

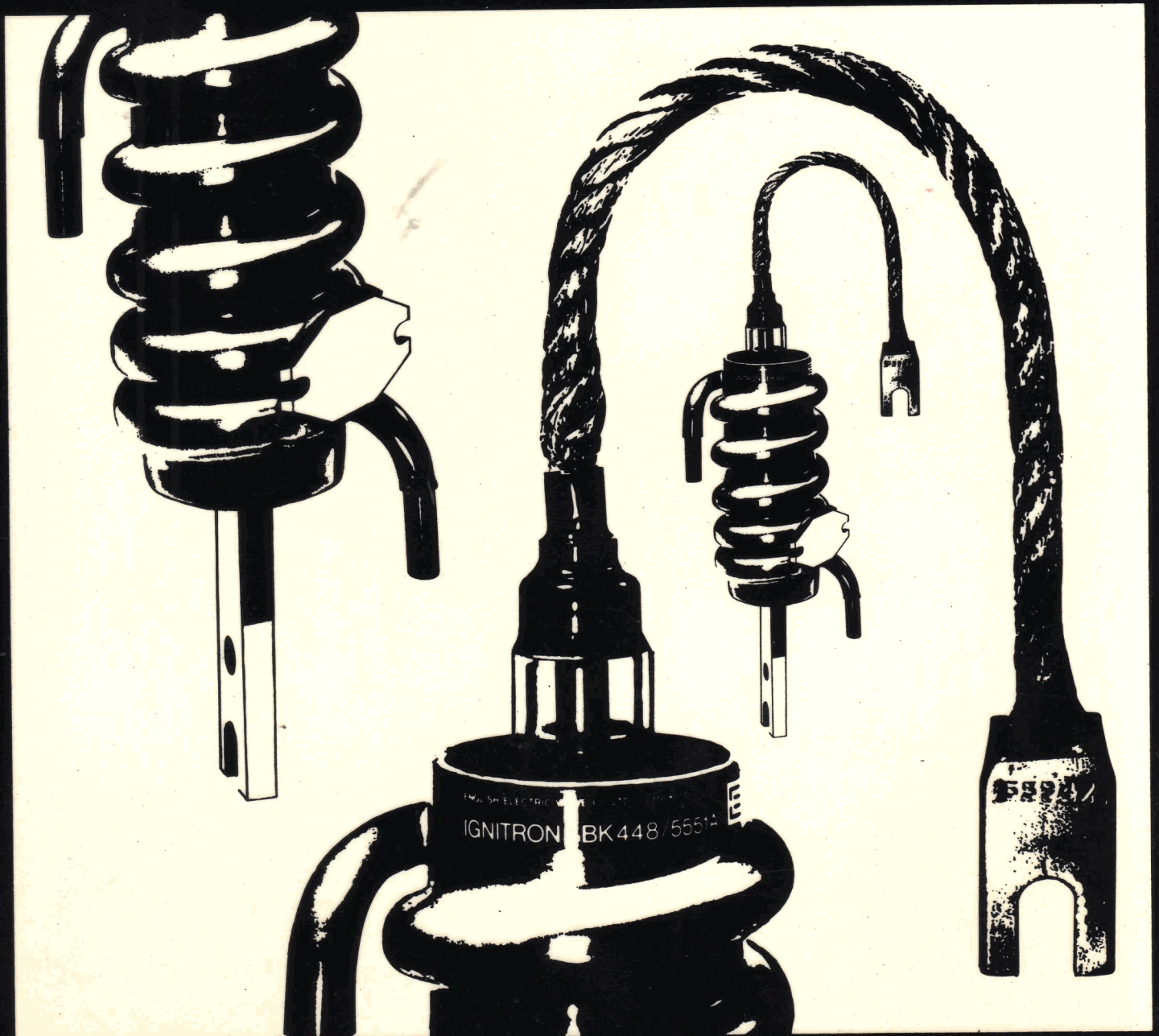
**ENGLISH  
ELECTRIC  
VALVE  
CO LTD**



**Ignitrons Rectifiers  
Industrial Thyratrons  
Voltage Stabilizers  
Other Products**

**Product  
Data**

**1971**



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**GENERAL SECTION**



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**IGNITRONS**



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**RECTIFIERS AND  
INDUSTRIAL THYRATRONS**



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**VOLTAGE STABILIZERS**



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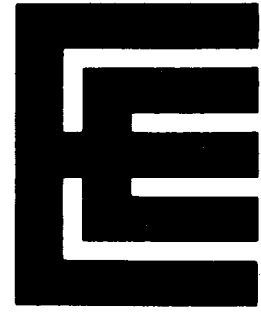
**OTHER PRODUCTS**



The Valve Data Book comprises ten bound volumes, made up as follows:

- **IGNITRONS**  
**RECTIFIERS**  
**INDUSTRIAL THYRATRONS**  
**VOLTAGE STABILIZERS**  
**OTHER PRODUCTS**
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- **MODULATORS**  
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**NOISE TUBES**
- **LIGHT CONVERSION DEVICES**  
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- **VACUUM CAPACITORS**

**These bound volumes** replace the previous loose-leaf books and will be **re-issued at intervals**. When the most recent data are required for equipment **design purposes**, the individual sheets should be obtained.



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**Ignitrons  
Rectifiers  
Industrial Thyratrons  
Voltage Stabilizers  
Other Products**

**English Electric Valve Company Limited**

Chelmsford, Essex, England CM1 2QU

Telephone: Chelmsford (0245) 61777

Telex: 99103 Telegrams: Enelectico Chelmsford

June 1971



# General Section



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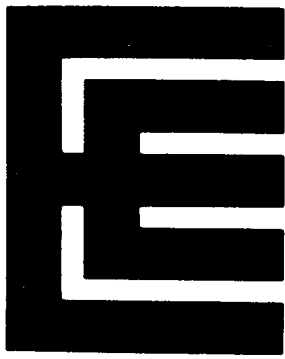
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# EQUIVALENTS INDEX

## IGNITRONS, RECTIFIERS INDUSTRIAL THYRATRONS COLD CATHODE TUBES

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
0A2	0A2	4H88A*	AH221
0A2WA	0A2WA	5H69R*	869B
0B2	0B2	6H51*	AH2511
0B2WA	0B2WA	7H57*	AH205/857B
0C2	0C2	11TA31*	0A2
0G3*	QS1209/5651	17	5557
1K24*	3B24W	21N13	5559
2G57	5557		BT5
2V/474C	AH238	24B1	24B9
2V/490C*	AH221	24B9	24B9
2V/500C	AH221	57	5559
2V/531E*	869B	75B1	QS75/20
3B24W	3B24W	75C1	75C1
3B29*	3B24W	85A2	QS1209/5651
3V/340B	BT19	90C1	QS1215
3V/390A	5559	95A1	QS95/10
3V/390B*	BT5	108C1	0B2
3V/490A*	BT17	150B2	QS1200
3V/500A*	BT95	150B3	QS150/15
4H73*	AH221	150C2	0A2

\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
150C4	150C4	4049D	AH221
272	5557	4078A*	869B
287A*	5557	4261	5557
309	5557	5550	BK66/5550
517	5557	5551A	BK42/5551A
575A*	AH2511	5552A	BK24/5552A
631*	5559	5553B	BK146/5553B
	BT5	5554	BK44/5554
632B*	5559	5555	BK46/5555
	BT5	5557	5557
651	BK24/5552A	5559	5559
652	BK42/5551A	5651*	QS1209/5651
656	BK24/5552A	5651WA	QS1212
657	BK42/5551A	5720*	5559
673*	AH2511	5728*	5559
676*	BT17	5822A	BK168/5822A
715	5557	5830*	BT69
857B*	AH205/857B	6031	5559
869B	869B	6073	0A2WA
967	5557	6074	0B2
1163	68506	6346*	BK42/5551A
1257	5559	6347*	BK24/5552A
1295*	5559	6348*	BK146/5553B
	BT5	6354	QS1200
3078A*	869B	6511*	BK168/5822A

\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
6512*	BK44/5554	AH213*	869B
6513*	BK46/5555	AH221	AH221
6626*	0A2WA	AH238	AH238
6627*	0B2WA	AH2511	AH2511
6693	AH2511	AJ5551	BK42/5551A
7669	BK442/7669	AJ5552	BK24/5552A
7671	BK444/7671	AJ6346*	BK42/5551A
7673	BK446/7673	AJ6347*	BK24/5552A
7703	7703	AR10T	BK24/5552A
38217	5557	AR14T	BK42/5551A
55306	ZD100551	AR31	BK66/5550
68506	68506	ASG5017	5557
A207	A207	BD10	BD10
A237	A237	BD12	BD12
A239	3B24W	BK24	BK24/5552A
A292	A292	BK24/5552A	BK24/5552A
AFX203	AFX203	BK42	BK42/5551A
AG869B	869B	BK42/5551A	BK42/5551A
AG5209	QS1209/5651	BK44	BK44/5554
AG5210	0B2	BK44/5554	BK44/5554
AG5211	0A2	BK46	BK46/5555
AH205	AH205/857B	BK46/5555	BK46/5555
AH205/857B	AH205/857B	BK66	BK66/5550
AH211	AH211A	BK66/5550	BK66/5550
AH211A	AH211A	BK146	BK146/5553B

\* Near equivalent

<b>Type to be replaced</b>	<b>EEV replacement</b>	<b>Type to be replaced</b>	<b>EEV replacement</b>
BK146/5553B	BK146/5553B	BS68	GXA80
BK168	BK168/5822A	BS90	GXA95
BK168/5822A	BK168/5822A	BS112	GXA60
BK178	BK178	BS136	GXE8
BK394	BK394	BS142	GXB160
BK396	BK472	BS192	GXF5
BK416	7703	BS208	GXE15
BK416/7703	7703	BS408	GXF15
BK428	BK472	BS422	GXF25
BK442	BK442/7669	BS436	GXF22
BK442/7669	BK442/7669	BS470	GXE30
BK444	BK444/7671	BS598	GXF17
BK444/7671	BK444/7671	BT5	BT5
BK446	BK446/7673	BT17	BT17
BK446/7673	BK446/7673	BT19	BT19
BK448/5551A	BK448/5551A	BT29	BT29
BK472	BK472	BT69	BT69
BK474	BK474	BT89	BT89
BK476	BK476	BT95	BT95
BK484	BK484	C1A*	AFX203
BK542/1081	BK542/1081	CE309	5557
BK544	BK544	CE869B	869B
BS4A	GXA160	CT1-500	BT19
BS5	GXA50	CT1-2500	5559
BS54	GXA85		BT5

\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
CV5	AH221	CV2109	BT89
CV233	GXA50	CV2124	BK24/5552A
CV284	QS75/20	CV2160	A207
CV286	QS95/10	CV2225	QS1200
CV287	QS150/15	CV2673	AH205/857B
CV295	GXA85	CV2775	68506
CV395	QS150/45	CV2858	3B24W
CV402	GXA80	CV2868	AFX203
CV422	QS108/45	CV2957	5557
CV434	QS75/60	CV4020	0A2WA
CV449	QS1209/5651	CV4028	0B2WA
CV482	A237	CV4048	QS1212
CV488	GXA95	CV4053	QS1203
CV532	AH211A	CV4054	QS1213
CV1144	BT19	CV4080	75C1
CV1147	BT5	CV4100	0A2WA
CV1420*	869B	CV4101	0B2WA
CV1435	AH221	CV5027	5559
CV1629	AH238	CV5083*	QS75/20
CV1742	BK44/5554	CV5141	BT95
CV1743	GXA60	CV5173	QS1215
CV1832	0A2	CV5285	QS1212
CV1833	0B2	CV5998	A292
CV1859	GXA160	CV6173	24B9
CV2012*	QS1209/5651	CV8051	A207

\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
CV8161	0A2	FG17	5557
CV8162	0B2	FG27A*	5559
CV8168	0A2WA	FG33	5559
CV8296	GXB160	FG57	5559
CV8766	0C2	FG81A*	BT89
DCG4/5000*	AH221	FG98A*	BT89
	AH238	FG235	BK24/5552A
DCG6-18	AH2511	FG238B	BK46/5555
DCG9-20*	869B	FG258A	BK146/5553B
DQ4*	AH238	FG271	BK42/5551A
DQ4a*	AH221	G40*	869B
DQ6	869B	G100A*	AH205/857B
DQ7*	AH205/857B	G180/2M	QS150/45
DR857B*	AH205/857B	GD75P*	75C1
DR869B	869B	GD85M/S	QS1209/5651
EE17	5557	GD85PR/S	QS1212
EE869B	869B	GD90M	QS1215
ESU77*	A207	GD150M	150C4
ESU111*	869B	GD150M/S	0A2
ESU150*	AH238	GD150P/S	QS1200
ESU200*	AH221	GL57	5559
F60	68506	GL678*	BT95
F575A*	AH2511	GL857B*	AH205/857B
F857B*	AH205/857B	GL869B	869B
F869B	869B	GL5550	BK66/5550

\* Near equivalent

<b>Type to be replaced</b>	<b>EEV replacement</b>	<b>Type to be replaced</b>	<b>EEV replacement</b>
GL5551A	BK42/5551A	GX/SG15	GX/SG15
GL5552A	BK24/5552A	GXA50	GXA50
GL5553B	BK146/5553B	GXA60	GXA60
GL5554	BK44/5554	GXA80	GXA80
GL5555	BK46/5555	GXA85	GXA85
GL5720	5559	GXA95	GXA95
GL5822A	BK168/5822A	GXA160	GXA160
GL7669	BK442/7669	GXB160	GXB160
GL7671	BK444/7671	GXE8	GXE8
GL7703	7703	GXE15	GXE15
Gle15000/1.5/6*	AH238	GXE30	GXE30
Gle15000/3/12	AH2511	GXF5	GXF5
Gle20000/2.5/10*	869B	GXF15	GXF15
GTR95M/S	QS95/10	GXF17	GXF17
GTR150M/S	QS150/15	GXF22	GXF22
GU18	AH238	GXF25	GXF25
GU20/21	AH221	M8098	QS1212
GU23*	AH221	M8142	QS1213
GX/SG4	GX/SG4	M8223	0A2WA
GX/SG5	GX/SG5	M8224	0B2WA
GX/SG10	GX/SG10	ME1504	5559
GX/SG11	GX/SG11	ME1505	BT19
GX/SG12	GX/SG12	ML857B*	AH205/857B
GX/SG13	GX/SG13	ML869B	869B
GX/SG14	GX/SG14	MT17	5557

\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
MT57	5559	PL5557	5557
MT5557	5557	PL5559	5559
MT5559	5559	PL5822A	BK 168/5822A
NFT1	NFT1	QS75/20	QS75/20
NFT2	NFT2	QS75/60	QS75/60
NFT3	NFT3	QS83/3	QS1209/5651
NFT4	NFT4	QS95/10	QS95/10
NFT5	NFT5	QS108/45	QS108/45
NL715	5557	QS150/15	QS150/15
NL1022A	BK 168/5822A	QS150/45	QS150/45
NL1051A	BK42/5551A	QS1200	QS1200
NL1052A	BK 24/5552A	QS1203	QS1203
NL1053A	BK 146/5553B	QS1207	0A2
NL1061	BK 442/7669	QS1208	0B2
NL1062	BK 444/7671	QS1209	QS1209/5651
NL1063*	BK 446/7673	QS1209/5651	QS1209/5651
NL1081	BK 542/1081	QS1210	0A2WA
NL5550	BK 66/5550	QS1211	0B2WA
PL17	5557	QS1212	QS1212
PL57	5559	QS1213	QS1213
PL255*	BT29	QS1215	QS1215
PL5551A	BK42/5551A	QT1256	QT1256
PL5552A	BK 24/5552A	QT1257	QT1257
PL5553B	BK 146/5553B	RG3-1250	AH238
PL5555	BK 46/5555	RG4-1250	AH221

\* Near equivalent



Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
RG4-3000	AH2511	TQ2*	5557
RL17	5557	TT17	5557
RL57	5559	TX920	5559
Ste1000/2.5/15	5559	UE967	5557
Ste2500/05/2	5557	WL575A*	AH2511
StR85/10*	QS1209/5651	WL624*	BT17
StR108/30*	0B2	WL632B*	5559
StR150/30*	0A2		BT5
STV85/10	QS1209/5651	WL651/656	BK 24/5552A
STV108/30	0B2	WL652	BK 42/5551A
STV150/30	0A2	WL655	BK 146/5553B
T149*	BT17	WL681*	BK 66/5550
TH3B24W	3B24W	WL857B*	AH205/857B
TH5040	869B	WL869B	869B
TH6011	5557	WL5550	BK 66/5550
TH6031	5559	WL5551A	BK 42/5551A
TH6120*	BT17	WL5552A	BK 24/5552A
TH7010	BK 66/5550	WL5553B	BK 146/5553B
TH7020	BK 42/5551A	WL5559	5559
TH7021*	BK 42/5551A	WL7669	BK 442/7669
TH7030	BK 24/5552A	WL7671	BK 444/7671
TH7031*	BK 24/5552A	WL7673	BK 446/7673
TH7040	BK 146/5553B	WT-210-0015	5557
TH7041*	BK 146/5553B	WT-210-0051	0A2
TH7050	BK 472	WT-210-0056	5559

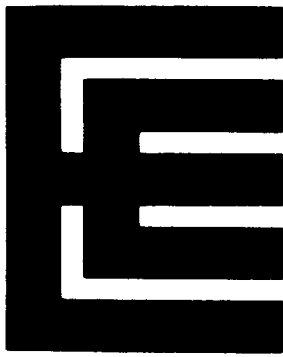
\* Near equivalent

Type to be replaced	EEV replacement	Type to be replaced	EEV replacement
WT-210-0069	5557	WT-210-0249	BK42/5551A
WT-210-0070	BK66/5550	WT-210-0252	BK24/5552A
WT-210-0071	BK42/5551A	WT-210-0285	BK444/7671
WT-210-0072	BK24/5552A	WT-210-0290	BK442/7669
WT-210-0073	BK146/5553B	WT-210-0306	BK146/5553B
WT-210-0075	BK168/5822A	WTT111	5559
WT-210-0147	BK24/5552A	WTT117	5557
WT-210-0149	BK42/5551A	XG1-2500	5559
WT-210-0152	BK146/5553B	XG2-12*	BT29
WT-210-0170	BK168/5822A	XG2-500	BT19
WT-210-0274	BK442/7669	XG2-6400*	BT17
WT-210-0275	BK444/7671	XG5-500	5557
WT-210-0156	BK42/5551A	XG15-12	BT69
WT-210-0157	BK24/5552A	ZX1051	BK42/5551A
WT-210-0158	BK42/5551A	ZX1052	BK24/5552A
WT-210-0159	BK24/5552A	ZX1053	BK146/5553B
WT-210-0165	BK146/5553B		

\* Near equivalent



**Ignitrons**



### A.C. RESISTANCE WELDING

EEV type	Size	Single-phase service‡			Three-phase service (at 1500V peak)	
		Maximum demand (kVA)	Corres- ponding average anode current (A)	Maximum average anode current (A)	Maximum peak anode current (A)	Corres- ponding average anode current (A)
<b>BK24/ 5552A</b>	C	1200	75.6	140	—	—
<b>BK42/ 5551A</b>	B	600	30.2	56	480	4.0
<b>BK66/ 5550</b>	A	300	12.1	22.4	—	—
<b>BK146/ 5553B</b>	D	2400	192	355	2400	32
<b>BK168/ 5822A</b>	C	—	—	—	1200	16
<b>BK442/ 7669</b>	B	Coaxial version of BK42/5551A				
<b>BK444/ 7671</b>	C	Coaxial version of BK24/5552A				
<b>BK446/ 7673</b>	D	Coaxial version of BK146/5553B				
<b>BK448/ 5551A</b>	B	Version of BK42/5551A with helical cooling				
<b>BK542/ 1081</b>	B	1000	43	75	—	—

‡ Ratings are for two tubes in inverse parallel, at any voltage from 250 to 600V<sub>r.m.s.</sub>  
Ignitor requirements (anode firing) 12A, 200V, for all types.

## POWER RECTIFICATION AND CONTROL

EEV type	Size	Maximum peak anode current (A)	Maximum average continuous current (A)	Maximum peak auxiliary anode current (A)	Maximum average auxiliary anode current (A)
BK44/5554	C	900* 600†	100* 75†	30	9.0
BK46/5555	D	1800* 1200†	200* 150†	30	9.0

## CAPACITOR DISCHARGE, PULSE DUTY

EEV type	Size	Maximum Ratings			
		Peak forward or inverse anode voltage (kV)	Peak anode current (kA)	Mean anode current (A)	Ampere-seconds per pulse (A.s)
7703‡	A	20	100	0.75	10
BK178	D	20	100	40	200
BK394	C	25	100	10	50
BK472**	A	20	100	0.75	10
BK474††	A	20	100	0.75	10
BK476‡‡	A	20	100	0.75	10

\* At peak anode voltage (forward and inverse) = 900V.

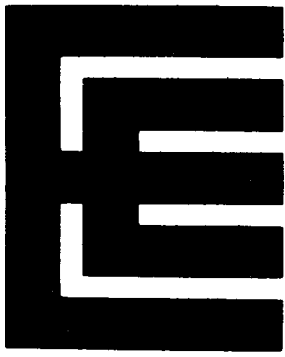
† At peak anode voltage (forward and inverse) = 2100V.

‡ For use with high voltage and high current reversal.

\*\* For reduced degree of current reversal and switching applications.

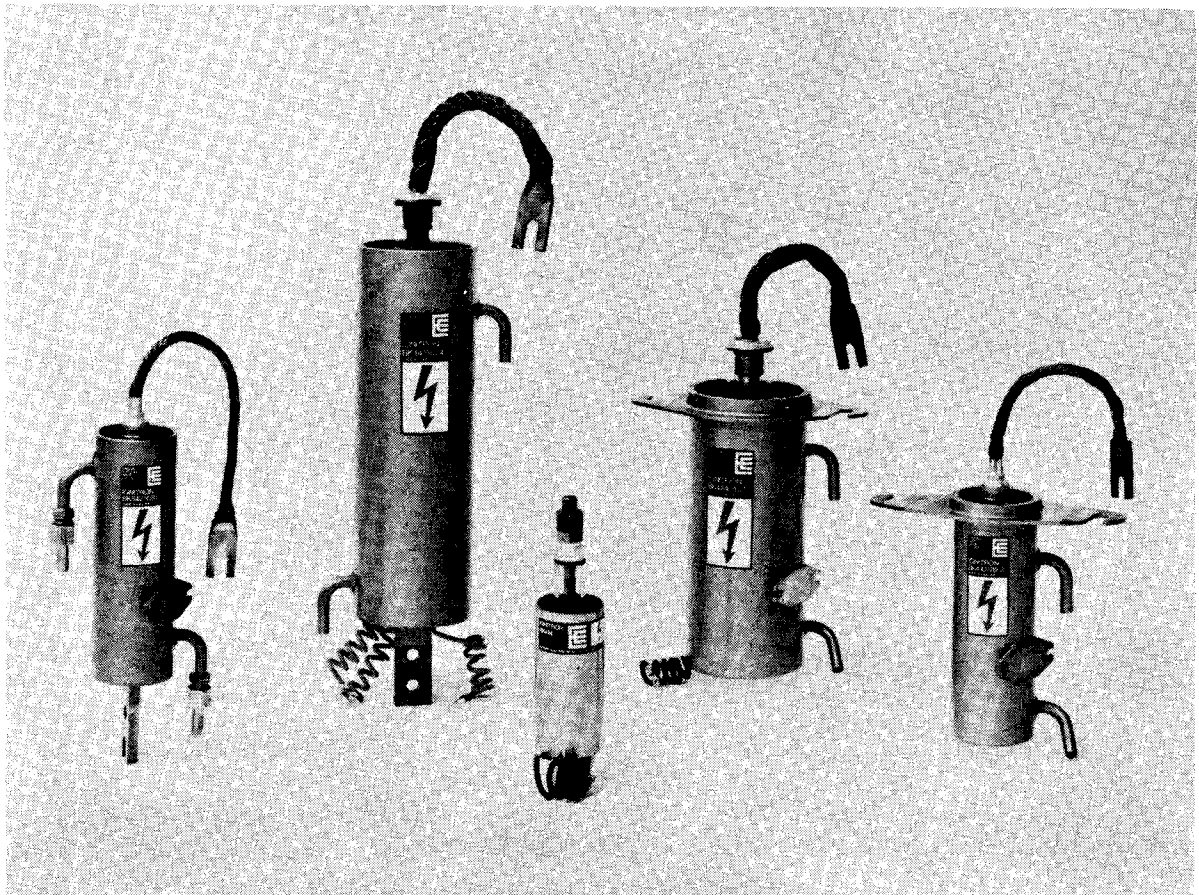
†† For current reversal at reduced voltage and current.

