

**MAZDA**

**VALVES &  
CATHODE  
RAY TUBES**

**VOL. 1**

**PICTURE  
TUBES**

*Tech. Publications.*

**Handbook User**

**MAZDA  
Commercial  
Division**

**MAZDA**

**THORN-AEI Radio Valves & Tubes Ltd**



# DESIGN DATA HANDBOOK

U.K. EDITION

Volume 1

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## Colour and Monochrome Picture Tubes

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A Data Service is provided for this Handbook.  
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**Head Office, Publicity Department and  
SALES DEPARTMENTS  
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## USE OF THIS HANDBOOK

Data sheets are filed in numerical/alphabetical order of the tube type numbers. Volume 1 contains colour and monochrome picture tubes. Volume 2 contains valves.

The CROSS REFERENCE INDEX covers all Volumes of the Handbook. The CONTENTS covers one particular Volume only, and is provided as a check against missing sheets.

## DESIGN DATA SERVICE

New handbooks are supplied at an initial charge of £1 (Sterling) per Volume, which includes the Data Service up to the following June.

New and revised data sheets for this handbook are sent direct from Thorn Radio Valves and Tubes Ltd. to all registered handbook holders. This service is normally invoiced annually in advance, in July, for the coming "Data Year" to June.

The Annual Service Charge (£1 Sterling) is so small that it is not practicable to invoice it in two parts in cases where the "Data Year" does not coincide with the subscriber's "Accounting Year".

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## APPLICATIONS SERVICE

The Applications Laboratory provides a free advisory service to equipment manufacturers.

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MAZDA Colour Tubes are manufactured by Thorn Colour Tubes Ltd., and distributed through Thorn Radio Valves & Tubes Ltd.

MAZDA Monochrome Picture Tubes are manufactured and distributed by Thorn Radio Valves & Tubes Ltd.

This Contents Sheet for the Mazda Data Handbook Volume 1 will be reissued periodically to allow Holders to check that their handbook contains all the latest sheets. Volume 1 contains data sheets for Colour and Monochrome Picture Tubes, each classified into Current Equipment types recommended for use in new equipment and Maintenance types available for replacement.

Volume 2 includes data sheets for Valves which are classified into Current Equipment and Maintenance types.

Sheets are filed in numerical-alphabetical order of the individual type number and in cases where sheets are dual coded the Mazda number is given first and sheets are filed under this type number. Abridged data on older maintenance types follows the individual data sheets at the end of the Maintenance Monochrome Picture Tubes section.

## INTRODUCTORY SHEETS

Sheet Description	Issue	Pages
Title Card - Volume 1	3	-
Contents - Volume 1	7	1 - 2
Cross Reference Index	7	1 - 5
Issue Letter(s)	-	-
Symbols Card	-	-

## GENERAL SECTION - Guide Card

Sheet Description	Issue	Pages
Current Monochrome Section Table	6	1
Television C. R. T. Nomenclature	3	1
Operational Recommendations	1	1 - 10
Aluminised W Screen Characteristic	1	1
Reference Line Gauges:		
Nos. 6 & 7	1	1 - 2
Nos. 12 & 13	1	1 - 2
No. 16	2	1
No. 22	1	1
B7G/D Base	2	1
B8H Base	1	1
B8H Sparkguard R Base	2	1
B8H Sparkguard S Base	3	1
CT8 Cap	1	1 - 2

Note: For Pro Electron and American Equivalents see Cross Reference Index following this Contents sheet.

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**CURRENT COLOUR PICTURE TUBES—Guide Card**

Type	Issue	Pages	Type	Issue	Pages
A49-191X	2	1 - 7	A56-120X	2	1 - 7
	2	C1-C3		2	C1-C3
A51-110X	1	1 - 6	A63-200X	2	1 - 7
	1	C1-C3		2	C1-C3
A55-14X	2	1 - 7	A67-120X	2	1 - 7
	2	C1-C3		2	C1-C3

**CURRENT MONOCHROME PICTURE TUBES—Guide Card**

Type	Issue	Pages	Type	Issue	Pages
CME1202	2	1	CME1520	2	1 - 5
	3	2	CME1713	1	1 - 5
	2	3		1	C1-C3
	3	4 - 5	CME2013	3	1 - 5
	2	C1-C3		3	C1-C3
CME1220	2	1 - 5	CME2413	1	1 - 6

**MAINTENANCE COLOUR PICTURE TUBES—Guide Card**

Type	Issue	Pages
A49-11X	4	1 - 5
	3	C1-C3
CTA2550	3	1 - 5
	3	C1-C3

**MAINTENANCE MONOCHROME PICTURE TUBES—Guide Card**

Type	Issue	Pages	Type	Issue	Pages
CME1201	2	1 - 6	CME2104	1	1 - 3
CME1601	2	1 - 6	CME2301	1	1 - 6
CME1602	2	1 - 6	CME2302	1	1 - 2
CME1702	1	1 - 6	CME2306	3	1 - 6
CME1703	1	1 - 2	CME2308	3	1 - 6
CME1705	1	1 - 2	CME2312	2	1 - 6
CME1903	4	1 - 6	CME2313	3	1 - 5
CME1905	3	1 - 6	CRM172	1	1 - 6
CME1906	3	1 - 6	CRM173	1	1 - 5
CME1907	2	1 - 6	CRM212	1	1 - 3
CME1908	2	1 - 6	Abridged		
CME1913	3	1 - 5	Data	1	21-22
CME2101	1	1 - 5			

Note: For Pro Electron and American Equivalents see Cross Reference Index following this Contents page.

# Data Handbook

# Cross Reference Index

## USE OF THE CROSS REFERENCE INDEX

This index has two functions:-

- (1) to locate data within the two volumes of this handbook,
- (2) to give a complete equivalents cross reference between Pro Electron, American and Mazda type numbers.

Since the sheets in this handbook are filed in Mazda type order (where allocated), the cross reference index should be used to find the filing number when searching for data on types having Pro Electron and American type numbers.

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro		Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro	
			Electron	American				Electron	American
1BQ2	2	DY802	DY802	1BQ2	6BQ5	2†	6P15	EL84	6BQ5
1C1	2*	1C1	DK91	1R5	6BW7	2†	6BW7		6BW7
1F3	2*	1F3	DF91	1T4	6BX6	2†	EF80	EF80	6BX6
1FD9	2*	1FD9	DAF91	1S5	6BY7	2†	6F26	EF85	6BY7
1M1	2†	1M1	DM71	1N3	6C12	2†	6C12	ECH81	6AJ8
1N3	2†	1M1	DM71	1N3	6C18	2	6C18	ECF805	6GV7
1P1	2*	1P1	DL96	3C4	6CA4	2†	UU12	EZ81	6CA4
1P10	2*	1P10	DL92	3S4	6CS6	2†	EH90	EH90	6CS6
1R5	2*	1C1	DK91	1R5	6D2	2†	6D2	EB91	6AL5
1S2	2	DY86/87	DY86	1S2	6DC8	2†	6FD12	EBF89	6DC8
1S2A	2	DY86/87	DY87	1S2A	6EC7	2†	6F18		6EC7
1S5	2*	1FD9	DAF91	1S5	6EH7	2	6F29	EF183	6EH7
1T4	2*	1F3	DF91	1T4	6EJ7	2	6F30	EF184	6EJ7
2J2	2†	U26	KY80	2J2	6EL7	2†	6F23	EF812	6EL7
3BH2	2†	GY501	GY501	3BH2	6F1	2*	6F1		
3C4	2*	1P1	DL96	3C4	6F12	2*	6F12	EF91	6AM6
3S4	2*	1P10	DL92	3S4	6F13	2*	6F13		
4CM4	2†	PC86	PC86	4CM4	6F14	2*	6F14		
4DL4	2†	PC88	PC88	4DL4	6F15	2*	6F15		
4FY5	2	PC97	PC97	4FY5	6F18	2†	6F18		6EC7
4HA5	2†	PC900	PC900	4HA5	6F22	2†	EF86	EF86	6267
6/30L2	2†	6/30L2	ECC804	6GA8	6F23	2†	6F23	EF812	6EL7
6AB8	2†	ECL80	ECL80	6AB8	6F26	2†	6F26	EF85	6BY7
6AJ8	2†	6C12	ECH81	6AJ8	6F28	2	6F28	EE80	
6AK8	2†	6LD12	EABC80	6AK8	6F29	2	6F29	EF183	6EH7
6AL5	2†	6D2	EB91	6AL5	6F30	2	6F30	EF184	6EJ7
6AM6	2*	6F12	EF91	6AM6	6FD12	2†	6FD12	EBF89	6DC8
6AQ8	2†	6L12	ECC85	6AQ8	6FY5	2	EC97	EC97	6FY5
6AT6	2†	EBC90	EBC90	6AT6	6GA8	2†	6/30L2	ECC804	6GA8
6BM8	2†	6PL12	ECL82	6BM8	6GV7	2	6C18	ECF805	6GV7

\* Included in Abridged Data sheets.

† Maintenance type.

CROSS REFERENCE INDEX

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Index	Hand- book Vol.	Filed under Type No.	Equivalent Types		Index	Hand- book Vol.	Filed under Type No.	Equivalent Types	
			Pro Electron	American				Pro Electron	American
6GW8	2	ECL86	ECL86	6GW8	10LD11	2*	10LD11		
6HU6	2†	EM87	EM87	6HU6	10LD13	2†	10LD13	UBC81	
6JX8	2†	ECH84	ECH84	6JX8	10P13	2*	10P13		
6K25	2*	6K25			10P18	2†	10P18	UL84	45B5
6L12	2†	6L12	ECC85	6AQ8	10PL12	2†	10PL12	UCL82	50BM8
6L13	2	6L13	ECC83	12AX7	12AT7	2	ECC81	ECC81	12AT7
6LD12	2†	6LD12	EABC80	6AK8	12AU7	2	ECC82	ECC82	12AU7
6N8	2†	EBF80	EBF80	6N8	12AX7	2	6L13	ECC83	12AX7
6P15	2†	6P15	EL84	6BQ5	12DT7	2	6L13	ECC83	12AX7
6PL12	2†	6PL12	ECL82	6BM8	12FB5	2†	30P12	PL801	12FB5
6S2	2†	EY86/87	EY86	6S2	13EC7	2†	10F18		13EC7
6S2A	2†	EY86/87	EY87	6S2A	13GC8	2	30PL1	PCL801	13GC8
6U8	2†	ECF82	ECF82	6U8	14GW8	2	PCL86	PCL86	14GW8
6V4	2†	EZ80	EZ80	6V4	15A6	2†	PL83	PL83	15A6
6X2	2†	EY51	EY51	6X2	15CW5	2†	30P18	PL84	15CW5
7AN7	2†	30L1	PCC84	7AN7	15DQ8	2	PCL84	PCL84	15DQ8
7DJ8	2†	PCC88	PCC88	7DJ8	16A5	2†	30P16	PL82	16A5
7ED7	2†	30F5	PF818	7ED7	16A8	2	30PL12	PCL82	16A8
7EK7	2†	30L15	PCC805	7EK7	16GK8	2†	30PL13	PCL800	16GK8
7ES8	2†	PCC189	PCC189	7ES8	16LD6	2†	PL802	PL802	16LD6
7FC7	2†	PCC89	PCC89	7FC7	17KW6	2†	PL508	PL508	17KW6
7GV7	2	30C18	PCF805	7GV7	17Y9	2	PFL200	PFL200	17Y9
8GJ7	2†	PCF801	PCF801	8GJ7	17Z3	2	PY81	PY81	17Z3
8HG8	2†	PCF86	PCF86	8HG8	18GV8	2	PCL805	PCL85	18GV8
8X9	2†	PCF200	PCF200	8X9	19CS4	2†	U191	PY301	19CS4
9A8	2	30C1	PCF80	9A8	19D8	2†	10C14	UCH81	19D8
9AQ8	2†	PCC85	PCC85	9AQ8	19FL8	2†	10FD12	UBF89	19FL8
9ED4	2†	PD500	PD500	9ED4	19Y3	2†	U192	PY82	19Y3
9EN7	2†	30C15	PCF800	9EN7	20D1	2*	20D1		
9GB8	2†	30FL1	PCE800	9GB8	20F2	2*	20F2		
9JW8	2†	PCF802	PCF802	9JW8	20L1	2*	20L1		
9U8	2†	PCF82	PCF82	9U8	20P3	2*	20P3		
9V9	2†	PCH200	PCH200	9V9	20P4	2*	20P4	CL30	
10C2	2*	10C2			20P5	2*	20P5		
10C14	2†	10C14	UCH81	19D8	21A6	2†	PL81	PL81	21A6
10D2	2†	10D2			23DFP4	1†	CME2308	A59-15W	27DFP4
10F9	2*	10F9			23DGP4	1†	CME2306	A59-13W	23DGP4
10F18	2†	10F18		13EC7	23DHP4	1†	CME2306	A59-13W	23DHP4
10FD12	2†	10FD12	UBF89	19FL8	25E5	2	PL36	PL36	25E5
10L14	2†	10L14	UCC85		25GF6	2†	30P4		25GF6

\* Included in Abridged Data sheets.

† Maintenance type.

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# Cross Reference Index

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro Electron	Types American	Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro Electron	Types American
25UP22	1†	CTA2550	A63-11X	25UP22	A47-28W	1†	CME1913	A47-28W	
27GB5	2†	PL500	PL500	27GB5	A49-11X	1†	A49-11X	A49-11X	
30AE3	2	PY88	PY88	30AE3	A49-191X	1	A49-191X	A49-191X	
30C1	2	30C1	PCF80	9A8	A50-12W	1	CME2013	A50-12W	
30C15	2†	30C15	PCF800	9EN7	A50-120W	1	CME2013	A50-120W	
30C17	2†	30C17	PCF87		A51-110X	1	A51-110X	A51-110X	
30C18	2	30C18	PCF805	7GV7	A55-14X	1	A55-14X	A55-14X	
30F5	2†	30F5	PF818	7ED7	A56-120X	1	A56-120X	A56-120X	
30FL1	2†	30FL1	PCE800	9GB8	A59-13W	1†	CME2306	A59-13W	23DGP4 23DHP4
30FL2	2	30FL2	PCF812						
30FL12	2†	30FL12	PCE82		A59-15W	1†	CME2308	A59-15W	23DFP4
30FL14	2	30FL14	PCF808		A59-16W	1†	CME2306	A59-16W	
30L1	2†	30L1	PCC84	7AN7	A59-23W	1†	CME2313	A59-23W	
30L15	2†	30L15	PCC805	7EK7	A59-25W	1†	CME2312	A59-25W	
30L17	2†	30L17	PCC806		A59-26W	1†	CME2313	A59-26W	
30P4	2†	30P4		25GF6	A61-120W	1	CME2413	A61-120W	
30P12	2†	30P12	PL801	12FB5	A63-11X	1†	CTA2550	A63-11X	25UP22
30P16	2†	30P16	PL82	16A5	A63-200X	1	A63-200X	A63-200X	
30P18	2†	30P18	PL84	15CW5	A67-120X	1	A67-120X	A67-120X	
30P19	2	30P19	PL302		AW47-91	1†	CME1903	AW47-91	
30PL1	2	30PL1	PCL801	13GC8	AW59-90	1†	CME2302	AW59-90	
30PL12	2	30PL12	PCL82	16A8	AW59-95	1†	CME2301	AW59-95	
30PL13	2†	30PL13	PCL800	16GK8	CL30	2*	20P4	CL30	
30PL14	2†	30PL14	PCL88		CME1201	1†	CME1201	A31-18W	
38A3	2†	U381	UY85	38A3	CME1202	1	CME1202	A31-181W	
42EC4	2†	PY500	PY500	42EC4	CME1220	1	CME1220	A31-120W	
45B5	2†	10P18	UL84	45B5	CME1520	1	CME1520	A38-160W	
50BM8	2†	10PL12	UCL82	50BM8	CME1601	1†	CME1601	A40-11W	
6267	2†	EF86	EF86	6267	CME1602	1†	CME1602	A40-12W	
A31-18W	1†	CME1201	A31-18W		CME1702	1†	CME1702		
A31-120W	1	CME1220	A31-120W		CME1703	1†	CME1703		
A31-181W	1	CME1202	A31-181W		CME1705	1†	CME1705		
A38-160W	1	CME1520	A38-160W		CME1713	1	CME1713	A44-120W	
A40-11W	1†	CME1601	A40-11W		CME1903	1†	CME1903	AW47-91	
A40-12W	1†	CME1602	A40-12W		CME1905	1†	CME1905	A47-17W	
A44-120W	1	CME1713	A44-120W		CME1906	1†	CME1906	A47-13W	
A47-13W	1†	CME1906	A47-13W		CME1907	1†	CME1907	A47-25W	
A47-14W	1†	CME1908	A47-14W		CME1908	1†	CME1908	A47-14W	
A47-17W	1†	CME1905	A47-17W		CME1913	1†	CME1913	A47-28W	
A47-25W	1†	CME1907	A47-25W		CME2013	1	CME2013	A50-120W	

\* Included in Abridged Data sheets.

† Maintenance type.

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro		Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro	
			Electron	American				Electron	American
CME2101	1†	CME2101			ECC85	2†	6L12	ECC85	6AQ8
CME2104	1†	CME2104			ECC804	2†	6/30L2	ECC804	6GA8
CME2301	1†	CME2301	AW59-95		ECF80	2†	ECF80	ECF80	
CME2302	1†	CME2302	AW59-90		ECF82	2†	ECF82	ECF82	6U8
CME2306	1†	CME2306	A59-13W	23DGP4 23DHP4	ECF805	2	6C18	ECF805	6GV7
CME2308	1†	CME2308	A59-15W	23DFP4	ECH81	2†	6C12	ECH81	6AJ8
CME2312	1†	CME2312	A59-25W		ECH84	2†	ECH84	ECH84	6JX8
CME2313	1†	CME2313	A59-23W		ECL80	2†	ECL80	ECL80	6AB8
CME2413	1	CME2413	A61-120W		ECL82	2†	6PL12	ECL82	6BM8
CRM121B	1*	CRM121B			ECL86	2	ECL86	ECL86	6GW8
CRM141	1*	CRM141/142			EE80	2	6F28	EE80	
CRM142	1*	CRM141/142			EF80	2†	EF80	EF80	6BX6
CRM151	1*	CRM151			EF85	2†	6F26	EF85	6BY7
CRM152B	1*	CRM152B			EF86	2†	EF86	EF86	6Z67
CRM153	1*	CRM153			EF91	2*	6F12	EF91	6AM6
CRM171	1*	CRM171			EF183	2	6F29	EF183	6EH7
CRM172	1†	CRM172			EF184	2	6F30	EF184	6EJ7
CRM173	1†	CRM173			EF812	2†	6F23	EF812	6EL7
CRM211	1*	CRM211			EH90	2†	EH90	EH90	6CS6
CRM212	1†	CRM212			EL84	2†	6P15	EL84	6BQ5
CTA2550	1†	CTA2550	A63-11X	25UP22	EM87	2†	EM87	EM87	6HU6
CY30	2*	U301	CY30		EY51	2†	EY51	EY51	6X2
DAF91	2*	1FD9	DAF91	1S5	EY86	2†	EY86/87	EY86	6S2
DF91	2*	1F3	DF91	1T4	EY87	2†	EY86/87	EY87	6S2A
DK91	2*	1C1	DK91	1R5	EZ80	2†	EZ80	EZ80	6V4
DL92	2*	1P10	DL92	3S4	EZ81	2†	UU12	EZ81	6CA4
DL96	2*	1P1	DL96	3C4	GY501	2†	GY501	GY501	3BH2
DM71	2†	1M1	DM71	1N3	KY80	2†	U26	KY80	2J2
DY86	2	DY86/87	DY86	1S2	PC86	2†	PC86	PC86	4CM4
DY87	2	DY86/87	DY87	1S2A	PC88	2†	PC88	PC88	4DL4
DY802	2	DY802	DY802	1BQ2	PC97	2	PC97	PC97	4FY5
EABC80	2†	6LD12	EABC80	6AK8	PC900	2†	PC900	PC900	4HA5
EB91	2†	6D2	EB91	6AL5	PCC84	2†	30L1	PCC84	7AN7
EBC90	2†	EBC90	EBC90	6AT6	PCC85	2†	PCC85	PCC85	9AQ8
EBF80	2†	EBF80	EBF80	6N8	PCC88	2†	PCC88	PCC88	7DJ8
EBF89	2†	6FD12	EBF89	6DC8	PCC89	2†	PCC89	PCC89	7FC7
EC97	2	EC97	EC97	6FY5	PCC189	2†	PCC189	PCC189	7ES8
ECC81	2	ECC81	ECC81	12AT7	PCC805	2†	30L15	PCC805	7EK7
ECC82	2	ECC82	ECC82	12AU7	PCC806	2†	30L17	PCC806	
ECC83	2	6L13	ECC83	12AX7	PCE82	2†	30FL12	PCE82	

\* Included in Abridged Data sheets.

† Maintenance type.

# Data Handbook

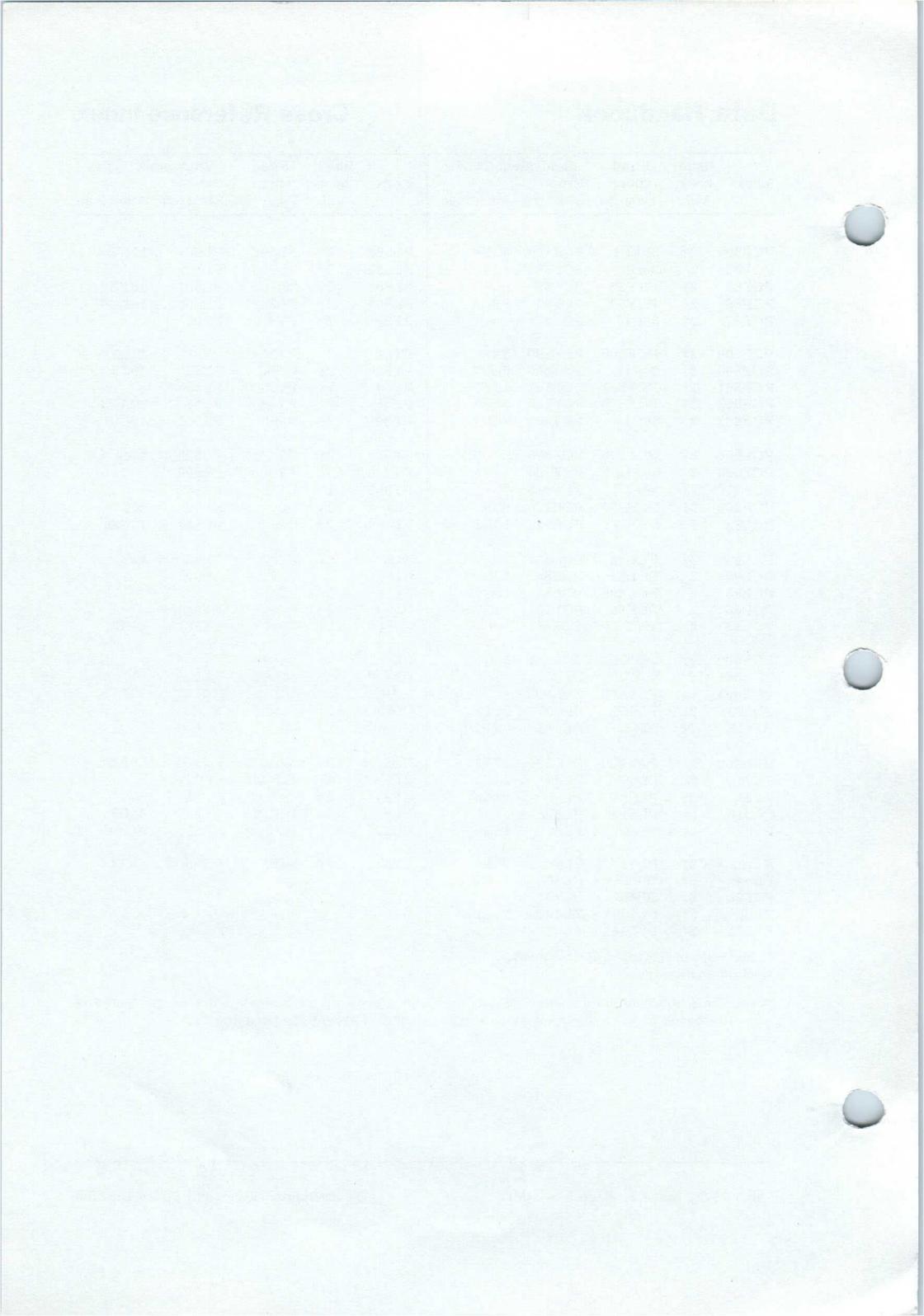
# Cross Reference Index

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro		Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro	
			Electron	American				Electron	American
PCE800	2†	30FL1	PCE800	9GB8	PL508	2†	PL508	PL508	17KW6
PCF80	2	30C1	PCF80	9A8	PL509	2†	PL509	PL509	
PCF82	2†	PCF82	PCF82	9U8	PL801	2†	30P12	PL801	12FB5
PCF86	2†	PCF86	PCF86	8HG8	PL802	2†	PL802	PL802	16LD6
PCF87	2†	30C17	PCF87		PY33	2†	PY33	PY33	
PCF200	2†	PCF200	PCF200	8X9	PY81	2	PY81	PY81	17Z3
PCF800	2†	30C15	PCF800	9EN7	PY82	2†	U192	PY82	19Y3
PCF801	2†	PCF801	PCF801	8GJ7	PY83	2†	PY83	PY83	
PCF802	2†	PCF802	PCF802	9JW8	PY88	2	PY88	PY88	30AE3
PCF805	2	30C18	PCF805	7GV7	PY301	2†	U191	PY301	19CS4
PCF806	2†	PCF806	PCF806		PY500	2†	PY500	PY500	42EC4
PCF808	2	30FL14	PCF808		PY800	2	PY800	PY800	
PCF812	2	30FL2	PCF812		PY801	2	U193	PY801	
PCH200	2†	PCH200	PCH200	9V9	U26	2†	U26	KY80	2J2
PCL82	2	30PL12	PCL82	16A8	U191	2†	U191	PY301	19CS4
PCL83	2†	PCL83	PCL83		U192	2†	U192	PY82	19Y3
PCL84	2	PCL84	PCL84	15DQ8	U193	2	U193	PY801	
PCL85	2	PCL805	PCL85	18GV8	U251	2*	U251		
PCL86	2	PCL86	PCL86	14GW8	U301	2*	U301	CY30	
PCL88	2†	30PL14	PCL88		U381	2†	U381	UY85	38A3
PCL800	2†	30PL13	PCL800	16GK8	U404	2*	U404		
PCL801	2	30PL1	PCL801	13GC8	UBC81	2†	10LD13	UBC81	
PCL805	2	PCL805	PCL805		UBF89	2†	10FD12	UBF89	19FL8
PD500	2†	PD500	PD500	9ED4	UCC85	2†	10L14	UCC85	
PF818	2†	30F5	PF818	7ED7	UCH81	2†	10C14	UCH81	19D8
PFL200	2	PFL200	PFL200	17Y9	UCL82	2†	10PL12	UCL82	50BM8
PL36	2	PL36	PL36	25E5	UCL83	2†	UCL83	UCL83	
PL81	2†	PL81	PL81	21A6	UF89	2†	UF89	UF89	
PL81A	2†	PL81A	PL81A		UL84	2†	10P18	UL84	45B5
PL82	2†	30P16	PL82	16A5	UU12	2†	UU12	EZ81	6CA4
PL83	2†	PL83	PL83	15A6	UY85	2†	U381	UY85	38A3
PL84	2†	30P18	PL84	15CW5					
PL302	2	30P19	PL302						
PL500	2†	PL500	PL500	27GB5					
PL504	2	PL504	PL504						

\* Included in Abridged Data sheets.

† Maintenance type.

Note: This information is supplied for the convenience of customers, but no guarantee is intended as regards the degree of equivalence of secondary parameters.



# SYMBOLS

The letter symbols used in this manual are based on those agreed between the British Radio Valve Manufacturers' Association and the British Standards Institution.

## VOLTAGE

Direct voltage.	V
Alternating voltage (r.m.s.)	$V_{r.m.s.}$
Alternating voltage, mean.	$V_{av}$
Peak voltage.	$V_{pk}$
Peak inverse voltage (rectifier)	P.I.V.
Anode supply voltage.	$V_a(b)$
Anode voltage.	$V_a$
Filament voltage, D.C.	$V_f$
Filament voltage, A.C. (r.m.s.)	$V_f(r.m.s.)$
D.C. grid voltage.	$V_g$
D.C. voltage applied to various grids.	$V_{g1}, V_{g2}, V_{g3}, V_{g4}, \text{etc.}$
Signal voltage.	$V_{sig}$
Output voltage.	$V_{out}$

## CURRENT

Direct current.	I
Alternating current (r.m.s.)	$I_{r.m.s.}$
Alternating current (mean)	$I_{av}$
Peak current.	$i_{pk}$
Anode current D.C.	$I_a$
A.C. Anode current (r.m.s.)	$I_a(r.m.s.)$
D.C. Grid current.	$I_g$
Currents to various grids.	$I_{g1}, I_{g2}, I_{g3}, \text{etc.}$
No signal current.	$I_o$

## POWER

Anode dissipation.	$P_a$
Output power.	$P_{out}$
Grid 2 dissipation.	$P_{g2}$

## IMPEDANCE

Valve anode resistance ( $\delta V_a / \delta I_a$ )	$r_a$
External load impedance.	$Z_L$

## RESISTANCE

External anode load resistance.	$R_a$
External resistance in series with $g_2$ .	$R_{g2}$
External grid leak.	$R_g$
External cathode resistance.	$R_k$
Insulation resistance, heater to cathode.	$r_{hk}$
Insulation resistance, anode to cathode.	$r_{ak}$

## CAPACITANCE

Capacitance (cold)—anode to all electrodes.	$c_{a,all}$
Capacitance (cold)—anode to grid 1.	$c_{a,g1}$
Capacitance (Working)—grid to cathode.	$c_{g1,k(w)}$
Input capacitance, grid to all electrodes except anode.	$c_{in}$
Output capacitance anode to all electrodes except grid.	$c_{out}$
Capacitance—Grid to anode.	$c_{ga}$

## MISCELLANEOUS

Mutual conductance (slope)	$g_m$
Conversion conductance.	$g_c$
Amplification factor.	$\mu$
Frequency.	$f$
Internal shield.	$s$
Internal conducting coating.	$m$
External conducting coating (metallising)	$M$
Fluorescent screen or other target.	$t$

*The examples given do not represent a complete standard and where the need arises additional symbols will be used for less common parameters.*

# **GENERAL INFORMATION**

FORWARDED TO THE

# Television Picture Tubes

# Current Monochrome Selection Table

## COMMON FEATURES

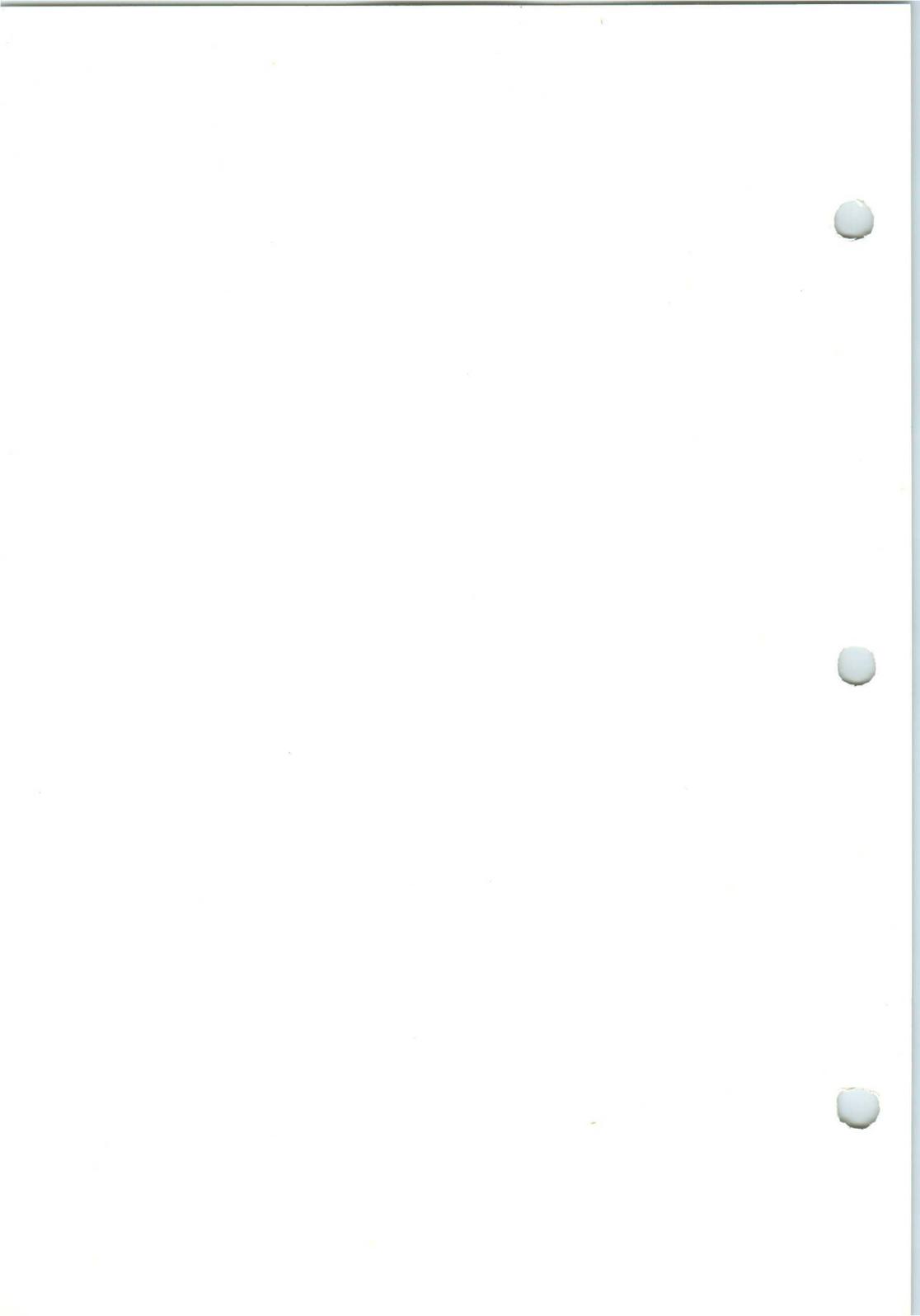
Rectangular face	Tinted glass
110° Deflection angle	Short neck
Electrostatic focus	Magnetic deflection
Rimguard III protection	Push-through presentation
Integral mounting lugs	External conductive coating
Aluminised screen	Silver activated phosphor
Straight gun	Non ion trap

Type Numbers		Face Transmission (approx.) %	Nominal Neck Diameter mm	Nominal Overall Length mm	Heater		Base Type
Pro Electron	Alternative				I <sub>h</sub> mA	V <sub>h</sub> V	
A31-120W	CME1220	50	20	226.5	75	11	B7G/D
A31-181W	CME1202	50	28.6	236.5	300	6.3	B8H
A38-160W	CME1520	50	20	250.5	75	11	B7G/D
A44-120W	CME1713	48	28.6	284.5	300	6.3	B8H
A50-120W	CME2013	45	28.6	312.5	300	6.3	B8H
A61-120W	CME2413	42	28.6	362	300	6.3	B8H

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## *Nomenclature for* **TELEVISION CATHODE RAY TUBES**

Two type nomenclature systems are currently in use for Mazda Cathode Ray Tubes and, where applicable, both type numbers are given at the head of each data sheet. The sheets are filed according to the Mazda system of numbering. Mazda Television Tubes are now dual branded with both Mazda and Pro Electron type numbers.

### **MAZDA SYSTEM**

Television type cathode ray tubes have a name comprising a letter classification followed by a number.

#### *Letter Classification*

- |            |   |
|------------|---|
| <b>CME</b> | Indicates a monochrome tube having electrostatic focus and magnetic deflection. |
| <b>CRM</b> | Indicates a monochrome tube having magnetic deflection and focus.               |
| <b>CTA</b> | Indicates a tube for colour television display.                                 |

#### *Number Classification*

The first part of the type number is used to identify the size of the cathode ray tube measured in inches. For round tubes the number indicates the overall diameter of the face and for rectangular tubes, the overall diagonal of the face of the tube.

The second part of the type number is a serial number to distinguish tubes in the same size group.

A suffix letter A or B, etc., may be added in order to indicate a tube with modified features, as for example a tinted front face as compared to clear glass or higher voltage ratings.

### **PRO ELECTRON SYSTEM**

The type nomenclature consists of one letter and number joined by a hyphen to a number and a final letter.

#### *First Letter Classification*

- |          |   |
|----------|---|
| <b>A</b> | Indicates a Television cathode ray tube for entertainment applications. |
|----------|---|

#### *First Number Classification*

The first number indicates the overall diameter or the overall diagonal of the glass envelope (face-plate) in cm.

- |           |  |
|-----------|--|
| <b>31</b> | Represents a 31 cm (12 in) face-plate. |
| <b>50</b> | Represents a 50 cm (20 in) face-plate. |

*Note:* Since the centimetre is smaller than the inch it is possible that more than one first number corresponds to a particular inch size tube, e.g. 47 and 49 have both been allocated for 19-inch tubes.

#### *Second Number Classification*

The second number is a two or three figure serial number indicating a particular design or development.

#### *Final Letter*

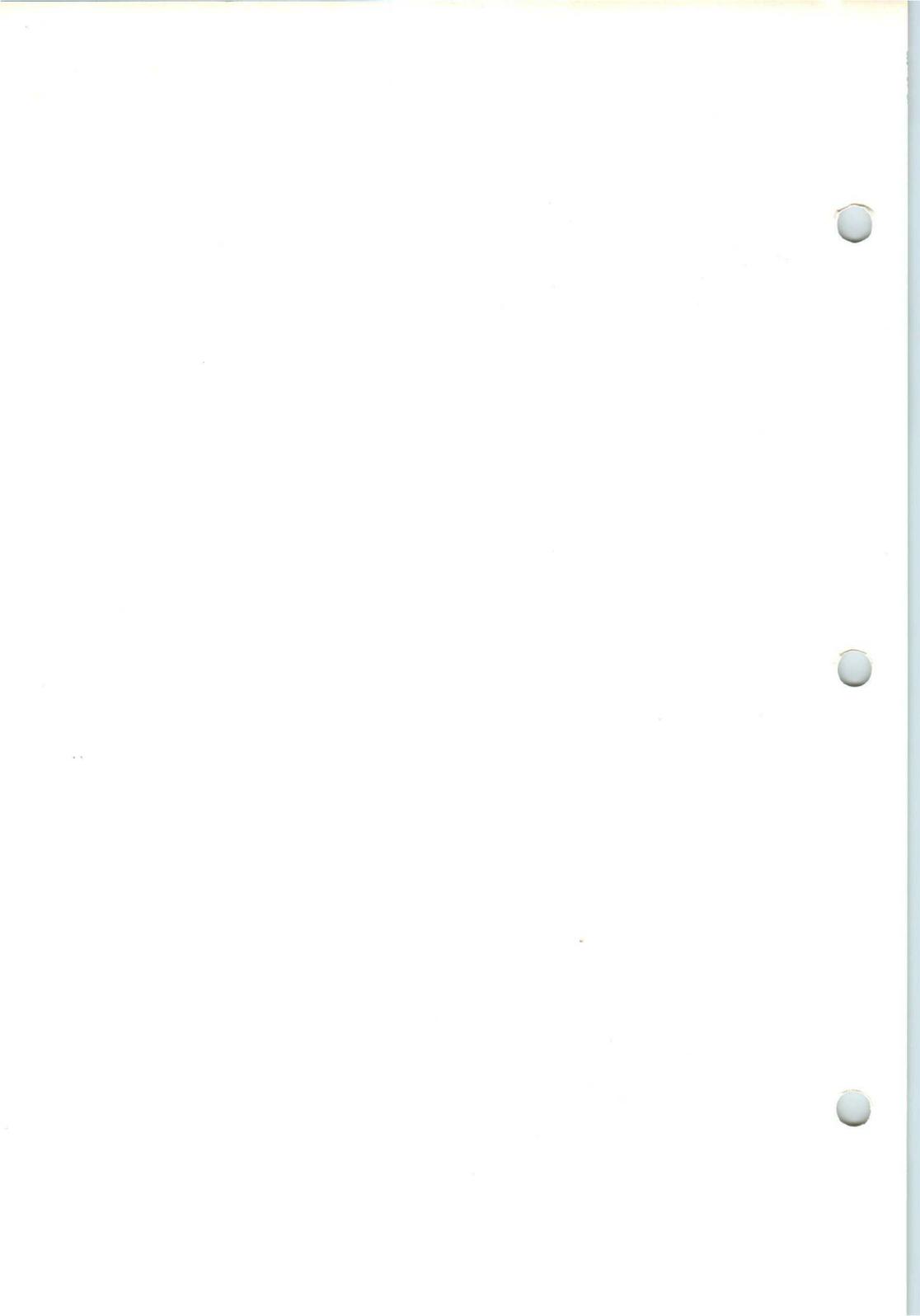
The final letter indicates the properties of the phosphor screen.

- |          |                                     |
|----------|-------------------------------------|
| <b>W</b> | White for monochrome television.    |
| <b>X</b> | Tri-phosphor for colour television. |

*Note:* Formerly the letter indicating the screen properties followed the initial letter.

#### *Suffix*

Sparkguard bases may be indicated by a letter suffix separated from the final letter by an oblique stroke.



## GENERAL

The following notes have been compiled to assist equipment designers in determining satisfactory operating conditions for television picture tubes in their equipment. The recommendations below are based on the British Standard Code of Practice CP1005 (1962) entitled 'The Use of Electronic Valves'. For further information designers should also consult standards dealing with safety requirements, for example, the International Electrotechnical Commission (I.E.C.) Publication 65.

The recommendations are necessarily of a general nature and should be interpreted accordingly. Where specific recommendations are published in the data relating to a particular tube, these should always be followed.

## RATINGS (In accordance with I.E.C. Publication 134)

Ratings may be defined as values which establish either limiting capabilities or limiting conditions for an electronic device. They are determined for specified values of environment and operation, and may be stated in any suitable terms. Limiting conditions may be either maxima or minima.

Ratings cannot be considered as barriers on one side of which satisfactory operation is obtained, while on the other side immediate failure will occur. The expectation of life decreases and some aspects of performance deteriorate if operated outside the limiting ratings. With a few exceptions, the more conservative the use of the tube with respect to limiting ratings, the greater is the life expectancy and reliability.

Unless otherwise stated, ratings given for tubes are in accordance with the design centre rating system. The design-maximum and absolute maximum rating systems may also be used in certain circumstances.

## DESIGN - CENTRE RATINGS

Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, which should not be exceeded under normal conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device in average applications, taking responsibility for the effect of normal changes in operating condition due to rated supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices in the equipment.

The equipment manufacturer should design so that, initially, no design-centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

N.B. - A bogey electronic device is an electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

## DESIGN-MAXIMUM RATINGS

Design-maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

## ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for the effect of equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating condition of supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

## ELECTRICAL FEATURES

### HEATER

Tubes are designed to operate with a specified heater voltage or current, and will give optimum life and performance when operated under the specified conditions. Deliberate over- or under-running of heaters to obtain apparently desirable characteristics is to be deprecated.

#### Parallel Operation

The heater voltage must be within  $\pm 7\%$  of the rated value when the supply voltage is at its nominal rated value, and when a tube having the published heater characteristics is employed.

This figure is permissible only if the voltage variation is dependent upon more than one factor. In these circumstances the total tolerance may be taken as the square root of the sum of the squares of the individual deviations arising from the effects of the tolerances of the separate factors, providing no one of these deviations exceeds  $\pm 5\%$ . Should the voltage variation depend on one factor only, the voltage variation must not exceed  $\pm 5\%$ .

#### Series Operation

The heater current must be within  $\pm 5\%$  of the rated value when the supply voltage is at its nominal rated value, and when a tube having the published heater characteristics is employed.

This figure is permissible only if the current variation is dependent upon more than one factor. In these circumstances, the total tolerance may be taken as the square root of the sum of the squares of the individual deviations arising from the effects of the tolerances of the separate factors, providing no one of these deviations exceeds  $\pm 3.5\%$ . Should the total current variation depend upon one factor only, the current variation must not exceed  $\pm 3.5\%$ .

When calculating the tolerances of associated components, the ratio of the change of heater voltage to the change of heater current in a typical series chain including a cathode ray tube is taken as 1.8, both deviations being expressed as percentages.

With certain combinations of valves and tubes, differences in thermal inertia may result in some heaters being run at exceedingly high temperature during the warming-up period. During this period, unless otherwise stated in the published data, it is permissible for the heater voltage of the tube to rise to a maximum value of 50% in excess of the nominal rated value when using a tube with the published heater characteristics. A surge limiting device may be necessary to meet this requirement. When measuring the surge value of heater voltage, it is important to employ a peak reading device such as an oscilloscope.

## Mains Variations

In addition to the tolerances quoted above, fluctuations in the mains supply voltage not exceeding  $\pm 10\%$  are permissible. These conditions are, however, the worst which are acceptable and it is better practice to maintain the heater as close as possible to its published nominal, particularly in television equipment where changes in valve characteristics can have an appreciable effect upon the picture. Furthermore, in all types of equipment closer adjustment of heater voltage or current will react favourably upon valve and tube life and performance.

## Stand - by Operation

It is permissible to operate picture tubes in the 'stand-by' condition (for 'instant on' applications). In order to ensure satisfactory life the heater voltage should be decreased to 75% of its nominal value.

## Heater to cathode insulation

The voltage between cathode and heater should always be as low as possible. The maximum value of heater to cathode voltage is quoted on individual data sheets and applies to that side of the heater where the heater to cathode voltage is greater.

Transformer windings supplying heaters should not be left 'floating'. Where no d.c. connection between the winding and the cathode exists, a resistor of the order of 100 k $\Omega$  should be connected between the heater and the cathode.

When the heater is in a series chain or earthed, the 50 Hz impedance between heater and cathode should not exceed 100 k $\Omega$ . In a series heater chain the tube should always be connected at the chassis end to avoid excessive hum and the a.c. component of the heater to cathode voltage should be less than 20 Vrms.

## CATHODE

Tubes should not be operated without a d.c. connection between cathode and each electrode and the total effective impedance between cathode and each electrode should be as low as possible for satisfactory operation.

## CONTROL GRID

The resistance between grid and cathode should be kept as low as possible, normally the absolute maximum resistance is  $1.5\text{ M}\Omega$ , but published data should be consulted.

## Grid cut - off voltages

Curves or data giving the limits of grid cut-off voltage for specific values of first anode voltage are included on individual tube data sheets. Care should be taken in circuit design to ensure there is ample negative bias available to control any tube, within the limits shown, at the appropriate first anode voltage.

## Modulation voltages

In general the grid bias voltage must not be allowed to become positive with respect to the cathode. The maximum positive grid excursion of the video signal under normal operating conditions is permitted to reach 5 V (peak). In order to ensure that this limit is not exceeded, it is suggested that an unbypassed resistor of  $10\text{ k}\Omega$  is inserted in series and close to the control grid. Individual tube data sheets should be consulted for details.

## FIRST ANODE VOLTAGE

The first anode voltage affects many features of tube performance and care should be taken not to exceed the limits to ensure reliability and quality. In general, within the ratings quoted, a higher first anode voltage will give an improved focus quality.

## FOCUS ANODE VOLTAGE

The focus electrode voltage limits are given in the data. The focus voltage supply should be arranged so that it can handle these limits and hence allow the operation of any tube at optimum focus. It is preferable that the focus supply should be arranged so that the voltage range available is greater than the limits specified; this ensures that the observer can pass through the point of focus to select the optimum.

## FINAL ANODE VOLTAGE

Individual tube data sheets quote maximum and minimum limits for final anode voltage, these limits should not be exceeded or picture performance and tube life may be impaired.

## X - radiation

Some tube types operated above 16 kV may emit x-radiation, but if operated as indicated on the data sheets, this radiation will not be above the internationally accepted dosage rate. It is wise to provide shielding for personnel who work for long periods at close range.

## EXTERNAL CONDUCTIVE COATING

For tubes with an external conductive coating the capacitance of this coating to the final anode may be used to provide smoothing for the e.h.t. supply and in all cases it should be connected to chassis. (See also section on Flashover.) This coating is not a perfect conductor and in order to reduce radiation at the timebase frequencies it may be necessary to make two separate connections to the coating on opposite sides of the cone.

## REINFORCING AND MOUNTING METALWARE

The reinforcing and mounting metalware, when incorporated, form an appreciable capacitance with the internal conductive layer of the tube. In order to avoid the possibility of an electric shock, a d.c. connection should be provided between this metalware and the rest of the receiver. The metalware should be connected to the chassis in a.c. equipment operating from a mains isolating transformer, or via a suitable leakage path in a.c./d.c. equipment, for example  $2\text{ M}\Omega$ . (See also section on Flashover.)

## FLASHOVER

Despite rigorous attention during the manufacture of cathode ray tubes there remains, as with all high vacuum devices, a finite possibility of an internal flashover in a small percentage of tubes. This flashover takes the form of an arc between the final anode and one or more of the electrodes connected to the tube base pins. Resulting transient currents and voltages can cause damage to components and the associated circuitry. The arc is only terminated when the e.h.t. and the mounting band capacitors are discharged. During the subsequent recharging period an additional load is also imposed on the e.h.t. generator.

It is of vital importance to provide protective measures, particularly when semiconductor devices are employed.

A sufficient degree of protection against transients can be obtained by providing suitable spark-gaps between appropriate pins and a common point connected directly to the external conductive coating. All voltage supplies to the tube should have a series resistance of at least  $1\text{ k}\Omega$ . When flashover protection is incorporated the chassis return paths should be made in a manner appropriate to the protection system employed.

## GUN CAPACITANCES

Unless otherwise stated the values given are nominal values measured on a cold tube at the tube contacts, the capacitance of any measuring leads and socket being excluded. In some cases capacitance values are measured in a typical holder and include the holder capacitance. This is indicated on the individual sheets.

## DEFLECTION AND OPTICAL FEATURES

### STRAY MAGNETIC FIELDS

The raster of a television picture tube is generated by horizontal and vertical deflection of the electron beam by electromagnetic fields. These fields are produced by currents in the coils of the deflector yoke and any stray magnetic fields may adversely affect the tube performance.

In a television receiver, stray magnetic fields may be generated by such components as the loud-speaker, mains transformers, chokes, field output transformers etc. Under influence of these fields, there may be distortion in the raster geometry and possible deformation of the focused spot. Stray magnetic fields must therefore be reduced to an acceptable level.

### REFERENCE LINE

The reference line indicated on the tube outline drawing is determined by means of a suitable gauge. Several gauge drawings follow these Operational Recommendations and give guidance for design of scanning yokes.

### CORNER CUTTING

Picture corner cutting, in general, is due to a direct obstruction of the electron beam after deflection before it reaches the screen and results in a blocking-out at the corners of the raster.

Corner cutting can be avoided by correct design of a deflector yoke appropriate to the deflection angle of the tube and the yoke should be located as close as possible to the reference line.

### PICTURE CENTRING

To centre the picture on the screen it is recommended that a magnetic field just behind the deflection coils (i.e. nearer the tube base) be used.

The centring device should provide a shift to allow for non-centrality of the spot with respect to the geometric centre of the screen. In addition, the centring device should provide the shift needed to compensate for non-centrality of the visible picture due to line blanking, time base non-linearity and effects of the earth's magnetic field. If the centring field is situated further from the reference line than recommended, distortion of the focused spot may be produced.

### PICTURE SHAPE

Modern flat-faced tubes and larger scanning angles inevitably make scanning linearity more difficult but this can be overcome by suitable yoke and circuit design.

## LUMINESCENT SCREEN

At all times it is desirable to keep the brightness level and beam current to the lowest practicable value to obtain optimum tube life. It is particularly important not to operate the tube with a stationary or slow-moving spot or permanent damage may be done to the screen. In order to avoid screen damage, it is desirable that beam deflection should be operating before the final anode voltage. Equally, it is important that immediately after switching-off the equipment, the screen should be discharged. This can be effected by choosing the time constants of the grid and the first anode circuits such that a beam current is maintained during a period sufficiently long to discharge the screen.

To improve screen contrast, tube screens are aluminised, that is, the phosphor on the side facing the electron gun is coated with a thin film of evaporated aluminium. This film increases contrast by reflecting forward that light from the phosphor which would otherwise be emitted into the tube cone.

## TINTED GLASS

Stray light falling on the screen results in loss of contrast and most tubes have the face-plate made of grey tinted glass to minimise this loss. If tubes are to be used in high ambient light conditions, a suitable filter or light hood will improve contrast.

## MECHANICAL FEATURES

### MOUNTING

Unless otherwise specified on the data sheets for individual tubes there are no restrictions on the mounting position. The mounting support must be arranged to avoid glass abrasion and glass stress. Tubes with large bulbs and narrow necks, should be supported only near the face-plate. Care must be taken to ensure that no stress is introduced by any external neck components or via the base socket. In the mounting arrangements no metal parts must come into contact with the glass.

Tubes with twin panels, bonded face-plates and reinforced envelopes, e.g. Ringuard protection, do not need a separate implosion protection panel in normal entertainment applications. These forms of protection produce tubes which will not fail in a violent manner when subjected to such thermal or mechanical shock as are likely to be encountered in everyday service. These tubes meet the international requirements for intrinsically safe tubes laid down in the section of I.E.C. Publication 65 dealing with implosion. For tubes without these special arrangements the viewing screen should be protected by means of a transparent material of suitable strength to withstand implosion of the tube.

The connections to tube sockets or e.h.t. side connections should be flexible. The use of spare socket contacts as wiring supports is not recommended and on no account should any connection be made to pins marked I.C. Care should be taken to avoid damaging the base pins. If bending has occurred, the pins should be straightened with a pin straightener before insertion in the socket. The connecting wires to sockets having floating contacts should be as flexible as possible, and wiring jigs should be employed while the connections are being made.

No conductor touching the tube should be left to adopt an arbitrary potential by leakage but should be connected to a suitable potential through an appropriate impedance.

### VENTILATION

Ventilation and layout of components should be such as to ensure no overheating of any portion of the tube.

### HANDLING

Care should be taken to avoid abrasion of the glass even for tubes with reinforced envelopes.

For non-reinforced envelopes, precautions taken in manufacture reduce the possibility of spontaneous implosion to a minimum, but any additional stress due to mishandling, considerably increases the risk of implosion; such implosion may occur immediately or may be delayed. Particular care should be taken when handling tubes to prevent glass surface damage, especially to the face-plate and the area where the face-plate and side walls meet, as this will appreciably weaken the glass and may lead to implosion of the tube immediately or possibly after a delay. A corresponding increase in handling care is required for large tubes and tubes with wide deflection angles. As a safety precaution eye shields should be worn when handling non-reinforced tubes.

All tubes are carefully inspected before despatch to ensure freedom from surface damage and there is little chance that a tube which has a damage-free surface will implode.

All tubes should be kept in the shipping carton, until just prior to installation. Following the removal of the tube from the shipping carton, the face-plate and the region where the face-plate and side walls meet must be protected from scratches, blows or contact with glass or metal surfaces. Tubes should always be handled by the bulb; when it is necessary to handle the neck great care should be taken to avoid sideways leverage. Where it is necessary to lay the tube down, it should always be placed on a soft pad of suitable material free from abrasive substances.

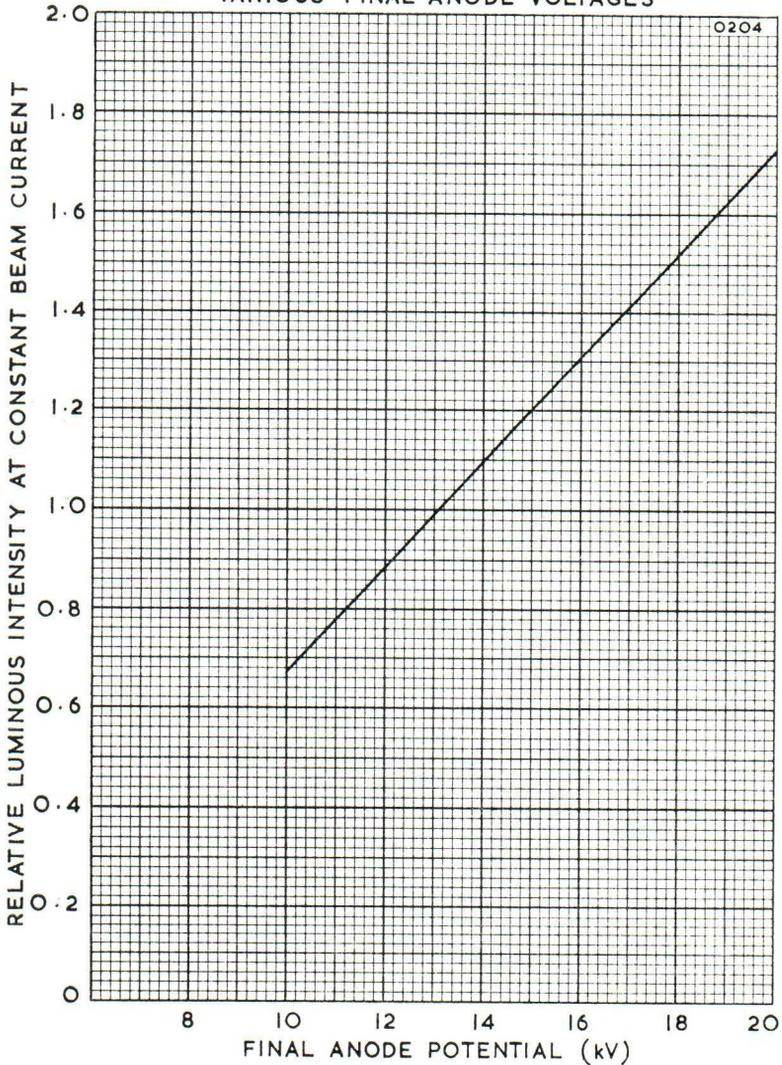
Tubes working at high final anode voltages have an annular region of anti-corona coating surrounding the final anode cap. The tube should not be handled in this region.

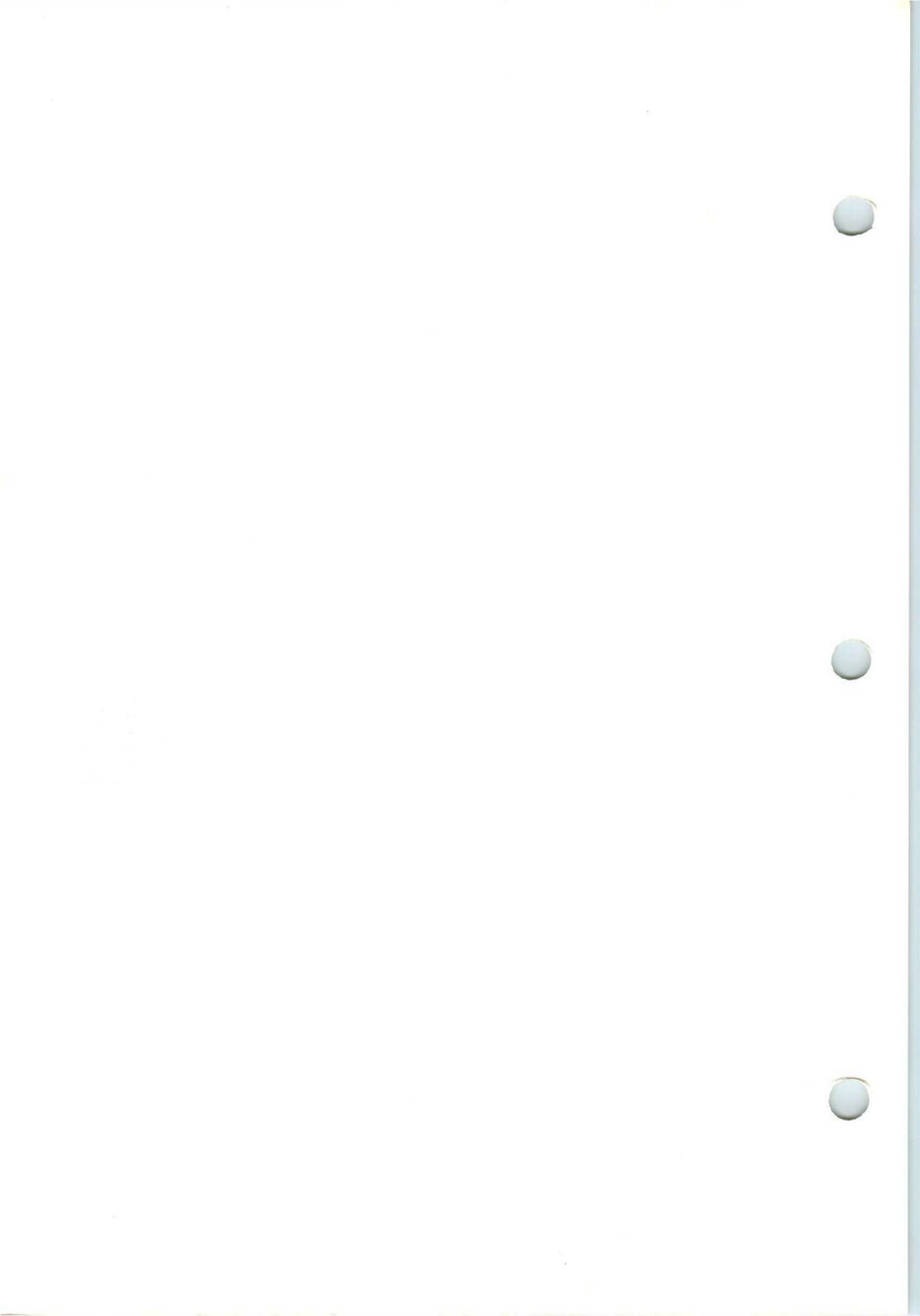
It should be noted that a high voltage charge may exist between the external conductive coating on the glass envelope and the final anode contact, even for some time after a tube has been removed from equipment. Anyone handling such a tube may receive a shock, which, while not generally dangerous to the person, can cause an involuntary reaction resulting in damage to the tube which might, for example, be dropped. To avoid this problem, the anode contact should be shorted via a 10 k $\Omega$  resistor to the external conductive coating each time before handling.

#### DIMENSIONS

Allowance should be made in design of the equipment for the dimensional tolerances of the tube envelope, shown in the data; reliance should not be placed on dimensions taken from individual tubes.

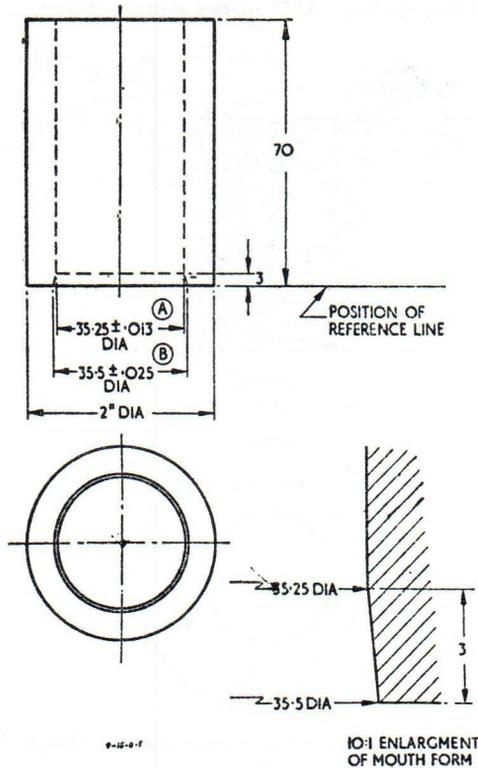
CHARACTERISTIC CURVE OF  
AVERAGE ALUMINISED W SCREEN  
RELATIVE LUMINOUS INTENSITY AT  
VARIOUS FINAL ANODE VOLTAGES





## C.R.T. REFERENCE LINE GAUGE NO. 6

For C.R. Tubes having a Nominal Neck Diameter of 34.5 mm.



All dimensions in mm. unless otherwise stated.

### NOTE 1—Deflector Yoke Design

The internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

### NOTE 2—Tolerances

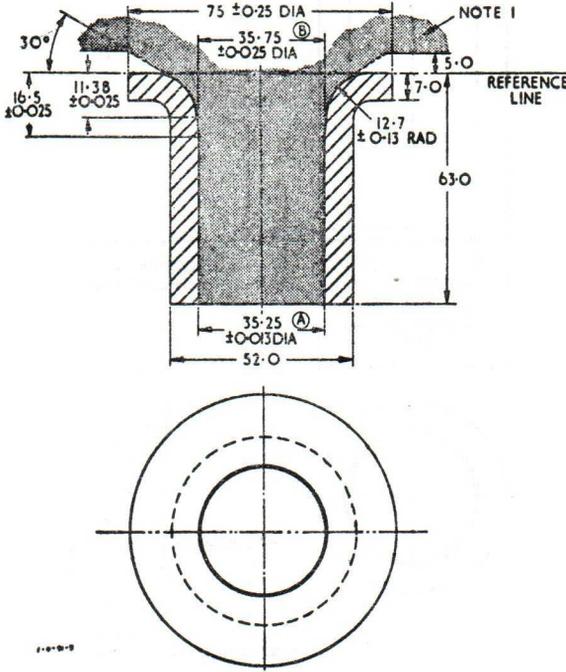
The tolerances shown are initial manufacturing limits. The figures given below are the maximum allowable limits for wear :

(A) + 0.059

(B) + 0.075

## C.R.T. REFERENCE LINE GAUGE NO. 7

For C.R. Tubes having a Nominal Neck Diameter of 34.5 mm.  
Deflection Angle 67.5° approx. (Picture Diagonal).



All dimensions in mm. unless otherwise stated.

**NOTE 1—Deflector Yoke Design**

The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

**NOTE 2—Tolerances**

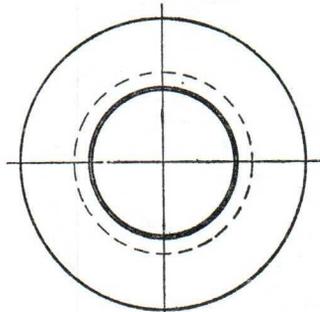
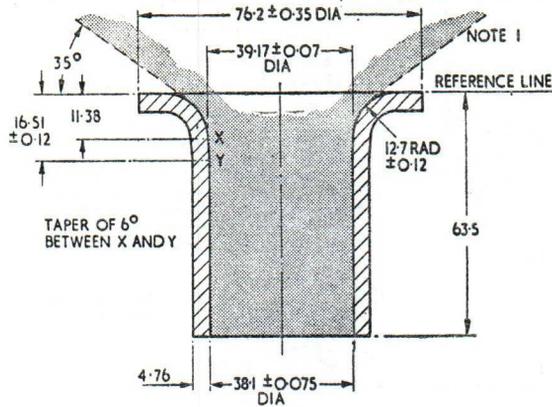
The tolerances shown are initial manufacturing limits.  
The figures given below are the maximum allowable limits for wear :

(A) + 0.059

(B) + 0.075

## C.R.T. REFERENCE LINE GAUGE NO. 12

For C.R. Tubes having a Nominal Neck Diameter of 36.5mm.



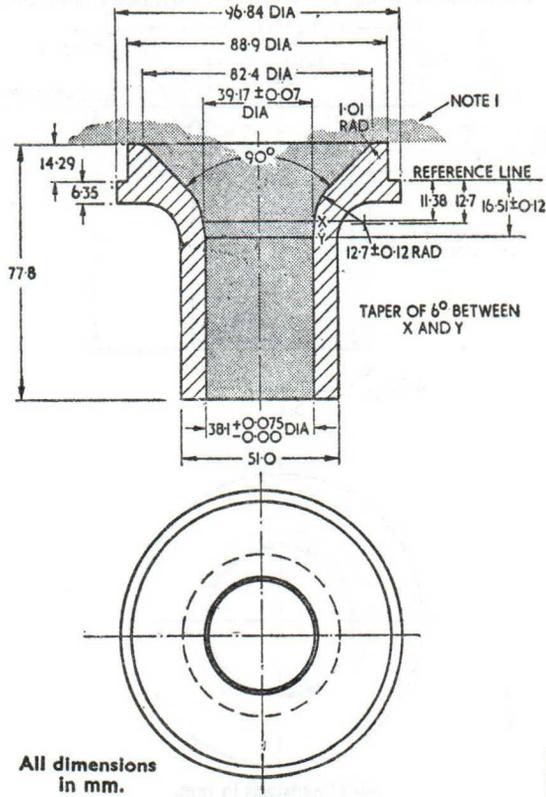
All dimensions in mm.

### NOTE 1—Deflector Yoke Design

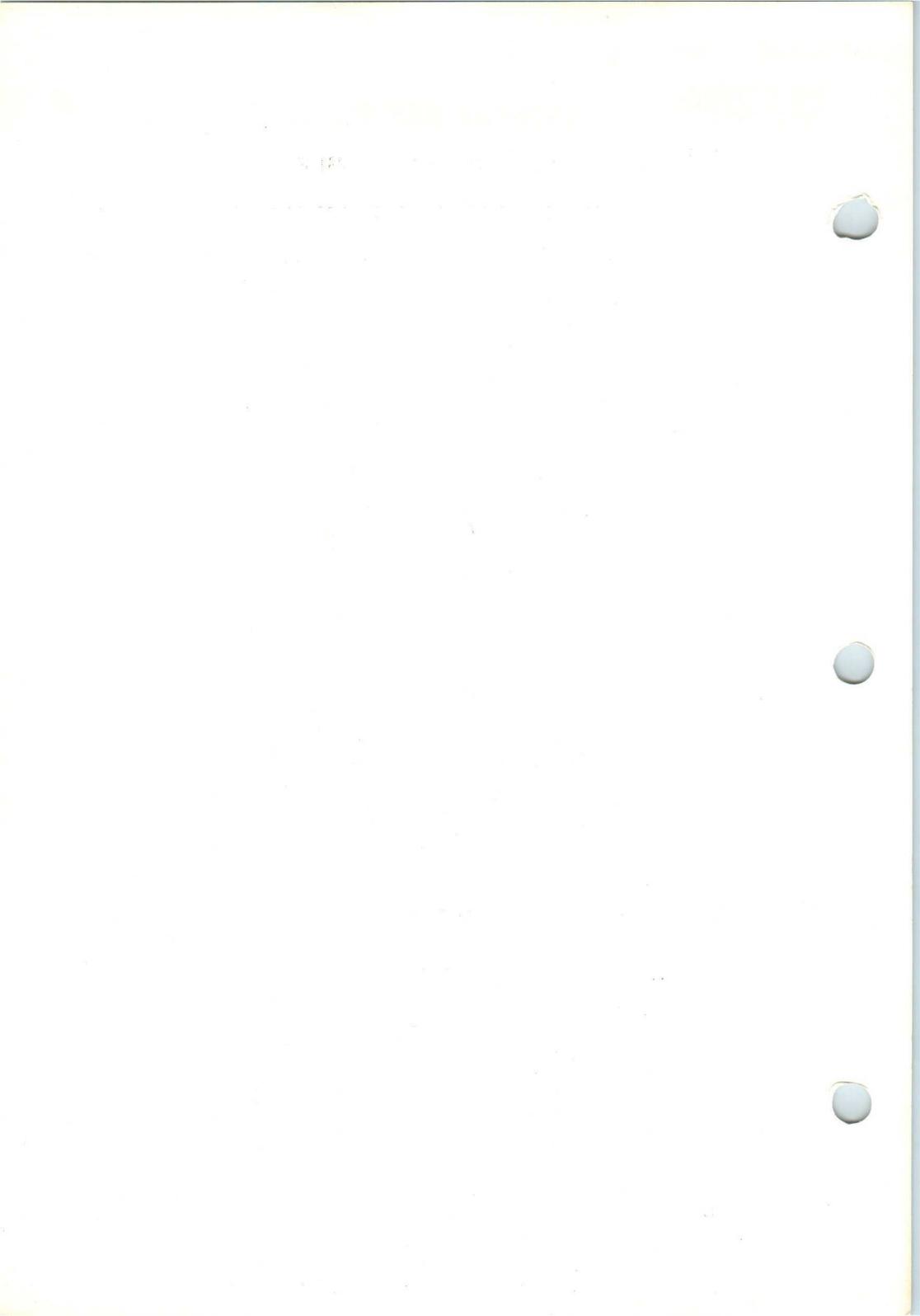
The inner surface of the yoke must not extend into the shaded region and the internal dimensions of the yoke must never be smaller than the maximum internal dimensions of the gauge.

## C.R.T. REFERENCE LINE GAUGE NO. 13

For C.R. Tubes having a Nominal Neck Diameter of 36.5 mm



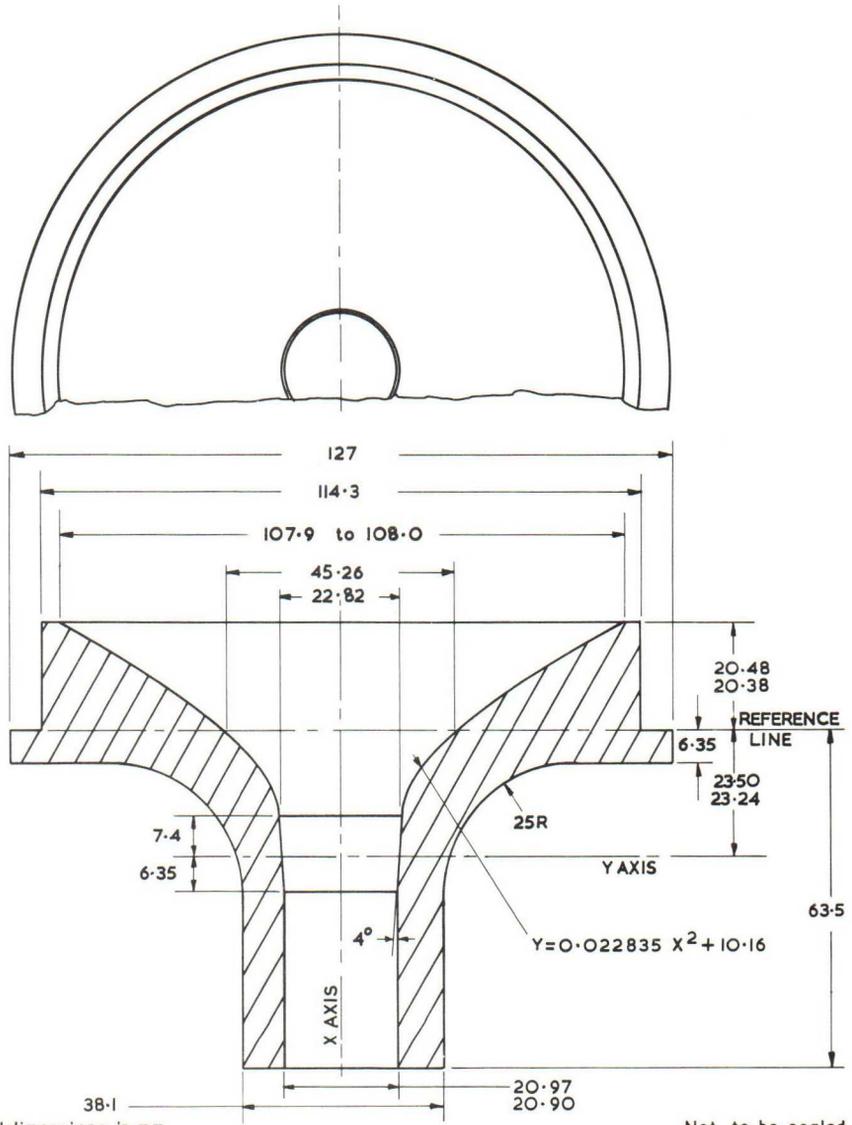




**Reference  
Line Gauge**

**Gauge  
No. 22**

NECK DIAMETER 20 NOMINAL DEFLECTION ANGLE 110°



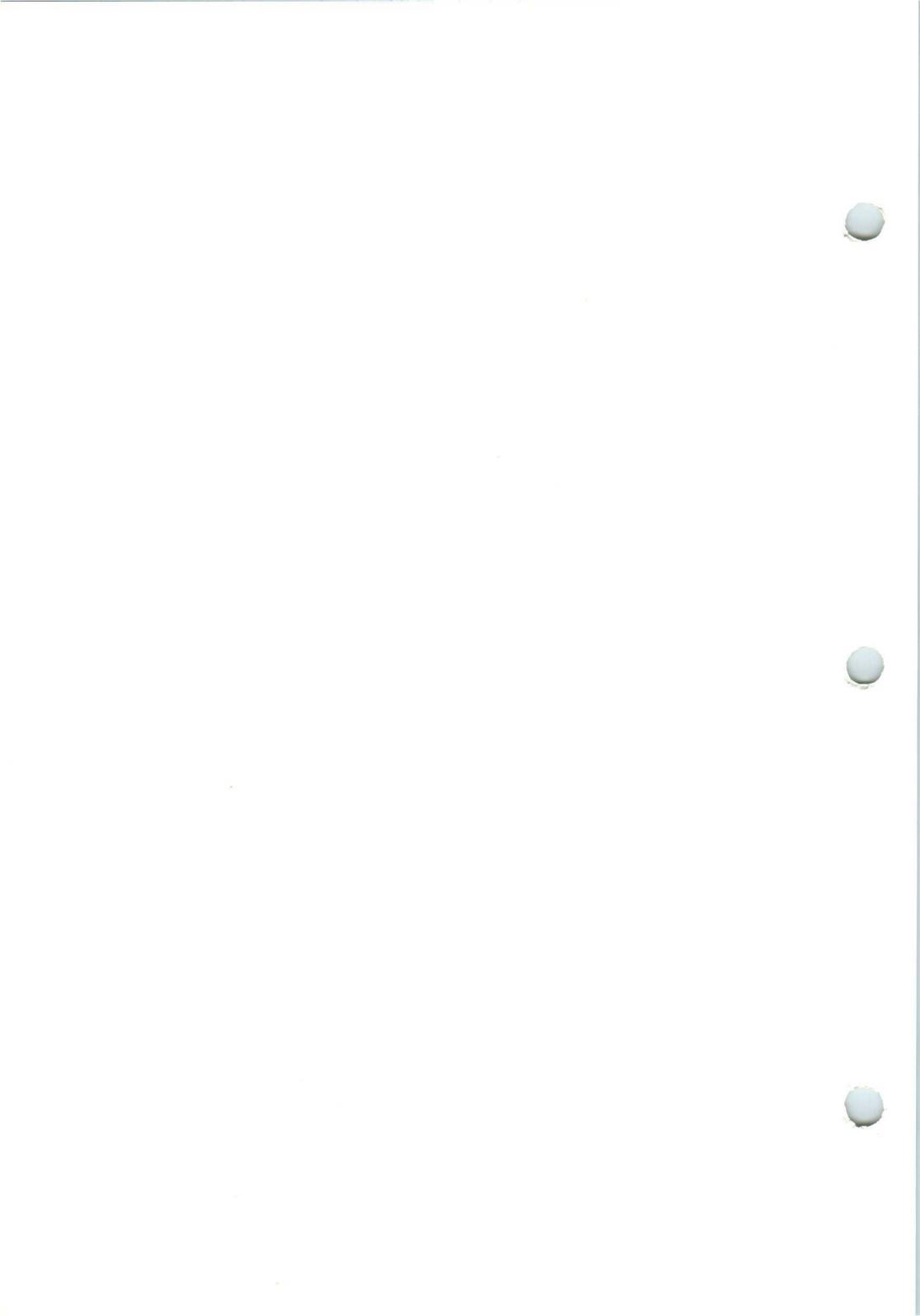
All dimensions in mm

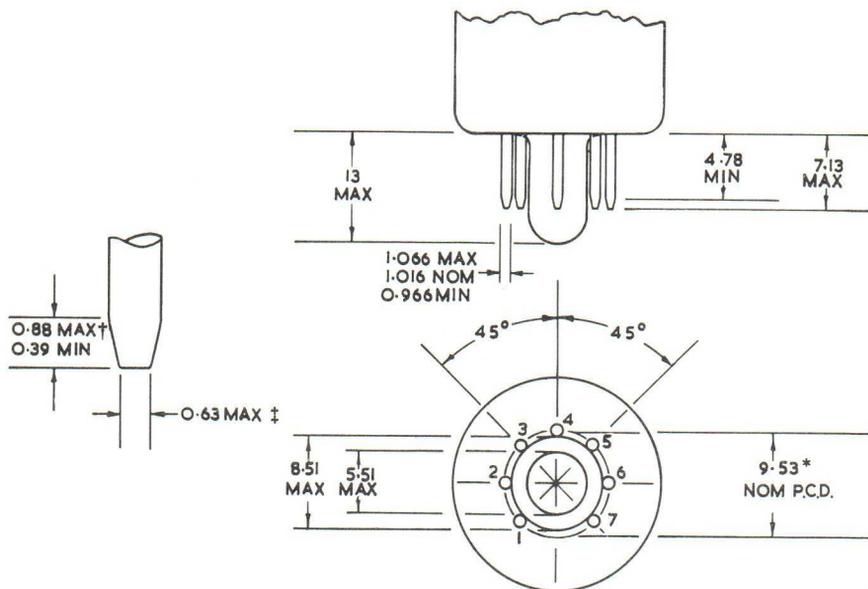
**Thorn Radio Valves and Tubes Limited**

Feb. 1971, Issue 1, Page 1

Not to be scaled







All dimensions in mm

Third angle projection

Not to be scaled

The drawing shows the numbering of the pins as seen from their free ends.

