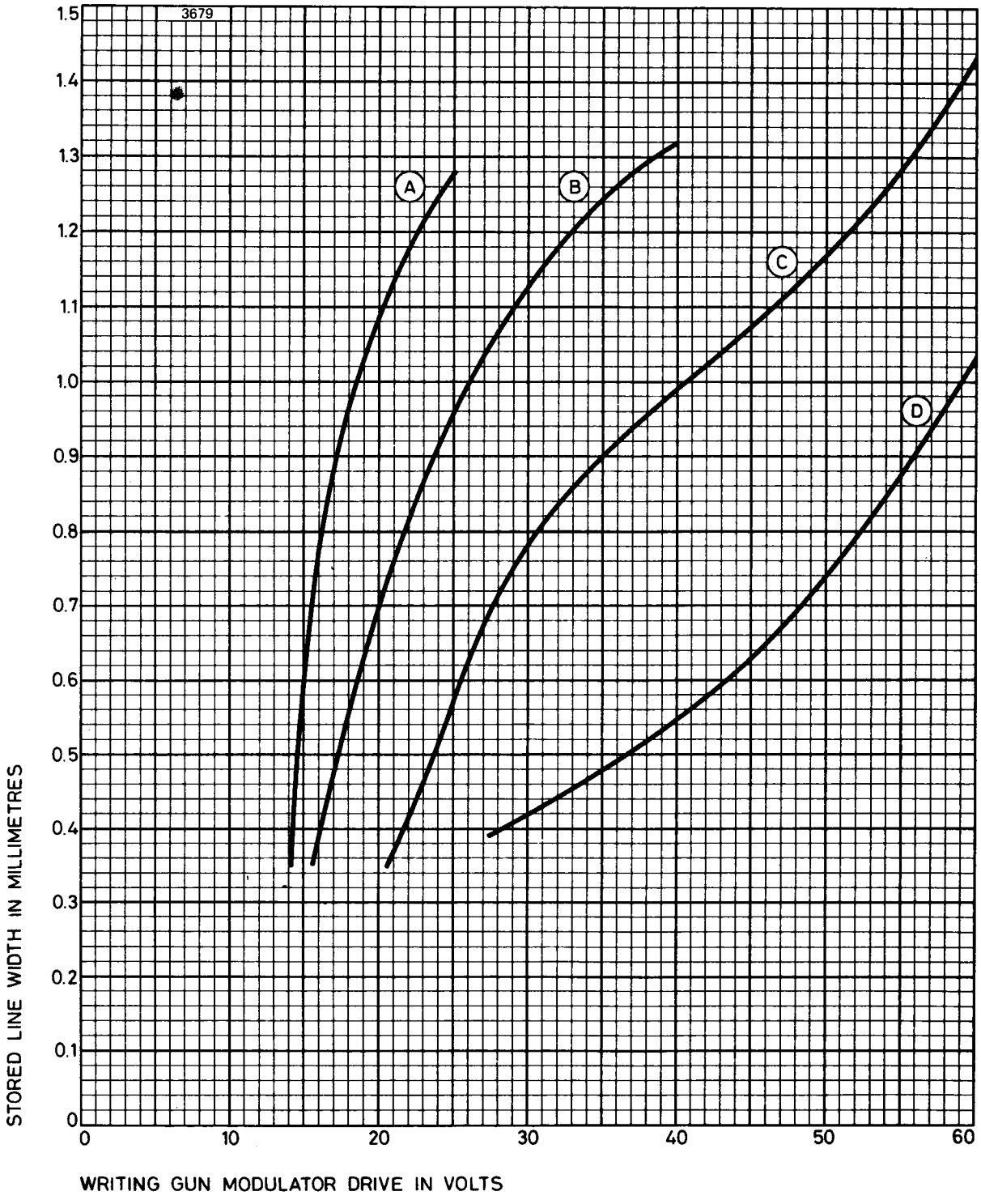
Any effect due to a reduction of mesh tension which may be evident soon after first switch-on will not be noticeable after an initial warm-up period and will not noticeably reappear when the tube is switched on again after a period of up to 24 hours switched off i.e. when used on a normal daily duty cycle.