‡‡ For zero current reversal



### INTRODUCTION

The ignitron is a high-current rectifier with a mercury pool cathode, usually in a water-cooled steel envelope. In its simplest form it consists of a cylindrical vacuum envelope with a heavy anode supported from the top by a glass insulator and a small ignitor electrode, also glass-insulated, dipping into the mercury pool at the bottom. For some applications, tubes may be provided with additional ignitors, auxiliary anodes and internal baffles.



A selection from the range of EEV ignitrons

Ignitrons are used in applications calling for high current levels, particularly in resistance welding and high power rectification, where the high efficiency, long life and ease of control of these tubes are of great value. There are also types intended for very high current single-pulse operation such as discharging capacitor banks; these are used to pulse particle accelerator magnet coils, for electro-magnetic forming of metals, and similar applications.

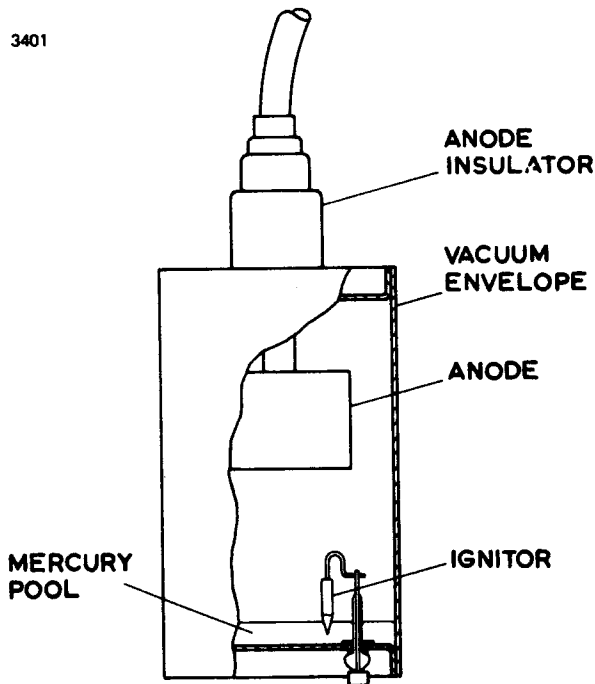
## SIZE CLASSIFICATION

Ignitrons are usually classified into groups according to size, as determined by the body diameter. The groups are identified by letters as follows.

Size	A	B	C	D	E
Approximate diameter in inches	2	2 $\frac{3}{4}$	4	5 $\frac{1}{2}$	9

## PRINCIPLES OF OPERATION

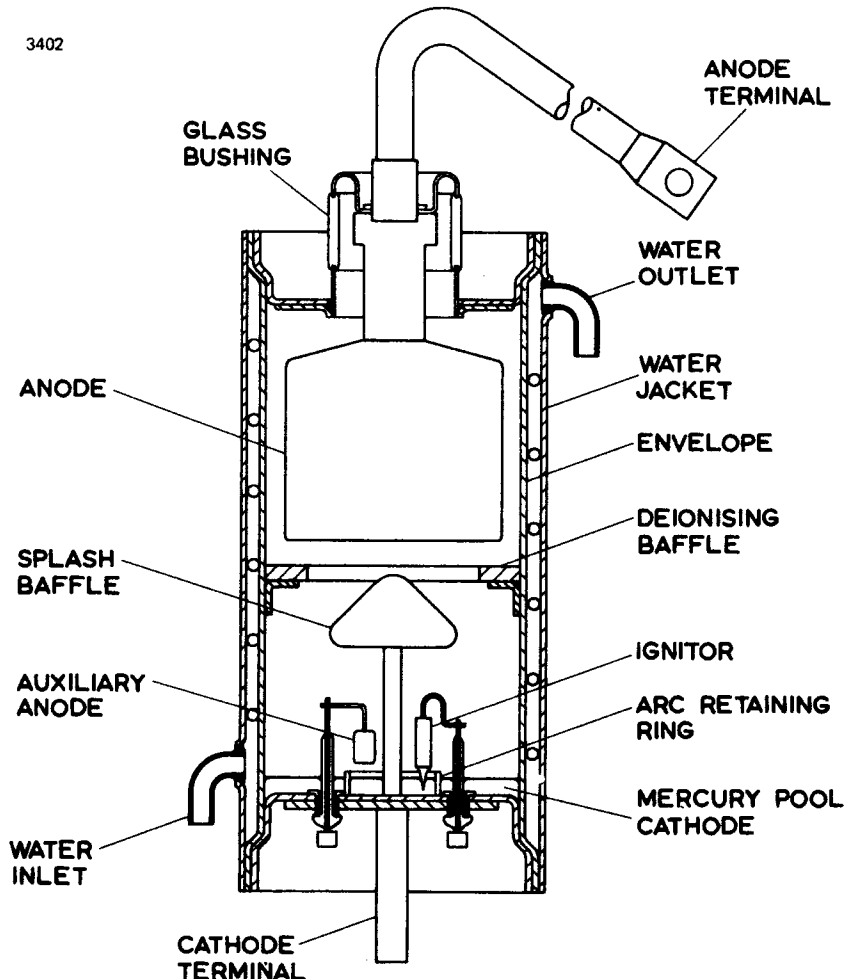
The ignitron operates as a controlled rectifier. The action is similar to a thyatron in that a control signal is needed to start conduction, which then continues until the current falls to zero. Where the tube is operating as an a.c. rectifier it conducts during one half-cycle of the supply frequency and must be ignited every alternate half-cycle for as long as it is required to conduct.



**Fig. 1** Essential components of a simple ignitron

The ignitor is a small rod of semi-conducting material, with a pointed end dipping into the cathode pool. When a suitable current pulse is passed through the ignitor-mercury junction, the ignitor being positive, a cathode spot is formed on the surface of the mercury and free electrons are emitted. If the anode is sufficiently positive with respect to cathode at this time, an arc will form between cathode and anode. Once the arc has struck the ignitor has no further control and the tube continues to conduct until the voltage across it falls below the ionization potential of the mercury vapour.

The internal construction of an ignitron varies according to the application for which it is intended. Tubes used in single-phase welding control equipment need only the basic elements shown in Fig. 1, but other applications usually require additional components. In a three-phase welding control circuit, the ignitron must de-ionize quickly in order to hold off the high inverse voltage which immediately follows the conduction cycle. This is accomplished by including a baffle which operates at cathode potential; no additional connections are involved but the voltage drop across the tube is increased slightly.



**Fig. 2** Cross-section of a rectifier ignitron

For power rectification at higher voltages, more elaborate baffles may be used and an auxiliary anode is also provided. The auxiliary anode is used to strike a small arc in a low-voltage circuit separate from the main load. This maintains the cathode spot at low load currents, ensuring stable operation under these conditions. Power rectifier service places a continuous heavy load on the ignitor, and ignitrons intended for this duty are normally fitted with two ignitors which may be used in succession, although both tend to deteriorate together.

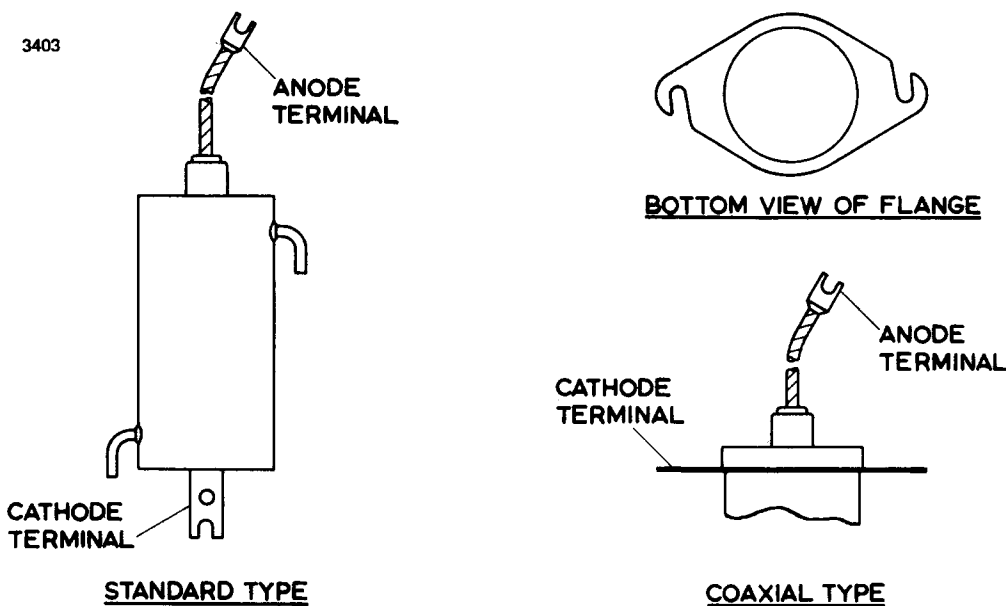


The large tubes designed for single-pulse operation are also fitted with two ignitrons and an auxiliary anode which may be used to prolong the ignition arc. Little or no baffling is used so as to keep the arc voltage drop as low as possible.

### STORAGE, INSTALLATION AND MAINTENANCE

Where ignitrons are to be stored for extended periods, they should be kept in the original packing under dry conditions. All high voltage ignitrons should be kept upright at all times, to prevent mercury reaching the upper parts of the tube which may subsequently cause voltage breakdown. It is particularly important that high voltage ignitrons should not be inverted after they have been used, as there is a danger of the mercury leaving a conducting film on the glass. It is not harmful to invert a new ignitron and no damage will be done provided the anode end is warmed before use. This precaution is not necessary unless the tube is to be operated at a voltage above 600V<sub>r.m.s.</sub>

When an ignitron is being installed, or handled for any other reason, it should be remembered that it has at least two glass-to-metal seals. Any excessive shock to the ignitron, or strain on the terminals, might fracture the glass and admit air which would destroy the tube.



**Fig. 3** Standard and coaxial type cathode terminals

Ignitrons are normally mounted by the cathode terminal; the latter may be either a heavy metal bar extending downwards from the base of the tube or, on alternative coaxial types, a slotted flange at the top of the envelope (see Fig. 3). In the coaxial type, the current flows via the arc from anode to

cathode, then returns up the wall of the envelope to the cathode terminal. This has the effect of neutralizing the magnetic field which would otherwise tend to deflect the arc towards the envelope walls at high peak currents.

All types of ignitron should be mounted in a vertical position, within  $3^\circ$ , to ensure correct operation. It is essential that the connections to anode and cathode have very low resistance, owing to the large currents carried. The contact areas should be cleaned when a tube is installed, and the terminals securely bolted together. Shakeproof washers or nuts should be used, in case of vibration in the equipment.

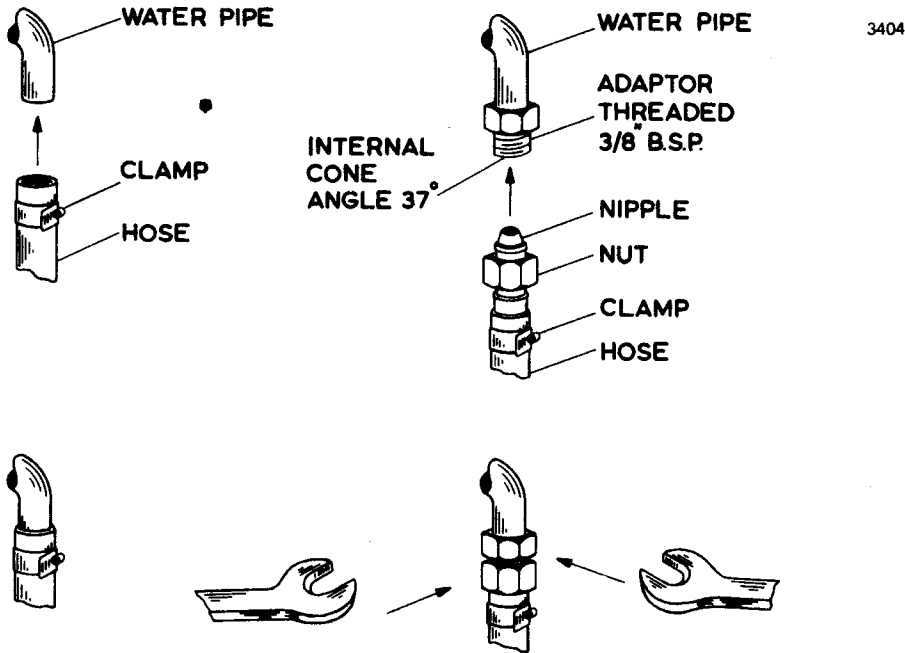
Ignitrons used for capacitor discharge require special attention when first installed in an equipment. Since these tubes may have to hold off very high voltages, it is particularly important that there should be no mercury condensed in the region of the anode seal. This is ensured by maintaining the seal region at a temperature well above that of the rest of the ignitron not only for a period before operation but also while the equipment is operating and during short shut-down periods. A newly installed tube should also be aged, after heating the anode seal, to hold off a voltage higher than the working voltage of the equipment. Details of this process are given in individual data sheets.

An ignitron should not normally require any maintenance. If deposits of carbonate scale or silt collect in the water jacket they can be cleaned with acetic acid diluted at 50%. The normal precautions should be taken when handling acids, such as the use of rubber gloves and goggles, and the acid should be poured slowly into the water jacket as there might be extensive bubbling at first. After cleaning wash out the water jacket very thoroughly with clean water and test with litmus until all acid is removed.

## COOLING

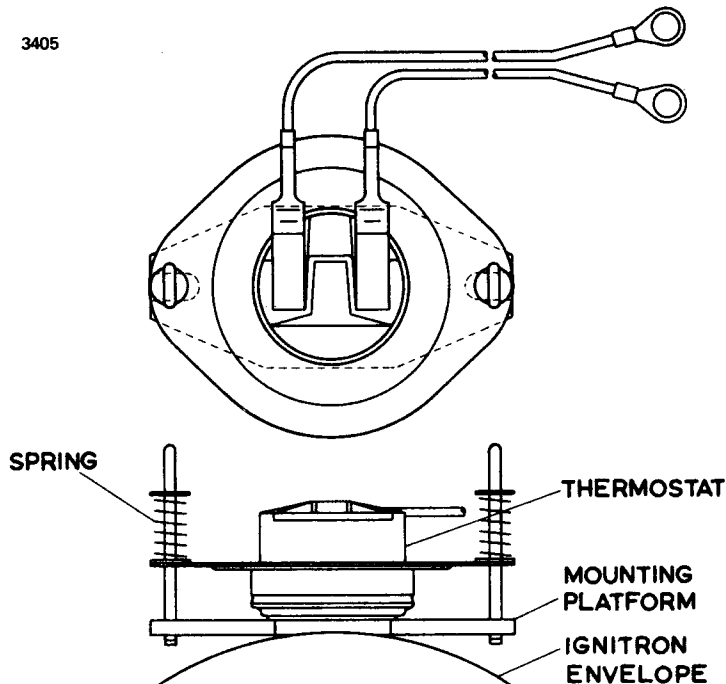
The water for cooling ignitrons must be clean and free from corrosive chemicals. Tap water suitable for drinking is normally satisfactory. The stainless steel used for the ignitrons resists corrosion because of a passive oxide film which is formed on the surface. If the film is broken corrosion can occur, but provided oxygen is present the film is capable of being repaired. Sometimes the attack is very localized and small pits are formed which may fairly quickly lead to perforation. This is because the water in a pit is not circulating properly, and becomes stagnant and low in oxygen. Halogen ions and especially chlorides tend to cause pitting, and are probably the most harmful of the impurities commonly present. Chloride ion concentrations exceeding 20 parts per million are likely to cause corrosion of the water jacket. It is advisable to fit a filter in the water system as deposits of dirt or silt will result in pockets of stagnant water being formed, and these may lead to pitting. In extreme cases dirt may cause a blockage and prevent proper circulation of the water. If a suitable water supply is not available, then a closed circuit system should be used with a heat exchanger.

Two types of water connector as shown in Fig. 4 are used on EEV ignitrons, either a plain pipe or a screwed union being available as required.



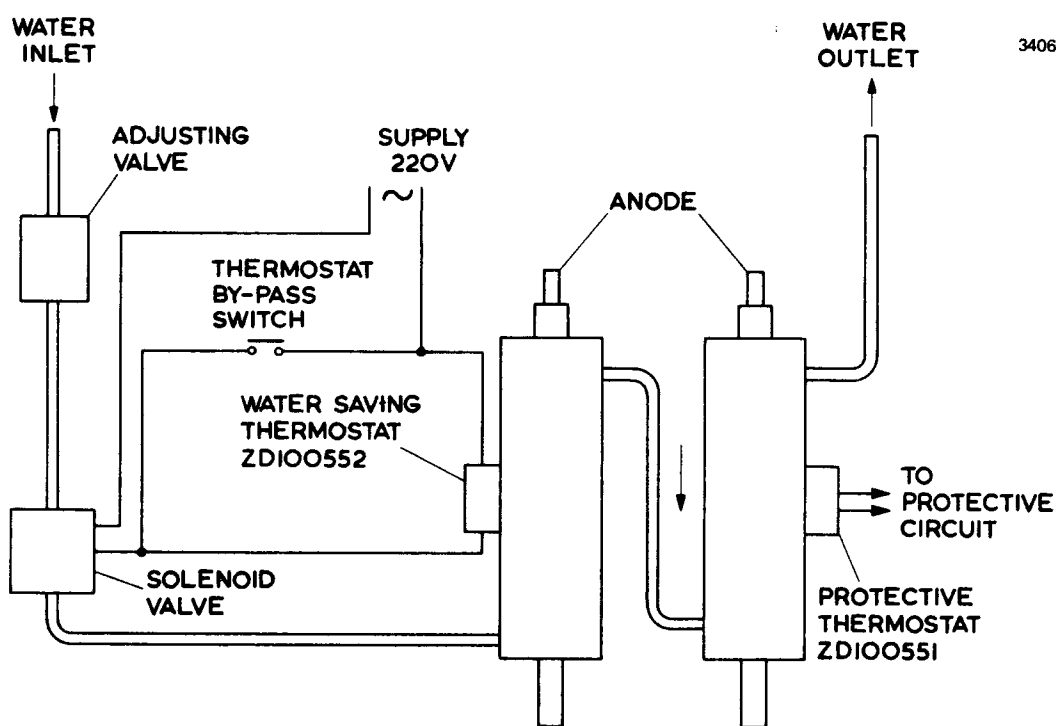
**Fig. 4** Alternative water connections

The normal circuit arrangement results in the water jackets being at mains voltage with respect to earth; therefore connections to the water supply must be made via insulating tubing. Up to three water jackets may be connected in series, provided the outlet water temperature does not exceed the rated value.



**Fig. 5** Thermostat mounting arrangement

Ignitrons designed for use in welders, where the operation may be of an intermittent nature, are usually fitted with a thermostat mounting platform. This is a metal plate attached to the side of the tube and making good thermal contact with the inner vacuum envelope. A thermostat mounted on this platform may be used to switch on the water flow when the tube reaches a certain temperature and the water saving can be appreciable. To guard against overheating, which would result from blockages or failures in the water supply, another thermostat is used to switch off the mains voltage before the temperature reaches a dangerous level. In a typical welder the water jackets of two or three tubes are connected in series and the over-temperature protection thermostat is mounted on the last tube in the line (the hottest). Only one thermostat can be fitted to each tube.



**Fig. 6** Typical cooling system

There is a short time-lag in the operation of the thermostat, and if the equipment is switched on at full load while the water jacket is empty the ignitron may be damaged before the thermostat can operate. This can happen when a tube is removed from the equipment for checking or replacement, or if the water outlet position is such that the contents of a water jacket can be siphoned out when the water is turned off. Since the water control valve is operated by the water saving thermostat, it prevents an immediate flow of water when the equipment is switched on from cold, and other means must be provided to fill the water jackets before the equipment is switched on. When an ignitron is operating near maximum ratings, the anode may become red-hot. If the flow of cooling water is stopped simultaneously with switch-

ing off the load, the heat stored in the hot anode may be sufficient to damage the tube. The data sheet for each ignitron type gives a minimum time for which the water flow must be maintained after switching off.

## **RATINGS •**

The method used to determine the ratings of an ignitron varies according to the application and it is necessary to consider the various types separately. It must be understood that the ratings given in individual data sheets are absolute limits. They are not design centre ratings and it is the responsibility of the equipment designer to ensure that they cannot be exceeded under the worst possible conditions of component tolerance, mains voltage fluctuation and load variation. Transient over-voltages in the mains supply may be neglected unless the contrary is stated.

### **Single-phase Welding Control**

Ignitrons for this application normally have non-simultaneous maximum ratings for average anode current and demand kVA. These ratings are shown in graphical form in the data sheets, the region enclosed by the line being the permitted operating area. Another graph is used to relate the maximum ratings for line demand current and duty cycle at various voltages.

In cases where phase control is used, the average anode current must be calculated for the full-cycle conduction condition, even if it is not used in practice, and the duty cycle is to be defined as the percentage of supply frequency cycles during which conduction occurs. The reason for this is that delayed firing of an ignitron in the usual inverse parallel welding circuit applies a high inverse voltage to the other tube, which has just ceased conducting. In order to compensate for the increased risk of arc-back it is necessary to de-rate the tubes under these conditions and this is done by requiring full-cycle conduction to be assumed in calculations.

### **Three-phase Welding Control**

In this case there are non-simultaneous maximum ratings for peak anode current and average anode current, and a graph is provided in the data sheets to show the permitted operating area.

### **Power Rectifiers**

These ignitrons have maximum peak and average anode current ratings given for two values of peak anode voltage. Short-period average anode current ratings are also quoted. Tubes designed for power rectifier service may also be used for resistance welding control at high voltages, and the ratings quoted for this purpose are applied in the same way as those for the normal welder ignitrons.

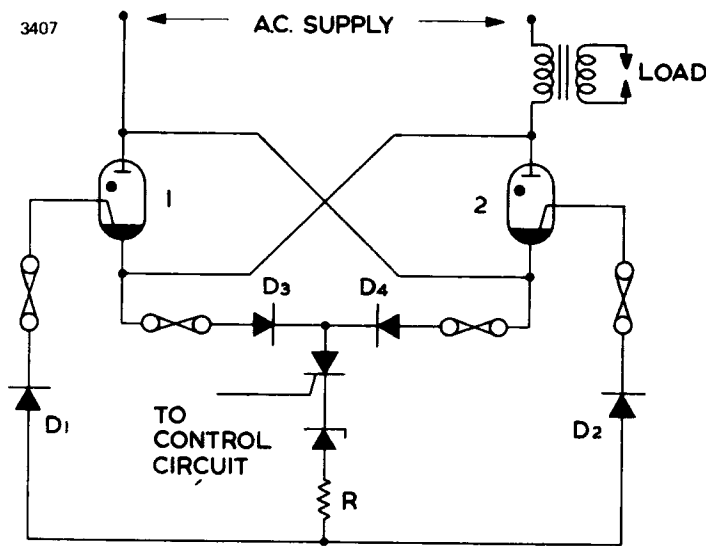
## Capacitor Discharge

The maximum coulomb-per-second transfer capability of the ignitron is basically constant. In uni-directional current applications, this capability is defined by specifying the maximum average anode current and the averaging time. In applications with current reversal (ringing), it is more convenient to specify the maximum energy that can be switched per minute as a function of peak anode voltage and percentage reversal. A maximum peak anode current rating is also given.