\* The dimensions fixing the position of the pins refer to the fixed ends of the pins. The disposition may be checked by the appropriate gauge.

† This dimension may vary within the limits shown around the periphery of any individual pin. The surface of the pin is convex or conical in shape and is not brought to a sharp point.

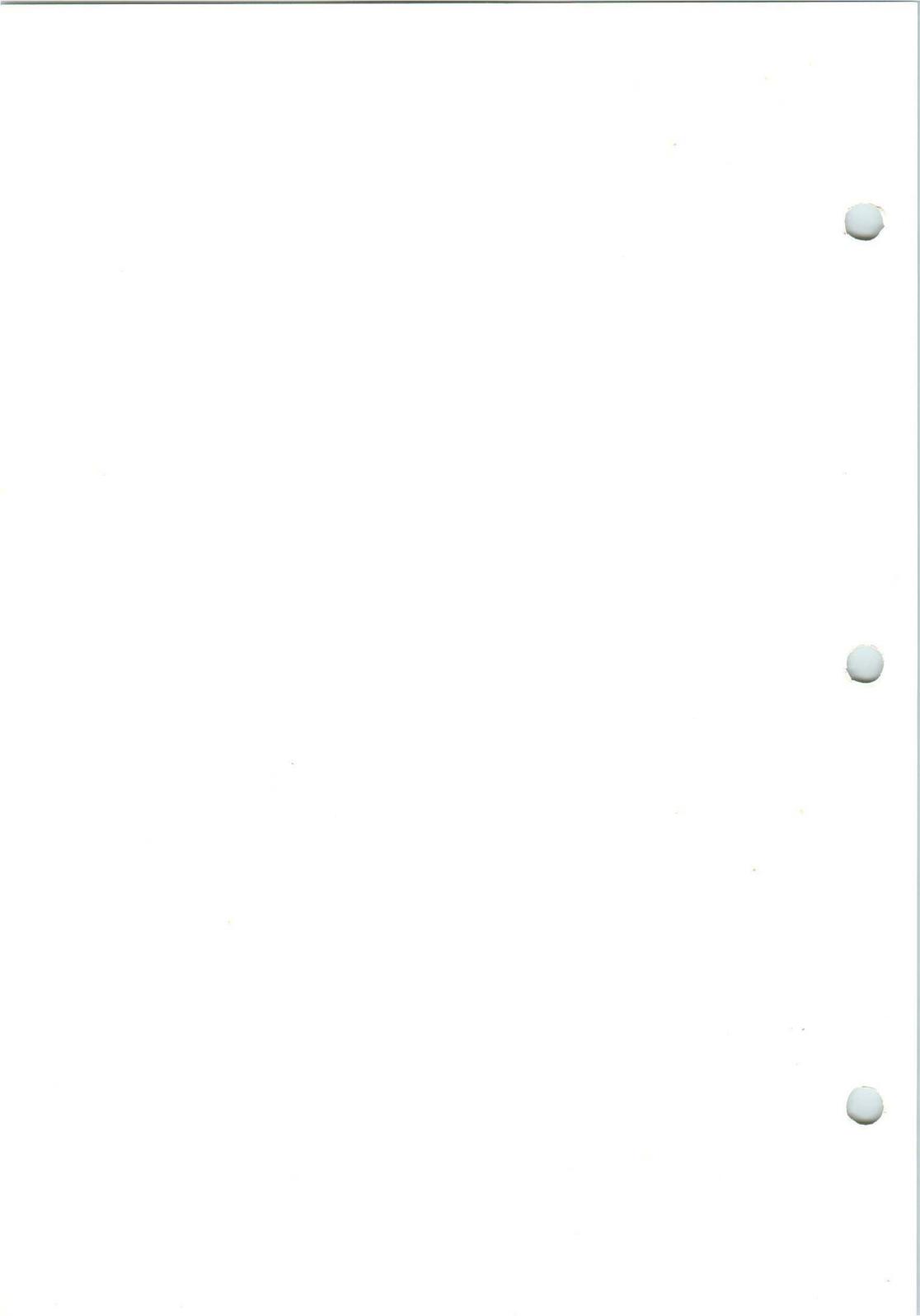
‡ This surface is flat.

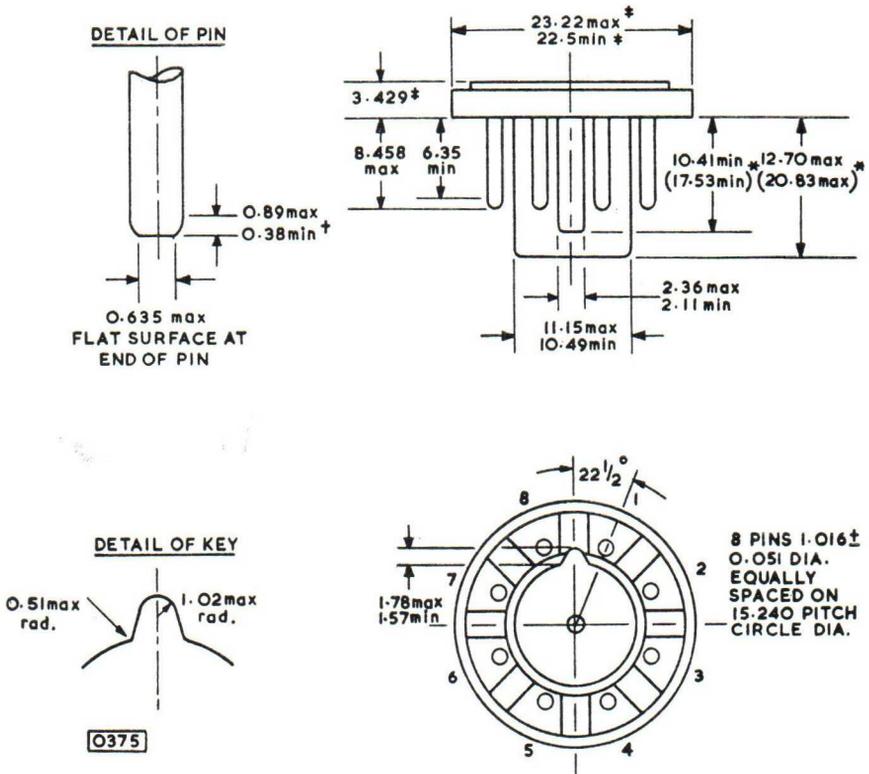
Conforms to JEDEC E7-91.

**Thorn Radio Valves and Tubes Limited**

July 1971, Issue 2, Page 1







All dimensions in mm.

Not to be scaled.

The millimetre dimensions are derived from the original inch dimensions.

The drawing shows the numbering of the pins as seen from their free ends.

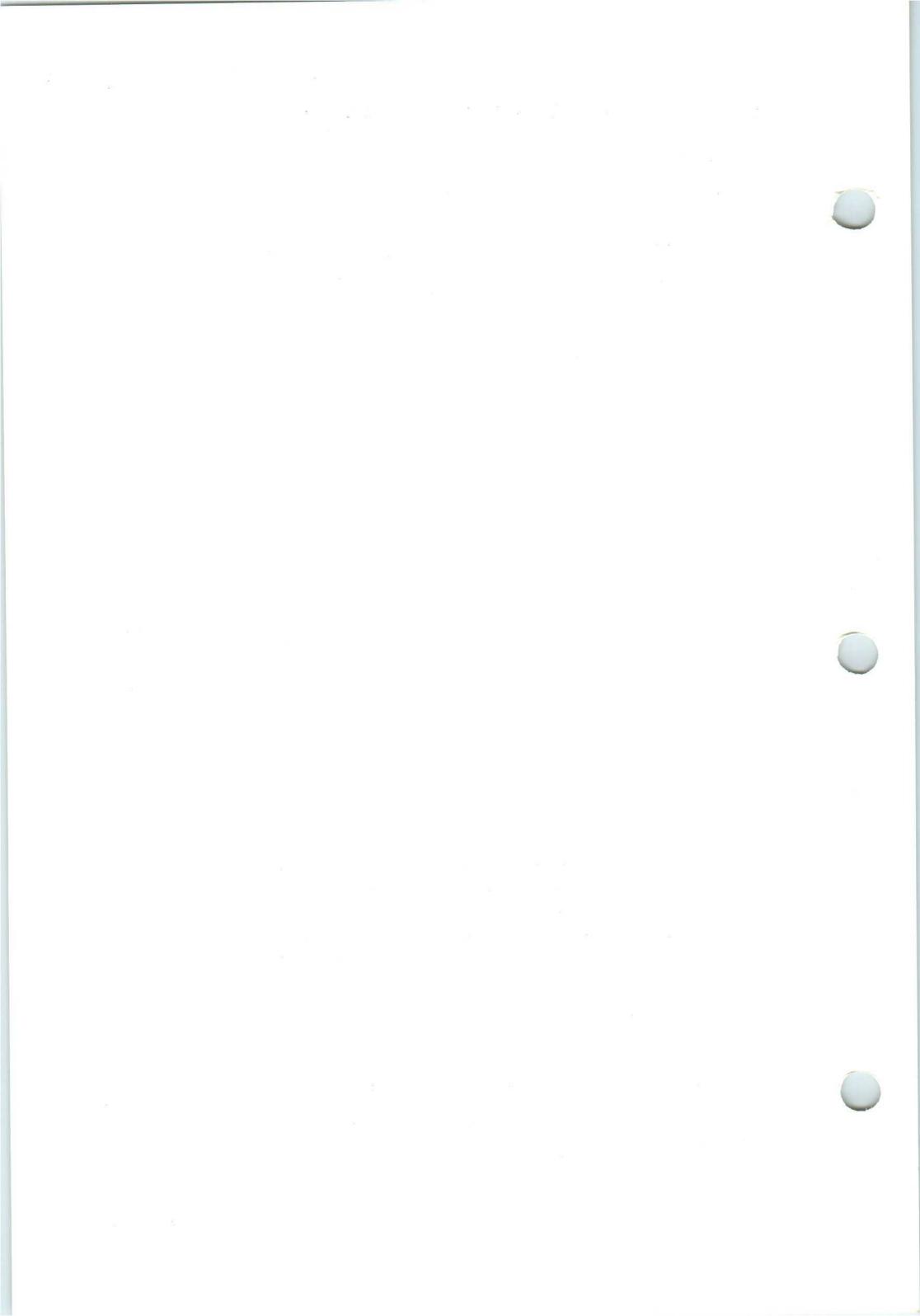
\* Dimensions for variant B8H base.

† This dimension may vary within the limits shown around the periphery of any individual pin. This surface of the pin shall be convex or conical in shape and shall not be brought to a sharp point.

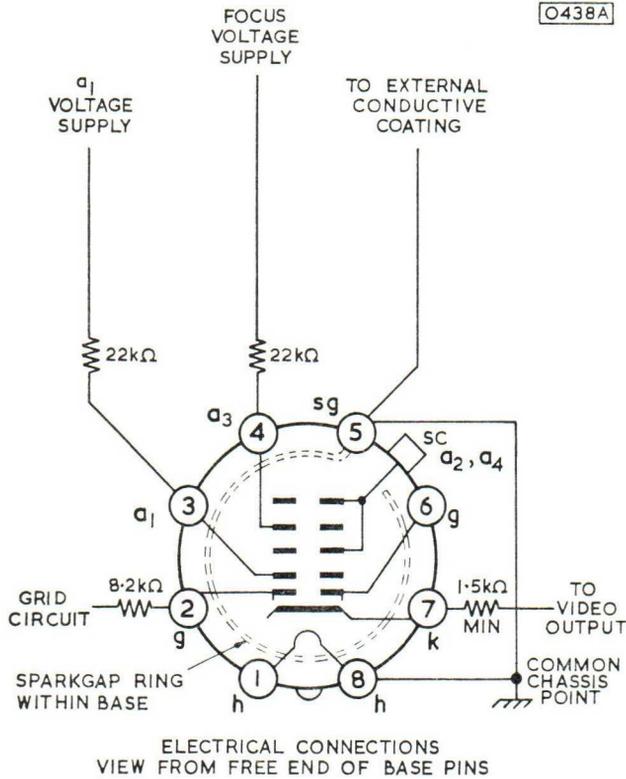
‡ These dimensions illustrate current practice and are not regarded as compatibility features.

**Note :**

Base pin positions are held to tolerances such that the base will fit a flat-plate gauge having a thickness of 9.525 mm and eight equally spaced holes of  $1.397 \pm 0.013$  mm diameter located on a  $15.240 \pm 0.013$  mm diameter circle. The gauge is also provided with a centre hole to provide 0.254 mm diametric clearance for the spigot and key. Pin fit in the gauge shall be such that the entire length of pins will, without undue force, enter into and disengage from the gauge.



### B8H SPARKGUARD R C.R.T. BASE CONNECTIONS

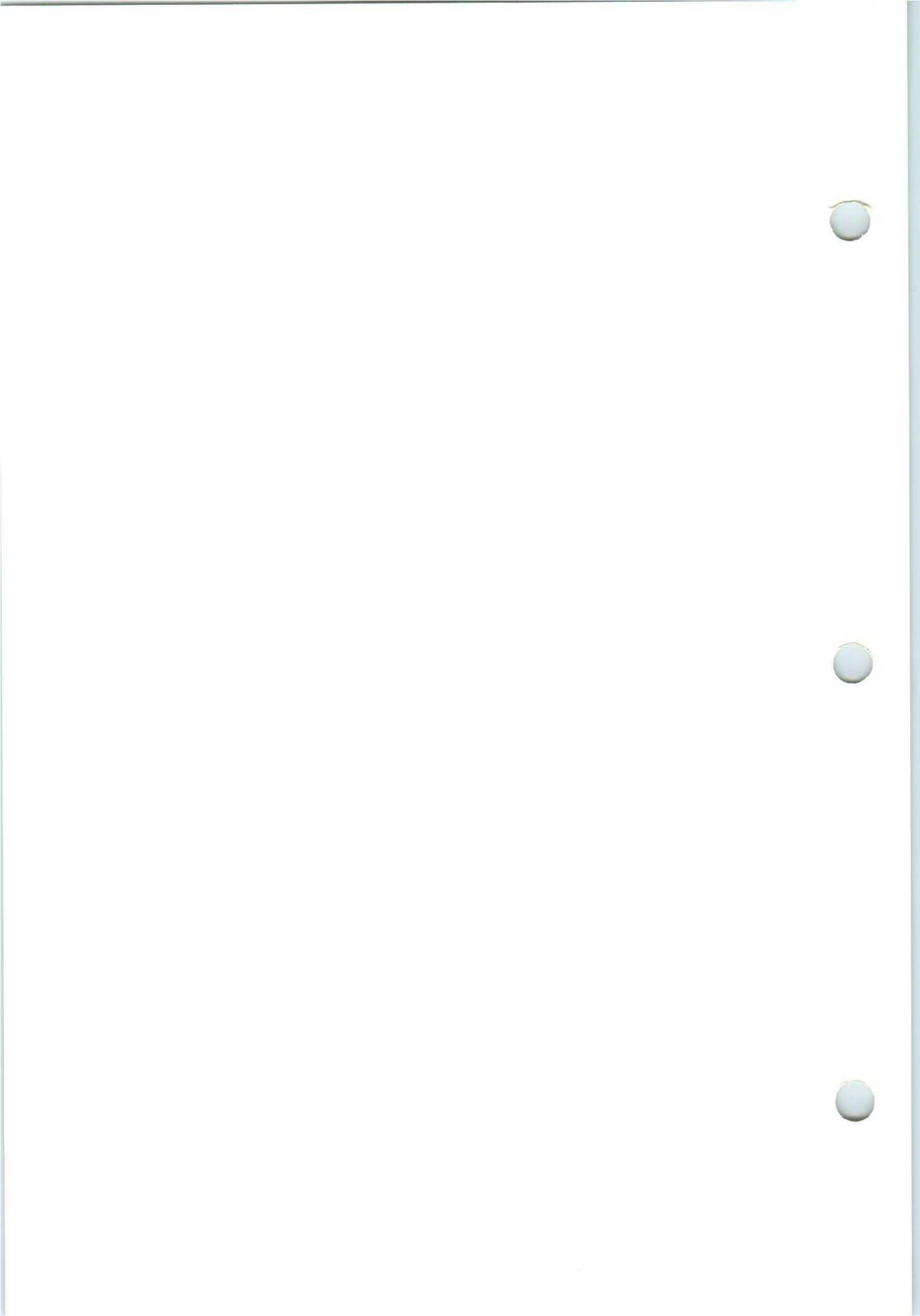


A metal ring within the B8H base, which is taken out to pin 5 (sg), forms a spark gap to all other tube electrodes thus providing flashover protection for all external electrode circuits and components.

All leads must be as short and direct as possible. The external conductive coating should be connected to pin 5 only, with no other connection to chassis.

The resistors, preferably carbon composition type, in series with the supply leads should be such as to have a minimum surface leakage path between leads of 10 mm.

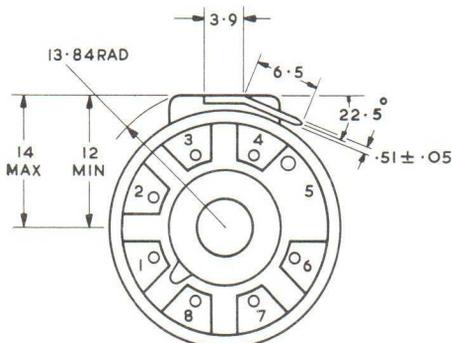
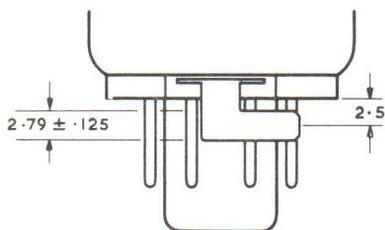
Tube types with the above sparkguard base have a suffix R after the type number and should only be used if the circuit modifications as above are incorporated.



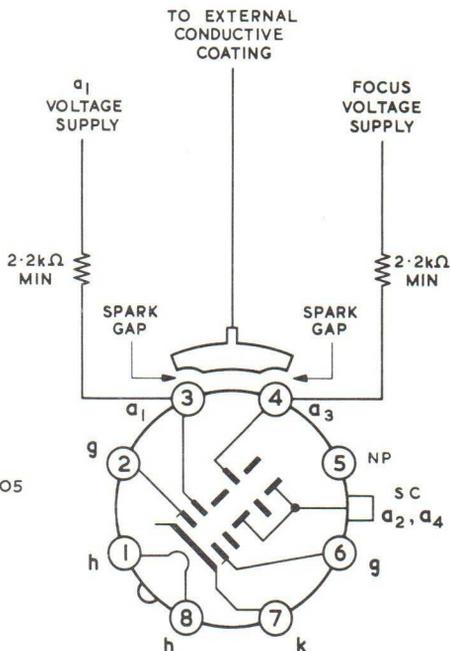
# Base

# B8H Sparkguard S

## B8H SPARKGUARD S C.R.T. BASE



VIEW FROM FREE END



ELECTRICAL CONNECTIONS

A metal plate within the B8H base, which is taken out to a flat, side, earthing tag, forms a spark gap to the first anode and focus electrode. The plastic of Sparkguard S is coloured black.

Tube types fitted with this base have a suffix S after the type number. Sparkguard S tubes can be used in any set without circuit modification, but in sets designed for Sparkguard R protection the side tag must be bonded to pin 5 on the socket.

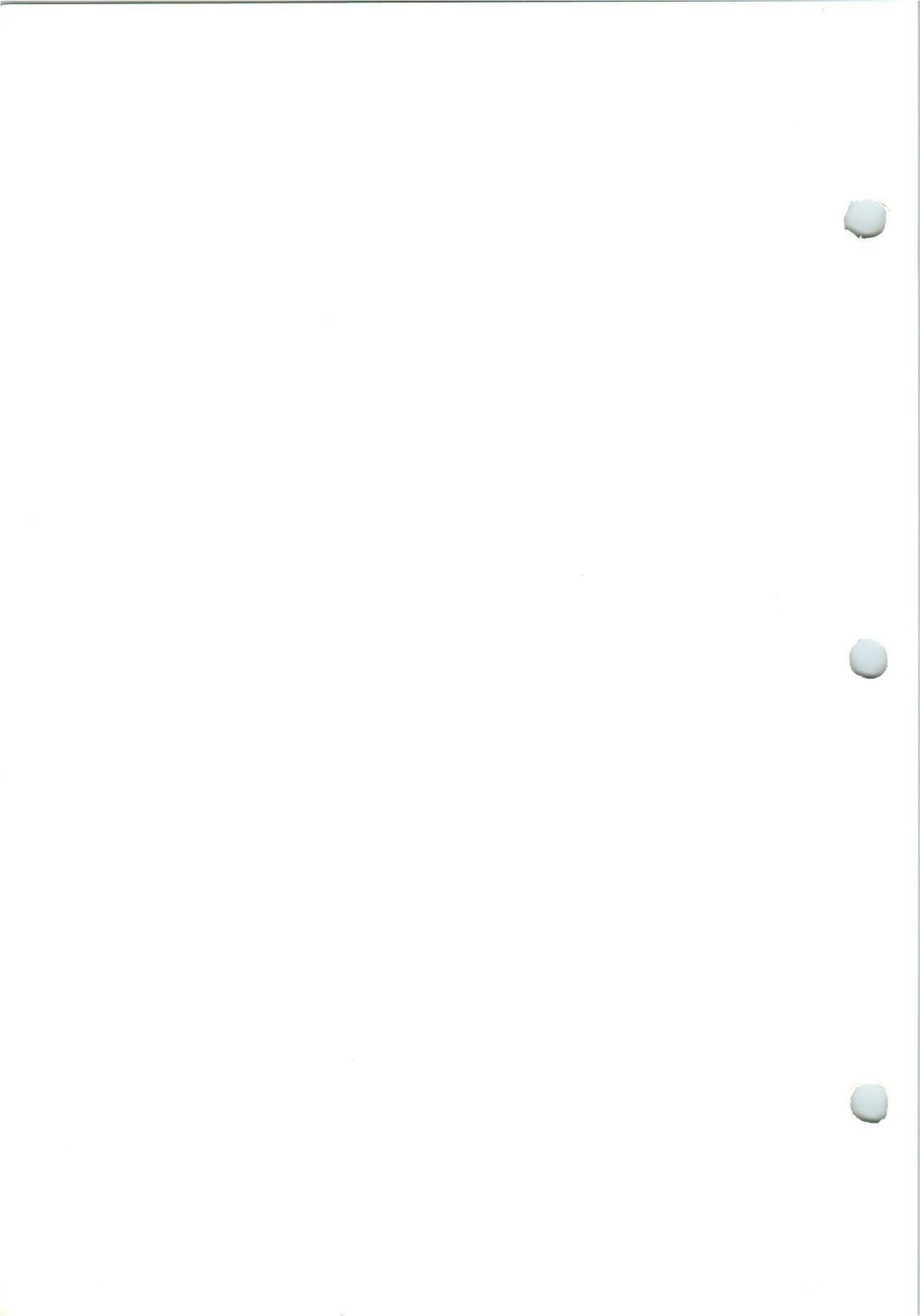
It is recommended that the earthing tag should be returned to the external conductive coating by the shortest possible route. The resistors of 2.2kΩ placed in series with the supply leads to the first anode and focus electrode should be such as to have a minimum surface leakage path between leads of 10 mm (e.g. at least 1/2 W size).

Connection to the earthing tag should be made by means of a push-on connector so that the connection may be removed whilst the deflector coil and other neck components are being fitted to the tube. An example of a suitable connector is the AMP "110 Series Faston Receptacle" (AMP of Great Britain Ltd., Terminal House, Stanmore, Middlesex).

**Thorn Radio Valves and Tubes Limited**

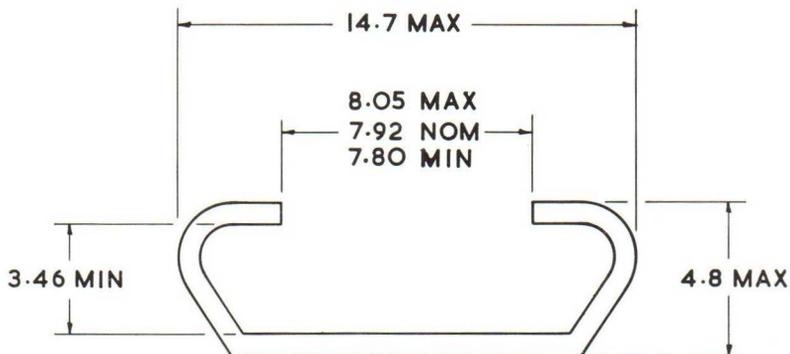
Jan. 1972, Issue 3, Page 1





# Cap

CT8



All dimensions in mm

Not to be scaled

## Notes

1. This drawing is for illustration only. The shape may be varied provided the specified dimensions are adhered to.
2. When attaching or detaching the connector, the total force required should not exceed 35 N (8 lbf) applied perpendicular to the plane of the cap rim.
3. Conforms to IEC 67-III-2 and JEDEC J1-21.

**Thorn Radio Valves and Tubes Limited**

Dec. 1968, Issue 1, Page 1



## CT8 SEAL TOLERANCES

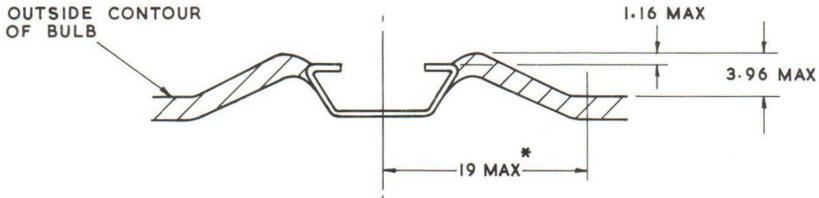


FIGURE 1

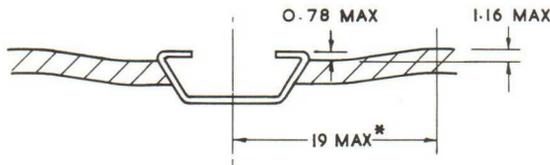


FIGURE 2

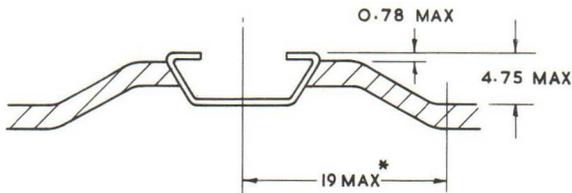


FIGURE 3

All dimensions in mm

Not to be scaled

**Notes**

\* Protrusion of glass around cap above bulb contour is limited to area bounded by circle concentric with cap axis and having radius of 19 mm max.

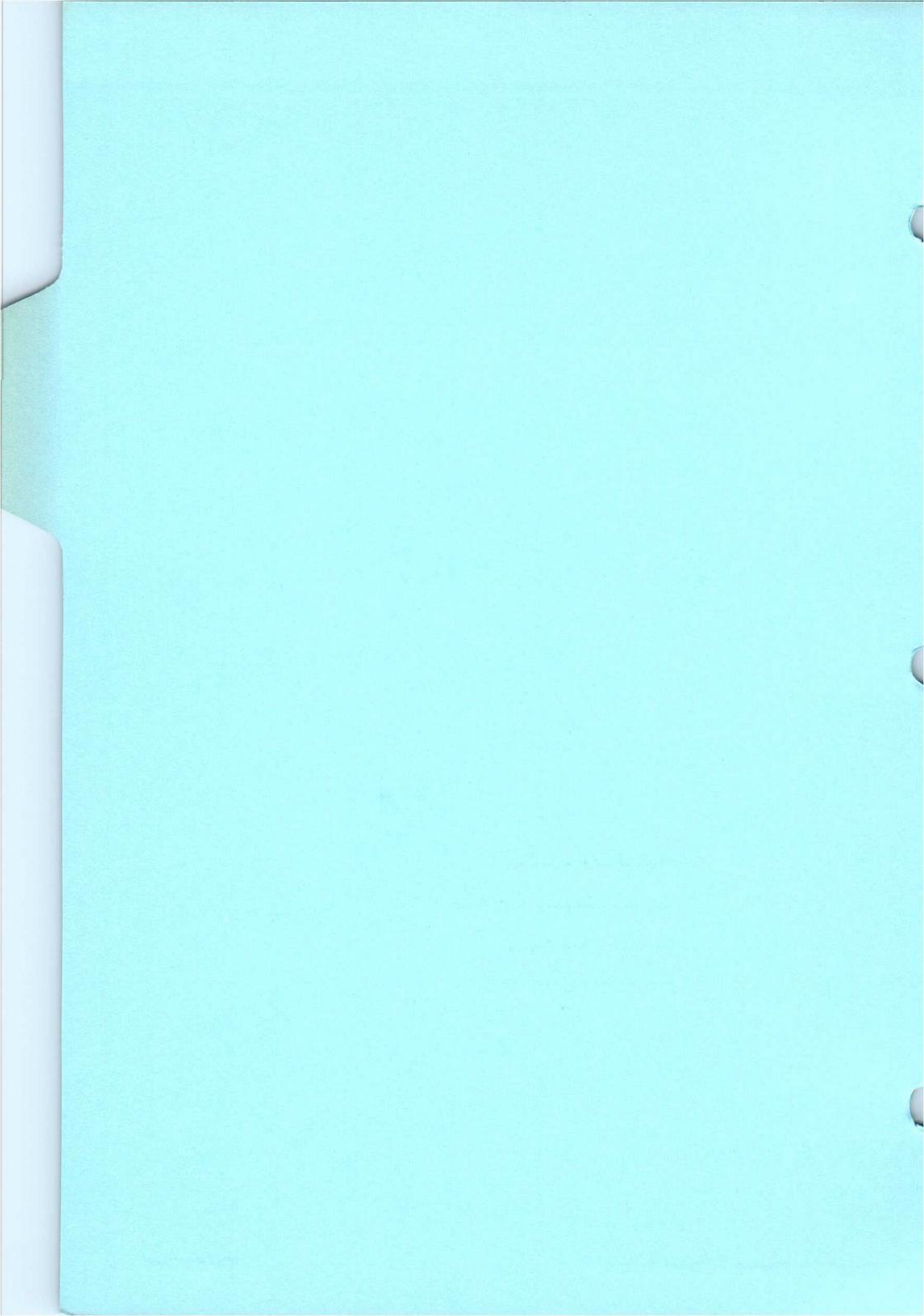
The shape of the cavity cap is for illustration purposes only.

Angle between plane of the rim of cap and plane tangent to original contour of bulb at centre of cap will not be more than 10°.

## **COLOUR PICTURE TUBES**

**CURRENT  
COLOUR**

**Current types  
recommended for  
inclusion in  
new equipment**



# Colour Television Picture Tube

## 49-cm, 90° Rectangular

A49-191X

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>* Electrostatic focus</li> <li>* Magnetic convergence</li> <li>* 46 cm Screen diagonal, 1161 sq. cm screen area</li> <li>* High resolution gun</li> <li>* High brightness screen</li> </ul> | <ul style="list-style-type: none"> <li>* Rare-earth (red) phosphor</li> <li>* New green phosphor</li> <li>* Temperature-compensated shadow-mask assembly</li> <li>* Banded-type implosion protection</li> <li>* For push-through cabinet designs</li> <li>* Integral mounting lugs</li> </ul> |
|--|---|

### CONSTRUCTIONAL FEATURES

A temperature-compensated shadow-mask assembly minimises the problem of shadow-mask expansion which formerly limited the performance of a rectangular colour picture tube. Optimum field purity and uniformity are maintained by the temperature-compensated shadow-mask assembly during warm-up.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide, rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

The tube also incorporates integral implosion protection provided by reinforcing bars which are attached to the periphery of the tube panel with epoxy resin and tension bands. This method makes this tube suitable for push-through cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis: Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic

Deflection Angles (Approx.):

Diagonal	89 deg
Horizontal	78 deg
Vertical	63 deg

Direct Interelectrode Capacitance (approx.):

Grid of any gun to all other electrodes	7.5 pF
Anode 2 to all other electrodes	6.5 pF
All cathodes to all other electrodes	15.0 pF
External conductive coating to anode 3 + 4	{ 2100 max. pF 1500 min. pF

#### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	53%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.58 mm

## Thorn Colour Tubes Limited

Product Engineering Skelmersdale Lancs.

Oct. 1971, Issue 2, Page 1



## Mechanical

### Tube Dimensions:

Overall length	453.5 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	493.3 ± 2.4 mm
Greatest width	431.2 ± 2.4 mm
Greatest height	347.0 ± 2.4 mm

### Minimum Screen Dimensions (Projected)

Diagonal	459.1 mm
Greatest width	395.9 mm
Greatest height	309.5 mm
Area	1161 sq. cm.

Base Designation*	B 14G 12-Pin
Bulb Contact Designation	CT8 Cavity Cap
Pin Position Alignment	Pin No. 12 Aligns approx. with Anode Bulb Contact
Weight (approx.)	10.9 kg

### Design Maximum Ratings †

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 Voltage	27.5 max. kV 20.0 min. kV
Total Anode Current long-term average	1000 max. $\mu$ A
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V

Heater Voltage (AC or DC)‡	
Under operating conditions	6.9 max. V
Under standby conditions	5.7 min. V 5.5 max. V

### Peak Heater-Cathode Voltage:

Heater negative with respect to cathode:	
During equipment warm-up period not exceeding 15 seconds	450 max. V
After equipment warm-up period:	
Combined AC and DC value	200 max. V
DC component value	200 max. V
Heater positive with respect to cathode:	
AC component value	200 max. V
DC component value	0 max. V

## Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltages between 20 and 27.5 kV  
Anode 2 (Focusing Electrode) 16.8% to 20% of Voltage  
Anode 3 + 4 voltage

### Anode 1 and Grid Voltages for

Visual Extinction of Focused Spot  
see cut-off design chart.

Maximum Ratio of Anode 1 voltages, Highest gun to lowest gun in any tube (At grid spot cut-off voltage of -100 V) 1.86

Heater Voltage:‡	
Under operating conditions:	
When standby operation is not utilised	6.3 V
When 5.0 V standby operation is utilised§	6.0 V
Under standby conditions	5.0 V
Anode 2 Current (Total)	-15 to +15 $\mu$ A
Anode 1 Current	-5.0 to +5.0 $\mu$ A

### Displacements, measured at centre of screen:

Raster centring displacement:	
Horizontal	± 11.4 mm
Vertical	± 11.4 mm
Lateral distance between the blue beam and the converged red and green beams	
	± 6.4 mm
Radial convergence displacement excluding effects of dynamic convergence (each beam)	
	± 9.4 mm

### Maximum required Correction for Register ¶

(Including effect of earth's magnetic field when using recommended components) as measured at the centre of the screen in any direction 0.13 mm max.

	<u>Illum. D</u>	
To produce white light of .....	6550° K+ 7M.P.C.D.	9300° K+ 27M.P.C.D.

CIE Co-ordinates		
X.....	0.313	0.281
Y.....	0.329	0.311

Percentage of total anode current supplied by each gun (average):		
Red.....	41%	30%
Blue.....	24%	31%
Green.....	35%	39%

Ratio of cathode currents:		
Red/Blue:		
Minimum.....	1.35	0.75
Typical.....	1.70	0.95
Maximum.....	2.20	1.25

All footnotes on page 3

## Red/Green:

Minimum.....	0.95	0.60
Typical.....	1.15	0.75
Maximum.....	1.70	1.10

## Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode)  
Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design  
utilises grid voltage of  
-150 V for visual extinction  
of focused spot 255 to 655 V

Grid Voltage for visual  
extinction of focused spot  
when circuit design utilises  
Anode 1 voltage of 300V -75 to -173 V

Heater Voltage‡

Under operating conditions:  
When standby operation  
is not utilised 6.3 V  
When 5.0 V standby operation  
is utilised‡ 6.0 V

Under standby conditions§ 5.0 V

## LIMITING CIRCUIT VALUES

### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

### Low-Voltage Circuits

Effective Grid-to-cathode-circuit  
resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios.

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than 0.5 M $\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CTS cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

De-gaussing of the tube will be necessary.

Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1 M $\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

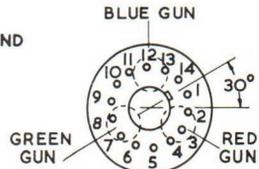
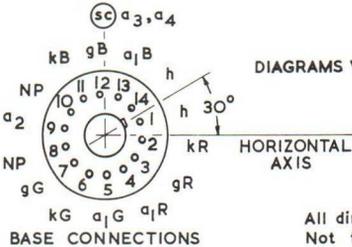
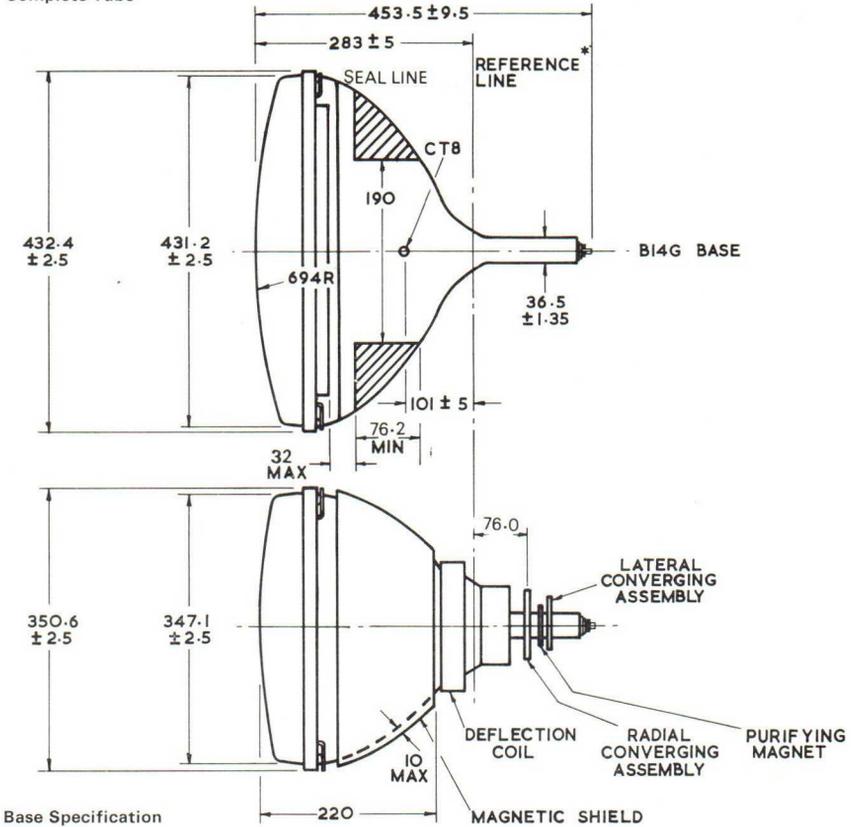
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

# Colour Television Picture Tube

# A49-191X

## DIMENSIONAL OUTLINE

Complete Tube

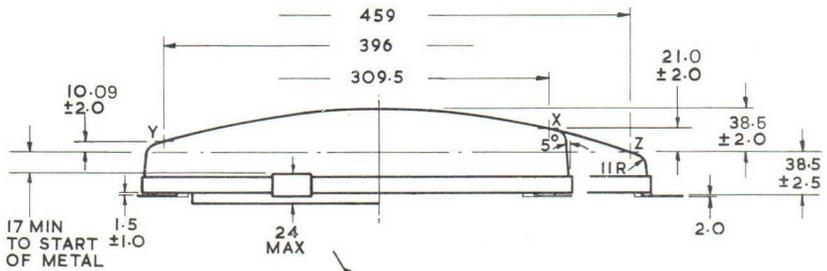
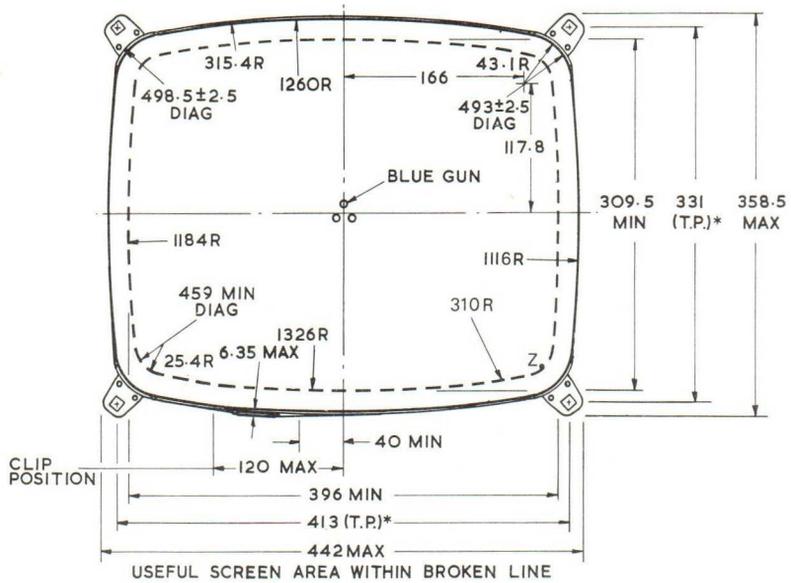


All dimensions in mm  
Not to be scaled

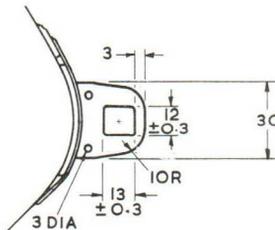
\* Determined by reference line gauge No. 14. JEDEC No. G162.

† Purifying magnet may be positioned on other side of lateral converging assembly.

Detail of Panel



Detail of Mounting Lug



All dimensions in mm

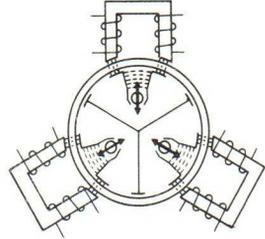
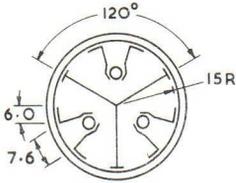
Not to be scaled

\* Bolts for mounting must be within circles of 8.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.

# Colour Television Picture Tube

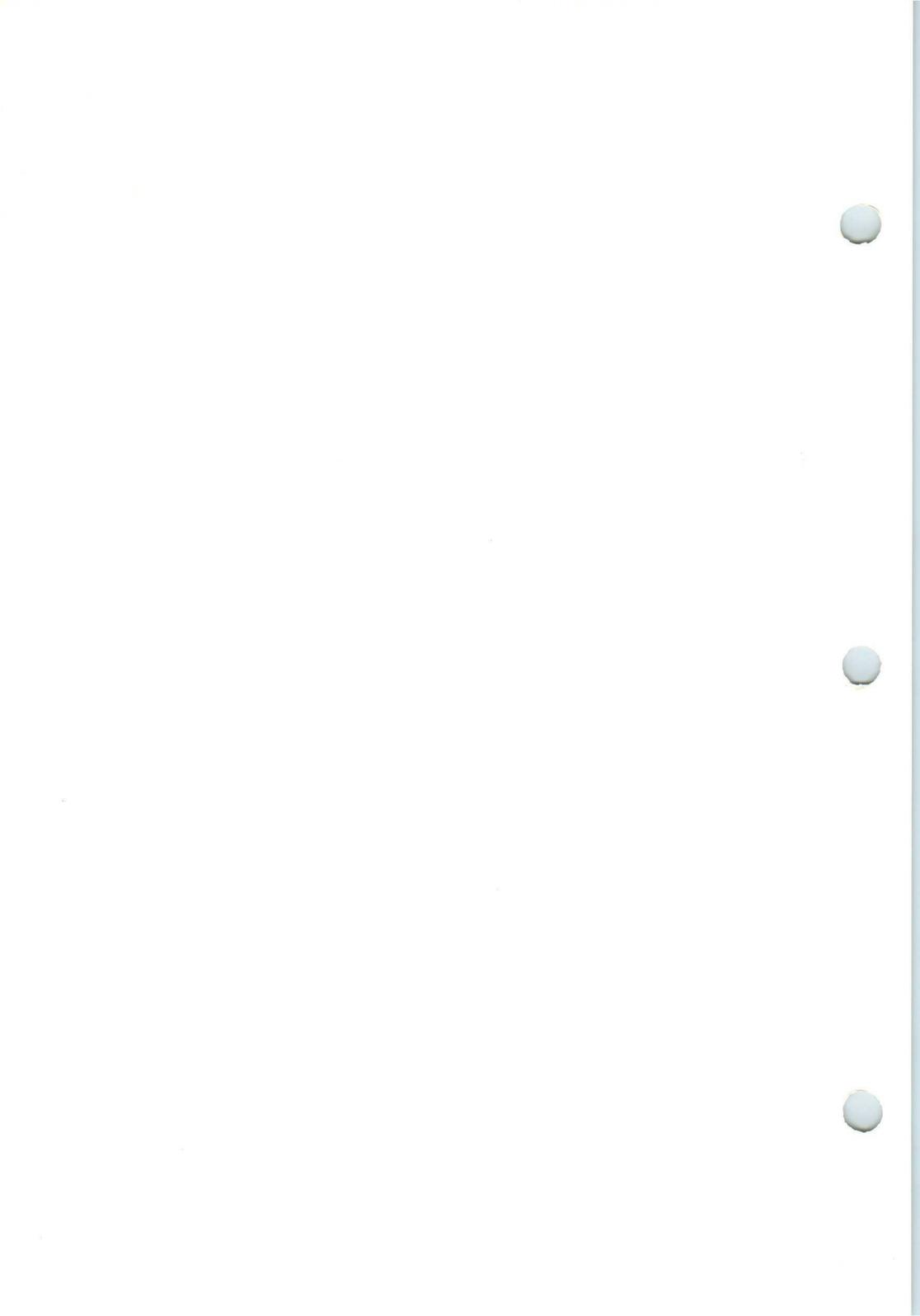
# A49-191X

Radial Converging



All dimensions in mm

Not to be scaled



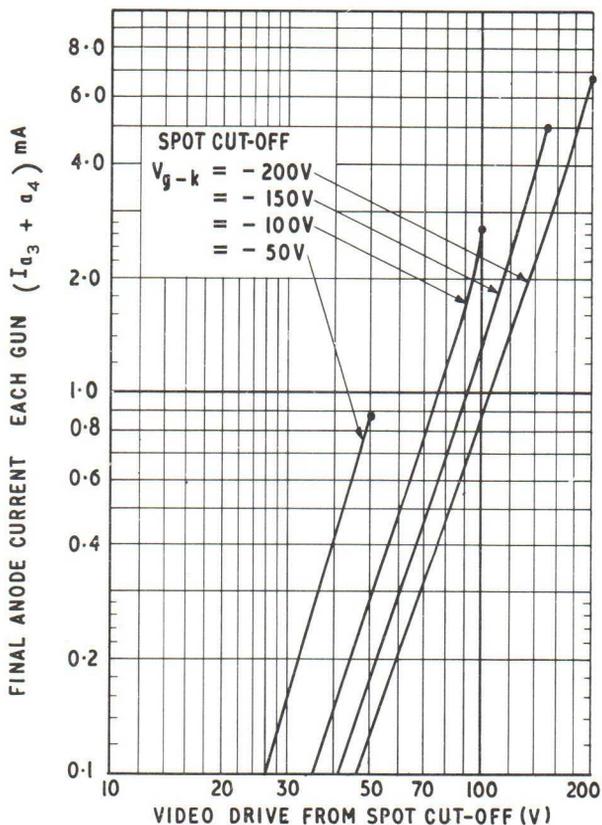
### GRID MODULATION — Each gun

$V_{a_3-a_4} = 20$  to  $27.5$  kV

$V_{a_2-k}$  adjusted for focus

$V_{a_1-k}$  adjusted to provide spot cut-off  
for required  $V_{g-k}$

- zero bias point



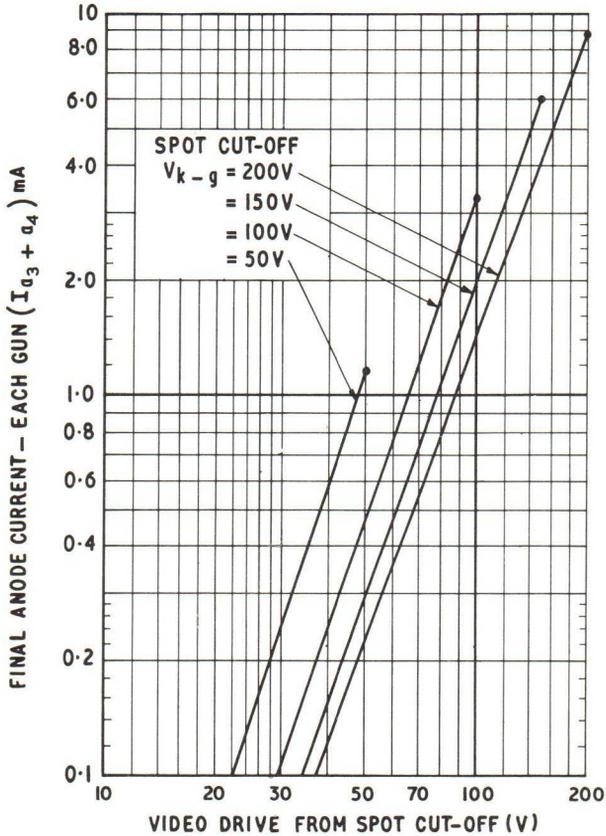
CATHODE MODULATION - Each gun

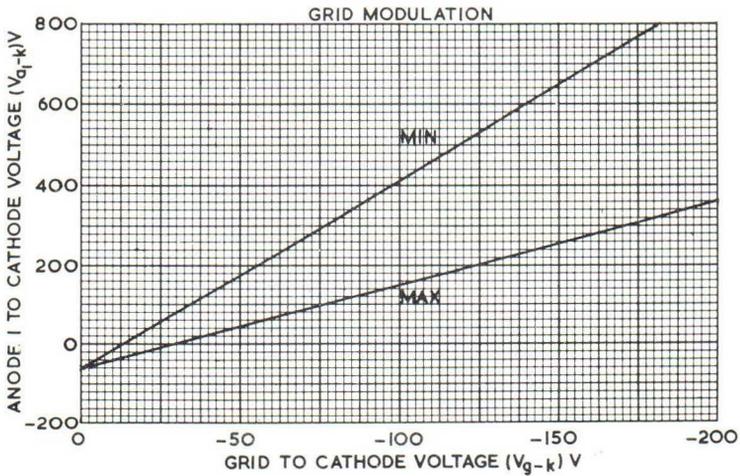
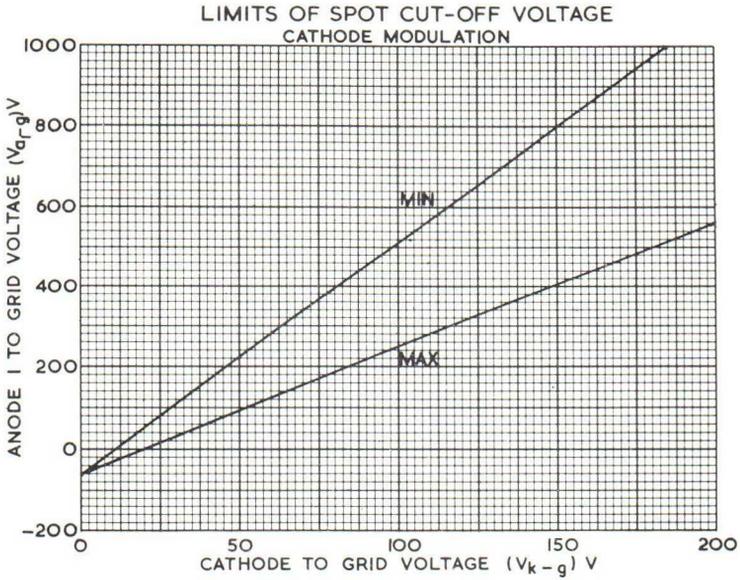
$V_{a_3-a_4} = 20$  to  $27.5$  kV

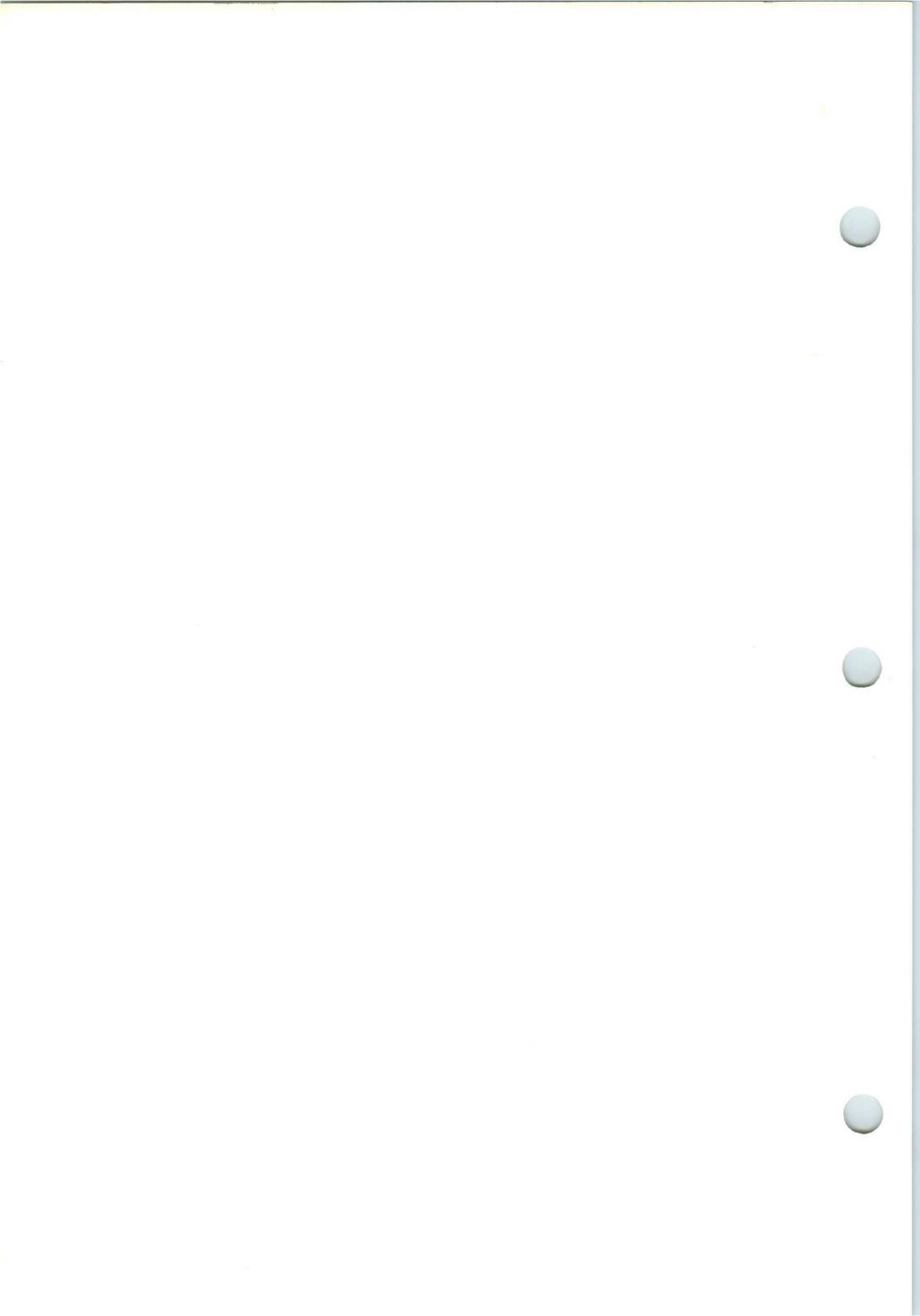
$V_{a_2-g}$  adjusted for focus

$V_{a_1-g}$  adjusted to provide spot cut-off  
for required  $V_{k-g}$

- zero bias point







# Colour Television Picture Tube

## 51-cm, 90° Ultra-Rectangular

A51-110X

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>* Ultra-Rectangular — Straighter sides and square corners</li> <li>* 4 x 3 Aspect ratio</li> <li>* 48 cm screen diagonal 1194 sq.cm screen area</li> <li>* High resolution gun</li> <li>* Moiré minimised in 625 TV-line systems</li> <li>* High brightness screen</li> </ul> | <ul style="list-style-type: none"> <li>* Rare-earth (red) phosphor</li> <li>* New green phosphor</li> <li>* Temperature-compensated shadow-mask assembly</li> <li>* Banded-type implosion protection</li> <li>* For push-through cabinet designs</li> <li>* Integral mounting lugs</li> </ul> |
|--|---|

### CONSTRUCTIONAL FEATURES

This is a 90° ultra-rectangular colour picture tube. The screen profile is more rectangular than previous tubes (straight sides and 'square corners') and has a 4 x 3 aspect ratio. The shadow mask of this tube has been designed to minimise moiré in 625 TV line systems.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide, rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

The tube also incorporates integral implosion protection provided by reinforcing bars which are attached to the periphery of the tube panel with epoxy resin and tension bands. This method makes this tube suitable for push-through cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis: Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	92 deg
Horizontal	79 deg
Vertical	61 deg

Direct Interelectrode Capacitance (approx.):

Grid of any gun to all other electrodes	7.5 pF
Anode 2 to all other electrodes	6.5 pF
All cathodes to all other electrodes	15 pF
External conductive coating to anode 3 + 4	2100 max. pF 1500 min. pF

#### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	53%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-Short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.64 mm

## Thorn Colour Tubes Limited

Product Engineering Skelmersdale Lancs.

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## Mechanical

Tube Dimensions:	
Overall length	458.4 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	513.5 ± 2.4 mm
Greatest width	440.5 ± 2.4 mm
Greatest height	341.8 ± 2.4 mm
Minimum Screen Dimensions (Projected)	
Diagonal	480.0 mm
Greatest width	404.4 mm
Greatest height	303.3 mm
Area	1194 sq. cm.
Base Designation*	Diheptar 12-Pin B14G
Bulb Contact Designation	Cavity Cap CT8
Pin Position Alignment	Pin No. 12 Aligns approx. with Anode Bulb Contact
Weight (approx.)	11.3 kg

## Design Maximum Ratings †

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 Voltage	27.5 max. kV 20 min. kV
Total Anode Current long-term average	1000 max. $\mu$ A
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V
Heater Voltage (AC or DC) ‡	
Under operating conditions	6.9 max. V 5.7 min. V
Under standby conditions	5.5 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode:	
During equipment warm-up period not exceeding 15 seconds	450 max. V
After equipment warm-up period:	
Combined AC and DC value	200 max. V
DC component value	200 max. V
Heater positive with respect to cathode:	
AC component value	200 max. V
DC component value	0 max. V

All footnotes on page 3

## Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltages between 20 and 27.5 kV  
Anode 2 (Focusing Electrode) 16.8% to 20% of  
Voltage Anode 3 + 4 voltage

Anode 1 and Grid Voltages for  
Visual Extinction of Focused Spot

see cut-off design chart

Maximum Ratio of Anode 1 voltages,  
Highest gun to lowest gun in any tube  
(At grid spot cut-off voltage of -100 V) 1.67

Heater Voltage: ‡

Under operating conditions:

When standby operation is  
not utilised 6.3 V

When 5.0 V standby operation  
is utilised § 6.0 V

Under standby conditions 5.0 V

Anode 2 Current (Total) ±15  $\mu$ A

Anode 1 Current ±5.0  $\mu$ A

Displacements, measured at centre of screen:

Raster centring displacement:

Horizontal ± 11.4 mm

Vertical ± 11.4 mm

Lateral distance between the blue  
beam and the converged red and  
green beams ± 6.4 mm

Radial convergence displacement  
excluding effects of dynamic  
convergence (each beam) ± 9.4 mm

Maximum required Correction for Register ¶

(Including effect of earth's magnetic field  
when using recommended components)  
as measured at the centre  
of the screen in any direction 0.13 mm max.

### illum. D

To produce white light of .....	6550° K+	9300° K+
	7 M.P.C.D.	27 M.P.C.D.

CIE Co-ordinates:

X.....	0.313	0.281
Y.....	0.329	0.311

Percentage of total  
anode current supplied  
by each gun (average):

Red.....	41	30%
Blue.....	24	31%
Green.....	35	39%

Ratio of cathode currents:

Red/Blue:		
Minimum.....	1.35	0.75
Typical.....	1.70	0.95
Maximum.....	2.20	1.25

## Red/Green:

Minimum.....	0.95	0.60
Typical.....	1.15	0.75
Maximum.....	1.70	1.10

## Blue/Green:

Minimum.....	0.50	0.60
Typical.....	0.70	0.80
Maximum.....	0.95	1.10

## Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode) Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design utilises grid voltage of -150 V for visual extinction of focused spot 260 to 660 V

Grid Voltage for visual extinction of focused spot when circuit design utilises Anode 1 voltage of 300V -76 to -168 V

Heater Voltage‡  
Under operating conditions:  
When standby operation is not utilised 6.3 V

When 5.0 V standby operation is utilised§ 6.0 V

Under standby conditions§ 5.0 V

## LIMITING CIRCUIT VALUES

### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

### Low-Voltage Circuits

Effective Grid-to-cathode-circuit resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than 0.5 M $\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CTS cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

De-gaussing of the tube will be necessary.

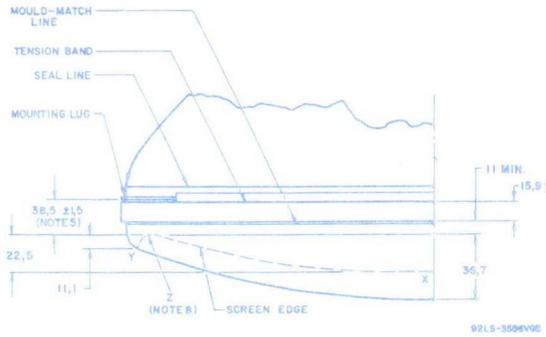
Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1 M $\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

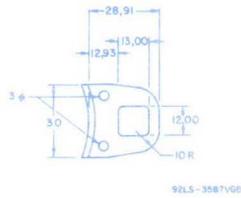
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.



## Detail of Panel



## Detail of Mounting Lug

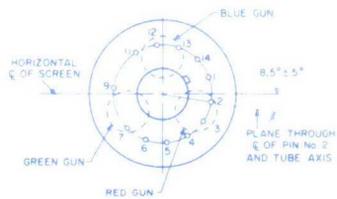


## Base Specification B14G

- Pin 1: Heater
- Pin 2: Cathode of Red Gun
- Pin 3: Grid of Red Gun
- Pin 4: Anode 1 of Red Gun
- Pin 5: Anode 1 of Green Gun
- Pin 6: Cathode of Green Gun
- Pin 7: Grid of Green Gun
- Pin 9: Anode 2
- Pin 11: Cathode of Blue Gun
- Pin 12: Grid of Blue Gun
- Pin 13: Anode 1 of Blue Gun
- Pin 14: Heater

Cap: Anode 3 + 4

C: External Conductive Coating



Viewed from free end

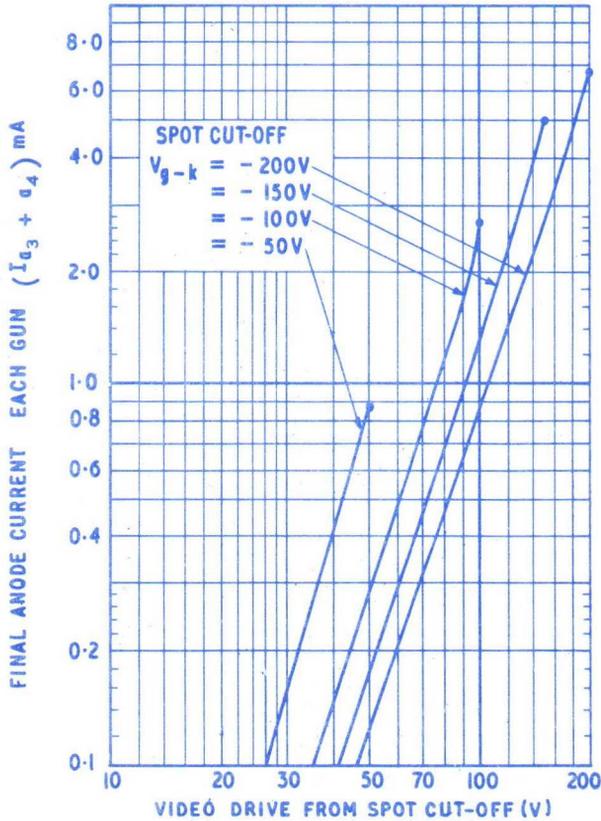
**GRID MODULATION - Each gun**

$V_{a_3 - a_4} = 20 \text{ to } 27.5 \text{ kV}$

$V_{a_2 - k}$  adjusted for focus

$V_{a_1 - k}$  adjusted to provide spot cut-off  
for required  $V_{g - k}$

- zero bias point



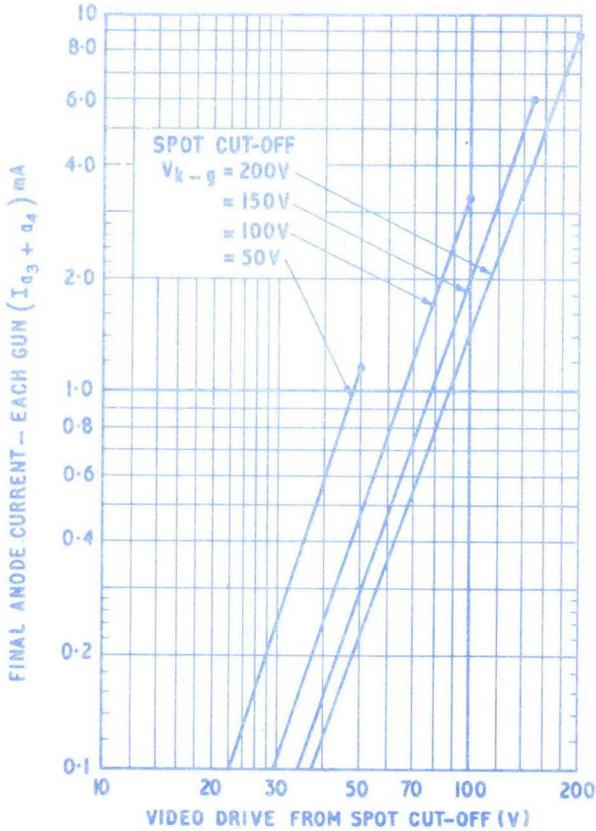
CATHODE MODULATION — Each gun

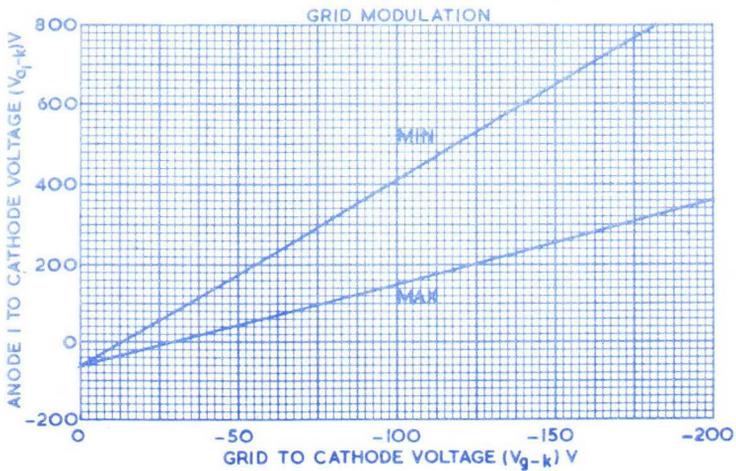
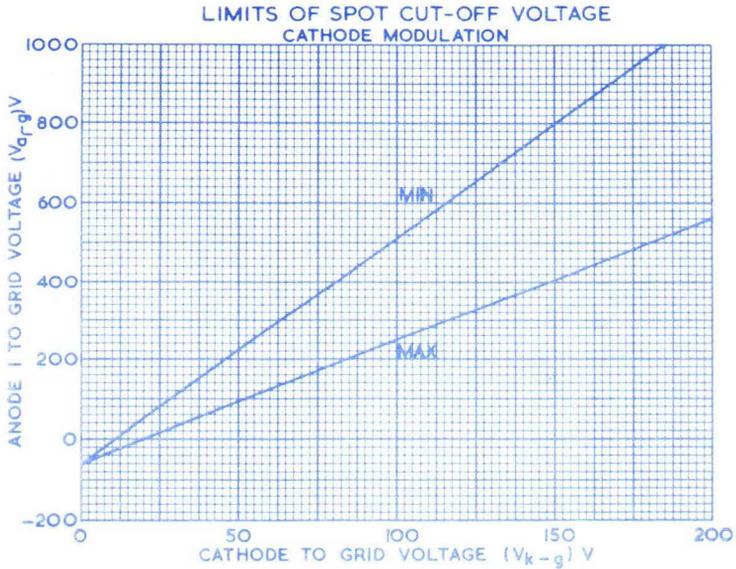
$V_{a_3-a_4} = 20$  to  $27.5$  kV

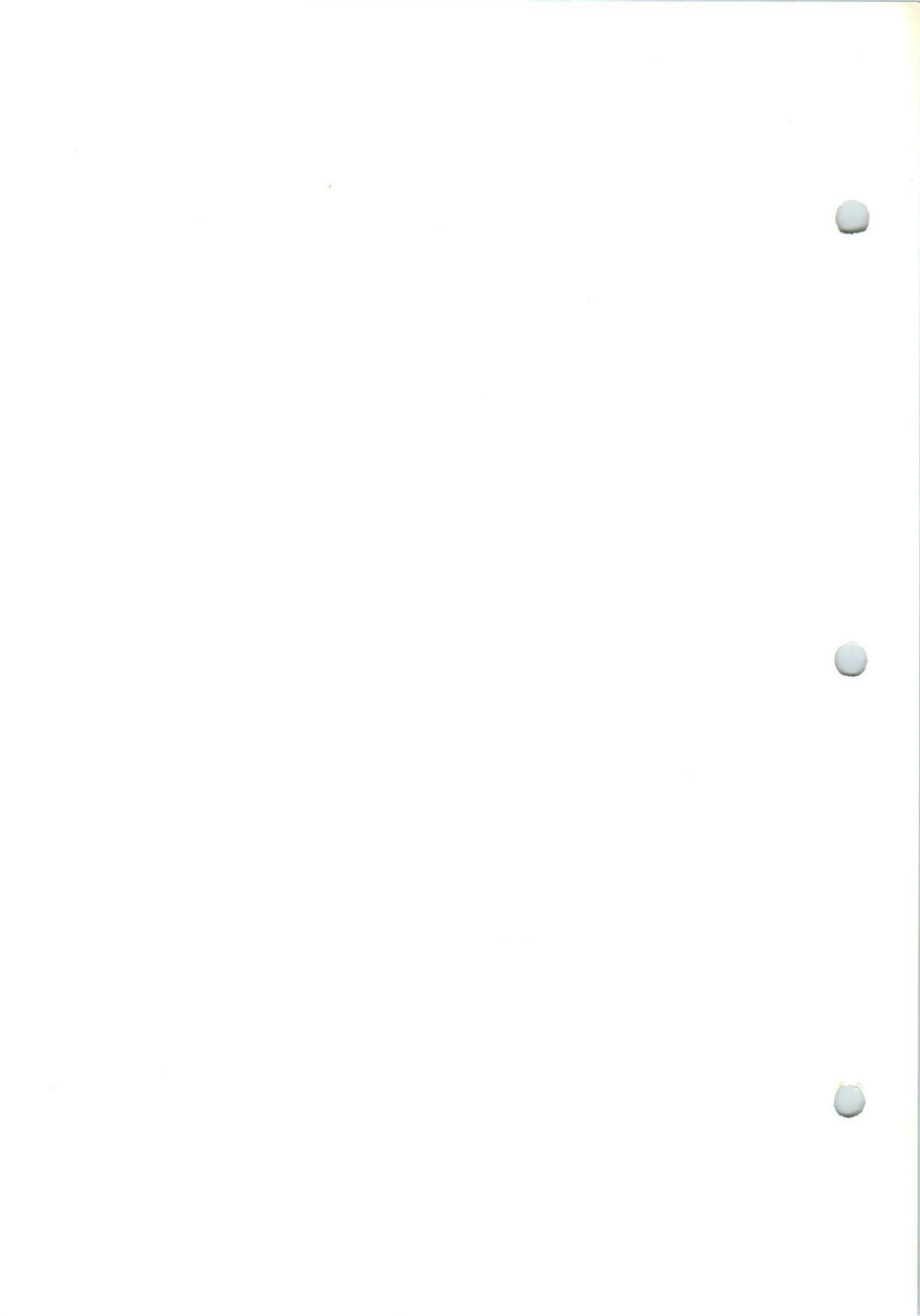
$V_{a_2-g}$  adjusted for focus

$V_{a_1-g}$  adjusted to provide spot cut-off  
for required  $V_{k-g}$

• zero bias point







# Colour Television Picture Tube

## 55-cm, 90° Rectangular

A55-14X

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>* Electrostatic focus</li> <li>* Magnetic convergence</li> <li>* 51 cm Screen diagonal, 1465 sq. cm screen area</li> <li>* High resolution gun</li> <li>* High brightness screen</li> </ul> | <ul style="list-style-type: none"> <li>* Rare-earth (red) phosphor</li> <li>* New green phosphor</li> <li>* Temperature-compensated shadow-mask assembly</li> <li>* Banded-type implosion protection</li> <li>* For push-through cabinet designs</li> <li>* Integral mounting lugs</li> </ul> |
|--|---|

### CONSTRUCTIONAL FEATURES

A temperature-compensated shadow-mask assembly minimises the problem of shadow-mask expansion which formerly limited the performance of a rectangular colour picture tube. Optimum field purity and uniformity are maintained by the temperature-compensated shadow-mask assembly during warm-up.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide, rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

Integral implosion protection is provided by tension bands attached to the periphery of the tube panel making it suitable for 'push-through' cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis:

Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	90 deg
Horizontal	79 deg
Vertical	63 deg

Direct Interelectrode Capacitance (approx.):

Grid of any gun to all other electrodes	7.5 pF
Anode 2 to all other electrodes	6.5 pF
All cathodes to all other electrodes	15 pF
External conductive coating to anode 3 + 4	{ 2500 max. pF 2000 min. pF

#### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	52%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.64 mm

## Thorn Colour Tubes Limited

Product Engineering Skelmersdale Lancs.

Oct. 1971, Issue 2, Page 1



**Mechanical**

**Tube Dimensions:**

Overall length	483.0 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	562.0 ± 2.4 mm
Greatest width	486.7 ± 2.4 mm
Greatest height	391.7 ± 2.4 mm
Minimum Screen Dimensions (Projected)	
Diagonal	514 mm
Greatest width	443 mm
Greatest height	346.5 mm
Area	1465 sq. cm.
Base Designation*	B14G 12-Pin
Bulb Contact Designation	CT8 Cavity Cap
Pin Position Alignment	Pin No. 12 Aligns
	approx. with Anode Bulb Contact
Weight (approx.)	12.7 kg

**Design Maximum Ratings**

**Design-Maximum Values:†**

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 Voltage	27.5 max. kV 20.0 min. kV
Total Anode Current	
long-term average	1000 max. µA
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V
Heater Voltage (AC or DC) ‡	
Under operating conditions	6.9 max. V 5.7 min. V
Under standby conditions	5.5 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode:	
During equipment warm-up period not exceeding 15 seconds	450 max. V
After equipment warm-up period:	
Combined AC and DC value	200 max. V
DC component value	200 max. V
Heater positive with respect to cathode:	
AC component value	200 max. V
DC component value	0 max. V

**Equipment Design Ranges**

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltages between 20 and 27.5 kV  
Anode 2 (Focusing Electrode) 16.8% to 20% of Voltage  
Anode 3 + 4 voltage

Anode 1 and Grid Voltages for

Visual Extinction of Focused Spot

see cut-off design chart  
Maximum Ratio of Anode 1 voltages, Highest gun to lowest gun in any tube (At grid spot cut-off voltage of -100 V) 1.86

Heater Voltage: ‡

Under operating conditions:

When standby operation is not utilised 6.3 V

When 5.0 V standby operation is utilised § 6.0 V

Under standby conditions 5.0 V

Anode 2 Current (Total) -45 to +15 µA

Anode 1 Current -5.0 to +5.0 µA

Displacements, measured at centre of screen:

Raster centring displacement:

Horizontal ±11.9 mm  
Vertical ±11.4 mm

Lateral distance between the blue beam and the converged red and green beams ±6.4 mm

Radial convergence displacement excluding effects of dynamic convergence (each beam) +9.4 mm

Maximum required Correction for Register ¶

(Including effect of earth's magnetic field when using recommended components) as measured at the centre of the screen in any direction 0.13 mm max.

	<u>llum. D</u>	
To produce white light of .....	6550°K+ 7 M.P.C.D.	9300°K+ 27 M.P.C.D.

CIE Co-ordinates:

X .....	0.313	0.281
Y .....	0.329	0.311

Percentage of total anode current supplied by each gun (average):

Red.....	41%	30%
Blue.....	24%	31%
Green.....	35%	39%

Ratio of cathode currents:

Red/Blue:		
Minimum.....	1.35	0.75
Typical.....	1.70	0.95
Maximum.....	2.20	1.25

All footnotes on page 3

## Red/Green:

Minimum.....	0.95	0.60
Typical.....	1.15	0.75
Maximum.....	1.70	1.10

## Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode)  
Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design  
utilises grid voltage of  
-150 V for visual extinction  
of focused spot 255 to 655 V

Grid Voltage for visual  
extinction of focused spot  
when circuit design utilises  
Anode 1 voltage of 300V -75 to -173 V

Heater Voltage‡  
Under operating conditions:  
When standby operation  
is not utilised 6.3 V  
When 5.0 V standby operation  
is utilised‡ 6.0 V  
Under standby conditions§ 5.0 V

## LIMITING CIRCUIT VALUES

### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

### Low-Voltage Circuits

Effective Grid-to-cathode-circuit  
resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios.