TYPICAL WRITING GUN CHARACTERISTIC



TYPICAL SINGLE SHOT STORED LINE WIDTH CHARACTERISTICS

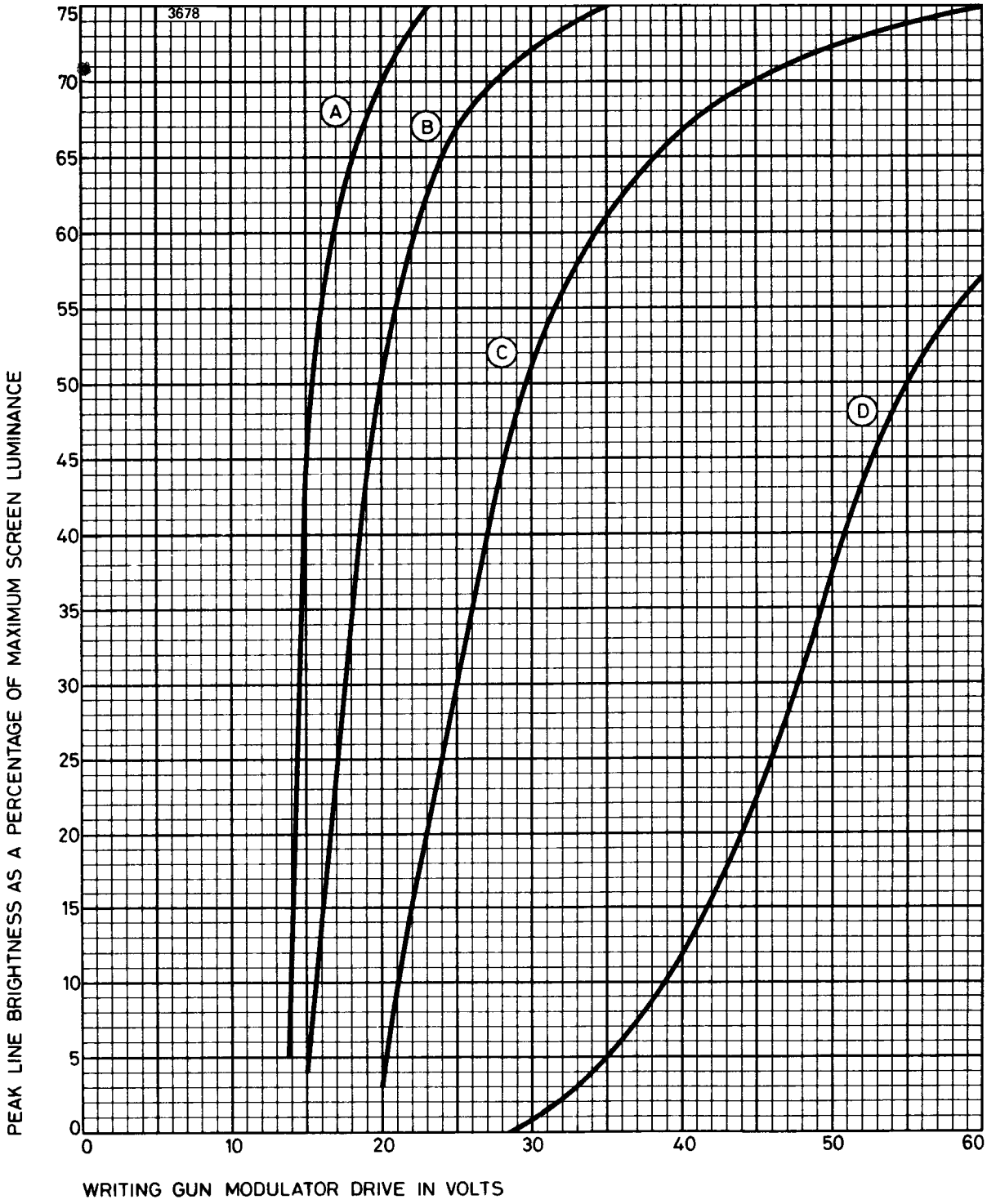
See Note 8 on page 6



Curve	Writing Speed (inch/second)
A	2.5×10^3
B	1.0×10^4
C	5.0×10^4
D	2.5×10^5

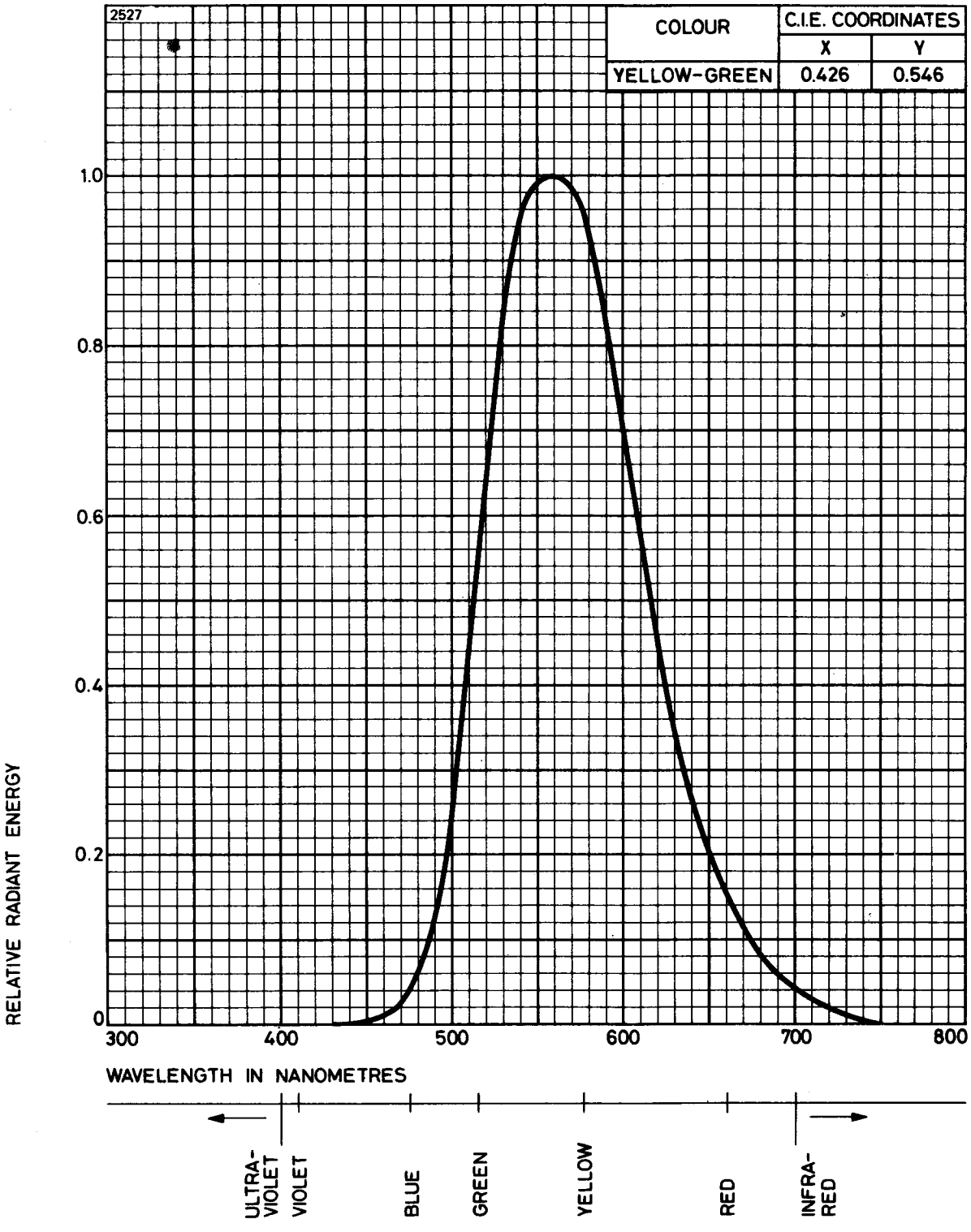
TYPICAL PEAK LINE BRIGHTNESS CHARACTERISTICS

See Note 8 on page 6

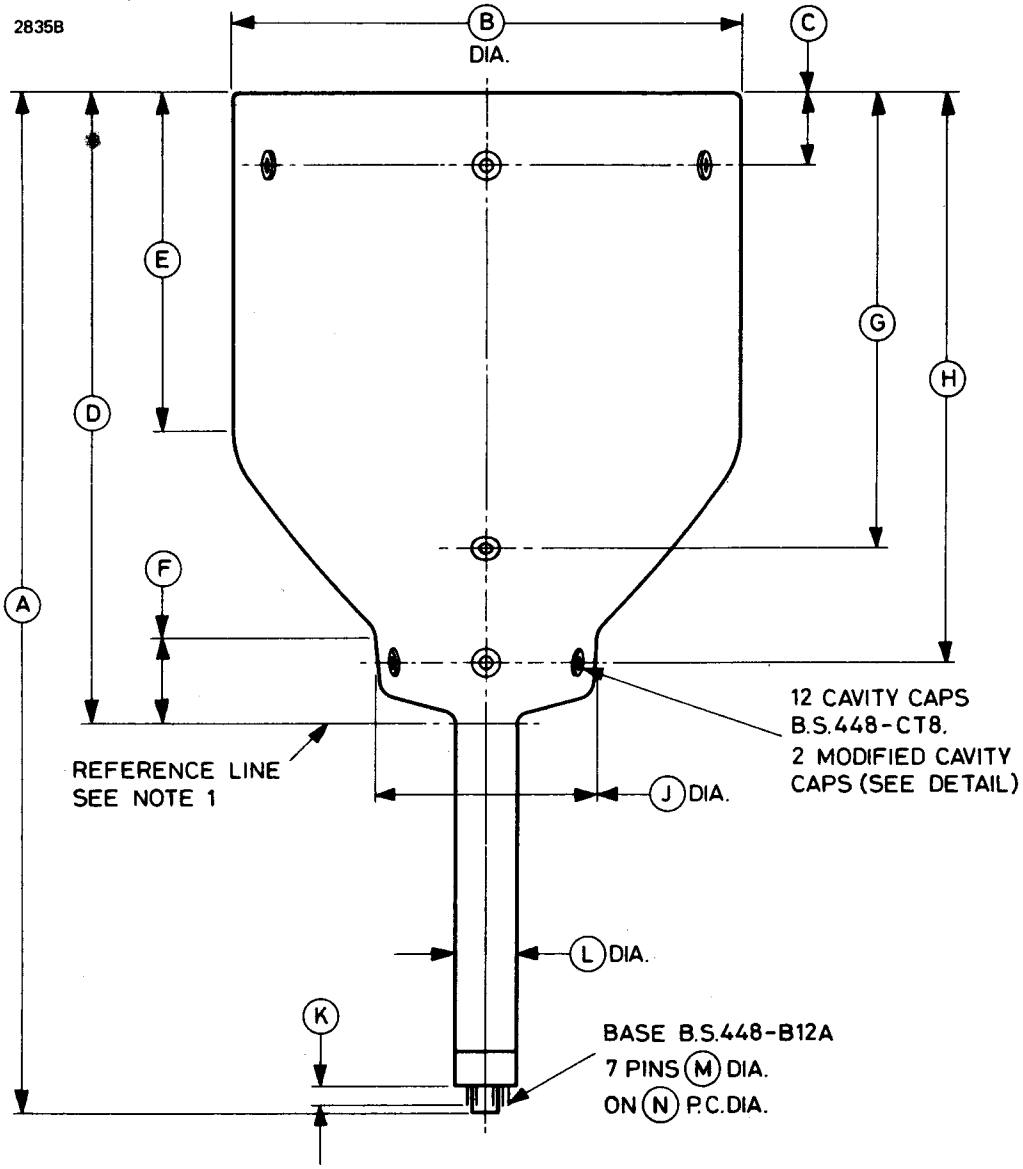


Curve	Writing Speed (inch/second)
A	2.5×10^3
B	1.0×10^4
C	5.0×10^4
D	2.5×10^5

TYPICAL SPECTRAL OUTPUT CHARACTERISTIC