## IGNITOR FIRING

### Anode Firing

This is the less expensive form of ignitor control and is used in most welder circuits. Fig. 7 shows a typical single phase welder circuit with a thyristor used as the control switch. In this circuit, as the anode of ignitron 1 goes



Supply voltage (r.m.s.)	250	440	600	1000	2000	2500	volts
Resistance R	2	3	4	10	35	50	ohms

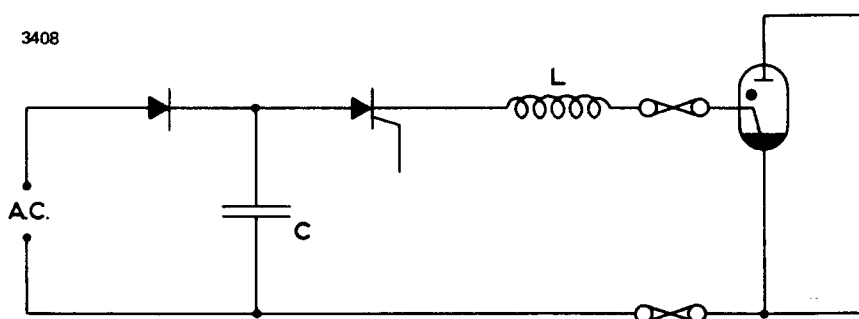
**Fig. 7** Single phase welder circuit, with SCR ignitor firing

positive, current may flow via D<sub>4</sub>, the thyristor, the zener diode and D<sub>1</sub> to the ignitor of ignitron 1. By controlling the gate voltage of the thyristor the firing can be stopped completely or delayed to any desired point in the positive half cycle. On the succeeding half cycle the process is repeated through D<sub>3</sub>, D<sub>2</sub> and ignitron 2. As soon as the ignitron fires the ignitron anode voltage falls to the arc drop value and the ignitor voltage is reduced correspondingly. It is necessary to put a zener diode in series with the thyristor as the voltage drop across the thyristor is considerably less than the arc voltage of the ignitron and an excessive current would otherwise persist for the entire period of conduction. The diodes D<sub>1</sub> and D<sub>2</sub> are necessary to prevent inverse voltage appearing across the ignitor. A failure of any of the four diodes would allow the full power current to flow and so fuses must be incorporated as a protection.

The maximum dissipation rating of the zener diode should be at least 75W, and it should have a breakdown voltage of 20V. The four diodes and the thyristor should be rated for at least 10A mean current. The fuses should not be less than 5A HRC. The voltage ratings of these components will depend on the supply, but should be generous.

### Separate Excitation

Separate excitation must be used when the anode voltage of the ignitron is not sufficient for anode firing to be used. Separate excitation is also used in some high voltage applications where precise and exact firing of the ignitron is required. A capacitor is discharged through the ignitor to cause ignition (see Fig. 8). An inductance of about 0.5mH is used in series so that a resonant circuit is formed which supplies a single current pulse of approximately sinusoidal shape. The pulse width is  $\pi\sqrt{LC}$  and the short circuit current  $V\sqrt{C/L}$  where V, L and C are in volts, henries and farads respectively. The size of the capacitor and the voltage to which it is charged is a matter of choice to suit the particular requirements. A firing time of less than 100 microseconds is satisfactory for many applications and so a low capacitor voltage can be used. The ignitron data sheets give the minimum requirements of voltage, current and time. Suitable minimum values of capacitance and voltage are  $5\mu\text{F}$  at 600V, or  $12\mu\text{F}$  at 450V.



**Fig. 8** Typical capacitor firing circuit

If quick firing of the order of one microsecond is required it is necessary to raise the capacitor voltage to at least 1500 volts and limit the current with a small resistor of about  $4\Omega$  instead of the inductance. The ignitor fires so quickly that a small capacitor is sufficient. Suitable values of capacitance and voltage are  $0.25\mu\text{F}$  and 1500 to 4000V.

In capacitor discharge circuits the ignitron has to pass a very high current and the conditions are naturally harmful to the ignitron. The mercury pool and the ignitor itself will become contaminated and the best life will only be obtained if a high voltage is applied to the ignitor. Under these conditions the capacitor should be  $0.25\mu\text{F}$  charged to at least 1500V even if fast firing is not required.

## IGNITRON CIRCUITS

### Welding Control

A typical spot or seam welder incorporates a power transformer which provides the high welding current at a low voltage. Switching on and off is accomplished by ignitrons in the high voltage side of the circuit. Coarse adjustment can be provided by transformer taps but fine control is only achieved with ignitrons. For seam welding the number of non-conducting cycles must also be closely controlled. For welding some materials it is necessary to allow for a preheat cycle, consisting of a few conduction cycles at a low power level to heat the weld area before the actual weld is made. During the weld pressure may be reduced in order to obtain higher effective resistance and then a post-heating period with increased pressure may be useful to forge the weld. Fig. 9 shows a typical welding cycle for spot welding thick steel sheets.

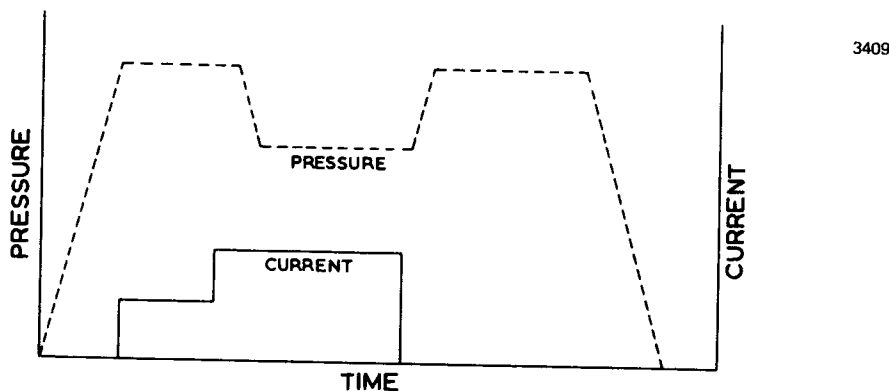


Fig. 9 Example of current and pressure sequence for a spot welder

### Single-Phase Welding Control

The usual circuit for this application provides full wave control by connecting two ignitrons in inverse parallel as shown in Fig. 7. As the load is inductive the current will lag behind the voltage, and under steady state conditions there would be a natural delay angle  $\phi$  between the voltage and current. If the ignitron is first fired at the natural point of zero current, that is  $\phi$  after voltage zero, the current will rise smoothly from zero and reach its natural peak level. If, however, the ignitron is fired earlier the current will be excessive in the first half cycle and could reach twice the normal peak current. This will set up transient surges which may damage electrical components and also cause a d.c. component in the transformer primary which may result in saturation. Therefore for full cycle conduction the ignitron is fired at a time  $\phi$  after voltage zero. Later firing than this (phase delay) is used to reduce the weld current and will not cause any serious transients provided the firing angle is the same for each conducting cycle.

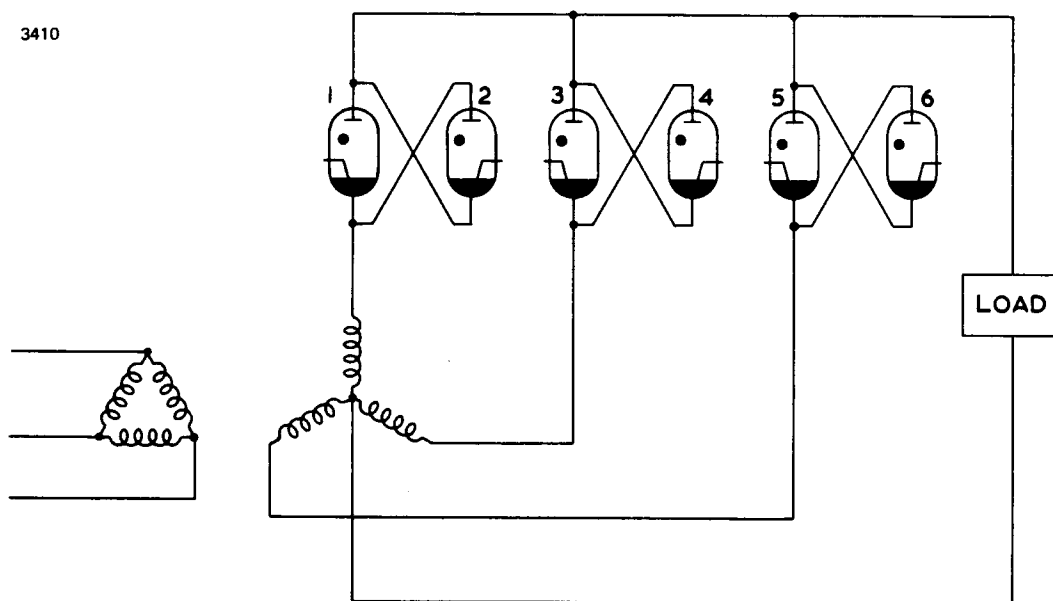


It is important that both ignitrons fire for an equal number of half cycles as otherwise there would be a d.c. component of current which might saturate the transformer core after repeated welds.

At low duty these effects may not be serious, but for heavy duty it is essential to have synchronous control to ensure correct timing of every cycle, especially the first.

### Three-phase Welding Control

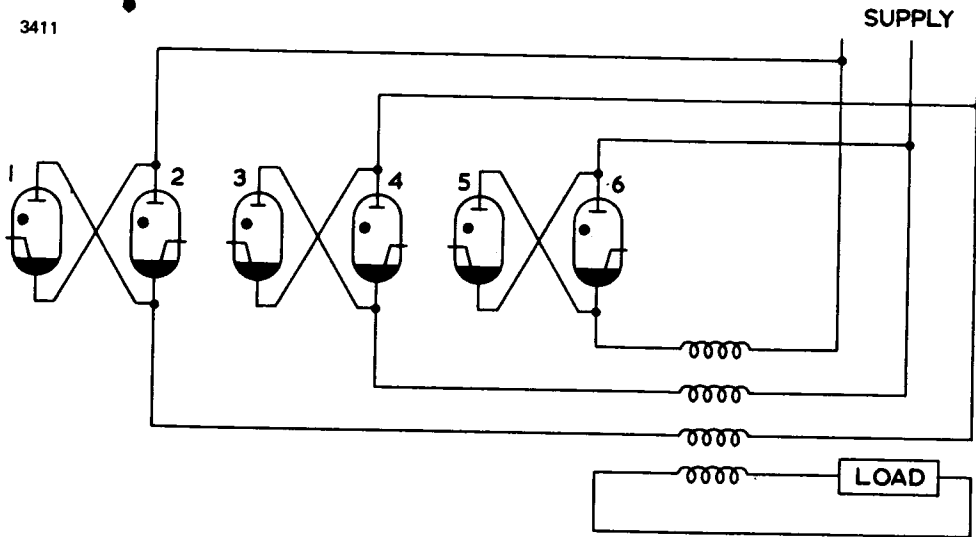
Although the single-phase system described above is very widely used, it has serious disadvantages for very large welding equipments. As the physical dimensions of the welder are increased the secondary circuit reactance becomes appreciable, giving a poor power factor, and the current loads involved are sufficient to seriously unbalance the supply if taken from a single phase. Both of these problems can be overcome by the three-phase frequency changing system, which produces a synthesized single-phase voltage at a frequency lower than that of the mains supply. The simplest method of doing this requires a four-wire supply, and the neutral wire has to carry the full primary current, so that it may be more economical to have a local delta-star transformer to supply the welding load only, as in Fig. 10.



**Fig. 10** Three-phase welder with local delta-star transformer

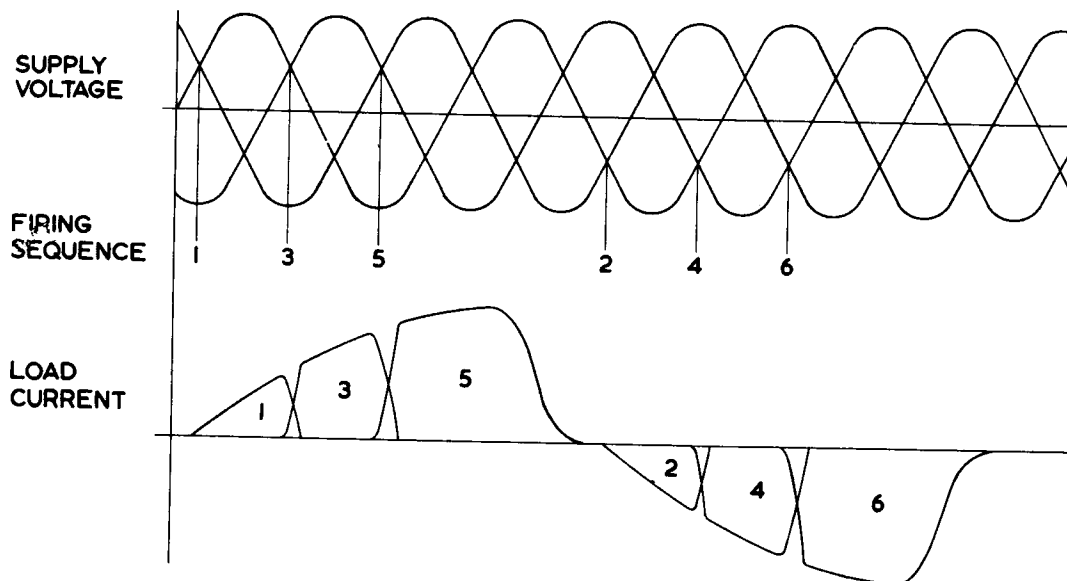
If the welding transformer is provided with three isolated primary windings and a single secondary, the ignitron pairs can be delta connected directly to the supply lines with a primary winding in series with each ignitron pair. Both circuits operate by firing the ignitrons in sequence, so that a rectified voltage pulse of approximately square waveform is applied to the transformer. For example, if the ignitrons numbered 1, 3 and 5 are fired in sequence, each conducts for one-half of a supply voltage cycle, the half-cycle pulse over-

lapping during commutation. The three tubes are fired in sequence until the required pulse length is achieved; then after a short non-conducting interval the other three tubes are fired to pass the second half of the low-frequency cycle. The interval between the long pulses is necessary so that the last tube



**Fig. 11** Three-phase welder with delta connected primary circuit

to carry the current has time to extinguish; as the current cannot transfer to another phase it continues to flow for an extended period. The current also increases steadily during the long pulse so that the last tube to conduct carries a much larger total current than the other two. If the same tube terminates every alternate long pulse, the average current in this tube will be the limiting factor in the ratings.



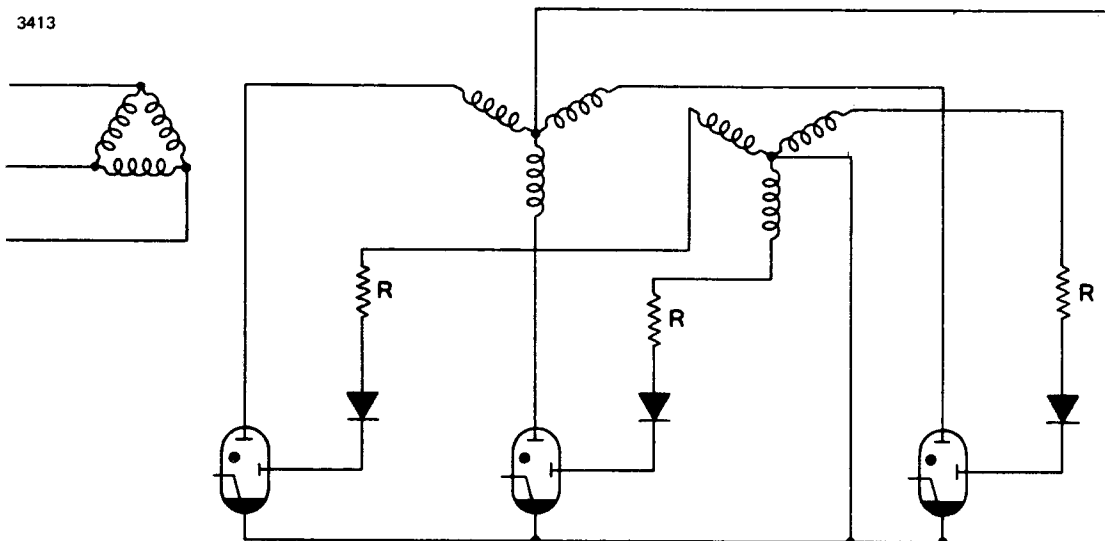
**Fig. 12** Waveforms in a three-phase frequency changing welder

## Power Rectification

Rectifier ignitrons can supply large d.c. loads from single phase or multiphase a.c. mains. The provision of variable phase delay of ignitor firing allows control of the output voltage over a wide range.

Where the load presents a counter e.m.f. as in battery charging, the driving voltage may be relatively low, being the value of the supply less the counter e.m.f., and at low values of ignitron main anode current it may be necessary to use the auxiliary anode to maintain conduction. If the load is a d.c. motor, this also presents a counter e.m.f. and the current may fall to a low value when the motor is lightly loaded. In cases where a counter e.m.f. is present this must be allowed for when considering the inverse voltage across the ignitrons.

It is not possible to operate ignitrons in parallel to obtain higher currents, unless each tube has sufficient impedance connected in series to ensure that both will conduct. Without this series impedance, the fall in voltage as the first arc strikes will prevent the second arc from establishing itself.



**Fig. 13** Auxiliary anode supplies for a three-phase rectifier

The usual half-wave and full-wave rectifier circuits can be employed, with additional transformer windings to supply the auxiliary anodes and ignitor firing circuits. In multiphase equipments, the phase delay of the ignitor circuits may be controlled by a phase-shifting transformer. The circuits for the auxiliary anodes must observe the maximum voltage and current ratings given in the tube data sheets, and must also meet the minimum requirements

necessary to strike and maintain the auxiliary arc. A voltage of 55 to 110V<sub>r.m.s.</sub> will normally give satisfactory operation but it should be noted that operation at low temperatures may involve compromising on stability so as to observe the ratings. In order to meet the limits on inverse voltage, a diode may be necessary in the lead to the auxiliary anode of each tube.

### Basic circuits for rectifier service

The values given do not allow for arc loss, phase delay, commutation or voltage drops in transformers.

Circuit	Fig. no.	V <sub>r.m.s.</sub>	I <sub>av</sub>	P.I.V. on ignitron
Single-phase half-wave	14	$2.22 \times V_{dc}$	$I_{dc}$	$3.14 \times V_{dc}$
Single-phase full-wave	15	$1.11 \times V_{dc}$	$0.5 \times I_{dc}$	$3.14 \times V_{dc}$
Single-phase bridge	16	$1.11 \times V_{dc}$	$0.5 \times I_{dc}$	$1.57 \times V_{dc}$
Three-phase half-wave	17	$0.855 \times V_{dc}$	$0.333 \times I_{dc}$	$2.09 \times V_{dc}$
Three-phase full-wave	18	$0.427 \times V_{dc}$	$0.333 \times I_{dc}$	$1.045 \times V_{dc}$
Six-phase half-wave	19	$0.741 \times V_{dc}$	$0.167 \times I_{dc}$	$2.09 \times V_{dc}$

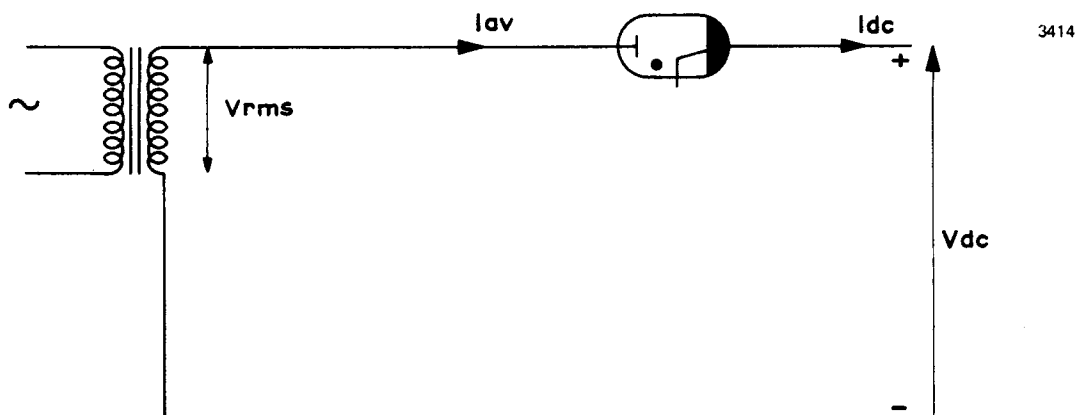


Fig. 14 Single-phase half-wave circuit

Basic circuits for rectifier service (continued)

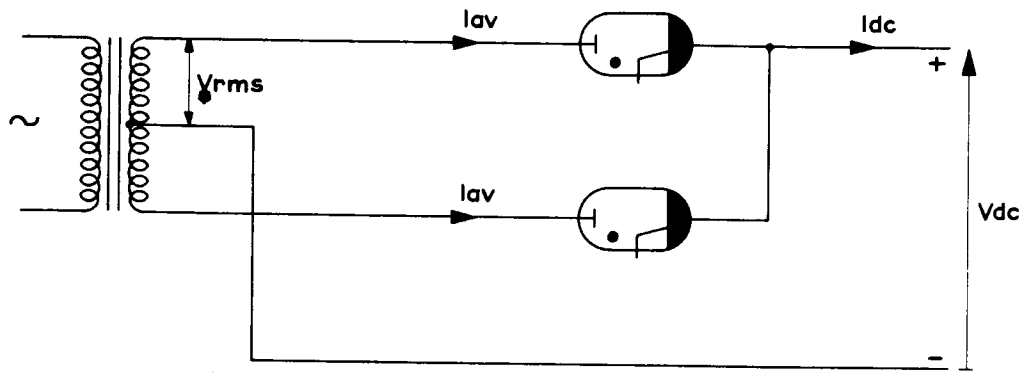


Fig. 15 Single-phase full-wave circuit

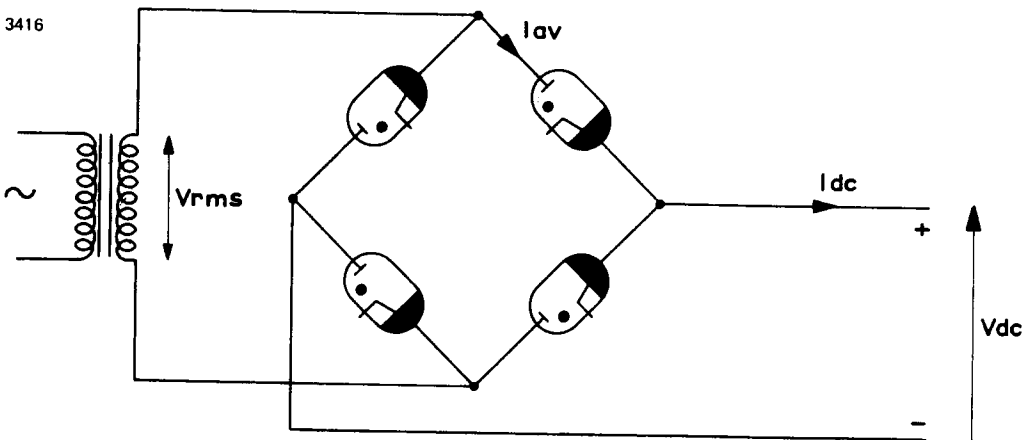
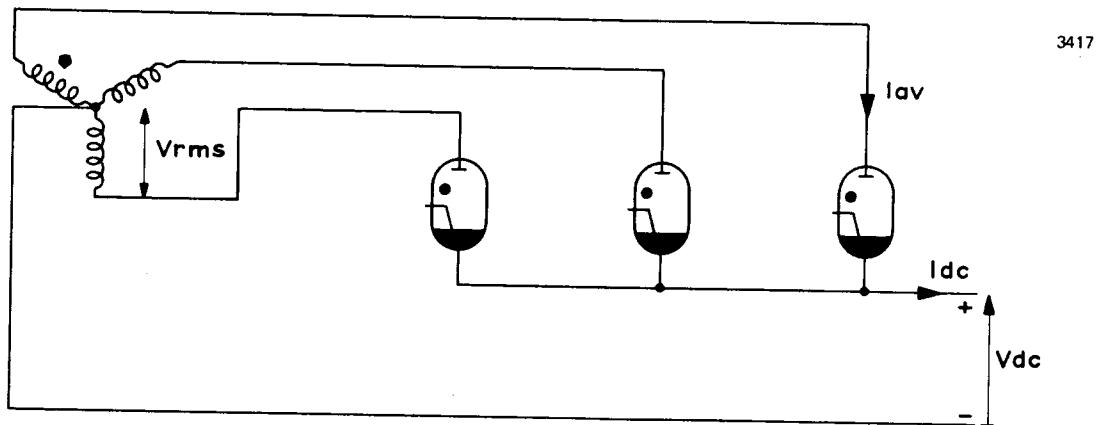
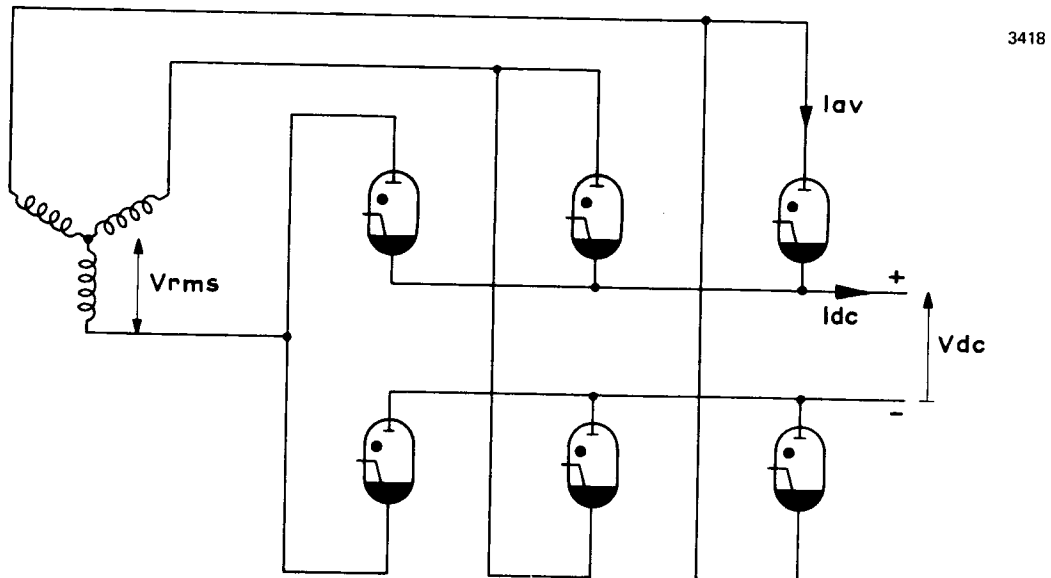