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than 0.5 M $\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CT8 cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

De-gaussing of the tube will be necessary.

Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1 M $\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

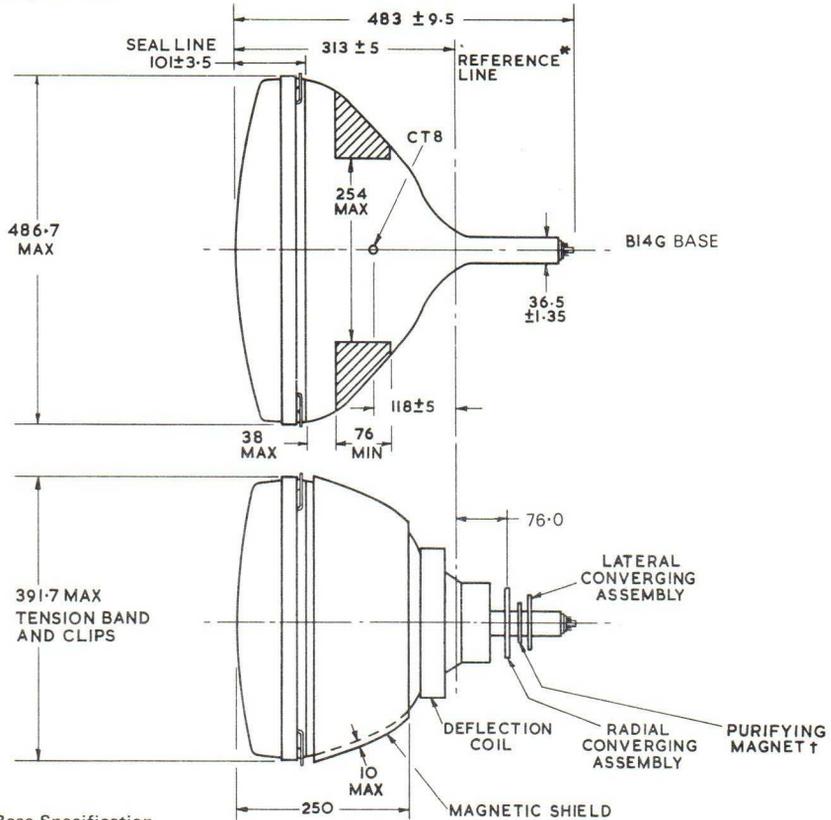
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

# Colour Television Picture Tube

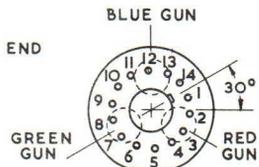
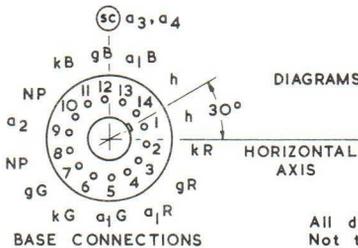
# A55-14X

## DIMENSIONAL OUTLINE

Complete Tube



Base Specification

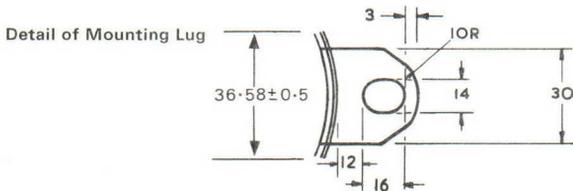
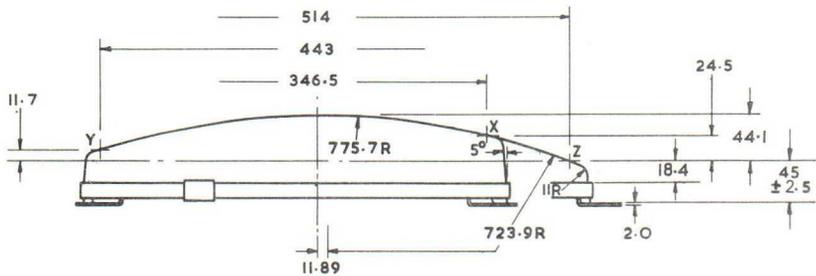
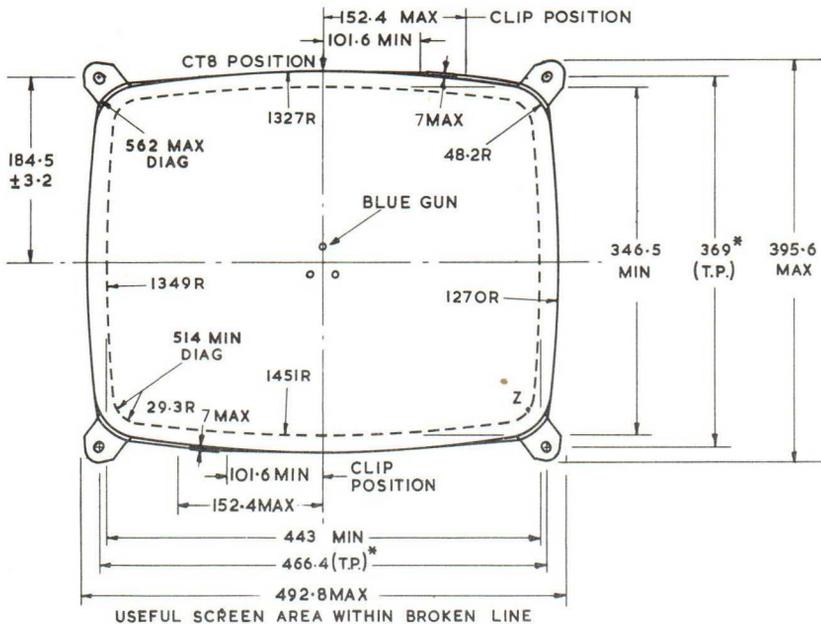


All dimensions in mm  
Not to be scaled

\* Determined by reference line gauge No. 14 JEDEC No. G162.

† Purifying magnet may be positioned on other side of lateral converging assembly.

Detail of Panel



All dimensions in mm

CORNER LUG

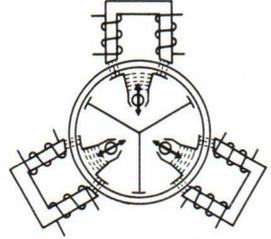
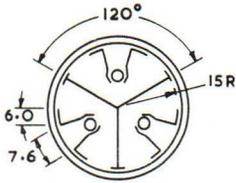
Not to be scaled

\* Bolts for mounting must be within circles of 9.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.

# Colour Television Picture Tube

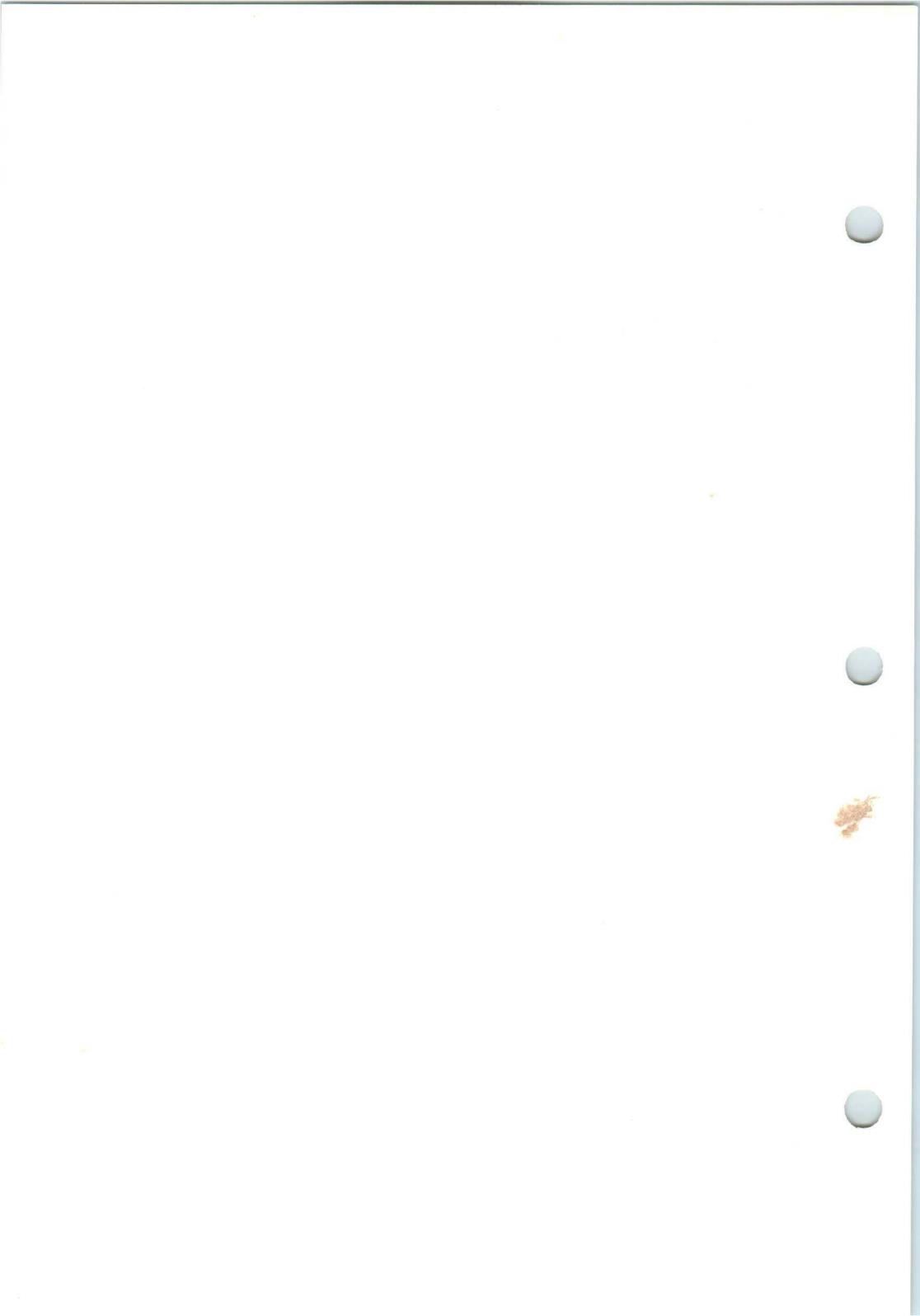
A55-14X

Radial Converging



All dimensions in mm

Not to be scaled



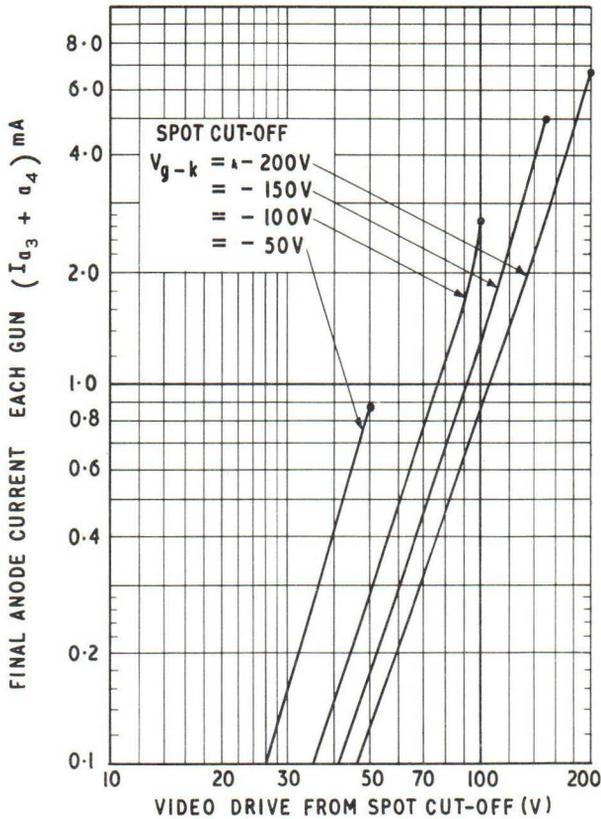
GRID MODULATION — Each gun

$V_{a_3 - a_4} = 20 \text{ to } 27.5 \text{ kV}$

$V_{a_2 - k}$  adjusted for focus

$V_{a_1 - k}$  adjusted to provide spot cut-off  
for required  $V_{g - k}$

- zero bias point



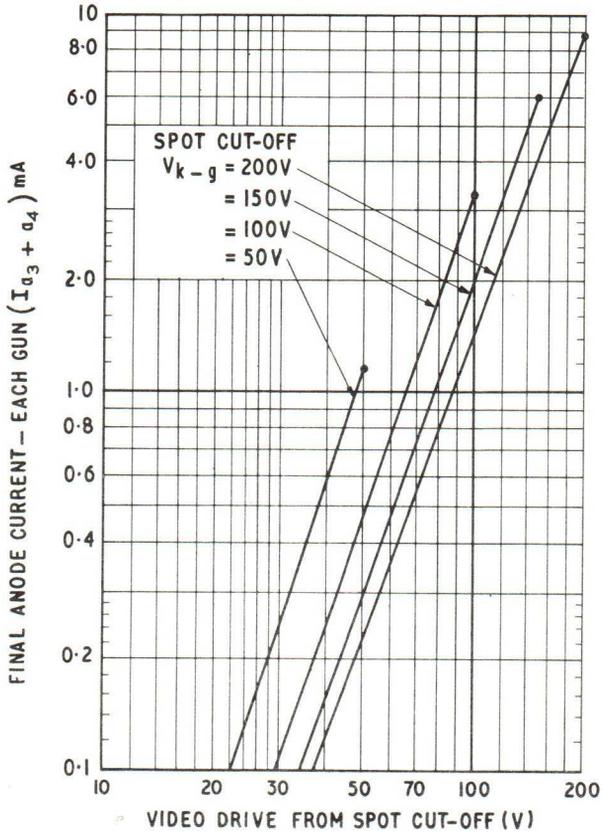
CATHODE MODULATION — Each gun

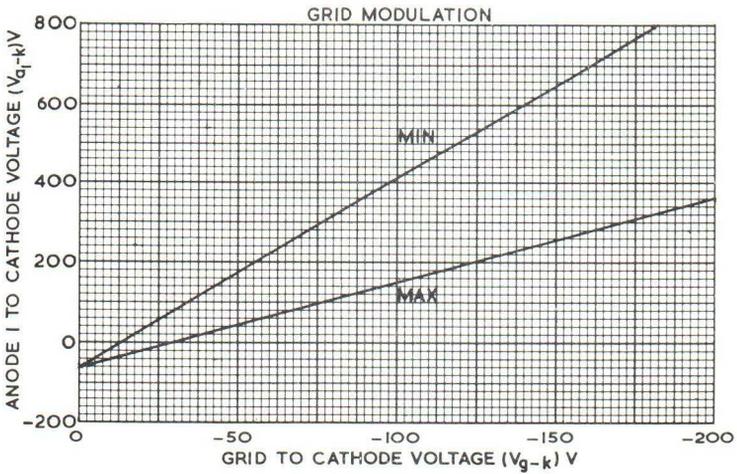
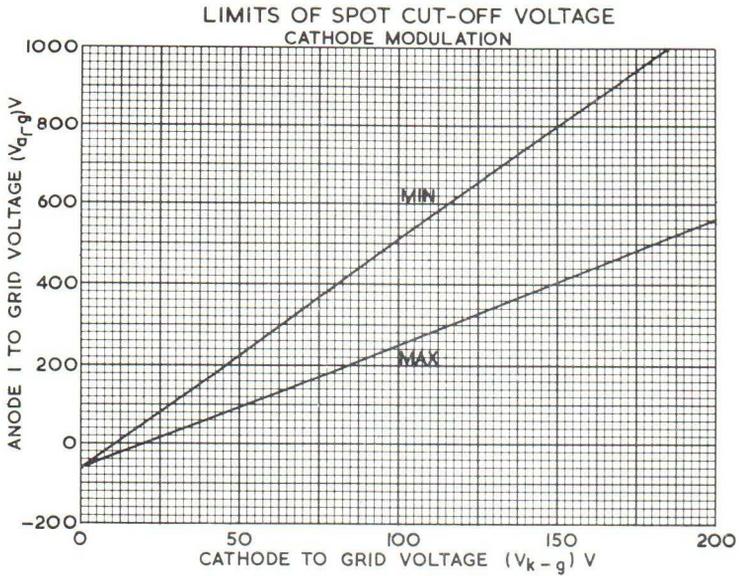
$V_{a_3 - a_4} = 20$  to  $27.5$  kV

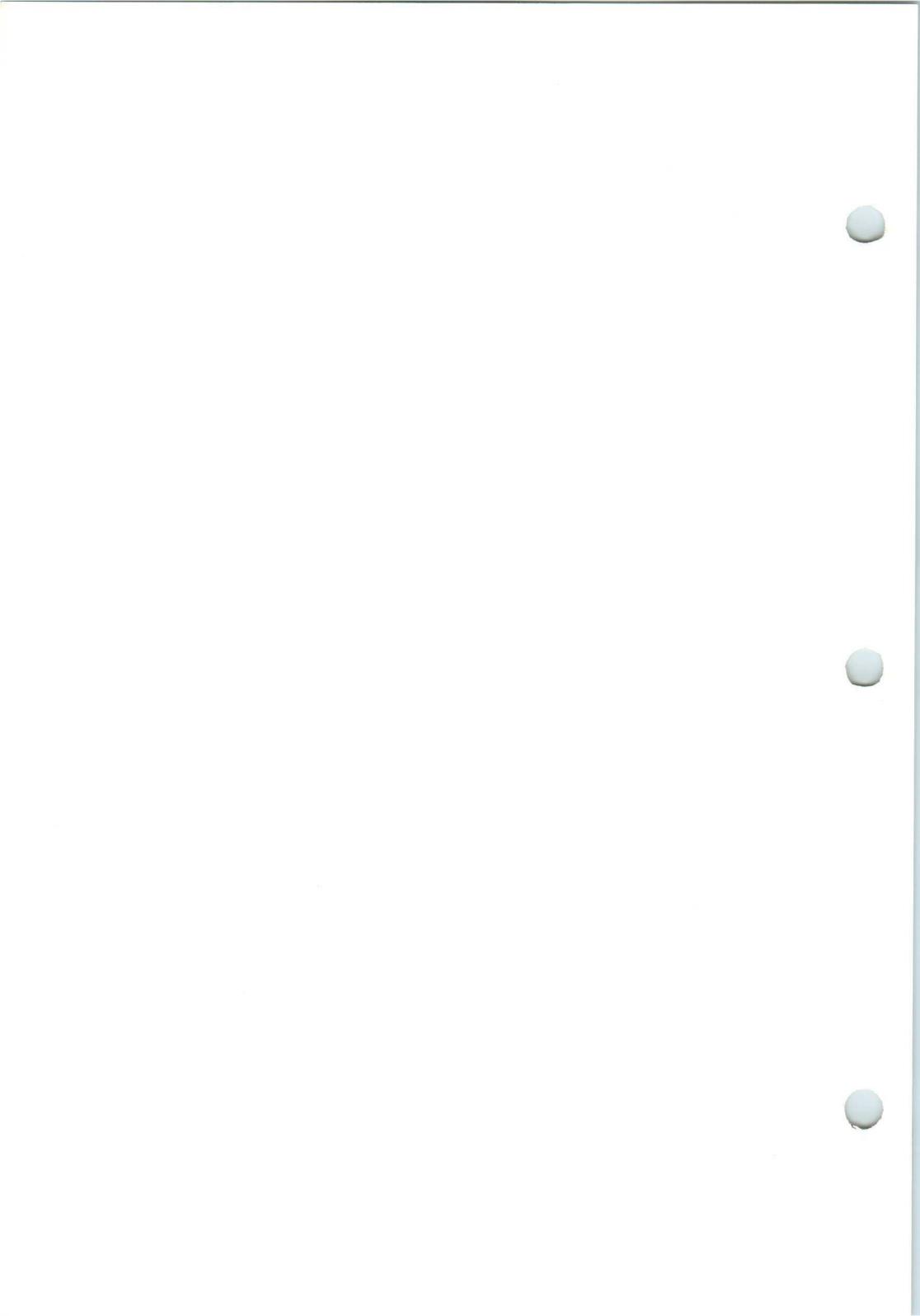
$V_{a_2 - g}$  adjusted for focus

$V_{a_1 - g}$  adjusted to provide spot cut-off  
for required  $V_{k - g}$

• zero bias point







# Colour Television Picture Tube

## 56-cm, 90° Ultra-Rectangular

# A56-120X

- \* Ultra-Rectangular — Straighter sides and square corners
  - \* 4 x 3 Aspect ratio
  - \* 53 cm screen diagonal, 1471 sq.cm screen area
  - \* High resolution gun
  - \* Moiré minimised in 625 TV-line systems
  - \* High brightness screen
- \* Rare-earth (red) phosphor
  - \* New green phosphor
  - \* Temperature-compensated shadow-mask assembly
  - \* Banded-type implosion protection
  - \* For push-through cabinet designs
  - \* Integral mounting lugs

### CONSTRUCTIONAL FEATURES

This is a 90° ultra-rectangular colour picture tube. The screen profile is more rectangular than previous tubes (straight sides and 'square corners') and has a 4 x 3 aspect ratio. The shadow mask of this tube has been designed to minimise moiré in 625 TV line systems.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide, rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

The tube also incorporates integral implosion protection provided by tension bands which are attached to the periphery of the tube panel with epoxy resin. This method makes the tube suitable for 'push-through' cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis: Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	92 deg
Horizontal	79 deg
Vertical	61 deg

Direct Interelectrode Capacitance (approx.):

Grid of any gun to all other electrodes	7.5 pF				
Anode 2 to all other electrodes	6.5 pF				
All cathodes to all other electrodes	15 pF				
External conductive coating to anode 3 + 4	<table style="display: inline-table; vertical-align: middle;"> <tr> <td style="font-size: 2em; vertical-align: middle;">}</td> <td>2250 max. pF</td> </tr> <tr> <td style="font-size: 2em; vertical-align: middle;">}</td> <td>1750 min. pF</td> </tr> </table>	}	2250 max. pF	}	1750 min. pF
}	2250 max. pF				
}	1750 min. pF				

#### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	53%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.71 mm

**Thorn Colour Tubes Limited**

Product Engineering Skelmersdale Lancs.

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## Mechanical

### Tube Dimensions:

Overall length	478.0 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	564.2 ± 2.4 mm
Greatest width	484.3 ± 2.4 mm
Greatest height	379.8 ± 2.4 mm

### Minimum Screen Dimensions (Projected)

Diagonal	533 mm
Greatest width	447 mm
Greatest height	337 mm
Area	1471 sq. cm.
Base Designation*	B14G 12-Pin
Bulb Contact Designation	CT8 Cavity Cap
Pin Position Alignment	Pin No. 12 Aligns
	approx. with Anode Bulb Contact
Weight (approx.)	15.2 kg

## Design Maximum Ratings †

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 Voltage	27.5 max. kV 20.0 min. kV
Total Anode Current	
long-term average	1000 max. $\mu$ A
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V
Heater Voltage (AC or DC) ‡	
Under operating conditions	6.9 max. V 5.7 min. V
Under standby conditions	5.5 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode:	
During equipment warm-up period not exceeding 15 seconds	450 max. V
After equipment warm-up period:	
Combined AC and DC value	200 max. V
DC component value	200 max. V
Heater positive with respect to cathode:	
AC component value	200 max. V
DC component value	0 max. V

## Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltages between 20 and 27.5 kV  
Anode 2 (Focusing Electrode) 16.8% to 20% of Voltage  
Anode 3 + 4 voltage

Anode 1 and Grid Voltages for

Visual Extinction of Focused Spot

see cut-off design chart

Maximum Ratio of Anode 1 voltages, Highest gun to lowest gun in any tube (At grid spot cut-off voltage of -100 V) 1.86

Heater Voltage: ‡

Under operating conditions:

    When standby operation is not utilised 6.3 V

    When 5.0 V standby operation is utilised § 6.0 V

Under standby conditions 5.0 V

Anode 2 Current (Total) -15 to +15  $\mu$ A

Anode 1 Current -5.0 to +5.0  $\mu$ A

Displacements, measured at centre of screen:

Raster centring displacement:

    Horizontal ± 11.4 mm

    Vertical ± 11.4 mm

Lateral distance between the blue beam and the converged red and green beams

± 6.4 mm

Radial convergence displacement

excluding effects of dynamic convergence (each beam)

± 9.4 mm

Maximum required Correction for Register ¶

(Including effect of earth's magnetic field when using recommended components)

as measured at the centre

of the screen in any direction 0.13 mm max.

Illum D.

To produce white light of.....	6550° K+	9300° K+
	7 M.P.C.D.	27 M.P.C.D.

CIE Co-ordinates:

X.....	0.313	0.281
Y.....	0.329	0.311

Percentage of total anode current supplied by each gun (average):

Red.....	41%	30%
Blue.....	24%	31%
Green.....	35%	39%

Ratio of cathode currents:

Red/Blue:		
Minimum.....	1-35%	0.75
Typical.....	1-70%	0.95
Maximum.....	2-20%	1.25

All footnotes on page 3

## Red/Green:

Minimum.....	0.95	0.60
Typical.....	1.15	0.75
Maximum.....	1.70	1.10,

## Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode) Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design utilises grid voltage of -150 V for visual extinction of focused spot 255 to 655 V

Grid Voltage for visual extinction of focused spot when circuit design utilises Anode 1 voltage of 300V -75 to -173 V

Heater Voltage‡  
 Under operating conditions:  
 When standby operation is not utilised 6.3 V  
 When 5.0 V standby operation is utilised‡ 6.0 V  
 Under standby conditions§ 5.0 V

## LIMITING CIRCUIT VALUES

### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

### Low-Voltage Circuits

Effective Grid-to-cathode-circuit resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios.

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than  $0.5 \text{ M}\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CT8 cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

De-gaussing of the tube will be necessary.

Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor ( $1 \text{ M}\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

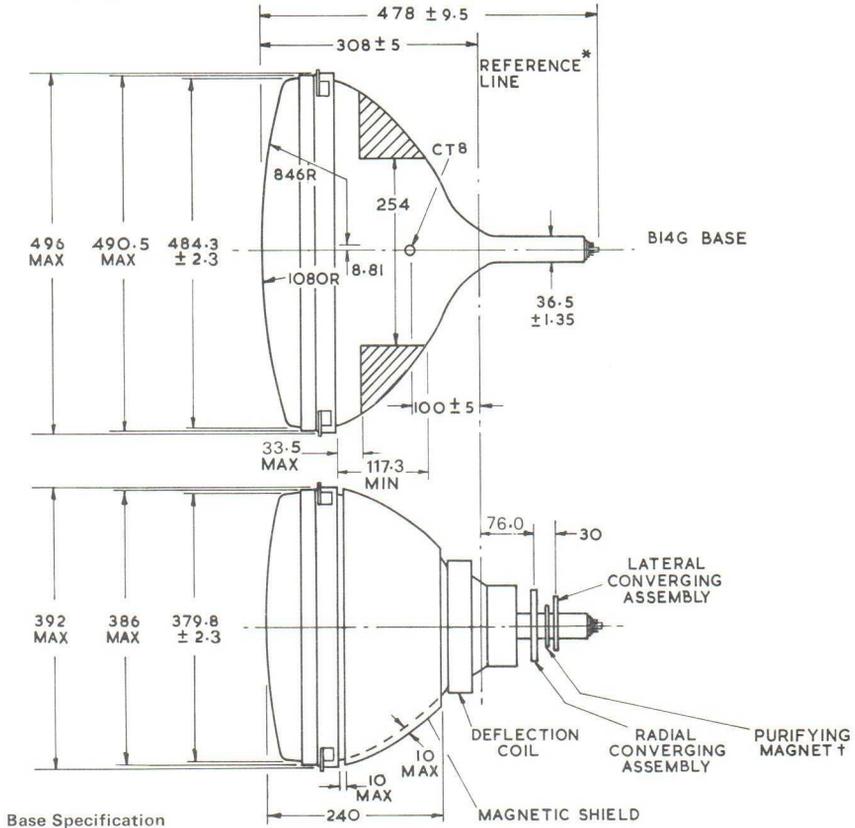
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

# Colour Television Picture Tube

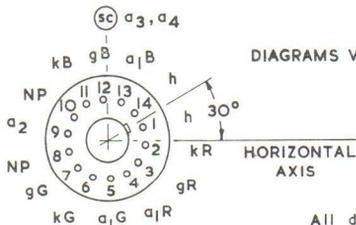
# A56-120X

## DIMENSIONAL OUTLINE

Complete Tube



Base Specification

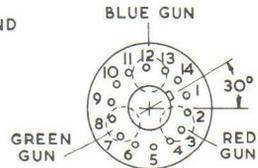


BASE CONNECTIONS

All dimensions in mm  
Not to be scaled

\* Determined by reference line gauge No. 14 JEDEC G162

† Purifying magnet may be positioned on other side of lateral converging assembly.

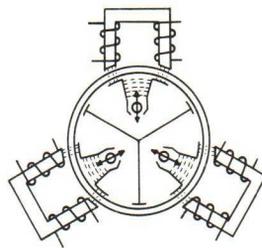
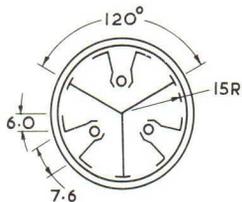




# Colour Television Picture Tube

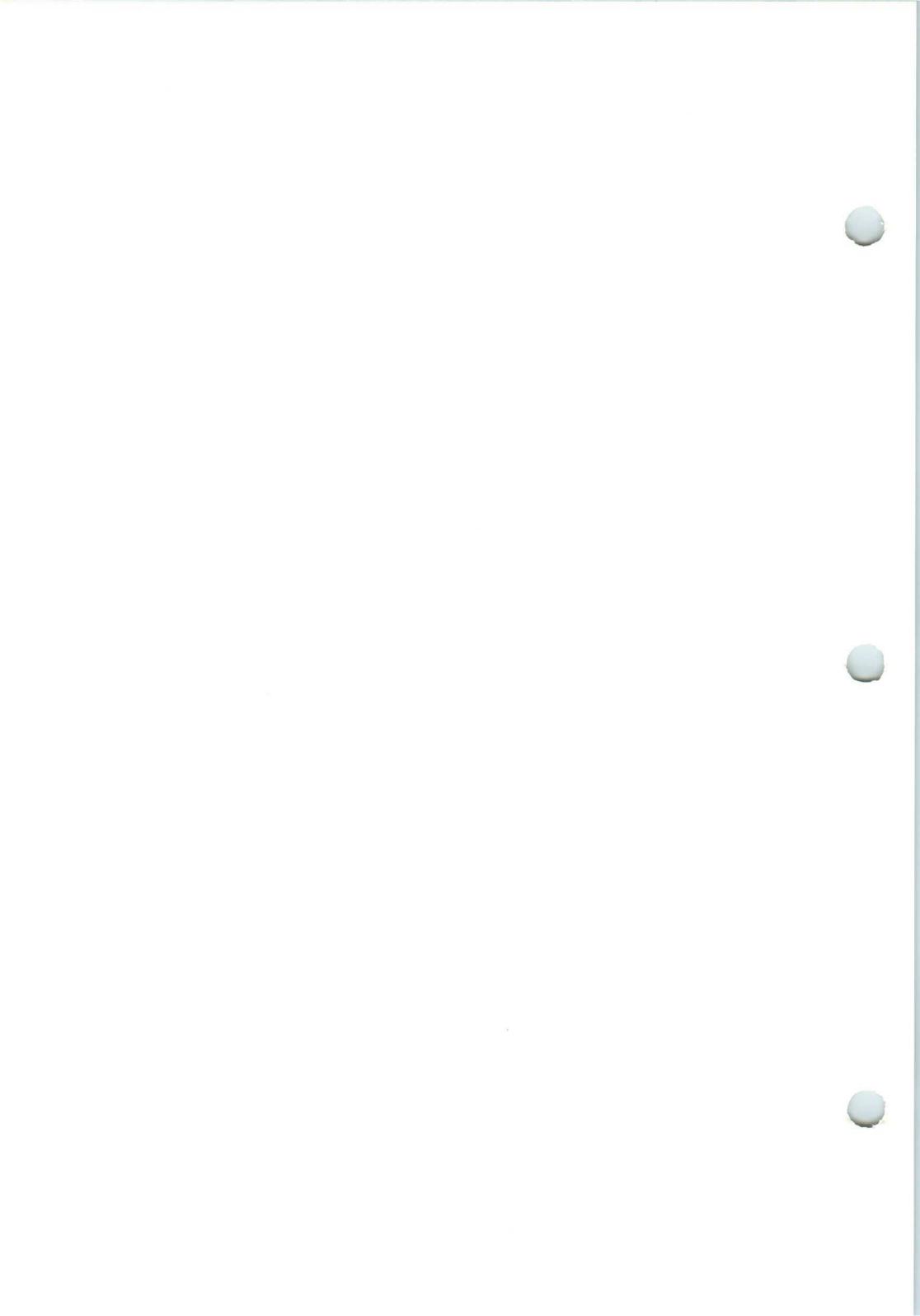
# A56-120X

Radial Converging



All dimensions in mm

Not to be scaled



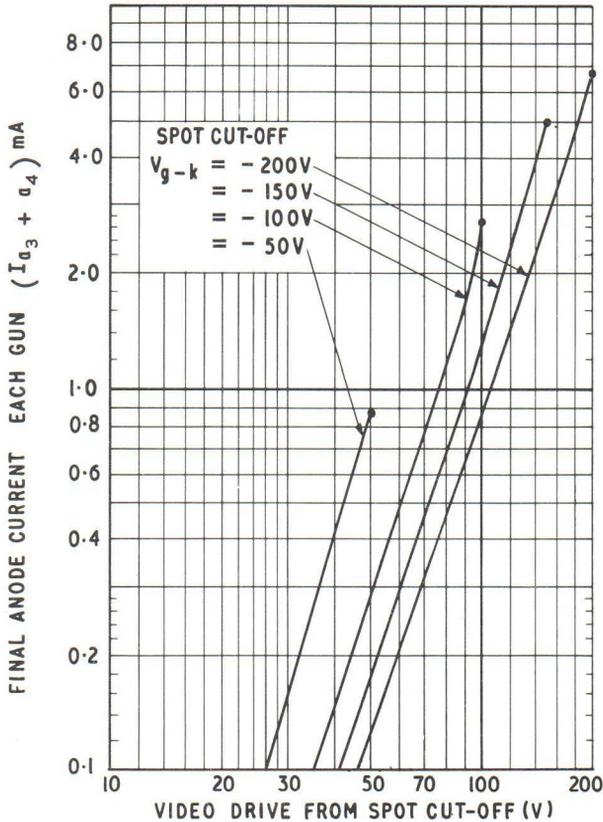
GRID MODULATION — Each gun

$V_{a_3-a_4} = 20$  to  $27.5$  kV

$V_{a_2-k}$  adjusted for focus

$V_{a_1-k}$  adjusted to provide spot cut-off for required  $V_{g-k}$

• zero bias point



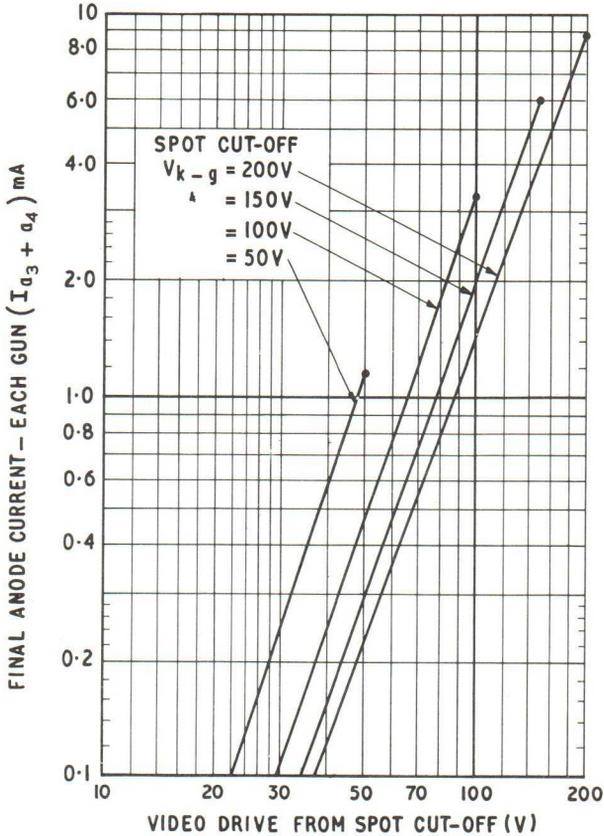
CATHODE MODULATION — Each gun

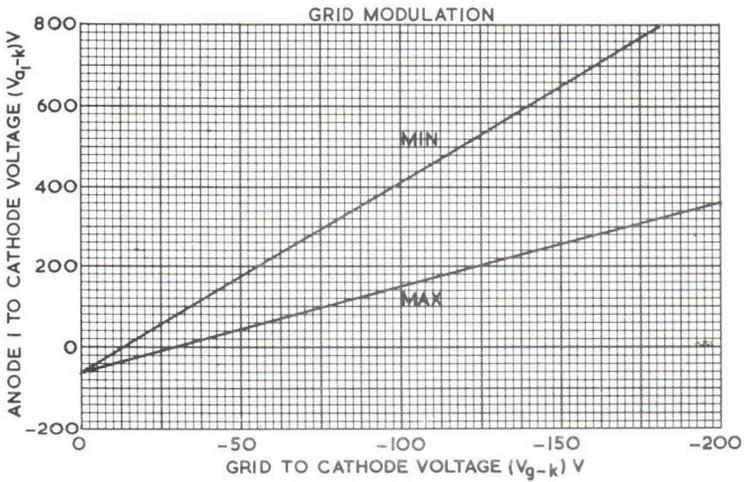
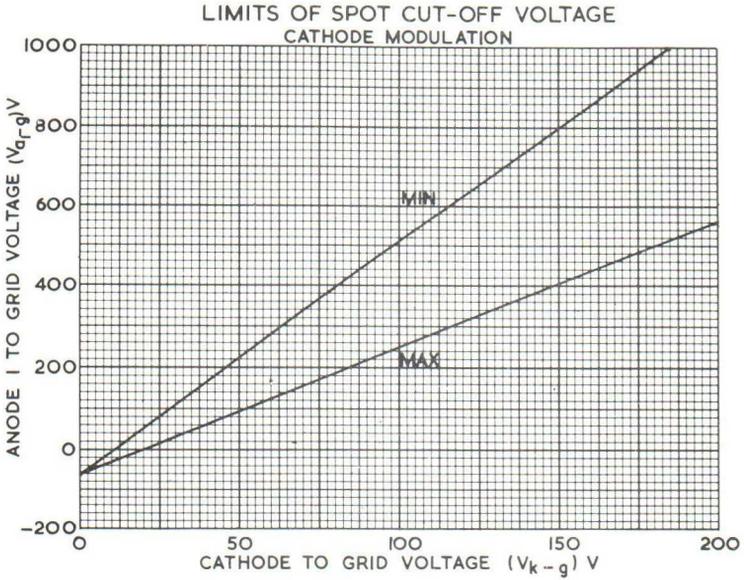
$V_{a_3-a_4} = 20$  to  $27.5$  kV

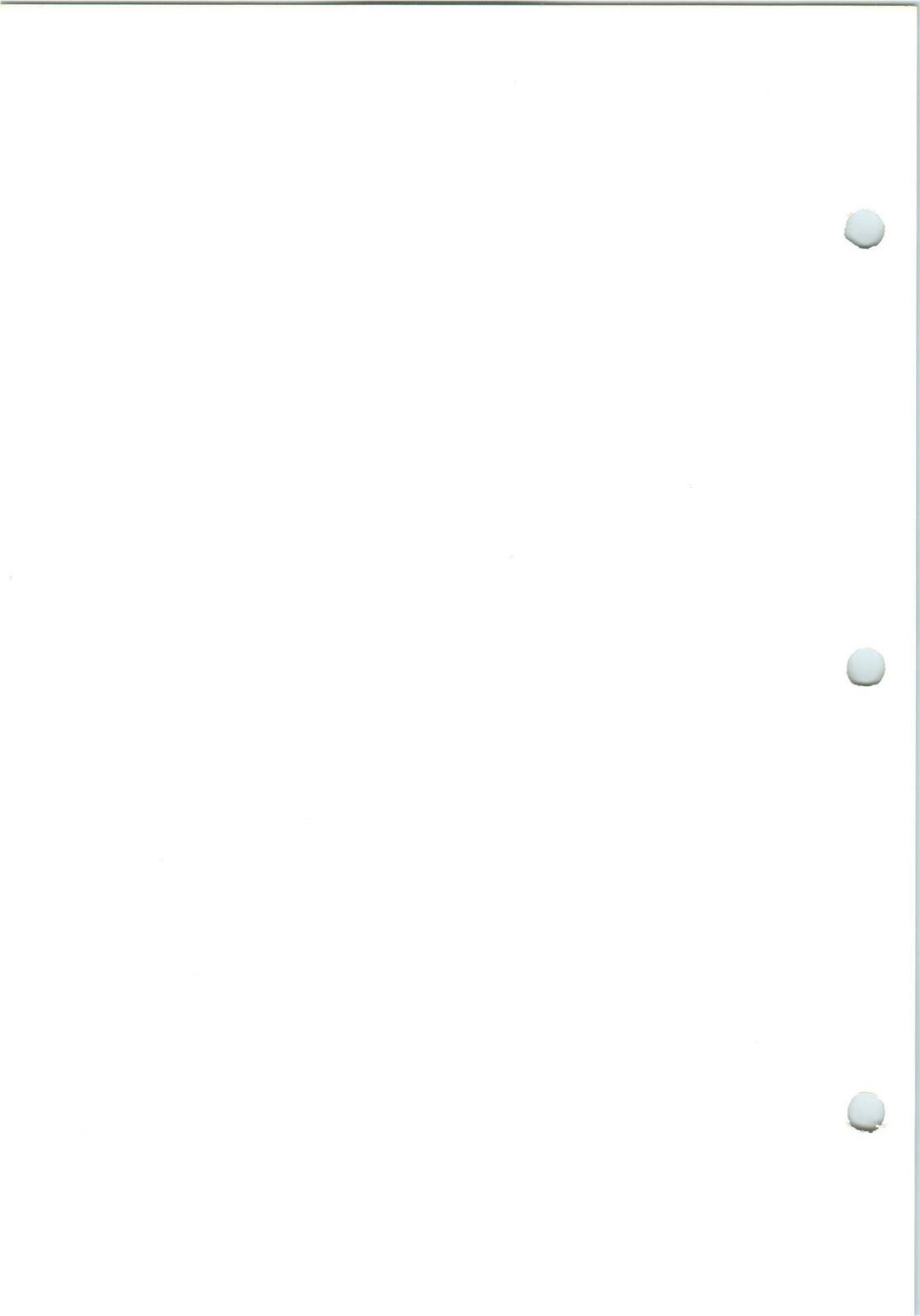
$V_{a_2-g}$  adjusted for focus

$V_{a_1-g}$  adjusted to provide spot cut-off  
for required  $V_{k-g}$

- zero bias point







# Colour Television Picture Tube

## 63-cm, 90° Rectangular

# A63-200X

- ★ Electrostatic focus
- ★ Rare-earth (red) phosphor
- ★ Magnetic convergence
- ★ New green phosphor
- ★ 63 cm Screen diagonal, 1905 sq. cm screen area
- ★ Temperature-compensated shadow-mask assembly
- ★ High resolution gun
- ★ Banded-type implosion protection
- ★ High brightness screen
- ★ For push-through cabinet designs
- ★ Integral mounting lugs

### CONSTRUCTIONAL FEATURES

A temperature-compensated shadow-mask assembly minimises the problem of shadow-mask expansion which formerly limited the performance of a rectangular colour picture tube. Optimum field purity and uniformity are maintained by the temperature-compensated shadow-mask assembly during warm-up.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

The tube also incorporates integral implosion protection provided by reinforcing bars which are attached to the periphery of the tube panel with epoxy resin and tension bands. This method makes this tube suitable for push-through cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis: Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic

#### Deflection Angles (Approx.):

Diagonal	89 deg
Horizontal	78 deg
Vertical	63 deg

#### Direct Interelectrode Capacitance (approx.):

Grid of any gun to all other electrodes	7.5 pF				
Anode 2 to all other electrodes	6.5 pF				
All cathodes to all other electrodes	15.0 pF				
External conductive coating to anode 3 + 4	<table style="display: inline-table; vertical-align: middle;"> <tr> <td style="font-size: 2em; padding-right: 5px;">{</td> <td>2500 max. pF</td> </tr> <tr> <td style="font-size: 2em; padding-right: 5px;">}</td> <td>2000 min. pF</td> </tr> </table>	{	2500 max. pF	}	2000 min. pF
{	2500 max. pF				
}	2000 min. pF				

### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	53%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.74 mm

## Thorn Colour Tubes Limited

Product Engineering Skelmersdale Lancs.

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## Mechanical

Tube Dimensions:	
Overall length	526.6 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	633.25 ± 2.4 mm
Greatest width	550.82 ± 2.4 mm
Greatest height	446.94 ± 2.4 mm
Minimum Screen Dimensions (Projected)	
Diagonal	584.1 mm
Greatest width	504.8 mm
Greatest height	395.6 mm
Area	1905 sq. cm.
Base Designation*	B14G 12-Pin
Bulb Contact Designation	CT8 Cavity Cap
Pin Position Alignment	Pin No. 12 Aligns approx. with Anode Bulb Contact
Weight (approx.)	18 kg

## Design Maximum Ratings †

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 Voltage	27.5 max. kV 20 min. kV
Total Anode Current	
long-term average	1000 max. μA
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V
Heater Voltage (AC or DC) ‡	
Under operating conditions	6.9 max. V 5.7 min. V
Under standby conditions	5.5 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode:	
During equipment warm-up period not exceeding 15 seconds	450 max. V
After equipment warm-up period:	
Combined AC and DC value	200 max. V
DC component value	200 max. V
Heater positive with respect to cathode:	
AC component value	200 max. V
DC component value	0 max. V

## Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltages between 20 and 27.5 kV  
Anode 2 (Focusing Electrode) 16.8% to 20% of Voltage  
Anode 3 + 4 voltage

Anode 1 and Grid Voltages for Visual Extinction of Focused Spot

see cut-off design chart.

Maximum Ratio of Anode 1 voltages, Highest gun to lowest gun in any tube (At grid spot cut-off voltage of -100 V) 1.86

Heater Voltage: ‡

Under operating conditions:

When standby operation is not utilised 6.3 V

When 5.0 V standby operation is utilised § 6.0 V

Under standby conditions 5.0 V

Anode 2 Current (Total) -15 to +15 μA

Anode 1 Current -5.0 to +5.0 μA

Displacements, measured at centre of screen:

Raster centring displacement:

Horizontal ± 11.9 mm

Vertical ± 11.4 mm

Lateral distance between the blue beam and the converged red and green beams ± 6.4 mm

Radial convergence displacement excluding effects of dynamic convergence (each beam) ± 9.4 mm

Maximum required Correction for Register ¶

(Including effect of earth's magnetic field when using recommended components) as measured at the centre of the screen in any direction 0.13 mm max.

### Illum. D

To produce white light of .....	6550° K+ 7 M.P.C.D.	9300° K+ 27 M.P.C.D.
---------------------------------	------------------------	-------------------------

CIE Co-ordinates:

X .....	0.313	0.281
Y .....	0.329	0.311

Percentage of total anode current supplied by each gun (average):

Red .....	41%	30%
Blue .....	24%	31%
Green .....	35%	39%

Ratio of cathode currents:

Red/Blue:		
Minimum .....	1.35	0.75
Typical .....	1.70	0.95
Maximum .....	2.20	1.25

All footnotes on page 3

## Red/Green:

Minimum.....	0.95	0.60
Typical .....	1.15	0.75
Maximum.....	1.70	1.10

## Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode) Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design utilises grid voltage of -150 V for visual extinction of focused spot 255 to 655 V

Grid Voltage for visual extinction of focused spot when circuit design utilises Anode 1 voltage of 300V -75 to -173 V

Heater Voltage‡  
 Under operating conditions:  
 When standby operation is not utilised 6.3 V  
 When 5.0 V standby operation is utilised‡ 6.0 V  
 Under standby conditions§ 5.0 V

## LIMITING CIRCUIT VALUES

### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

### Low-Voltage Circuits

Effective Grid-to-cathode-circuit resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios.

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than 0.5 M $\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CTS cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours. De-gaussing of the tube will be necessary.

Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1 M $\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

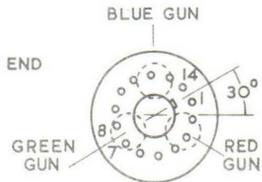
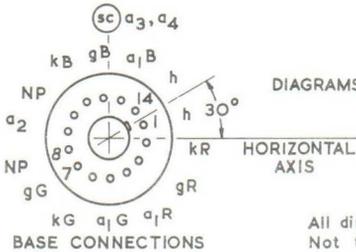
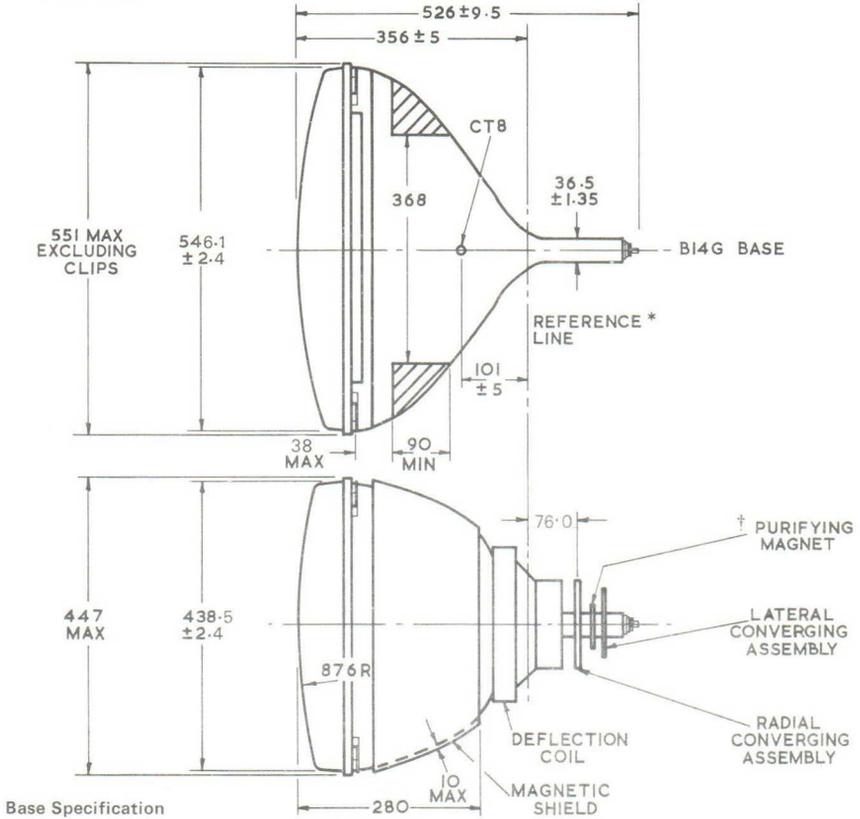
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

# Colour Television Picture Tube

# A63-200X

## DIMENSIONAL OUTLINE

Complete Tube

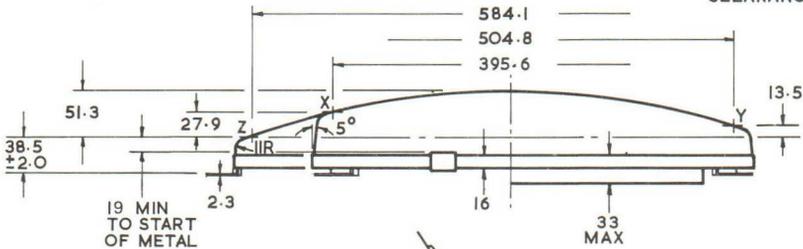
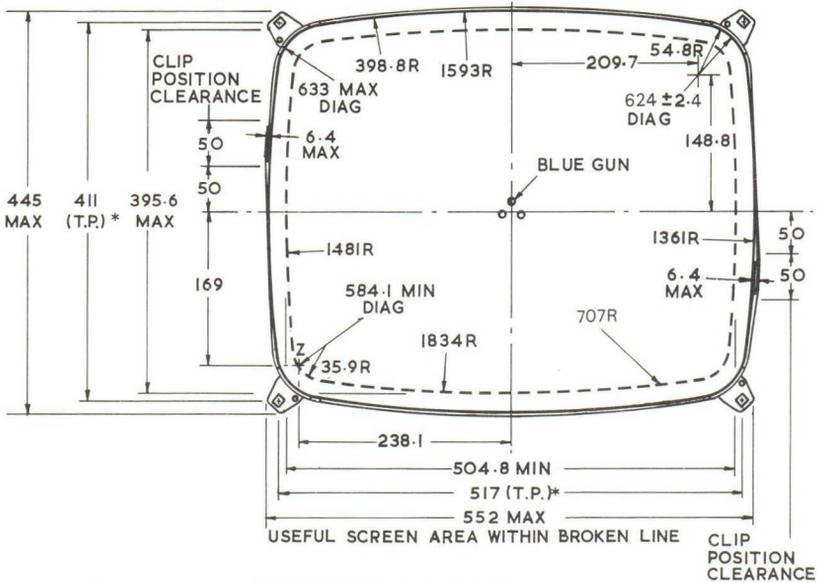


All dimensions in mm  
Not to be scaled

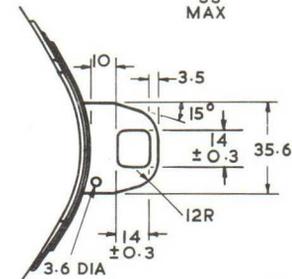
\* Determined by reference line gauge No. 14.JEDEC No.G162.

† Purifying magnet may be positioned on other side of lateral converging assembly.

Detail of Panel



Detail of Mounting Lug



All dimensions in mm

CORNER LUG

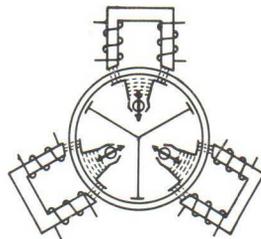
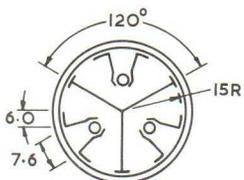
Not to be scaled

\* Bolts for mounting must be within circles of 9.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.

# Colour Television Picture Tube

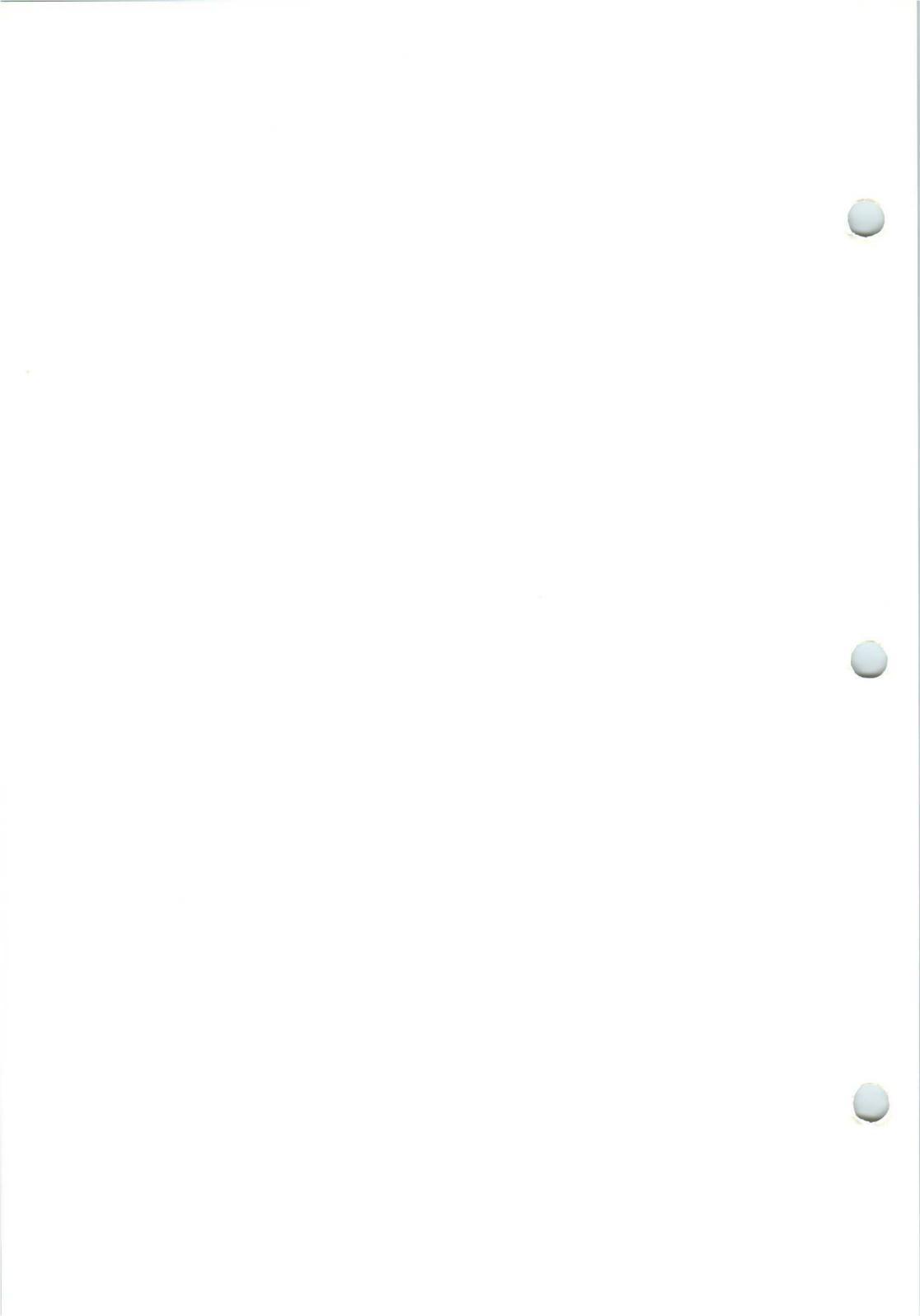
# A63-200X

Radial Converging



All dimensions in mm

Not to be scaled



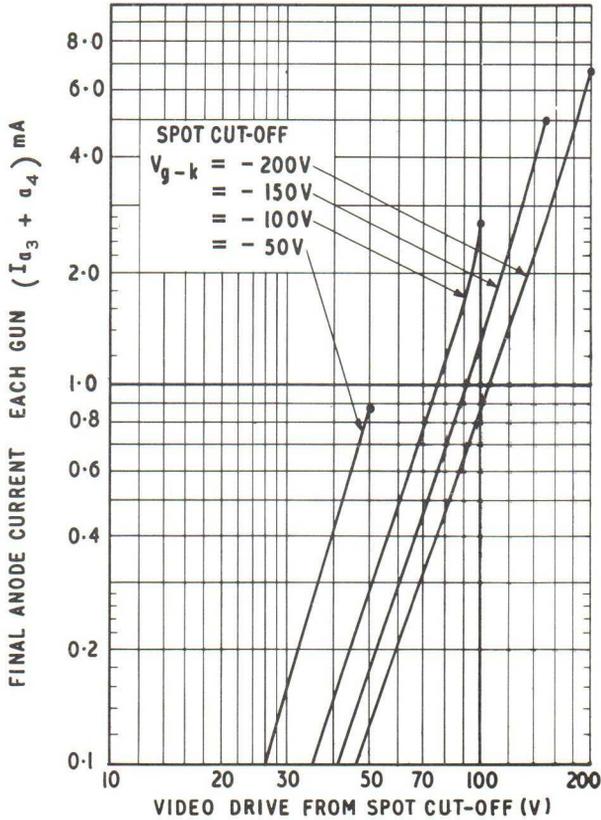
GRID MODULATION — Each gun

$V_{a_3 - a_4} = 20$  to  $27.5$  kV

$V_{a_2 - k}$  adjusted for focus

$V_{a_1 - k}$  adjusted to provide spot cut-off  
for required  $V_{g - k}$

• zero bias point



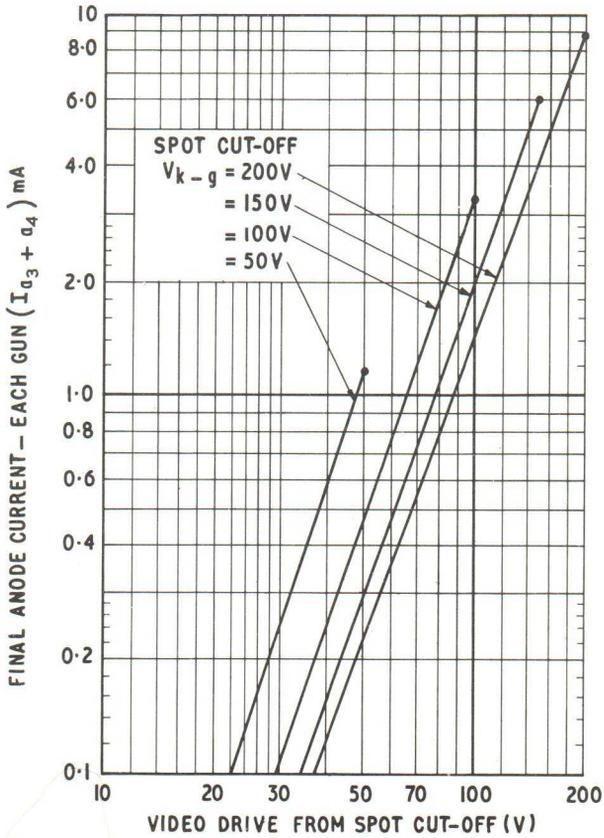
CATHODE MODULATION — Each gun

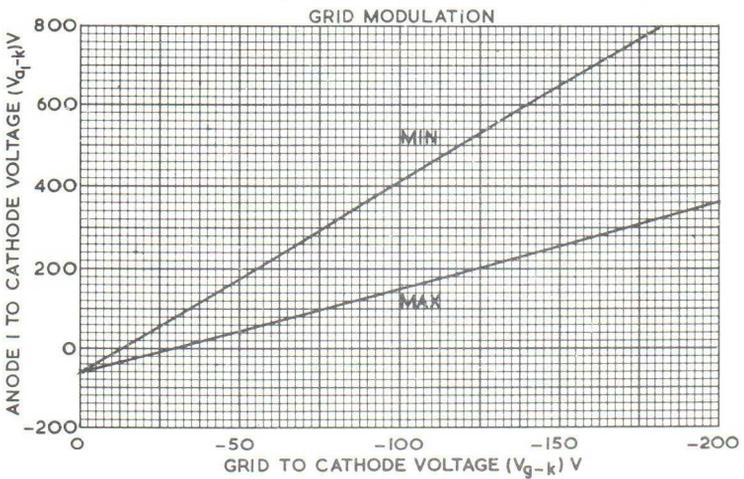
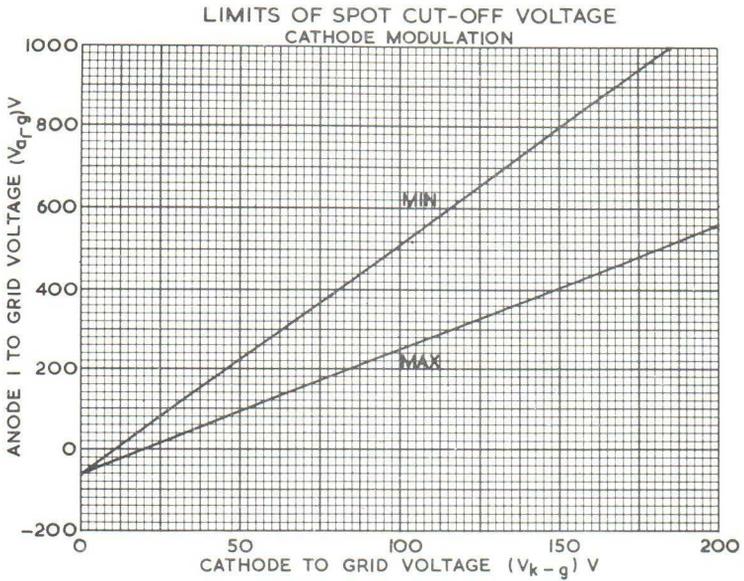
$V_{a_3 - a_4} = 20 \text{ to } 27.5 \text{ kV}$

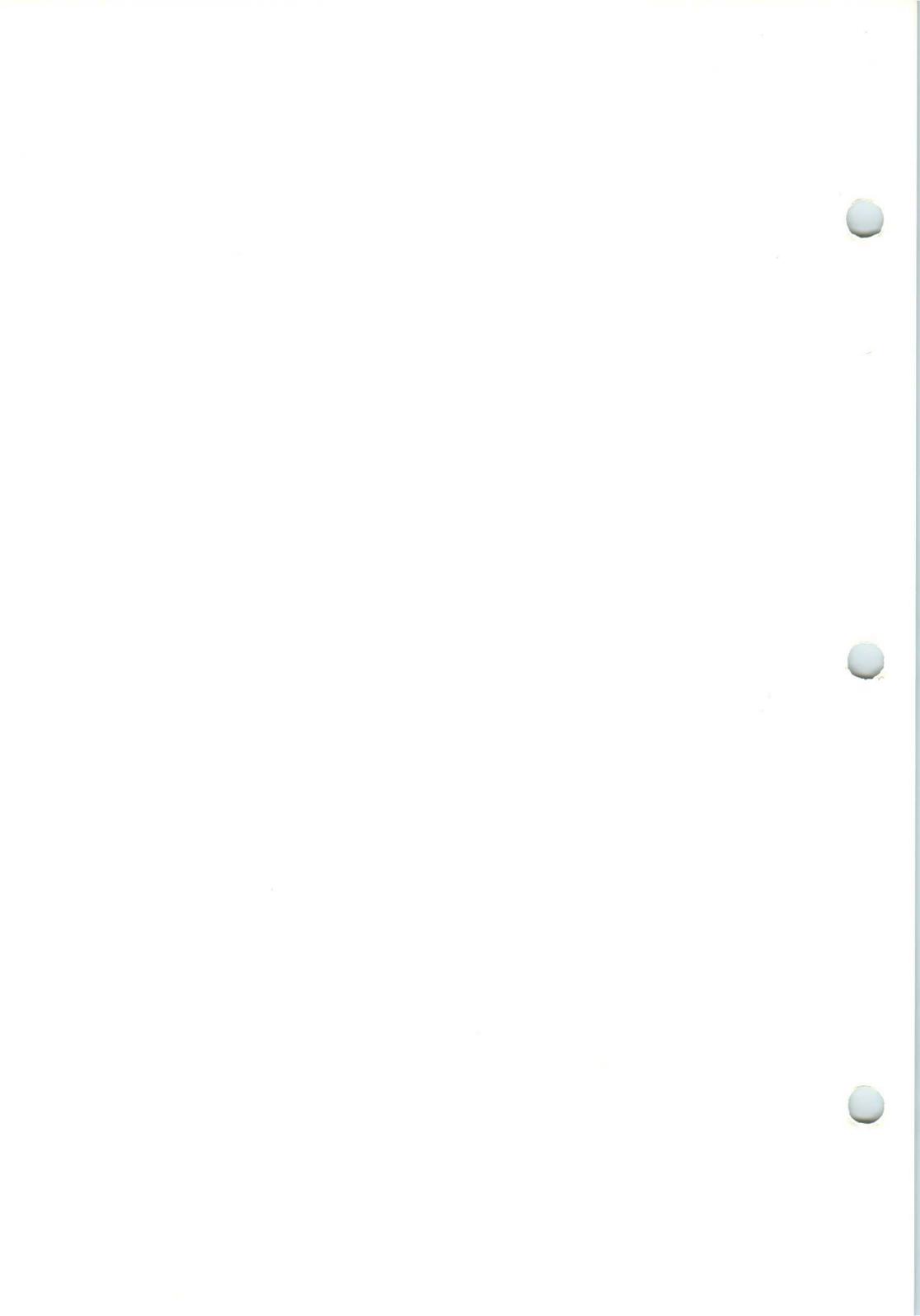
$V_{a_2 - g}$  adjusted for focus

$V_{a_1 - g}$  adjusted to provide spot cut-off  
for required  $V_{k - g}$

• zero bias point







# Colour Television Picture Tube

## 67-cm, 90° Ultra-Rectangular

# A67-120X

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>★ Ultra-Rectangular — Straighter sides and square corners</li> <li>★ 4 x 3 Aspect ratio</li> <li>★ 63 cm Screen diagonal, 2032 sq.cm screen area</li> <li>★ High resolution gun</li> <li>★ Moiré minimised in 625 TV-line systems</li> <li>★ High brightness screen</li> </ul> | <ul style="list-style-type: none"> <li>★ Rare-earth (red) phosphor</li> <li>★ New green phosphor</li> <li>★ Temperature-compensated shadow-mask assembly</li> <li>★ Banded-type implosion protection</li> <li>★ For push-through cabinet designs</li> <li>★ Integral mounting lugs</li> </ul> |
|---|---|

### CONSTRUCTIONAL FEATURES

This is a 90° ultra-rectangular colour picture tube. The screen profile is more rectangular than previous tubes (straight sides and 'square corners') and has a 4 x 3 aspect ratio. The shadow-mask of this tube has been designed to minimise moiré in 625 TV line systems.

The screen incorporates improved phosphors consisting of red-emitting, yttrium-oxysulphide rare-earth phosphor; a new green-emitting sulphide phosphor; and a blue-emitting sulphide phosphor.

A slurry process is used to deposit these phosphors on the faceplate to attain their full efficiencies.

The tube also incorporates integral implosion protection provided by reinforcing bars which are attached to the periphery of the tube panel with epoxy resin and tension bands. This method makes this tube suitable for push-through cabinet designs. Four mounting lugs have been incorporated in the system to facilitate mounting in the colour TV cabinet.

### GENERAL DATA

#### Electrical

Electron Guns, three with axes tilted towards tube axis: Red, Blue, Green

Heater of each gun, series connected internally with each of the other two heaters:

Current at 6.3 V	900 mA
Convergence Method	Magnetic
Focusing Method	Electrostatic
Focus Lens	Bipotential
Deflection Method	Magnetic
Deflection Angles (Approx.):	
Diagonal	90 deg
Horizontal	78 deg
Vertical	60 deg
Direct Interelectrode Capacitance (approx.):	
Grid of any gun to all other electrodes	7.5 pF
Anode 2 to all other electrodes	6.5 pF
All cathodes to all other electrodes	15 pF
External conductive coating to anode 3 + 4	{ 2500 max. pF 2000 min. pF

#### Optical

Faceplate	Filterglass
Light transmission at centre (approx.)	52%
Surface	Polished
Screen	Aluminised
Phosphor, rare-earth (Red), sulphide (Blue and Green)	
Persistence	Medium-short
Array	Dot trios
Spacing between centres of adjacent dot trios (approx.)	0.66 mm

## Thorn Colour Tubes Limited

Product Engineering Skelmersdale Lancs.

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## Mechanical

### Tube Dimensions:

Overall length	544.3 ± 9.5 mm
Neck length	170.0 ± 4.8 mm
At mould-match line:	
Diagonal	666.7 ± 2.4 mm
Greatest width	571.8 ± 2.4 mm
Greatest height	442.5 ± 2.4 mm

### Minimum Screen Dimensions (Projected)

Diagonal	626.3 mm
Greatest width	527.7 mm
Greatest height	395.8 mm
Area	2032 sq.cm

Bulb Designation*	B14G 12-Pin
Bulb Contact Designation	CT8 Cavity Cap
Pin Position Alignment	Pin No. 12 Aligns approx. with Anode Bulb Contact
Weight (approx.)	20.7 kg

### Design Maximum Ratings †

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

Anode 3 + 4 voltages	27.5 max. kV 20.0 min. kV
Total Anode Current long-term average	1000 max. $\mu$ A
Anode 2 (Focusing Electrode) Voltage	6000 max. V
Peak Anode 1 Voltage, including Video Signal Voltage	1000 max. V
Grid Voltage:	
Negative bias value	400 max. V
Negative operating cut-off value	200 max. V
Positive bias value	0 max. V
Positive peak value	2 max. V

### Heater Voltage (AC or DC) ‡

Under operating conditions	6.9 max. V 5.7 min. V
Under standby conditions	5.5 max. V

### Peak Heater-Cathode Voltage:

Heater negative with respect to cathode:

During equipment warm-up period not exceeding 15 seconds 450 max. V

After equipment warm-up period:

Combined AC and DC value 200 max. V  
DC component value 200 max. V

Heater positive with respect to cathode:

AC component value 200 max. V  
DC component value 0 max. V

## Equipment Design Ranges

Unless otherwise specified, values are for each gun and voltage values are positive with respect to cathode.

For Anode 3 + 4 voltage 25 kV  
Anode 2 (Focusing Electrode) Voltage 16.8% to 20% of Anode 3 + 4 voltage

Anode 1 and Grid Voltages for Visual Extinction of Focused Spot

see cut-off design chart

Maximum Ratio of Anode 1 voltages, Highest gun to lowest gun in any tube (At grid spot cut-off voltage of -100 V) 1.86  
Heater Voltage: ‡

Under operating conditions:

When standby operation is not utilised 6.3 V

When 5.0 V standby operation is utilised § 6.0 V

Under standby conditions 5.0 V

Anode 2 Current (Total) -15 to +15  $\mu$ A

Anode 1 Current -5.0 to +5.0  $\mu$ A

Displacements, measured at centre of screen:

Raster centring displacement:

Horizontal ± 11.4 mm  
Vertical ± 11.4 mm

Lateral distance between the blue beam and the converged red and green beams ± 6.4 mm

Radial convergence displacement excluding effects of dynamic convergence (each beam) ± 9.4 mm

Maximum required Correction for Register ¶

(Including effect of earth's magnetic field when using recommended components) as measured at the centre of the screen in any direction 0.13 mm max.

### Illum. D

To produce white light of .....	6550° K+ 7 M.P.C.D.	9300° K+ 27 M.P.C.D.
---------------------------------	------------------------	-------------------------

CIE Co-ordinates:

X.....	0.313	0.281
Y.....	0.329	0.311

Percentage of total anode current supplied by each gun (average):

Red.....	41%	30%
Blue.....	24%	31%
Green.....	35%	39%

Ratio of cathode currents:

Red/Blue:		
Minimum.....	1.35	0.75
Typical.....	1.70	0.95
Maximum.....	2.20	1.25

All footnotes on page 3

### Red/Green:

Minimum.....	0.95	0.60
Typical.....	1.15	0.75
Maximum.....	1.70	1.10

### Typical Operation

Unless otherwise specified, voltage values are for each gun and are positive with respect to cathode.

Anode 3 + 4 Voltage 25 kV

Anode 2 (Focusing Electrode) Voltage 4200 to 5000 V

Anode 1 Voltage when circuit design utilises grid voltage of -150 V for visual extinction of focused spot 255 to 655 V

Grid Voltage for visual extinction of focused spot when circuit design utilises Anode 1 voltage of 300V -75 to -173 V

Heater Voltage‡  
 Under operating conditions:  
 When standby operation is not utilised 6.3 V  
 When 5.0 V standby operation is utilised§ 6.0 V  
 Under standby conditions§ 5.0 V

### LIMITING CIRCUIT VALUES

#### High-Voltage Circuits

Anode 2 circuit resistance 7.5 max. MΩ

In order to minimise the possibility of damage to the tube caused by a momentary internal arc, it is recommended that the high-voltage power supply and the anode 2 power supply be of the limited-energy type, in which the short-circuit current does not exceed 20 milliamperes.

#### Low-Voltage Circuits

Effective Grid-to-cathode-circuit resistance (each gun) 0.75 max. MΩ

The low-voltage circuits, including all heater circuits, should be analysed by assuming the colour picture tube heater is connected directly to the receiver chassis ground. Under these conditions the circuits to the elements of all tubes, including the colour picture tube, operating from the same heater winding and all connections of any other circuits to the heater winding should each have an impedance such that their respective power sources in combination will not supply a continuous short circuit current of more than 750 milliamperes total in the assumed picture tube heater ground connection. The leads from all other circuits must be separated from the picture tube leads by a minimum distance of 6.4 mm to prevent energy transfer to the picture tube circuits. Such current limitation will help prevent picture tube damage in case of momentary cascade arcing.

\* The tube socket, including its associated, physically-attached hardware and circuitry, must not weigh more than one-half kilogram.

† The maximum ratings in the tabulated data are established in accordance with the following definitions of the Design-Maximum Rating System for rating electron devices.

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no Design-Maximum value

for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variations, signal variation, and environmental conditions.

‡ For maximum cathode life, it is recommended that the heater supply be regulated. The series impedance to any chassis connection in the DC biasing circuit for the heater should be between 100 kilohms and 1 megohm.

§ The use of a 5 volt standby condition in conjunction with 6 volt operating condition is recommended to improve the reliability of the colour picture tube by extending the emission life and reducing other gun-related defects. A maximum heater voltage of 5.5 volts (Design-Maximum value) may be maintained on the colour picture tube when the receiver is in the "off" (standby) position. All other voltages normally applied to the tube must be removed during standby operation.

¶ Register is defined as the relative position of the beam trios with respect to the associated phosphor-dot trios.

## GENERAL CONSIDERATIONS

### X-Radiation

This tube does not emit X-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance equal to or greater than 0.5 M $\Omega$ .

### Tube Handling

This tube should be handled carefully as required by any glass picture tube. Particular care should be taken to prevent damage to the seal area.

There is a region of anti-corona coating surrounding the CT8 cap, the tube should not be handled in this region.

### Orientation

Any position. Without pincushion correction, the best apparent balance of top and bottom pincushion distortion is obtained when the tube is operated with blue gun down. In this orientation, the bulb contact will be on the bottom.

It is recommended that any mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

De-gaussing of the tube will be necessary.

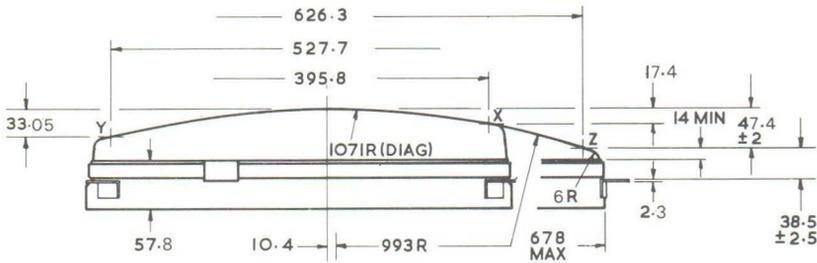
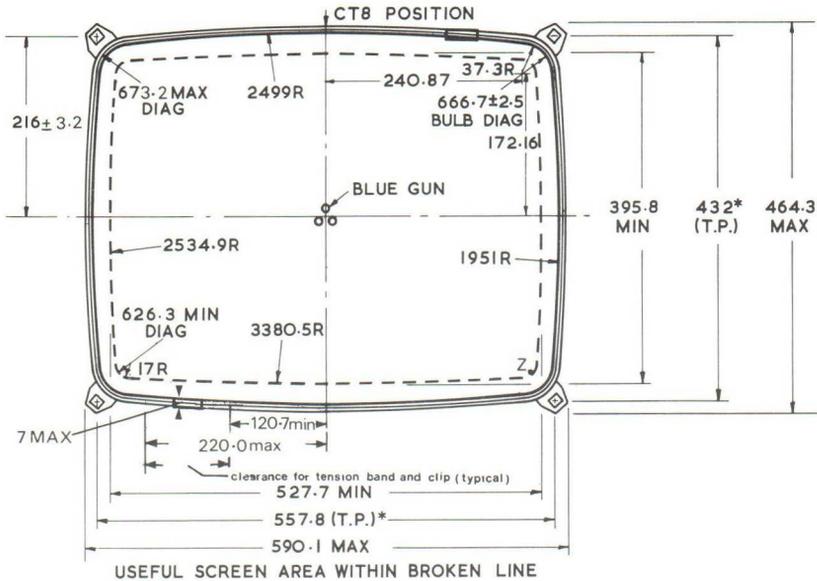
Mounting of this tube is by the integral mounting lugs. If the integral mounting system is accessible in the receiver it is recommended that it be connected to the receiver chassis through one of the mounting lugs. If the chassis is not at earth potential the connection should be made through a current limiting resistor (1 M $\Omega$ ).