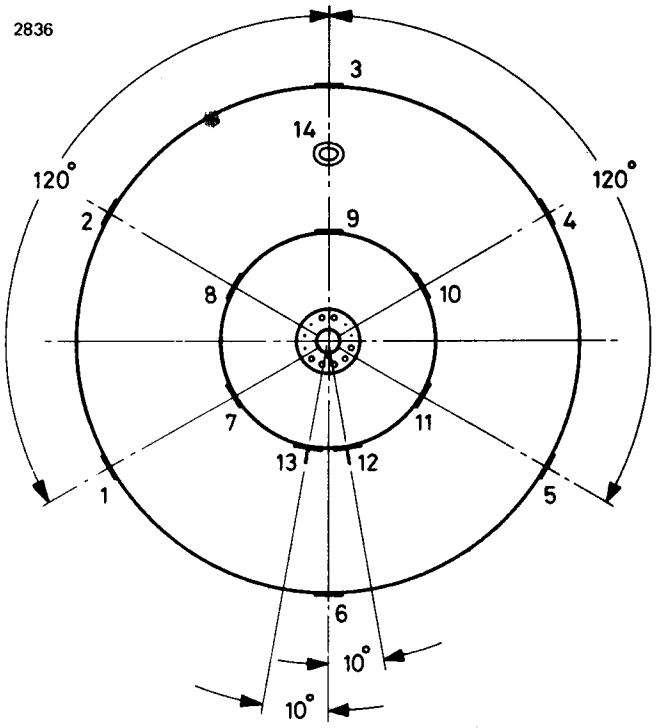
OUTLINE



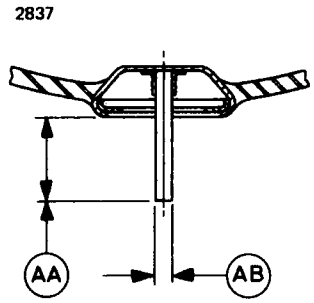
Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	560.0 ± 15.0	22.05 ± 0.59	J	120.0 ± 5.0	4.724 ± 0.197
B	280.0 ± 4.0	11.02 ± 0.16	K*	11.35 max	0.447 max
C	40.0 ± 6.0	1.575 ± 0.236	L	35.5 max	1.398 max
D	350.0 ± 15.0	13.78 ± 0.59	M*	2.362 ± 0.076	0.093 ± 0.003
E	205.0 max	8.07 max	N*	27.00	1.063
F	44.0 ± 3.0	1.732 ± 0.118	AA	9.0 ± 0.5	0.354 ± 0.020
G	250.0 ± 15.0	9.843 ± 0.590	AB	1.5 ± 0.1	0.059 ± 0.004
H	315.0 ± 15.0	12.40 ± 0.59			