Fig. 16 Single-phase bridge circuit

## Basic circuits for rectifier service (continued)

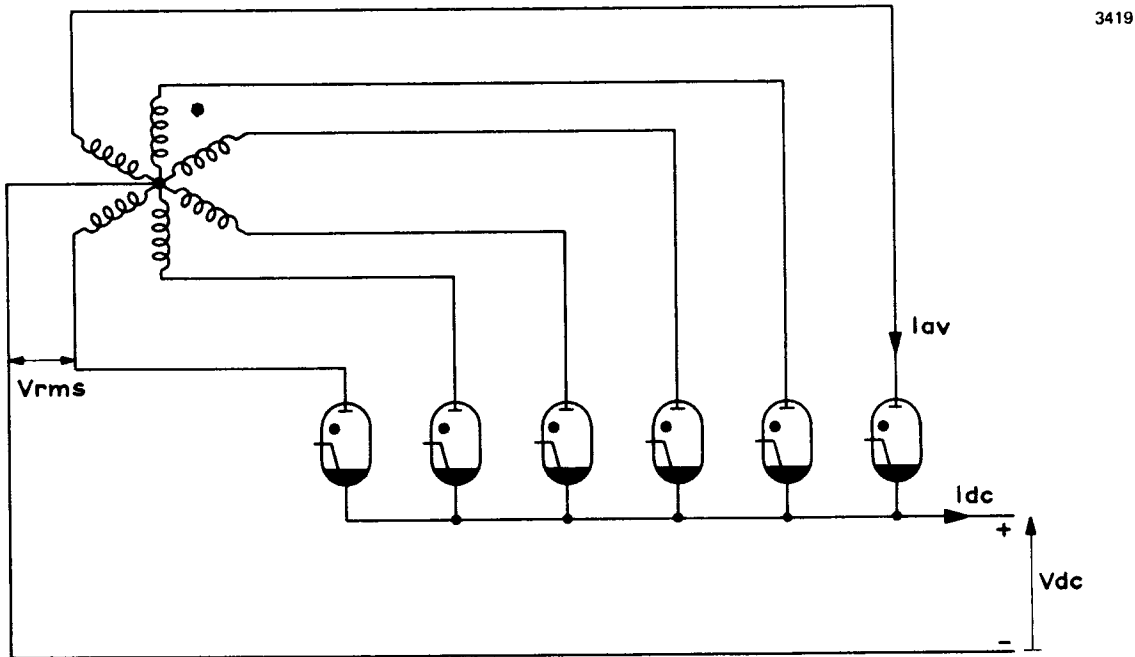


**Fig. 17** Three-phase half-wave circuit



**Fig. 18** Three-phase full-wave circuit

## Basic circuits for rectifier service (continued)



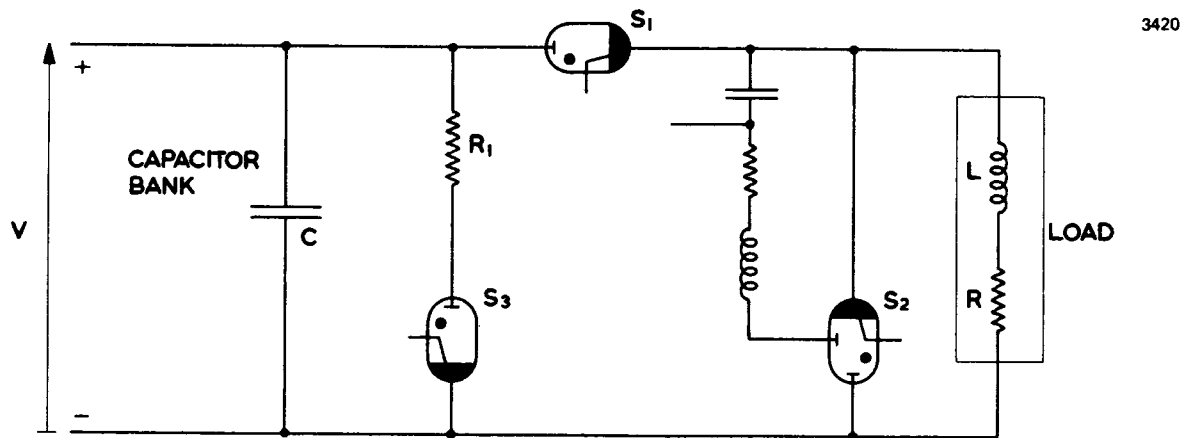
**Fig. 19** Six-phase half-wave circuit

### Capacitor Discharge

Ignitrons used for capacitor discharge service may be required to reach a fully conductive state very quickly and at an accurately controlled point in time. To achieve this it is usual to fire the ignitrons by discharging a small capacitor, charged to a voltage high enough to ensure rapid firing, through the ignitor. Individual tube data sheets give details of the recommended values. This type of application frequently involves a highly inductive load, such as a magnet coil, and it is necessary either to allow for an oscillatory current through the ignitron or to prevent it by including a clamping tube in parallel with the load.

In Fig. 20, firing  $S_1$  discharges the capacitor into the load, and as the capacitor voltage reaches zero the load current is transferred to  $S_2$ , which can be fired simultaneously with  $S_1$  and held conductive by an arc to the auxiliary anode. In order to ensure rapid commutation of the current from  $S_1$  to  $S_2$  the auxiliary anode current may be quite large, about 50A. In a typical case a  $30\mu\text{F}$  capacitor charged to 200V is discharged through the auxiliary anode circuit and a limiting resistance. A series inductance may be included to improve the shape of the auxiliary current pulse. The load current decays exponentially after transferring to  $S_2$ , and it should be noted that the ampere-second product carried by  $S_2$  may considerably exceed the original charge on the capacitor.

The current carrying capacity of each ignitron is a function of the energy dissipated per pulse. This is the product of the average arc voltage drop, the pulse length and the current, and is measured in joules. At the high peak currents involved, the arc drop may be considerably higher than in other ignitron applications, particularly during ionization at the start of the current pulse. High rates of rise of current cause severe conditions and lead to shorter life.



**Fig. 20** Typical capacitor discharge circuit

For  $S_1$  the current pulse approximates to one-quarter of a sine wave cycle, the current rising to a peak value

$$I = V \sqrt{\frac{C}{L}}$$

The ampere-second product of the  $S_1$  pulse =  $CV$ , the initial capacitor charge. The ampere-second product of the  $S_2$  pulse is  $IL/R$ . The rate of rise of current in  $S_2$  during commutation is also very high, and since  $S_2$  must also be able to hold off the full capacitor voltage in the inverse direction when  $S_1$  is fired and  $S_2$  itself may have been fired simultaneously on the auxiliary anode, the clamping tube operates in all respects under the most severe conditions of the three. The discharge tube,  $S_3$ , is included so that the capacitor can be discharged quickly under fault conditions or when the load is disconnected.

## DEFINITIONS

### Average Anode Current

The arithmetic mean anode current, averaged over a time not exceeding the rated Maximum Averaging Time.

### Maximum Fault Current

The highest anode current that the ignitron can carry for a short time without



serious damage. The maximum time for which this current may be carried is also quoted.

Repeated fault current loadings may reduce the life of a tube.

### **Line Demand Current**

The r.m.s. current passed by a pair of ignitrons connected in inverse parallel, under full-cycle conduction conditions.

### **Demand kVA**

The product of the Line Demand Current and the r.m.s. line voltage.

### **Duty Cycle**

The percentage of mains-voltage cycles for which the ignitrons conduct during a period not exceeding the Maximum Averaging Time.

### **Maximum Averaging Time**

The longest period over which the anode current may be integrated to determine its average value.

### **Arc Voltage Drop**

The potential difference between anode and cathode during normal conduction.

### **Voltage Polarities**

A forward voltage on any electrode of the ignitron is one which makes that electrode positive with respect to the cathode.

### **Full Cycle Conduction**

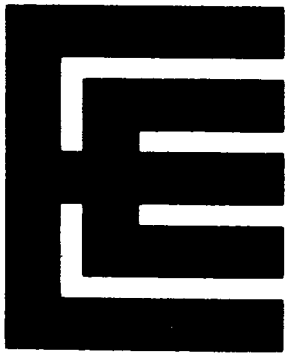
The condition where each ignitron is ignited as early as possible in its forward voltage cycle.

### **Ignitor Circuit Requirements**

The minimum values of ignitor voltage and current given are those which will produce ignition within the specified time.

### **Ignition**

The production of an arc between the cathode and the upper end of the ignitor, accompanied by a drop in ignitor voltage.



**7703 BK472**  
**BK474 BK476**

**IGNITRONS**

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### **INTRODUCTION: Ignitrons for Switching Applications**

The choice of an ignitron for switching service is dependent upon several conditions. One of the most important is the extent of current reversal in ringing circuits and a molybdenum anode type is generally considered to be best for this usage. For high reliability at high voltage a type with a complex anode seal may be used. In applications requiring the use of several ignitrons in parallel, then high triggering reliability is essential if the ignitrons are to fire simultaneously or in a predetermined sequence, and here again a molybdenum anode is preferred.

If current reversal is limited, or if reduced life is acceptable, then a tube with a less expensive anode material of stainless steel or graphite can be used.

All four ignitrons have the same ratings; the 7703 will give the best life under arduous conditions and the others are intended for less severe applications.

Brief details of the ignitrons are as follows:

**7703** employs a molybdenum anode and complex anode seal for the most severe applications of high voltage and high current reversal (up to 85%). The area around the anode seal is potted.

**BK472** employs a stainless steel anode and simpler anode seal with slightly increased length. It is therefore suitable for a reduced degree of current reversal and for d.c. switching applications.

**BK474** retains the simpler anode seal but includes a molybdenum anode and is therefore most suitable for ringing applications at a reduced voltage and current.

**BK476** also has the simpler anode seal but includes a graphite anode. It is suitable for applications where current reversal is zero, and although rated at 20kV may require careful ageing to hold off more than 15kV on repeated switching.

## GENERAL DATA

### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

### Mechanical

Overall length (7703) . . . . .	7.813 inches (198.5mm) max
Overall length (BK472, BK474, BK476) . . . . .	8.375 inches (212.7mm) max
Body diameter . . . . .	2.2 inches (55.88mm) max
Net weight . . . . .	2 pounds (0.9kg) approx
Mounting position (see note 1) . . . . .	vertical, anode terminal up

### Accessories

Ignitor lead . . . . .	ZD100222
Water-cooled clamp . . . . .	ZD100365

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### Capacitor Discharge Service (These ratings do not apply to BK476)

Intermittent pulse duty, ringing applications

	Min	Max	
Peak forward anode voltage (see note 2) . . . . .	0.1	20	kV
Peak inverse anode voltage (see note 2) . . . . .	—	20	kV
Peak anode current (see graph, page 4) . . . . .	—	100	kA
Ionization time . . . . .	0.5		$\mu$ s approx
Tube inductance . . . . .	0.04		$\mu$ H approx
Discharge rate per minute (see note 3) . . . . .	—	2	

### D.C. Short-circuiting Switch Service

	Min	Max	
Peak forward voltage (see note 2) . . . . .	0.1	20	kV
Peak inverse voltage (see note 2) . . . . .	—	20	kV
Peak anode current . . . . .	—	35	kA
Average anode current . . . . .	—	0.25	A
Averaging time . . . . .	—	1.0	minute
Ionization time . . . . .	0.5		$\mu$ s approx
Tube inductance . . . . .	0.04		$\mu$ H approx

## Ignitor Circuit Requirements

The recommended excitation circuit consists of a  $0.25\mu\text{F}$  capacitor, charged to a voltage between 1500 and 4000V and discharged through the ignitor-cathode circuit and a current limiting resistor of 2 to 6 ohms. The inverse ignitor voltage must never exceed 5.0V.

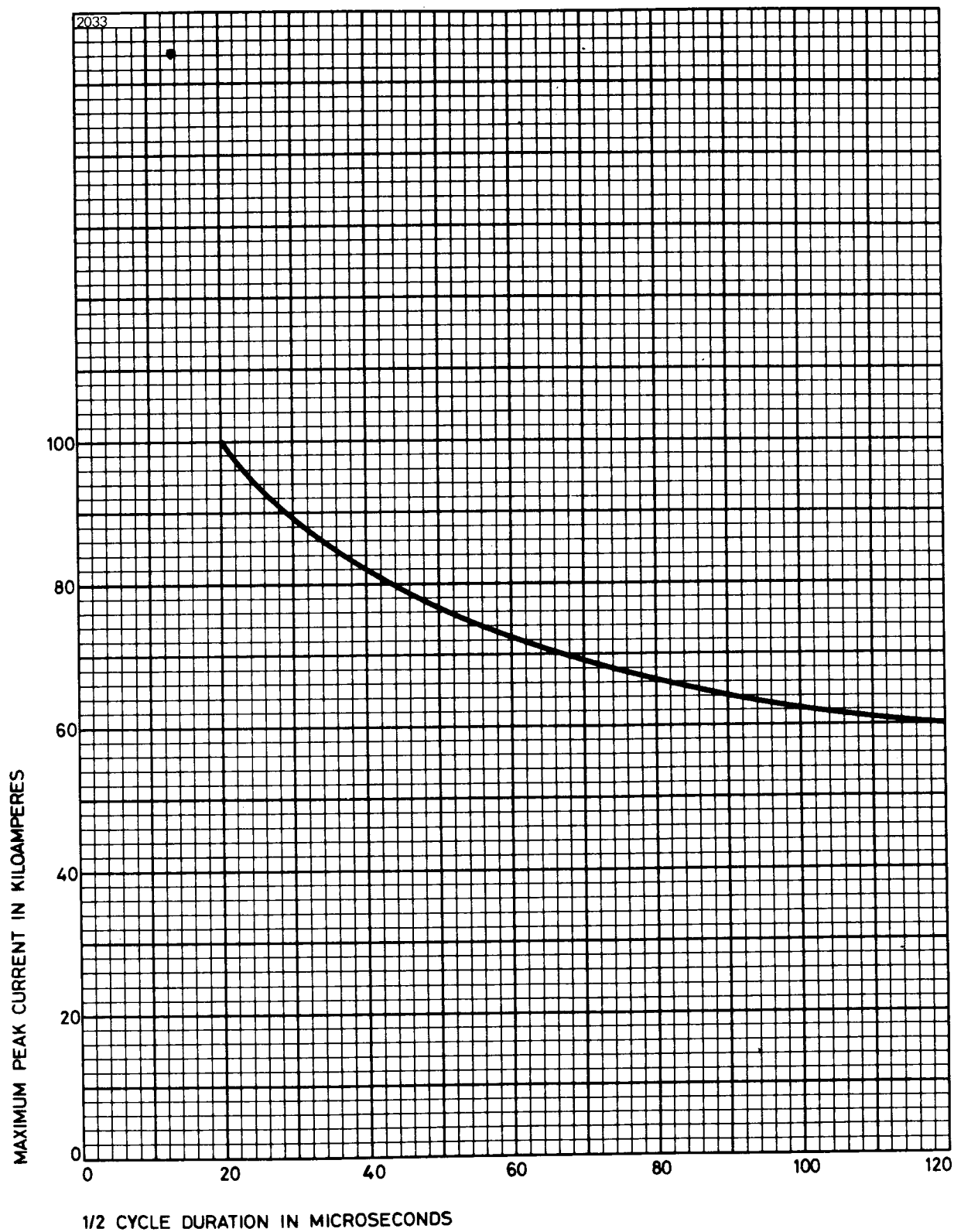
### Cooling (see note 4)

	Min	Max	
Cooling clamp temperature . . . . .	10	30	°C
Cathode temperature . . . . .	—	37	°C
Anode insulator temperature . . . . .	—	70	°C

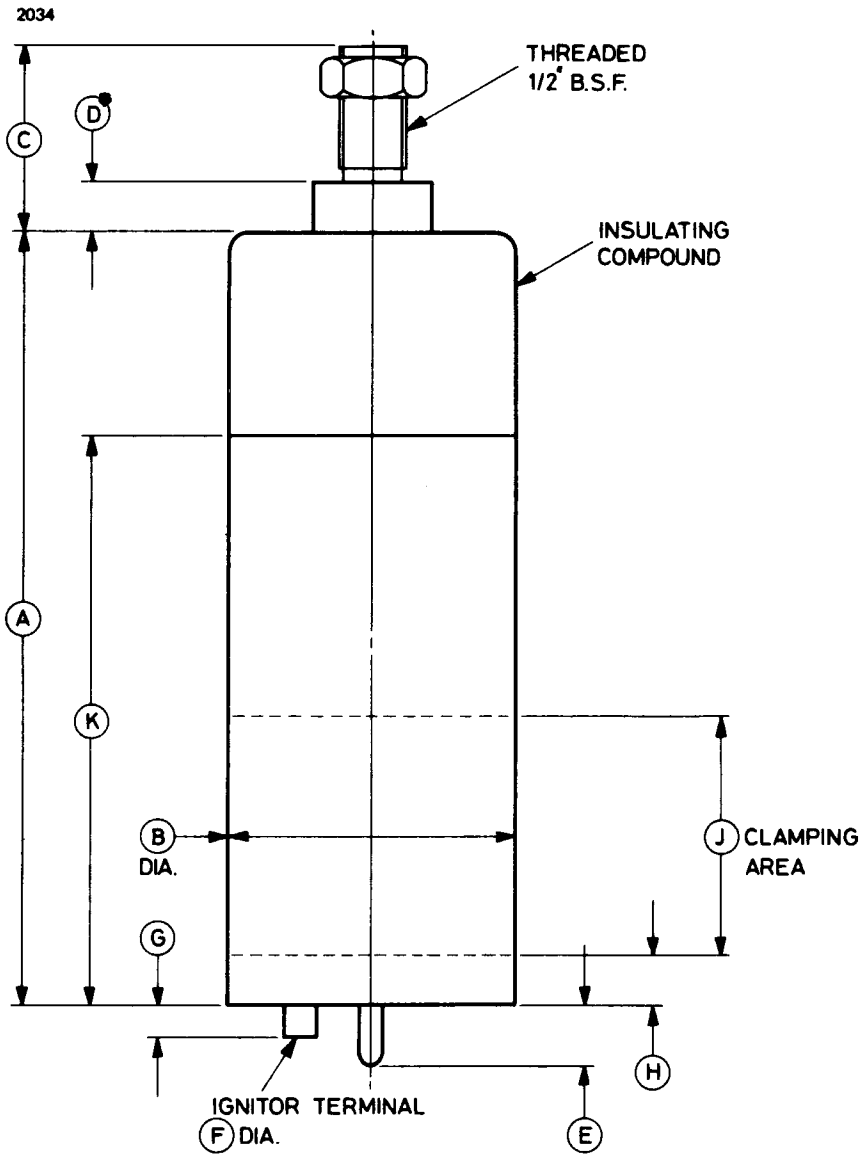
### NOTES

1. The life of the ignitron will be improved if operated in a space free from magnetic fields. Such fields tend to force the arc towards the envelope from which sputtering may occur, resulting in ignitor wetting. A coaxial form of mounting is recommended.
2. After heat-conditioning (see note 4) and before the ignitron is put into operation, it is recommended that it be aged to withstand a voltage of 30 to 35kV without breakdown. This may be accomplished by the application of a variable voltage, preferably d.c. through a current limiting resistor of about  $100\text{k}\Omega$ . It is useful to connect a capacitor of approximately  $500\text{pF}$  directly between anode and cathode.  
The ignitron may not withstand the full rated voltage immediately after conducting. A delay of 1 to 10 seconds is recommended.
3. The ignitrons may be operated at higher repetition rates if the voltage or current is reduced. Users are recommended to apply for advice in these circumstances.
4. The anode insulator temperature must be higher than the cathode temperature at all times. The anode end must be heated before operation to vaporize any mercury in the area of the anode seal. When first installed the anode stud should be heated to about  $100^\circ\text{C}$  for two hours. Care is needed during cooling to ensure a cathode temperature lower than the anode seal temperature, to prevent mercury condensation in the anode region.

# ANODE CURRENT – PULSE DURATION LIMITS



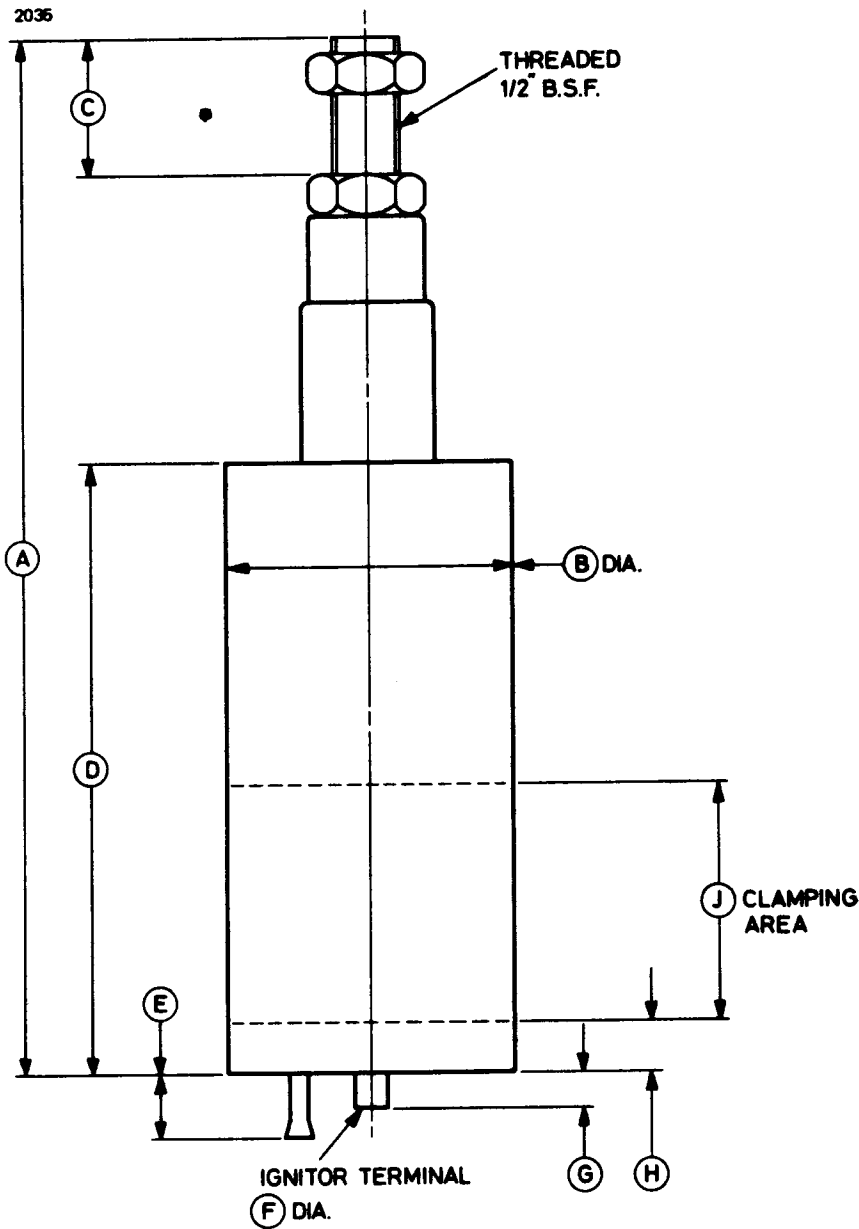
# OUTLINE FOR 7703



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.687 ± 0.125	144.4 ± 3.2	F	0.250 ± 0.005	6.35 ± 0.13
B	2.130 ± 0.010	54.10 ± 0.25	G	0.250 max	6.35 max
C	1.375 ± 0.125	34.93 ± 3.18	H	0.375	9.53
D	0.375 ± 0.062	9.53 ± 1.57	J	1.750 min	44.45 min
E	0.500 max	12.70 max	K	4.187 ± 0.125	106.3 ± 3.2

Millimetre dimensions have been derived from inches.