The colour receiver mounting system should incorporate sufficient cushioning so that under normal conditions of shipment or handling an impact force of more than 35g is never applied to the tube.

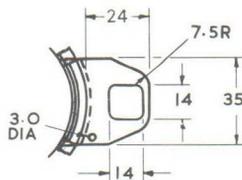
Contact to the external conductive coating should be made by multiple fingers to prevent possible damage to the tube from localised overheating due to poor contact. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.



Detail of Panel



Detail of Mounting Lug



All dimensions in mm

CORNER LUG

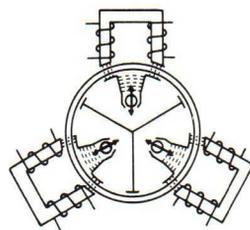
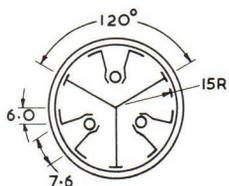
Not to be scaled

\* Bolts for mounting must be within circles of 9.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.

# Colour Television Picture Tube

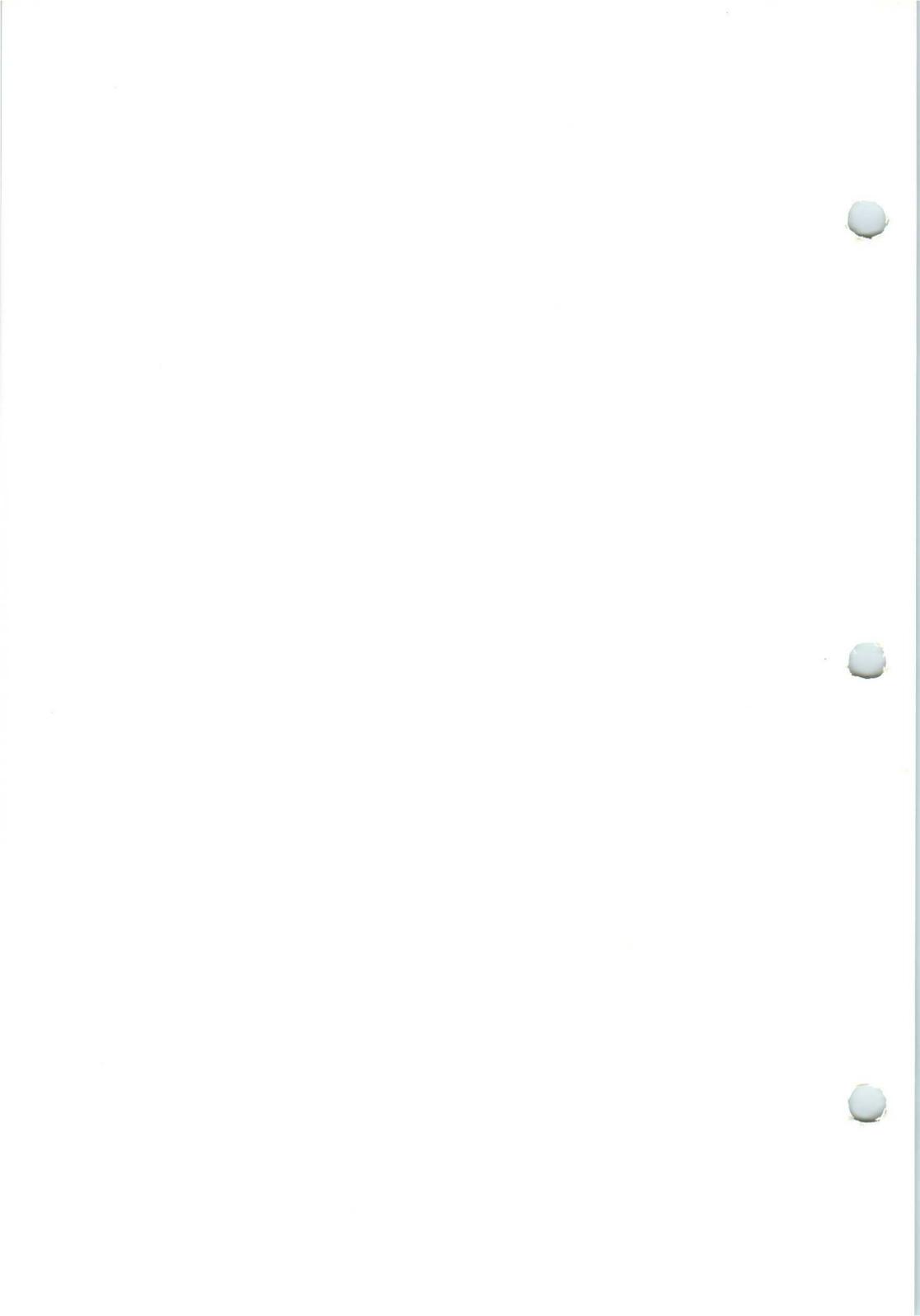
# A67-120X

Radial Converging



All dimensions in mm

Not to be scaled



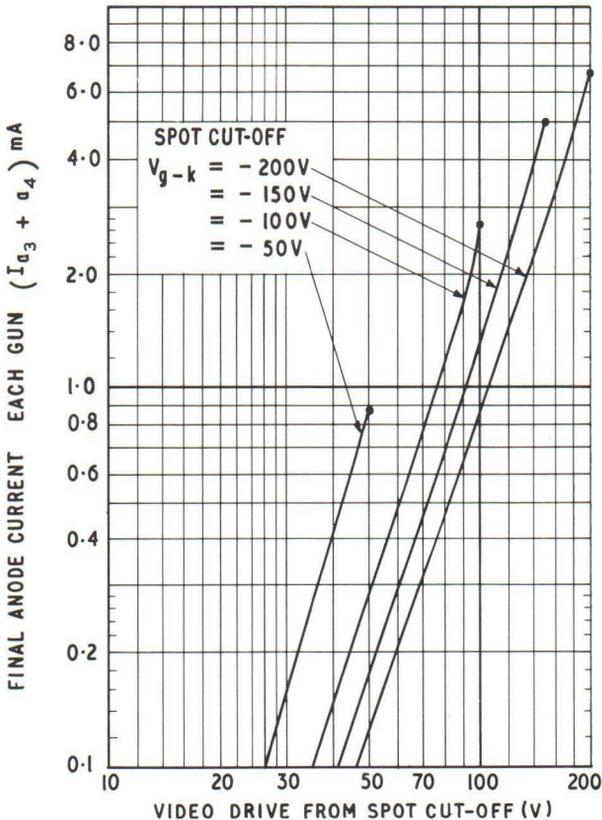
GRID MODULATION — Each gun

$V_{a_3-a_4} = 20$  to  $27.5$  kV

$V_{a_2-k}$  adjusted for focus

$V_{a_1-k}$  adjusted to provide spot cut-off  
for required  $V_{g-k}$

• zero bias point



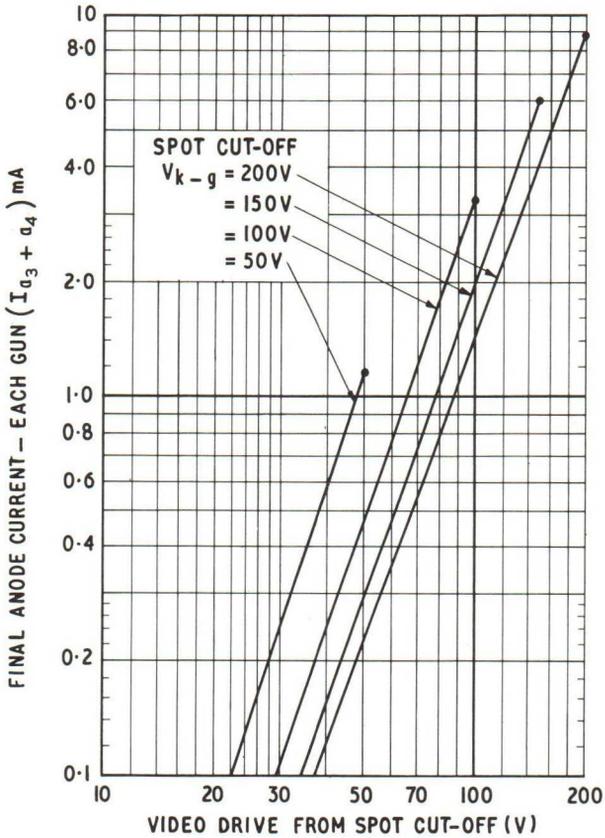
CATHODE MODULATION — Each gun

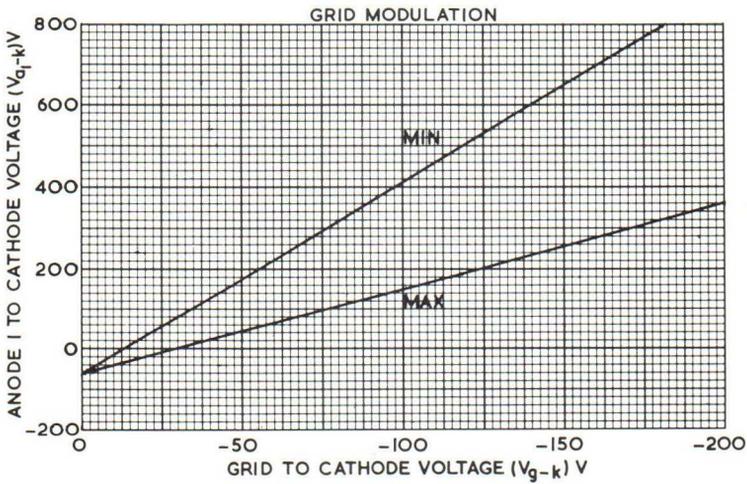
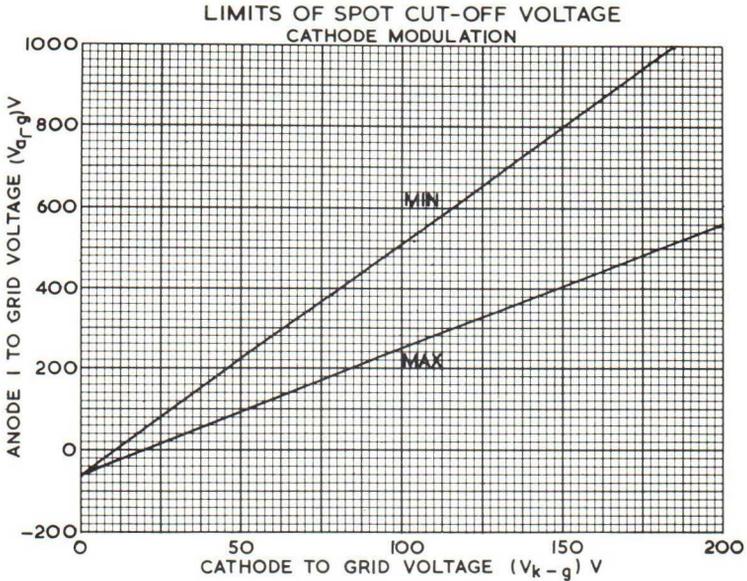
$V_{a_3-a_4} = 20 \text{ to } 27.5 \text{ kV}$

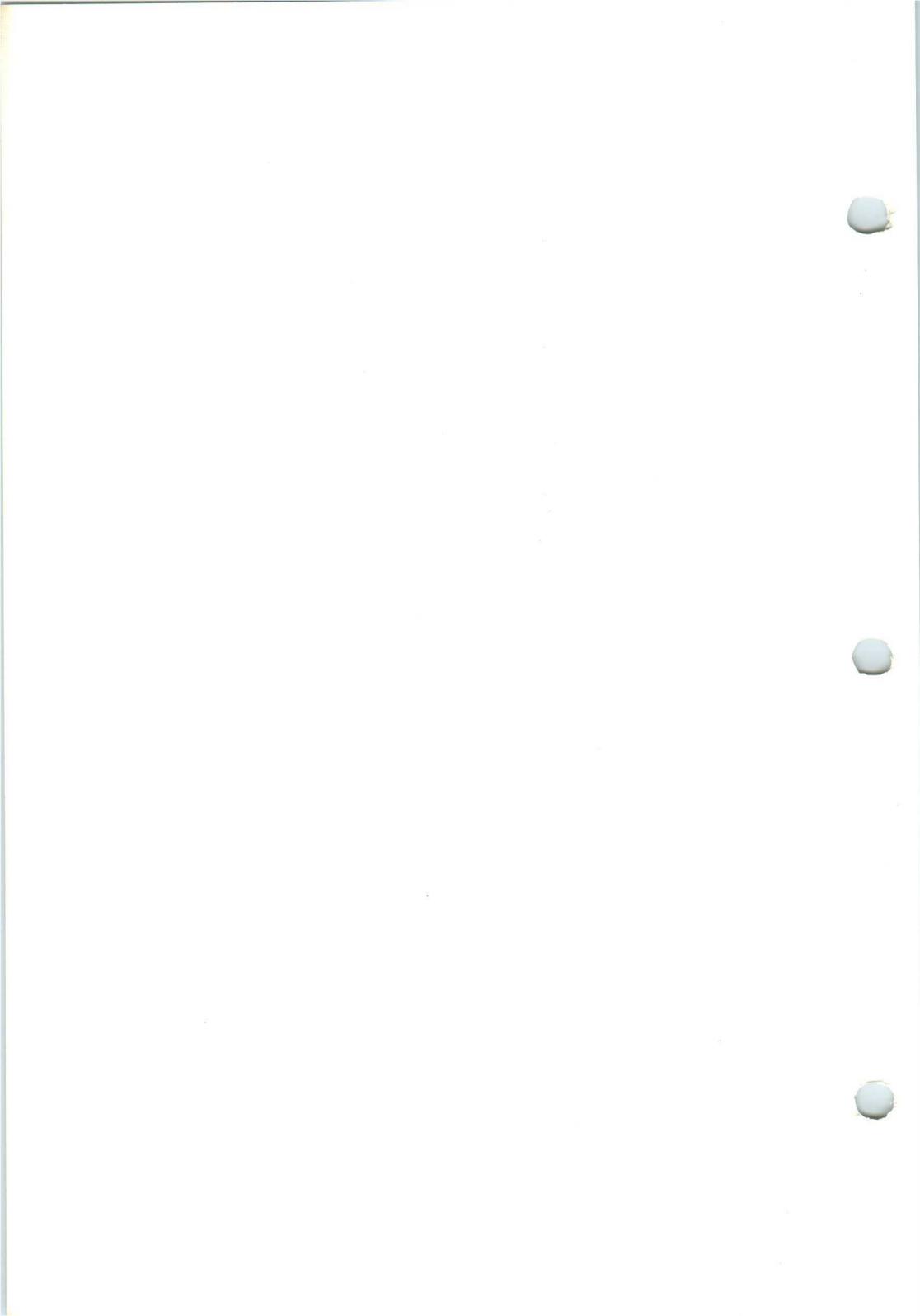
$V_{a_2-g}$  adjusted for focus

$V_{a_1-g}$  adjusted to provide spot cut-off  
for required  $V_{k-g}$

• zero bias point



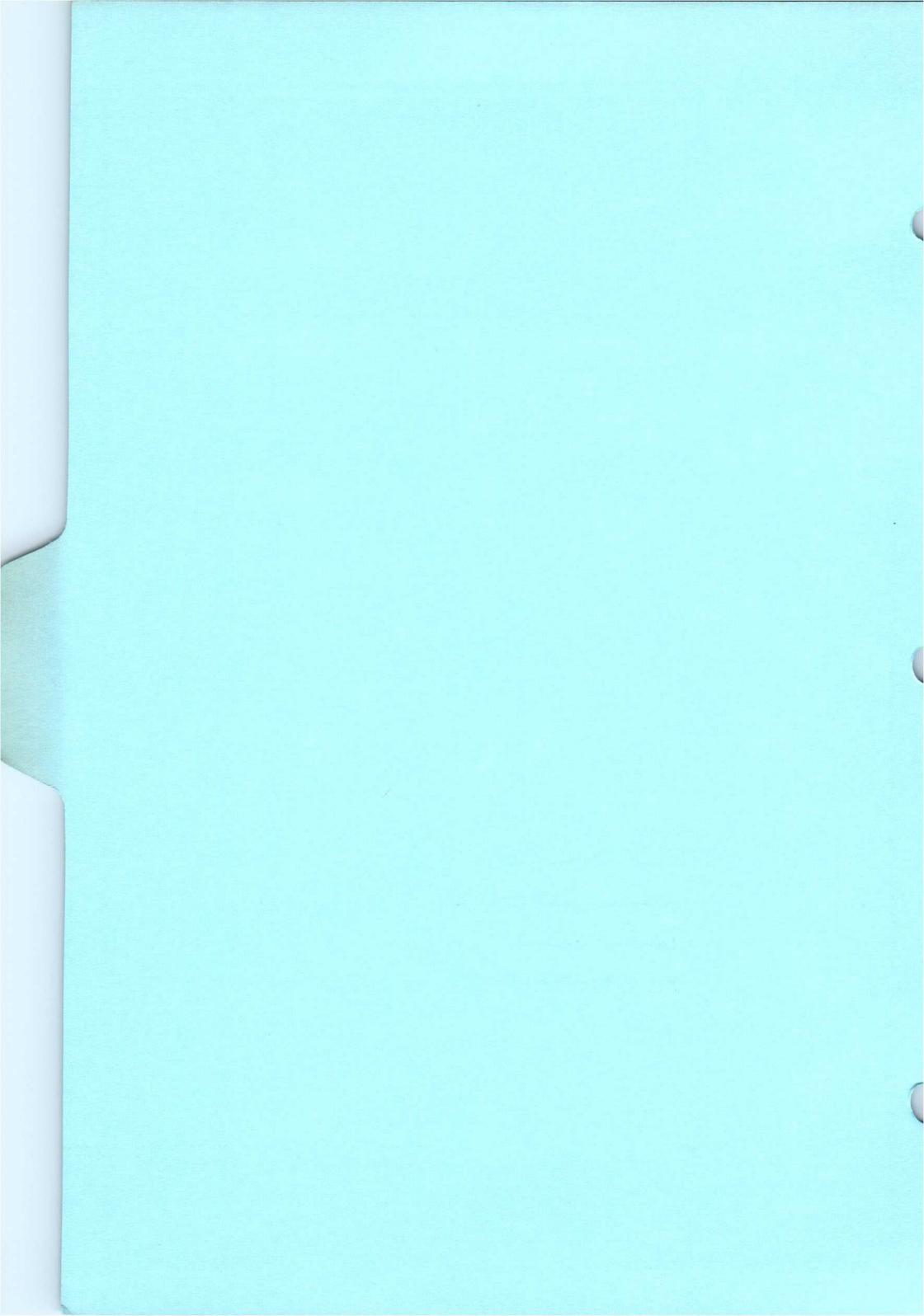




# **MONOCHROME PICTURE TUBES**

**Current types  
recommended for  
inclusion in  
new equipment**

**CURRENT  
MONOCHROME**



# Television Picture Tube

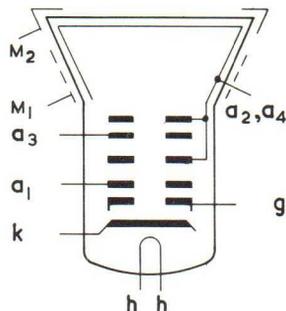
**CME1202**  
**A31-181W**

## GENERAL

Rectangular face, 12 inch, 110° diagonal  
Rimguard III reinforced envelope ¶  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 50% transmission (approx.)  
Straight gun, non ion trap  
External conductive coating  
29.4 mm maximum neck diameter

Heater voltage  $V_h$  6.3 V

Heater current  $I_h$  0.3\* A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4}(\max)$	13.5†	kV
Minimum second and fourth anode voltage	$V_{a2+a4}(\min)$	10.5	kV
Maximum third anode voltage	$V_{a3}(\max)$	+1000 to -500	V
Maximum first anode voltage	$V_{a1}(\max)$	550	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k}(\max)$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$V_{h-k}(\text{pk})\max$	400§	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k}(\max)$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k}(\max)$	1.5	MΩ

All voltages referred to cathode

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† The absolute rating of 16.5 kV must not be exceeded.

§ During a warming up period not exceeding 45 seconds.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard base see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

¶ This tube meets the requirements for intrinsically safe tubes laid down in the section of I.E.C. Publication 65 dealing with implosion.

**Thorn Radio Valves and Tubes Limited**

June 1971, Issue 2, Page 1



**INTER-ELECTRODE CAPACITANCES**

		*	†	
Cathode to all	$c_{k-all}$	3.0	3.5	pF
Grid to all	$c_{g-all}$	6.5	8.0	pF
Anodes 2 and 4 to coating $M_1$ (min)	$c_{a2+a4-M1}$ (min)		450	pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$c_{a2+a4-M2}$		150	pF ←

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

**TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)**

Second and fourth anode voltage	$V_{a2+a4-k}$	12		kV
First anode voltage	$V_{a1-k}$	400		V
Third anode voltage range for focus	$V_{a3-k}$	0	to 400	V
Final anode current (peak)	$i_{a2+a4(pk)}$	200	350	$\mu A$
Average peak to peak picture modulating voltage		29	36	V
Grid to cathode voltage for cut-off of raster	$V_{g-k}$		-40 to -77	V

**TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)**

Second and fourth anode voltage	$V_{a2+a4-g}$	12		kV
First anode voltage	$V_{a1-g}$	400		V
Third anode voltage range for focus	$V_{a3-g}$	0	to 400	V
Final anode current (peak)	$i_{a2+a4}$	200	350	$\mu A$
Average peak to peak picture modulating voltage		25	31	V
Cathode to grid voltage for cut-off of raster	$V_{k-g}$		36 to 66	V

# Television Picture Tube

**CME1202**  
**A31-181W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	15	Gs
Maximum distance of centre of magnetic field from reference line	53	mm

## DEFLECTION ANGLES

Height	80°	Width	99°	Diagonal	110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

There is an annular region of anti-corona coating with external diameter of 75 mm surrounding the CT8 cap, the tube should not be handled in this region.

The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 44 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal shell ( $M_2$ ) should be connected to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example  $2M\Omega$ .

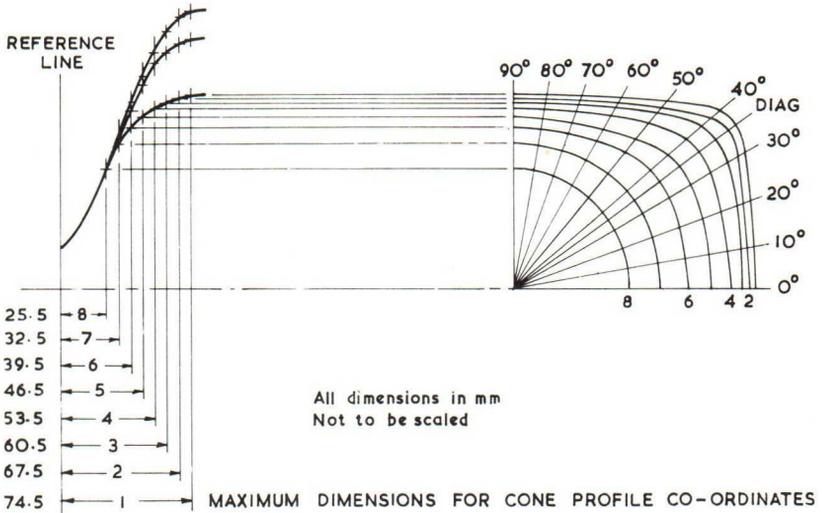
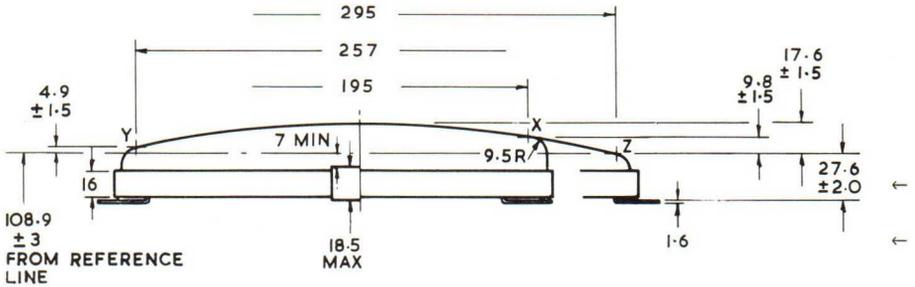
When flashover protection is incorporated the chassis return paths of  $M_1$  and  $M_2$  should be made in a manner appropriate to the protection system employed.

**TUBE WEIGHT** (approximate) - net 3.0 kg (6.5 lb)



# Television Picture Tube

**CME1202**  
**A31-181W**



Reference Plane No.	0° Major	10°	20°	30°	Diag.	40°	50°	60°	70°	80°	90° Minor
1	140.2	141.5	146.0	154.0	157.8	154.6	136.7	123.5	115.5	111.0	109.6
2	137.8	139.2	143.4	151.1	154.1	151.5	134.3	121.6	113.7	109.4	108.1
3	133.9	134.8	137.8	143.0	145.3	143.2	129.4	118.4	111.1	107.3	106.0
4	127.3	127.7	129.3	132.0	133.2	132.1	122.3	113.2	107.2	103.8	102.6
5	116.4	116.8	117.7	119.2	120.0	119.3	112.8	105.9	101.5	98.6	98.1
6	103.0	103.2	103.8	104.8	105.2	104.7	101.5	97.0	94.2	92.5	91.9
7	87.0	87.1	87.2	87.4	87.8	87.1	85.9	84.6	83.6	83.0	82.8
8	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3

0420

### GRID MODULATION

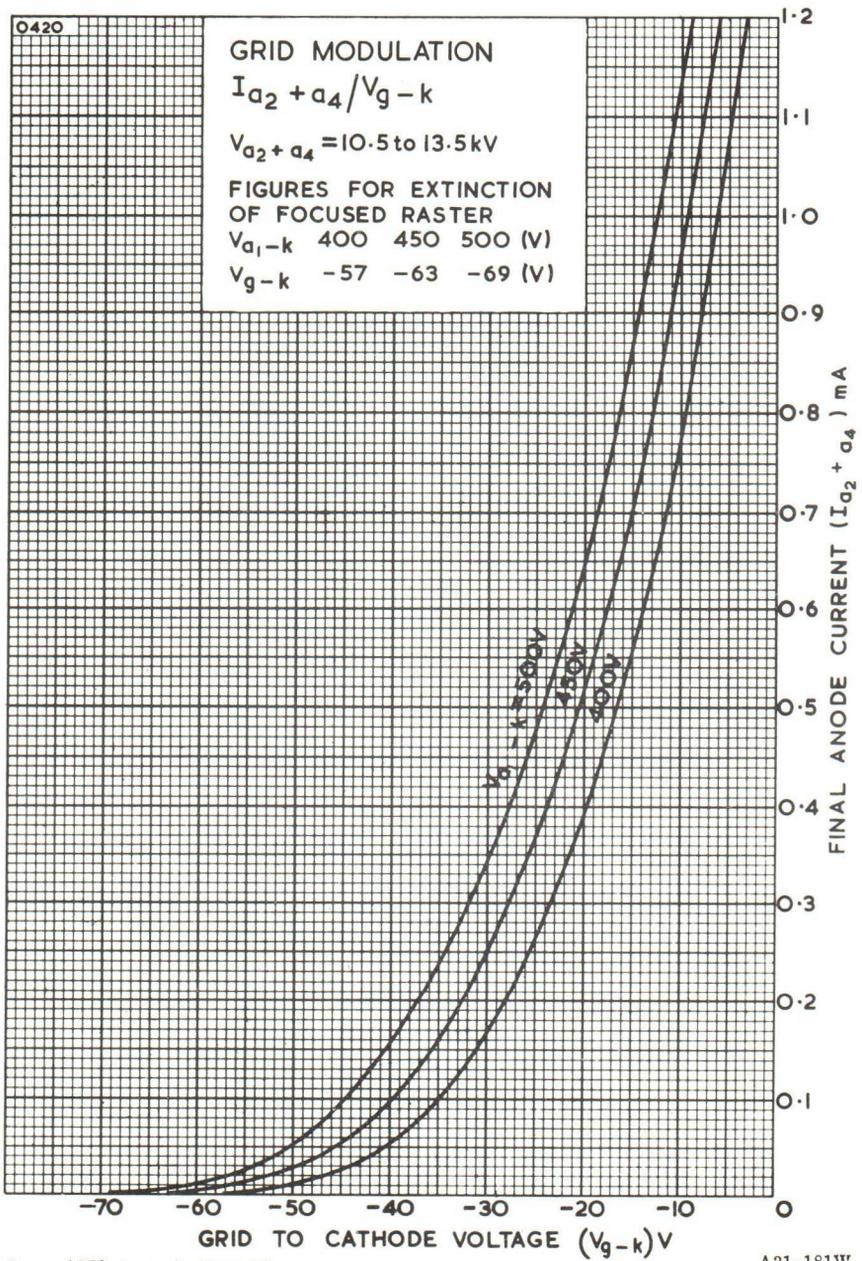
$$I_{a_2 + a_4} / V_{g-k}$$

$V_{a_2 + a_4} = 10.5 \text{ to } 13.5 \text{ kV}$

FIGURES FOR EXTINCTION  
OF FOCUSED RASTER

$V_{a_1-k}$  400 450 500 (V)

$V_{g-k}$  -57 -63 -69 (V)



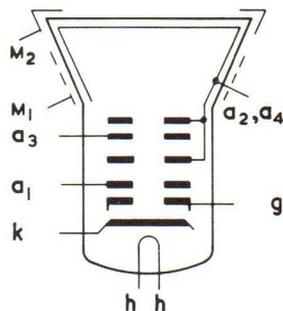
# Television Picture Tube

**CME1220  
A31-120W**

## GENERAL

Rectangular face, 12 inch, 110° diagonal  
Rimguard III reinforced envelope\*\*  
Integral mounting lugs, 20 mm dia. neck  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 50% transmission (approx.)  
Straight gun, non ion trap  
External conductive coating

Heater voltage  $V_h$  11 V  
Heater current  $I_h$  75 mA



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4}(\max)$	13.5†	kV
Minimum second and fourth anode voltage	$V_{a2+a4}(\min)$	10.5*	kV
Maximum third anode voltage - range	$V_{a3}(\max)$	-50 to +500	V
Maximum first anode voltage	$V_{a1}(\max)$	350	V
Maximum negative grid voltage	$-V_g(\max)$	100	V
Maximum peak negative grid voltage	$-V_g(\max)$	350§	V
Maximum positive grid voltage	$V_g(\max)$	0†	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k}(\max)$	110	V
Maximum peak heater to cathode voltage, heater negative	$V_{h-k}(\text{pk})\max$	130	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k}(\max)$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k}(\max)$	1.5	MΩ

All voltages referred to cathode

† The absolute rating of 16.5 kV must not be exceeded.

\* Absolute minimum rating is 8.5 kV.

§ Maximum pulse duration 22% of one cycle with a maximum of 1.5 ms.

† The peak positive excursion of the video signal should not exceed + 5V and this may be achieved by the series connection of a 10 kΩ resistor close to the tube base.

\*\* This tube meets the requirements for intrinsically safetubes laid down in the section of I.E.C. Publication 65 dealing with implosion.

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### INTER - ELECTRODE CAPACITANCES

Cathode to all	$C_{k-all}$	3.0*	pF
Grid to all	$C_{g-all}$	4.0*	pF
Anodes 2 and 4 to coating $M_1$ (min.)	$C_{a2+a4-M1}$ (min.)	450	pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$C_{a2+a4-M2}$	200	pF

\* Holder capacitance balanced out.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	12	kV
First anode voltage	$V_{a1-k}$	250	V
Third anode voltage range for focus	$V_{a3-k}$	0 to 350	V
Final anode current (peak)	$i_{a2+a4}$ (pk)	250	$\mu A$
Average peak to peak picture modulating voltage		33	V
Grid to cathode voltage for cut-off of raster	$V_{g-k}$	-35 to -69	V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	12	kV
First anode voltage	$V_{a1-g}$	250	V
Third anode voltage range for focus	$V_{a3-g}$	0 to 350	V
Final anode current (peak)	$i_{a2+a4}$	250	$\mu A$
Average peak to peak picture modulating voltage		26	V
Cathode to grid voltage for cut-off of raster	$V_{k-g}$	32 to 58	V

# Television Picture Tube

**GME1220**  
**A31-120W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	15	Gs
Maximum distance of centre of magnetic field from reference line	44	mm

## DEFLECTION ANGLES

Height 80°	Width 99°	Diagonal 110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

There is an annular region of anti-corona coating with external diameter of 70 mm surrounding the CT8 cap, the tube should not be handled in this region.

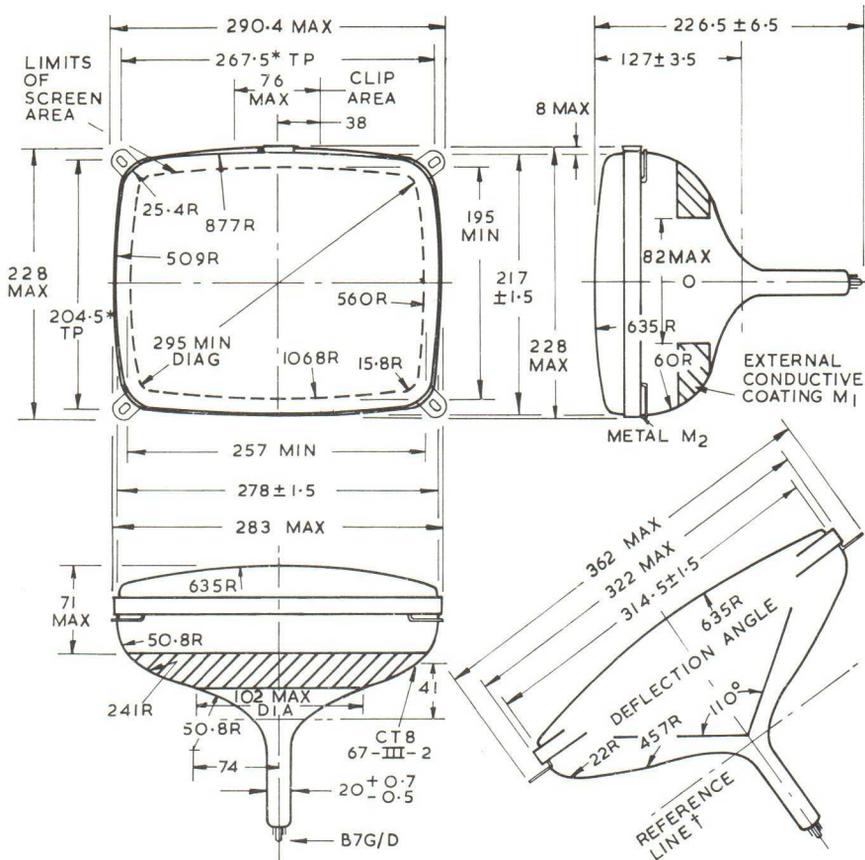
The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 44 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal shell ( $M_2$ ) should be connected to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example  $2M\Omega$ .

When flashover protection is incorporated the chassis return paths of  $M_1$  and  $M_2$  should be made in a manner appropriate to the protection system employed.

**TUBE WEIGHT** (approximate) - net 3.0 kg (6.5 lb)



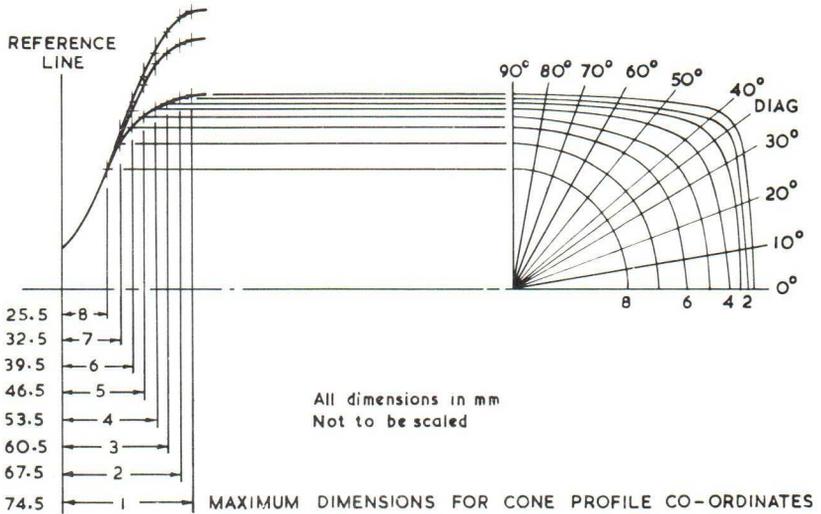
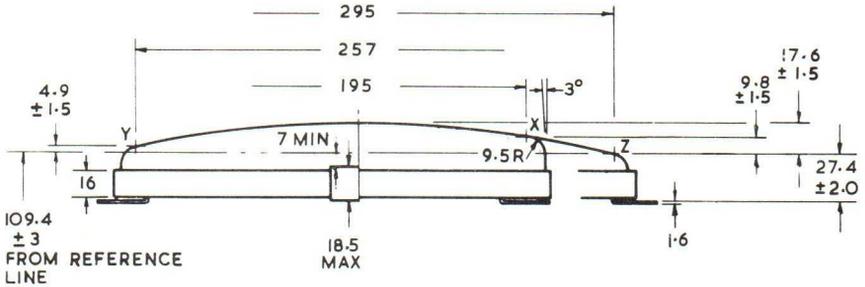
Minimum screen area 477 cm<sup>2</sup>

\* The bolts to be used for mounting the tube must lie within circles of 7.0 mm diameter centred on these true positions. One of the four lugs may deviate 2.0 mm maximum from the plane through the other three lugs.

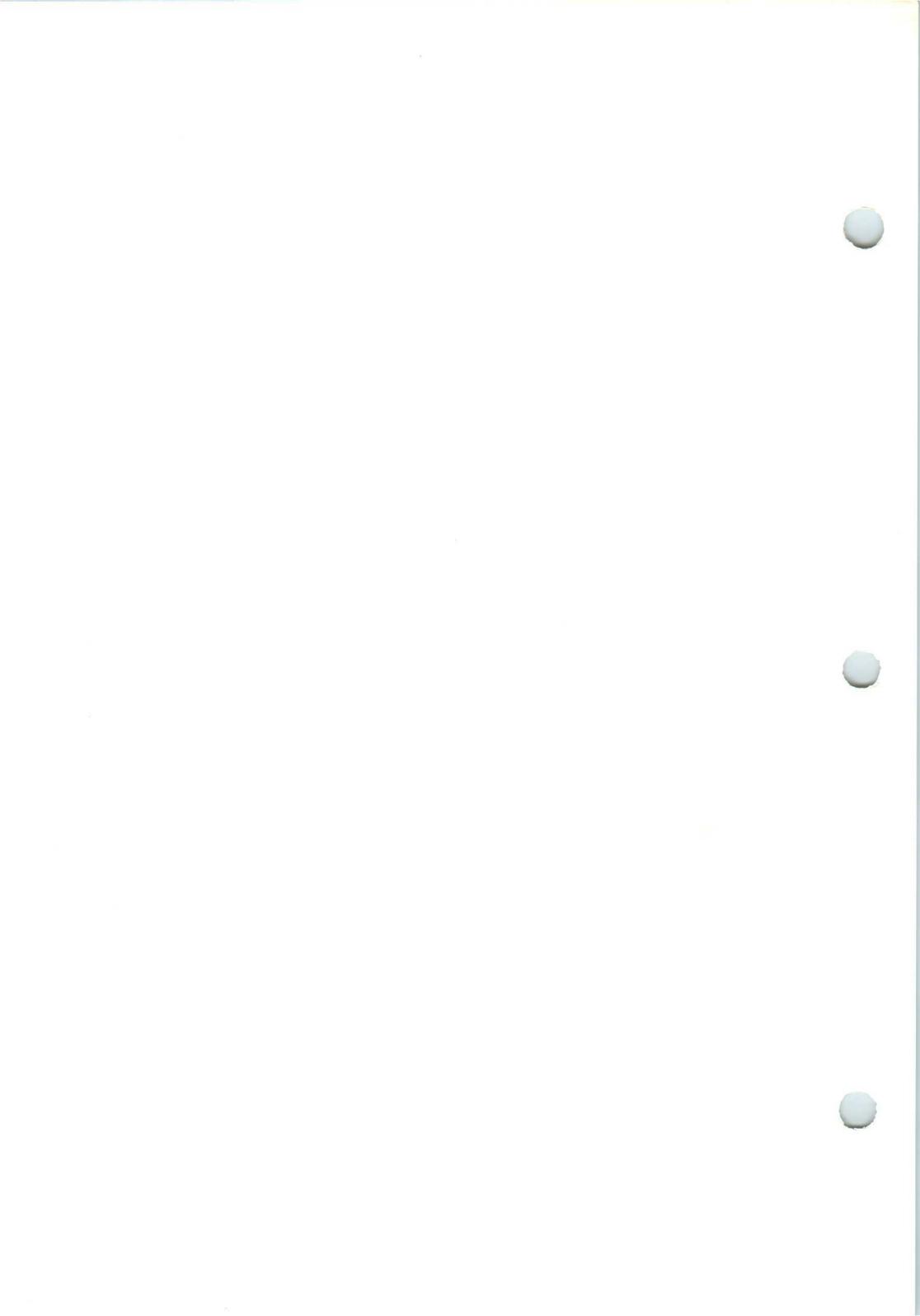
† Determined by reference line No. 22.

# Television Picture Tube

**CME1220**  
**A31-120W**



Reference Plane No.	0° Major	10°	20°	30°	Diag.	40°	50°	60°	70°	80°	90° Minor
1	140.2	141.5	146.0	154.0	157.8	154.6	136.7	123.5	115.5	111.0	109.6
2	137.8	139.2	143.4	151.1	154.1	151.5	134.3	121.6	113.7	109.4	108.1
3	133.9	134.8	137.8	143.0	145.3	143.2	129.4	118.4	111.1	107.3	106.0
4	127.3	127.7	129.3	132.0	133.2	132.1	122.3	113.2	107.2	103.8	102.6
5	116.4	116.8	117.7	119.2	120.0	119.3	112.8	105.9	101.5	98.6	98.1
6	103.0	103.2	103.8	104.8	105.2	104.7	101.5	97.0	94.2	92.5	91.9
7	87.0	87.1	87.2	87.4	87.8	87.1	85.9	84.6	83.6	83.0	82.8
8	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3



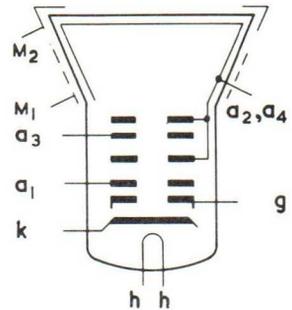
# Television Picture Tube

**CME1520**  
**A38-160W**

## GENERAL

Rectangular face, 15 inch, 110° diagonal  
Ringuard III reinforced envelope †  
Integral mounting lugs. 20 mm dia. neck  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 50% transmission (approx.)  
Straight gun, non ion trap  
External conductive coating

Heater voltage	$V_h$	11	V
Heater current	$I_h$	75	mA



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2-a4(max)}$	15*	kV
Minimum second and fourth anode voltage	$V_{a2-a4(min)}$	11	kV
Maximum third anode voltage - range	$V_{a3(max)}$	-50 to +500	V
Maximum first anode voltage	$V_{a1(max)}$	350	V
Maximum negative grid voltage	$-V_g(max)$	150	V
Maximum peak negative grid voltage	$-v_g(max)$	350†	V
Maximum positive grid voltage	$V_g(max)$	0§	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k(max)}$	110	V
Maximum peak heater to cathode voltage, heater negative	$v_{h-k(pk)max}$	130	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode

\*  $I_{a2+a4} = 0$

† Maximum pulse duration 22% of one cycle with a maximum of 1.5 ms.

§ The peak positive excursion of the video signal should not exceed +5V and this may be achieved by the series connection of a 10 kΩ resistor close to the tube base.

¶ This tube meets the requirements for intrinsically safe tubes laid down in the section of I.E.C. Publication 65 dealing with implosion.

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### INTER - ELECTRODE CAPACITANCES

Cathode to all	$c_{k-all}$	3.0*	pF
Grid to all	$c_{g-all}$	4.0*	pF ←
Anodes 2 and 4 to coating $M_1$ (approx.)	$c_{a2+a4-M1}$	450	pF ←
Anodes 2 and 4 to shell $M_2$ (approx.)	$c_{a2+a4-M2}$	250	pF ←

\* Holder capacitance balanced out.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	12 to 14	kV
First anode voltage	$V_{a1-k}$	300	V
Third anode voltage range for focus	$V_{a3-k}$	0 to 400	V
Final anode current (peak)	$i_{a2+a4}(pk)$	250	$\mu A$
Average peak to peak picture modulating voltage		29	V
Grid to cathode voltage for cut-off of raster	$V_{g-k}$	-31 to -75	V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2-a4-g}$	12 to 14	kV
First anode voltage	$V_{a1-g}$	300	V
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	V
Final anode current (peak)	$i_{a2+a4}$	250	$\mu A$
Average peak to peak picture modulating voltage		26	V
Cathode to grid voltage for cut-off of raster	$V_{k-g}$	27 to 64	V

# Television Picture Tube

**CME1520**  
**A38-160W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	17	Gs
Maximum distance of centre of magnetic field from reference line	44	mm

## DEFLECTION ANGLES

Height	80°	Width	99°	Diagonal	110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

There is an annular region of anti-corona coating with external diameter of 75 mm surrounding the CT8 cap, the tube should not be handled in this region.

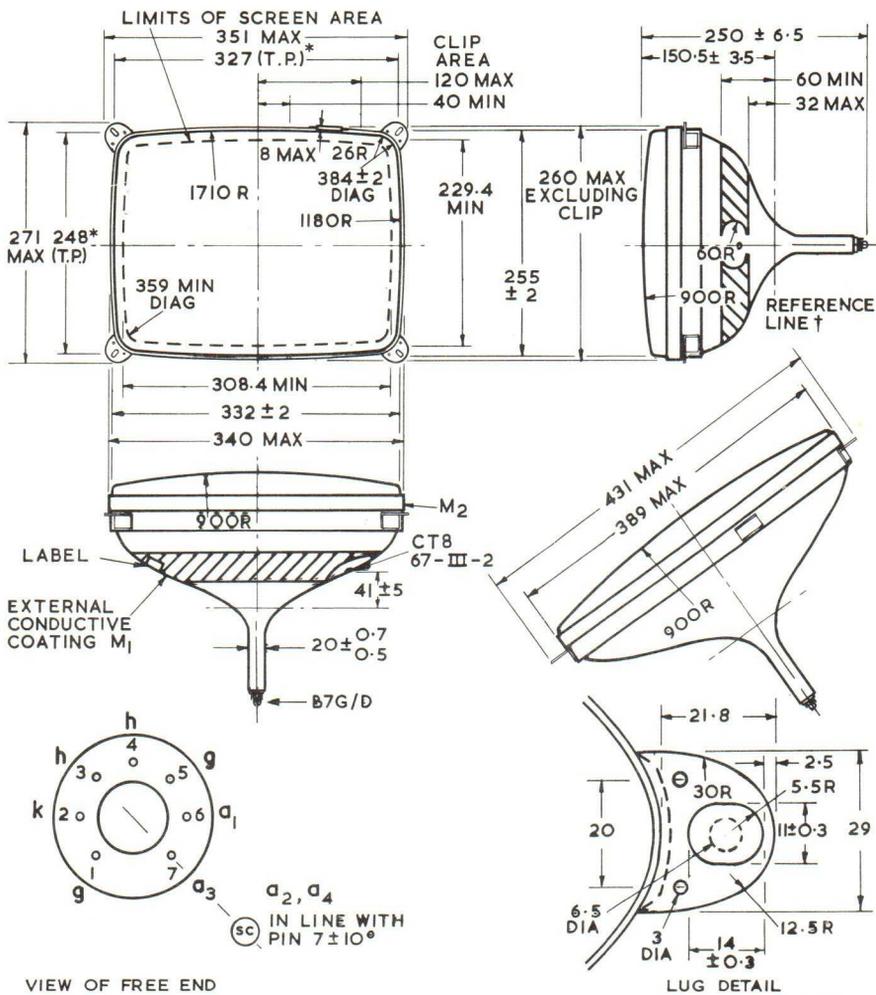
The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 44 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal shell ( $M_2$ ) should be connected to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example  $2M\Omega$ .

When flashover protection is incorporated the chassis return paths of  $M_1$  and  $M_2$  should be made in a manner appropriate to the protection system employed.

**TUBE WEIGHT** (approximate) - net 5.0 kg



All dimensions in mm

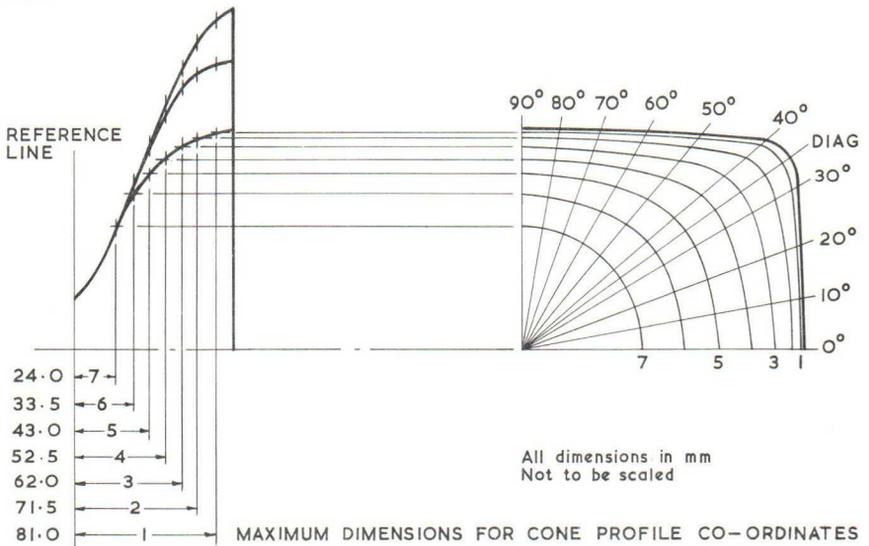
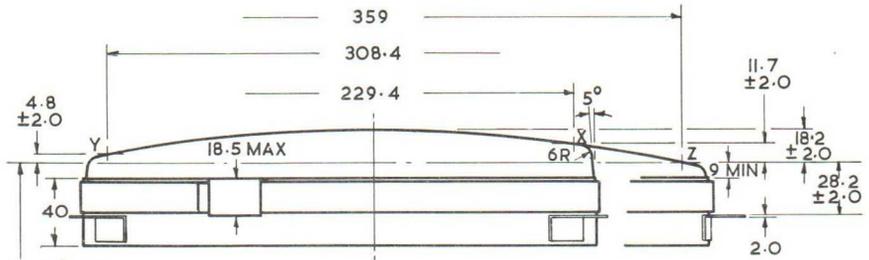
\* The bolts to be used for mounting the tube must lie within the circles of 6.5 mm diameter centred on these true positions. One of the four lugs may deviate 2 mm maximum from the plane through the other three lugs.

† Determined by reference line gauge No. 22.

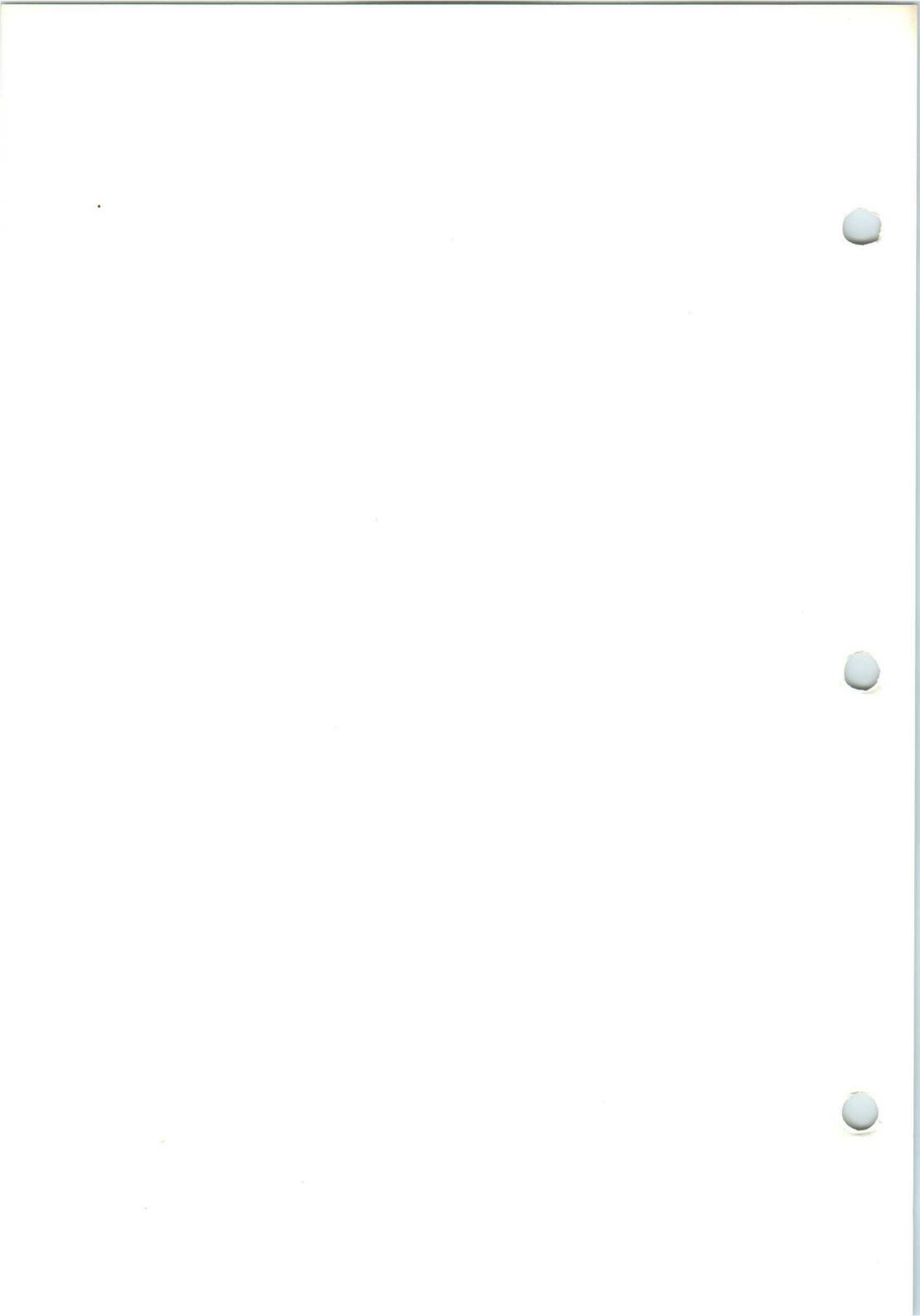
Minimum useful screen area 685 cm<sup>2</sup>.

# Television Picture Tube

**CME1520**  
**A38-160W**



Reference Plane No.	0° Major	10°	20°	30°	Diag.	40°	50°	60°	70°	80°	90° Minor
1	163.8	165.3	171.5	182.8	187.3	183.6	159.6	143.3	133.0	127.6	125.8
2	158.4	159.6	164.0	171.5	174.5	171.7	153.0	138.4	128.8	123.8	122.2
3	149.5	149.8	152.0	155.9	157.2	155.8	142.5	130.7	122.7	118.5	117.3
4	134.0	134.0	135.5	138.0	138.6	137.7	129.4	120.8	114.8	111.6	110.7
5	116.2	116.1	117.0	118.2	118.6	118.1	113.4	108.9	105.0	103.0	102.2
6	95.7	95.8	95.9	96.2	96.5	96.3	94.4	93.0	91.2	90.6	90.3
7	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0



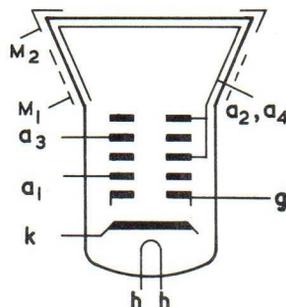
# Television Picture Tube

**GME1713**  
**A44-120W**

## GENERAL

Rectangular face, 17 inch, 110° diagonal  
Rimguard III reinforced envelope  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 48% transmission (approx)  
Straight gun, non ion trap  
External conductive coating

Heater voltage	$V_h$	6.3	V
Heater current	$I_h$	0.3*	A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4(max)}$	18†	kV
Minimum second and fourth anode voltage	$V_{a2+a4(min)}$	13	kV
Maximum third anode voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum first anode voltage	$V_{a1(max)}$	700	V
Maximum negative grid voltage	$-V_{g(max)}$	150	V
Maximum peak negative grid voltage	$-v_{g(pk)max}$	400**	V
Maximum positive grid voltage	$V_{g(max)}$	0†	V
Maximum heater to cathode voltage heater negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$V_{h-k(pk)max}$	400§	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode

\* In a series heater chain the CRT should always be connected at the chassis end.

†  $I_{a2+a4} = 0$

§ During a warming up period not exceeding 45 seconds.

† The peak positive excursion of the video signal should not exceed + 5V and this may be achieved by the series connection of a 10kΩ resistor close to the tube base.

\*\* Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard bases see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

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### INTER-ELECTRODE CAPACITANCES

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anodes 2 and 4 to coating $M_1$ (approx)	$C_{a2+a4-M1}$	700 to 1300		pF
Anodes 2 and 4 to shell $M_2$ (approx)	$C_{a2+a4-M2}$	200		pF

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	17	17	kV
First anode voltage †	$V_{a1-k}$	400	500	V
Third anode voltage, range for focus	$V_{a3-k}$	0 to 400	0 to 400	V
Final anode current (peak)	$i_{a2+a4(pk)}$	500	500	$\mu A$
Average peak to peak picture modulating voltage		40.5	45	V
Grid to cathode voltage limits for cut-off of raster	$V_{g-k}$	-40 to -77	-50 to -93	V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	17	17	kV
First anode voltage †	$V_{a1-g}$	400	500	V
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	0 to 400	V
Final anode current (peak)	$i_{a2+a4(pk)}$	500	500	$\mu A$
Average peak to peak picture modulating voltage		35.5	39.5	V
Cathode to grid voltage limits for cut-off of raster	$V_{k-g}$	36 to 66	45 to 80	V

† Within this range a higher first anode voltage will provide improved focus performance

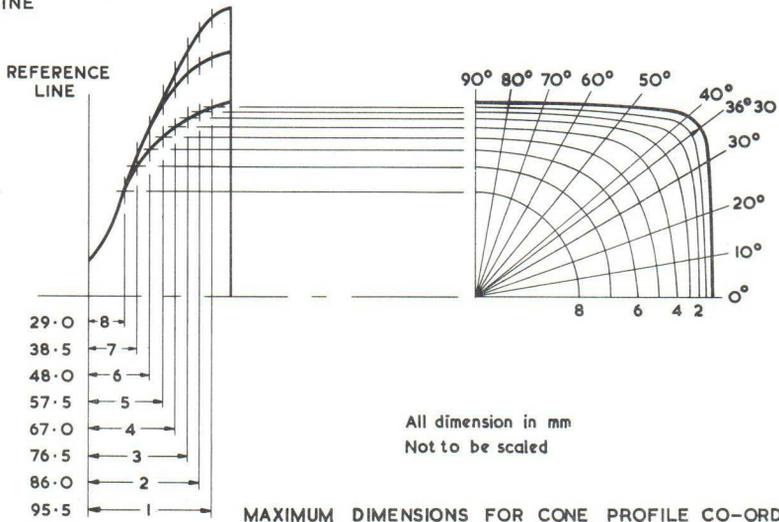
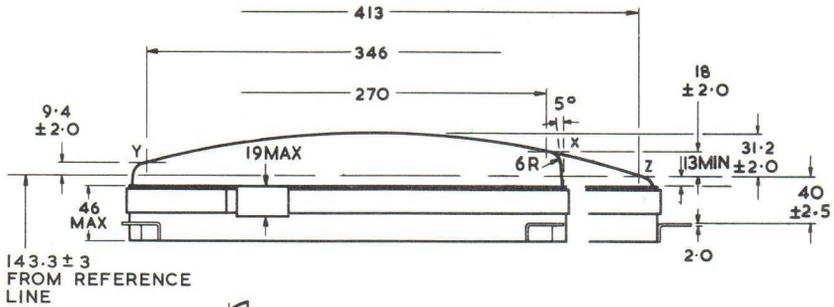
If this tube is operated at voltages in excess of 18 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.





# Television Picture Tube

**CME1713  
A44-120W**



All dimension in mm  
Not to be scaled

MAXIMUM DIMENSIONS FOR CONE PROFILE CO-ORDINATES

Reference Plane No.	0° Major	10°	20°	30°	36°30' Diag.	40°	50°	60°	70°	80°	90° Minor
1	181.0	183.0	190.0	202.5	210.8	209.0	182.5	164.5	153.0	147.1	145.0
2	175.8	177.8	184.2	195.7	199.0	197.3	177.0	159.7	148.6	142.9	141.0
3	168.8	170.2	175.4	183.6	184.8	183.6	170.1	154.0	143.6	138.1	136.2
4	158.7	159.2	161.9	166.3	168.1	167.7	159.2	144.9	136.7	131.9	130.1
5	144.1	144.6	146.2	148.7	149.9	149.3	144.0	134.2	127.3	123.5	122.4
6	127.3	127.3	128.8	130.7	131.2	130.8	126.8	121.0	116.5	114.2	113.2
7	107.5	107.8	108.7	109.5	109.5	109.4	107.7	104.8	102.3	101.0	100.3
8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8

0464

## GRID MODULATION

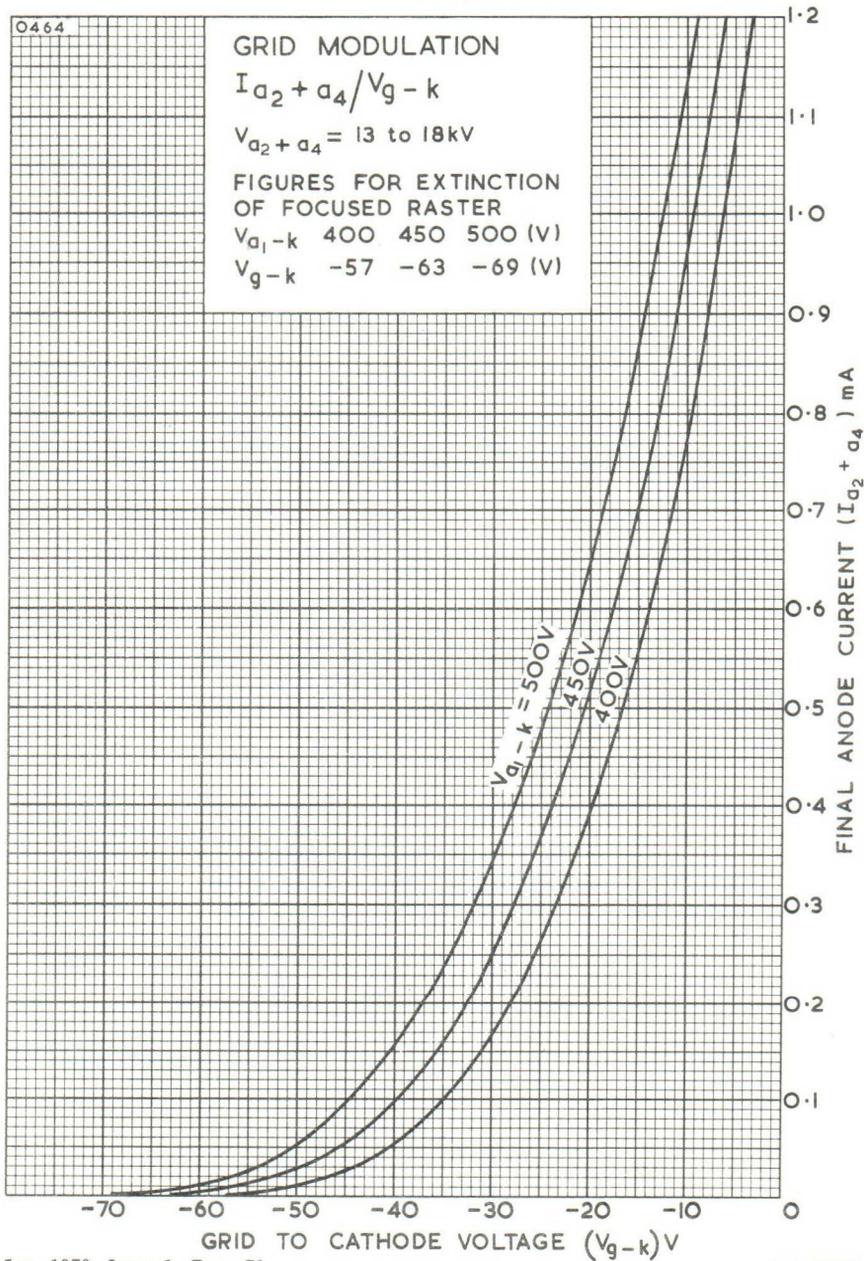
$$I_{a_2 + a_4} / V_{g-k}$$

$$V_{a_2 + a_4} = 13 \text{ to } 18 \text{ kV}$$

FIGURES FOR EXTINCTION  
OF FOCUSED RASTER

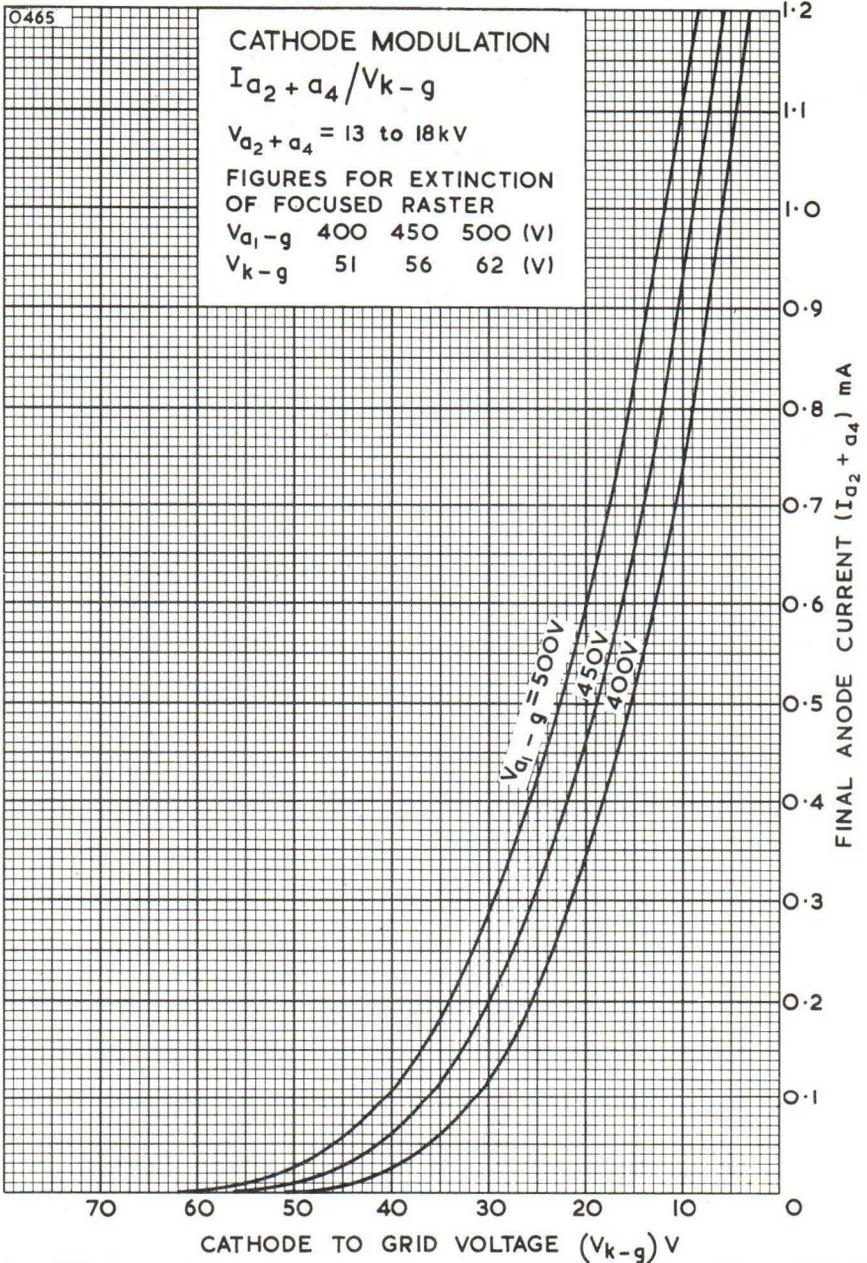
$$V_{a_1-k} \quad 400 \quad 450 \quad 500 \text{ (V)}$$

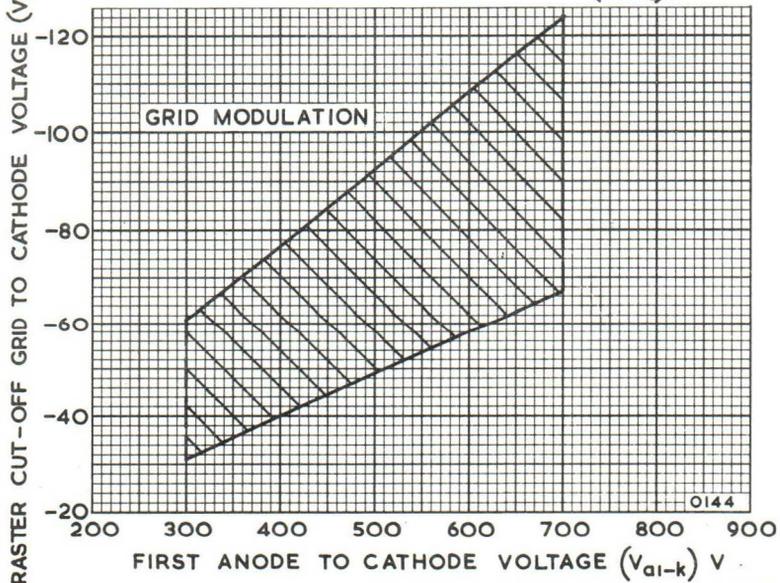
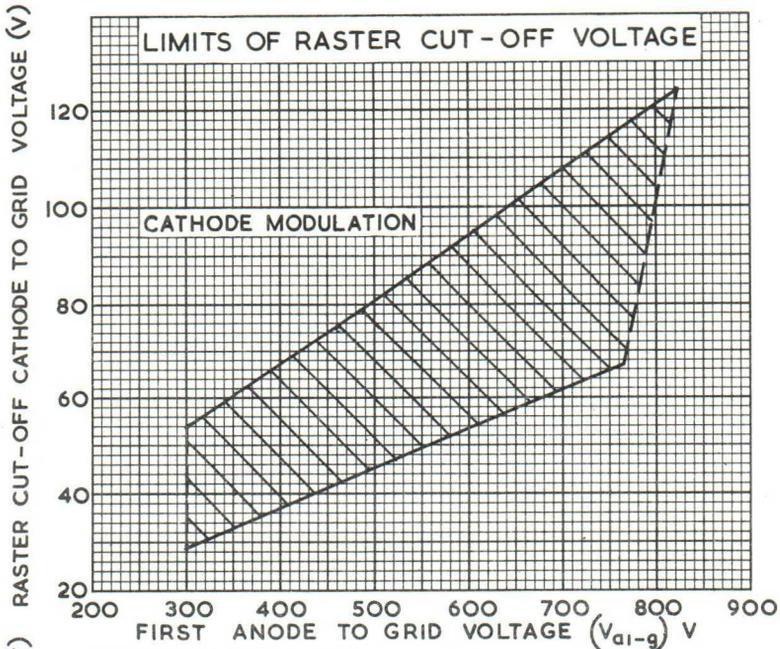
$$V_{g-k} \quad -57 \quad -63 \quad -69 \text{ (V)}$$



# Television Picture Tube

**CME1713**  
**A44-120W**





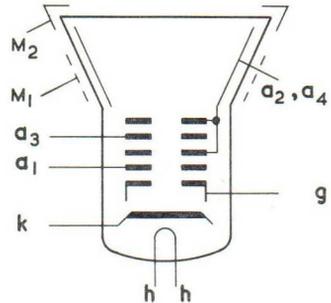
# Television Picture Tube

**GME2013  
A50-120W**

## GENERAL

Rectangular face, 20 inch, 110° diagonal  
Ringuard III reinforced envelope  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 45% transmission (approx)  
Straight gun, non ion trap  
External conductive coating

Heater voltage  $V_h$  6.3 V  
Heater current  $I_h$  0.3\* A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4(\max)}$	20†	kV
Minimum second and fourth anode voltage	$V_{a2+a4(\min)}$	13	kV
Maximum third anode voltage	$V_{a3(\max)}$	+1000 to -500	V
Maximum first anode voltage	$V_{a1(\max)}$	700	V
Maximum negative grid voltage	$-V_g(\max)$	150	V ←
Maximum peak negative grid voltage	$-V_g(\text{pk})\max$	400**	V ←
Maximum positive grid voltage	$V_g(\max)$	0‡	V ←
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k(\max)}$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$V_{h-k(\text{pk})\max}$	400§	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k(\max)}$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k(\max)}$	1.5	MΩ

All voltages referred to cathode

\* In a series heater chain the CRT should always be connected at the chassis end.

†  $I_{a2+a4} = 0$

§ During a warming up period not exceeding 45 seconds.

‡ The peak positive excursion of the video signal should not exceed +5V and this may be achieved by the series connection of a 10kΩ resistor close to the tube base.

\*\* Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard bases see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

**Thorn Radio Valves and Tubes Limited**

Aug. 1969, Issue 3, Page 1



### INTER-ELECTRODE CAPACITANCES

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anodes 2 and 4 to coating $M_1$ (approx.)	$C_{a2+a4-M1}$	1000		pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$C_{a2+a4-M2}$	350		pF ←

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	18	18	kV		
First anode voltage †	$V_{a1-k}$	400	500	V		
Third anode voltage range for focus	$V_{a3-k}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		35.5	40.5	39.5	45	V
Grid to cathode voltage range for cut-off of raster	$V_{g-k}$	-40 to -77	-50 to -93			V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	18	18	kV		
First anode voltage †	$V_{a1-g}$	400	500	V		
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		31.5	35.5	34.5	39.5	V
Cathode to grid voltage range for cut-off of raster	$V_{k-g}$	36 to 66	45 to 80			V

† Within this range a higher first anode voltage will provide improved focus performance.

If this tube is operated at voltages in excess of 20 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. ←

# Television Picture Tube

**GME2013**  
**A50-120W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	17	Gs
Maximum distance of centre of magnetic field from reference line	53	mm

## DEFLECTION ANGLES

Height	81°	Width	98°	Diagonal	110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

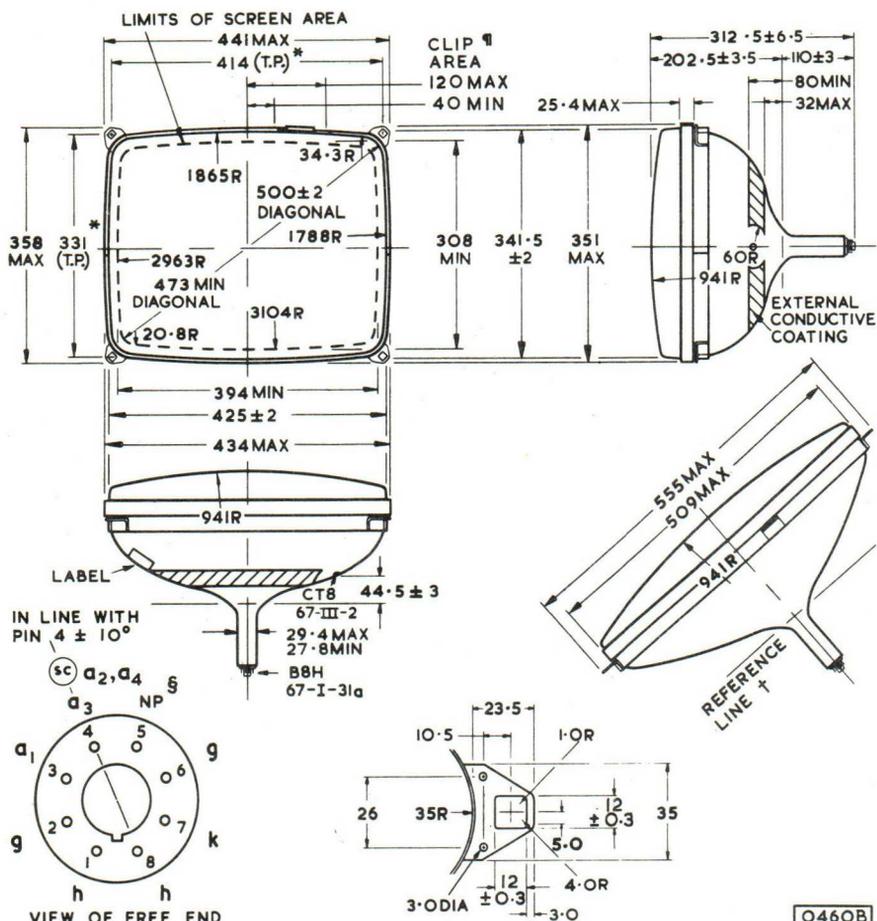
There is an annular region of anti-corona coating with external diameter of 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

The tube can be mounted in any position. The tube socket should not be rigidly mounted but **should** have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal frame ( $M_2$ ) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2 M $\Omega$ .

**TUBE WEIGHT** (approximate) - net 9.5 kg (21 lb)



All dimensions in mm

Not to be scaled

\* The bolts to be used for mounting the tube must lie within the circles of 8.0 mm diameter centred on these true positions. One of the four lugs may deviate 2.0 mm maximum from the plane through the other three lugs.