Inch dimensions have been derived from millimetres except where indicated thus *.

Cavity Cap Connections (See Note 2)



Detail of Caps 12 and 13



Cavity Cap	Element
1	Grid 3A (flood gun)
2	Grid 4 (flood gun)
3	Internal connection
4	Backing electrode
5	Grid 3 (flood gun)
6	Screen
7	Cathode (flood gun), grid 2 (writing gun), grid 4 (writing gun)

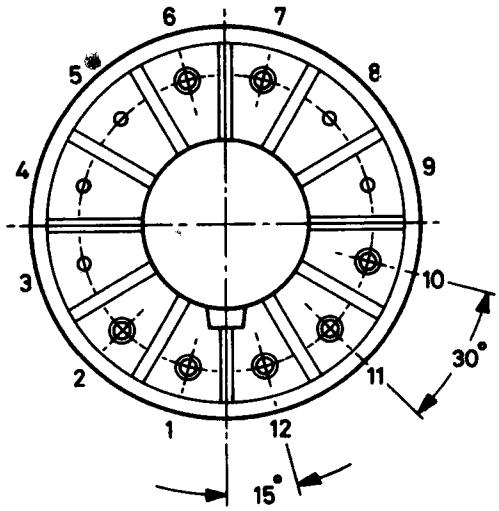
Cavity Cap	Element
8	Grid 2 (flood gun)
9	Shield (flood gun)
10	Grid 1A (flood gun)
11	Grid 1 (flood gun)
12	Heater (flood gun) negative
13	Heater (flood gun) positive
14	Grid 2A (flood gun)

Outline Notes

1. The reference line is defined by a ring gauge 36.0mm internal diameter.
2. The cavity caps to be within 3° of the angular positions indicated.

Base Connections

2838



Pin	Element
1	Heater (writing gun)
2	Grid 1 (writing gun)
3	No pin
4	No pin
5	No pin
6	No connection
7	No connection
8	No pin
9	No pin
10	Grid 3 (writing gun)
11	Cathode (writing gun)
12	Heater (writing gun)

Note The base key will be in line with cavity cap 6 within 15°.