# OUTLINE FOR BK472, BK474 AND BK476



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	7.625 ± 0.250	193.7 ± 6.4	F	0.250	6.35
B	2.130 ± 0.010	54.10 ± 0.25	G	0.250 max	6.35 max
C	1.000 ± 0.125	25.40 ± 3.18	H	0.375 nom	9.53 nom
D	4.500 ± 0.250	114.3 ± 6.4	J	1.750 min	44.45 min
E	0.500 max	12.7 max			

Millimetre dimensions have been derived from inches.



# BK24/5552A

## IGNITRON

### Equivalent to 5552A

The data should be read in conjunction with the Ignitron Preamble.

#### ABRIDGED DATA

Size C, stainless-steel-jacketed, water-cooled ignitron intended primarily for single-phase resistance welding control applications. It has a platform for mounting a detachable thermostat for temperature control.

For an electrically identical version with coaxial cathode terminal see BK444/7671.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 75.6A) . . . . .	1200	kVA
Maximum average anode current (for demand not exceeding 400kVA) . . . . .	140	A

#### GENERAL

##### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 440A peak current . . . . .	14	V
at 6800A peak current . . . . .	28	V

##### Mechanical

Overall length (excluding flexible lead) . . . . .	14.750 inches (374.7mm) max
Overall width . . . . .	7.250 inches (184.2mm) max
Body diameter . . . . .	4.625 inches (117.5mm) max
Net weight . . . . .	8½ pounds (3.9kg) approx
Mounting position . . . . .	vertical, anode terminal up

##### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2



**Accessories (continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .				1.0	kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Single-phase Resistance Welding Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	Min	Max	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 75.6A) . . . . .	—	1200	kVA
Anode current (average) (for demand not exceeding 400kVA) . . . . .	—	140	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	5.9	s
at 440V <sub>r.m.s.</sub> . . . . .	—	8.0	s
at 250V <sub>r.m.s.</sub> . . . . .	—	14	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	5600	A
at 250V <sub>r.m.s.</sub> . . . . .	—	13 450	A
Duration of fault current . . . . .	—	0.15	s

**Ignitor**

Peak forward ignitor voltage . . . . .	—	Anode voltage	
Peak inverse ignitor voltage . . . . .	—	5.0	V
Ignitor current:			
peak forward . . . . .	—	100	A
r.m.s. . . . .	—	10	A
average . . . . .	—	1.0	A
averaging time . . . . .	—	5.0	s

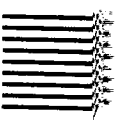
## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx sine wave) . . . . .	500	$\mu$ s



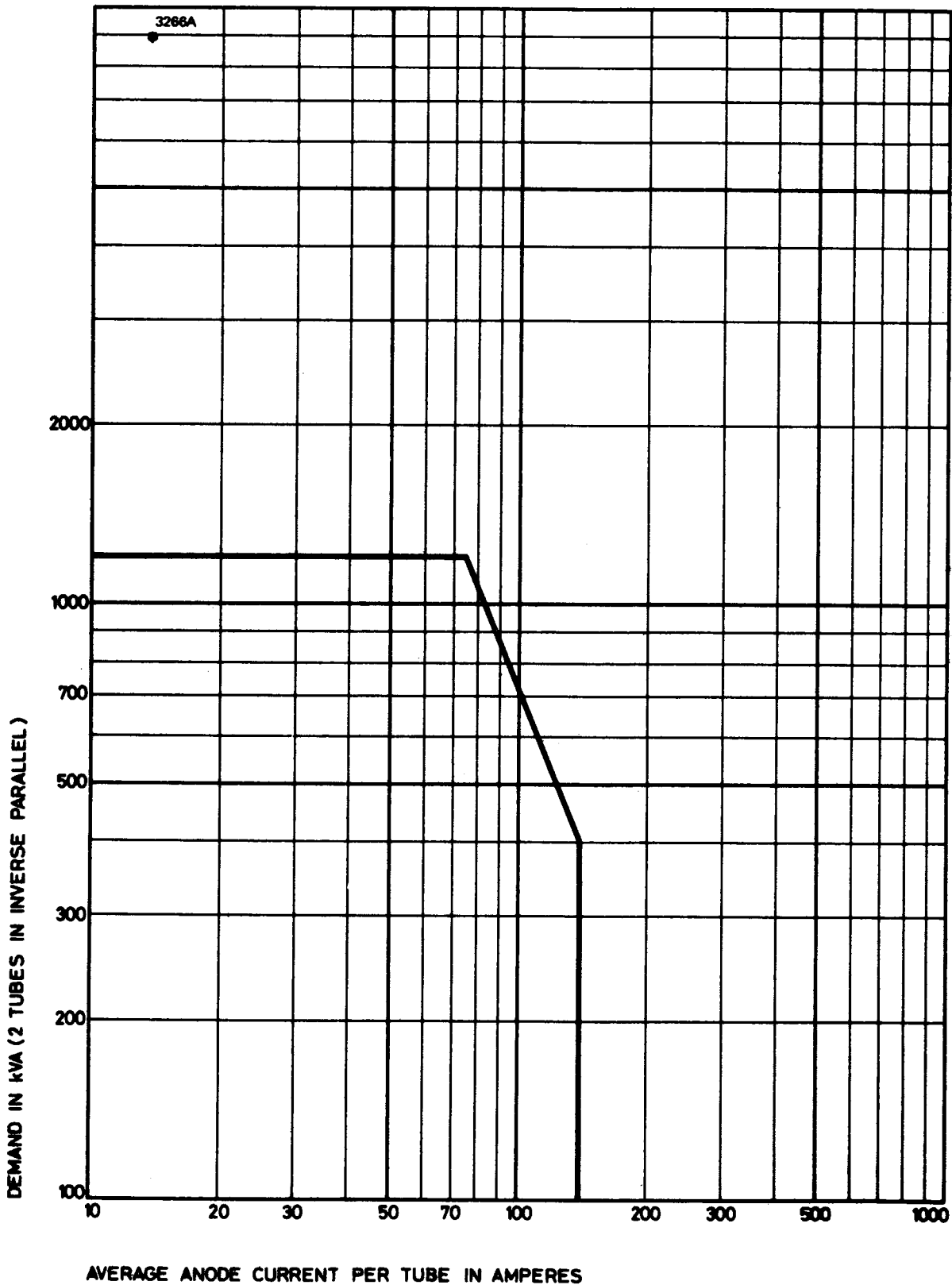
## COOLING

Minimum water flow rate (see note) . . . . .	1.5	imp.gal/min
	7.0	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	6.0	$^{\circ}$ C max

### Note

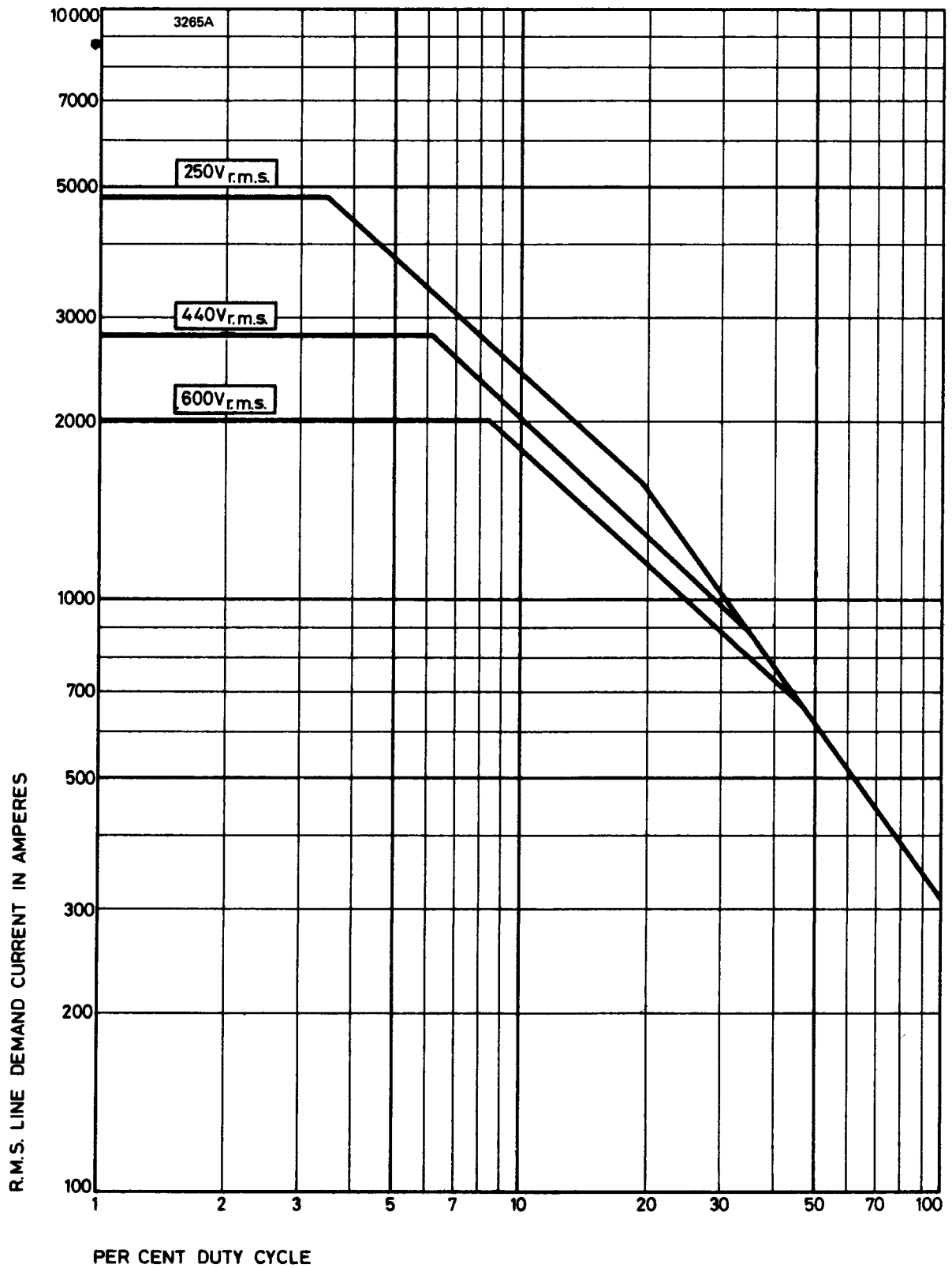
At the minimum flow rate of 1.5 imp.gal/min, the pressure drop across the jacket will be 4.5 lb/in<sup>2</sup> (0.32kg/cm<sup>2</sup>) approx. The water flow must be maintained for 15 minutes after switching off.

**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
Two ignitrons in inverse parallel for welder control at 250 to 600 volts

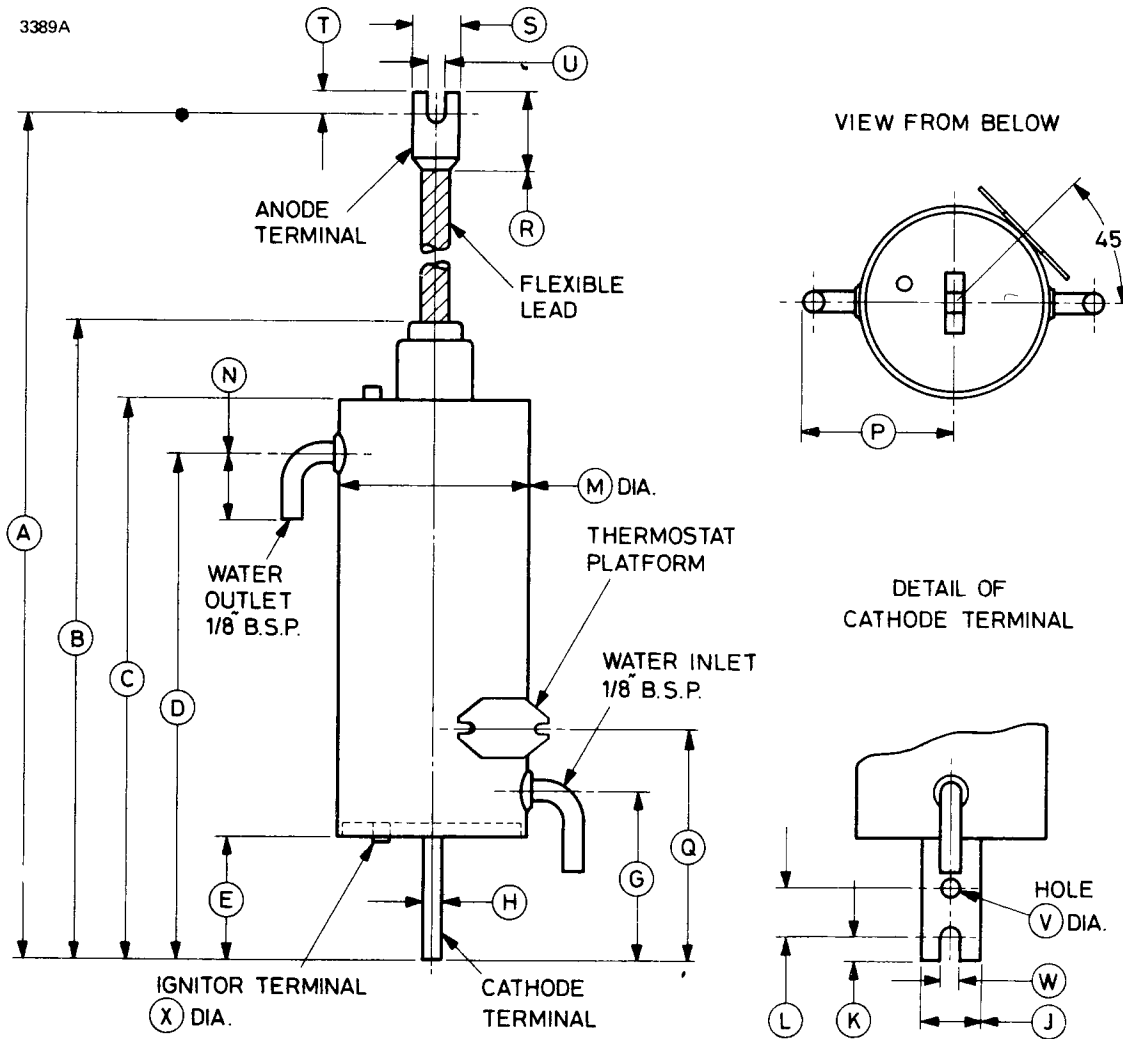


# LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)

Two ignitrons in inverse parallel for welder control



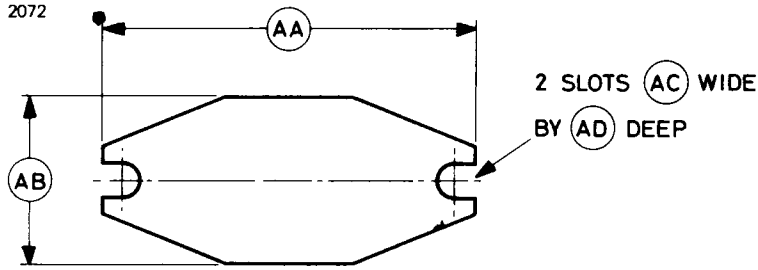
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	24.250 min	617.0 min	N	2.500 max	63.50 max
B	14.750 max	374.7 max	P	3.625 max	92.08 max
C	12.500 max	317.5 max	Q	5.500 ± 0.375	139.7 ± 9.53
D	10.750	273.1	R	3.000 max	76.20 max
E	2.375 min	60.33 min	S	1.250 max	31.75 max
G	3.750	95.25	T	1.000 max	25.40 max
H	0.500 ± 0.031	12.70 ± 0.79	U	0.437 ± 0.062	11.10 ± 1.57
J	1.250 ± 0.062	31.75 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.625 ± 0.062	15.88 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13
M	4.625 max	117.5 max			

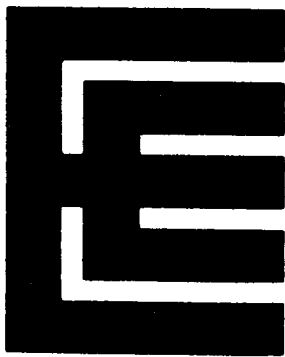
Millimetre dimensions have been derived from inches.

**Thermostat Mounting Plate (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
AA	2.750	69.85
AB	1.250	31.75
AC	0.219	5.56
AD	0.375	9.53

Millimetre dimensions have been derived from inches.



# BK42/5551A

## IGNITRON

### Equivalent to 5551A

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size B, stainless-steel jacketed, water-cooled ignitron intended primarily for single-phase or three-phase (frequency changing) resistance welding control applications. It has a platform for mounting a detachable thermostat for temperature control.

For an electrically identical version with coaxial cathode terminal see BK442/7669.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 30.2A) . . . . .	600	kVA
Maximum average anode current (for demand not exceeding 200kVA) . . . . .	56	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 150A peak current . . . . .	13	V
at 3400A peak current . . . . .	26	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	13.000 inches (330.2mm) max
Overall width . . . . .	5.750 inches (146.1mm) max
Body diameter . . . . .	3.250 inches (82.55mm) max
Net weight . . . . .	3¾ pounds (1.7kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

### Accessories (continued)

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .				1.0	kV max
Ignitor lead . . . . .					ZD100222

### MAXIMUM AND MINIMUM RATINGS (Absolute values)

#### Single-phase Resistance Welding Control Service

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	Min	Max	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 30.2A) . . . . .	—	600	kVA
Anode current (average) (for demand not exceeding 200kVA) . . . . .	—	56	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	7.5	s
at 440V <sub>r.m.s.</sub> . . . . .	—	10.2	s
at 250V <sub>r.m.s.</sub> . . . . .	—	18	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	2800	A
at 250V <sub>r.m.s.</sub> . . . . .	—	6720	A
Duration of fault current . . . . .	—	0.15	s

#### Three-phase (Frequency Changing) Welding Control or Power Rectifier Service (Intermittent Duty)

##### Anode

	Peak anode voltage 1.2kV	Peak anode voltage 1.5kV	
Anode current (peak) . . . . .	600	480	A max
corresponding average . . . . .	5.0	4.0	A max
Anode current (average) . . . . .	22.5	18	A max
corresponding peak . . . . .	135	108	A max
Averaging time . . . . .	10	10	s max
Peak fault current . . . . .	7500	6000	A max
Duration of fault current . . . . .	0.15	0.15	s max
Frequency range . . . . .	50–60	50–60	Hz



## MAXIMUM AND MINIMUM RATINGS (Continued)

### Ignitor

Peak forward ignitor voltage . . . . .	Anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak forward . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max



## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

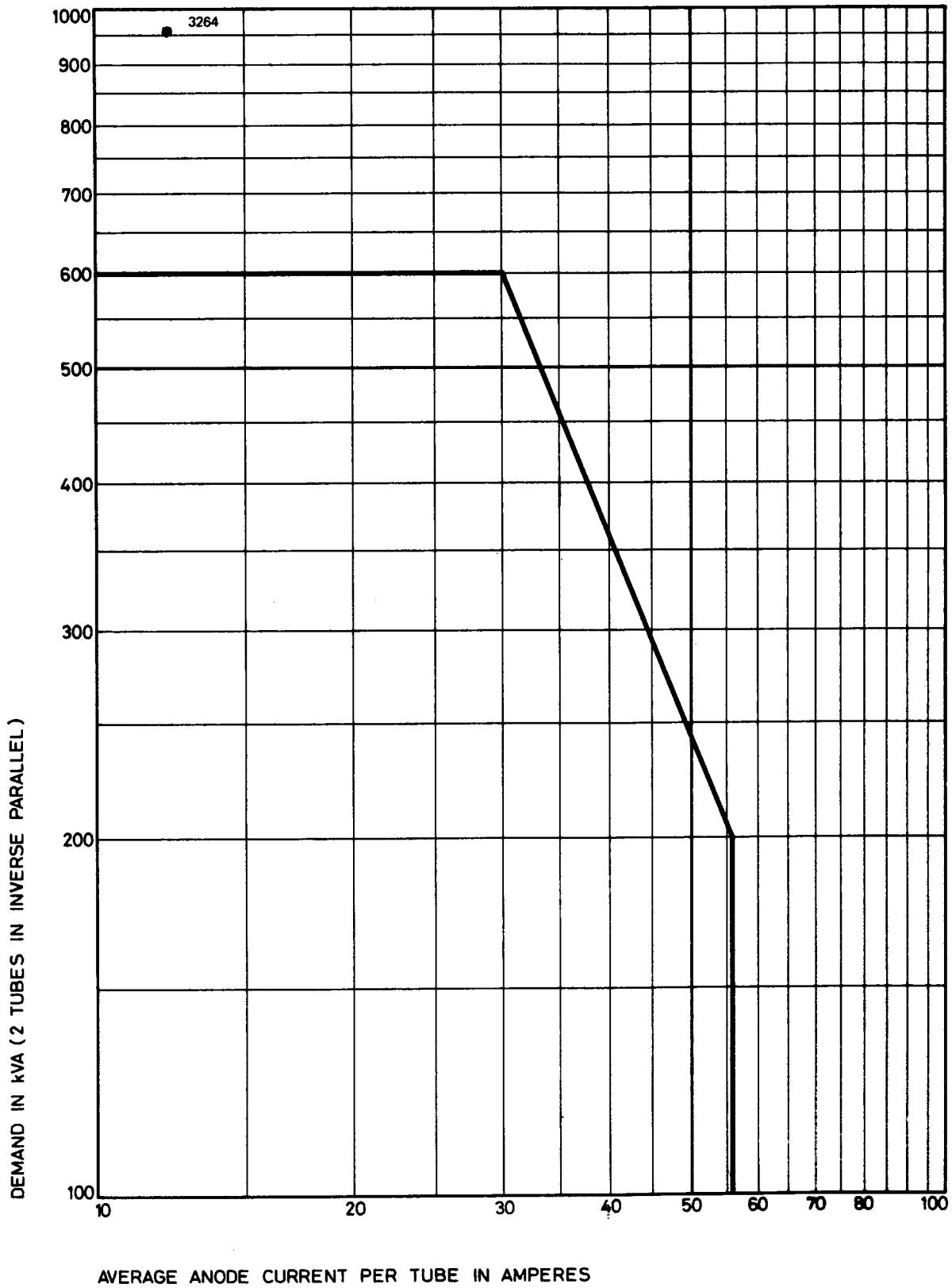
## COOLING

Minimum water flow rate (see note) . . . . .	1.0	imp.gal/min
	4.5	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	4.0	$^{\circ}$ C max

### Note

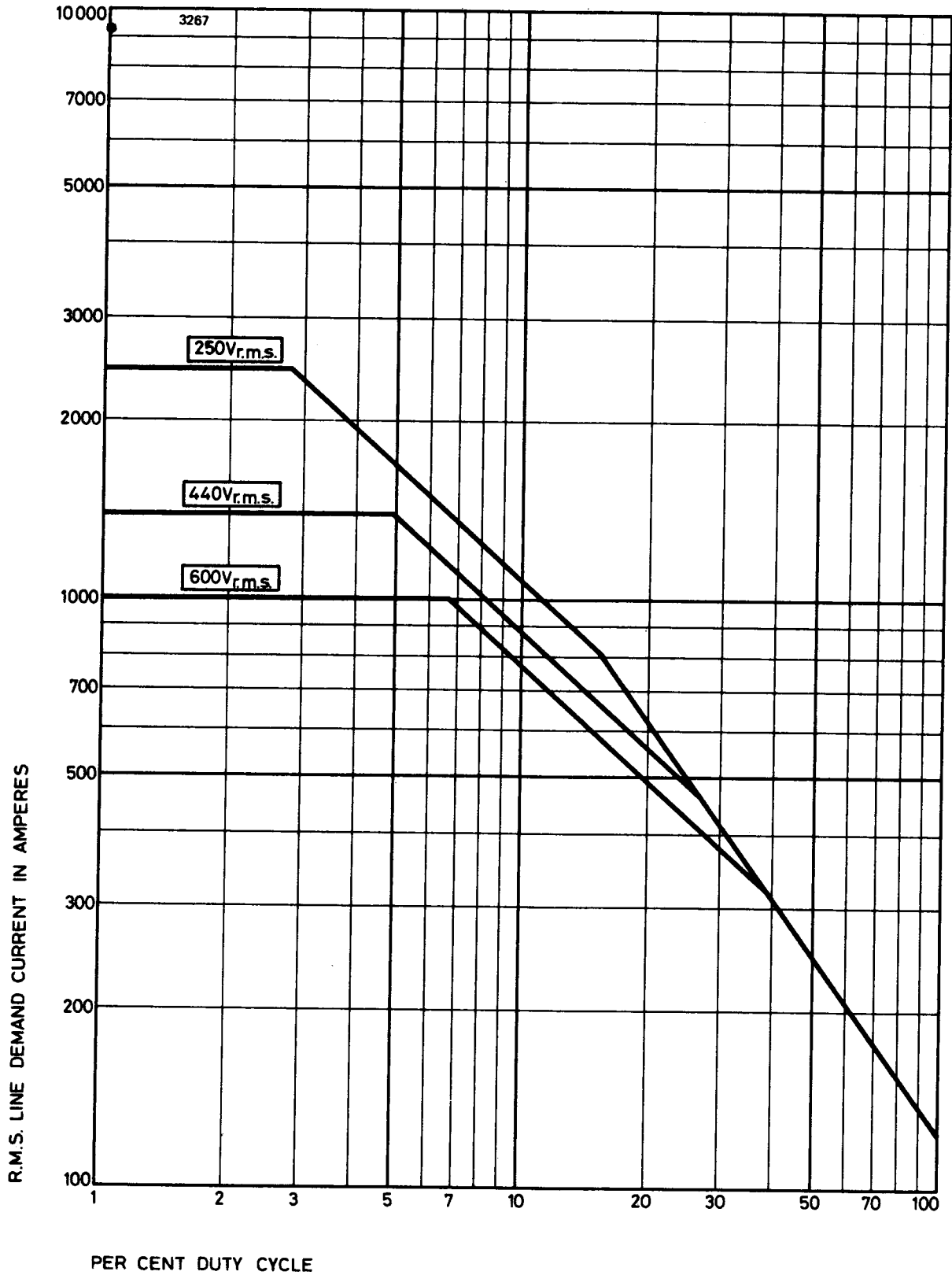
At the minimum flow rate of 1.0 imp.gal/min, the pressure drop across the jacket will be 1.8 lb/in<sup>2</sup> (0.13kg/cm<sup>2</sup>) approx. The water flow must be maintained for 10 minutes after switching off.