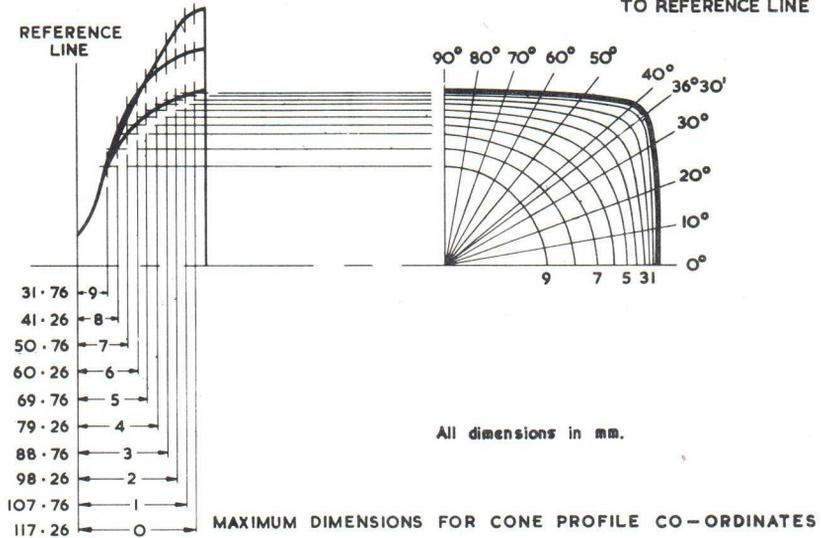
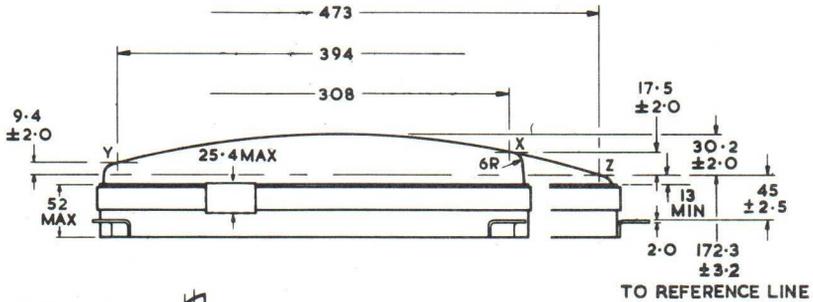
† Determined by reference line gauge No. 16 (B.S.RL4 : IEC 67-IV-3 : JEDEC 126).

‡ Total thickness of shell, tension band and clip 8.0 mm maximum.

§ Pin 5 is included for Sparkguard R base and the common connection for the parallel spark gaps is made to this pin. For further details see separate sheet.

# Television Picture Tube

**GME2013  
A50-120W**



Reference Plane No.	0° Major	10°	20°	30°	36°30' Diag.	40°	50°	60°	70°	80°	90° Minor
0	210.5	213.3	222.0	237.8	247.1	243.7	213.5	192.0	178.6	171.3	168.9
1	207.0	209.6	218.0	233.4	241.2	238.1	209.5	188.5	175.0	167.8	165.5
2	202.7	205.2	212.4	225.0	228.3	225.6	202.3	183.2	170.5	163.9	162.0
3	197.1	198.8	204.4	213.0	213.9	211.6	192.7	176.4	165.3	159.2	157.8
4	190.0	191.0	194.6	198.8	198.5	196.1	181.8	168.0	159.2	153.7	152.6
5	180.9	181.4	182.7	183.6	182.0	179.7	169.2	158.5	151.3	147.0	146.2
6	168.8	168.5	168.6	167.0	164.2	162.1	154.3	147.3	142.0	139.2	138.3
7	151.5	150.4	149.5	147.2	144.8	143.4	138.2	134.0	131.2	129.0	128.5
8	130.1	128.5	126.6	125.0	123.3	122.6	120.0	118.2	116.7	116.0	115.9
9	103.4	102.5	101.0	99.6	99.2	99.2	99.1	99.1	98.9	98.7	98.4

0045D

GRID MODULATION

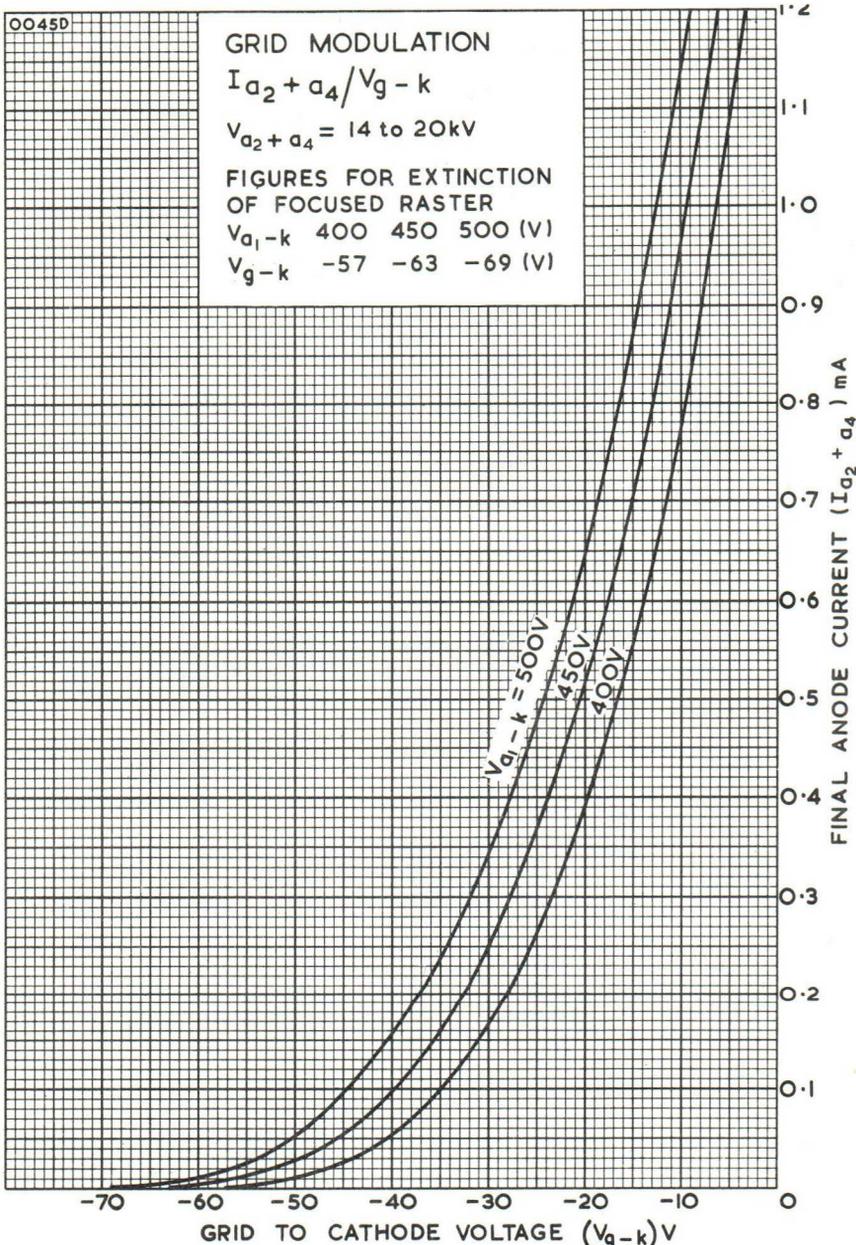
$$I_{a_2 + a_4} / V_{g-k}$$

$$V_{a_2 + a_4} = 14 \text{ to } 20 \text{ kV}$$

FIGURES FOR EXTINCTION  
OF FOCUSED RASTER

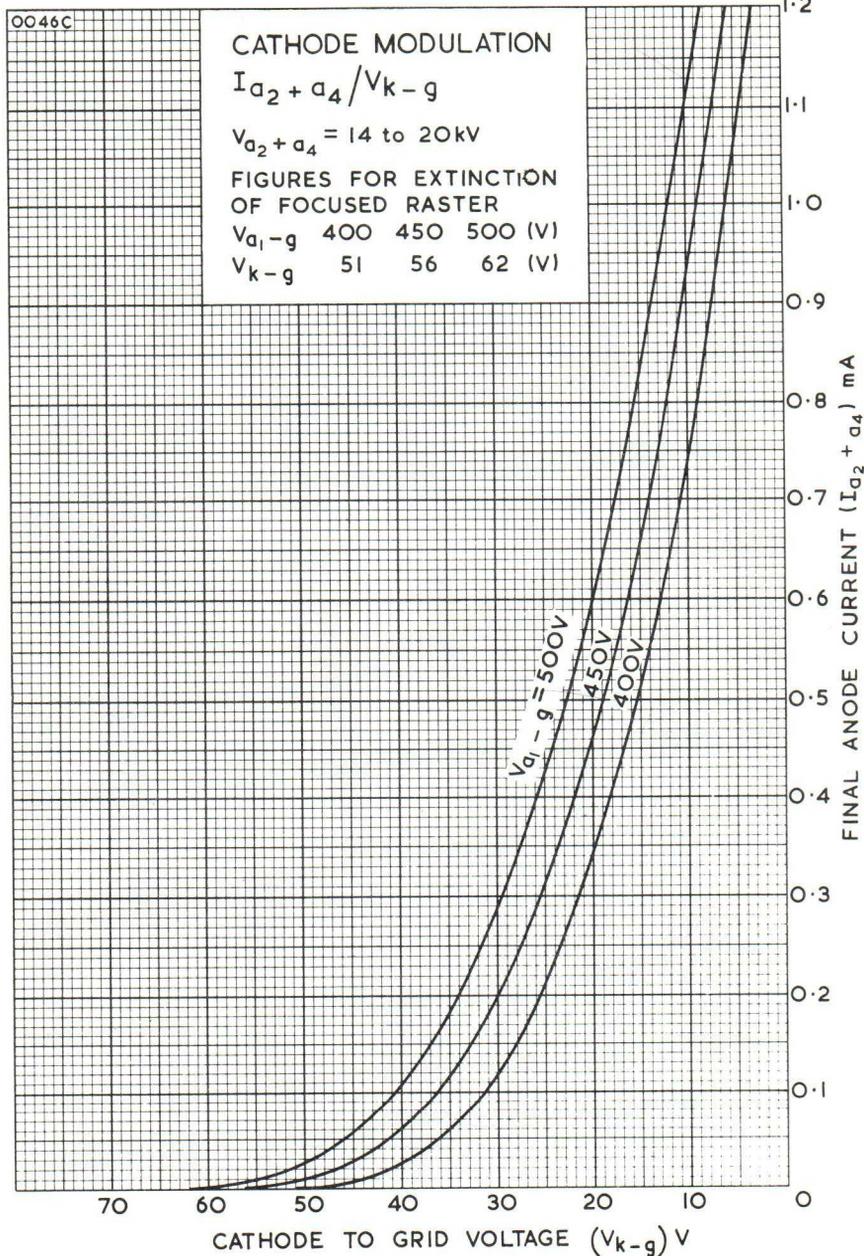
$V_{a_1-k}$  400 450 500 (V)

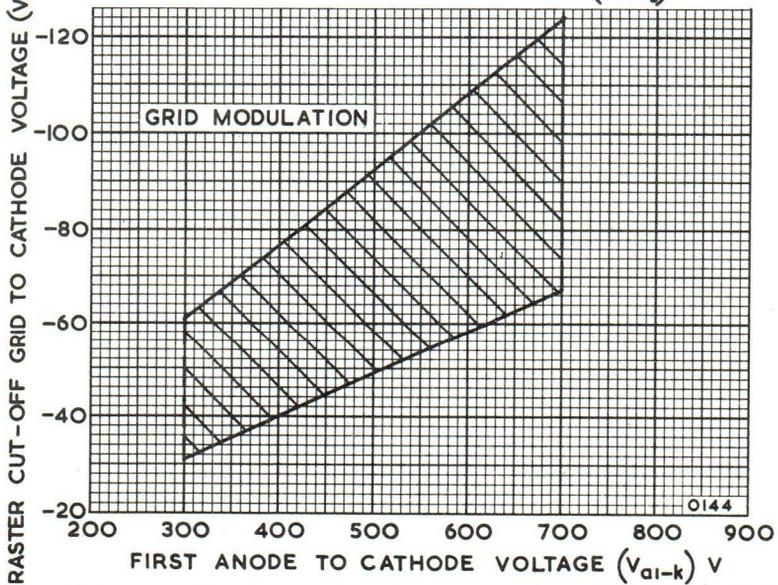
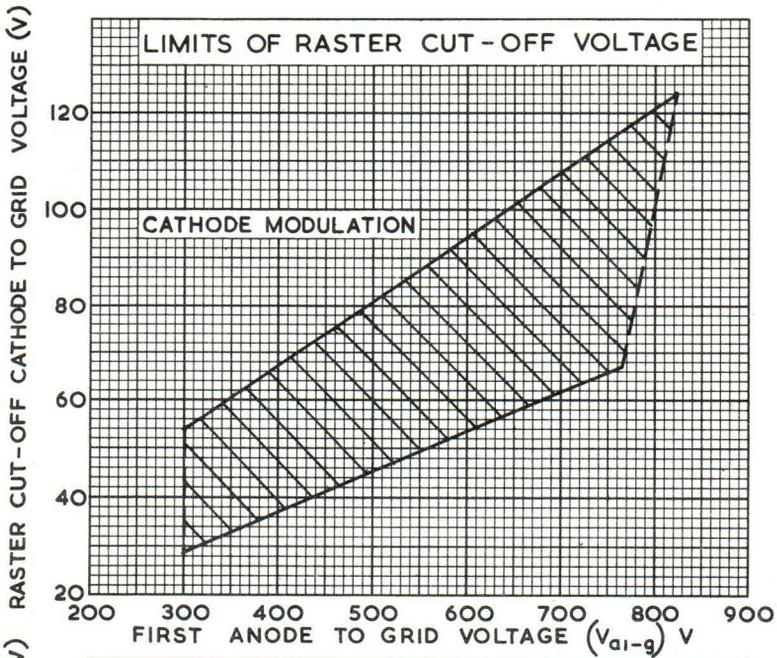
$V_{g-k}$  -57 -63 -69 (V)



# Television Picture Tube

**CME2013  
A50-120W**





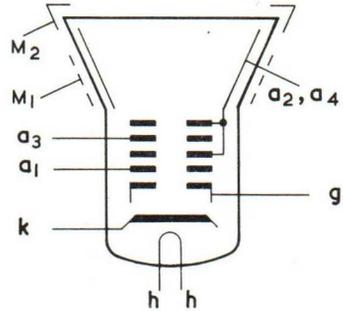
# Television Picture Tube

**CME2413  
A61-120W**

## GENERAL

Rectangular face, 24 inch, 110° diagonal  
Rimguard III reinforced envelope  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 42% transmission (approx.)  
Straight gun, non ion trap  
External conductive coating

Heater voltage	$V_h$	6.3	V
Heater current	$I_h$	0.3*	A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4(max)}$	20†	kV
Minimum second and fourth anode voltage	$V_{a2+a4(min)}$	13	kV
Maximum third anode voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum first anode voltage	$V_{a1(max)}$	700	V
Maximum negative grid voltage	$-V_g(max)$	150	V
Maximum peak negative grid voltage	$-V_g(pk)max$	400**	V
Maximum positive grid voltage	$V_g(max)$	0 †	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$V_{h-k(pk)max}$	400 §	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode

\* In a series heater chain the CRT should always be connected at the chassis end.

†  $I_{a2+a4} = 0$

§ During a warming up period not exceeding 45 seconds.

† The peak positive excursion of the video signal should not exceed + 5V and this may be achieved by the series connection of a 10 kΩ resistor close to the tube base.

\*\* Maximum pulse duration 22% of one cycle with a maximum of 1.5 ms.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard bases see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

**Thorn Radio Valves and Tubes Limited**

Jan. 1970, Issue 1, Page 1



### INTER-ELECTRODE CAPACITANCES

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anodes 2 and 4 to coating $M_1$ (approx.)	$C_{a2+a4-M1}$	1700 to 2500		pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$C_{a2+a4-M2}$	350		pF

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	18	18	kV		
First anode voltage †	$V_{a1-k}$	400	500	V		
Third anode voltage range for focus	$V_{a3-k}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		35.5	40.5	39.5	45	V
Grid to cathode voltage range for cut-off of raster	$V_{g-k}$	-40 to -77	-50 to -93			V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	18	18	kV		
First anode voltage †	$V_{a1-g}$	400	500	V		
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		31.5	35.5	34.5	39.5	V
Cathode to grid voltage range for cut-off of raster	$V_{k-g}$	36 to 66	45 to 80			V

† Within this range a higher first anode voltage will provide improved focus performance.

If this tube is operated at voltages in excess of 20 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.

# Television Picture Tube

**CME2413**  
**A61-120W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	17	Gs
Maximum distance of centre of magnetic field from reference line	53	mm

## DEFLECTION ANGLES

Height 81°	Width 98°	Diagonal 110°
------------	-----------	---------------

## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

There is an annular region of anti-corona coating with external diameter of 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

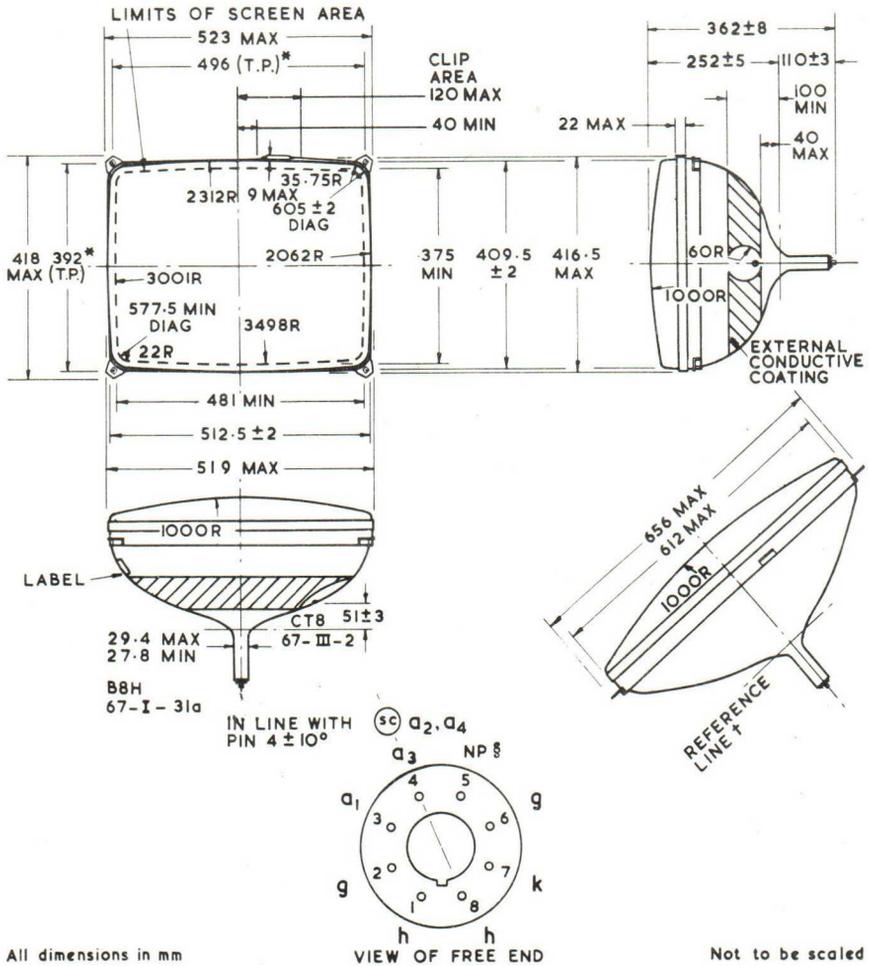
The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply

The metal frame ( $M_2$ ) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example  $2\text{ M}\Omega$ .

**TUBE WEIGHT** (approximate) - net 13.2 kg (29 lb)

Characteristic curves as CME2013  
A50-120W



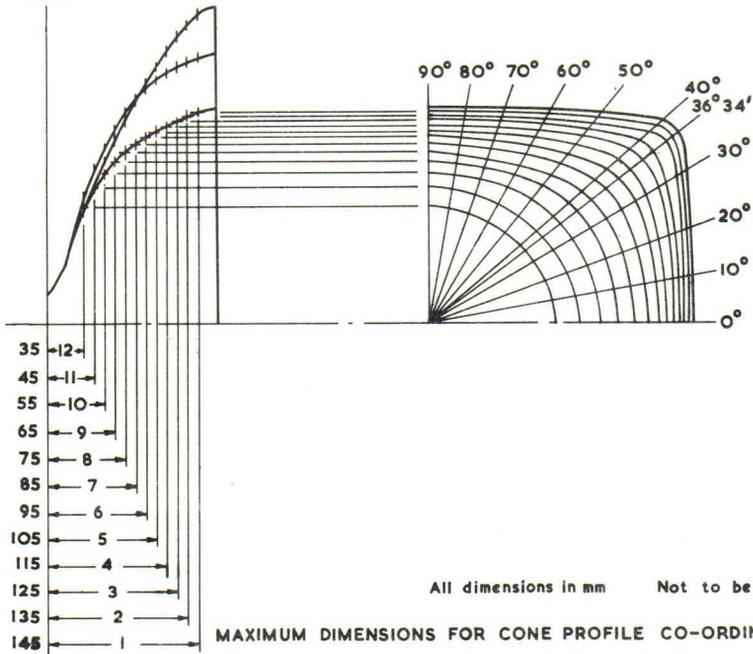
\* The bolts to be used for mounting the tube must lie within the circles of 8.0 mm diameter centred on these true positions. One of the four lugs may deviate 2.0 mm maximum from the plane through the other three lugs.

† Determined by reference line gauge No. 16 (B.S.RL4 : IEC 67-IV-3 : JEDEC 126).

§ Pin 5 is included for the Sparkguard R base and the common connection for the parallel spark gaps is made to this pin. For further details on Sparkguard bases see separate sheets.



REFERENCE  
LINE



All dimensions in mm Not to be scaled

MAXIMUM DIMENSIONS FOR CONE PROFILE CO-ORDINATES

Reference Plane No.	0° Major	10°	20°	30°	36°34' Diag.	40°	50°	60°	70°	80°	90° Minor
1	250.5	254.0	265.0	284.8	<b>293.5</b>	288.5	252.0	226.0	210.5	201.8	199.0
2	245.5	249.0	259.4	278.0	<b>282.1</b>	278.0	244.5	220.5	205.5	198.0	195.0
3	241.0	243.5	252.0	263.7	269.8	<b>266.0</b>	237.0	215.0	201.5	193.5	191.5
4	236.5	238.5	245.0	255.8	256.0	253.5	228.8	208.5	195.8	189.0	186.5
5	229.5	231.0	236.5	243.0	242.1	240.0	219.5	201.5	189.5	184.0	181.0
6	221.0	222.0	226.0	229.0	227.0	224.0	207.0	192.5	183.0	178.0	176.0
7	210.0	210.5	213.0	214.5	210.1	209.0	195.0	183.0	174.8	170.5	169.0
8	198.0	198.0	198.0	198.0	194.0	192.5	181.0	172.5	166.0	162.5	161.0
9	183.0	181.0	180.7	180.0	176.2	175.5	168.5	161.0	155.5	152.5	151.5
10	166.0	164.0	161.7	160.0	156.5	156.5	151.5	146.0	143.5	142.0	142.0
11	146.5	144.0	141.5	140.0	134.6	135.5	131.5	129.5	128.5	128.5	128.5
12	122.0	120.2	117.0	116.0	111.5	113.5	111.0	111.0	111.0	111.0	111.5

# **COLOUR PICTURE TUBES FOR MAINTENANCE**

**Superseded types  
still available for  
maintenance purposes**

**MAINTENANCE  
COLOUR**



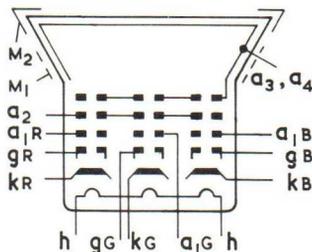
# Colour Television Picture Tube

# A49-11X

## GENERAL

Shadow-mask three gun tube  
 Ringuard I reinforcement & mounting lugs  
 Unity current ratios  
 Rectangular face, 19 inch 90° diagonal  
 Three colour phosphor dots, rare earth red  
 Grey glass, 54% transmission (approx)  
 Electrostatic focus, magnetic deflection  
 External conductive coating

Heater voltage	$V_h$	6.3	V
Heater current	$I_h$	0.9	A



## DESIGN CENTRE RATINGS (each gun)

Maximum third and fourth anode voltage (absolute)	$V_{a3+a4}(\max)$	27.5*†	kV
Minimum third and fourth anode voltage (absolute)	$V_{a3+a4}(\min)$	20	kV
Maximum second anode voltage	$V_{a2}(\max)$	6.0†	kV
Maximum peak first anode voltage	$v_{a1}(\text{pk})\max$	1.0	kV
Maximum negative grid voltage	$-V_g(\max)$	400	V
Maximum grid voltage	$V_g(\max)$	0	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k}(\max)$	250	V
Maximum peak heater to cathode voltage (absolute), heater negative	$v_{h-k}(\text{pk})\max$	410§	V
Maximum long term average current for three guns	$I_{a3+a4}(\text{av})\max$	750¶	$\mu\text{A}$
Maximum grid to cathode resistance	$R_{g-k}(\max)$	0.75	$\text{M}\Omega$
Maximum second anode resistance (absolute)	$R_{a2}(\max)$	7.5	$\text{M}\Omega$

\*  $I_{a3+a4} = 0$

† Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused in the event of a high voltage flashover within the cathode ray tube.

§ During a warming-up period not exceeding 15 seconds.

¶ This long term average maximum current will be met provided a device is incorporated in the circuit to limit the short term average current to 1.1 mA.

The tube does not emit x-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance  $\geq 0.5 \text{ M}\Omega$ .

## Thorn Colour Tubes Limited

Mar. 1970, Issue 4, Page 1



### INTER-ELECTRODE CAPACITANCES (approximate)

Grid to all (each gun)	$C_g$ -all	6.5	pF
Cathode to all (each gun)	$C_k$ -all	5.7	pF
Cathodes to all	$C_{kR+kB+kG}$ -all	16	pF
Anode 2 to all	$C_{a2}$ -all	6.5	pF
Anodes 3 and 4 to coating $M_1$	$C_{a3+a4-M1}$	1500 to 2000	pF
Anodes 3 and 4 to shell $M_2$	$C_{a3+a4-M2}$	400	pF

### TYPICAL OPERATION (each gun) - voltages referred to cathode

Third and fourth anode voltage	$V_{a3+a4}$	25	kV
Second anode voltage for focus	$V_{a2}$	4.2 to 5.0	kV
First anode voltage for cut-off of raster ( $V_g = -100V$ )	$V_{a1}$	210 to 495	V
Grid voltage for cut-off of raster ( $V_{a1} = 300V$ )	$V_g$	-65 to -135	V
Light output at screen centre ( $I_{a3+a4} = 750 \mu A$ )		92*	nt

\* To produce white (C.I.E. Co-ordinates  $x=0.281, y=0.311$ ), raster size  $396 \times 310 \text{ mm}^2$

### DESIGN RANGES (each gun, where applicable)

Third and fourth anode voltage	$V_{a3+a4}$	20 to 27.5	kV
Ratio focus to final anode voltage	$V_{a2}/V_{a3+a4}$	0.168 to 0.2	
Variations in grid cut-off voltage between guns in one tube†		0.65 to 1.0	
Second anode current	$I_{a2}$	-15 to +15	$\mu A$
First anode current	$I_{a1}$	-5.0 to +5.0	$\mu A$
Grid current at $V_g = -150V$	$I_g$	-5.0 to +5.0	$\mu A$

Typical contributions to total anode current to produce white

Red gun	34%	Blue gun	32%	Green gun	34%
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Ratios of cathode current to produce white

	min	av	max
Red gun to green gun	0.65	1.0	1.5
Red gun to blue gun	0.75	1.1	1.5
Blue gun to green gun	0.6	0.91	1.3

Maximum shift requirements - at centre of screen

For registration by purifying magnets	$\pm 0.11$	mm
By lateral convergence magnets (blue beam with respect to the converged red and green beams)	$\pm 5.5$	mm
By radial convergence magnets (each beam)	$\pm 8.0$	mm
By direct current in deflector coils (raster)	$\pm 12$	mm

† Values quoted are the ratio of the lowest to the highest value of grid cut-off voltages for constant first anode voltage. For constant grid voltage the corresponding minimum ratio of first anode cut-off voltages is 0.6.

# Colour Television Picture Tube

A49-11X

## DEFLECTION ANGLES

Height 62°

Width 79°

Diagonal 90°

## PHOSPHOR DOT TRIADS SPACING

Spacing between centres of adjacent dot triads (approximate) 0.61 mm

## MOUNTING

The tube should be operated with the major axis in the horizontal plane and the blue electron gun uppermost. Magnetic shielding must be provided to minimise the effects of extraneous magnetic fields, including the earth's magnetic field, when the receiver orientation is changed. De-gaussing of the shield and tube will be necessary.

The metal shell (M<sub>2</sub>) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver.

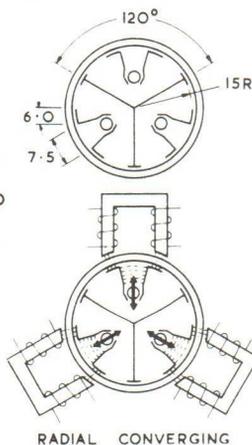
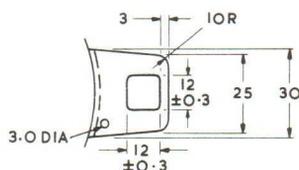
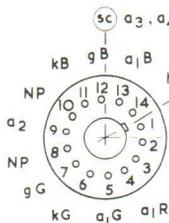
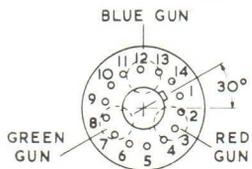
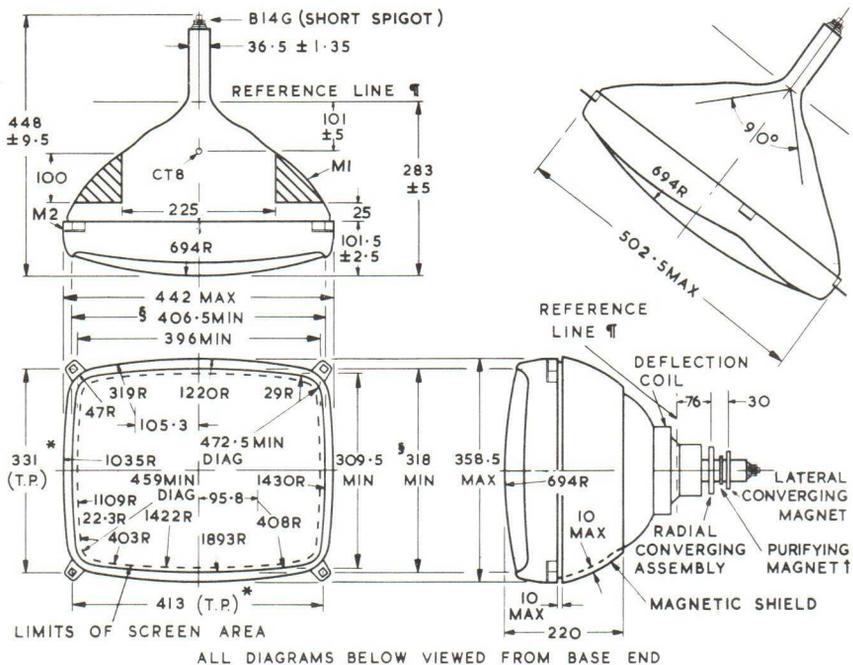
There is an annular region of anti-corona coating with an external diameter of 150 mm surrounding the CT8 cap, the tube should not be handled in this region.

## BASE SOCKET

Pin 9 is operated at high potential, hence it is recommended that the base socket used should have contacts omitted for pins 8 and 10.

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle concentric with the bulb axis and having a diameter of 52.5 mm.

**TUBE WEIGHT** (approximate) - net 10.9 kg (24 lb)



All dimensions in mm  
 Not to be scaled

¶ Determined by reference line gauge No. 14.

† Purifying magnet may be positioned on other side of lateral converging assembly.

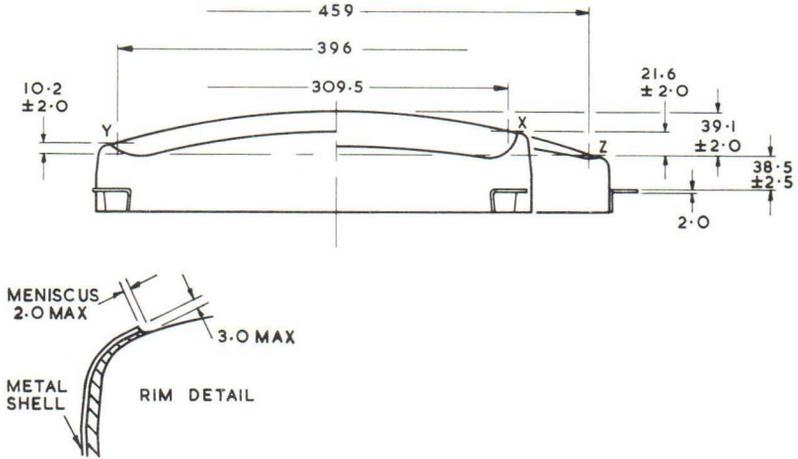
\* Bolts for mounting must be within circles of 8.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.

§ Eccentricity with respect to centre of screen 1.5 max.

Useful screen area (approx.)  $1160 \text{ cm}^2$ .

# Colour Television Picture Tube

# A49-11X



All dimensions in mm

Mar. 1970, Issue 4, Page 5

Not to be scaled

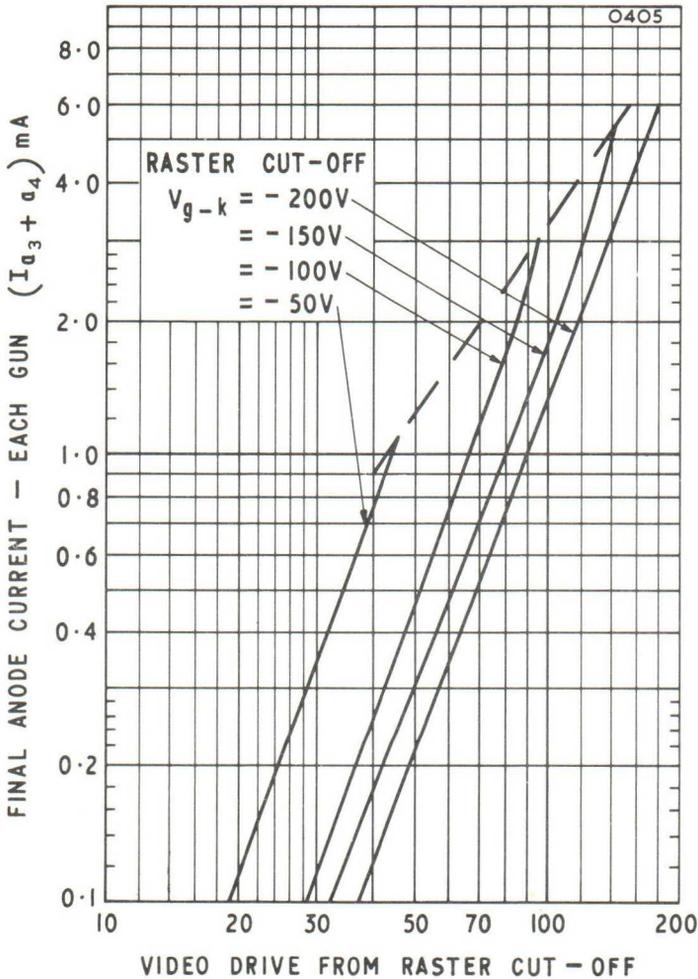
Thorn Colour Tubes Limited

GRID MODULATION - Each gun

$V_{a_3+a_4} = 20 \text{ to } 27.5\text{kV}$

$V_{a_2-k}$  adjusted for focus

$V_{a_1-k}$  adjusted to provide raster cut-off  
for required  $V_{g-k}$

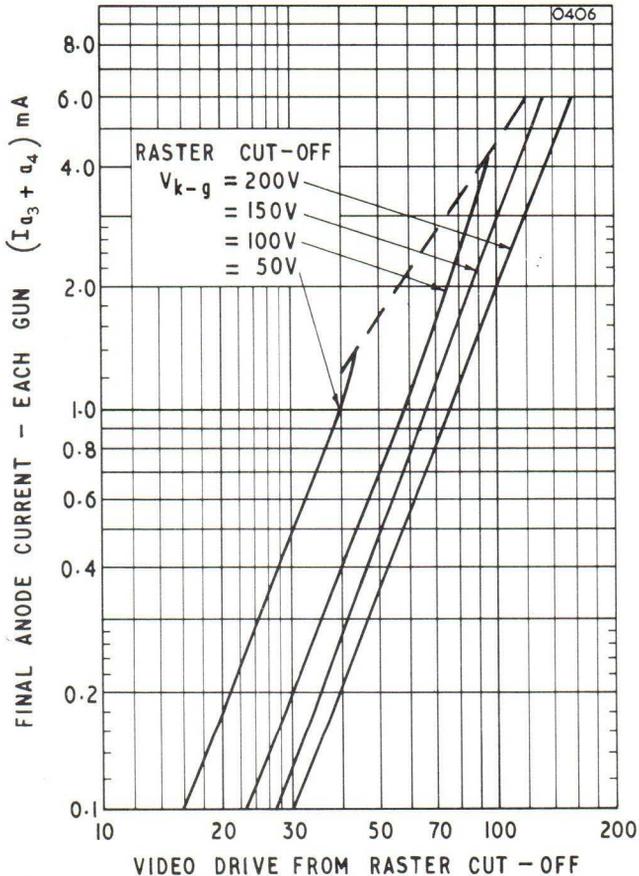


### CATHODE MODULATION - Each gun

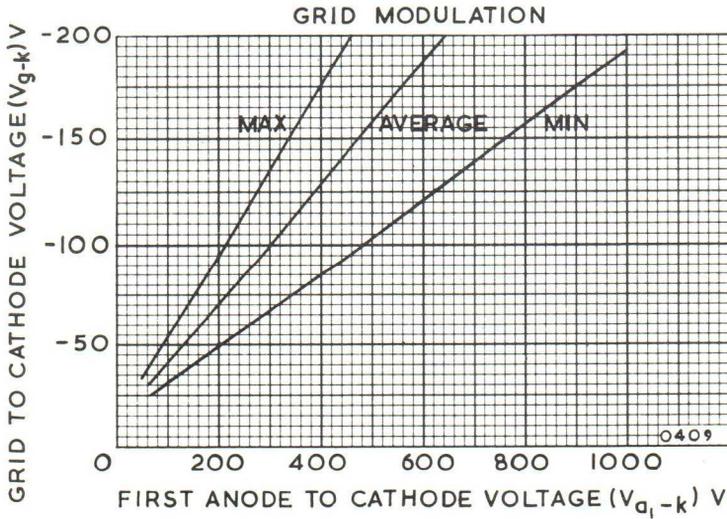
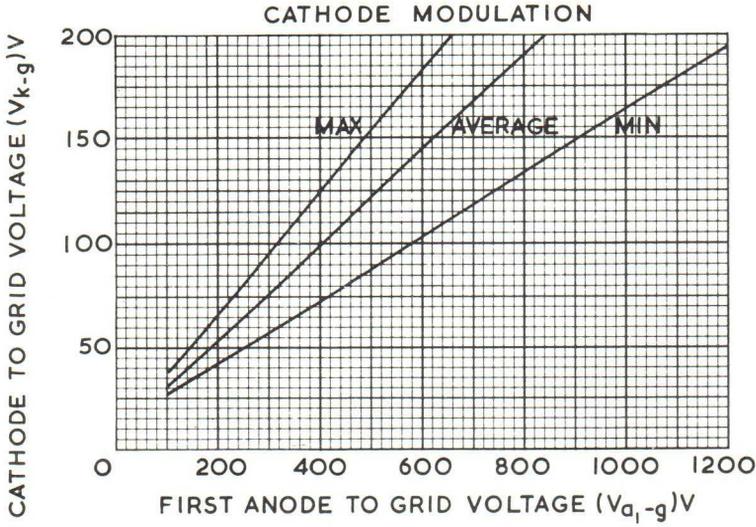
$$V_{a_3 + a_4} = 20 \text{ to } 27.5 \text{ kV}$$

$V_{a_2 - g}$  adjusted for focus

$V_{a_1 - g}$  adjusted to provide raster cut-off for required  $V_{k - g}$



# LIMITS OF RASTER CUT-OFF VOLTAGE



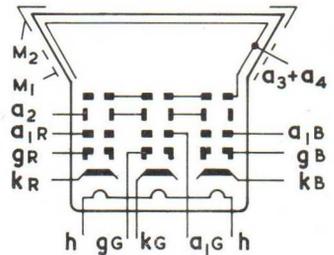
# Colour Television Picture Tube

**CTA2550  
A63-11X**

## GENERAL

Shadow-mask, three gun tube  
 Ringuard I reinforcement & mounting lugs  
 Unity current ratios  
 Rectangular face, 25 inch 90° diagonal  
 Three colour phosphor dots, rare earth red  
 Grey glass, 52% transmission (approx)  
 Electrostatic focus, magnetic deflection  
 External conductive coating

Heater voltage	$V_h$	6.3	V
Heater current	$I_h$	0.9	A



## DESIGN CENTRE RATINGS (each gun)

Maximum third and fourth anode voltage (absolute)	$V_{a3+a4}(\max)$	27.5*†	kV
Minimum third and fourth anode voltage (absolute)	$V_{a3+a4}(\min)$	20	kV
Maximum second anode voltage	$V_{a2}(\max)$	6.0†	kV
Maximum peak first anode voltage	$V_{a1}(\text{pk})\max$	1.0	kV
Maximum negative grid voltage	$-V_g(\max)$	400	V
Maximum grid voltage	$V_g(\max)$	0	V
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k}(\max)$	250	V
Maximum peak heater to cathode voltage (absolute), heater negative	$V_{h-k}(\text{pk})\max$	410‡	V
Maximum long term average current for three guns	$I_{a3+a4}(\text{av})\max$	1.0§	mA
Maximum grid to cathode resistance	$R_{g-k}(\max)$	0.75	MΩ
Maximum second anode resistance (absolute)	$R_{a2}(\max)$	7.5	MΩ

\*  $I_{a3+a4} = 0$

† Adequate precautions should be taken to ensure that the receiver is protected from damage which may be caused in the event of a high voltage flashover within the cathode ray tube.

‡ During a warming-up period not exceeding 15 seconds.

§ This long term average maximum current will be met provided a device is incorporated in the circuit to limit the short term average current to 1.5 mA.

The tube does not emit x-radiation above the internationally accepted maximum dosage rate if it is operated from an e.h.t. source supplying an absolute maximum voltage of 27.5 kV at zero beam current and with an internal impedance  $\geq 0.5 \text{ M}\Omega$ .

**Thorn-AEI Radio Valves and Tubes Limited**

Feb. 1969, Issue 3, Page 1



**INTER-ELECTRODE CAPACITANCES** (approximate)

Grid to all (each gun)	$C_{g-all}$	6.5	pF ←
Cathode to all (each gun)	$C_{k-all}$	5.7	pF ←
Cathodes to all	$C_{kR+kB+kG-all}$	16	pF
Anode 2 to all	$C_{a2-all}$	6.5	pF ←
Anodes 3 and 4 to coating M <sub>1</sub>	$C_{a3+a4-M1}$	2000 to 2500	pF ←
Anodes 3 and 4 to shell M <sub>2</sub>	$C_{a3+a4-M2}$	500	pF

**TYPICAL OPERATION** (each gun - voltages referred to cathode)

Third and fourth anode voltage	$V_{a3+a4}$	25	kV
Second anode voltage for focus	$V_{a2}$	4.2 to 5.0	kV
First anode voltage for cut-off of raster ( $V_g = -100V$ )	$V_{a1}$	210 to 495	V
Grid voltage for cut-off of raster ( $V_{a1} = 300V$ )	$V_g$	-65 to -135	V
Light output at screen centre ( $I_{a3+a4} = 800 \mu A$ )		69*	nt ←

\* To produce white(C.I.E.Co-ordinates  $x=0.281, y=0.311$ ), raster size 504 x 396 mm<sup>2</sup>

**DESIGN RANGES** (each gun, where applicable)

Third and fourth anode voltage	$V_{a3+a4}$	20 to 27.5	kV
Ratio focus to final anode voltage	$V_{a2}/V_{a3+a4}$	0.168 to 0.2	
Variations in grid cut-off voltage between guns in one tube†		0.65 to 1.0	
Second anode current	$I_{a2}$	-15 to +15	$\mu A$
First anode current	$I_{a1}$	-5.0 to +5.0	$\mu A$
Grid current at $V_g = -150V$	$I_g$	-5.0 to +5.0	$\mu A$ ←

Typical contributions to total anode current to produce white

Red gun	34%	Blue gun	32%	Green Gun	34% ←
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Ratios of cathode current to produce white

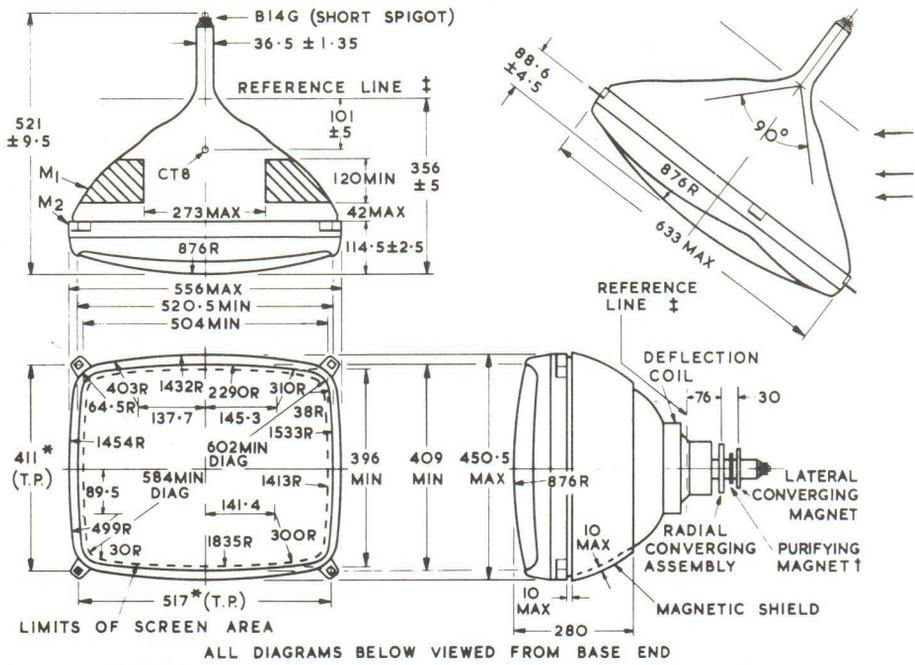
	min	av	max	
Red gun to green gun	0.65	1.0	1.5	←
Red gun to blue gun	0.75	1.1	1.5	←
Blue gun to green gun	0.6	0.91	1.3	←

Maximum shift requirements - at centre of screen

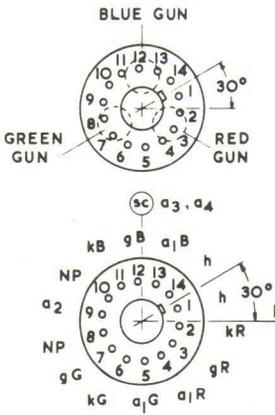
For registration by purifying magnets	± 0.13	mm
By lateral convergence magnets (blue beam with respect to the converged red and green beams)	± 6.5	mm ←
By radial convergence magnets (each beam)	± 9.5	mm
By direct current in deflector coils (raster)	± 15	mm

† Values quoted are the ratio of the lowest to the highest value of grid cut-off voltages for constant first anode voltage. For constant grid voltage the corresponding minimum ratio of first anode cut-off voltages is 0.6.

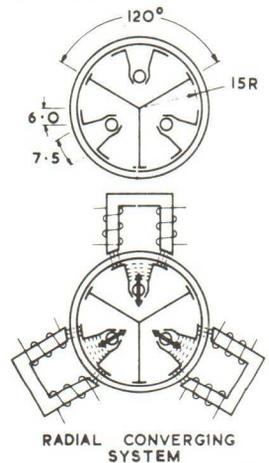




ALL DIAGRAMS BELOW VIEWED FROM BASE END



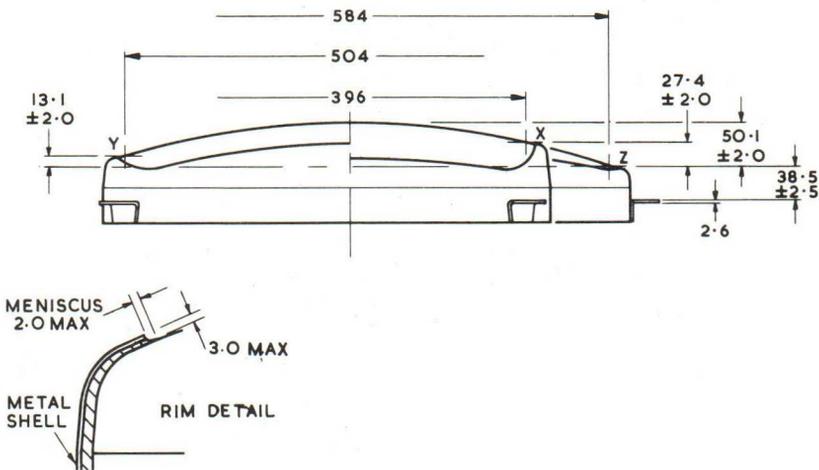
All dimensions in mm. Not to be scaled.



BASE CONNECTIONS  
 † Determined by reference line gauge No.14.  
 ‡ Purifying magnet may be positioned on other side of lateral converging assembly.  
 \* Bolts for mounting must be within circles of 9.5 mm diameter centred on these true positions. One of the lugs may deviate 2 mm max. from the plane through the other 3.  
 Useful screen area (approx.) 1905 cm<sup>2</sup>

# Colour Television Picture Tube

CTA2550  
A63-11X

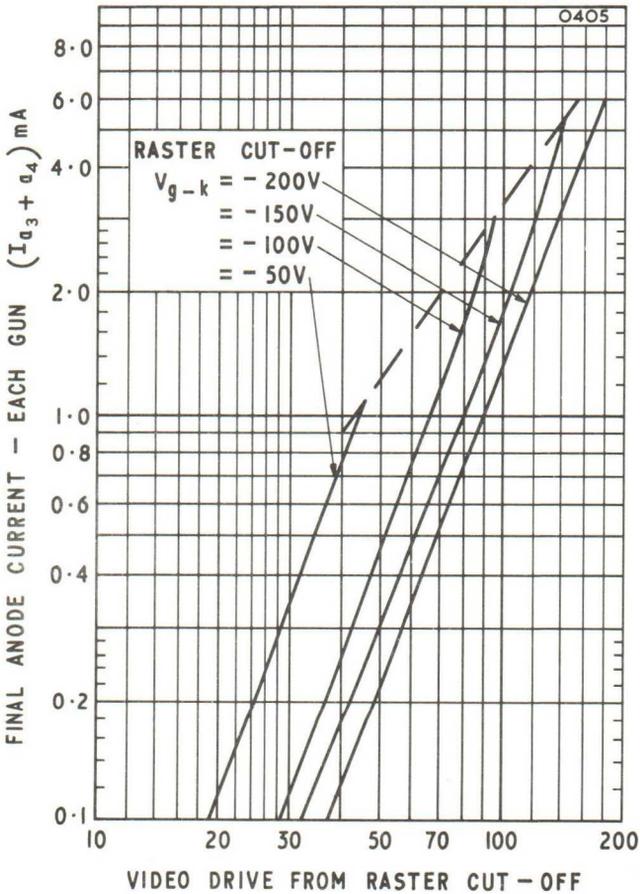


GRID MODULATION — Each gun

$V_{a_3+a_4} = 20$  to  $27.5$  kV

$V_{a_2-k}$  adjusted for focus

$V_{a_1-k}$  adjusted to provide raster cut-off  
for required  $V_{g-k}$

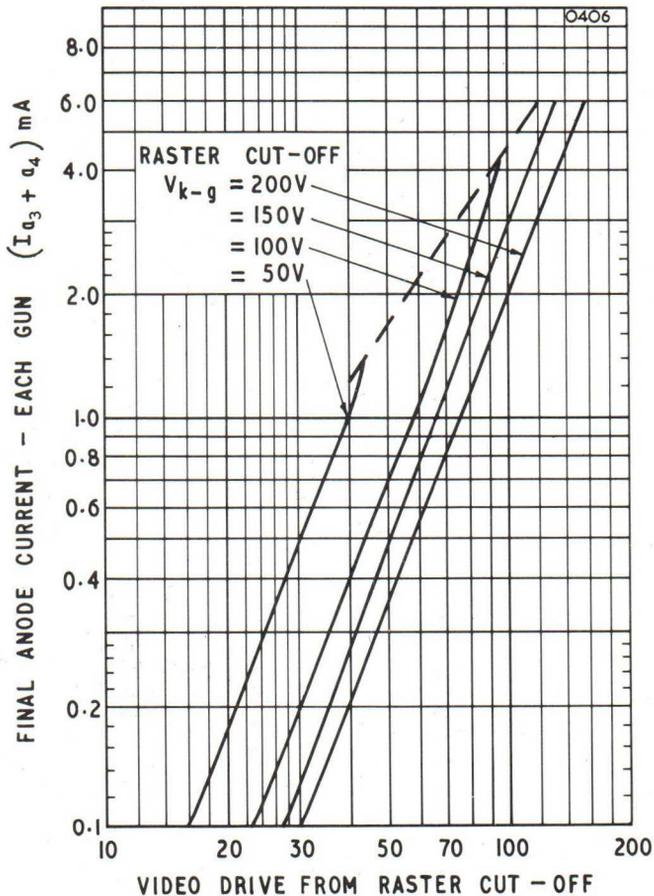


CATHODE MODULATION - Each gun

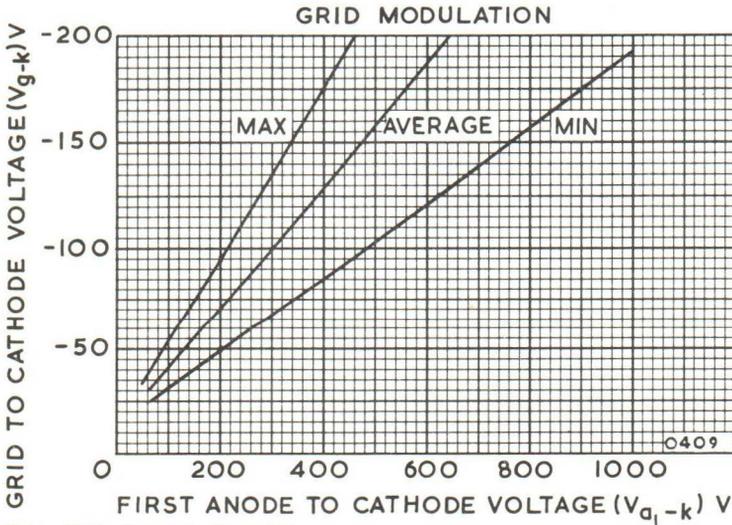
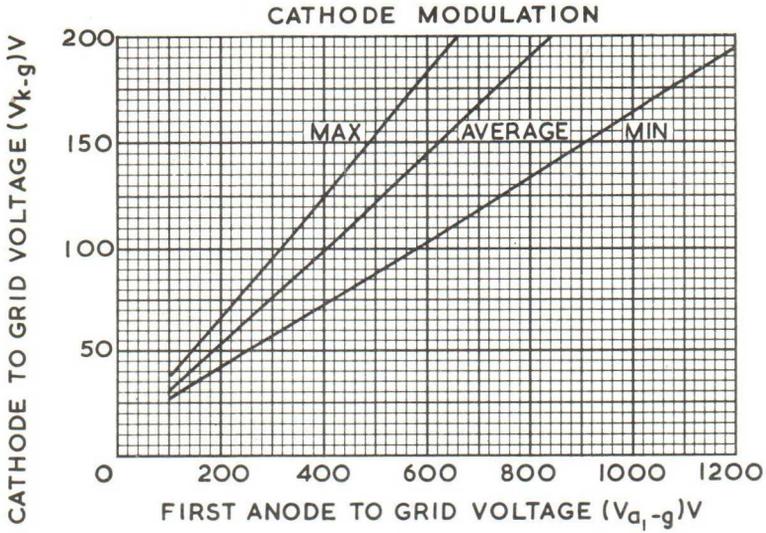
$V_{a_3+a_4} = 20$  to  $27.5$  kV

$V_{a_2-g}$  adjusted for focus

$V_{a_1-g}$  adjusted to provide raster cut-off  
for required  $V_{k-g}$



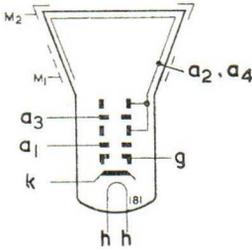
# LIMITS OF RASTER CUT-OFF VOLTAGE



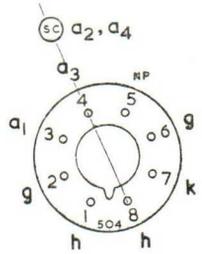
# **MONOCHROME PICTURE TUBES FOR MAINTENANCE**

**Superseded types  
still available for  
maintenance purposes**





### RIMBAND TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face .....	12 in Diagonal
Rimbando .....	Reinforced Envelope
Deflection Angle .....	110° Diagonal
Electrostatic Focus .....	Magnetic Deflection
Aluminised Screen .....	White Fluorescence
Grey Glass .....	50% Transmission (Approx)
Straight Gun .....	Non Ion Trap
External Conductive Coating	

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3*	A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2+a4(max)}$	13.5†	kV
Minimum Second and Fourth Anode Voltage	$V_{a2+a4(min)}$	10.5	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	550	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400‡§	V
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† The absolute rating of 16.5 kV must not be exceeded.

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

Tubes incorporating a B8H Sparkguard base will have a suffix S after the type number. For details of the Sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

Cathode to all	$C_{k-all}$	*	3.0	†	3.5 pF
Grid to all	$C_{g-all}$		7.0		8.5 pF
Anode 2 and Anode 4 to External Conductive Coating $M_1$ and Band $M_2$ (approx)	$C_{a2+a4-M1+M2}$		500		pF

\* Inter-electrode capacitances with holder capacitance balanced out.

† Total inter-electrode capacitances including a typical B8H holder.

**TYPICAL OPERATION—Grid Modulation (Voltages referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2+a4-k}$		12		kV
First Anode Voltage	$V_{a1-k}$		400		V
Final Anode Current	$I_{a2+a4}$		200		350 $\mu$ A
Third Anode Voltage for Focus	$V_{a3-k}$		0 to 400		V
Average Peak to Peak Picture Modulating Voltage			29		36 V
Grid to Cathode Voltage Limits for cut-off of raster	$V_{g-k}$		-40 to -76		V

**TYPICAL OPERATION—Cathode Modulation (Voltages referred to grid)**

Second and Fourth Anode Voltage	$V_{a2+a4-g}$		12		kV
First Anode Voltage	$V_{a1-g}$		400		V
Final Anode Current	$I_{a2+a4}$		200		350 $\mu$ A
Third Anode Voltage for Focus	$V_{a3-g}$		0 to 400		V
Average Peak to Peak Picture Modulating Voltage			25		31 V
Cathode to Grid Voltage Limits for cut-off of raster	$V_{k-g}$		37 to 66		V

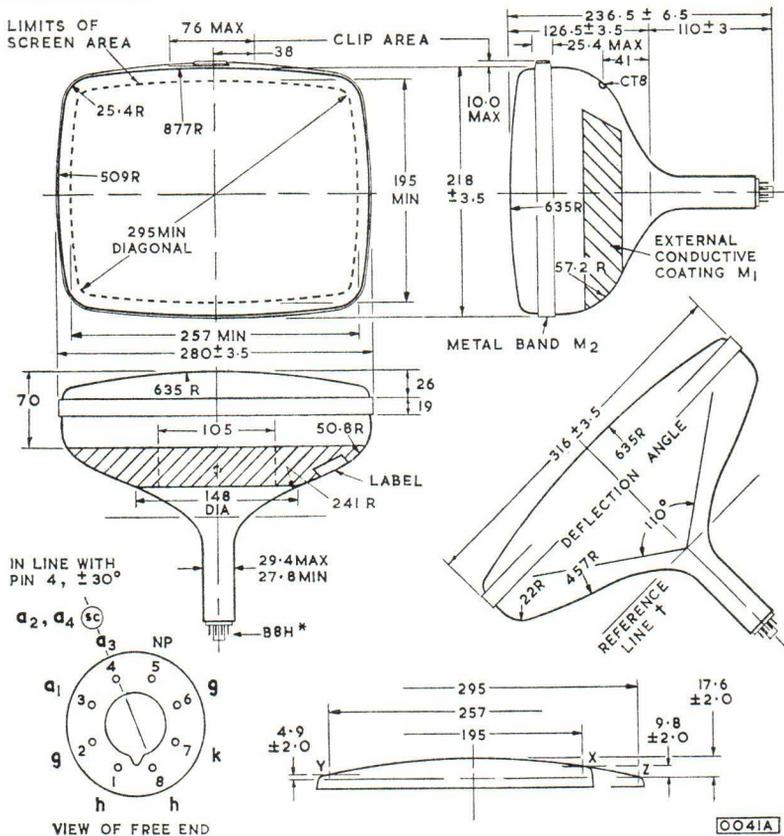
**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	15 Gs
Maximum distance of centre of magnetic field from reference line	53 mm

**DEFLECTION ANGLES**

Height	80°
Width	99°
Diagonal	110°

**TUBE WEIGHT (approx)—Net 2.7 kg (6.0 lb)**



All dimensions in mm.

Not to be scaled

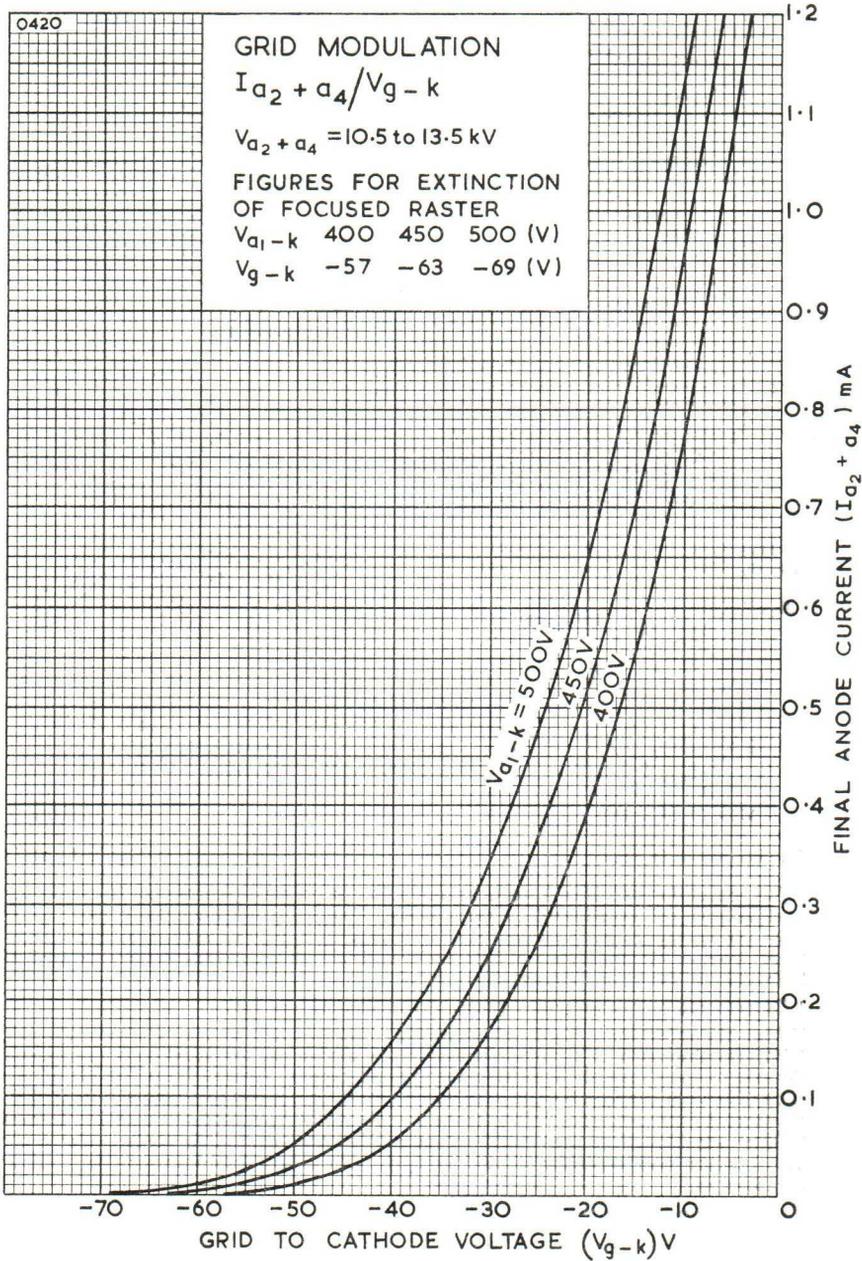
\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44 mm.

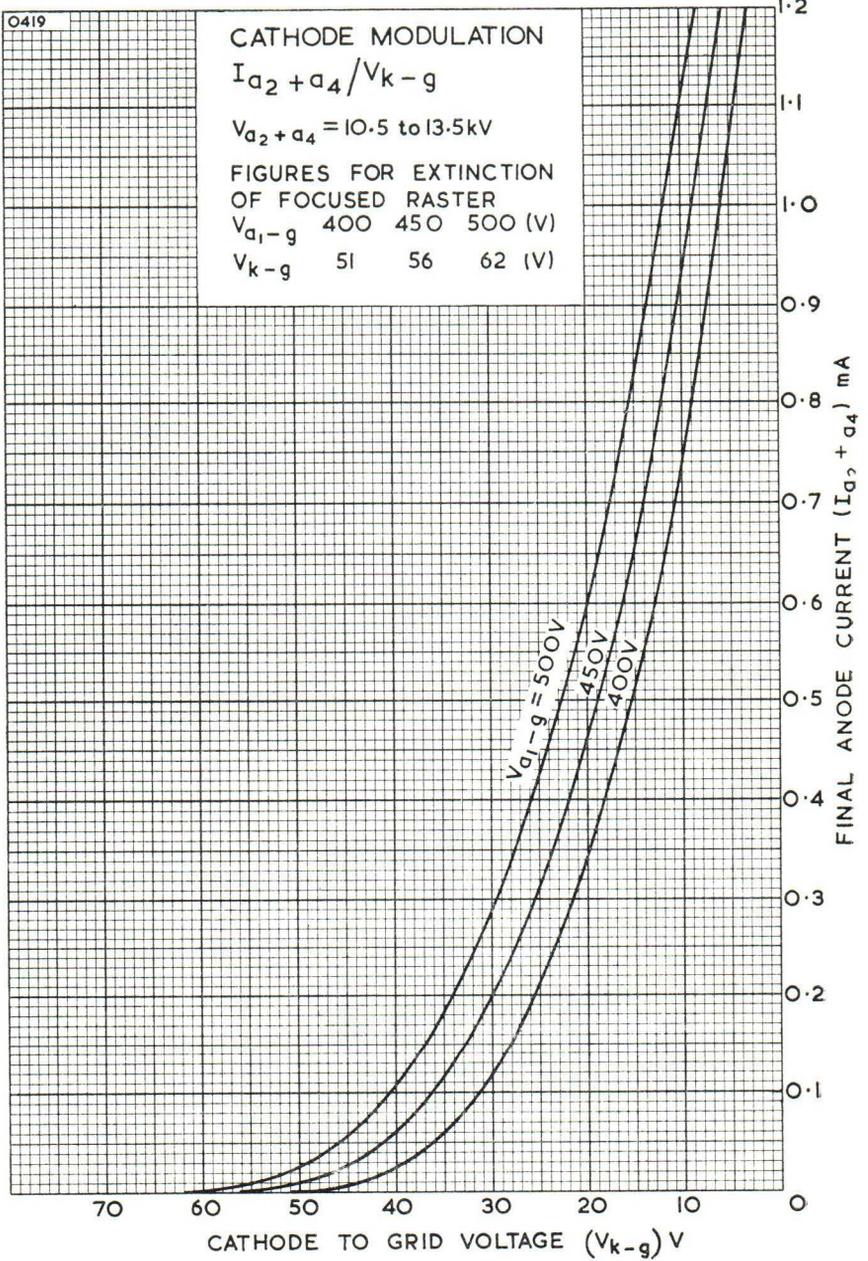
† Determined by reference line gauge No. 16 (JEDEC No. 126.)

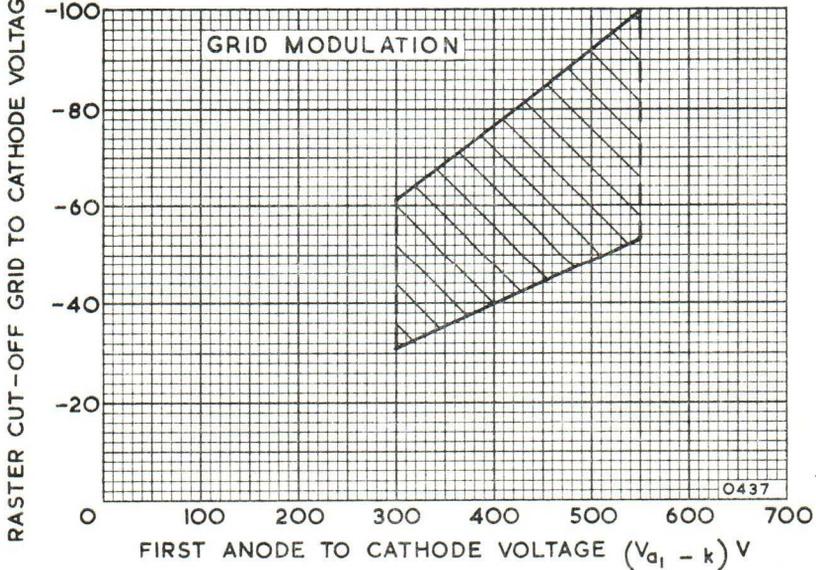
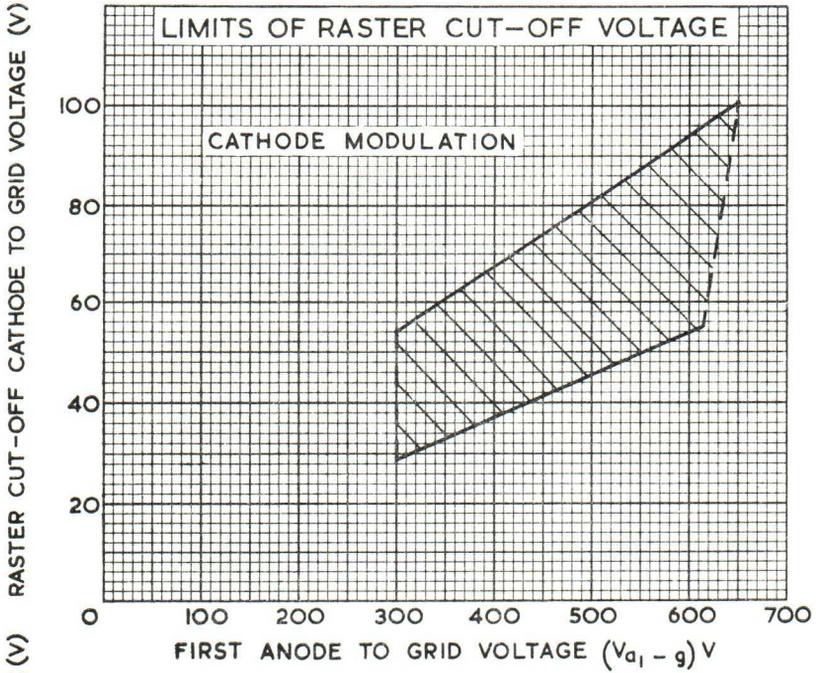
Where the metal band M<sub>2</sub> is not accessible from the front of the receiver (e.g. meets BS415 requirements of clearance and creepage distances), the band may be connected directly to the external conductive coating and chassis. Alternatively if the band M<sub>2</sub> is accessible from the front of the receiver M<sub>2</sub> must be connected to chassis via a 2.2 MΩ resistor. It is recommended that the resistor should be by-passed by a capacitor between 2000 pF and 4000 pF to provide improved EHT smoothing and RF radiation screening. The resistor and capacitor should comply with BS415 requirements for isolating components.

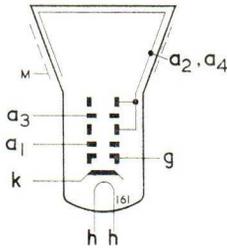
Minimum screen area 477 cm<sup>2</sup>.

There is an annular region of anti-corona coating with diameters of 30 mm and 75 mm surrounding the CT8 cap, the tube should not be handled in this region.

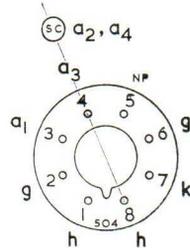








### TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face	...	16 in Diagonal
Deflection Angle	...	110° Diagonal
Grey Glass	...	65% Transmission (approx)
Aluminised Screen	...	White Fluorescence
Electrostatic Focus	...	Magnetic Deflection
Straight Gun	...	Non Ion Trap

#### External Conductive Coating

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3*	A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a_2, a_4}(\max)$	17†	kV
Minimum Second and Fourth Anode Voltage	$V_{a_2, a_4}(\min)$	11	kV
Maximum Third Anode Voltage	$V_{a_3}(\max)$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a_1}(\max)$	550	V
Maximum Heater to Cathode Voltage	$V_{h-k}(\max)$	250	V
Heater Negative (d.c.)			
Maximum Peak Heater to Cathode Voltage	$V_{h-k}(\text{pk})_{\max}$	400±§	V
Heater Negative			
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k}(\max)$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k}(\max)$	1.5	MΩ

All voltages referred to cathode.

\* The CRT heater should always be connected at the chassis end if used in a series heater chain.

†  $I_{a_2} + a_4 = 0$ .

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

#### INTER-ELECTRODE CAPACITANCES

Grid to all	$C_{g-\text{all}}$	7.0	8.5	pF
Cathode to all	$C_{k-\text{all}}$	3.0	3.5	pF
Anode 2 and Anode 4 to External Conductive Coating	$C_{a_2, a_4-M}$	1000 (approx)		pF

φ Inter-electrode capacitances with holder capacitance balanced out.

|| Total inter-electrode capacitances including an AEI B8H holder VH68/81 (8 pin).

The A40-11W/CME1601 is electrically identical to the AW47-91/CME1903.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**TYPICAL OPERATION—Grid Modulation (Voltages referred to cathode)**

Second and Fourth Anode Voltage	$V_{a_2, a_4-k}$	16	16	kV
First Anode Voltage*	$V_{a_1-k}$	400	500	V
Beam Current	$I_{a_2+a_4}$	350 500	350 500	$\mu A$
Third Anode Voltage for Focus" (Mean)	$V_{a_3-k(av)}$	200 140	220 160	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for Cut-off of Raster (See charts for limits)	$V_{g-k}$	-57	-69	V

Within range of operating conditions for all tubes the value of  $V_{a_3-k}$  required for focus will lie between 0 and +400V.

**TYPICAL OPERATION—Cathode Modulation (Voltages referred to grid)**

Second and Fourth Anode Voltage	$V_{a_2, a_4-g}$	16	16	kV
First Anode Voltage*	$V_{a_1-g}$	400	500	V
Beam Current	$I_{a_2+a_4}$	350 500	350 500	$\mu A$
Third Anode Voltage for Focus" (Mean)	$V_{a_3-g(av)}$	220 160	240 180	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for Cut-off of Raster (see charts for limits)	$V_{k-g}$	51	62	V

\* Within this range a higher First Anode Voltage will provide an improved focus performance.

" For best overall focus with resolution maintained at the centre.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

**DEFLECTION ANGLES**

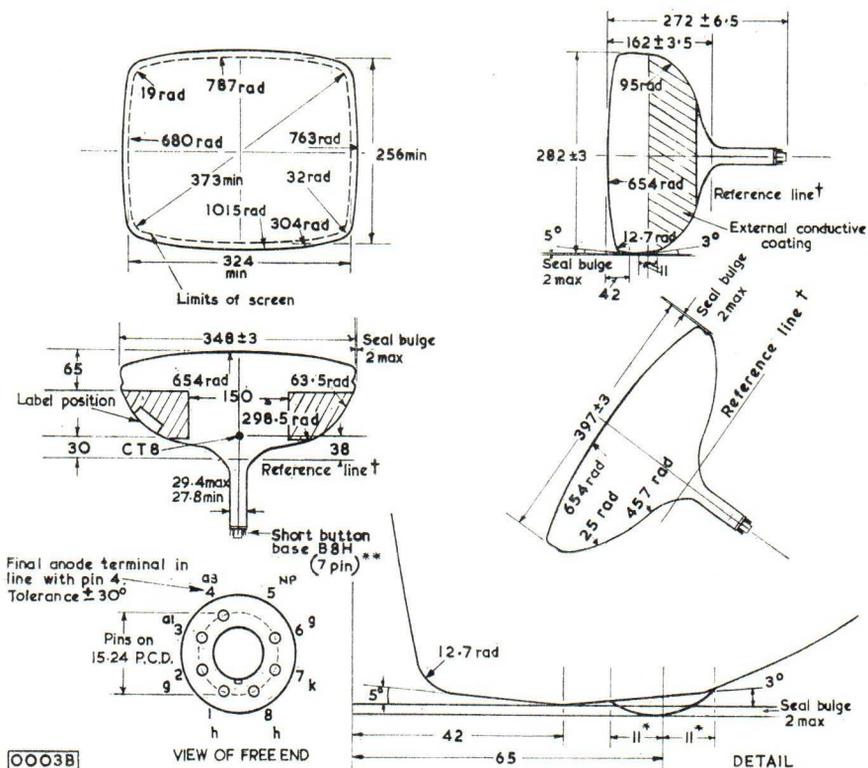
Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight: Net	8 lb (3.6 kg)
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**NOTE**

If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliröntgens per hour the window will normally provide adequate protection.



All dimensions in mm.

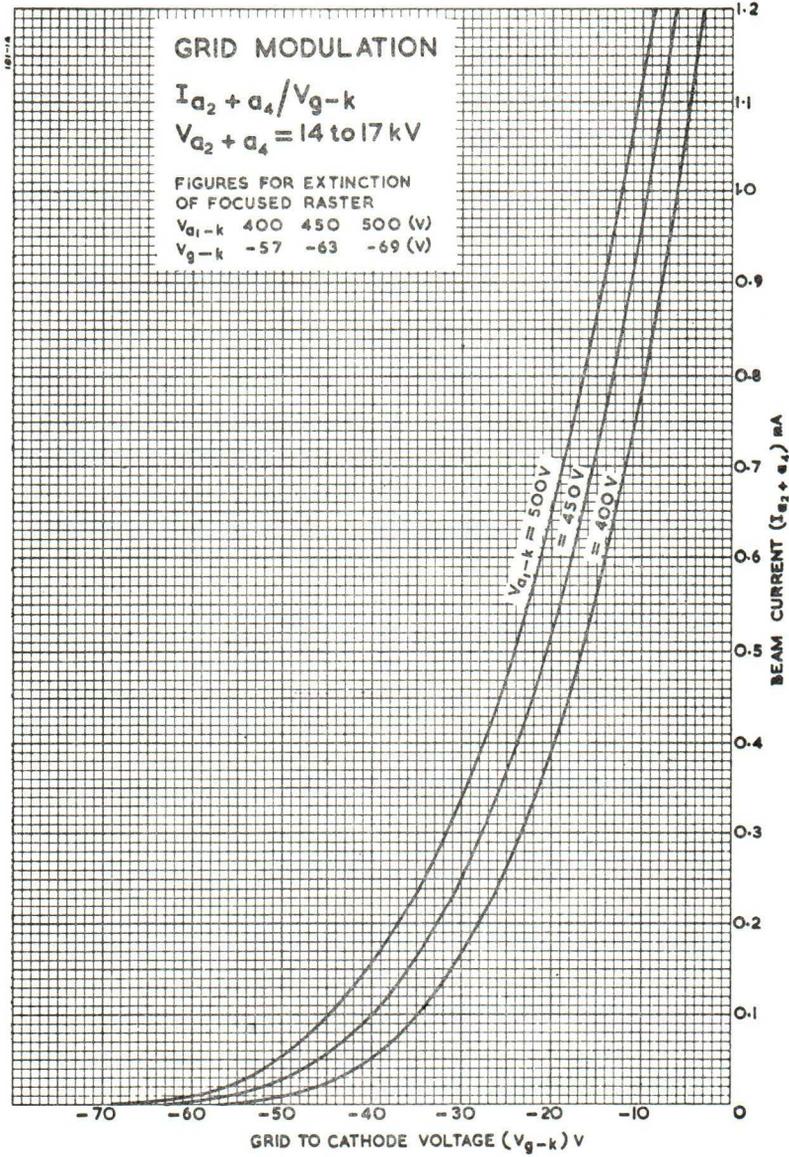
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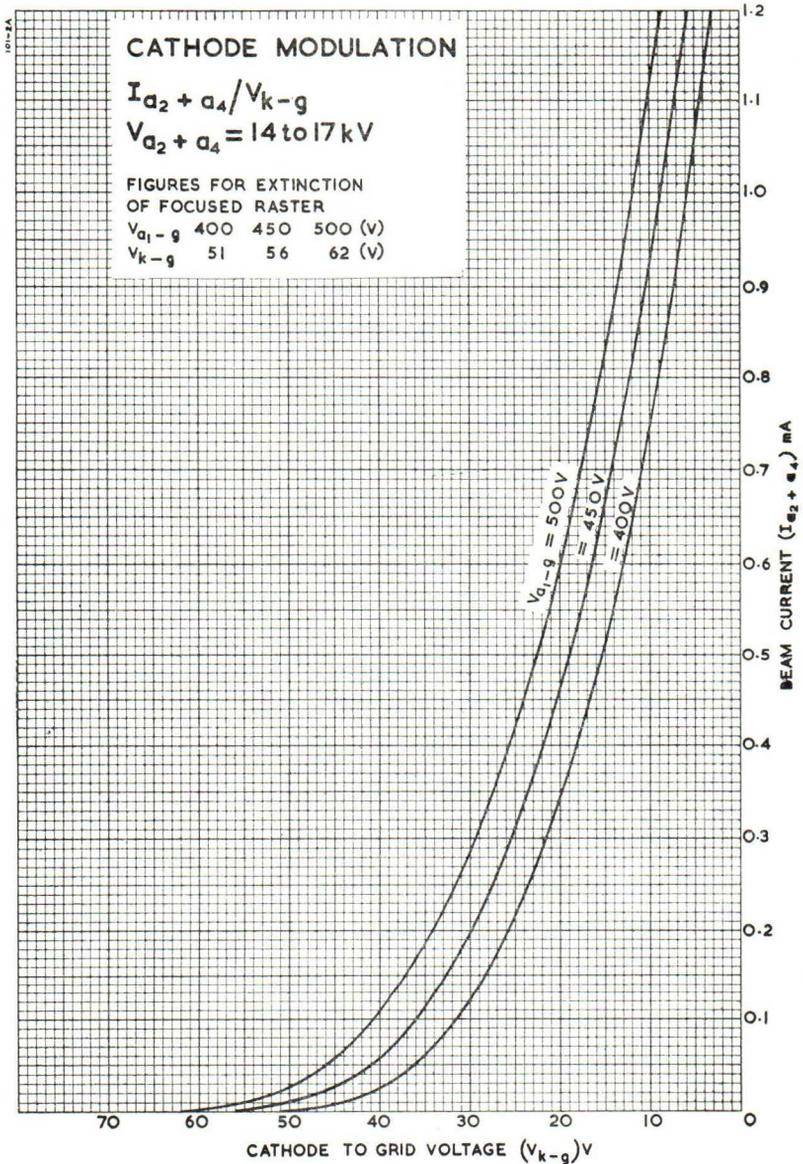
### Notes

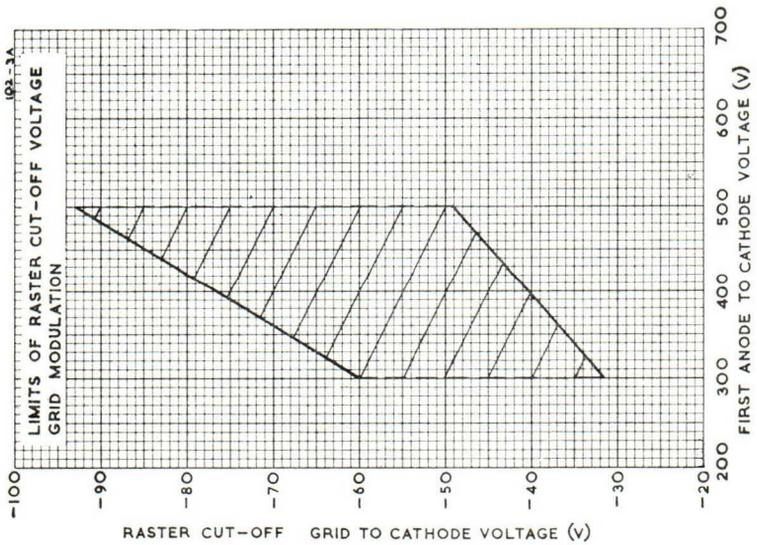
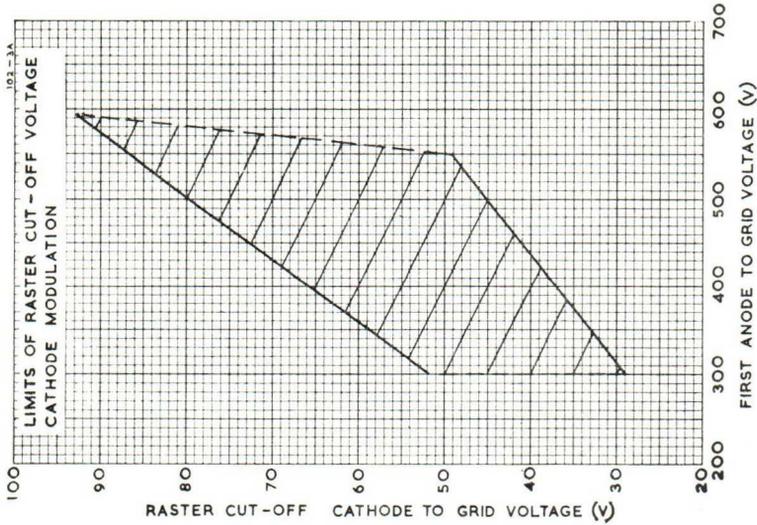
\* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

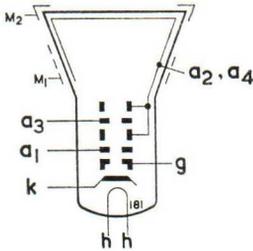
† Determined by Reference Gauge No. 16 (JEDEC No.126).

\*\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44 mm.

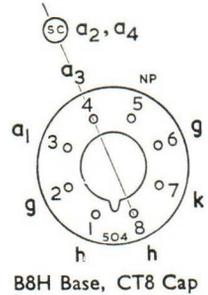








### RIMGUARD II TELEVISION PICTURE TUBE



#### GENERAL

Rectangular Face .....	16 in Diagonal
Reinforced Envelope .....	Integral Mounting Lugs
Electrostatic Focus .....	Magnetic Deflection
Deflection Angle .....	110° Diagonal
Aluminised Screen .....	White Fluorescence
Grey Glass .....	65% Transmission (Approx)
Straight Gun .....	Non Ion Trap
External Conductive Coating	
Heater Voltage	$V_h$ 6.3 V
Heater Current	$I_h$ 0.3* A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2+a4(max)}$	17†	kV
Minimum Second and Fourth Anode Voltage	$V_{a2+a4(min)}$	11	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	550	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400† §	V
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† For  $I_{a2+a4}=0$ .

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

Tubes incorporating a B8H Sparkguard base will have a Suffix S after the type number. For details of the Sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anode 2 and Anode 4 to External Conductive Coating, $M_1$ (approx)	$C_{a2+a4-M1}$	1000		pF
Anode 2 and Anode 4 to Shell, $M_2$ (approx)	$C_{a2+a4-M2}$	250		pF

\* Inter-electrode capacitances with holder capacitance balanced out.

† Total inter-electrode capacitances including a typical B8H holder.

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2+a4-k}$	16	16	kV
First Anode Voltage ‡	$V_{a1-k}$	400	500	V
Final Anode Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for cut-off of raster (See chart for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2+a4-g}$	16	16	kV
First Anode Voltage ‡	$V_{a1-g}$	400	500	V
Final Anode Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for cut-off of raster (See chart for limits)	$V_{k-g}$	51	62	V

‡ Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 Gs
Maximum distance of centre of magnetic field from reference line	53 mm

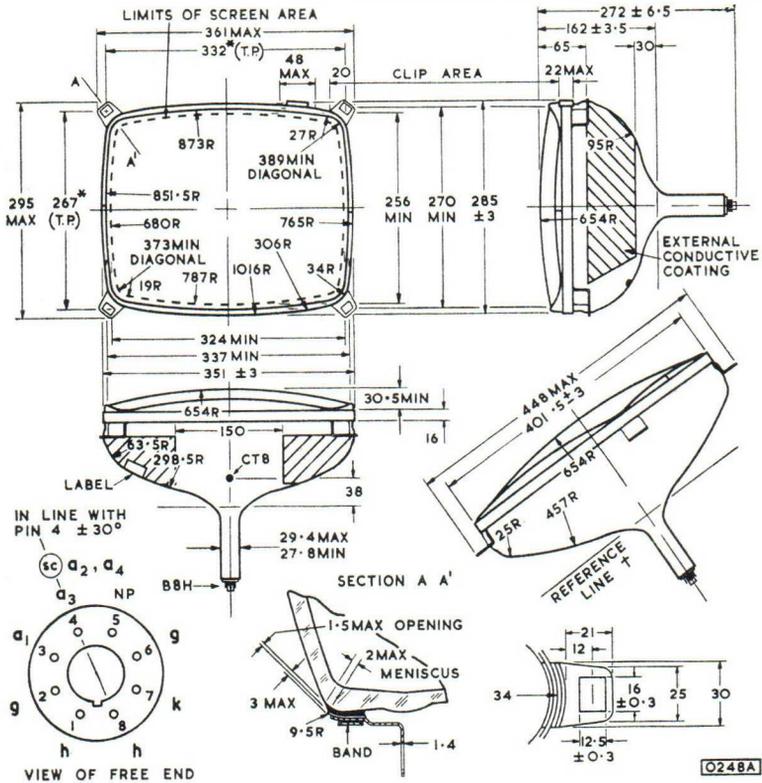
**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**TUBE WEIGHT (approx)—Net 4.3 kg (9.5 lb)**

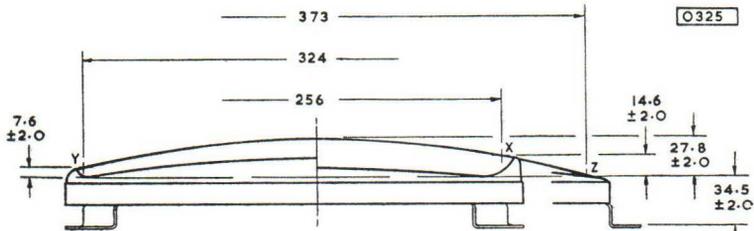
**Note :**

If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.



O248A

O325



All dimensions in mm.

Not to be scaled.

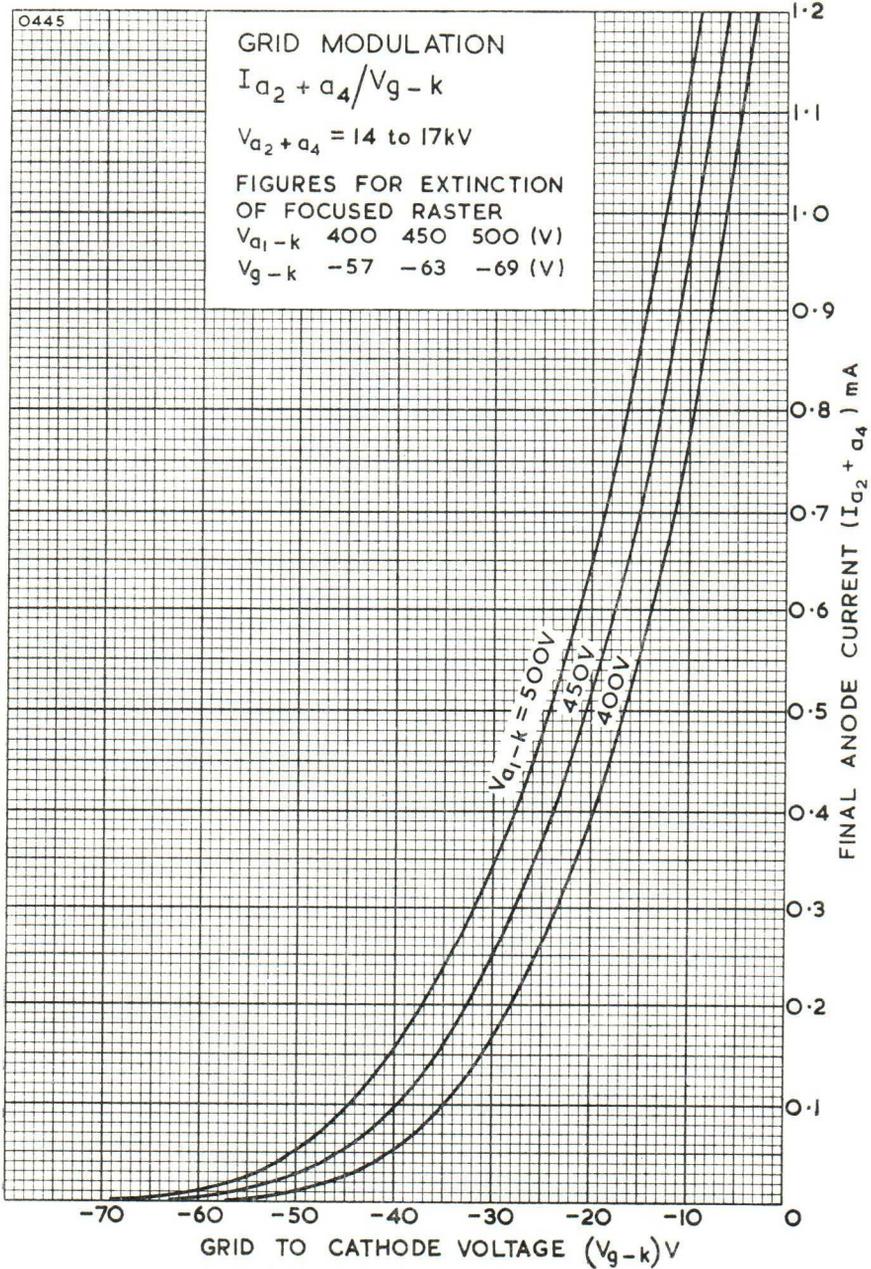
\* The bolts to be used for mounting the tube must lie within the circles of 8.5 mm diameter centred on these true positions. One of the four lugs may deviate 2 mm maximum from the plane through the other three lugs.

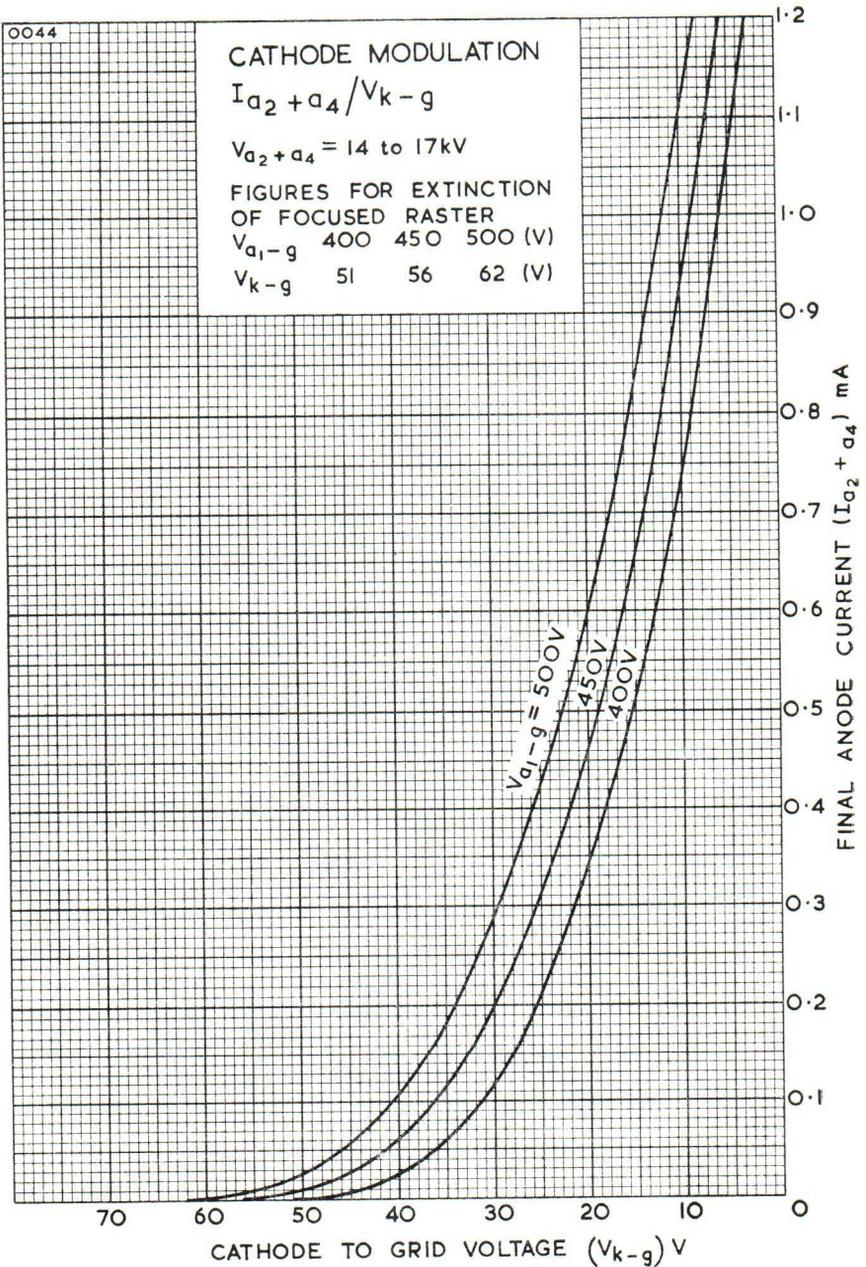
† Determined by reference line gauge No. 16 (JEDEC No. 126).

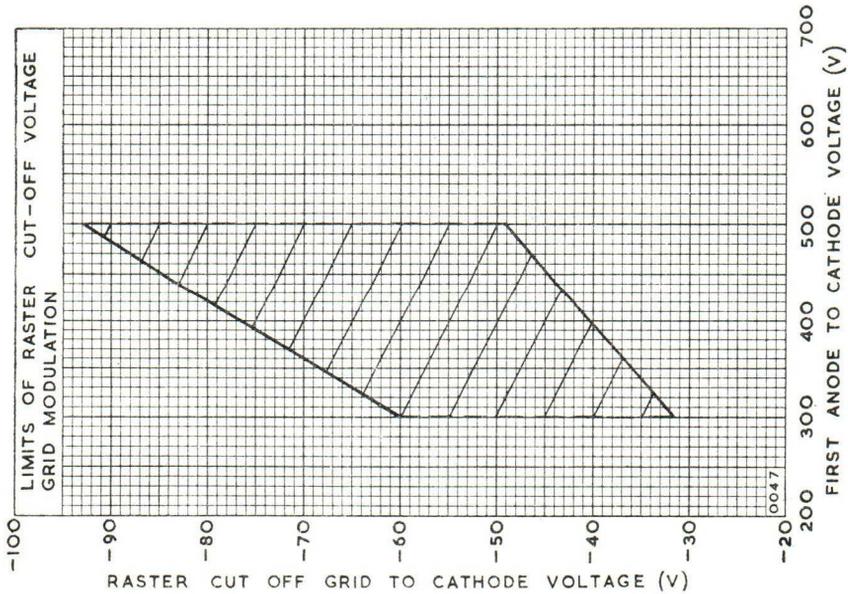
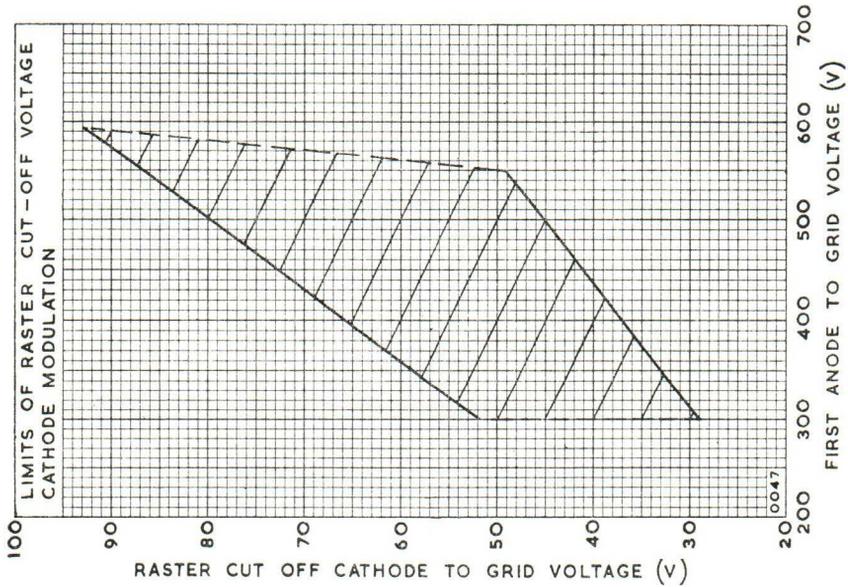
It is recommended that the mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

The metal shell M<sub>2</sub> must be connected to chassis via a 2MΩ resistor.

There is an annular region of anti-corona coating with diameters of 30 mm and 75 mm surrounding the CT8 cap, the tube should not be handled in this region.







**CME1702**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**



GENERAL

The CME1702 is an electrostatically focussed and magnetically deflected television cathode ray tube. The grey glass face of the tube is rectangular and has a total light transmission at the centre of 74%, reducing the effect of incident light on picture contrast. The television type screen gives a substantially black and white picture and is aluminised for increased brilliance and freedom from ion burn. The tube is fitted with a straight gun, requiring no ion trap magnet and an external conductive coating which may be used in the smoothing of the E.H.T. supply.

RATING

Heater Voltage	(volts)	$V_h$	12.6	
Heater Current	(amps)	$I_h$	0.3*	
Maximum Second and Fourth Anode Voltage	(kV)	$V_{a2,a4(max)}$	16.0§	←
Minimum Second and Fourth Anode Voltage	(kV)	$V_{a2,a4(min)}$	12.0	
Maximum First Anode Voltage	(volts)	$V_{a1(max)}$	400	
Maximum Third Anode Voltage	(volts)	$V_{a3(max)}$	±700	←
Maximum Heater to Cathode Voltage, Heater Negative (DC)	(volts)	$V_{h-k(max)}$	180	
Maximum Peak Heater to Cathode Voltage, Heater Negative (DC)	(volts)	$V_{h-k(pk)max}$	400‡	

\* The Cathode Ray Tube heater should always be connected at the chassis end in a series heater chain.

§ The maximum rating of 16kV is a Design Centre Rating, and the Absolute Rating of 17.6kV must not be exceeded. ←

‡ Absolute Rating during a warming-up period not exceeding one minute.

Indicates a change ←

**CME1702**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**

INTER-ELECTRODE CAPACITANCES (pF)

Grid/Earth	$C_{g-E}$	9.0
Cathode/Earth	$C_{k-E}$	6.5
Anode 2 and Anode 4/External Conductive Coating (approx)	$C_{a2,a4-M}$	1,300 ←

These capacities include an Ediswan Clix holder type CRT92/7

SCANNING ANGLE—90° (diagonal)DIMENSIONS

Maximum Overall Length	(mm)	383
Maximum Diagonal	(mm)	425
Maximum Height	(mm)	314
Maximum Width	(mm)	394
Maximum Neck Diameter	(mm)	38
Approximate Nett Weight	(lbs)	13¼
Approximate Packed Weight	(lbs)	19½

TYPICAL OPERATION

Second and Fourth Anode Voltage	(kV)	$V_{a2,a4}$	14.0—15.0
First Anode Voltage	(volts)	$V_{a1}$	300
Third Anode Voltage for Focus (mean)	(volts)	$V_{a3}$	+100
Grid Bias for Cut-off of Raster	(volts)	$V_{g1}$	30—72
Average Peak to Peak Modulating Voltage for Modulation up to 150 $\mu$ A	(volts)		24 ←
Centreing Magnet Flux Density	(Gauss)		0—10
Maximum distance of centre of centreing field from Reference line	(mm)		59

Indicates a change ←

#### CME1702

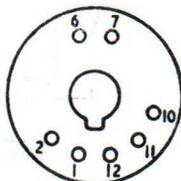
#### TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS



ANODE CAP—Cavity (CT8)

In line with pin 6 of base Tolerance  $\pm 30\%$

BASE—Duodecal (B12A)



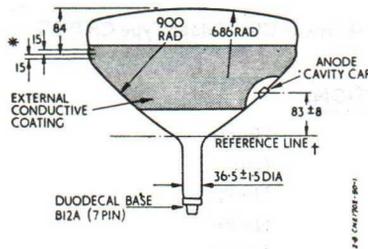
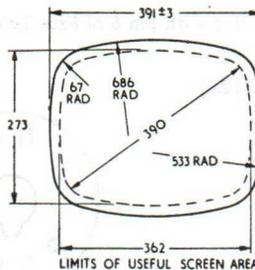
Viewed from free end of pins

SOCKET—Ediswan Clix Holder Type CRT92/7.

#### CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	Third Anode	a3
Pin 7	Internal Connection	IC
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	First Anode	a1
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Second and Fourth Anode	a2, a4

## CME1702

TELEVISION CATHODE RAY TUBE  
ELECTROSTATIC FOCUS

All dimensions in mm.

## NOTE\*

During the face sealing operation the glass in this area (total 30mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material). All dimensions in mm. unless otherwise stated.

† Determined by Reference Gauge No. 13.

Indicates a change ←

## CME1702 TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS

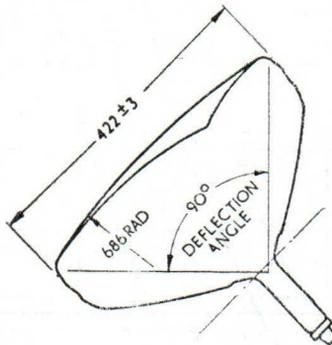
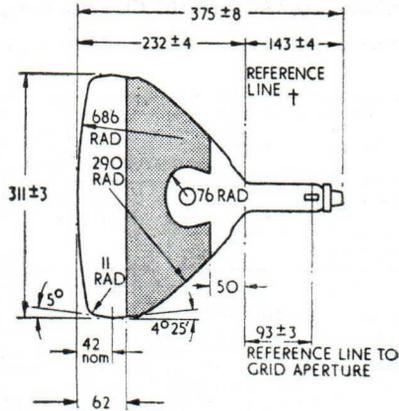


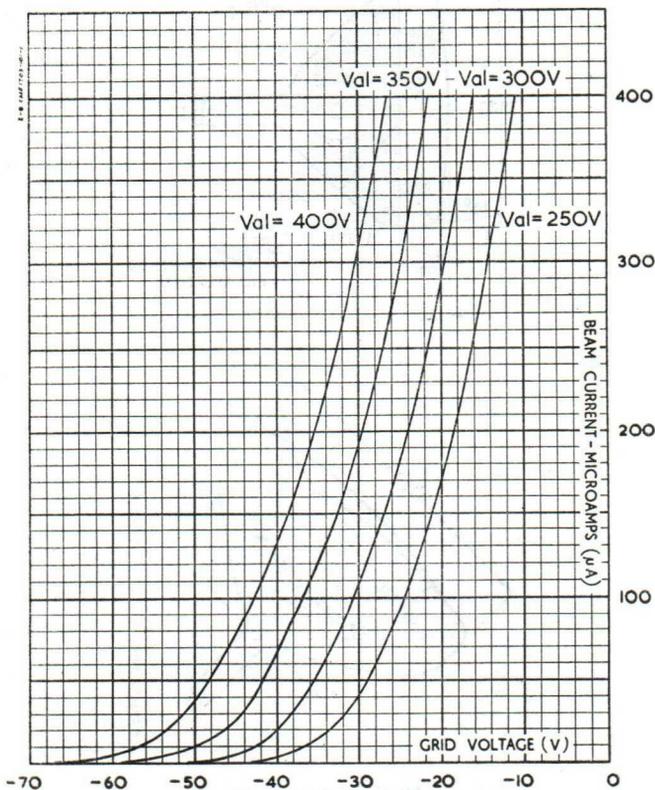
FIG. CME1702-90-1

All dimensions in mm.

† Determined by Reference Gauge No. 13

**CME1702**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**

AVERAGE CHARACTERISTIC CURVES :  $I_{\text{Beam}}/V_g$   
 Curves apply for  $V_{a2,a4}$  between 12kV and 16kV



## CME1703

### TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS Indirectly heated

#### GENERAL

Deflection Angle .....	110° Diagonal
Rectangular Face .....	17° Diagonal
Grey Glass Face .....	75% Light Transmission
Aluminised Screen	Magnetic Deflection
Straight Gun	B8H Base
	External Conductive Coating
	Heater for use in Series Chain

#### RATING

Heater Voltage	V <sub>h</sub>	12.6 V
Heater Current	I <sub>h</sub>	0.3* A
Maximum Second and Fourth Anode Voltage	V <sub>a2,a4(max)</sub>	16** kV
Minimum Second and Fourth Anode Voltage	V <sub>a2,a4(min)</sub>	12 kV
Maximum First Anode Voltage	V <sub>a1(max)</sub>	400 V
Maximum Third Anode Voltage	V <sub>a3(max)</sub>	±700 V
Maximum Heater/Cathode Voltage, Heater Negative (d.c.)	V <sub>h-k(max)</sub>	180 V
Maximum Peak Heater/Cathode Voltage, Heater Negative (d.c.)	V <sub>h-k(pk)max</sub>	400†§ V

\* The cathode ray tube heater should always be connected at the chassis end in a series heater chain.

\*\* 16kV is a design centre rating, the absolute rating of 20kV must not be exceeded.

† Absolute rating.

§ During a warming up period not exceeding one minute.

#### INTER-ELECTRODE CAPACITANCES

		††	§§	
Cathode/All other electrodes	c <sub>k-all</sub>	4.5	5.0	pF
Grid/All other electrodes	c <sub>g-all</sub>	6.0	7.5	pF
Anode 2, Anode 4/External Conductive Coating (approx.)	c <sub>a2,a4-M</sub>		1700	pF

†† Inter-electrode capacities with holder capacity balanced out.

§§ Inter-electrode capacities including Clix B8H holder VH68/81 (8-pin).

## CME1703

## TELEVISION CATHODE RAY TUBE

## ELECTROSTATIC FOCUS

Indirectly heated

## TYPICAL OPERATION

Second and Fourth Anode Voltage	$V_{a2,a4}$	14	16	kV
First Anode Voltage	$V_{a1}$	300	300	V
Third Anode Voltage for Focus (mean)	$V_{a3}$	100	190	V
Grid Bias Voltage for Cut-off of Raster	$V_g$	-30 to -72	-30 to -72	V
Average Peak/Peak Modulating Voltage for Modulation up to $150\mu A$		24	24	V

## NOTE

If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

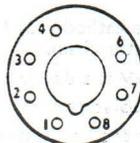
## DIMENSIONS

Maximum Overall Length	324	mm
Maximum Face Diagonal	424 $\ddagger$	mm
Maximum Face Height	327 $\ddagger$	mm
Maximum Face Width	400 $\ddagger$	mm
Maximum Neck Diameter	29.4	mm
Approximate Net Weight	11.5	lb
Approximate Packed Weight	16	lb

$\ddagger$  The maximum dimension at the face seal may be 7mm larger than this dimension but at any point around the seal the bulge will not protrude more than 3.5mm.

CAP—Cavity (CT8)

BASE—Button Base (B8H)



Viewed from free end of pins.

## CONNECTIONS

Pin 1	Heater	h
Pin 2	Control Grid	g
Pin 3	First Anode	a1
Pin 4	Third Anode	a3
Pin 5	No Pin	NP
Pin 6	Control Grid	g
Pin 7	Cathode	k
Pin 8	Heater	h
Cap	Second and Fourth Anode	a2,a4

### CME1705

#### TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS Indirectly heated

#### GENERAL

Deflection Angle .....	110° Diagonal
Rectangular Face .....	17" Diagonal
Grey Glass Face .....	75% Light Transmission
Aluminised Screen .....	Magnetic Deflection
Straight Gun .....	B8H Base

External Conductive Coating

Heater for use in Series Chain

#### RATING

Heater Voltage	$V_h$	12.6 V
Heater Current	$I_h$	0.3* A
Maximum First and Second Anode Voltage	$V_{a1,a2(max)}$	500 V
Minimum First Anode Voltage	$V_{a1(min)}$	400 V
Maximum Third Anode Voltage	$V_{a3(max)}$	16** kV
Minimum Third Anode Voltage	$V_{a3(min)}$	14 kV
Maximum Heater/Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	180 V
Maximum Peak Heater/Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(pk)max}$	400†† V

\* The cathode ray tube heater should always be connected at the chassis end in a series heater chain.

\*\* 16kV is a design centre rating, the absolute rating of 20kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding one minute.

#### INTER-ELECTRODE CAPACITANCES

		††	§§
Grid/All other electrodes	$c_{g-all}$	8.0	9.5 pF
Cathode/All other electrodes	$c_{k-all}$	4.5	5.0 pF
Anode 3/External Conductive Coating (approx)	$c_{a3-M}$	1700	pF

†† Inter-electrode capacitance with holder capacitance balanced out.

§§ Inter-electrode capacitance including Clix B8H holder VH68/81 (8 pin).

#### TYPICAL OPERATION

First Anode Voltage	$V_{a1}$	450	450 V
Third Anode Voltage	$V_{a3}$	15	16 kV
Second Anode Voltage for Focus (approx.)	$V_{a2}$	100	160 V
Grid Bias for Cut-off of Raster	$V_g$	-30 to -72	-30 to -72 V
Average Peak/Peak Modulating Voltage for Modulation up to 350μA		35.5	35.5 V

**CME1705**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated

**NOTE**

If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

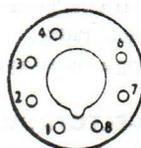
**DIMENSIONS**

Maximum Overall Length	290.5 mm
Maximum Face Diagonal	424§ mm
Maximum Face Height	327§ mm
Maximum Face Width	400§ mm
Maximum Neck Diameter	29.4 mm
Approximate Net Weight	11.5 lb
Approximate Packed Weight	16 lb

§ The maximum dimension at the face seal may be 7mm larger than this dimension but at any point around the seal the bulge will not protrude more than 3.5 mm.

**CAP**—Cavity (CT8)

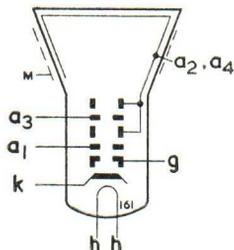
**BASE**—Short Button Base (B8H)



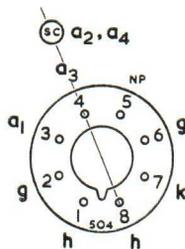
Viewed from free end of pins

**CONNECTIONS**

Pin 1	Heater	h
Pin 2	Control Grid	g
Pin 3	First Anode	a1
Pin 4	Second Anode	a2
Pin 5	No Pin	NP
Pin 6	Control Grid	g
Pin 7	Cathode	k
Pin 8	Heater	h
Cap	Third Anode	a3



### TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face.....19 in. Diagonal  
 Electrostatic Focus .....Magnetic Deflection  
 Deflection Angle .....110° Diagonal  
 Aluminised Screen .....White Fluorescence  
 Grey Glass.....75% Transmission (approx.)  
 Straight Gun .....Non Ion Trap

#### External Conductive Coating

Heater Voltage	$V_h$	6.3 V
Heater Current	$I_h$	0.3 A

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20* kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13 kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500 V
Maximum First Anode Voltage	$V_{a1(max)}$	700 V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250 V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400†† V
Maximum Impedance Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5 MΩ
Maximum Resistance Grid to Cathode	$R_{g-k(max)}$	1.5 MΩ

All voltages referred to cathode.

\* For  $I_{a2+a4}=0$ .

† Absolute rating.

†† During a warming-up period not exceeding 45 seconds.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

Cathode to all	$C_{k-all}$	§	3.0	φ	3.5	pF
Grid to all	$C_{g-all}$		7.0		8.5	pF
Second and Fourth Anode to External Conductive Coating (approx.)	$C_{a2,a4-M}$			1250		pF

§ Inter-electrode capacitances with holder capacitance balanced out.

φ Total inter-electrode capacitances including a typical B8H holder.

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18		18		kV
First Anode Voltage*	$V_{a1-k}$	400		500		V
Final Anode Current	$I_{a2+a4}$	350	500	350	500	μA
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400		0 to 400		V
Average Peak to Peak Picture Modulating Voltage		35.5	40.5	39.5	45	V
Grid to Cathode Voltage for Cut-off of Raster (See chart for limits)	$V_{g-k}$	-57		-69		V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18		18		kV
First Anode Voltage*	$V_{a1-g}$	400		500		V
Final Anode Current	$I_{a2+a4}$	350	500	350	500	μA
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400		0 to 400		V
Average Peak to Peak Picture Modulating Voltage		31.5	35.5	34.5	39.5	V
Cathode to Grid Voltage for Cut-off of Raster (See chart for limits)	$V_{k-g}$	51		62		V

\* Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 Gs
Maximum distance of centre of magnetic field from reference line	53 mm

**NOTE**

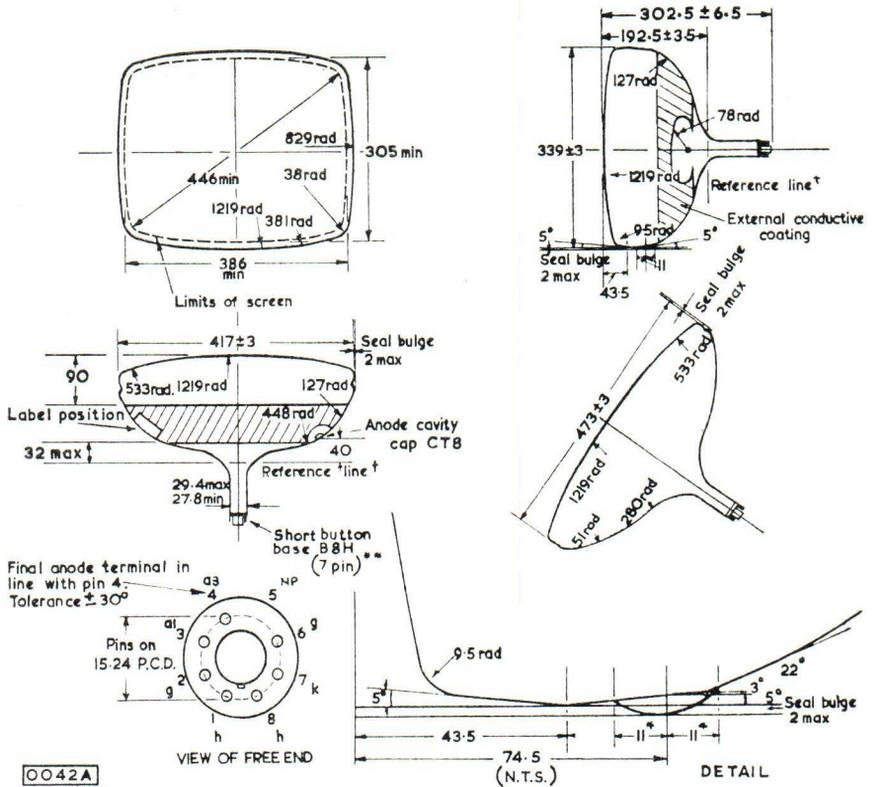
If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliröntgens per hour, the window will normally provide adequate protection.

**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight : Net	7.2 kg (16 lb)
Packed	9.1 kg (20 lb)



All dimensions in mm.

Not to be scaled.

#### Notes :

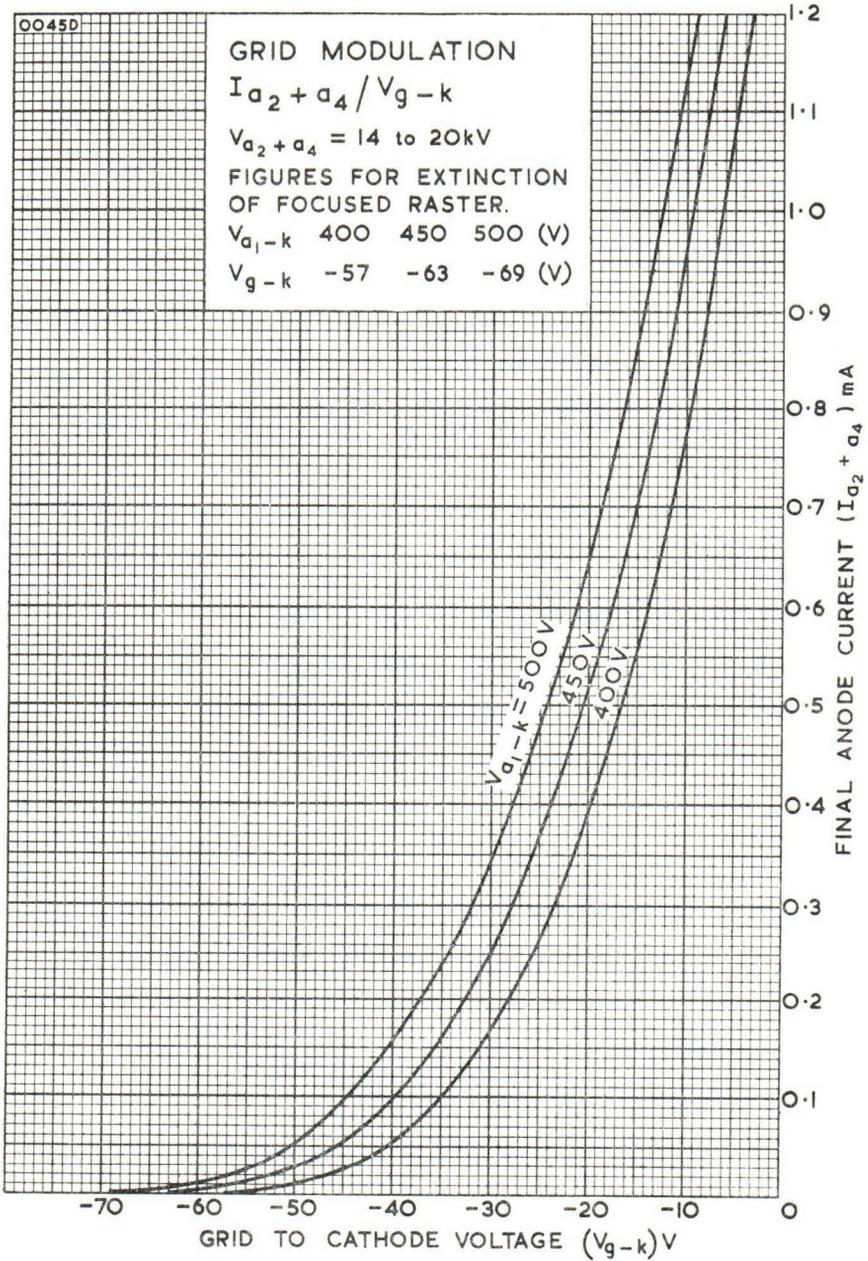
\* During the face sealing operation the glass in this area (total 22mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

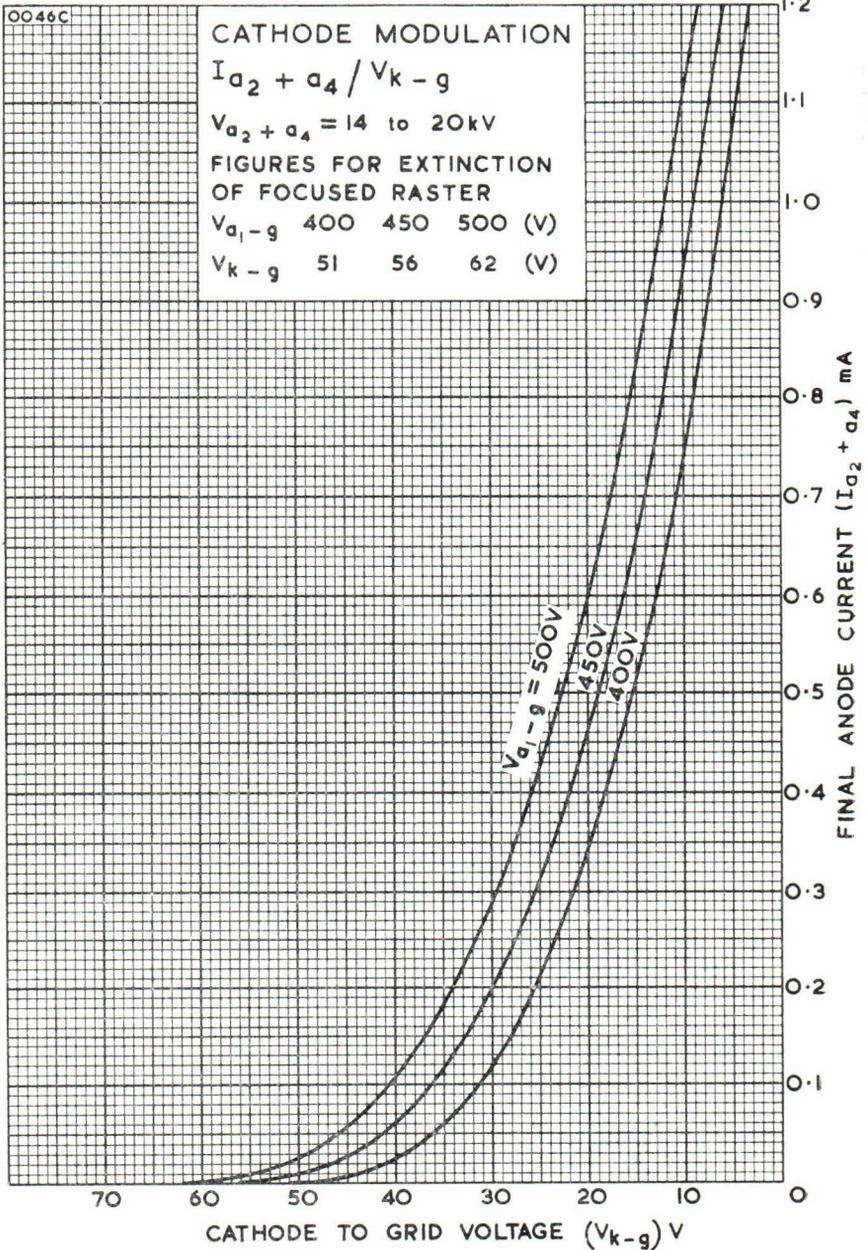
† Determined by Reference Gauge No. 16 (JEDEC No. 126).

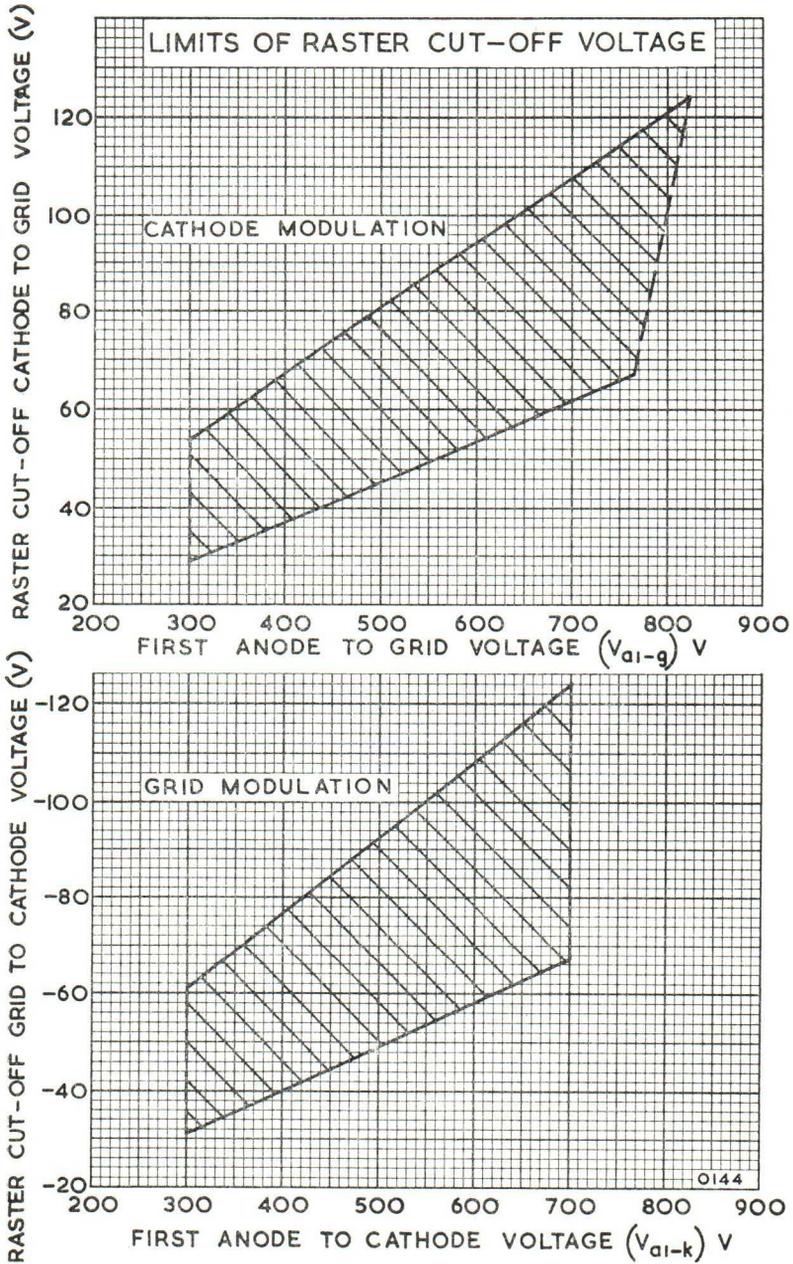
\*\*The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44mm.

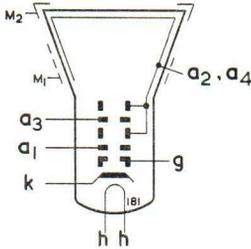
The maximum dimensions at the face seal may be 3.5 mm larger than the maximum face dimensions but at any point around the seal the bulge will not protrude more than 2 mm.

There is an annular region of anti-corona coating with diameters of 30 mm and 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

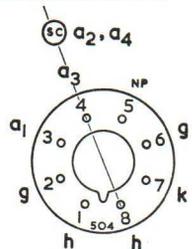








### RIMGUARD TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face .....	19 in.	Diagonal
Reinforced Envelope.....	Integral Mounting Lugs	
Electrostatic Focus .....	Magnetic Deflection	
Deflection Angle .....	110° Diagonal	
Aluminised Screen .....	White Fluorescence	
Grey Glass .....	50% Transmission (Approx)	
Straight Gun .....	Non Ion Trap	
External Conductive Coating		

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3*	A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20†	kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400‡§	V
Maximum Impedance, Grid to Cathode (50 c/s)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

The A47-17W/CME1905 is electrically identical to the AW47-91/CME1903.

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† For  $I_{a2+a4} = 0$ .

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

The mechanical fixing of this tube is interchangeable with other existing reinforced tubes.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

		*	†	
Cathode to all	C <sub>k-all</sub>	3·0	3·5	pF
Grid to all	C <sub>g-all</sub>	7·0	8·5	pF
Anode 2 and Anode 4 to External Conductive Coating, M <sub>1</sub> (approx)	C <sub>a2,a4-M1</sub>	1000		pF
Anode 2 and Anode 4 to Shell, M <sub>2</sub> (approx)	C <sub>a2,a4-M2</sub>	400		pF

\* Inter-electrode capacitances with holder capacitance balanced out.

† Total inter-electrode capacitances including an AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	V <sub>a2,a4-k</sub>	18	18	kV
First Anode Voltage ‡	V <sub>a1-k</sub>	400	500	V
Beam Current	I <sub>a2+a4</sub>	350 500	350 500	μA
Third Anode Voltage Range for Focus	V <sub>a3-k</sub>	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35·5 40·5	39·5 45	V
Grid to Cathode Voltage for cut-off of raster (See charts for limits)	V <sub>g-k</sub>	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	V <sub>a2,a4-g</sub>	18	18	kV
First Anode Voltage ‡	V <sub>a1-g</sub>	400	500	V
Beam Current	I <sub>a2+a4</sub>	350 500	350 500	μA
Third Anode Voltage Range for Focus	V <sub>a3-g</sub>	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31·5 35·5	34·5 39·5	V
Cathode to Grid Voltage for cut-off of raster (See charts for limits)	V <sub>k-g</sub>	51	62	V

‡ Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

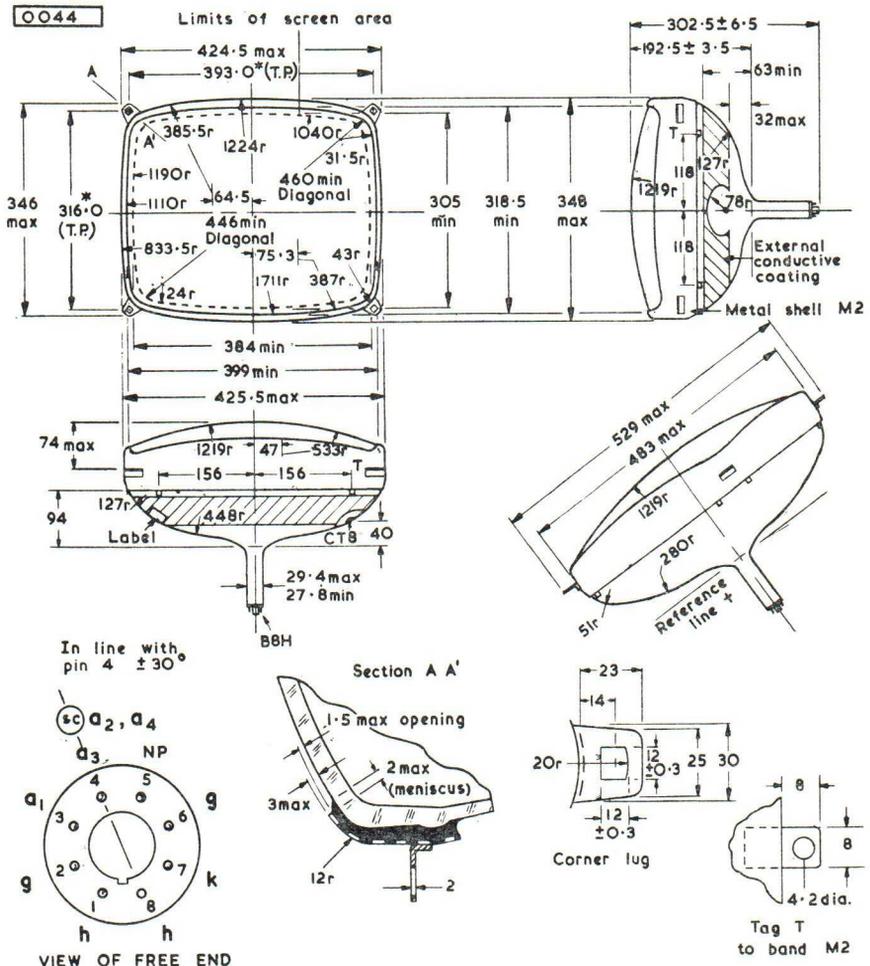
**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**TUBE WEIGHT (approx)—Net 21 lb (9·5 kg)**

**Note :**

If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.



All dimensions in mm.

Not to be scaled.

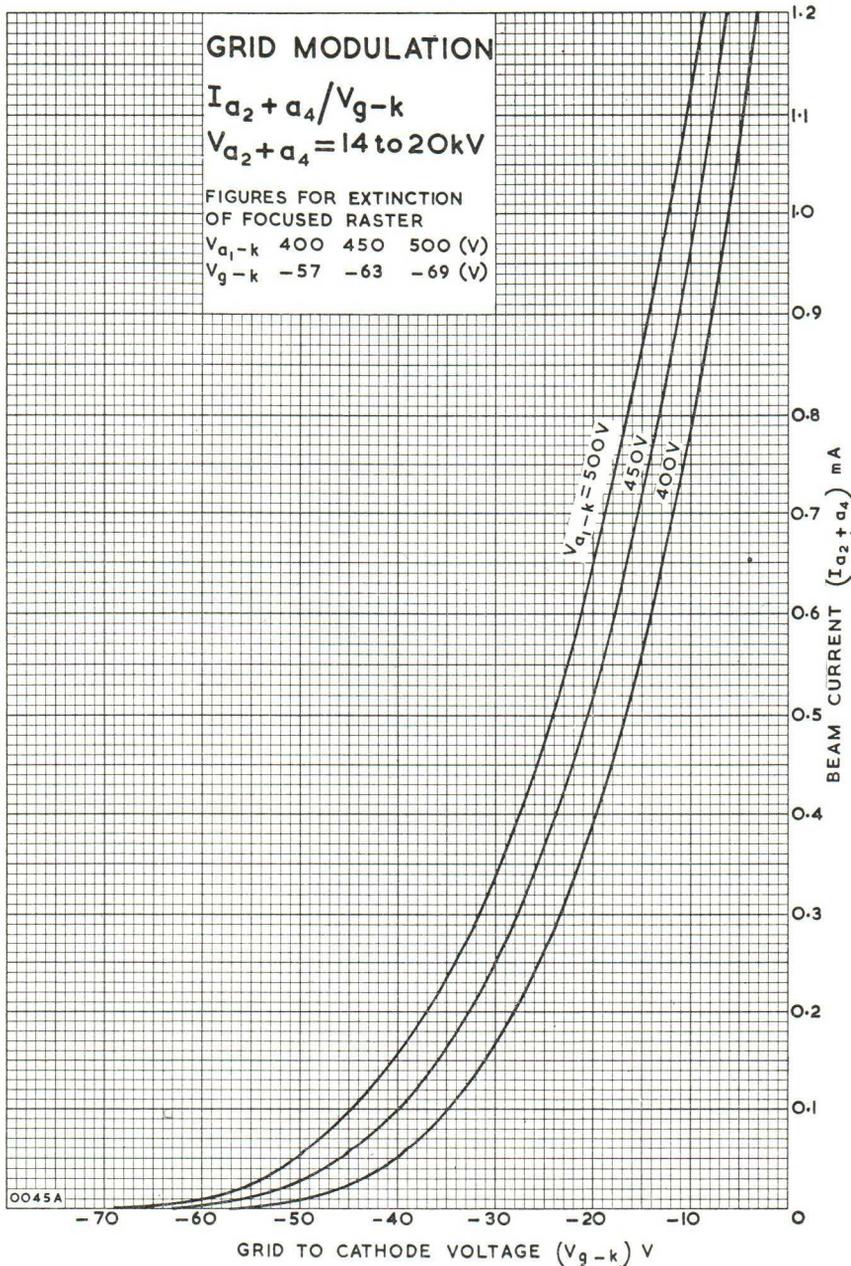
#### Notes:

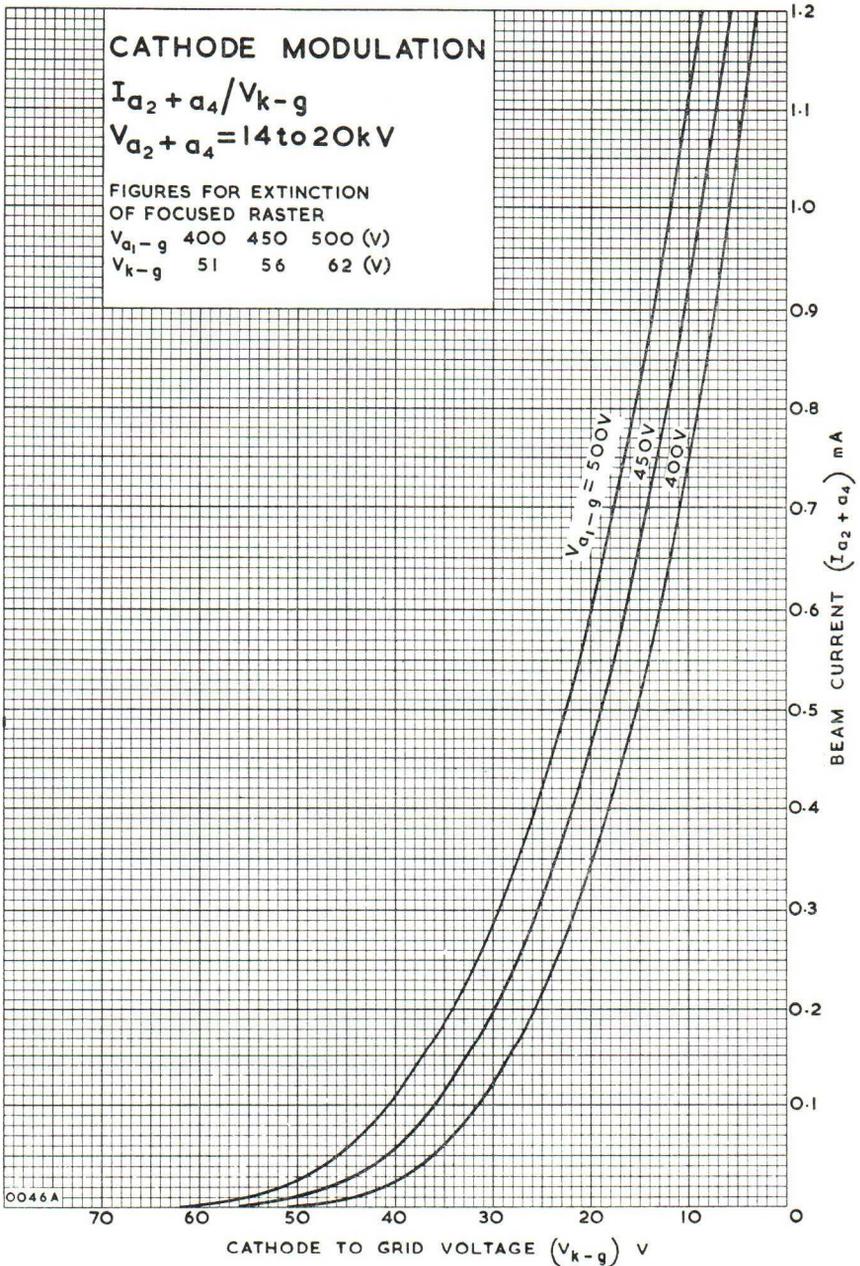
It is recommended that the mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

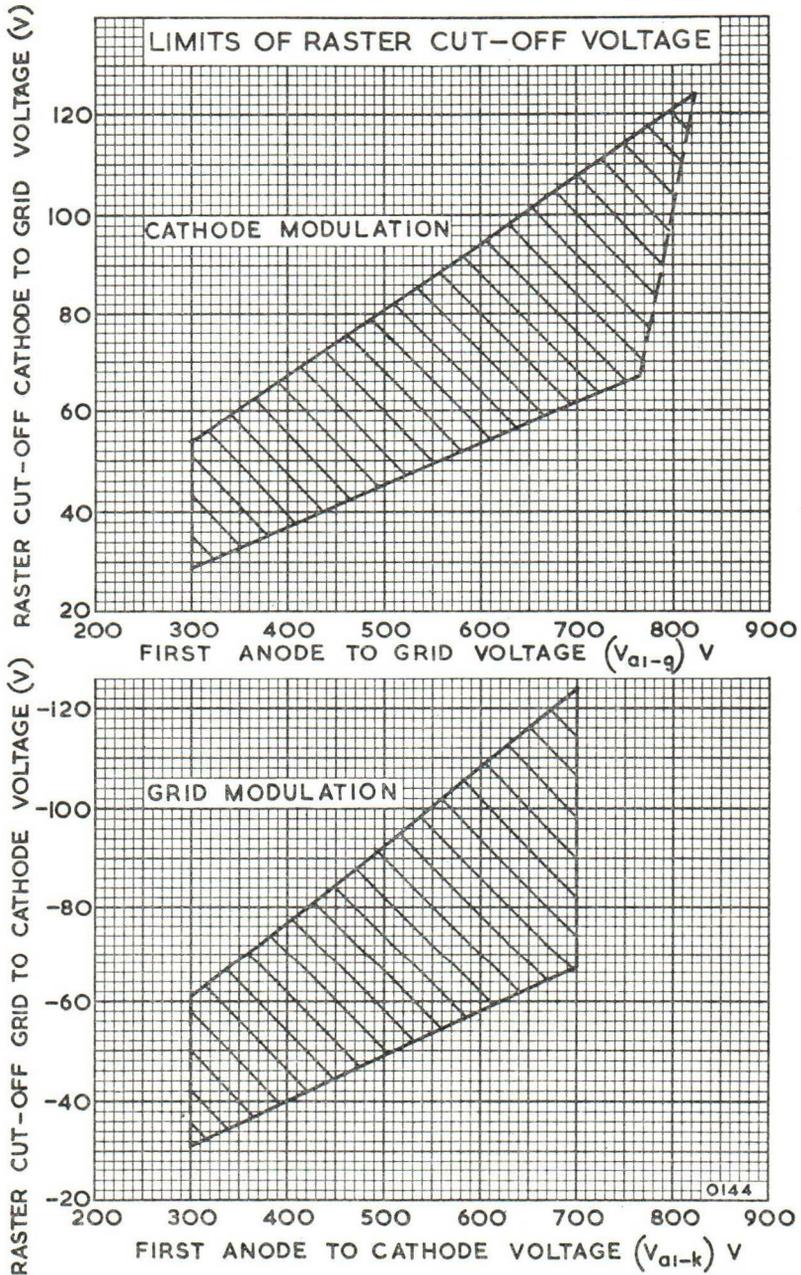
The metal shell M2 must be connected to chassis via a 2MΩ resistor.

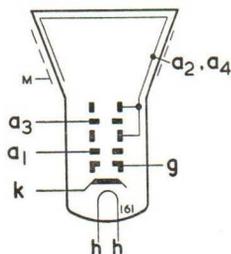
\* The bolts to be used for mounting the tube must lie within the circles of 8.5 mm diameter centred on these true positions (Diagonal 504). One of the four lugs may deviate 2 mm maximum from the plane through the other three lugs.

† Determined by reference line gauge No. 16 (JEDEC No. 126).

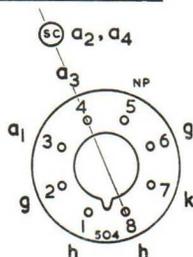








## TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

### GENERAL

Twin Panel .....	Tinted Grey Glass
Deflection Angle .....	110° Diagonal
Rectangular Face .....	19 in. Diagonal
Light Transmission .....	65% Approximately
Aluminised Screen.....	White Fluorescence
Electrostatic Focus .....	Magnetic Deflection
Short Neck .....	Straight Gun—non ion trap

#### External Conductive Coating

Heater Current	$I_h$	0.3	A
Heater Voltage	$V_h$	6.3	V

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20* kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13 kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500 V
Maximum First Anode Voltage	$V_{a1(max)}$	700 V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250 V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400†‡ V
Maximum Impedance Grid to Cathode (50c/s)	$Z_{g-k(max)}$	0.5 MΩ
Maximum Resistance Grid to Cathode	$R_{g-k(max)}$	1.5 MΩ

All voltages referred to cathode.

\* For  $I_{a2+a4}=0$ .

† Absolute rating.

‡ During a warming-up period not exceeding 45 seconds.

**Note :** The A47-13W/CME1906 is the AW47-91/CME1903 with the addition of a tinted glass panel.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

Cathode to all	$C_{k-all}$	§ 3·0	φ 3·5	pF
Grid to all	$C_{g-all}$	7·0	8·5	pF
Second and Fourth Anode to External Conductive Coating (approx.)	$C_{a2,a4-M}$		1250	pF

§ Inter-electrode capacitances with holder capacitance balanced out.

φ Total inter-electrode capacitances including AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18	18	kV
First Anode Voltage*	$V_{a1-k}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35·5 40·5	39·5 45	V
Grid to Cathode Voltage for Cut-off of Raster (See charts for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18	18	kV
First Anode Voltage*	$V_{a1-g}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31·5 35·5	34·5 39·5	V
Cathode to Grid Voltage for Cut-off of Raster (See charts for limits)	$V_{k-g}$	51	62	V

\*Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

**NOTE**

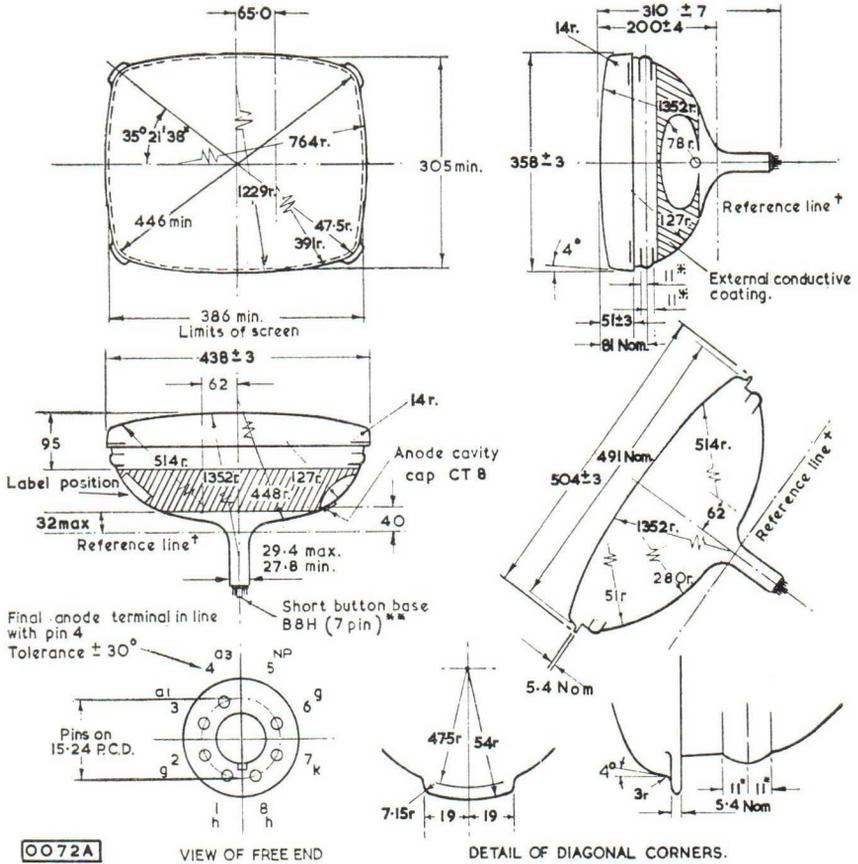
If this tube is operated at voltage in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.

**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight : Net	22·5 lb (10·2 kg)
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All dimensions in mm.

Not to be scaled.

### Notes :

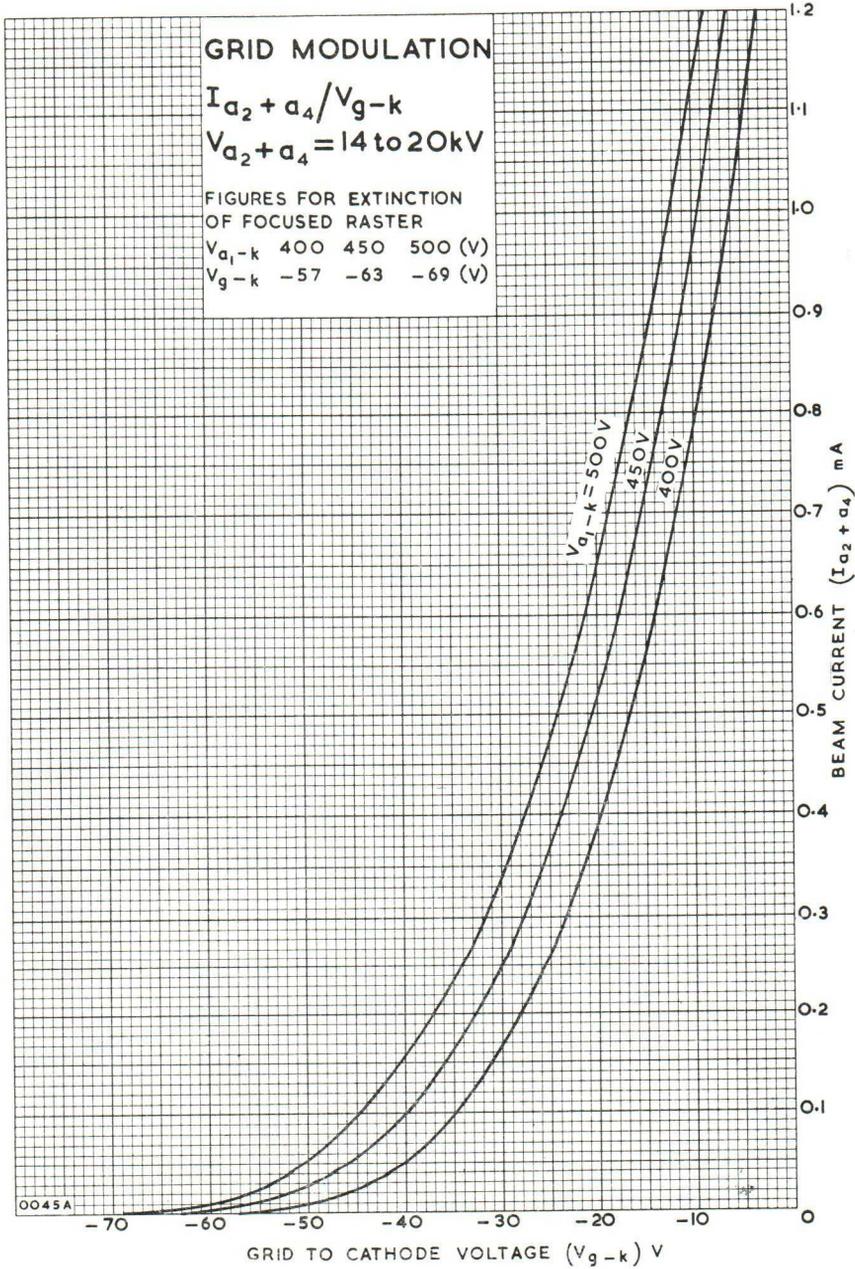
\* During the face sealing operation the glass in this area (total 22mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

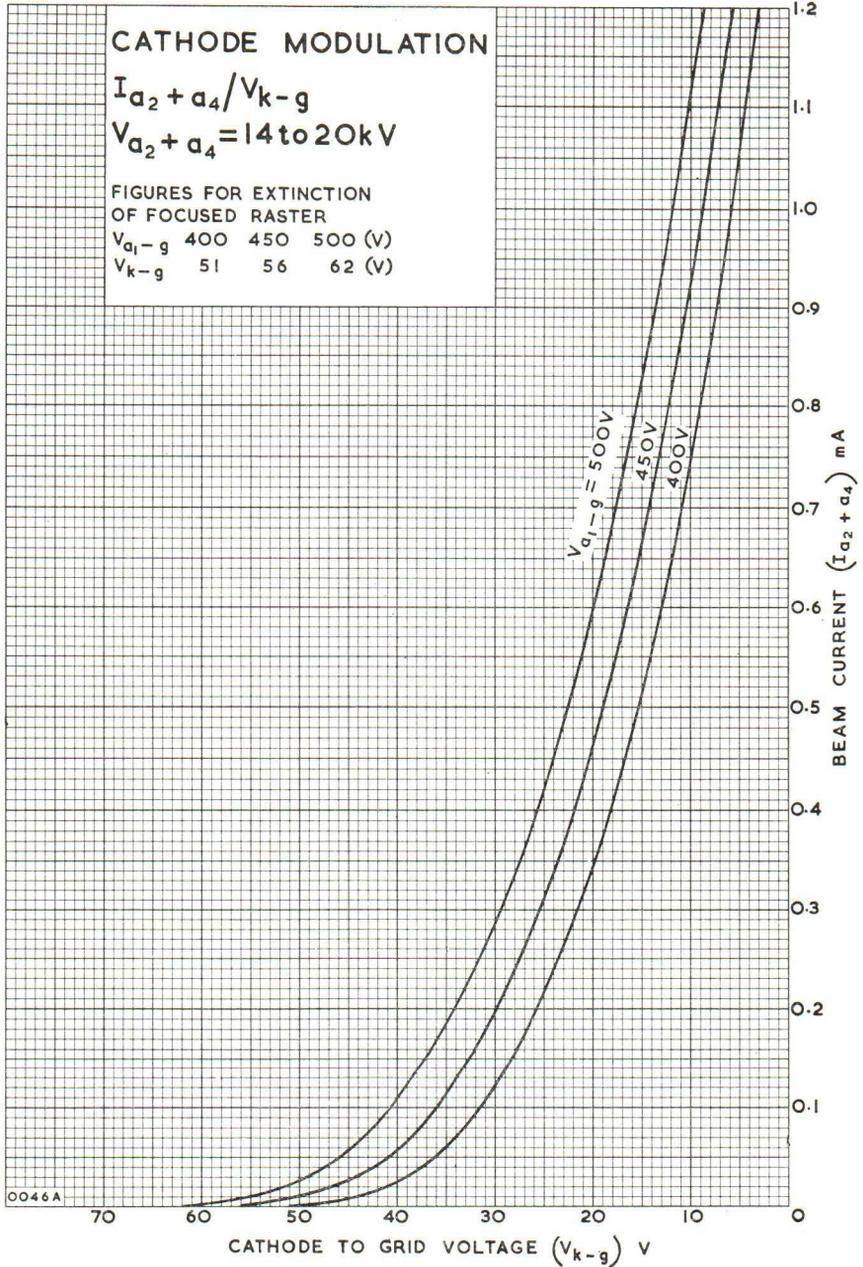
\*\*The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44mm.