**DEMAND KVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 250 to 600 volts**



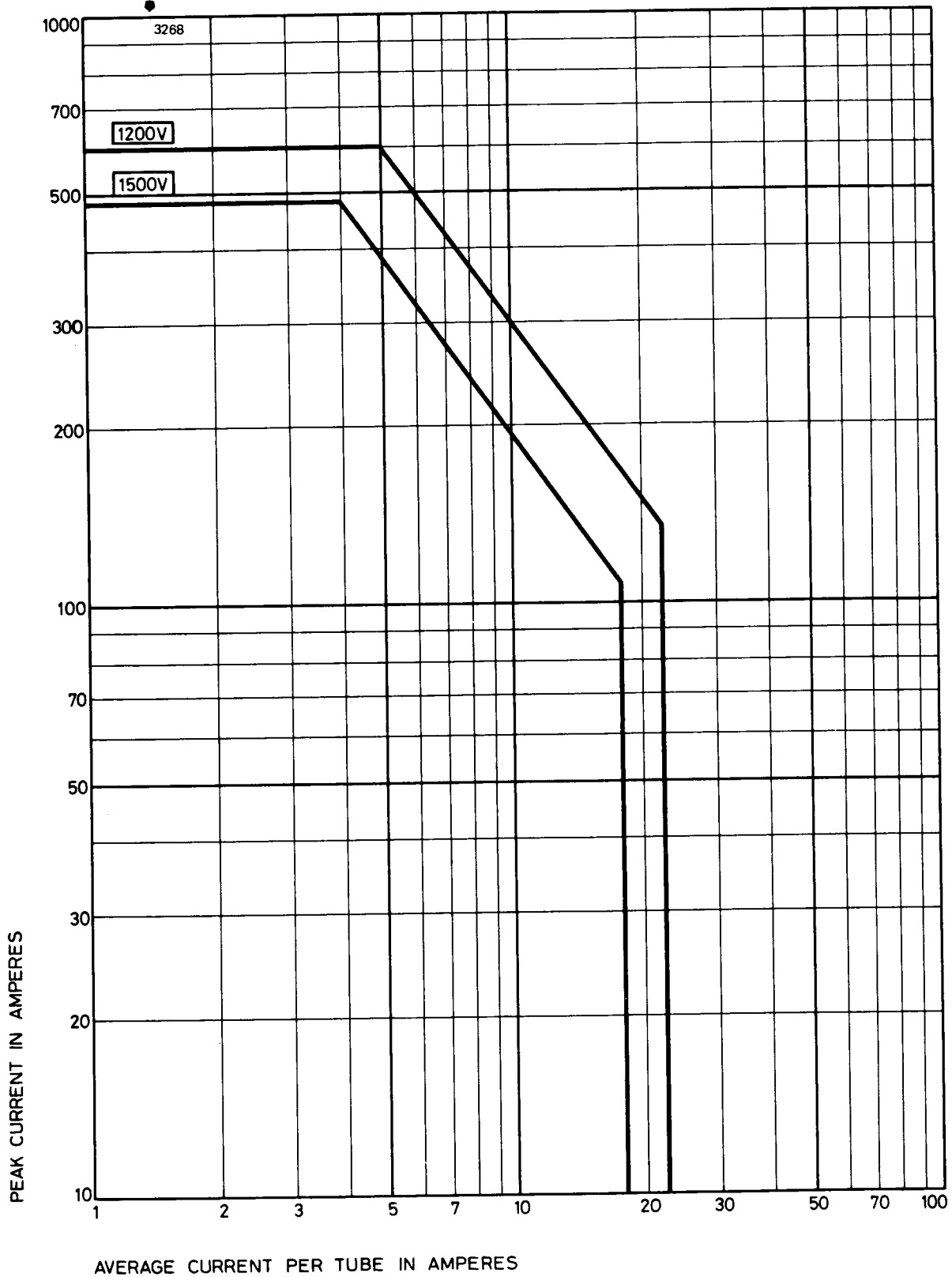
# LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)

Two ignitrons in inverse parallel for welder control service

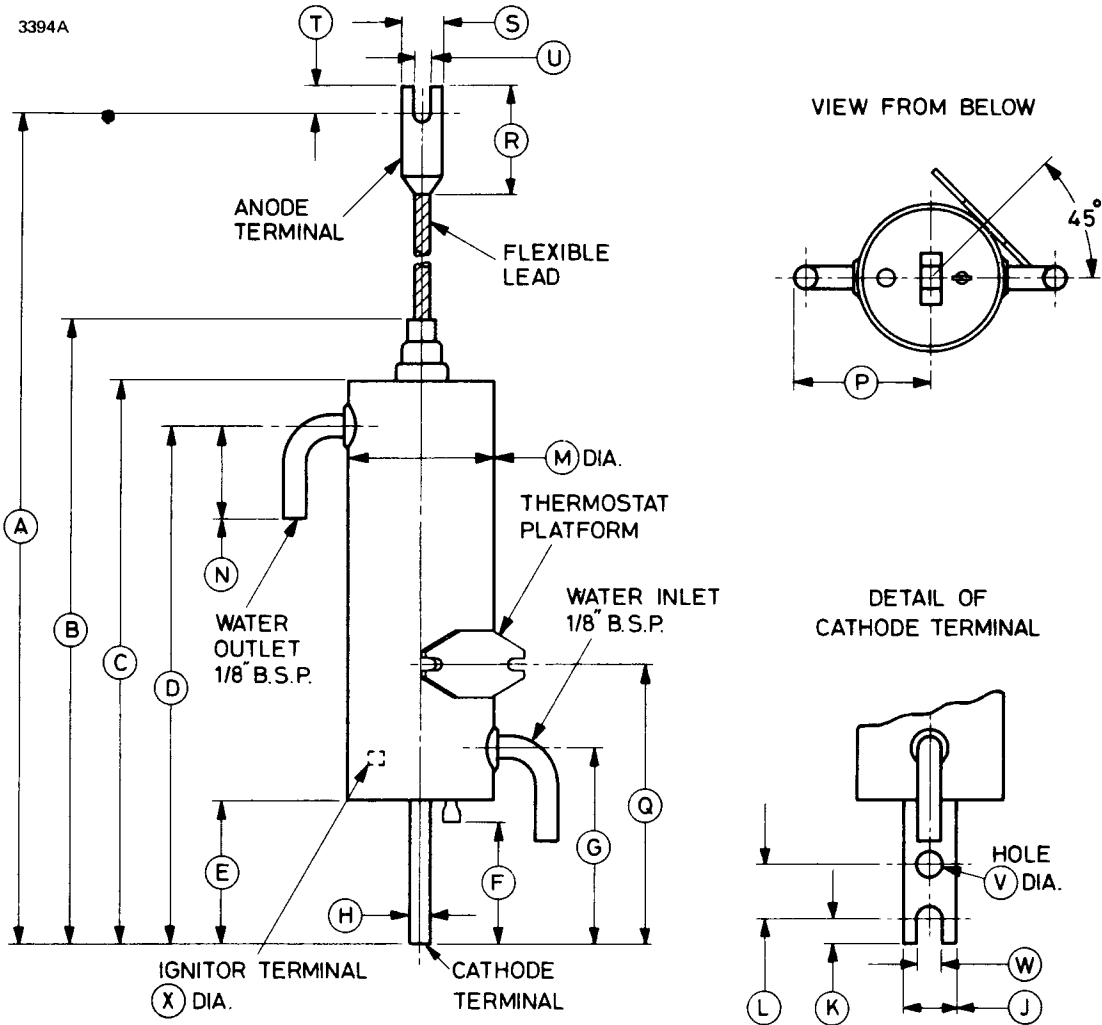


# PEAK CURRENT – AVERAGE CURRENT PER IGNITRON (MAXIMUM RATINGS)

Three-phase welder control service



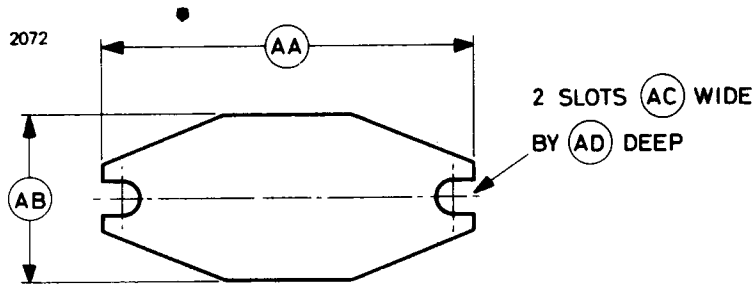
# OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	21.750 min	552.5 min	M	3.250 max	82.55 max
B	13.000 max	330.2 max	N	2.500 max	63.50 max
C	11.000 max	279.4 max	P	2.875 max	73.03 max
D	9.500	241.3	Q	5.125 ± 0.250	130.18 ± 6.35
E	2.375 min	60.33 min	R	2.375 max	60.33 max
F	2.000 min	50.80 min	S	1.000 max	25.40 max
G	3.625	92.08	T	0.812 max	20.62 max
H	0.375 ± 0.031	9.53 ± 0.79	U	0.406 ± 0.031	10.31 ± 0.79
J	1.000 ± 0.062	25.40 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.500 ± 0.062	12.70 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13

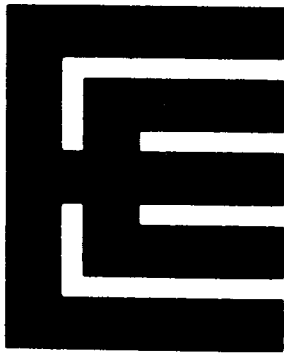
Millimetre dimensions have been derived from inches.

**Thermostat Mounting Plate (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
AA	2.750	69.85
AB	1.250	31.75
AC	0.219	5.56
AD	0.375	9.53

Millimetre dimensions have been derived from inches.



# BK44/5554

## IGNITRON

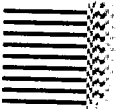
### Service Type CV1742

Equivalent to 5554

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size C, stainless-steel-jacketed, water-cooled ignitron intended primarily for rectifier service. It is also suitable for high-voltage resistance welding control.



#### Power Rectifier Service

Peak anode voltage . . . . .	900	2100	V
Maximum continuous average anode current . . . . .	100	75	A

#### Welder Control Service

Supply voltage (r.m.s.) . . . . .		2400	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 75A) . . . . .		1200	kVA
Maximum average anode current (for demand not exceeding 600kVA) . . . . .		113	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitrons . . . . .	2
auxiliary anode . . . . .	1

Arc voltage drop (approx):

at 300A peak current . . . . .	14	V
at 600A peak current . . . . .	17	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	17.000 inches (432mm) max
Overall width . . . . .	7.250 inches (184.2mm) max
Body diameter . . . . .	4.125 inches (104.8mm) max
Net weight . . . . .	13 pounds (5.9kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Ignitor lead . . . . .	ZD100222
Auxiliary anode lead . . . . .	ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Anode Ratings – Power Rectifier Service**

	Peak anode voltage 0.9kV	Peak anode voltage 2.1kV	
Peak anode current . . . . .	900	600	A max
Average anode current:			
continuous . . . . .	100	75	A max
two hours (averaging time 2 minutes) . . . . .	150	113	A max
one minute (averaging time 1 minute) . . . . .	200	150	A max
Fault current (peak) . . . . .	6000	4500	A max
Duration of fault current . . . . .	0.15	0.15 s	max
Frequency range . . . . .	25–60	25–60	Hz

**Anode Ratings – Welder Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

Supply voltage (r.m.s.) . . . . .	2400	V
Frequency range . . . . .	25 to 60	Hz
Demand (for average current not exceeding 75A) . . . . .	1200	kVA max
Anode current (average) (for demand not exceeding 600kVA) . . . . .	113	A max
Anode current averaging time (at 2400V) . . . . .	1.5	s max
Fault current (peak) . . . . .	3000	A max
Duration of fault current . . . . .	0.15	s max

**Auxiliary Anode**

Peak forward voltage . . . . .	160	V max
Peak inverse voltage:		
main anode conducting . . . . .	25	V max
main anode not conducting . . . . .	160	V max
Current:		
peak . . . . .	30	A max
r.m.s. . . . .	15	A max
average . . . . .	9	A max
averaging time . . . . .	10	s max

**Ignitor**

Peak forward ignitor voltage . . . . .	anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	15	A max
average . . . . .	2.0	A max
averaging time . . . . .	10	s max



## MAXIMUM AND MINIMUM RATINGS (Continued)

### IGNITOR CIRCUIT REQUIREMENTS

#### Anode Firing

Ignitor voltage required to fire . . . . .	250	V min
Ignitor current required to fire . . . . .	25	A min
Typical current at ignition . . . . .	6 to 12	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

#### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A) . . . . .	500	$\mu$ s min
Recommended pulse length (approx sine wave) . . . . .	800	$\mu$ s

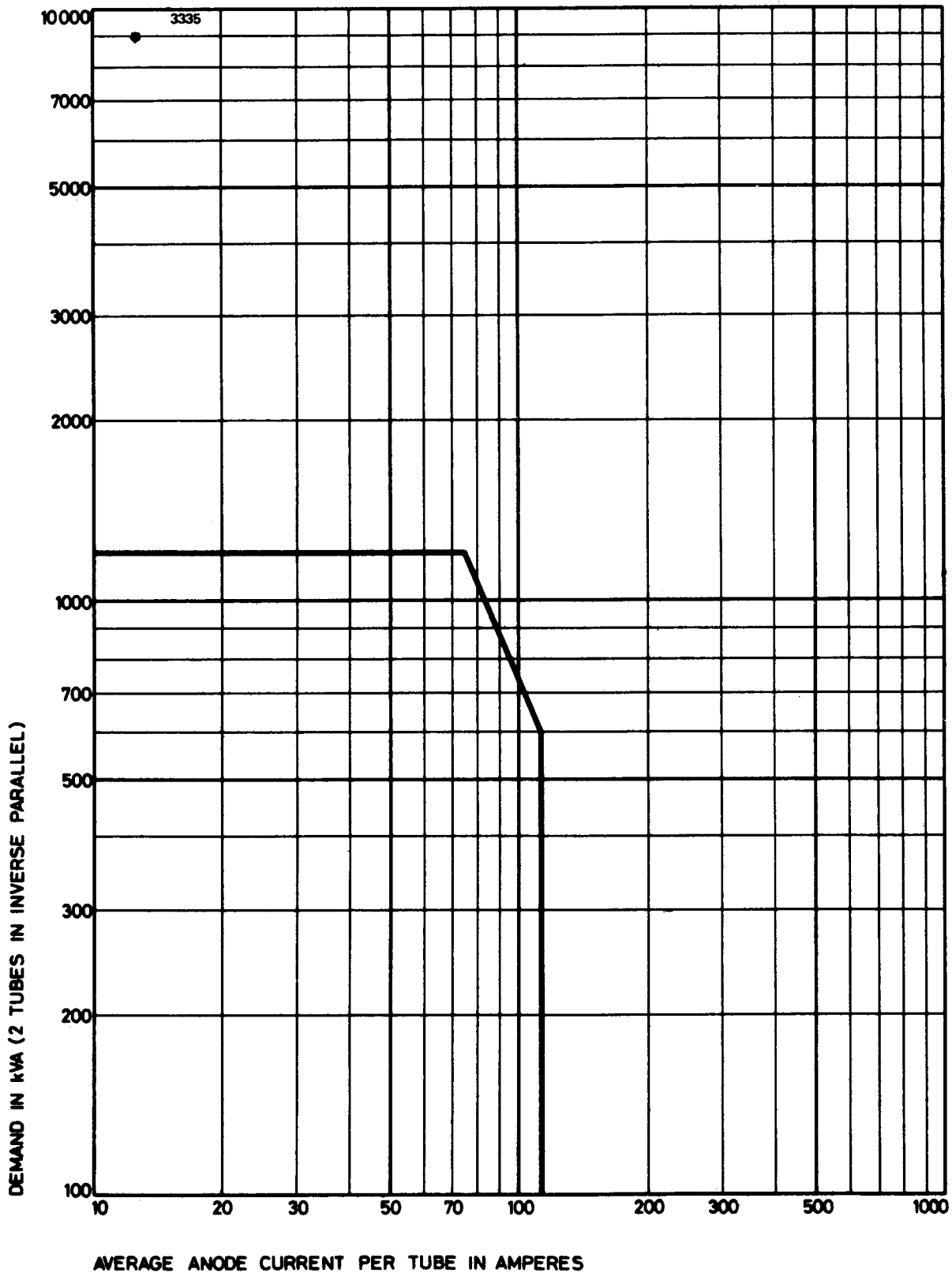
### COOLING

Minimum water flow rate (see note) . . . . .	1.5	imp. gal/min
	7.0	l./min
Inlet water temperature . . . . .	6.0	$^{\circ}$ C min
Outlet water temperature:		
rectifier service at 900V . . . . .	60	$^{\circ}$ C max
rectifier service at 2100V . . . . .	45	$^{\circ}$ C max
welder service at 2400V . . . . .	30	$^{\circ}$ C max
Temperature rise across jacket . . . . .	6.0	$^{\circ}$ C max

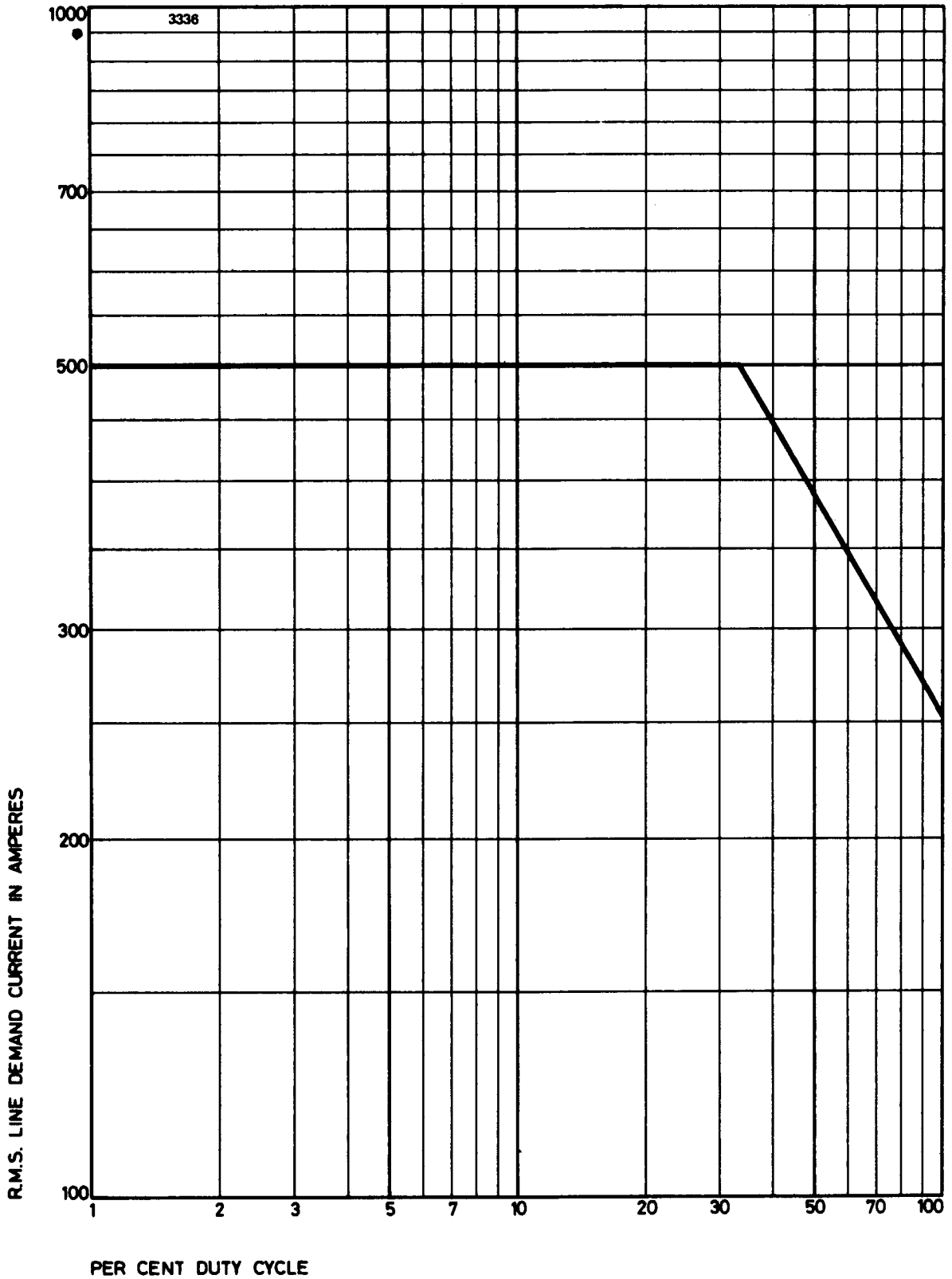
#### Note

At the minimum flow rate of 1.5 imp. gal/min, the pressure drop across the jacket will be 5 lb/in<sup>2</sup> (0.35kg/cm<sup>2</sup>) approx. The water flow must be maintained for 15 minutes after switching off.