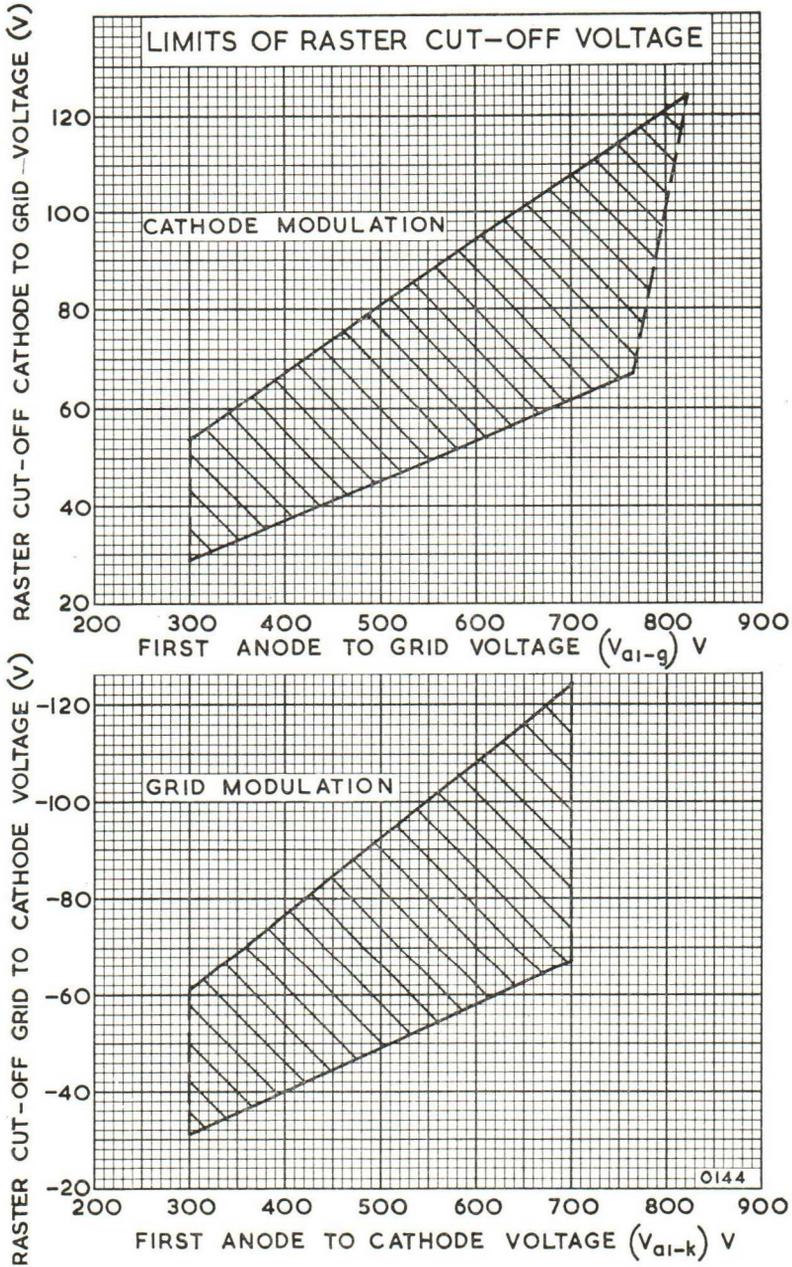
† Determined by Reference Gauge No. 16 (JEDEC 126).

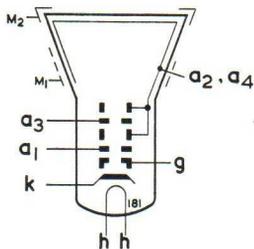
The tube may be supported by clamping to the mounting lugs provided at each corner of the protective panel.

Tube mounting clamps must be spaced from the tube by the use of cushioning pads.

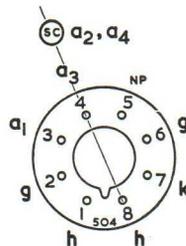








### RIMGUARD II TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face .....	19 in. Diagonal
Reinforced Envelope.....	Integral Mounting Lugs
Electrostatic Focus .....	Magnetic Deflection
Deflection Angle .....	110° Diagonal
Aluminised Screen.....	White Fluorescence
Grey Glass .....	50% Transmission (Approx.)
Straight Gun .....	Non Ion Trap

#### External Conductive Coating

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3*	A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20†	kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400‡§	V
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5	M Ω
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	M Ω

All voltages referred to cathode.

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† For  $I_{a2+a4}=0$ .

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

The A47-25W/CME1907 is electrically identical to the AW47-91/CME1903.

The mechanical fixing of this tube is interchangeable with other existing reinforced tubes.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anode 2 and Anode 4 to External Conductive Coating, $M_1$ (approx.)	$C_{a2,a4-M1}$	1000		pF
Anode 2 and Anode 4 to Shell, $M_2$ (approx.)	$C_{a2,a4-M2}$	250		pF

\* Inter-electrode capacitances with holder capacitance balanced out.

† Total inter-electrode capacitances including an AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18	18	kV
First Anode Voltage‡	$V_{a1-k}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for cut-off of raster (See chart for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18	18	kV
First Anode Voltage ‡	$V_{a1-g}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for cut-off of raster (See chart for limits)	$V_{k-g}$	51	62	V

‡ Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17	G
Maximum distance of centre of magnetic field from reference line	53	mm

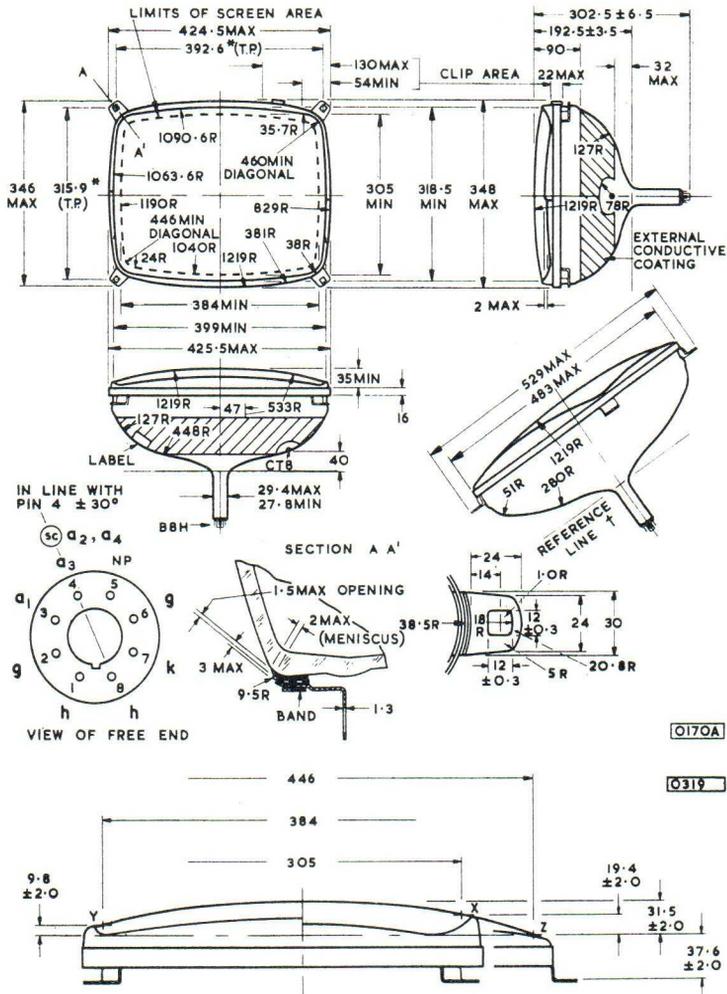
**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**TUBE WEIGHT (approx.)—Net 191b (8.6 kg)**

**Note :**

If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.



0170A

0319

All dimensions in mm.

Not to be scaled.

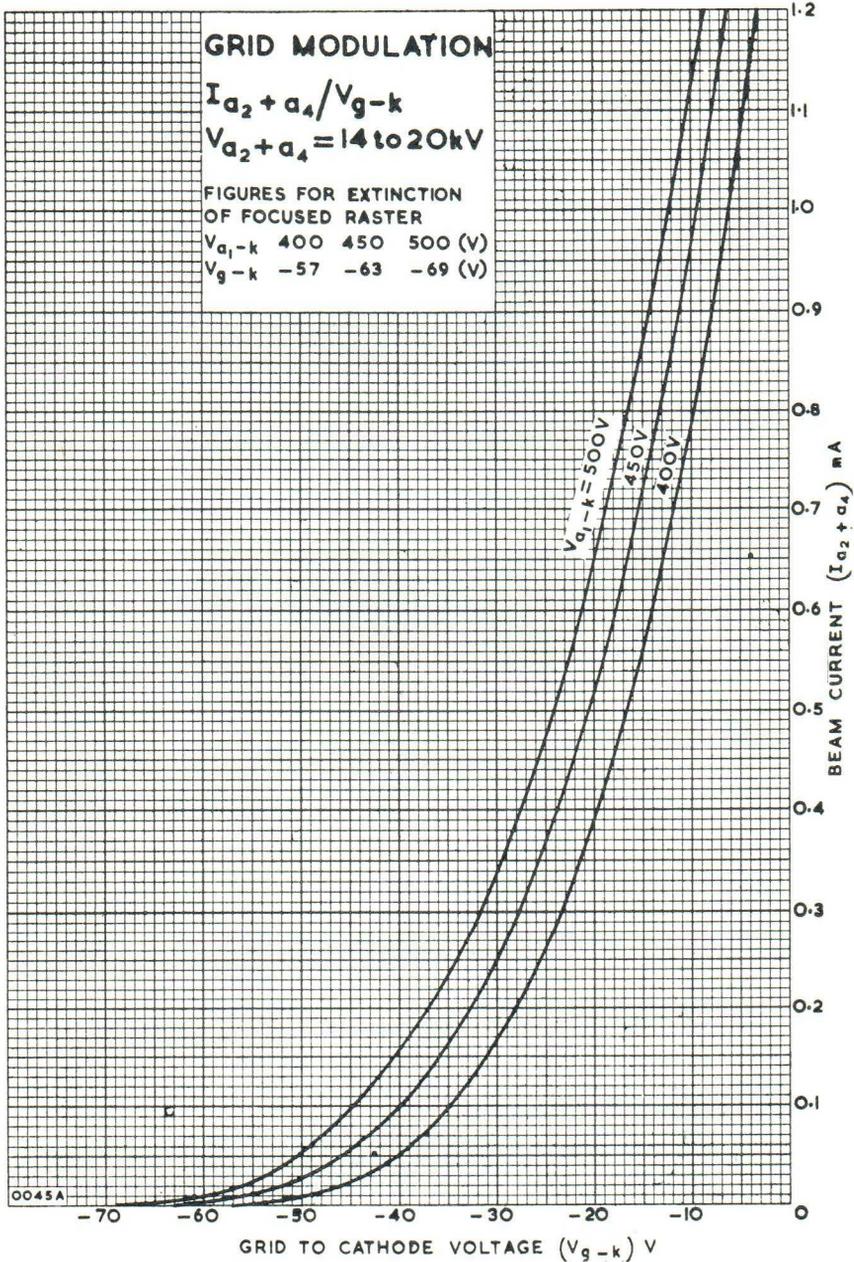
#### Notes :

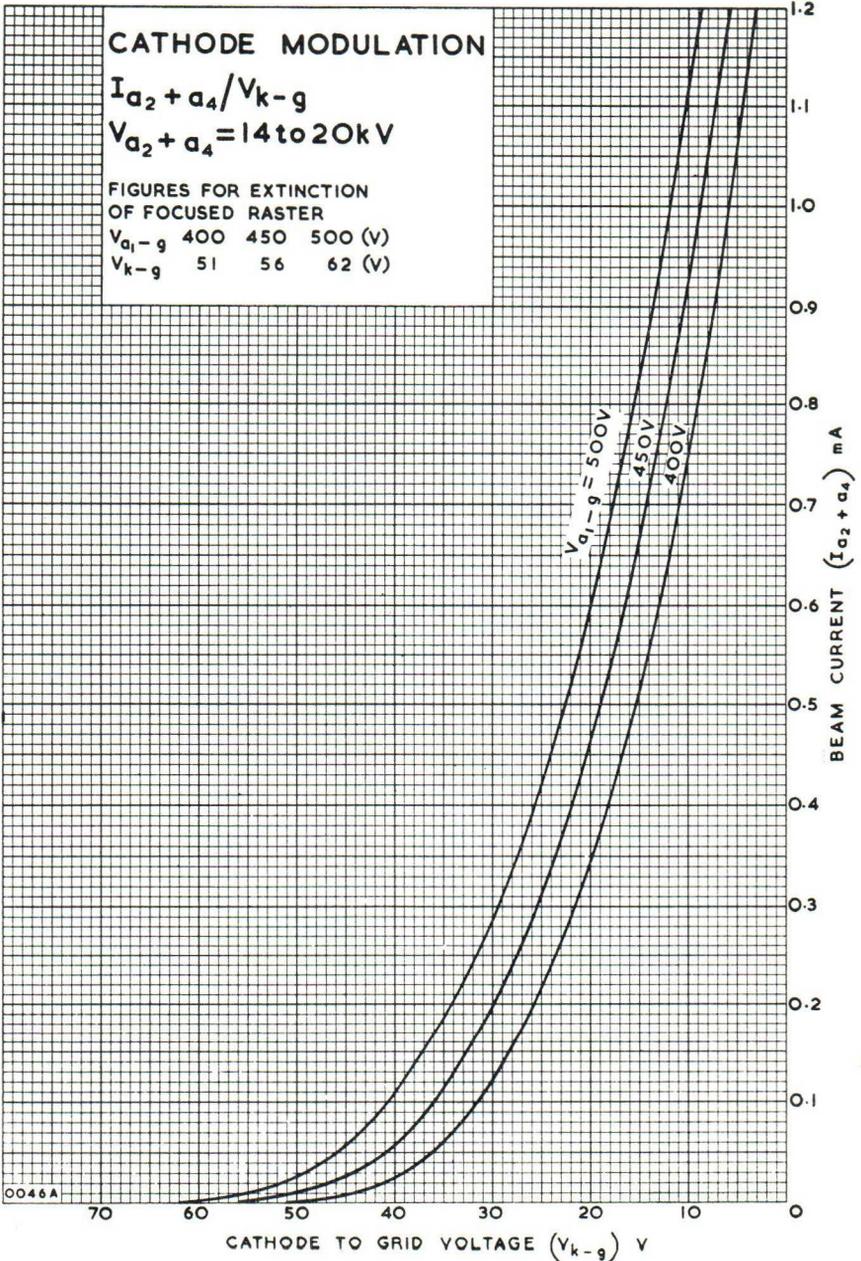
It is recommended that the mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

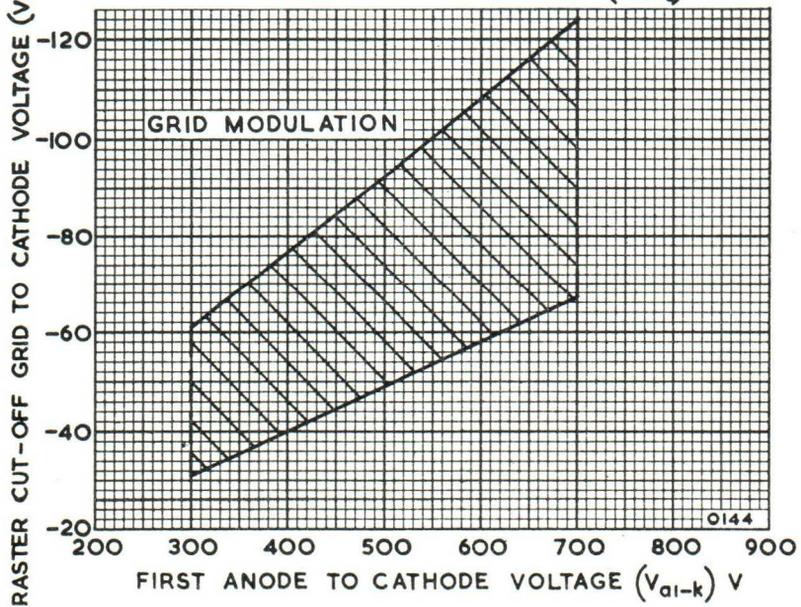
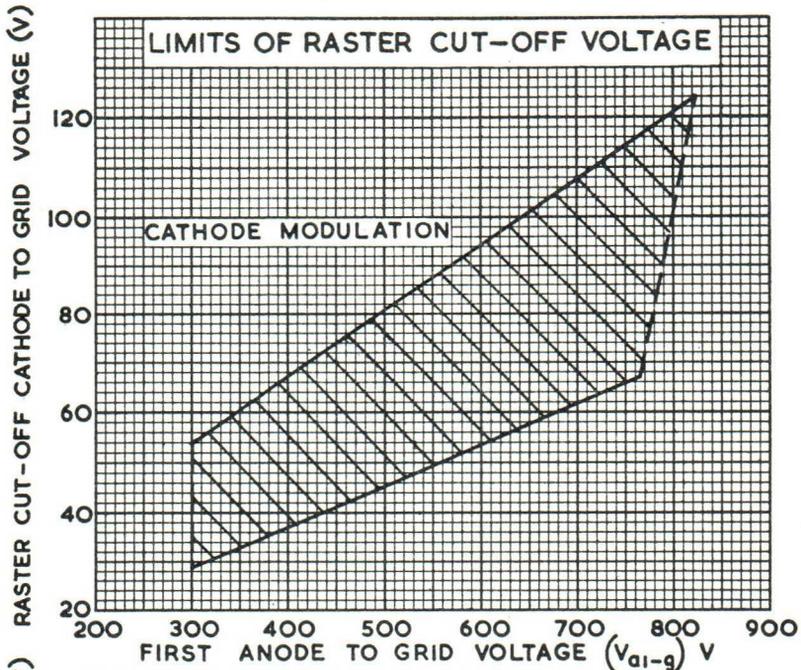
The metal shell M<sub>2</sub> must be connected to chassis via a 2MΩ resistor.

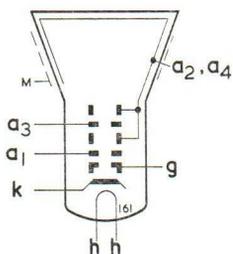
\* The bolts to be used for mounting the tube must lie within the circles of 8.5 mm diameter centred on these true positions (Diagonal 504). One of the four lugs may deviate 2 mm maximum from the plane through the other three lugs.

† Determined by reference line gauge No. 16 (JEDEC No. 126).

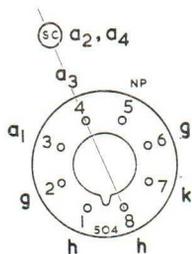








### TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Deflection Angle	110° Diagonal
Rectangular Face Grey Glass	19 in Diagonal
Light Transmission	50% Approximately
Aluminised Screen	White Fluorescence
Electrostatic Focus	Magnetic Deflection
Short Neck	Straight Gun—non ion trap

#### External Conductive Coating

Heater Current	$I_h$ 0.3	A
Heater Voltage	$V_h$ 6.3	V

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20*	kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage Heater Negative	$V_{h-k(pk)max}$	400†‡	V
Maximum Impedance, Grid to Cathode (50 c/s)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* For  $I_{a2+a4}=0$ .

† Absolute rating.

‡ During a warming-up period not exceeding 45 seconds.

The A47-14W/CME1908 is electrically identical to the AW47-91/CME1903.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

Cathode to all	$C_{k-all}$	§ 3.0	φ 3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Second and Fourth Anode to External Conductive Coating (approx)	$C_{a2,a4-M}$	1 250		pF

§ Inter-electrode capacitances with holder capacitance balanced out.

φ Total inter-electrode capacitances including AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18	18	kV
First Anode Voltage*	$V_{a1-k}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for Cut-off of Raster (See charts for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18	18	kV
First Anode Voltage*	$V_{a1-g}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for Cut-off of Raster (See charts for limits)	$V_{k-g}$	51	62	V

\* Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

**Note**

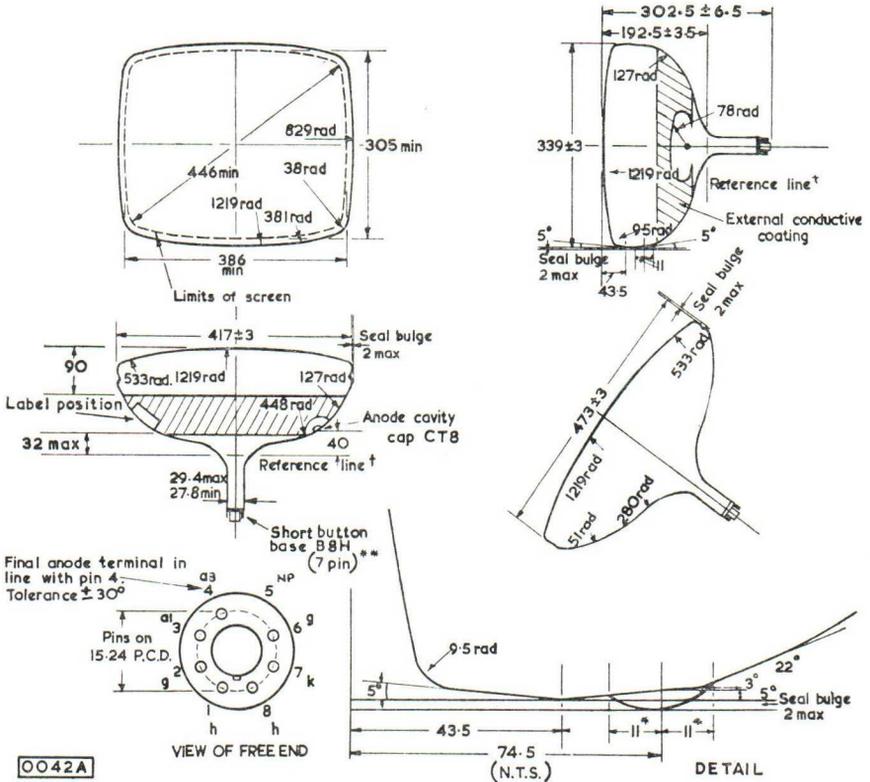
If this tube is operated at voltage in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protection viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliröntgens per hour, the window will normally provide adequate protection.

**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight: Net	17 lb (7.8 kg)
-------------------------------------	----------------



All dimensions in mm.

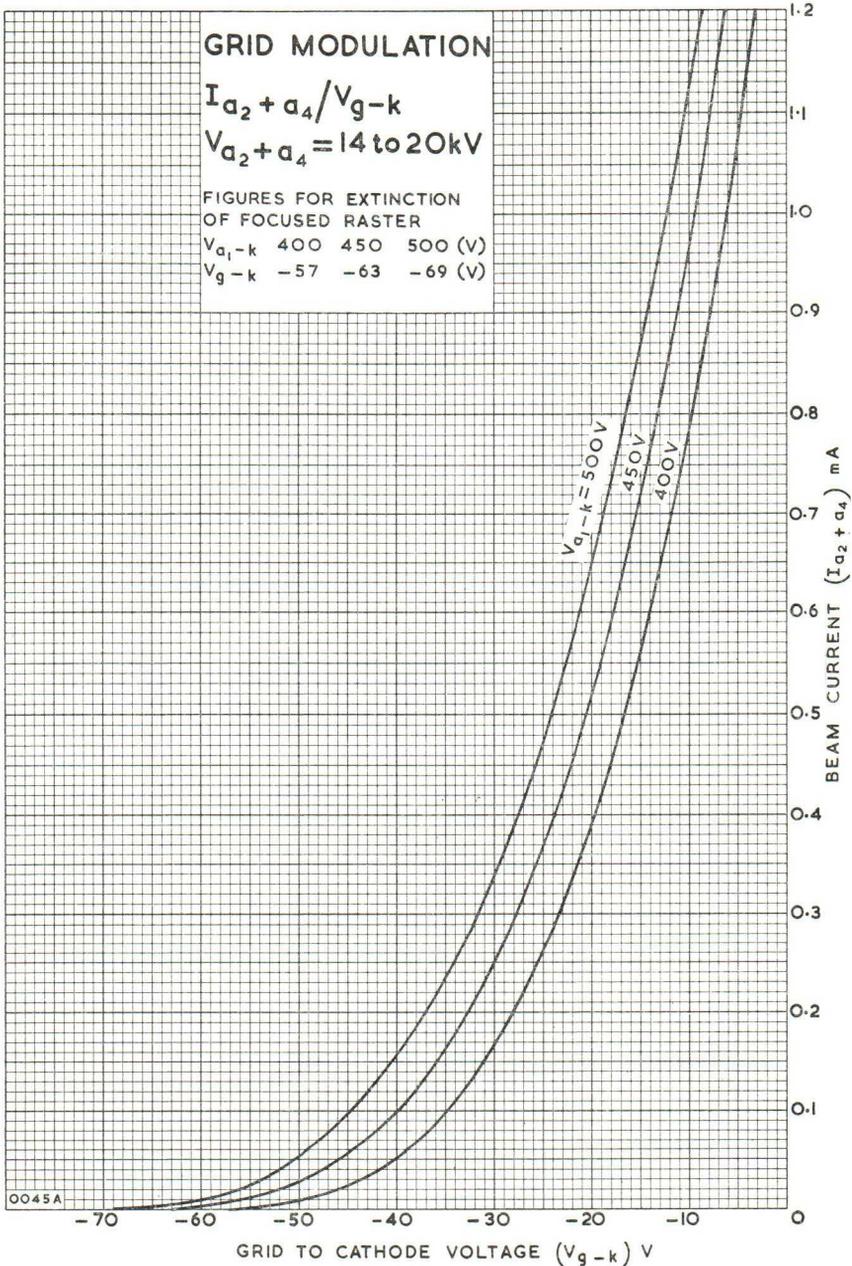
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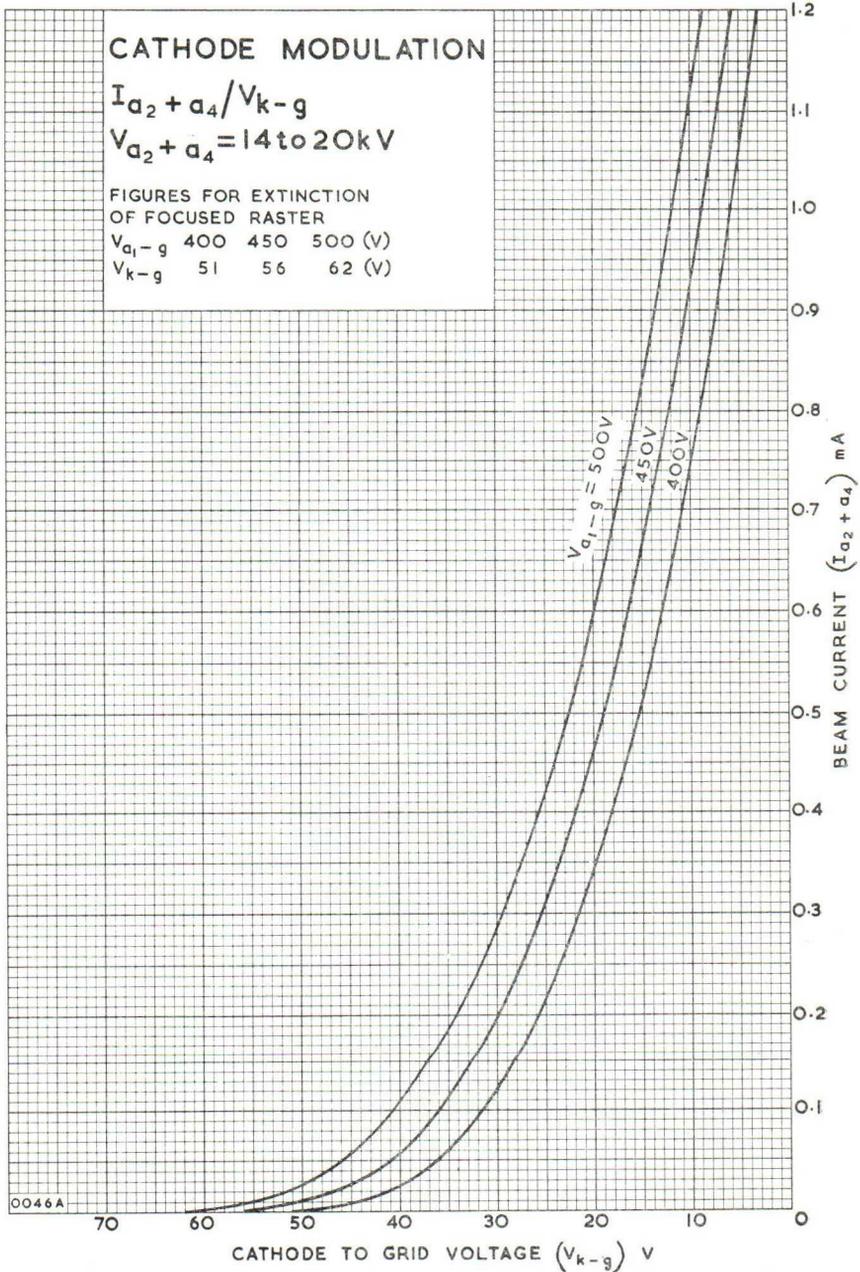
### Notes

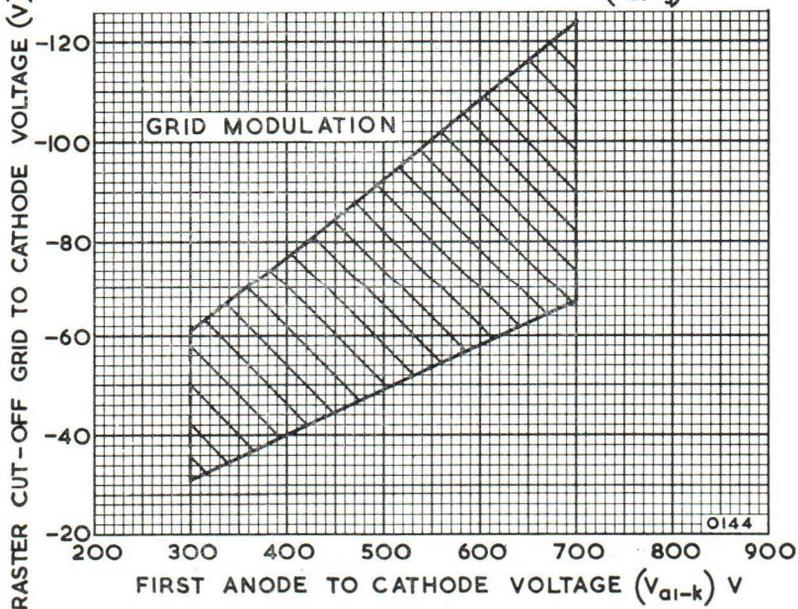
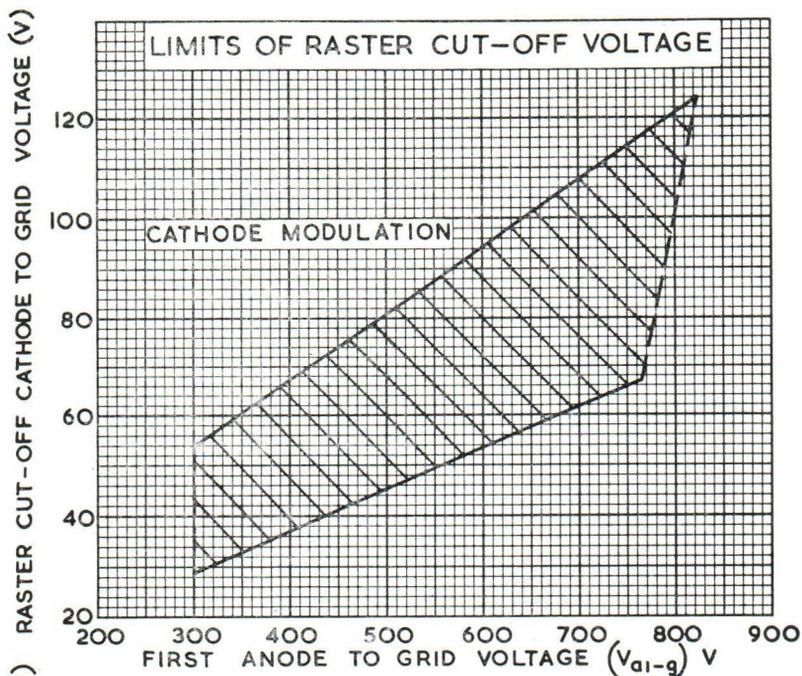
\* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

† Determined by Reference Gauge No. 16 (JEDEC 126).

\*\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44 mm.







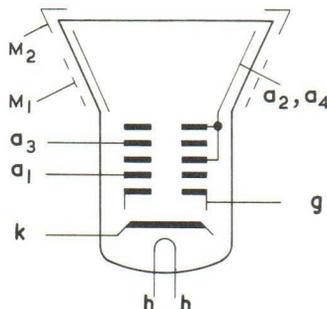
# Television Picture Tube

**CME1913**  
**A47-28W**

## GENERAL

Rectangular face, 19 inch, 110° diagonal  
Rimguard III reinforced envelope  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 50% transmission (approx)  
Straight gun, non ion trap  
External conductive coating

Heater voltage  $V_h$  6.3 V  
Heater current  $I_h$  0.3\* A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4(max)}$	20†	kV
Minimum second and fourth anode voltage	$V_{a2+a4(min)}$	13	kV
Maximum third anode voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum first anode voltage	$V_{a1(max)}$	700	V
Maximum negative grid voltage	$-V_g(max)$	150	V ←
Maximum peak negative grid voltage	$-V_g(pk)max$	400**	V ←
Maximum positive grid voltage	$V_g(max)$	0‡	V ←
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$v_{h-k(pk)max}$	400§	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode

\* In a series heater chain the CRT should always be connected at the chassis end.

†  $I_{a2+a4} = 0$

§ During a warming up period not exceeding 45 seconds.

‡ The peak positive excursion of the video signal should not exceed + 5V and this may be achieved by the series connection of a 10kΩ resistor close to the tube base.

\*\* Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard bases see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

**Thorn Radio Valves and Tubes Limited**

Oct. 1969, Issue 3, Page 1



### INTER-ELECTRODE CAPACITANCES

		*	†	
Cathode to all	$c_{k-all}$	3.0	3.5	pF
Grid to all	$c_{g-all}$	7.0	8.5	pF
Anodes 2 and 4 to coating $M_1$ (approx.)	$c_{a2+a4-M1}$	1000		pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$c_{a2+a4-M2}$	250		pF

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	18	18	kV		
First anode voltage ¶	$V_{a1-k}$	400	500	V		
Third anode voltage range for focus	$V_{a3-k}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		35.5	40.5	39.5	45	V
Grid to cathode voltage range for cut-off of raster	$V_{g-k}$	-40 to -77	-50 to -93			V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	18	18	kV		
First anode voltage ¶	$V_{a1-g}$	400	500	V		
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		31.5	35.5	34.5	39.5	V
Cathode to grid voltage range for cut-off of raster	$V_{k-g}$	36 to 66	45 to 80			V

¶ Within this range a higher first anode voltage will provide improved focus performance.

If this tube is operated at voltages in excess of 20 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.

Characteristic curves as A50-120W / CME2013

# Television Picture Tube

**CME1913**  
**A47-28W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	17	Gs
Maximum distance of centre of magnetic field from reference line	53	mm

## DEFLECTION ANGLES

Height	82°	Width	99°	Diagonal	110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

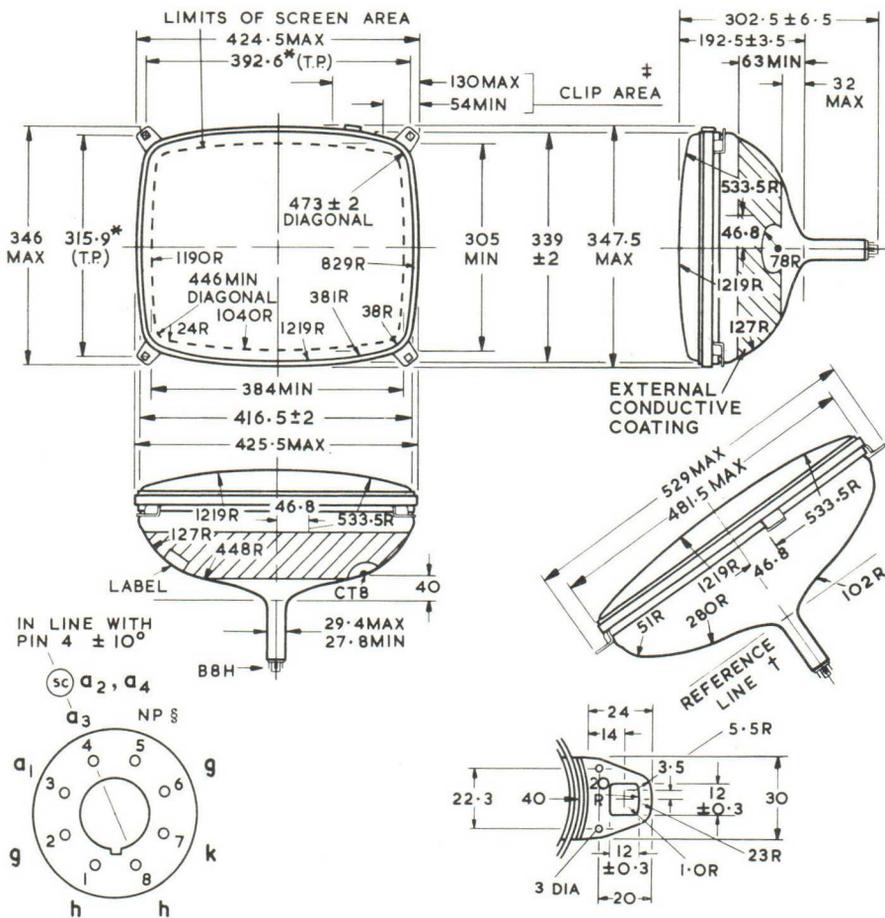
There is an annular region of anti-corona coating with external diameter of 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal frame ( $M_2$ ) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2 M $\Omega$ .

**TUBE WEIGHT** (approximate) - net 8.6 kg (19 lb)



VIEW OF FREE END

All dimensions in mm

Not to be scaled

\* The bolts to be used for mounting the tube must lie within the circles of 8.5 mm diameter centred on these true positions (Diagonal = 504mm). One of the four lugs may deviate 2.0 mm maximum from the plane through the other three lugs.

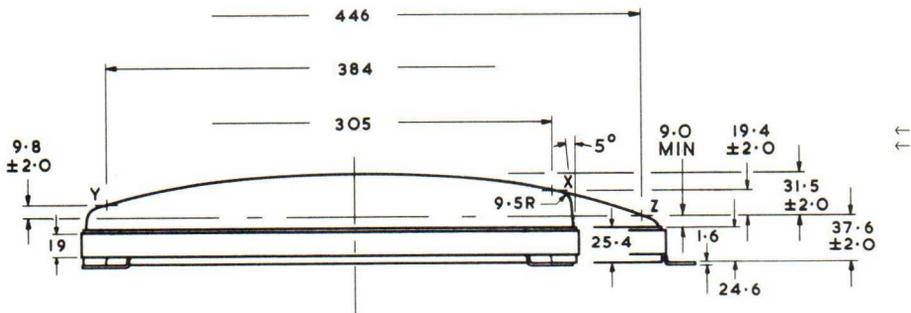
† Determined by reference line gauge No. 16 (B.S.RL4 : IEC 67-IV-3 : JEDEC 126).

‡ Total thickness of shell, tension band and clip 8.0 mm maximum.

§ Pin 5 is included for Sparkguard R base and the common connection for the parallel spark gaps is made to this pin. For further details see separate sheet.

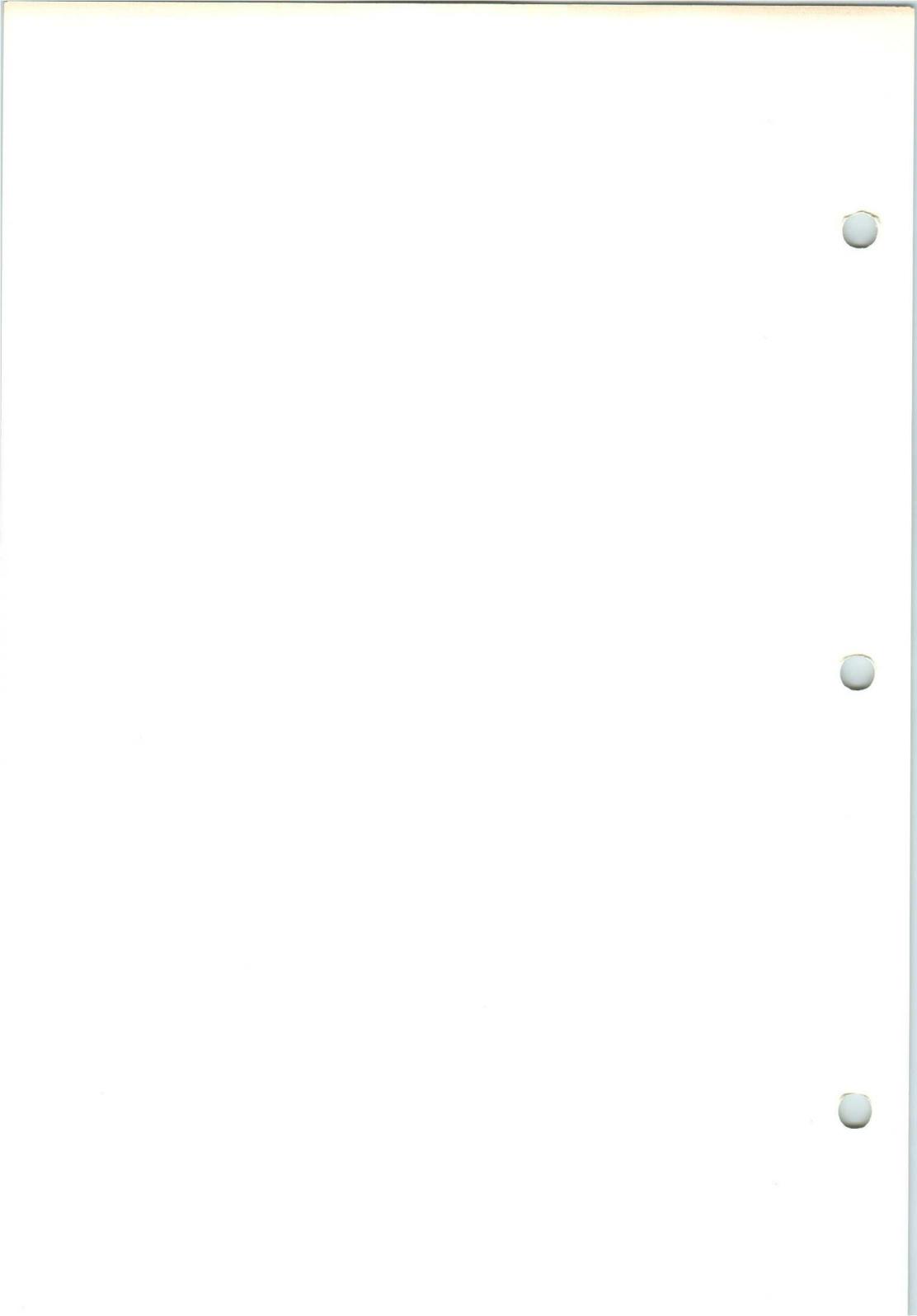
# Television Picture Tube

**CME1913**  
**A47-28W**



All dimensions in mm

Not to be scaled



**CME2101**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated

### GENERAL

Deflection Angle .....	110° Diagonal
Rectangular Face .....	21" Diagonal
Grey Glass Face .....	74% Light Transmission
Aluminised Screen	Magnetic Deflection
Straight Gun	B8H Base
	External Conductive Coating
	Heater for use in Series Chain

### RATING

Heater Voltage	V <sub>h</sub>	12.6 V
Heater Current	I <sub>h</sub>	0.3* A
Maximum Second and Fourth Anode Voltage	V <sub>a2,a4(max)</sub>	16** kV
Minimum Second and Fourth Anode Voltage	V <sub>a2,a4(min)</sub>	14 kV
Maximum First Anode Voltage	V <sub>a1(max)</sub>	400 V
Maximum Third Anode Voltage	V <sub>a3(max)</sub>	±700 V
Maximum Heater/Cathode Voltage, Heater Negative (d.c.)	V <sub>h-k(max)</sub>	180 V
Maximum Peak Heater/Cathode Voltage, Heater Negative (d.c.)	v <sub>h-k(pk)max</sub>	400†‡ V

\* The cathode ray tube heater should always be connected at the chassis end in a series heater chain.

\*\* 16kV is a design centre rating, the absolute rating of 20kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding one minute.

### INTER-ELECTRODE CAPACITANCES

Cathode/all other electrodes	ck-all	†† 4.5	§§ 5.0 pF
Grid/all other electrodes	cg-all	6.0	7.5 pF
Anode 2, Anode 4/External Conductive Coating (approx.)	ca <sub>2,a4-M</sub>	2000	pF

†† Inter-electrode capacitances with holder capacity balanced out.

§§ Inter-electrode capacitances including a Clix B8H holder VH68/81 (8-pin).

**CME2101**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated

**TYPICAL OPERATION**

Second and Fourth Anode Voltage	$V_{a2,a4}$	14 to 16 kV
First Anode Voltage	$V_{a1}$	300 V
Third Anode Voltage for Focus (mean)	$V_{a3}$	100 V
Grid Bias Voltage for Cut-off of Raster	$V_g$	-30 to -72 V
Average Peak/Peak Modulating Voltage for Modulation up to $150\mu A$		24 V

**NOTE**

If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

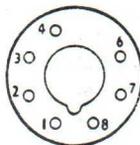
**DIMENSIONS**

Maximum Overall Length	378 mm
Maximum Face Diagonal	546† mm
Maximum Face Height	419† mm
Maximum Face Width	518† mm
Maximum Neck Diameter	29.4 mm
Approximate Net Weight	21 lb
Approximate Packed Weight	28 lb

† The maximum dimension at the face seal may be 3.5mm larger than this dimension but at any point around the seal the bulge will not protrude more than 2mm.

**CAP**—Cavity (CT8)

**BASE**—Button Base (B8H)

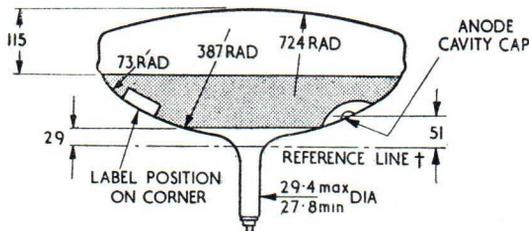
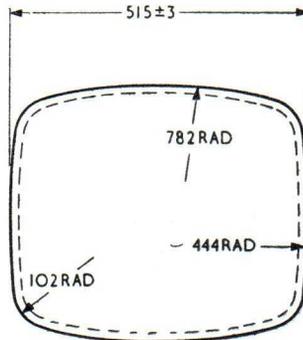


Viewed from free end of pins

**CONNECTIONS**

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	First Anode	a1
Pin 4	Third Anode	a3
Pin 5	No Pin	NP
Pin 6	Grid	g
Pin 7	Cathode	k
Pin 8	Heater	h
Cap	Second and Fourth Anode	a2,a4

**CME2101**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated



BUTTON BASE  
 B8H (7 PIN)  
 \* \*

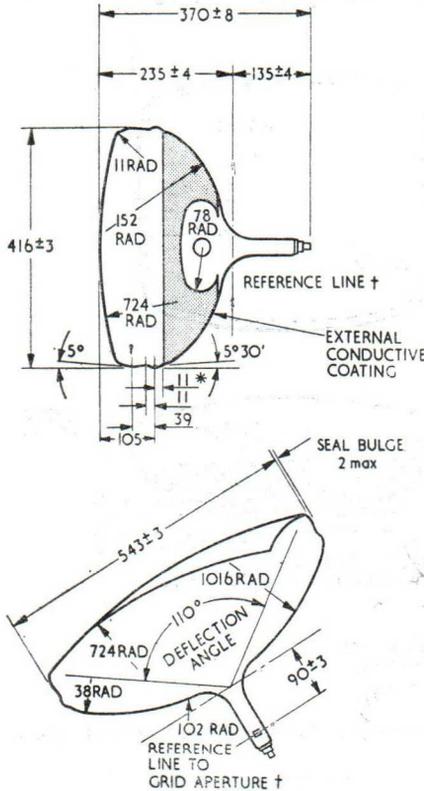
(Anode cavity cap in line with Pin 4. Tolerance  $\pm 30^\circ$ )

All dimensions in mm.

**NOTES**

- † Determined by Reference Gauge No. 16.
- \*\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44mm.

**CME2101**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated



All dimensions in mm.

**NOTES**

\* During the face sealing operation the glass in this area (total 22mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

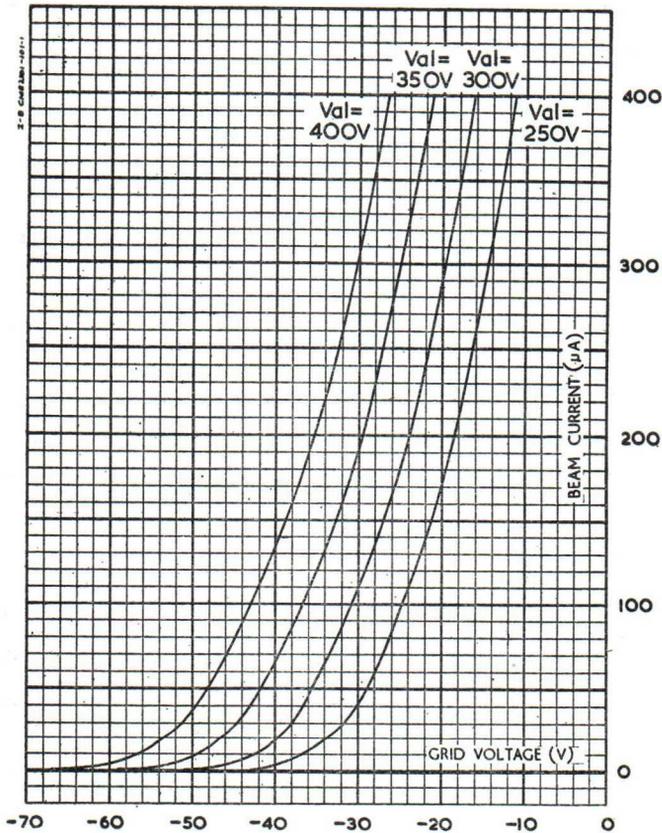
† Determined by Reference Gauge No. 16.

**CME2101**  
TELEVISION CATHODE RAY TUBE  
ELECTROSTATIC FOCUS  
Indirectly heated

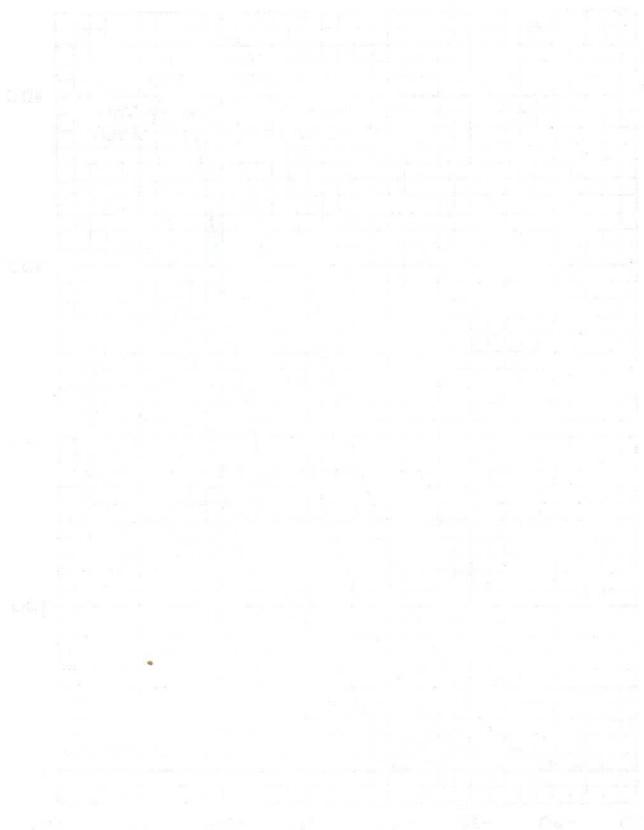
AVERAGE CHARACTERISTIC CURVES

$$I_b/V_g$$

( $V_{a2,a4} = 14 - 17\text{kV}$ )



1015380  
 NOVA  
 ADJAM



## CME2104

### TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS Indirectly heated

#### GENERAL

Deflection Angle .....	110° Diagonal
Rectangular Face .....	21" Diagonal
Grey Glass Face .....	74% Light Transmission
Aluminised Screen .....	Magnetic Deflection
Straight Gun .....	B8H Base

External Conductive Coating  
Heater for use in series chain

#### RATING†

Heater Voltage	V <sub>h</sub>	12.6	V
Heater Current	I <sub>h</sub>	0.3*	A
Maximum First Anode Voltage	V <sub>a1(max)</sub>	500	V
Minimum First Anode Voltage	V <sub>a1(min)</sub>	400	V
Maximum Second Anode Voltage	V <sub>a2(max)</sub>	500	V
Maximum Third Anode Voltage	V <sub>a3(max)</sub>	18**	kV
Minimum Third Anode Voltage	V <sub>a3(min)</sub>	15††	kV
Maximum Heater/Cathode Voltage, Heater Negative (d.c.)	V <sub>h-k(max)</sub>	180	V
Maximum Peak Heater/Cathode Voltage, Heater Negative (d.c.)	V <sub>h-k(pk)max</sub>	400‡§	V
Maximum Impedance Grid/Cathode (50c/s)	Z <sub>g-k(max)</sub>	0.5	MΩ

\* The cathode ray tube heater should always be connected at the chassis end in a series heater chain.

\*\* 18kV is a design centre rating, the absolute rating of 19.8kV must not be exceeded.

† All voltages referred to cathode unless otherwise stated.

†† With a final anode voltage of 15kV the first anode voltage should be 400V.

‡ Absolute rating.

§ During a warming-up period not exceeding one minute.

#### INTER-ELECTRODE CAPACITANCES

Grid/All other electrodes	c <sub>g-all</sub>	††	8.0	§§	9.5	pF
Cathode/All other electrodes	c <sub>k-all</sub>		4.5		5.0	pF
Anode 3/External Conductive Coating (approx.)	ca <sub>3-M</sub>		2000			pF

†† Inter-electrode capacitances with holder capacitance balanced out.

§§ Total inter-electrode capacitances including Clix B8H holder VH68/81 (8 pin)

## CME2104

TELEVISION CATHODE RAY TUBE  
ELECTROSTATIC FOCUS  
Indirectly heated

**TYPICAL OPERATION**—Grid Modulation (Voltages referred to cathode)

Third Anode Voltage*	V <sub>a3-k</sub>	16	17	kV		
First Anode Voltage	V <sub>a1-k</sub>	450	450	V		
Beam Current		350	500	350	500	μA
Second Anode Voltage for Focus**	V <sub>a2-k</sub>	120	50	200	130	V
Average Peak/Peak Picture Modulating Voltage		35.5	40	35.5	40	V
Minimum Grid/Cathode Voltage for Cut-off of Raster	V <sub>g-k(min)</sub>	-30		-30		V
Maximum Grid/Cathode Voltage for Cut-off of Raster	V <sub>g-k(max)</sub>	-72		-72		V

**TYPICAL OPERATION**—Cathode Modulation (Voltages referred to grid)

Third Anode Voltage	V <sub>a3-g</sub>	16	17	kV		
First Anode Voltage	V <sub>a1-g</sub>	500	500	V		
Beam Current		350	500	350	500	μA
Second Anode Voltage for Focus**	V <sub>a2-g</sub>	90	10	170	90	V
Average Peak/Peak Picture Modulating Voltage		33	37.5	33	37.5	V
Minimum Cathode/Grid Voltage for Cut-off of Raster	V <sub>k-g(min)</sub>	31		31		V
Maximum Cathode/Grid Voltage for Cut-off of Raster	V <sub>k-g(max)</sub>	69		69		V

## Approximate Focus Voltage variations with other Electrode Conditions

Change of Focus Voltage due to 100V increase in V <sub>a1</sub> Voltage	-150	V
Change in Focus Voltage due to 1kV increase in Final Anode Voltage	80	V
Change of Focus Voltage due to 100μA increase in Beam Current	-50	V

## Picture Centring

Maximum Magnet Flux Density at centre of neck not less than	15	G
Maximum Distance of centre of Magnetic Field from reference line	53	mm

\* With a final anode voltage of 15kV the first anode voltage should be 400V.

\*\* For best overall focus with resolution maintained at the centre.

**NOTE**

Within range of operating conditions all tubes will focus with V<sub>a2-k</sub> between -100V and +400V.

**DEFLECTION ANGLES**

Height	87°
Width	105°
Diagonal	110°

### CME2104

### TELEVISION CATHODE RAY TUBE ELECTROSTATIC FOCUS Indirectly heated

#### NOTE

If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

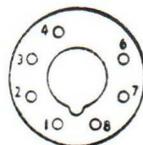
#### DIMENSIONS

Maximum Overall Length	344.5 mm
Maximum Face Diagonal	546† mm
Maximum Face Height	419† mm
Maximum Face Width	518† mm
Maximum Neck Diameter	29.4 mm
Approximate Net Weight	21 lb
Approximate Packed Weight	28 lb

† The maximum dimension at the face seal may be 3.5mm larger than this dimension, but at any point around the seal the bulge will not protrude more than 2mm.

**CAP**—Cavity (CT8)

**BASE**—Short Button Base (B8H)



Viewed from free end of pins

#### CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	First Anode	a1
Pin 4	Second Anode	a2
Pin 5	No Pin	NP
Pin 6	Grid	g
Pin 7	Cathode	k
Pin 8	Heater	h
Cap	Third Anode	a3

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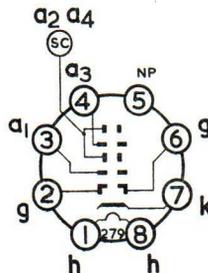
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## TELEVISION PICTURE TUBE ELECTROSTATIC FOCUS



B8H Base  
CT8 Side Contact

### GENERAL

Deflection Angle .....110° Diagonal  
 Rectangular Face .....23" Diagonal  
 Grey Glass Face .....75% Light Transmission  
 Aluminised Screen .....Silver Activated Phosphor  
 Magnetic Deflection.....Straight Gun—non ion trap

External Conductive Coating  
 Heater for use in Series Chain

Heater Current	$I_h$	0.3	A
Heater Voltage	$V_h$	12.6	V

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

### RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a_2, a_4(\max)}$	17*	kV
Minimum Second and Fourth Anode Voltage	$V_{a_2, a_4(\min)}$	15	kV
Maximum Third Anode Voltage	$V_{a_3(\max)}$	$\pm 700$	V
Maximum First Anode Voltage	$V_{a_1(\max)}$	550	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(\max)}$	180	V
Maximum Peak Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(pk)\max}$	400 $\pm\ddagger$	V
Maximum Impedance Grid to Cathode (50 c/s)	$Z_{g-k(\max)}$	0.5	M $\Omega$

All voltages referred to cathode.

\* 17kV is a design centre rating, the absolute rating of 21kV must not be exceeded.

† Absolute rating.

‡ During a warming-up period not exceeding 1 minute.

### INTER-ELECTRODE CAPACITANCES

Cathode to all	$C_{k-all}$	$\S$ 4.5	$\phi$ 5	pF
Grid to all	$C_{g-all}$	6.5	8	pF
Second and Fourth Anode to External Conductive Coating (approx.)	$C_{a_2, a_4-M}$	2000		pF

$\S$  Inter-electrode capacitances with holder capacitance balanced out.

$\phi$  Total inter-electrode capacitances including AEI.B8H holder VH68/81 (8 pin).

Indicates a change

**TYPICAL OPERATION—Grid Modulation (Voltages referred to cathode)** ←

Second and Fourth Anode Voltage	$V_{a2, a4-k}$	16		kV
First Anode Voltage	$V_{a1-k}$	450		V
Beam Current		350	500	$\mu A$
Third Anode Voltage for Focus" (Mean)	$V_{a3-k(av)}$	180	110	V
Average Peak to Peak Picture Modulating Voltage		35.5	40	V
Grid to Cathode for Cut-off of Raster (See charts for limits)	$V_{g-k}$	-54		V

Within range of operating conditions for all tubes the value of  $V_{a3-k}$  required for focus will lie between 0 and +400V.

**TYPICAL OPERATION—Cathode Modulation (Voltages referred to grid)** ←

Second and Fourth Anode Voltage	$V_{a2, a4-g}$	16		kV
First Anode Voltage	$V_{a1-g}$	500		V
Beam Current		350	500	$\mu A$
Third Anode Voltage for Focus" (Mean)	$V_{a3-g(av)}$	200	130	V
Average Peak to Peak Picture Modulating Voltage		33.5	38	V
Cathode to Grid Voltage for Cut-off of Raster (See charts for limits)	$V_{k-g}$	54		V

"For best overall focus with resolution maintained at the centre.

**PICTURE CENTRING** ←

Maximum magnet flux density at centre of neck should not be less than	15	G
Maximum distance of centre of magnetic field from reference line	53	mm

**NOTE**

If this tube is operated at voltage in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliröntgen per hour, the window will normally provide adequate protection.

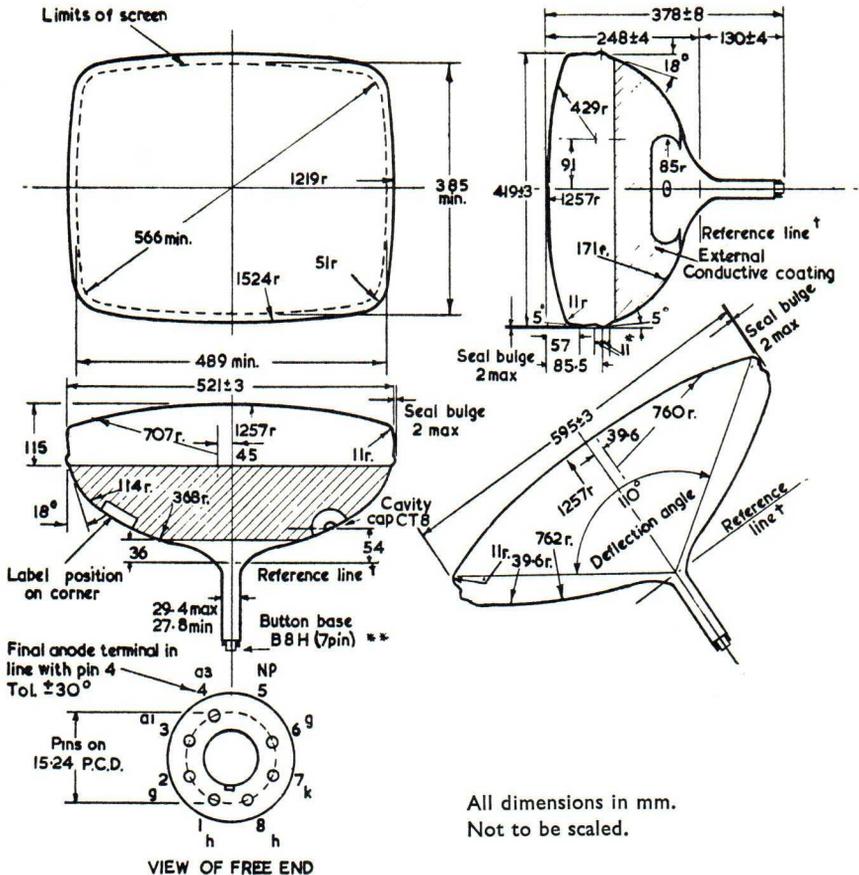
**DEFLECTION ANGLES** ←

Height	82°
Width	99°
Diagonal	110°

**WEIGHT** ←

Approximate Single Tube Weight: Net 27 lb

Indicates a change ←



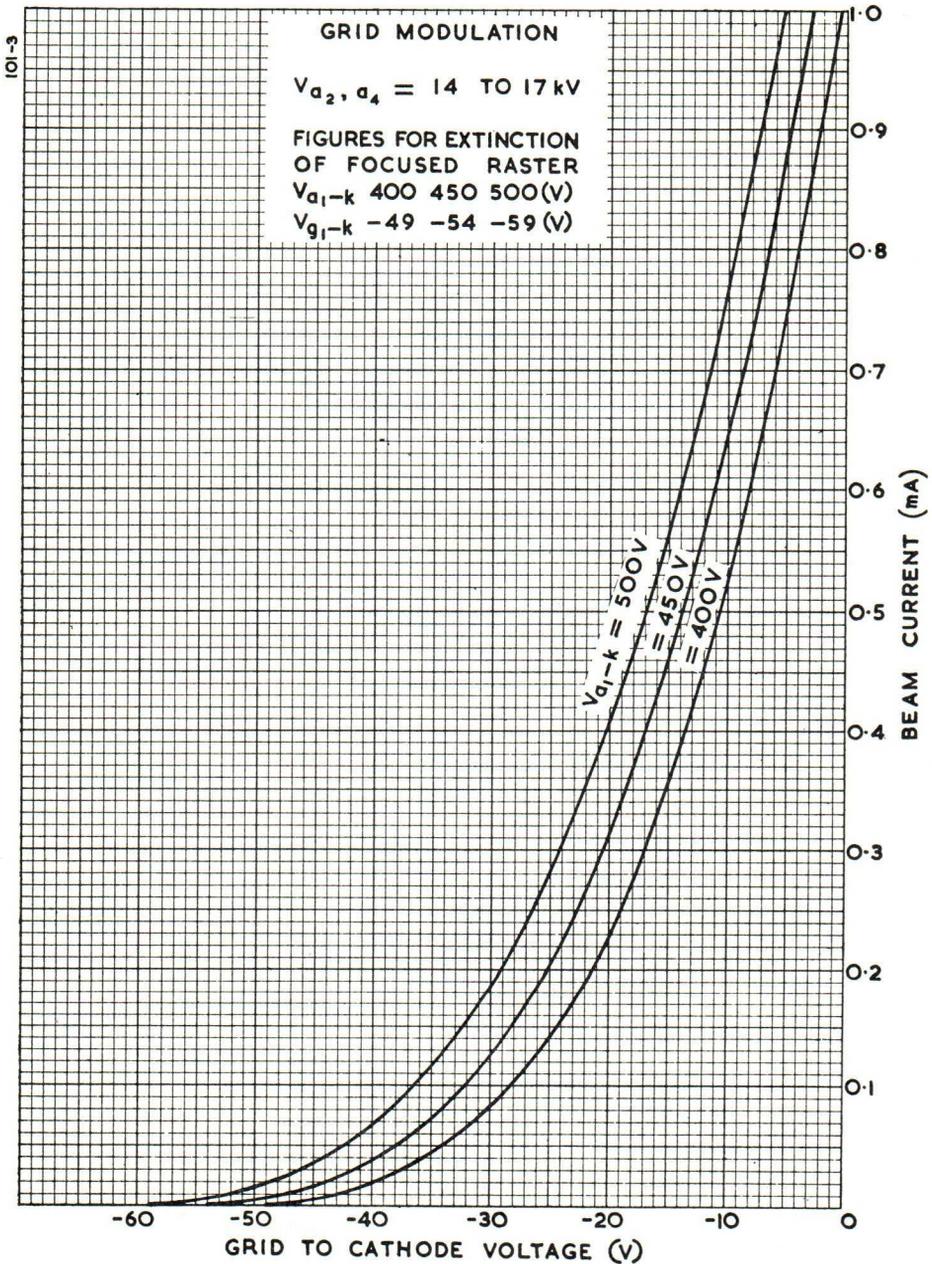
All dimensions in mm.  
Not to be scaled.

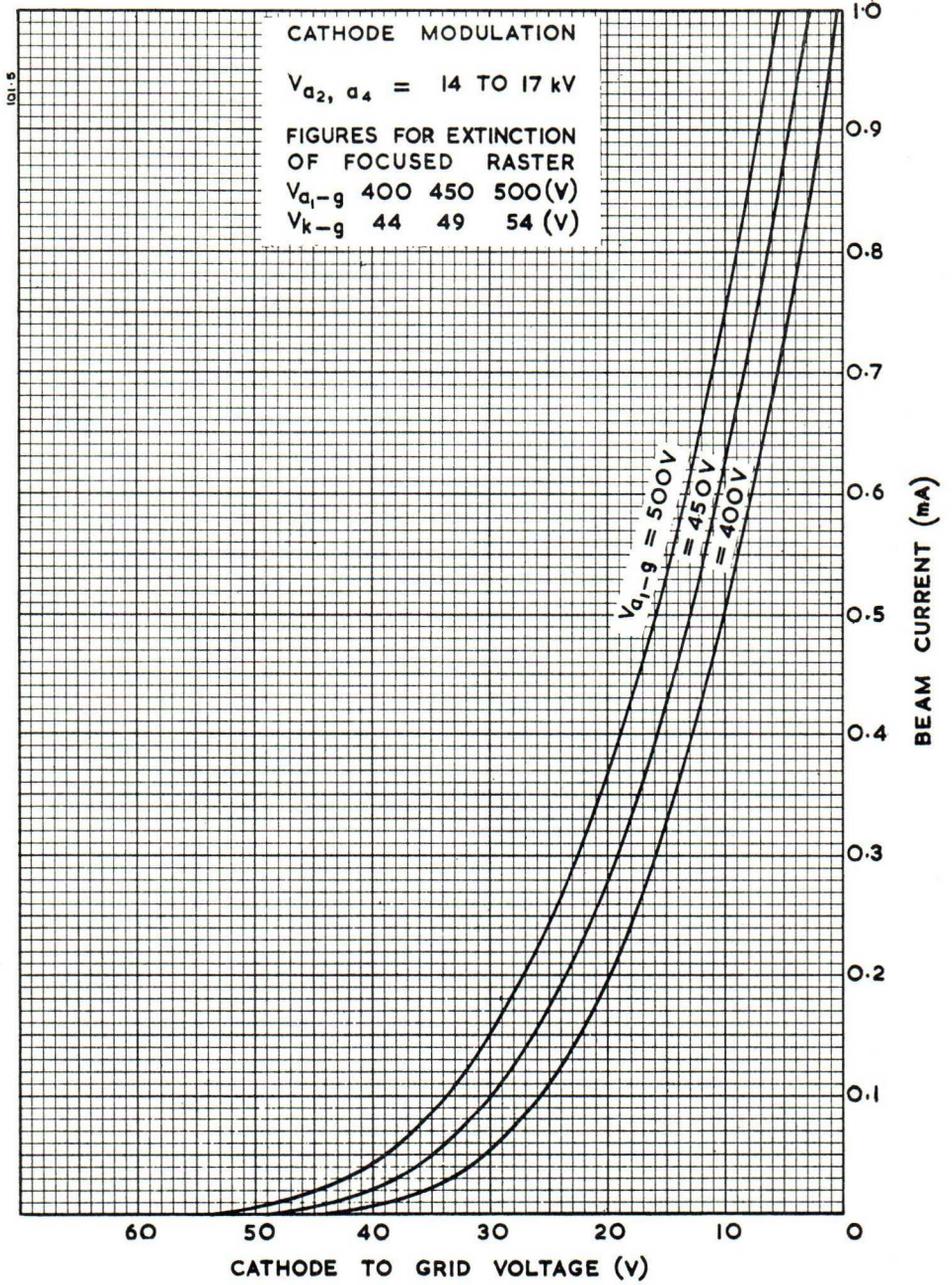
#### Notes:

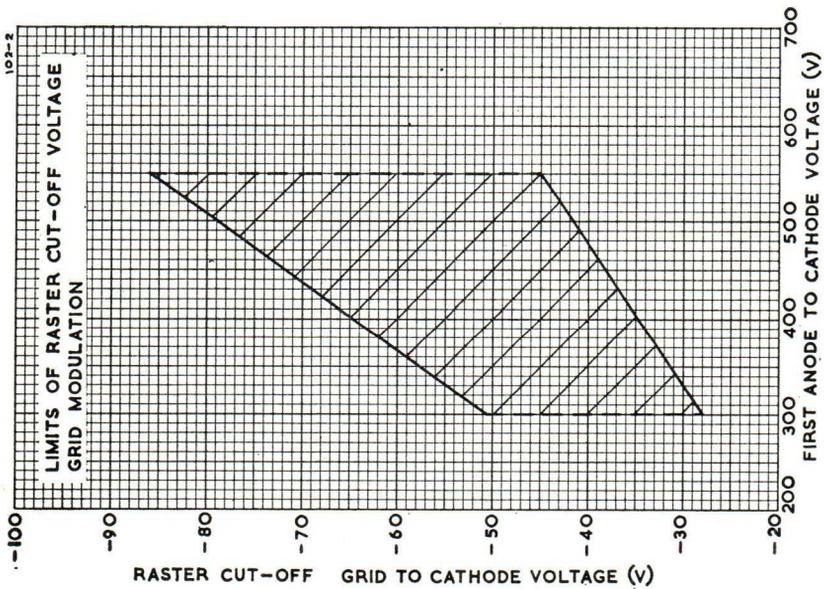
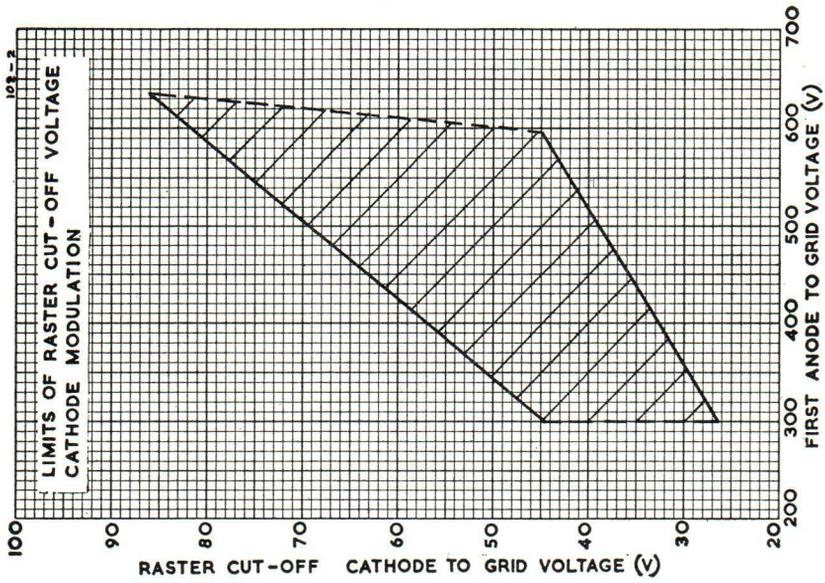
\* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

\*\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44 mm.

† Determined by Reference Gauge No. 16.







**CME2302**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated

**GENERAL**

Deflection Angle.....	110° Diagonal
Rectangular Face.....	23" Diagonal
Grey Glass Face.....	74% Light Transmission
Aluminised Screen	Magnetic Deflection
Straight Gun	B8H Base

External Conductive Coating  
 Heater for use in Series Chain

**RATING**

Heater Voltage	$V_h$	6.3 V
Heater Current	$I_h$	0.3* A
Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	17** kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13 kV
Maximum First Anode Voltage	$V_{a1(max)}$	500 V
Maximum Third Anode Voltage	$V_{a3(max)}$	1000 to -500 V
Maximum Heater/Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	200 V
Maximum Peak Heater/Cathode Voltage, Heater Negative (d.c.)	$v_{h-k(pk)max}$	400†§ V

\* The cathode ray tube heater should always be connected at the chassis end in a series heater chain.

\*\* 17kV is a design centre rating, the absolute rating of 21kV must not be exceeded.

† Absolute rating.

§ During a warming-up period not exceeding 45 secs.

**INTER-ELECTRODE CAPACITANCES**

		††	§§	
Grid/All other electrodes	$c_{g-all}$	7.0	8.5	pF
Cathode/All other electrodes	$c_{k-all}$	3.0	3.5	pF
Anode 2 and Anode 4/External Conductive Coating (approx)	$c_{a2,a4-M}$		2000	pF

†† Inter-electrode capacitances with holder capacitance balanced out.

§§ Total inter-electrode capacitances including Clix B8H holder VH68/81 (8 pin).

**CME2302**  
**TELEVISION CATHODE RAY TUBE**  
**ELECTROSTATIC FOCUS**  
 Indirectly heated

**DIMENSIONS**

Maximum Overall Length	386 mm
Maximum Face Diagonal	598± mm
Maximum Face Height	422± mm
Maximum Face Width	524± mm
Maximum Neck Diameter	29.4 mm
Approximate Net Weight	27 lb.

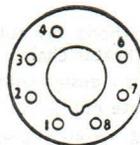
‡ The maximum dimension at the face seal may be 3.5mm larger than this dimension, but at any point around the seal the bulge will not protrude more than 2mm.

**TYPICAL OPERATION**—All voltages with respect to cathode

Second and Fourth Anode Voltage	$V_{a2,a4}$	16 kV
First Anode Voltage	$V_{a1}$	400 V
Third Anode Voltage for Focus (Range)	$V_{a3}$	0 to 400 V
Grid Bias Voltage for Cut-off of Raster	$V_{g1}$	-38 to -94 V
Average Peak/Peak Modulating Voltage for Modulation up to 350µA		39 V

**NOTE**

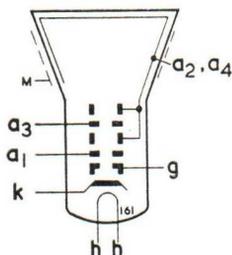
If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

**ANODE CAP**—Cavity (CT8)**BASE**—Button Base (B8H)

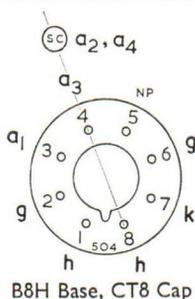
Viewed from free end of pins

**CONNECTIONS**

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	First Anode	a1
Pin 4	Third Anode	a3
Pin 5	No Pin	NP
Pin 6	Grid	g
Pin 7	Cathode	k
Pin 8	Heater	h
Cap	Second and Fourth Anode	a2,a4



### TELEVISION PICTURE TUBE



#### GENERAL

Twin Panel .....	Tinted Grey Glass
Deflection Angle .....	110° Diagonal
Rectangular Face .....	23 in. Diagonal
Light Transmission .....	45% Approximately
Aluminised Screen .....	White Fluorescence
Electrostatic Focus .....	Magnetic Deflection
Short Neck .....	Straight Gun—non ion trap
External Conductive Coating	

Heater Current	$I_h$	0.3	A
Heater Voltage	$V_h$	6.3	V

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2, a4(max)}$	20*	kV
Minimum Second and Fourth Anode Voltage	$V_{a2, a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400†‡	V
Maximum Impedance Grid to Cathode (50c/s)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* For  $I_{a2+a4}=0$ .

† Absolute rating.

‡ During a warming-up period not exceeding 45 seconds.

**Note :** The A59-13W/CME2306 is the AW59-91/CME2303 with the addition of a tinted glass panel.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

Cathode to all	$C_{k-all}$	§ 3.0	φ 3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Second and Fourth Anode to External Conductive Coating (approx.)	$C_{a2,a4-M}$	2000		pF

§ Inter-electrode capacitances with holder capacitance balanced out.

φ Total inter-electrode capacitances including AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18	18	kV
First Anode Voltage*	$V_{a1-k}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for Cut-off of Raster (See charts for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18	18	kV
First Anode Voltage*	$V_{a1-g}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	μA
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for Cut-off of Raster (See charts for limits)	$V_{k-g}$	51	62	V

\* Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

**NOTE**

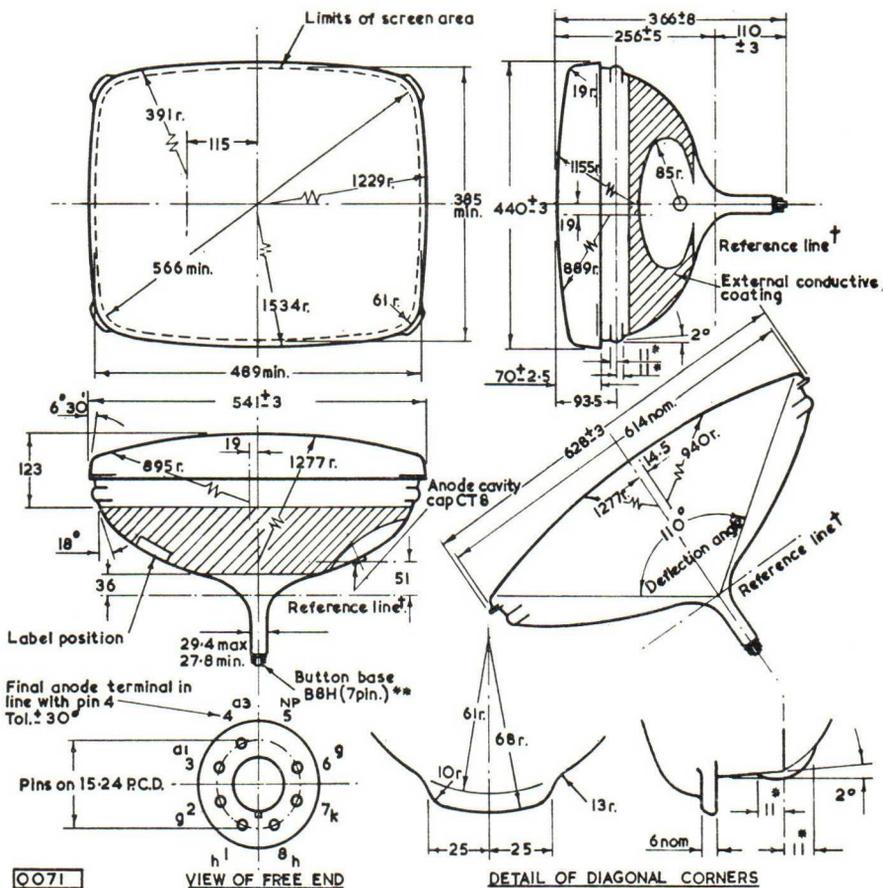
If this tube is operated at voltage in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.

**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight : Net	37.5 lb (17 kg)
--------------------------------------	-----------------



All dimensions in mm.

Not to be scaled.

#### Notes :

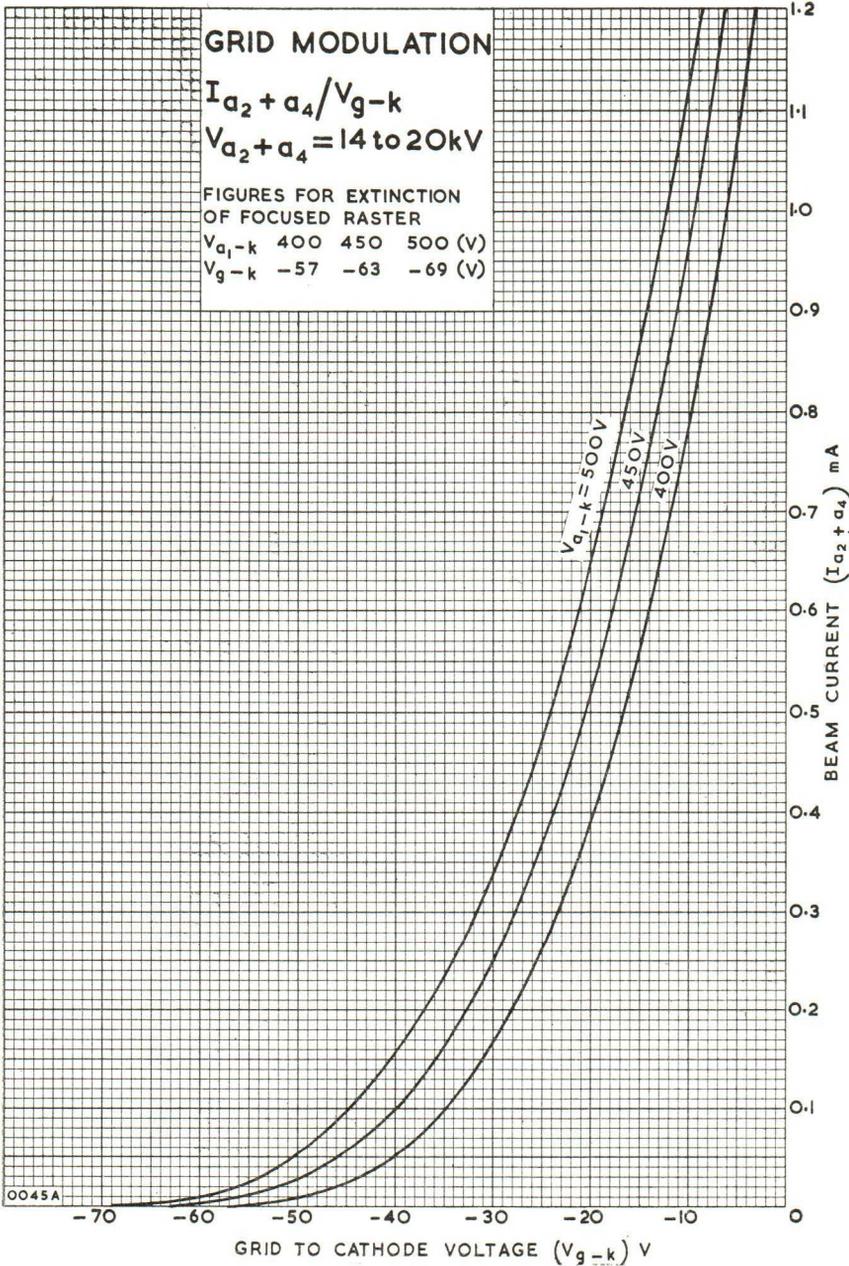
\* During the face sealing operation the glass in this area (total 22mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

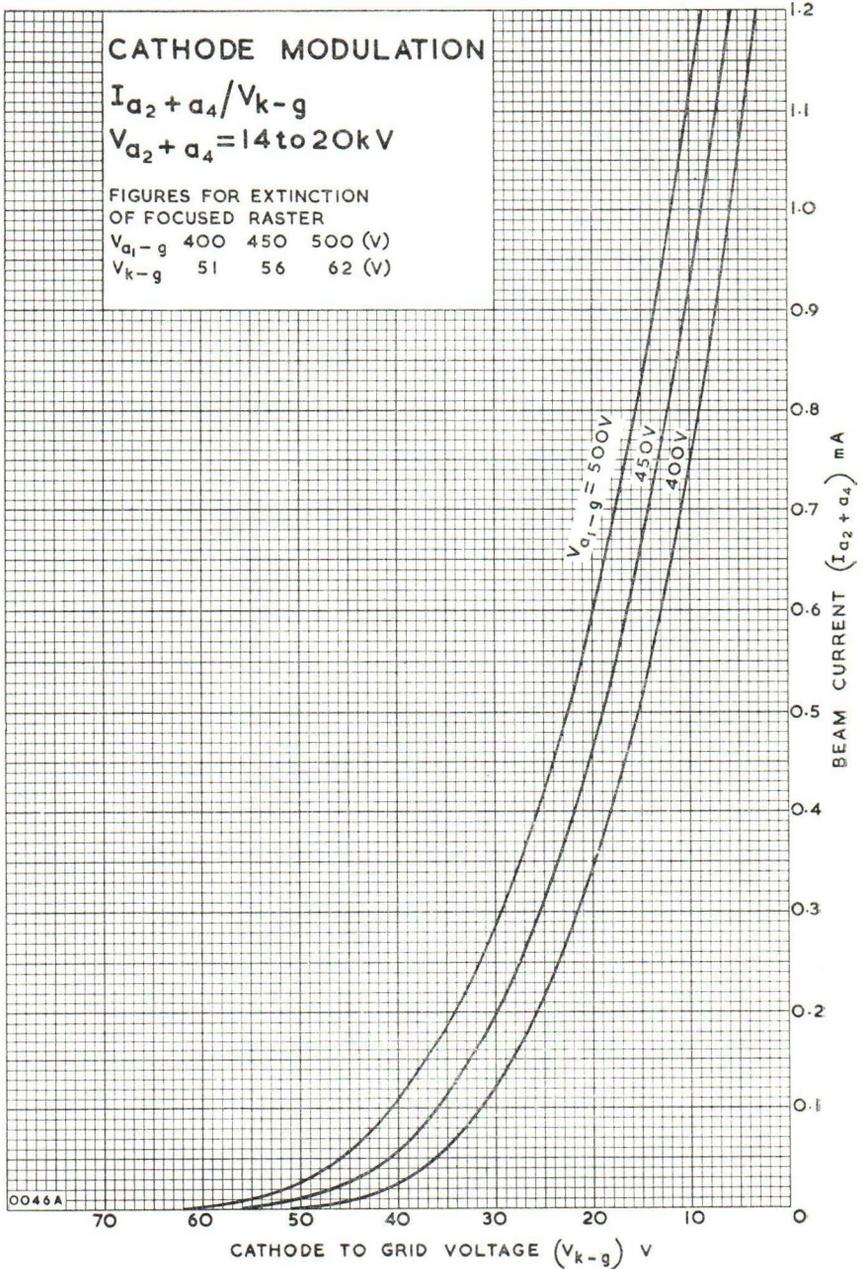
\*\*The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and have a diameter of 44mm.

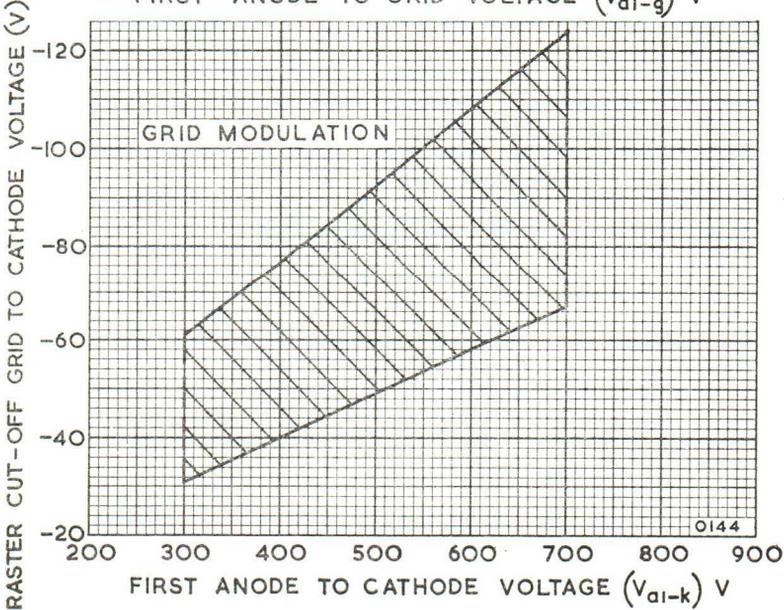
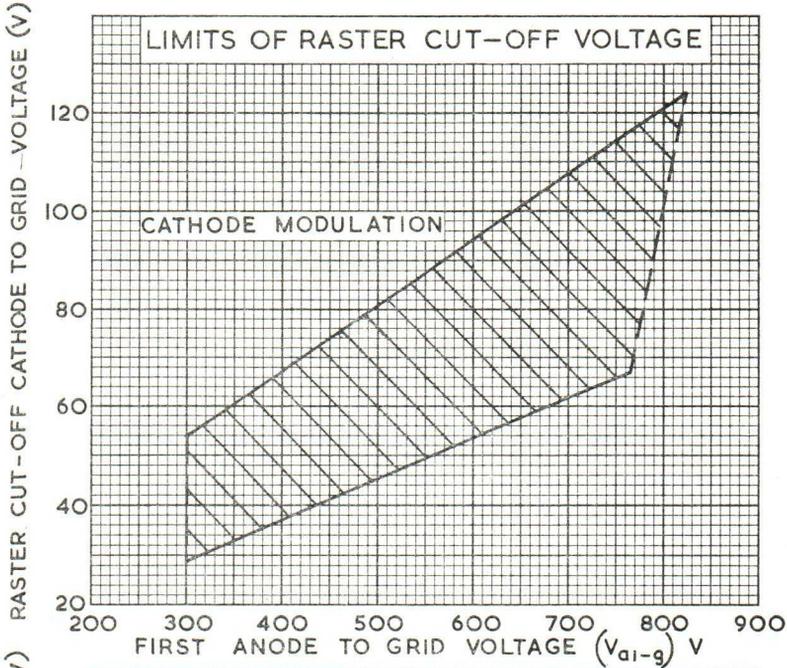
† Determined by Reference Gauge No.16 (JEDEC 126).

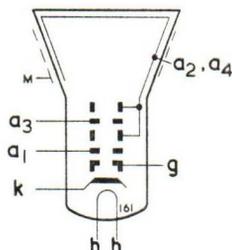
The tube may be supported by clamping to the mounting lugs provided at each corner of the protective panel.

Tube mounting clamps must be spaced from the tube by the use of cushioning pads.

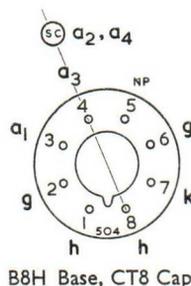








## TELEVISION PICTURE TUBE



### GENERAL

Rectangular Face .....	23 in Diagonal
Electrostatic Focus.....	Magnetic Deflection
Deflection Angle .....	110° Diagonal
Aluminised Screen.....	White Fluorescence
Grey Glass.....	45% Transmission (approx)
Straight Gun .....	Non Ion Trap
External Conductive Coating	

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3	A

The cathode ray tube heater should always be connected at the chassis end if used in a series heater chain.

### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20*	kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$		
Heater Negative (d.c.)		250	V
Maximum Peak Heater to Cathode Voltage	$V_{h-k(pk)max}$		
Heater Negative		400†‡	V
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* For  $I_{a2+a4}=0$

† Absolute rating.

‡ During a warming-up period not exceeding 45 seconds.

The A59-15W/CME2308 is electrically identical to the AW59-91/CME2303.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

		§	φ	
Cathode to all	C <sub>k-all</sub>	3.0	3.5	pF
Grid to all	C <sub>g-all</sub>	7.0	8.5	pF
Second and Fourth Anode to External Conductive Coating (approx)	C <sub>a2,a4-M</sub>		2000	pF

§ Inter-electrode capacitances with holder capacitance balanced out.

φ Total inter-electrode capacitances including a typical B8H holder.

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	V <sub>a2,a4-k</sub>	18	18	kV
First Anode Voltage*	V <sub>a1-k</sub>	400	500	V
Final Anode Current	I <sub>a2+a4</sub>	350 500	350 500	μA
Third Anode Voltage Range for Focus	V <sub>a3-k</sub>	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for Cut-off of Raster (See chart for limits)	V <sub>g-k</sub>	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	V <sub>a2,a4-g</sub>	18	18	kV
First Anode Voltage*	V <sub>a1-g</sub>	400	500	V
Final Anode Current	I <sub>a2+a4</sub>	350 500	350 500	μA
Third Anode Voltage Range for Focus	V <sub>a3-g</sub>	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for Cut-off of Raster (See chart for limits)	V <sub>k-g</sub>	51	62	V

\* Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 Gs
Maximum distance of centre of magnetic field from reference line	53 mm

**Note**

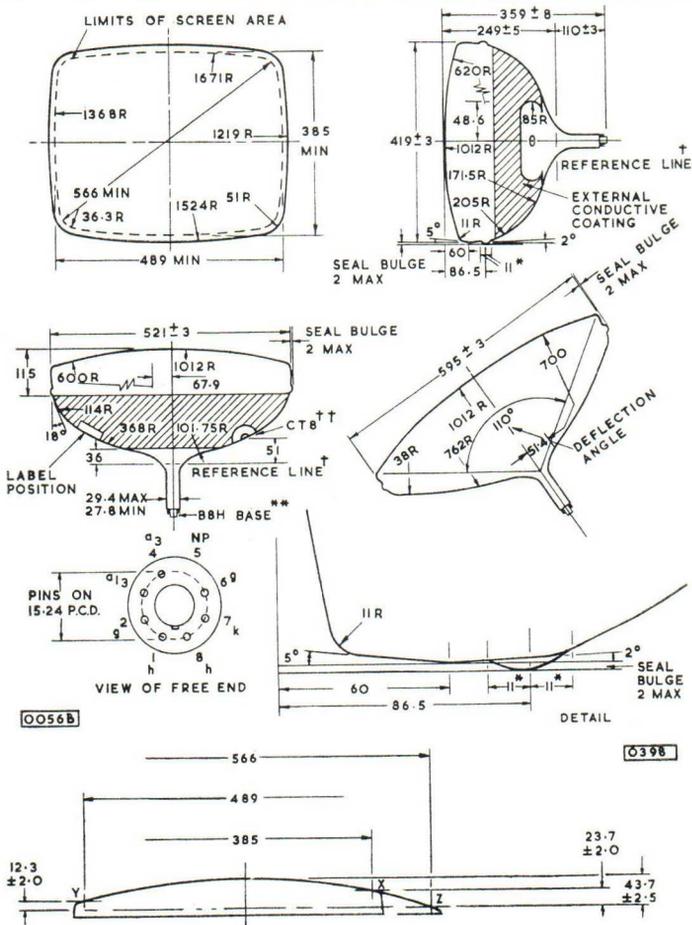
If this tube is operated at voltages in excess of 16 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protection viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliröntgens per hour the window will normally provide adequate protection.

**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**WEIGHT**

Approximate Single Tube Weight: Net	13.3 kg (29 lb)
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All dimensions in mm

Not to be scaled.

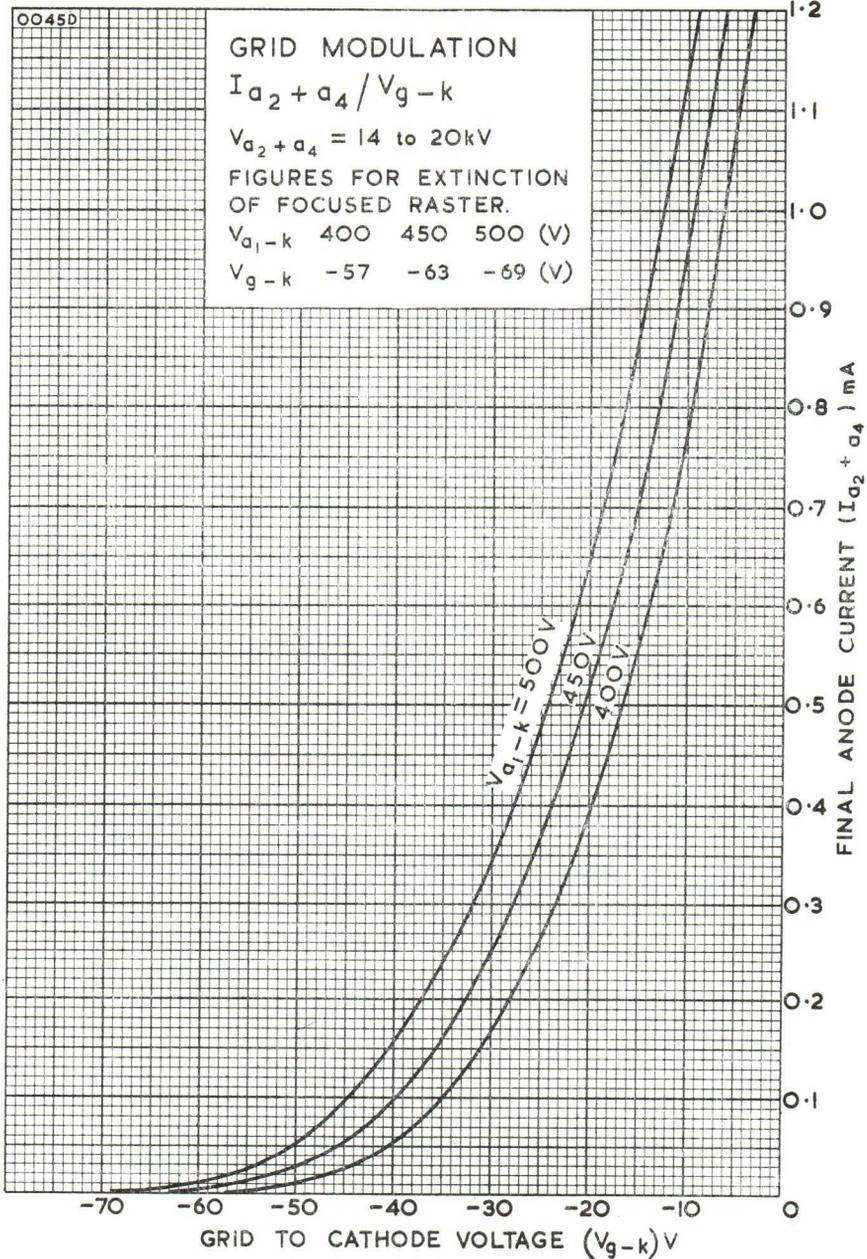
\* During the face sealing operation the glass in this area (total 22 mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material).

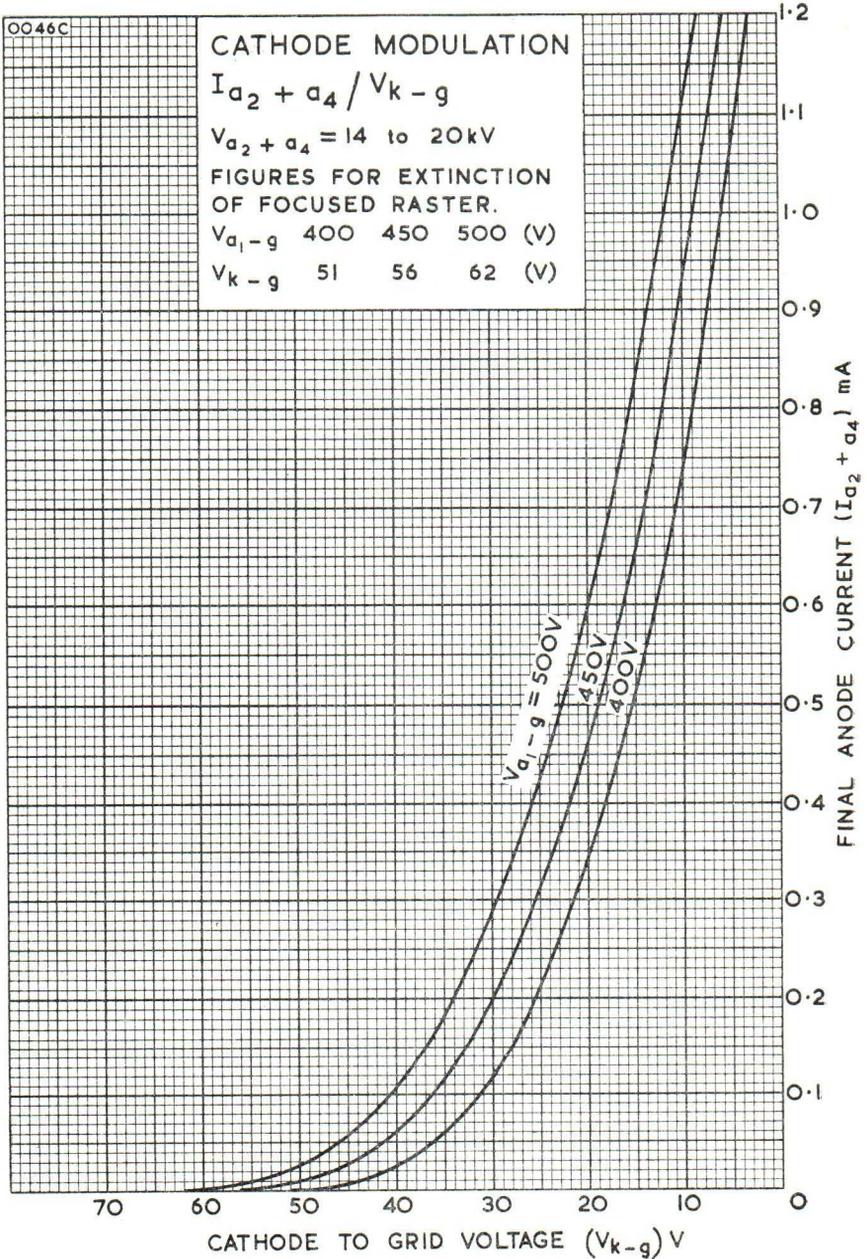
† Determined by Reference Gauge No. 16 (JEDEC No. 126).

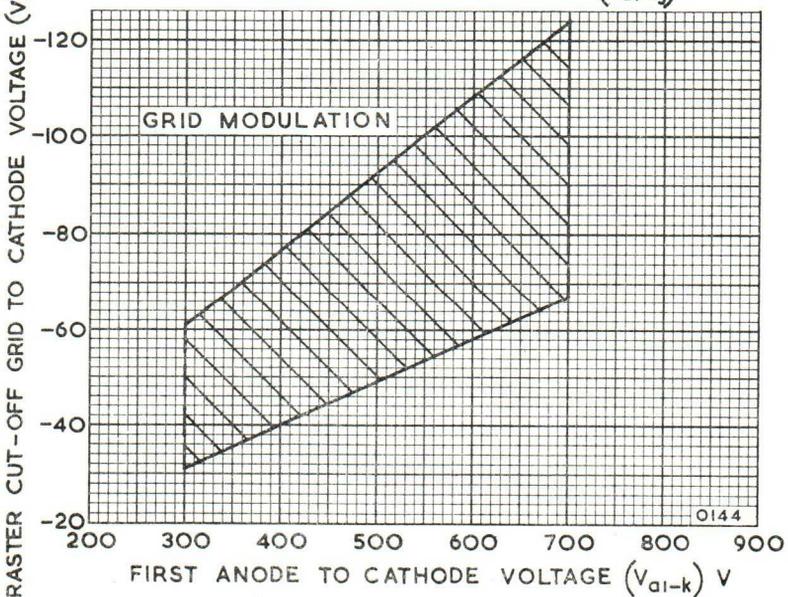
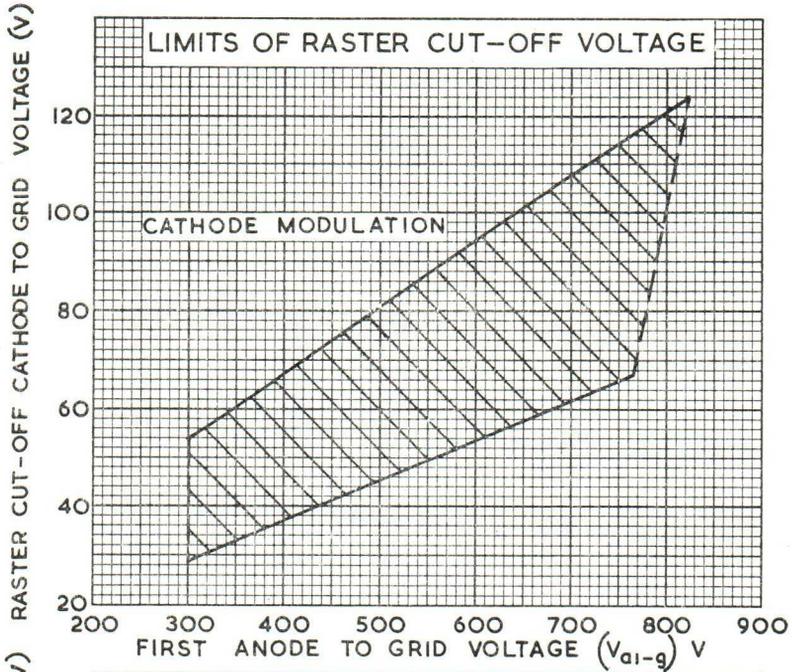
\*\* The socket for the B8H button base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. The design of the socket should be such that the wiring cannot impress lateral strains through the socket contacts on the base. Bottom circumference of base wafer will fall within a circle concentric with the bulb axis and having a diameter of 44 mm.

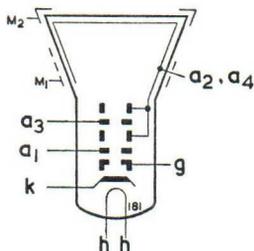
†† Anode terminal in line with pin 4. Tolerance  $\pm 30^\circ$ .

There is an annular region of anti-corona coating with diameters of 30 mm and 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

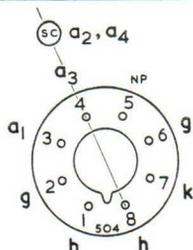








### RIMGUARD II TELEVISION PICTURE TUBE



B8H Base, CT8 Cap

#### GENERAL

Rectangular Face .....	23 in.	Diagonal
Reinforced Envelope.....		Integral Mounting Lugs
Electrostatic Focus .....		Magnetic Deflection
Deflection Angle .....	110°	Diagonal
Aluminised Screen .....		White Fluorescence
Grey Glass .....	45%	Transmission (approx.)
Straight Gun .....		Non Ion Trap
		External Conductive Coating

Heater Voltage	$V_h$	6.3	V
Heater Current	$I_h$	0.3*	A

#### DESIGN CENTRE RATINGS

Maximum Second and Fourth Anode Voltage	$V_{a2,a4(max)}$	20†	kV
Minimum Second and Fourth Anode Voltage	$V_{a2,a4(min)}$	13	kV
Maximum Third Anode Voltage	$V_{a3(max)}$	+1000 to -500	V
Maximum First Anode Voltage	$V_{a1(max)}$	700	V
Maximum Heater to Cathode Voltage, Heater Negative (d.c.)	$V_{h-k(max)}$	250	V
Maximum Peak Heater to Cathode Voltage, Heater Negative	$V_{h-k(pk)max}$	400‡§	V
Maximum Impedance, Grid to Cathode (50 Hz)	$Z_{g-k(max)}$	0.5	MΩ
Maximum Resistance, Grid to Cathode	$R_{g-k(max)}$	1.5	MΩ

All voltages referred to cathode.

\* The CRT heater should always be connected at the chassis end in a series heater chain.

† For  $I_{a2+a4}=0$ .

‡ Absolute rating.

§ During a warming-up period not exceeding 45 seconds.

The A59-25W/CME2312 is electrically identical to the AW59-91/CME2303.

The mechanical fixing of this tube is interchangeable with other existing reinforced tubes.

Tubes incorporating a B8H sparkguard base will have a suffix S after the type number. For details of the sparkguard base see separate sheet.

**INTER-ELECTRODE CAPACITANCES**

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anode 2 and Anode 4 to External Conductive Coating, $M_1$ (approx)	$C_{a2,a4-M1}$		1500	pF
Anode 2 and Anode 4 to Shell, $M_2$ (approx.)	$C_{a2,a4-M2}$		300	pF

\* Inter-electrode capacitances with holder capacitance balanced out.

† Total inter-electrode capacitances including an AEI B8H holder VH68/81 (8 pin).

**TYPICAL OPERATION—Grid Modulation (Voltage referred to cathode)**

Second and Fourth Anode Voltage	$V_{a2,a4-k}$	18	18	kV
First Anode Voltage †	$V_{a1-k}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-k}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		35.5 40.5	39.5 45	V
Grid to Cathode Voltage for cut-off of raster (See chart for limits)	$V_{g-k}$	-57	-69	V

**TYPICAL OPERATION—Cathode Modulation (Voltage referred to grid)**

Second and Fourth Anode Voltage	$V_{a2,a4-g}$	18	18	kV
First Anode Voltage †	$V_{a1-g}$	400	500	V
Beam Current	$I_{a2+a4}$	350 500	350 500	$\mu A$
Third Anode Voltage Range for Focus	$V_{a3-g}$	0 to 400	0 to 400	V
Average Peak to Peak Picture Modulating Voltage		31.5 35.5	34.5 39.5	V
Cathode to Grid Voltage for cut-off of raster (See chart for limits)	$V_{k-g}$	51	62	V

† Within this range a higher First Anode Voltage will provide an improved focus performance.

**PICTURE CENTRING**

Maximum magnet flux density at centre of neck should not be less than	17 G
Maximum distance of centre of magnetic field from reference line	53 mm

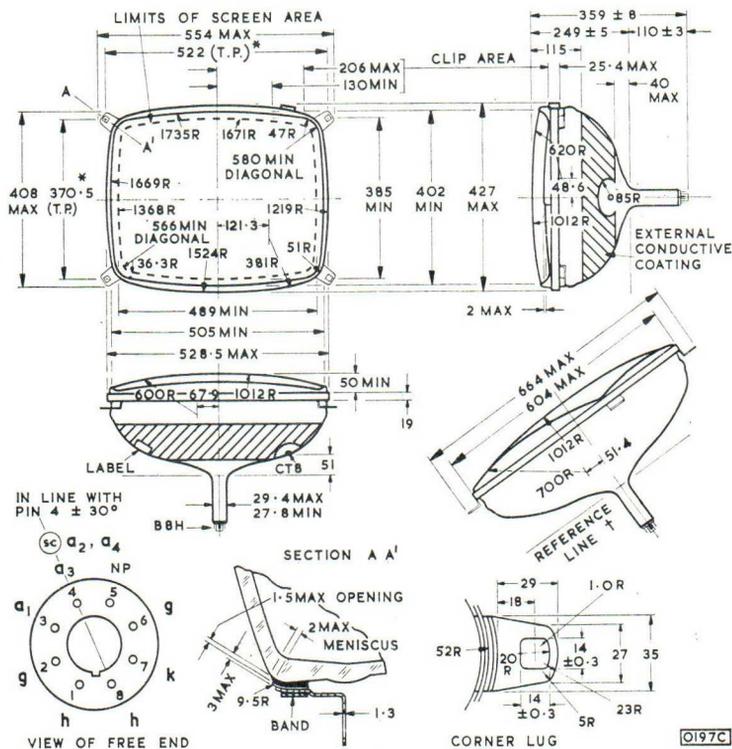
**DEFLECTION ANGLES**

Height	82°
Width	99°
Diagonal	110°

**TUBE WEIGHT (approx.)—Net 30 lb (13.5 kg)**

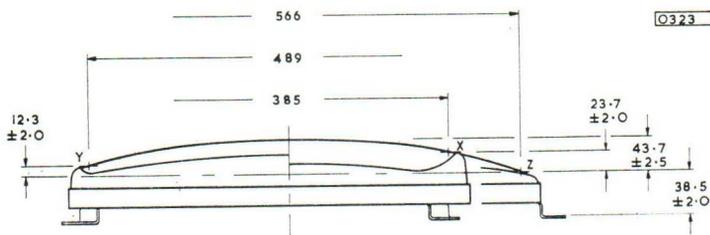
**Note :**

If this tube is operated at voltages in excess of 16kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.



0197C

0323



All dimensions in mm.

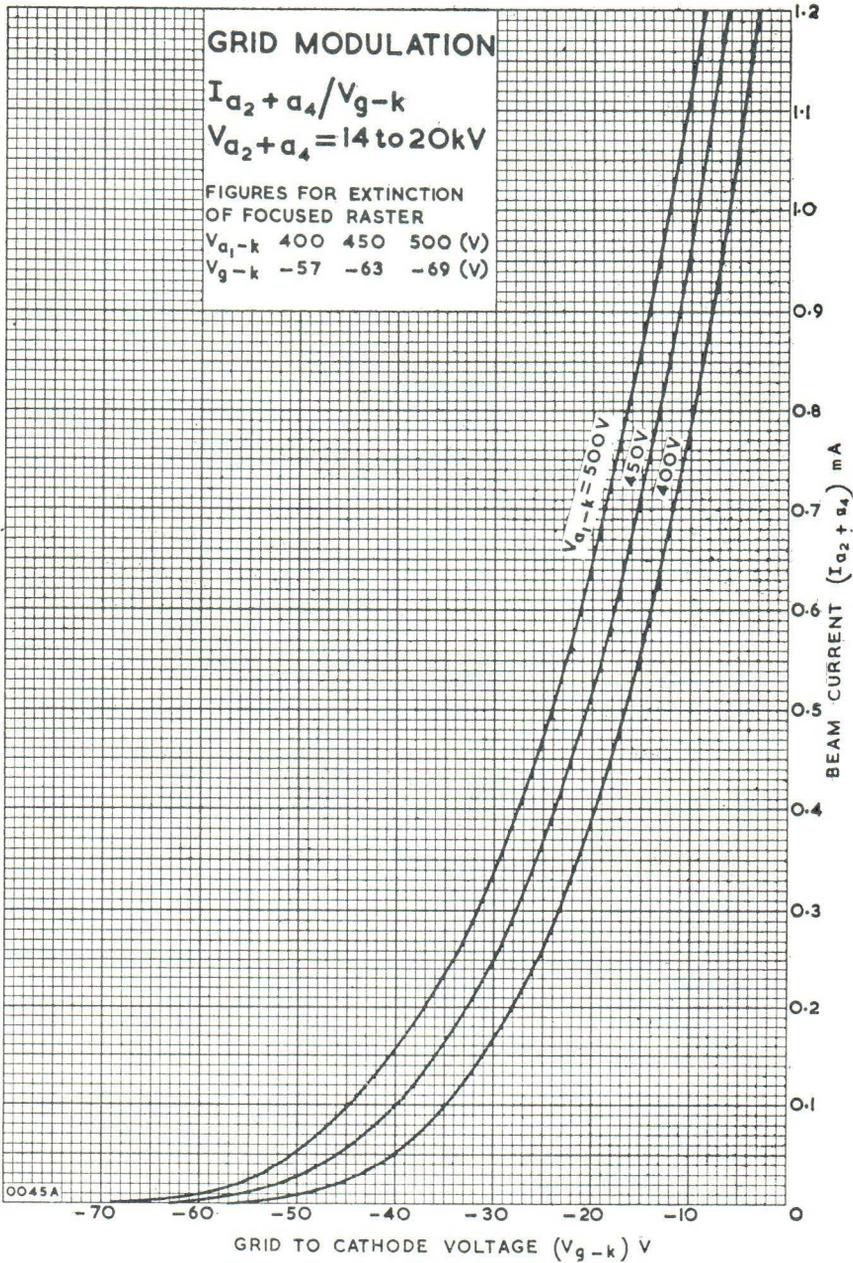
Not to be scaled.

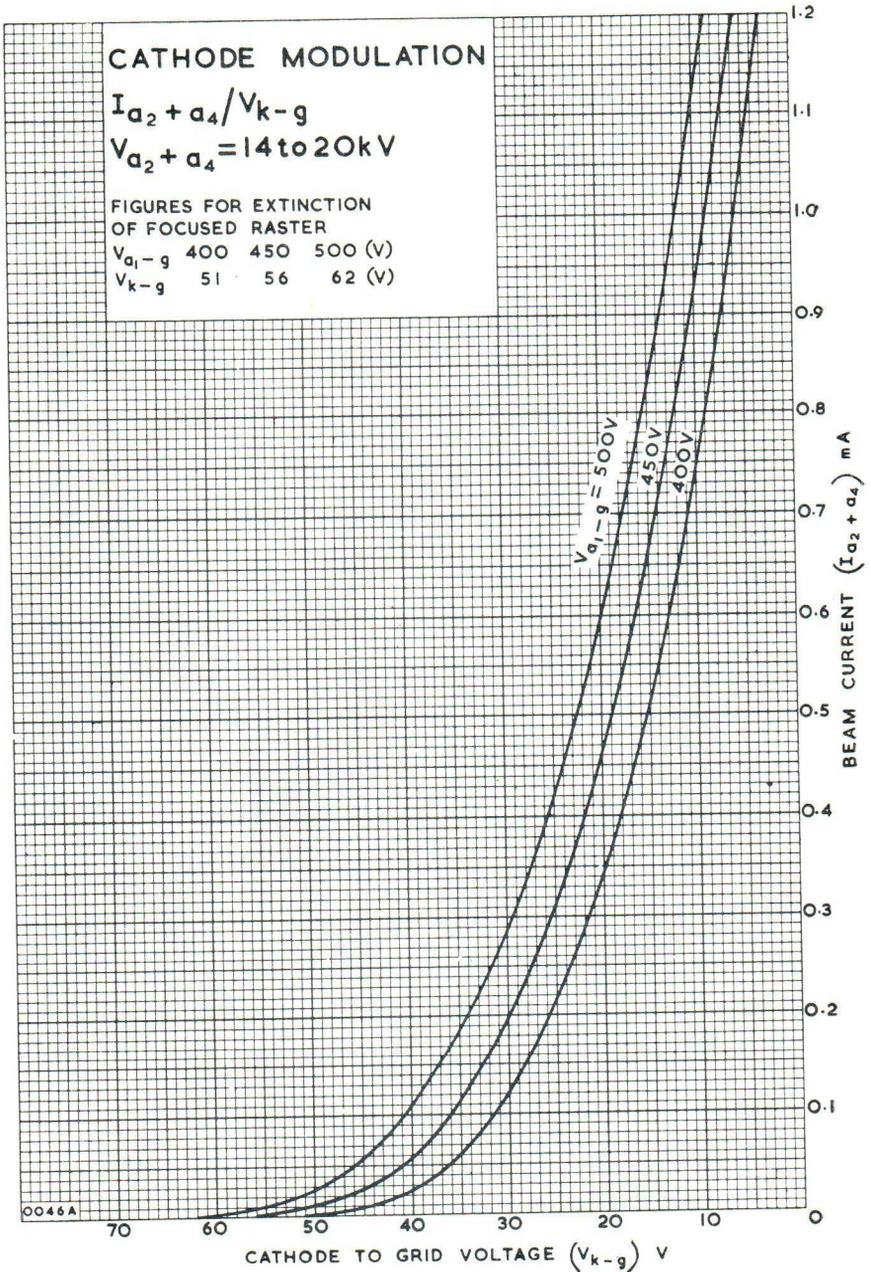
It is recommended that the mask used with this tube is flexible enough to take up small variations in fixing and bulb contours.

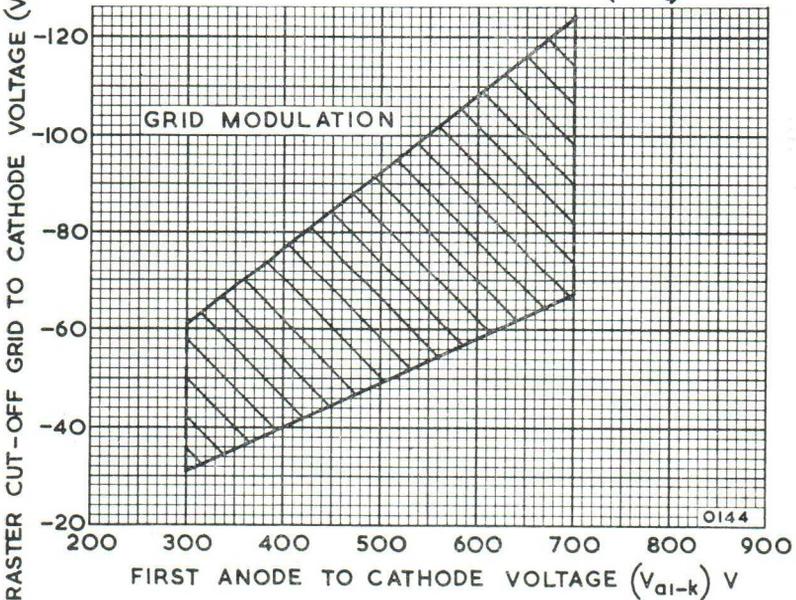
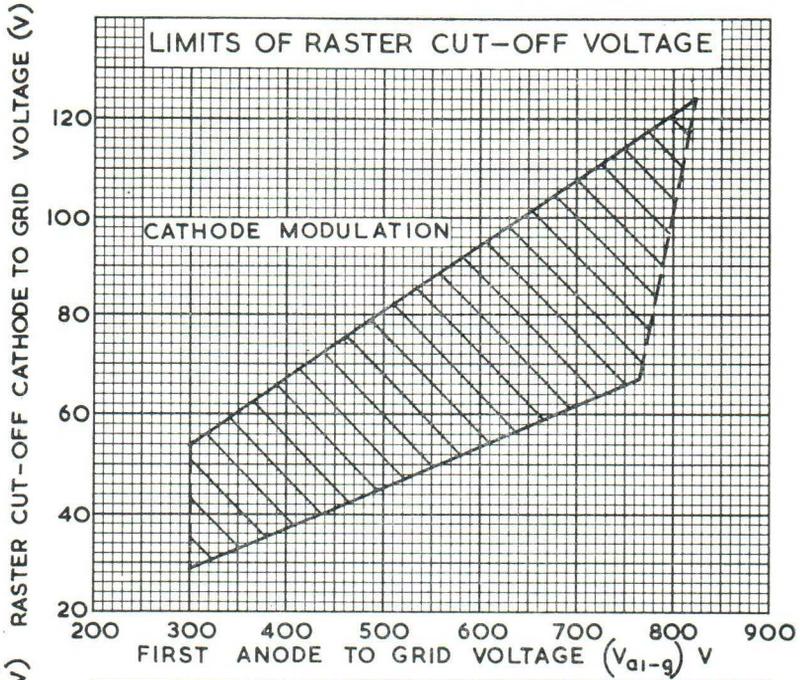
The metal shell M<sub>2</sub> must be connected to chassis via a 2MΩ resistor.

\* The bolts to be used for mounting the tube must lie within circles of 9.5 mm diameter centred on these true positions (Diagonal 640). One of the four lugs may deviate 2 mm maximum from the plane through the other three lugs.

† Determined by reference line gauge No. 16 (JEDEC No. 126).







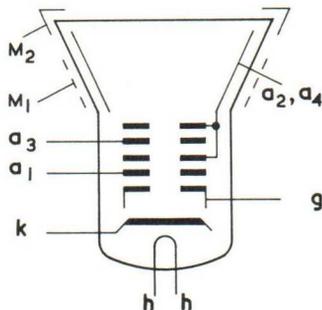
# Television Picture Tube

**CME2313**  
**A59-23W**

## GENERAL

Rectangular face, 23 inch, 110° diagonal  
Rimguard III reinforced envelope  
Integral mounting lugs  
Electrostatic focus, magnetic deflection  
Aluminised screen, white fluorescence  
Grey glass, 45% transmission (approx)  
Straight gun, non ion trap  
External conductive coating

Heater voltage  $V_h$  6.3 V  
Heater current  $I_h$  0.3\* A



## DESIGN CENTRE RATINGS

Maximum second and fourth anode voltage	$V_{a2+a4}(\max)$	20†	kV
Minimum second and fourth anode voltage	$V_{a2+a4}(\min)$	13	kV
Maximum third anode voltage	$V_{a3}(\max)$	+1000 to -500	V
Maximum first anode voltage	$V_{a1}(\max)$	700	V
Maximum negative grid voltage	$-V_g(\max)$	150	V ←
Maximum peak negative grid voltage	$-v_g(\text{pk})\max$	400**	V ←
Maximum positive grid voltage	$V_g(\max)$	0‡	V ←
Maximum heater to cathode voltage, heater negative (d.c.)	$V_{h-k}(\max)$	250	V
Maximum peak heater to cathode voltage, heater negative (absolute rating)	$v_{h-k}(\text{pk})\max$	400§	V
Maximum impedance, grid to cathode (50 Hz)	$Z_{g-k}(\max)$	0.5	MΩ
Maximum resistance, grid to cathode	$R_{g-k}(\max)$	1.5	MΩ

All voltages referred to cathode

\* In a series heater chain the CRT should always be connected at the chassis end.

†  $I_{a2+a4} = 0$

§ During a warming up period not exceeding 45 seconds.

‡ The peak positive excursion of the video signal should not exceed +5V and this may be achieved by the series connection of a 10kΩ resistor close to the tube base.

\*\* Maximum pulse duration 22% of one cycle with a maximum of 1.5ms.

Tubes incorporating a B8H Sparkguard base will have a suffix after the type number. For details of the Sparkguard bases see separate sheets. Tubes with a Sparkguard R base should only be used where the required circuit modifications are made.

**Thorn Radio Valves and Tubes Limited**

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### INTER-ELECTRODE CAPACITANCES

		*	†	
Cathode to all	$C_{k-all}$	3.0	3.5	pF
Grid to all	$C_{g-all}$	7.0	8.5	pF
Anodes 2 and 4 to coating $M_1$ (approx.)	$C_{a2+a4-M1}$	1500		pF
Anodes 2 and 4 to shell $M_2$ (approx.)	$C_{a2+a4-M2}$	300		pF

\* Holder capacitance balanced out.

† Total capacitances including a typical B8H holder.

### TYPICAL OPERATION - Grid modulation (Voltage referred to cathode)

Second and fourth anode voltage	$V_{a2+a4-k}$	18	18	kV		
First anode voltage ¶	$V_{a1-k}$	400	500	V		
Third anode voltage range for focus	$V_{a3-k}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		35.5	40.5	39.5	45	V
Grid to cathode voltage range for cut-off of raster	$V_{g-k}$	-40 to -77	-50 to -93			V

### TYPICAL OPERATION - Cathode modulation (Voltage referred to grid)

Second and fourth anode voltage	$V_{a2+a4-g}$	18	18	kV		
First anode voltage ¶	$V_{a1-g}$	400	500	V		
Third anode voltage range for focus	$V_{a3-g}$	0 to 400	0 to 400	V		
Final anode current	$I_{a2+a4}$	350	500	350	500	$\mu A$
Average peak to peak picture modulating voltage		31.5	35.5	34.5	39.5	V
Cathode to grid voltage range for cut-off of raster	$V_{k-g}$	36 to 66	45 to 80			V

¶ Within this range a higher first anode voltage will provide improved focus performance.

If this tube is operated at voltages in excess of 20 kV, x-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range.

Characteristic curves as A50-120W / CME2013

# Television Picture Tube

**GME2313**  
**A59-23W**

## PICTURE CENTRING

Maximum magnet flux density at centre of neck should not be less than	17	Gs
Maximum distance of centre of magnetic field from reference line	53	mm

## DEFLECTION ANGLES

Height 82°	Width 99°	Diagonal 110°
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## MOUNTING

This tube is intended for 'push-through' presentation without masking, but if a mask is used it should be flexible enough to take up small variations in fixing and bulb contours.

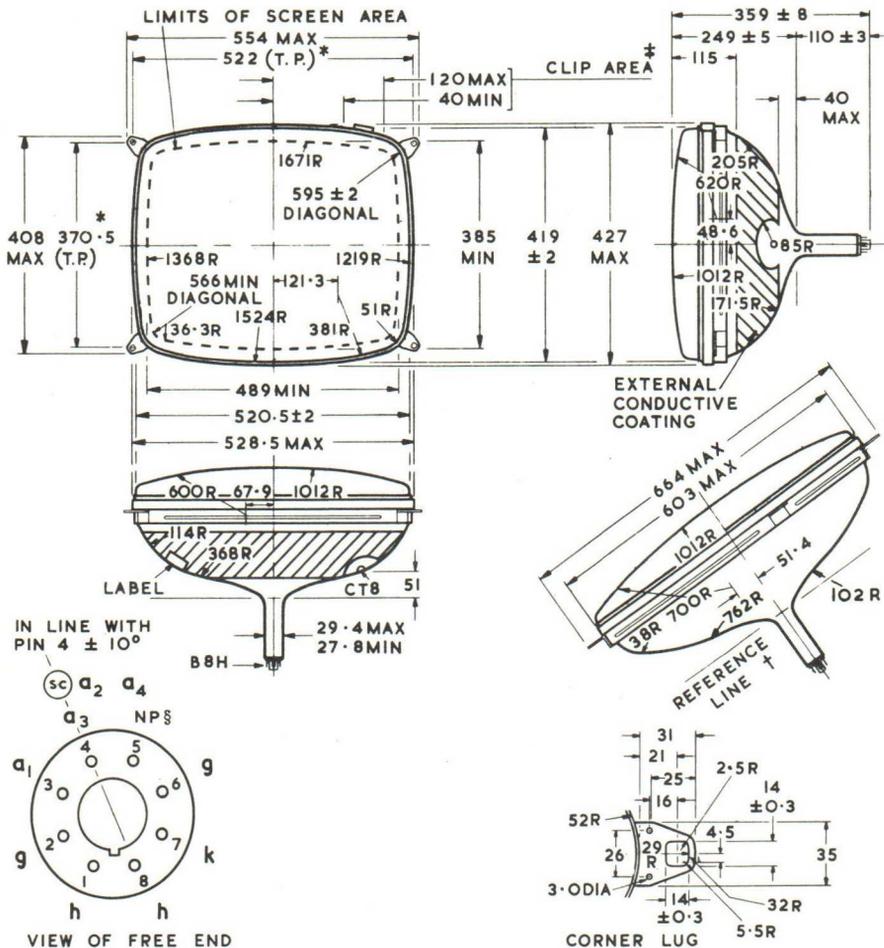
There is an annular region of anti-corona coating with external diameter of 100 mm surrounding the CT8 cap, the tube should not be handled in this region.

The tube can be mounted in any position. The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely. The bottom circumference of the base shell will fall within a circle of 40 mm diameter which is centred on the perpendicular from the centre of the face.

The external conductive coating ( $M_1$ ) of this tube should be connected to chassis. The capacitance between this coating and final anode may be used to provide smoothing for the e.h.t. supply.

The metal frame ( $M_2$ ) should be connected directly to the chassis in an a.c. receiver operating from an isolating transformer, or via a suitable leakage path in an a.c./d.c. receiver, for example 2 M $\Omega$ .

**TUBE WEIGHT** (approximate) - net 13.5 kg (30 lb)



All dimensions in mm

Not to be scaled

\* The bolts to be used for mounting the tube must lie within the circles of 9.5 mm diameter centred on these true positions (Diagonal=640mm). One of the four lugs may deviate 2.0 mm maximum from the plane through the other three lugs.

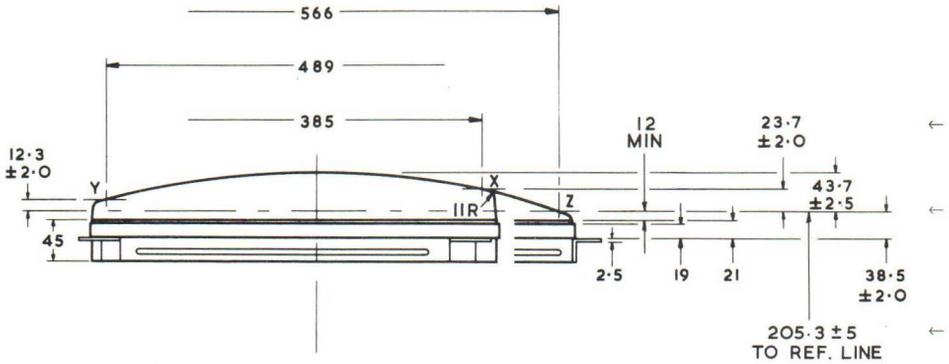
† Determined by reference line gauge No.16 (B.S.RL4 : IEC 67-1V-3 JEDEC 126 ).

‡ Total thickness of shell, tension bands and clip 8.0 mm maximum.

§ Pin 5 is included for Sparkguard R base and the common connection for the parallel spark gaps is made to this pin. For further details see separate sheet.

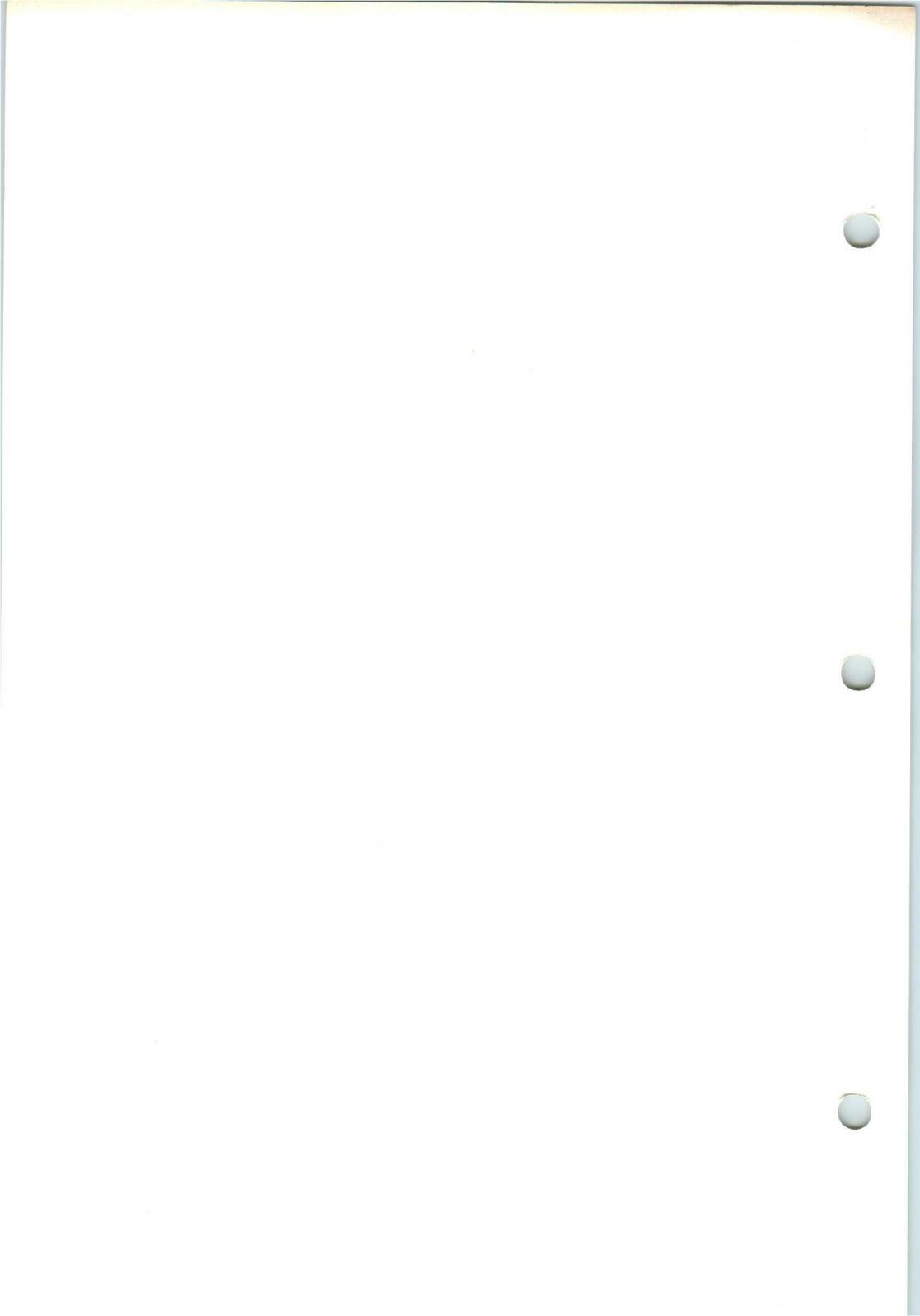
# Television Picture Tube

**CME2313**  
**A59-23W**



All dimensions in mm

Not to be scaled



### CRM172

#### MAGNETIC TELEVISION CATHODE RAY TUBE

Indirectly heated

#### GENERAL

The CRM172 has a 17" aluminised screen giving a black and white picture, and a grey face plate (light transmission 72%) enabling a high degree of contrast to be attained in the presence of incident light.

The tube is of the tetrode ion trap type and has an external conductive coating for E.H.T. smoothing purposes.

#### RATING

Heater Voltage	(volts)	$V_h$	12.6
Heater Current	(amps)	$I_h$	0.3‡
Maximum Final Anode Voltage	(kV)	$V_{a2(max)}$	16†
Minimum Final Anode Voltage	(kV)	$V_{a2(min)}$	10
Maximum First Anode Voltage	(volts)	$V_{a1(max)}$	400
Maximum Heater to Cathode Voltage—Heater Negative (DC)	(volts)	$V_{h-k(max)}$	180
Maximum Peak Heater to Cathode Voltage—Heater Negative (DC)	(volts)	$V_{h-k(pk)max}$	400§

‡ The Cathode Ray Tube heater should always be connected at the chassis end in a series heater chain.

† The maximum final anode voltage rating of 16 kV is a design centre rating. The absolute rating of 17.5 kV must not be exceeded.

§ Absolute Rating during a warming up period not exceeding 1 minute.

#### INTER-ELECTRODE CAPACITANCES (pF)

Grid/Earth	$c_{g-E}$	8.5*
Cathode/Earth	$c_{k-E}$	6.5*
Final Anode/External Conductive Coating (approx)	$c_{a2-M}$	1,400

## CRM172

## MAGNETIC TELEVISION CATHODE RAY TUBE

Indirectly heated

\* The capacitances include a "Cinch" wafer type duodecal holder.

"Earth" denotes the remaining earth potential electrodes, heater and shields connected to cathode.

DIMENSIONS

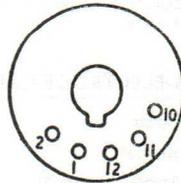
Maximum Overall Length	(mm)	501
Maximum Diagonal	(mm)	425
Maximum Height	(mm)	314
Maximum Width	(mm)	394
Maximum Neck Diameter	(mm)	35
Approximate Nett Weight	(lbs)	16
Approximate Packed Weight	(lbs)	23

TYPICAL OPERATION

Final Anode Voltage	(kV)	V <sub>a2</sub>	14-16
First Anode Voltage	(volts)	V <sub>a1</sub>	300
Grid Voltage for cut-off of raster (negative)	(volts)	-V <sub>g1</sub>	30-72
Average Peak to Peak modulating Voltage for modulation up to 150 $\mu$ A	(volts)		26.5

CAP—Cavity (CT8)

BASE—Duodecal (B12A)



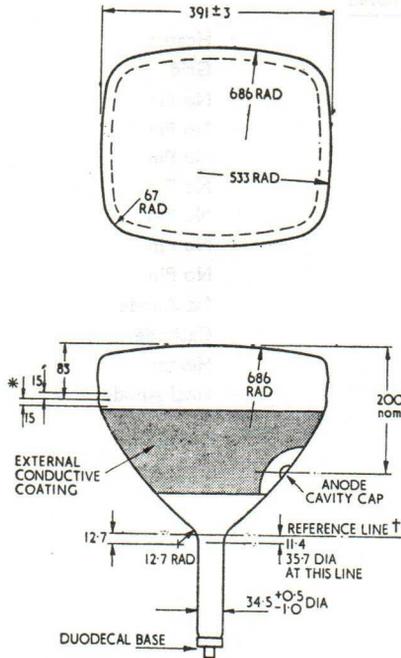
Viewed from free end of pins

**CRM172**  
**MAGNETIC TELEVISION CATHODE RAY TUBE**  
Indirectly heated

CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	No Pin	NP
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	1st Anode	a1
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Final Anode	a2

**CRM172**  
**MAGNETIC TELEVISION CATHODE RAY TUBE**  
 Indirectly heated



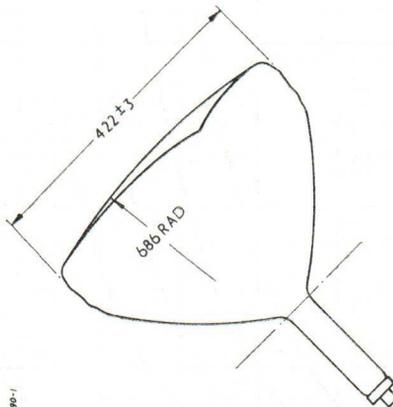
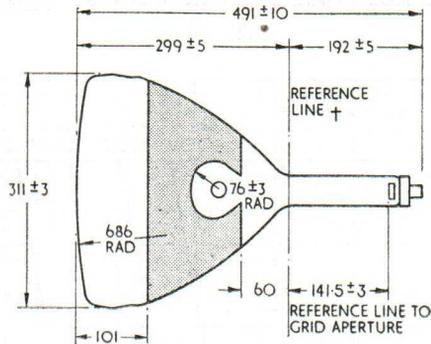
Anode Cap in line with Pin 6 position. Tolerance  $\pm 30^\circ$

**NOTE\***

During the face sealing operation the glass in this area (total 30mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material). All dimensions in mm. unless otherwise stated.

† Determined by Reference Line Gauge No. 7

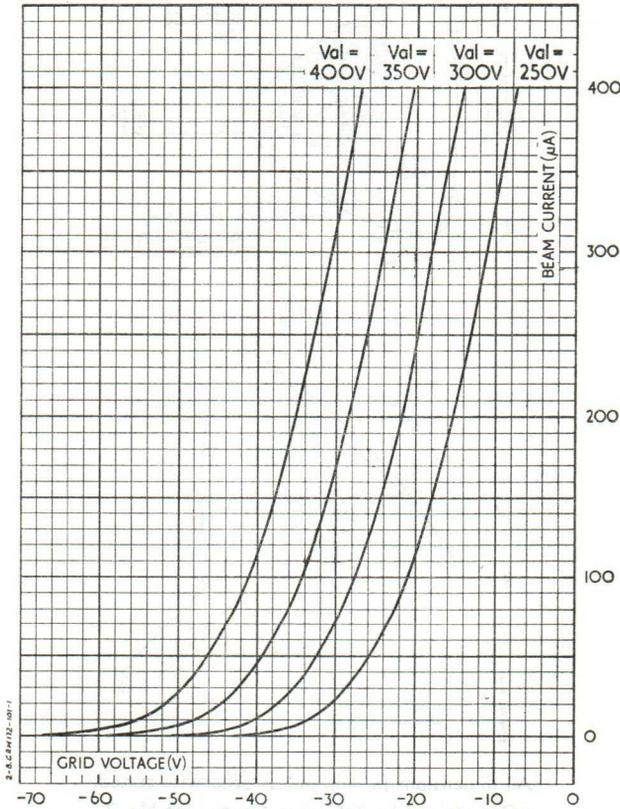
## CRM172 MAGNETIC TELEVISION CATHODE RAY TUBE Indirectly heated



All dimensions in mm. unless otherwise stated.  
† Determined by Reference Gauge Line No. 7

**CRM172**  
MAGNETIC TELEVISION CATHODE RAY TUBE  
Indirectly heated

AVERAGE CHARACTERISTIC CURVES:  $I_{beam}/V_g$   
 $V_{a2} = 14kV$



**CRM173**  
**MAGNETIC TELEVISION CATHODE RAY TUBE**  
 Indirectly heated



GENERAL

The CRM173 is a magnetic focus and deflection (90°) rectangular cathode ray tube designed for the reproduction of television pictures. The screen, which has a 17" diagonal, is coated with a compound giving a substantially black and white picture. The bulb interior is aluminised enabling a high degree of contrast to be attained, and the front face is of a grey glass having an average total light transmission at the centre of 72% to improve daylight viewing. The electron gun is of the Inclined Tetrode Ion Trap type, and an external conductive coating has been applied for use in smoothing the E.H.T. supply.

RATING

Heater Voltage	(volts)	$V_h$	12.6
Heater Current	(amps)	$I_h$	0.3*
Maximum Final Anode Voltage	(kV)	$V_{a2(max)}$	16†
Minimum Final Anode Voltage	(kV)	$V_{a2(min)}$	11
Maximum First Anode Voltage	(volts)	$V_{a1(max)}$	400
Maximum Heater to Cathode Voltage— (DC) Heater Negative	(volts)	$V_{h-k(max)}$	180
Maximum Peak Heater to Cathode Voltage— (DC) Heater Negative	(volts)	$V_{h-k(pk)max}$	400‡

\* The Cathode Ray Tube heater should always be connected at the chassis end in a series heater chain.

† Design Centre Rating, the Absolute Rating of 17.5 kV must not be exceeded.

‡ Absolute Rating during a warming up period not exceeding 1 minute.

Indicates a change ←

**CRM173**  
**MAGNETIC TELEVISION CATHODE RAY TUBE**  
 Indirectly heated

INTER-ELECTRODE CAPACITANCES (pF)

Grid/All other electrodes	c <sub>g-all</sub>	7.5
Cathode/All other electrodes	c <sub>k-all</sub>	6.5
Final Anode/External Conductive Coating (approx.)	c <sub>a2-M</sub>	1,100

These capacities include an Ediswan Clix duodecal holder type CRT93/5

DIMENSIONS

Maximum Overall Length	(mm)	427
Maximum Diagonal	(mm)	425
Maximum Height	(mm)	314
Maximum Width	(mm)	394
Maximum Neck Diameter	(mm)	38
Approximate Nett Weight	(lbs)	15
Approximate Packed Weight	(lbs)	22

TYPICAL OPERATION

Final Anode Voltage	(kV)	V <sub>a2</sub>	14-16
First Anode Voltage	(volts)	V <sub>a1</sub>	300
Grid Voltage for cut-off of raster	(volts)	V <sub>g</sub>	30-72
Average Peak to Peak modulating voltage for modulation up to 150 $\mu$ A	(volts)		26.5

ION TRAP MAGNET

An ion trap magnet having a field strength equivalent to 60 Gauss should be used with this cathode ray tube, situated so that the front edge of the magnet is approximately 5mm behind the grid plane, i.e., 141.5 mm from the Reference Line.

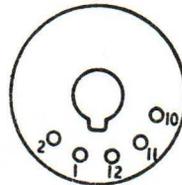
Indicates a change ←

**CRM173**  
MAGNETIC TELEVISION CATHODE RAY TUBE  
Indirectly heated



ANODE CAP—Cavity (CT8)

BASE—Duodecal (B12A)



Viewed from free end of pins

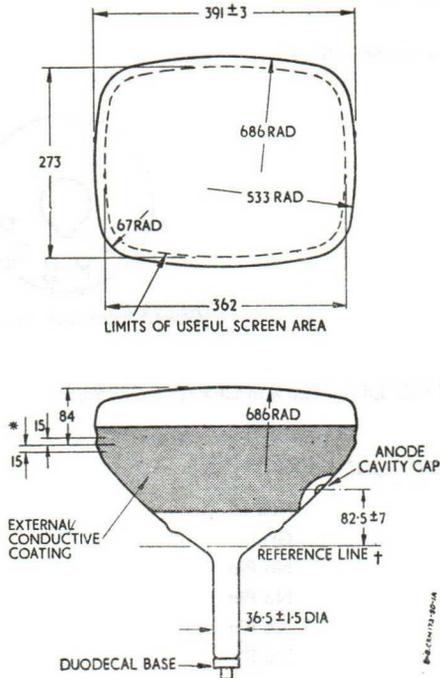
VALVE HOLDER—Ediswan Clix type CRT93/5

#### CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	No Pin	NP
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	First Anode	a1
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Second Anode	a2

Indicates a change ←

**CRM173**  
**MAGNETIC TELEVISION CATHODE RAY TUBE**  
 Indirectly heated



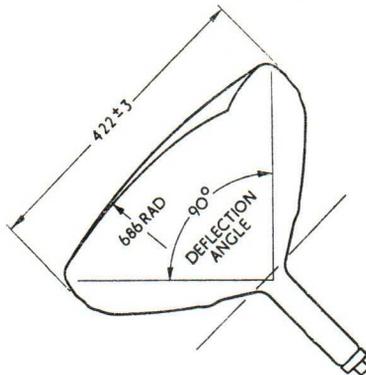
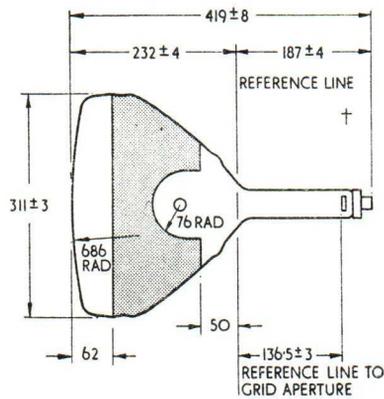
Anode cap in line with Pin 6. Tolerance  $\pm 30^\circ$

**NOTE\***

During the face sealing operation the glass in this area (total 30mm) may be disturbed. As the shape of the contour within this area may be either convex or concave the bulb should not be gripped within this region unless special precautions are taken (such as the use of resilient packing material). All dimensions in mm. unless otherwise stated.

† Determined by Reference Line Gauge No. 13

**CRM173**  
MAGNETIC TELEVISION CATHODE RAY TUBE  
Indirectly heated



24-CRM173-901/A

All dimensions in mm. unless otherwise stated.

$\dagger$  Determined by Reference Line Gauge No. 13

GRINTS  
 MAGNETIC TELEVISION CATHODE RAY TUBE  
 (Technical Drawing)



Fig. 1. Cathode ray tube.



Fig. 2. Cathode ray tube.

Technical drawing of a magnetic television cathode ray tube.

### CRM212

### MAGNETIC TELEVISION CATHODE RAY TUBE

Indirectly heated

#### GENERAL

The CRM212 is a magnetically focussed and deflected rectangular cathode ray tube designed for the reproduction of television pictures. The screen, which has a 21" diagonal, is coated with a compound giving a substantially black and white picture. The bulb interior is aluminised, enabling a high degree of contrast to be attained. The front face is of grey glass having an average total light transmission at the centre of 69%. A tetrode ion trap gun is incorporated. This tube has a layer of aquadag applied to a portion of the surface of the bulb, and this external conductive coating should be earthed; the capacitance formed by this coating and the final anode may be used to provide smoothing for the E.H.T. supply.

#### RATING

Heater Voltage (volts)	$V_h$	12.6
Heater Current (amps)	$I_h$	0.3
Maximum Final Anode Voltage (volts)	$V_{a2}$ (max)	*20,000
Minimum Final Anode Voltage (volts)	$V_{a2}$ (min)	14,000
Maximum First Anode Voltage (volts)	$V_{a1}$ (max)	400

\* 20kV is a design centre rating. The absolute rating of 22kV must not be exceeded.

#### INTER-ELECTRODE CAPACITANCES (pF)

†Grid/all other electrodes	$c_{g,all}$	8.5
†Cathode/all other electrodes	$c_{k,all}$	6.5
Final Anode/external conductive coating	$c_{a2,M}$	700 (approx.)

† These capacitances include a "Cinch" wafer duodecal holder.

## CRM212

MAGNETIC TELEVISION CATHODE RAY TUBE  
Indirectly heatedSCANNING ANGLE—90° (diagonal)DIMENSIONS

Maximum Overall Length (mm)	520
Maximum Diagonal (mm)	546
Maximum Height (mm)	419
Maximum Width (mm)	518
Maximum Neck Diameter (mm)	38

TYPICAL OPERATION

Final Anode Voltage (volts)	$V_{a2}$	16,000–18,000
First Anode Voltage (volts)	$V_{a1}$	300
Grid Bias for Cut-off of Raster (volts)	$V_g$	30–72
Average Peak to Peak Modulating Voltage for Modulation up to 150 $\mu$ A (volts)		26.5

If this tube is operated at voltages in excess of 16,000 X-ray radiation shielding may be necessary to avoid possible danger of personal injury from prolonged exposure at close range. The normal glass protective viewing window may provide such a safeguard. If the radiation measured in contact with this window does not exceed 0.5 milliroentgens per hour, the window will normally provide adequate protection.

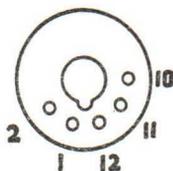
### CRM212

MAGNETIC TELEVISION CATHODE RAY TUBE

Indirectly heated

ANODE CAP—Cavity (CT8)

BASE—Duodecal (B12A).



Viewed from Free End of pins

### CONNECTIONS

Pin 1	Heater	h
Pin 2	Grid	g
Pin 3	No Pin	NP
Pin 4	No Pin	NP
Pin 5	No Pin	NP
Pin 6	No Pin	NP
Pin 7	No Pin	NP
Pin 8	No Pin	NP
Pin 9	No Pin	NP
Pin 10	First Anode	a <sub>1</sub>
Pin 11	Cathode	k
Pin 12	Heater	h
Cap	Final Anode	a <sub>2</sub>

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### REPLACEMENT TYPES

CATHODE RAY TUBES	RATING												
	Type	V <sub>h</sub> (Volts)	I <sub>h</sub> (Amps)	V <sub>a1</sub> (kV)	V <sub>a2</sub> (kV)	V <sub>g1</sub> (max) (Volts)	Deflection Angle						
<b>CRM91</b> 9" Triode	2	1-3	6 max	—	—	64°	<i>OBsolete</i>						
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(Cap)				
MO	h	NP	k	NP	g <sub>1</sub>	NP	NP	h	a <sub>1</sub>				
<b>CRM92/92A</b> 9" Triode	2	1-3	7 max	—	-100	57°	<i>OBsolete</i>						
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(Cap)				
MO	h	NP	k	NP	g <sub>1</sub>	NP	NP	h	a <sub>1</sub>				
<b>CRM93</b> 9" Tetrode	12-6	0-3	0-4 max	9 max 7-5 min	—	-125	57°	<i>OBsolete</i>					
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(Cap)
Duodecal	h	g <sub>1</sub>	NP	NP	NP	NP	NP	NP	a <sub>1</sub>	k	h	a <sub>2</sub>	
<b>CRM121/121A</b> 12" Triode	2	1-4	7-5 max	—	-100	—	<i>OBsolete</i>						
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(Cap)				
MO	h	NP	k	NP	g <sub>1</sub>	NP	NP	h	a <sub>1</sub>				
<b>CRM121B</b> 12" Triode	2	1-3	10 max	—	—	57°							
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(Cap)				
MO	h	NP	k	NP	g <sub>1</sub>	NP	NP	h	a <sub>1</sub>				
<b>CRM123</b> 12" Triode	2	1-3	10 max 7-5 min	—	—	57°							
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(Cap)				
MO	h	NP	k	NP	g <sub>1</sub>	NP	NP	h	a <sub>1</sub>				
<b>CRM124</b> 12" Tetrode	12-6	0-3	0-4 max	10 max 7-5 min	—	-125	57°	<i>OBsolete</i>					
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(Cap)
Duodecal	h	g <sub>1</sub>	NP	NP	NP	NP	NP	NP	a <sub>1</sub>	k	h	a <sub>2</sub>	

## REPLACEMENT TYPES

CATHODE RAY TUBES	RATING						Deflection Angle							
	Type	V <sub>h</sub> (Volts)	I <sub>h</sub> (Amps)	V <sub>a1</sub> (kV)	V <sub>a2</sub> (kV)	V <sub>g1</sub> (max) (Volts)								
<b>CRMI41/142</b> 14" Tetrode	12.6	0.3	0.4 max	14 max 8 min	—125	67°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) NP	(11) a <sub>1</sub>	(12) k	(Cap) h	a <sub>2</sub>
<b>CRMI43</b> 14" Tetrode	12.6	0.3	0.4 max	14 max 8 min	—125	70°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) NP	(11) a <sub>1</sub>	(12) k	(Cap) h	a <sub>2</sub>
<b>CRMI51</b> 15" Triode	2	1.3	13 max 9 min	—	—	51°								
Base Connections MO	(1) h	(2) NP	(3) k	(4) NP	(5) g <sub>1</sub>	(6) NP	(7) NP	(8) NP	(9) h	(10) a <sub>1</sub>	(11) (Cap)	(12)		
<b>CRMI52A</b> 15" Triode	2	1.4	13 max 9 min	—	—300	—								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) NC	(11) k	(12) h	(Cap) a <sub>1</sub>	
<b>CRMI52B</b> 15" Triode	2	1.3	13 max 9 min	—	—300	67°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) NC	(11) k	(12) h	(Cap) a <sub>1</sub>	
<b>CRMI53</b> 15" Tetrode	12.6	0.3	0.4 max	15 max 10 min	—125	67°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) a <sub>1</sub>	(11) k	(12) h	(Cap) a <sub>2</sub>	
<b>CRMI71</b> 17" Tetrode	12.6	0.3	0.4 max	16 max 10 min	—125	70°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) a <sub>1</sub>	(11) k	(12) h	(Cap) a <sub>2</sub>	
<b>CRM211</b> 21" Tetrode	12.6	0.3	0.4 max	18 max 14 min	—125	70°								
Base Connections Duodecal	(1) h	(2) g <sub>1</sub>	(3) NP	(4) NP	(5) NP	(6) NP	(7) NP	(8) NP	(9) NP	(10) a <sub>1</sub>	(11) k	(12) h	(Cap) a <sub>2</sub>	

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*Obsolete*