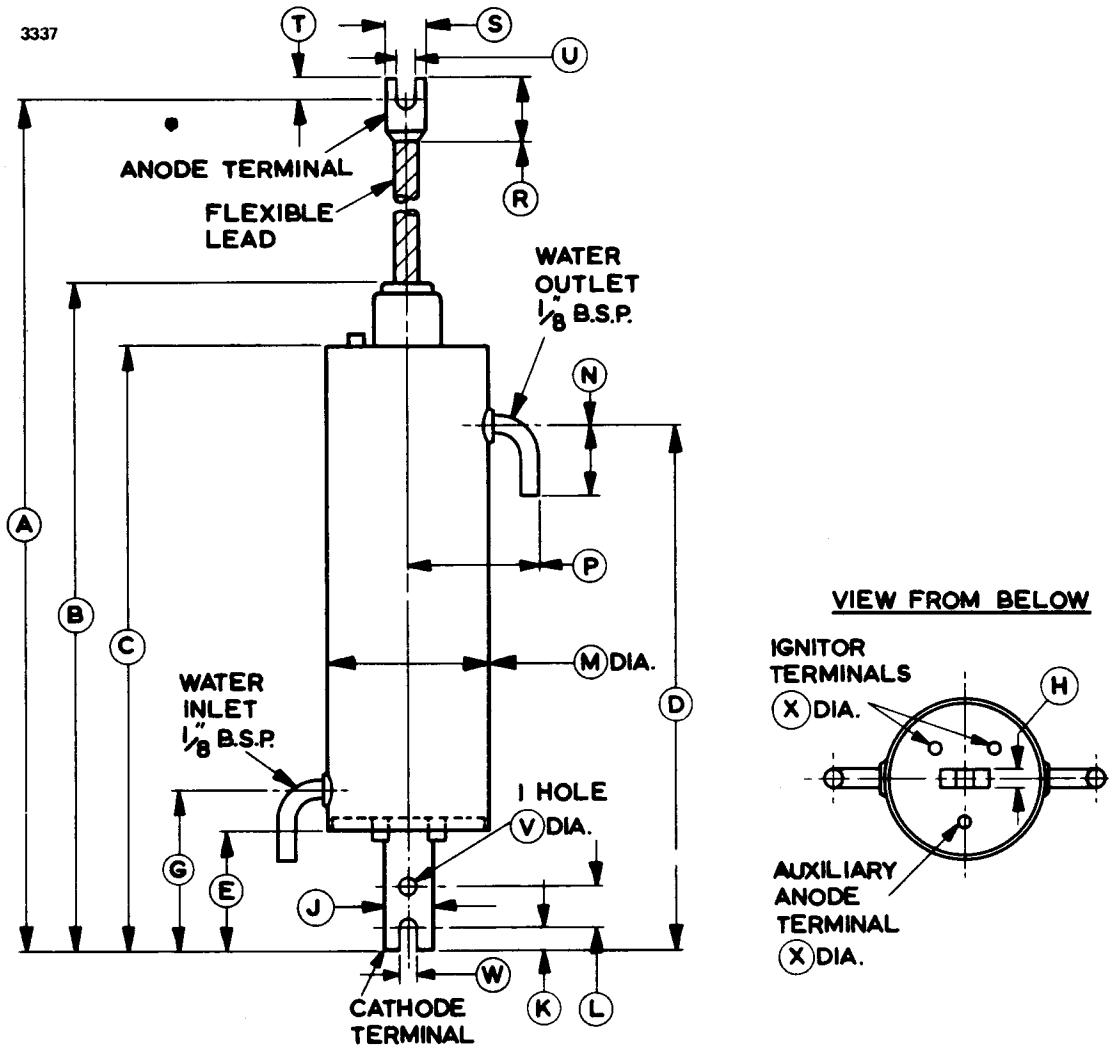
**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 2400 volts**



**LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 2400 volts**



**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	25.187 min	639.7 min	M	4.000 ± 0.125	101.6 ± 3.2
B	17.000 max	431.8 max	N	2.500 max	63.50 max
C	15.250 max	387.4 max	P	3.625 max	92.08 max
D	12.750	323.9	R	3.000 max	76.20 max
E	2.375 min	60.33 min	S	1.250 max	31.75 max
G	3.750	95.25	T	1.000 max	25.40 max
H	0.500 ± 0.031	12.70 ± 0.79	U	0.437 ± 0.062	11.10 ± 1.57
J	1.250 ± 0.062	31.75 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.625 ± 0.062	15.88 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13

Millimetre dimensions have been derived from inches.



# BK46/5555

## IGNITRON

### Equivalent to 5555

The data should be read in conjunction with the Ignitron Preamble.

#### ABRIDGED DATA

Size D, stainless-steel-jacketed, water-cooled ignitron intended primarily for rectifier service. It is also suitable for high-voltage resistance welding control.



#### Power Rectifier Service

Peak anode voltage . . . . .	900	2100	V
Maximum continuous average anode current . . . . .	200	150	A

#### Welder Control Service

Supply voltage (r.m.s.) . . . . .	2400	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 135A) . . . . .	2400	kVA
Maximum average anode current (for demand not exceeding 1105kVA) . . . . .	207	A

#### GENERAL

##### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitors . . . . .	2
auxiliary anode . . . . .	1

Arc voltage drop (approx):

at 600A peak current . . . . .	16	V
at 1200A peak current . . . . .	19	V

##### Mechanical

Overall length (excluding flexible lead) . . . . .	21.000 inches (533.4mm) max
Overall width . . . . .	8.625 inches (219.1mm) max
Body diameter . . . . .	5.750 inches (146.1mm) max
Net weight . . . . .	25 pounds (11.3kg) approx
Mounting position . . . . .	vertical, anode terminal up

##### Accessories

Ignitor lead . . . . .	ZD100222
Auxiliary anode lead . . . . .	ZD100222

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### Anode Ratings – Power Rectifier Service

	Peak anode voltage 0.9kV	Peak anode voltage 2.1kV	
Peak anode current . . . . .	1800	1200	A max
Average anode current:			
continuous . . . . .	200	150	A max
two hours (averaging time 2 minutes) . . . . .	300	225	A max
one minute (averaging time 1 minute) . . . . .	400	300	A max
Fault current (peak) . . . . .	12 000	9000	A max
Duration of fault current . . . . .	0.15	0.15	s max
Frequency range . . . . .	25–60	25–60	Hz

### Anode Ratings – Welder Control Service

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

Supply voltage (r.m.s.) . . . . .	2400	V
Frequency range . . . . .	25 to 60	Hz
Demand (for average current not exceeding 135A) . . . . .	2400	kVA max
Anode current (average) (for demand not exceeding 1105kVA) . . . . .	207	A max
Anode current averaging time . . . . .	1.66	s max
Fault current (peak) . . . . .	6000	A max
Duration of fault current . . . . .	0.15	s max

### Auxiliary Anode

Peak forward voltage . . . . .	160	V max
Peak inverse voltage:		
main anode conducting . . . . .	25	V max
main anode not conducting . . . . .	160	V max
Current:		
peak . . . . .	30	A max
r.m.s. . . . .	15	A max
average . . . . .	9.0	A max
averaging time . . . . .	10	s max

### Ignitor

Peak forward ignitor voltage . . . . .	anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	15	A max
average . . . . .	2.0	A max
averaging time . . . . .	10	s max

## MAXIMUM AND MINIMUM RATINGS (Continued)

### IGNITOR CIRCUIT REQUIREMENTS

#### Anode Firing

Ignitor voltage required to fire . . . . .	250	V min
Ignitor current required to fire . . . . .	25	A min
Typical current at ignition . . . . .	6 to 12	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

#### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A) . . . . .	500	$\mu$ s min
Recommended pulse length (approx sine wave) . . . . .	800	$\mu$ s

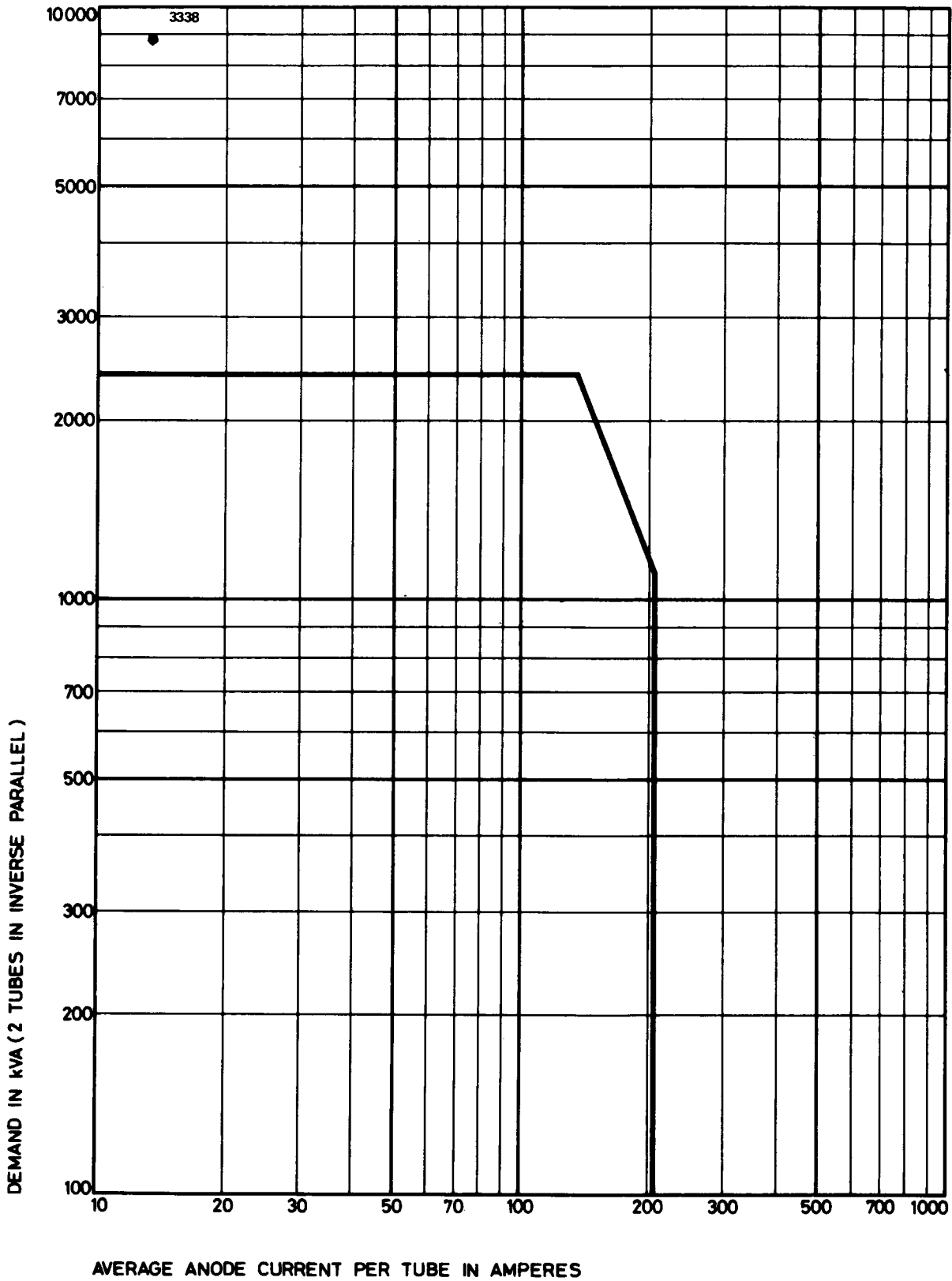
### COOLING

Minimum water flow rate (see note) . . . . .	3.0	imp. gal/min
	14	l./min
Inlet water temperature . . . . .	6.0	$^{\circ}$ C min
Outlet water temperature:		
rectifier service at 900V . . . . .	60	$^{\circ}$ C max
rectifier service at 2100V . . . . .	45	$^{\circ}$ C max
welder service at 2400V . . . . .	30	$^{\circ}$ C max
Temperature rise across jacket . . . . .	4.5	$^{\circ}$ C max

#### Note

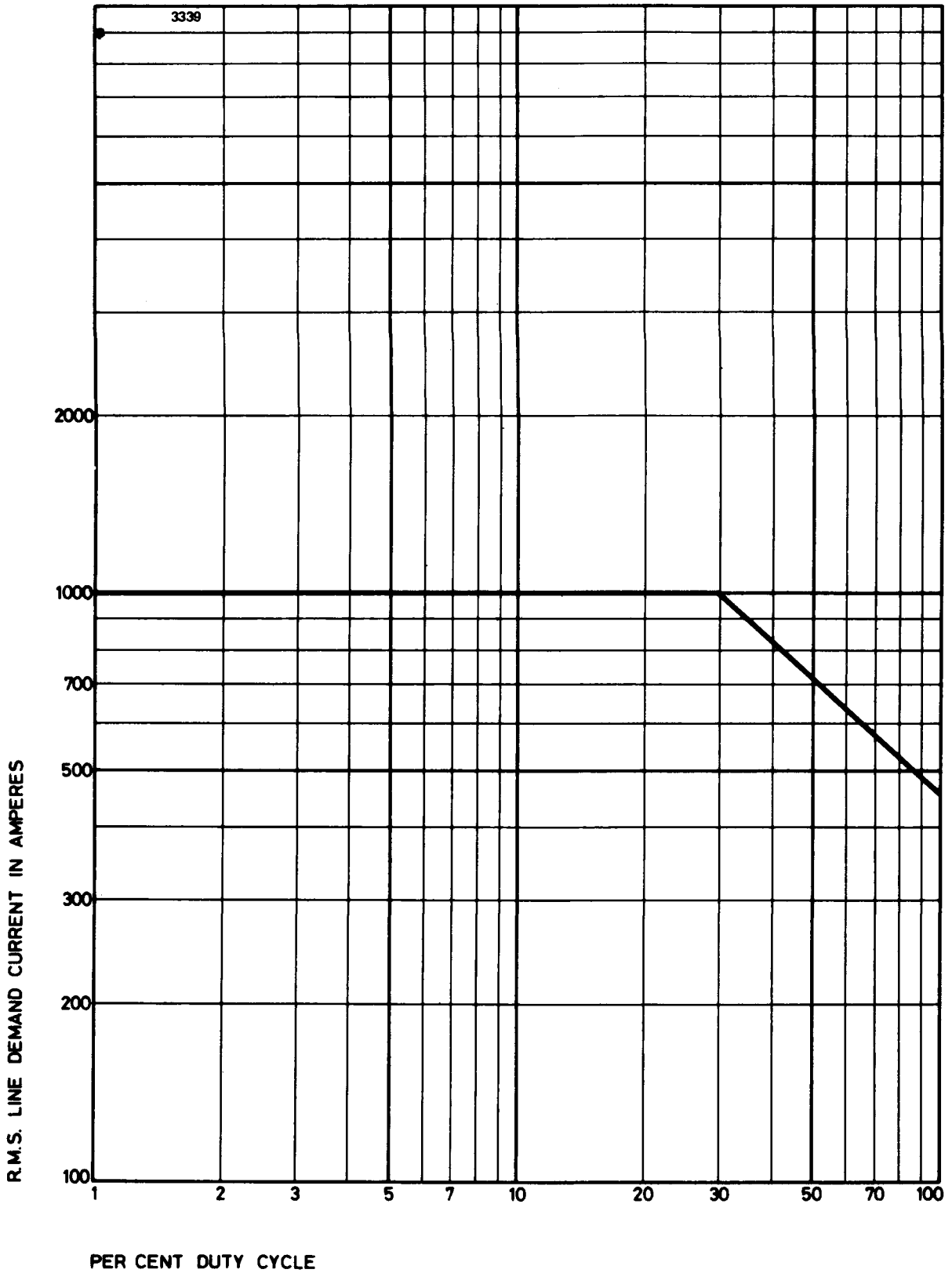
At the minimum flow rate of 3.0 imp. gal/min, the pressure drop across the jacket will be 6.0 lb/in<sup>2</sup> (0.42kg/cm<sup>2</sup>) max. The water flow must be maintained for 30 minutes after switching off.

**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 2400 volts**

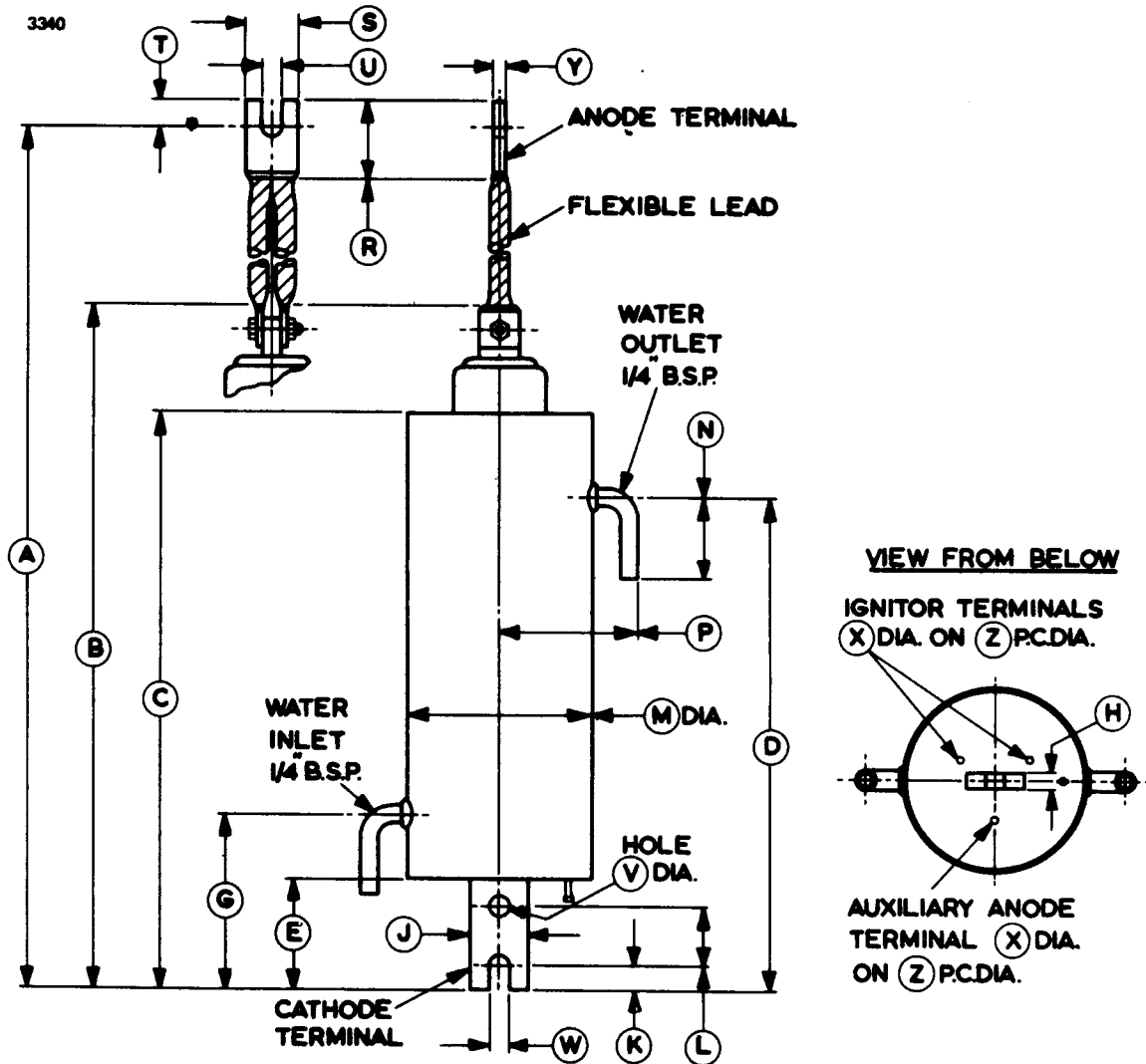




**LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 2400 volts**

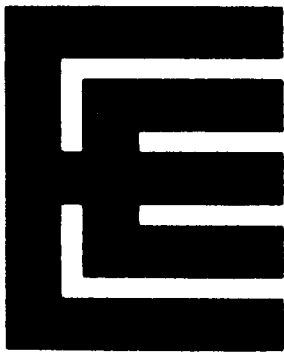


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	27.375 min	695.3 min	N	3.000 max	76.20 max
B	21.000 max	533.4 max	P	4.312 max	109.5 max
C	17.500 max	444.5 max	R	3.750 max	95.25 max
D	14.500	368.3	S	1.750 max	44.45 max
E	3.125 min	79.38 min	T	1.500 max	38.10 max
G	5.125	130.2	U	0.562 ± 0.062	14.27 ± 1.57
H	0.500 ± 0.031	12.70 ± 0.79	V	0.562 ± 0.031	14.27 ± 0.79
J	1.750 ± 0.062	44.45 ± 1.57	W	0.562 ± 0.031	14.27 ± 0.79
K	0.750 ± 0.062	19.05 ± 1.57	X	0.250 ± 0.005	6.35 ± 0.13
L	1.750 ± 0.031	44.45 ± 0.79	Y	0.312	7.93
M	5.750 max	146.1 max	Z	2.250	57.15

Millimetre dimensions have been derived from inches.



## IGNITRON

### Equivalent to 5550

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size A, stainless-steel-envelope ignitron intended primarily for single-phase resistance welding control applications. It is cooled by means of a removable water cooled clamp which also acts as a cathode terminal and provides means for mounting the ignitron.



Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 12.1A) . . . . .	300	kVA
Maximum average anode current (for demand not exceeding 100kVA) . . . . .	22.4	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 70A peak current . . . . .	12	V
at 1700A peak current . . . . .	25	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	9.000 inches (228.6mm) max
Body diameter . . . . .	2.140 inches (54.35mm) max
Net weight . . . . .	1½ pounds (0.68kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water-cooled clamp . . . . .	ZD100365
Ignitor lead . . . . .	ZD100222

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### Single-phase Resistance Welding Control Service

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	Min	Max	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz)	250	600	V
Demand (for average current not exceeding 12.1A)	—	300	kVA
Anode current (average) (for demand not exceeding 100kVA)	—	22.4	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub>	—	9.2	s
at 440V <sub>r.m.s.</sub>	—	11	s
at 250V <sub>r.m.s.</sub>	—	22	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub>	—	1400	A
at 250V <sub>r.m.s.</sub>	—	3360	A
Duration of fault current	—	0.15	s

### Ignitor

Peak forward ignitor voltage	—	anode voltage	
Peak inverse ignitor voltage	—	5.0	V
Ignitor current:			
peak	—	100	A
r.m.s.	—	10	A
average	—	1.0	A
averaging time	—	5.0	s

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire	200	V min
Ignitor current required to fire	12	A min
Typical current at ignition	5 to 8	A
Starting time at required voltage or current	100	μs max

### Separate Excitation

Open-circuit voltage of excitation circuit	450	V min
Short-circuit current of excitation circuit	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A)	150	μs min
Recommended pulse length (approx sine wave)	500	μs

**COOLING**

Minimum water flow rate (see note)	1.0	imp. gal/min
	4.5	l./min
Cooling clamp temperature:		
maximum	50	°C
minimum	10	°C

**Caution**

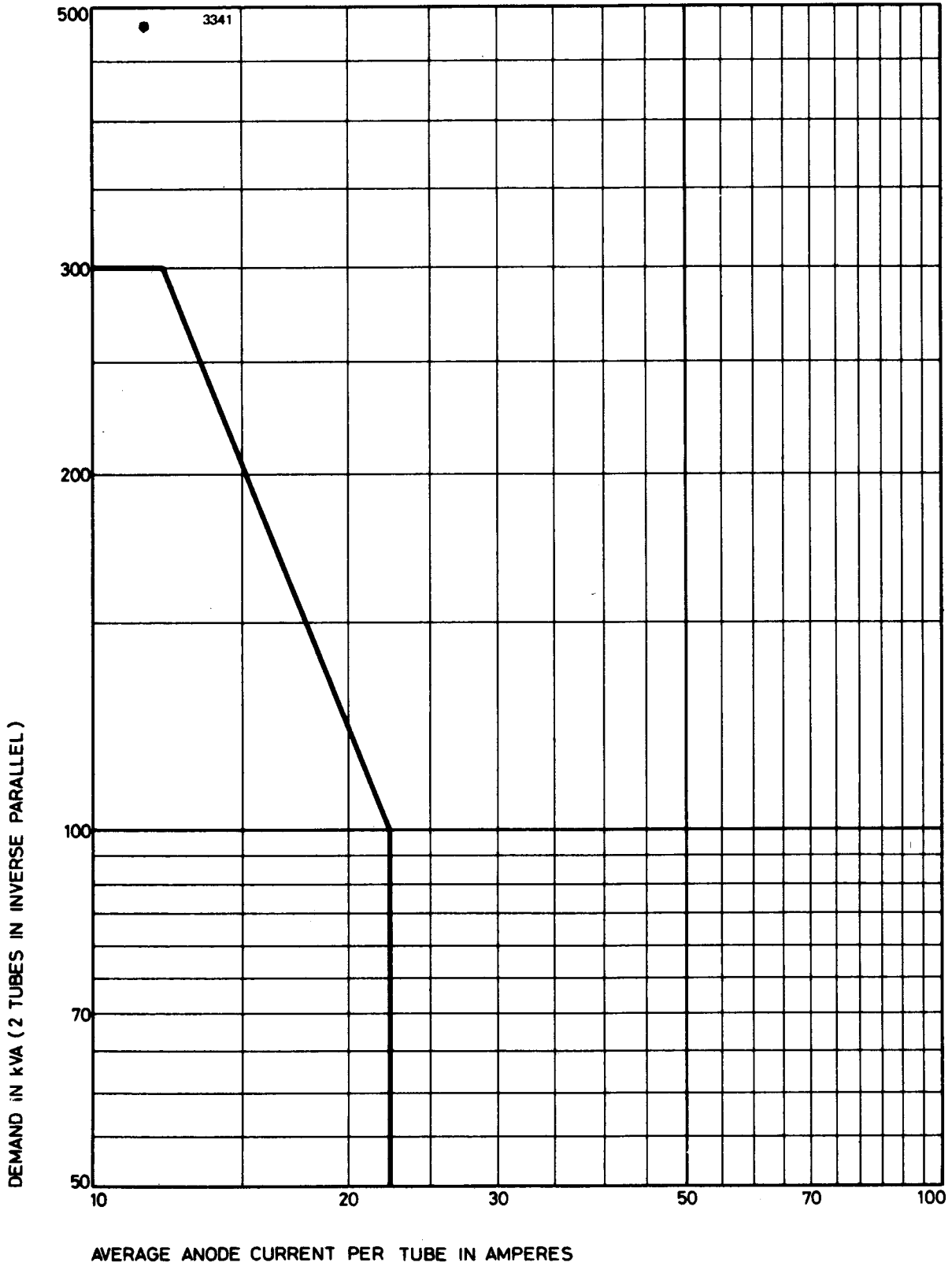
The cooling clamp must be in good thermal contact with the ignitron envelope. Accidental damage to the inside of the clamp may produce areas of poor contact. The ignitron and clamp should both be wiped clean before assembly, as small dirt particles can cause severe local heating.



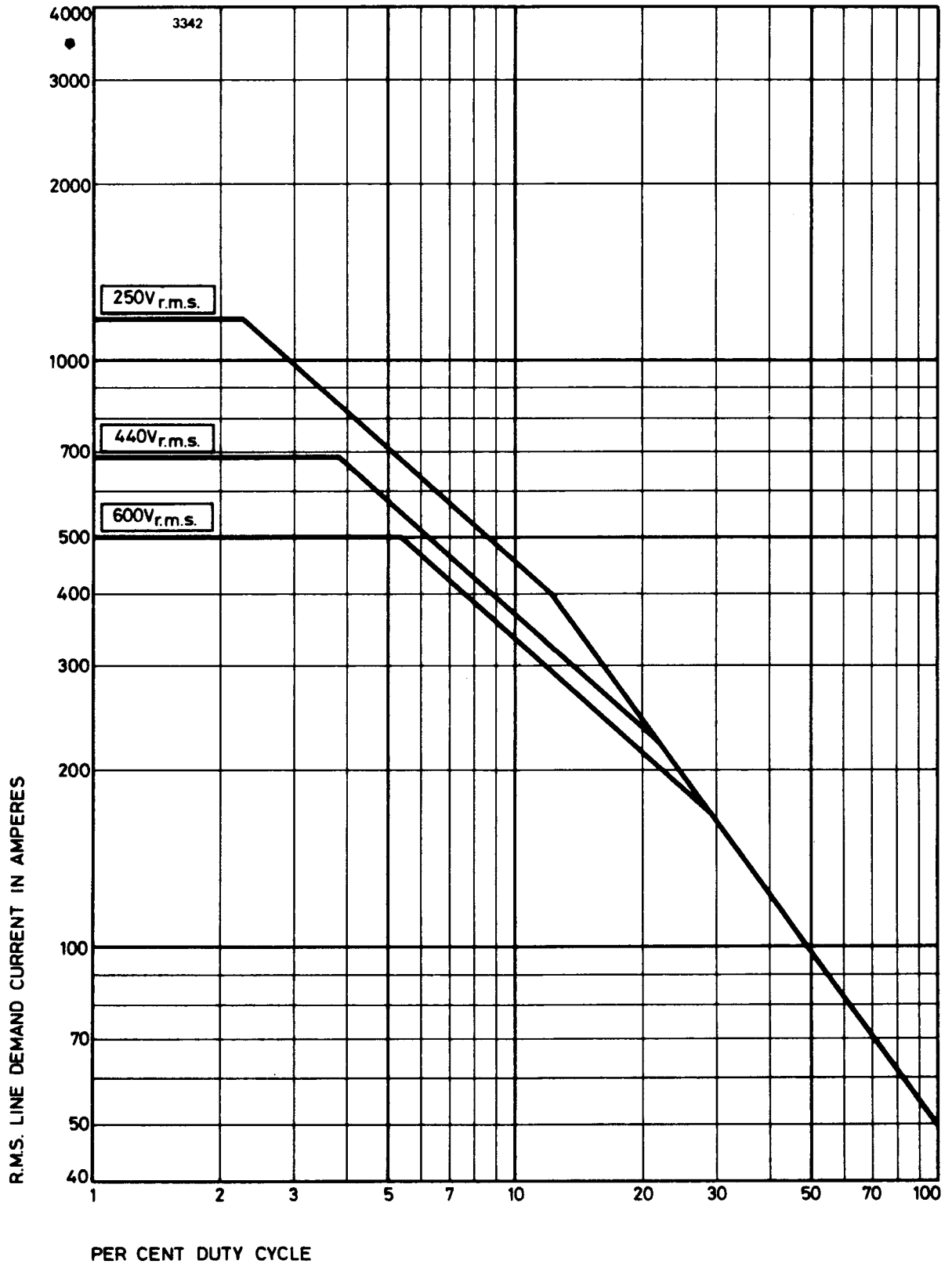
**Note**

It is essential that the flow of water be maintained for 5 minutes after switching off.

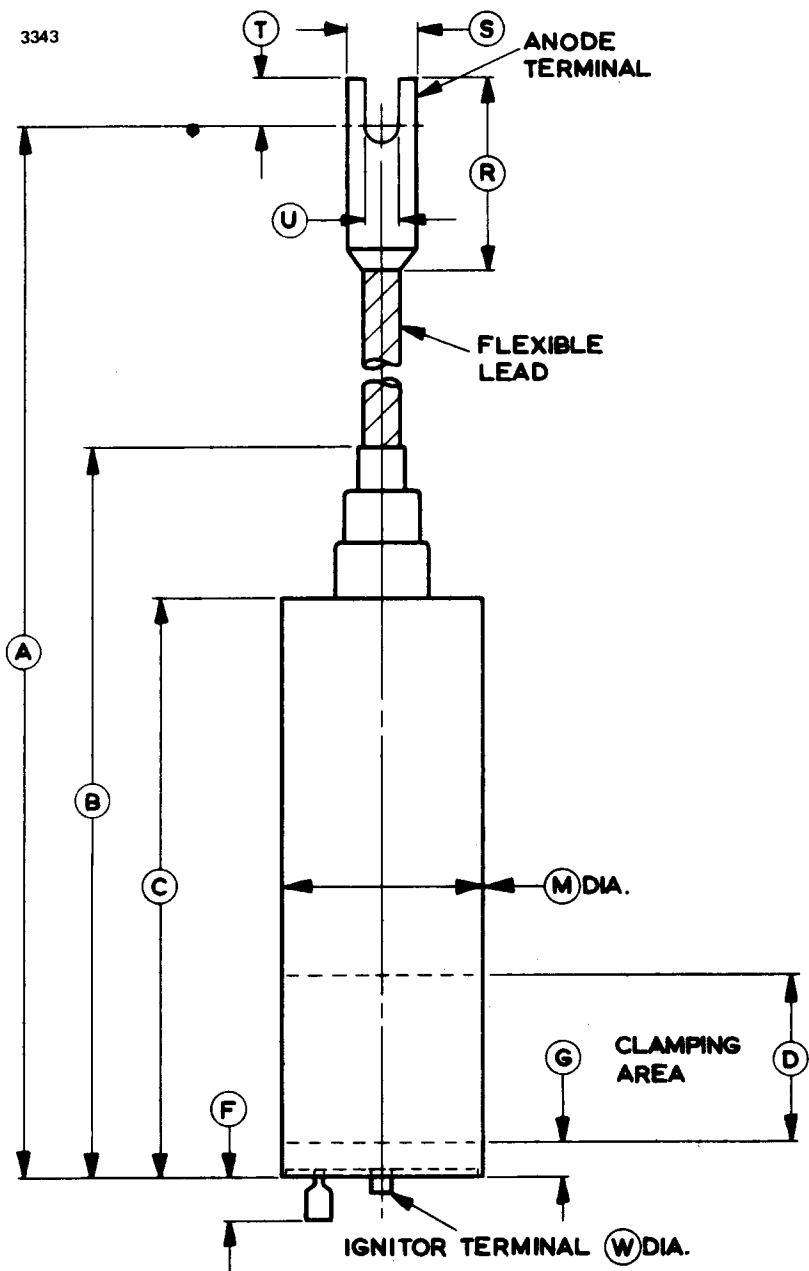
**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 250 to 600 volts**



**LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control**



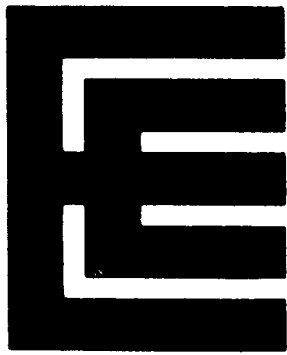
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	14.375 min	365.1 min	M	2.130 ± 0.010	54.10 ± 0.25
B	8.250 max	209.6 max	R	2.375 max	60.33 max
C	5.500 ± 0.125	139.7 ± 3.2	S	1.000 max	25.40 max
D	1.750 min	44.45 min	T	0.812 max	20.62 max
F	0.750 max	19.05 max	U	0.406 ± 0.031	10.31 ± 0.79
G	0.375	9.53	W	0.250 ± 0.005	6.35 ± 0.13

Millimetre dimensions have been derived from inches.





# BK146/5553B

## IGNITRON

### Equivalent to 5553B

The data should be read in conjunction with the Ignitron Preamble.

#### ABRIDGED DATA

Size D, stainless-steel-jacketed, water-cooled ignitron intended primarily for single-phase or three-phase (frequency changing) resistance welding control applications. It has a platform for mounting a detachable thermostat for temperature control.



For an electrically identical version with coaxial cathode terminal see BK446/7673.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 192A) . . . . .	2400	kVA
Maximum average anode current (for demand not exceeding 800kVA) . . . . .	355	A

#### GENERAL

##### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 1115A peak current . . . . .	17	V
at 13 600A peak current . . . . .	36	V

##### Mechanical

Overall length (excluding flexible lead) . . . . .	20.000 inches (508.0mm) max
Overall width . . . . .	9.375 inches (238.1mm) max
Body diameter . . . . .	7.125 inches (181.0mm) max
Net weight . . . . .	21 pounds (9.5kg) approx
Mounting position . . . . .	vertical, anode terminal up

##### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

**Accessories (continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .					1.0 kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Single-phase Resistance Welding Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	<b>Min</b>	<b>Max</b>	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 192A) . . . . .	—	2400	kVA
Anode current (average) (for demand not exceeding 800kVA) . . . . .	—	355	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	4.6	s
at 440V <sub>r.m.s.</sub> . . . . .	—	6.3	s
at 250V <sub>r.m.s.</sub> . . . . .	—	11	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	11.2	kA
at 250V <sub>r.m.s.</sub> . . . . .	—	27	kA
Duration of fault current . . . . .	—	0.15	s

**Three-phase (Frequency Changing) Welding Control  
or Power Rectifier Service (Intermittent Duty)**

**Anode**

	<b>Peak anode voltage 0.6kV</b>	<b>Peak anode voltage 1.2kV</b>	<b>Peak anode voltage 1.5kV</b>	
Anode current (peak) . . . . .	4.0	3.0	2.4	kA max
Corresponding average . . . . .	54	40	32	A max
Anode current (average) . . . . .	190	140	112	A max
Corresponding peak . . . . .	1140	840	672	A max
Averaging time . . . . .	6.25	6.25	6.25	s max
Peak fault current . . . . .	50	37.5	30	kA max
Duration of fault current . . . . .	0.15	0.15	0.15	s max
Frequency range . . . . .	50—60	50—60	50—60	Hz

## MAXIMUM AND MINIMUM RATINGS (Continued)

### Ignitor

Peak forward ignitor voltage . . . . .	anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

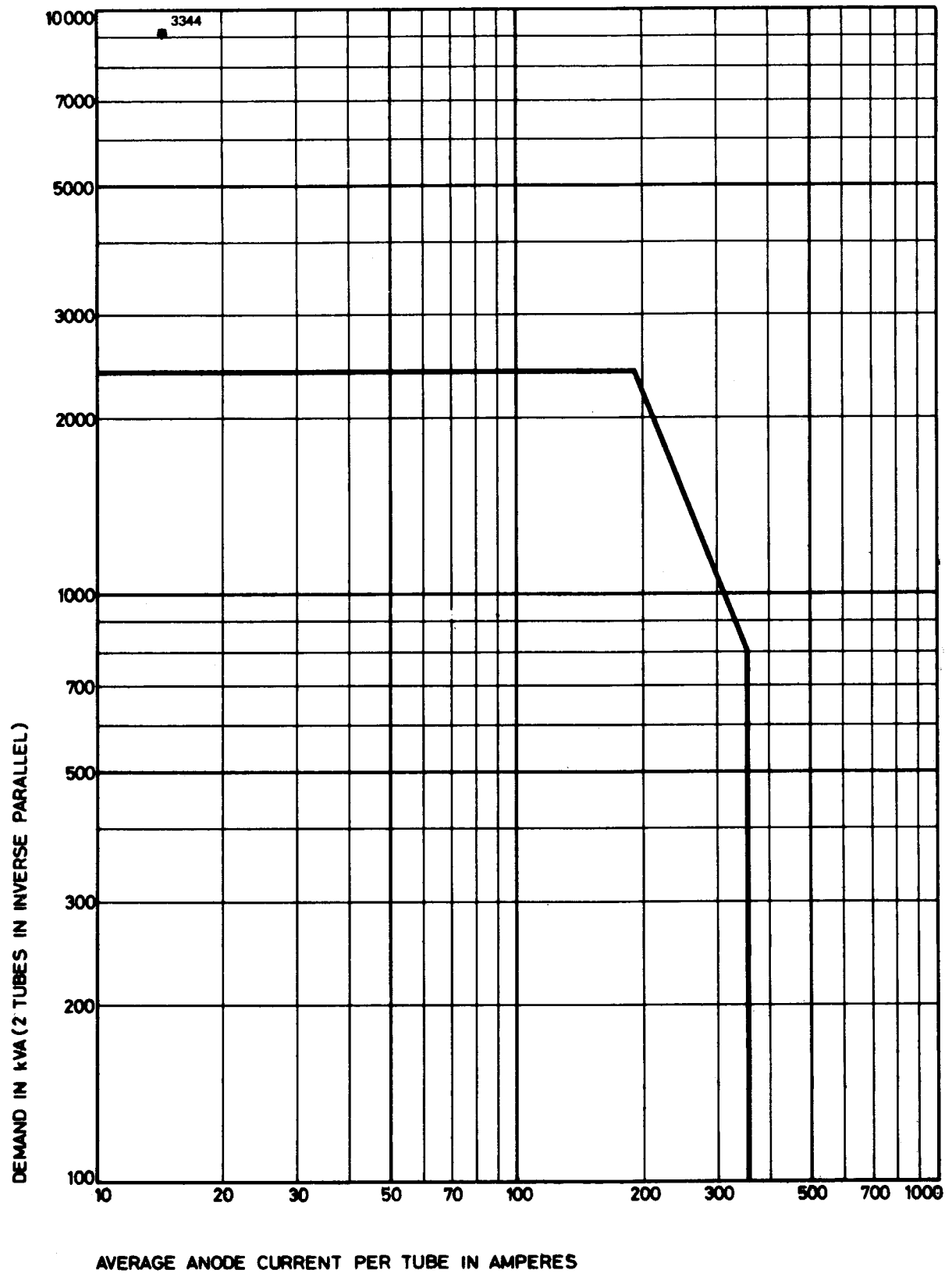
## COOLING

Minimum water flow rate (see note) . . . . .	3.0	imp. gal/min
	14	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	9.0	$^{\circ}$ C max

### Note

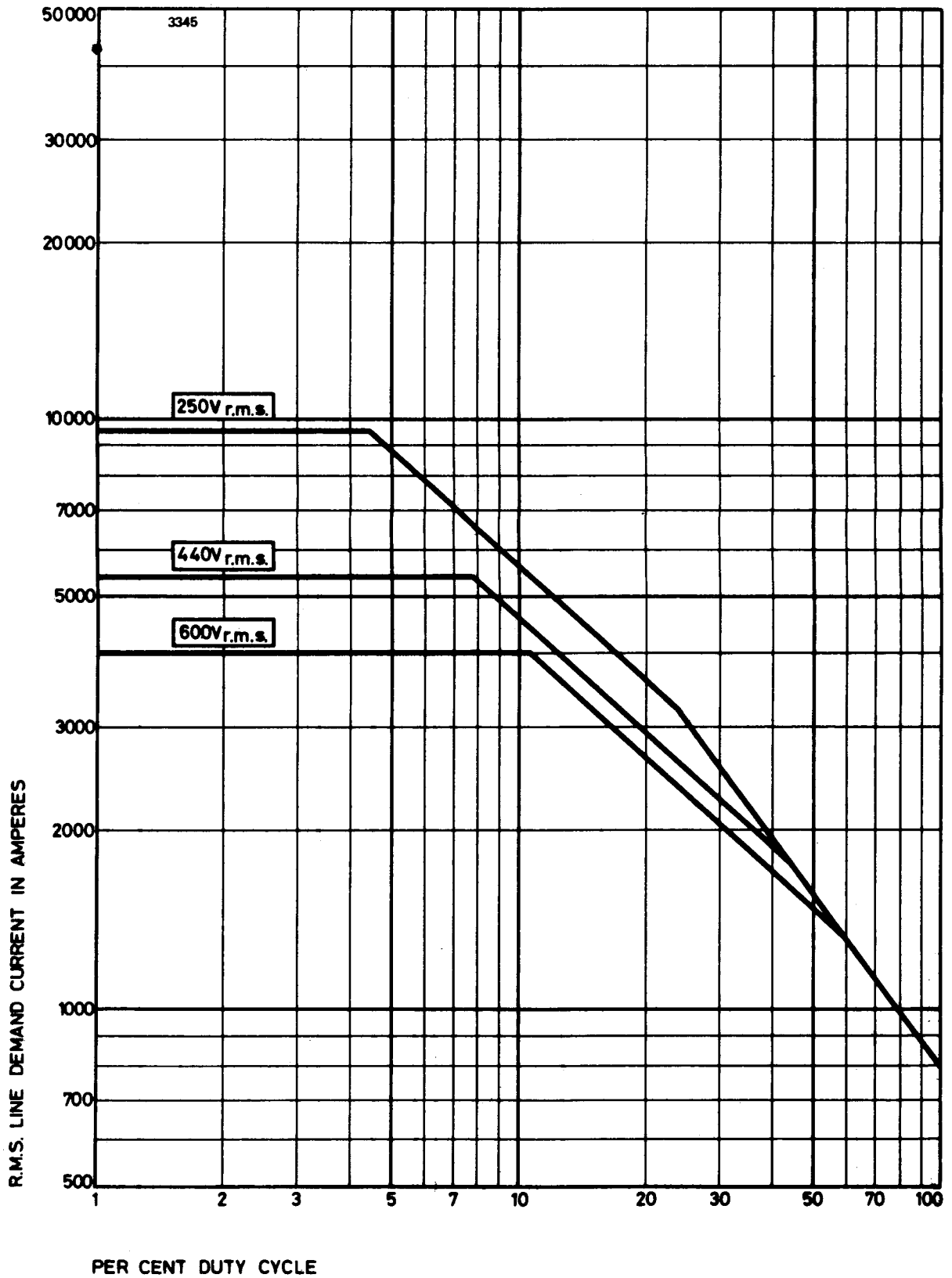
At the minimum flow rate of 3.0 imp. gal/min, the pressure drop across the jacket will be 5.0 lb/in<sup>2</sup> (0.35kg/cm<sup>2</sup>) approx. The water flow must be maintained for 30 minutes after switching off.

**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 250 to 600 volts**



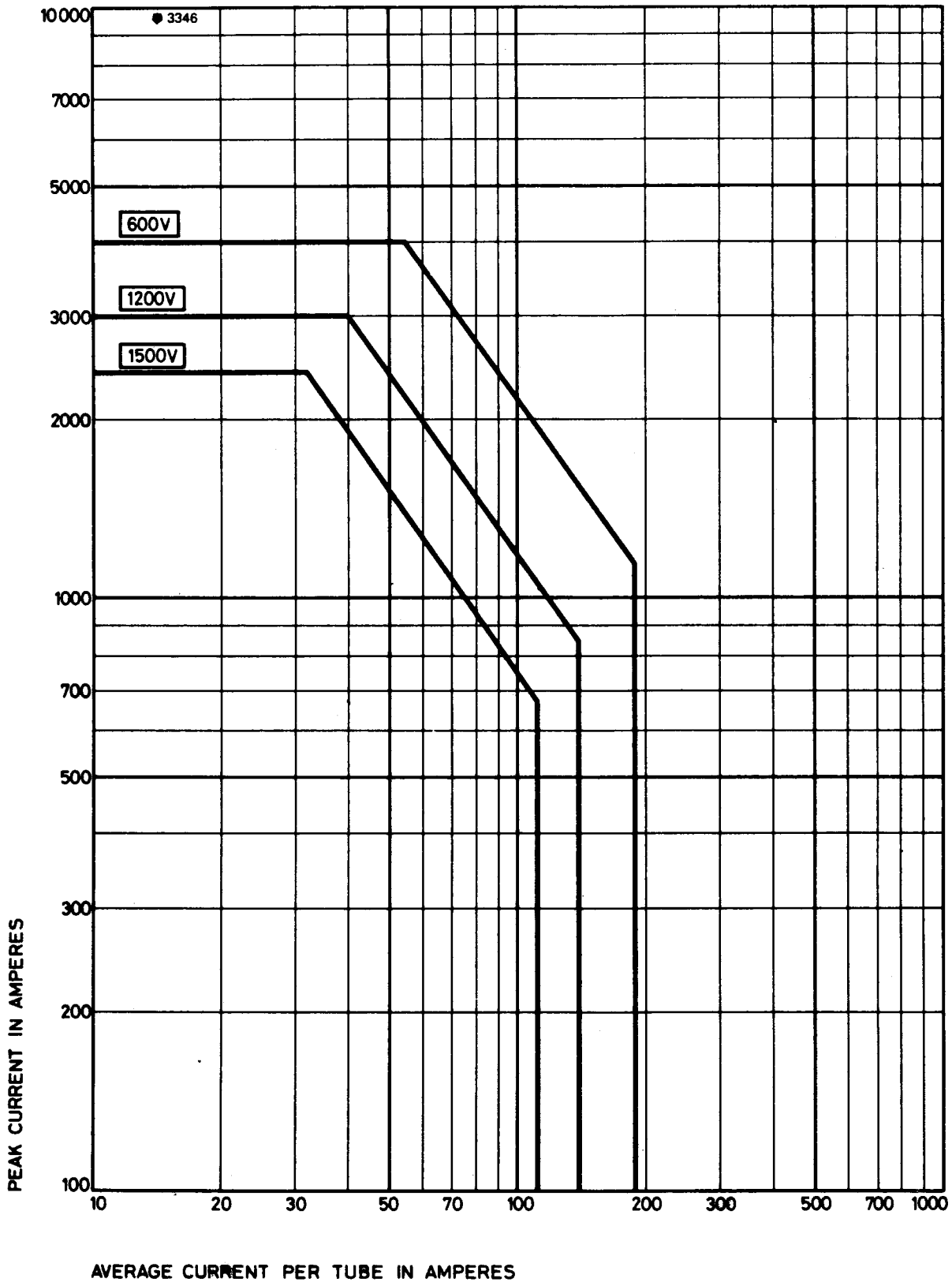
# LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)

Two ignitrons in inverse parallel for welder control service

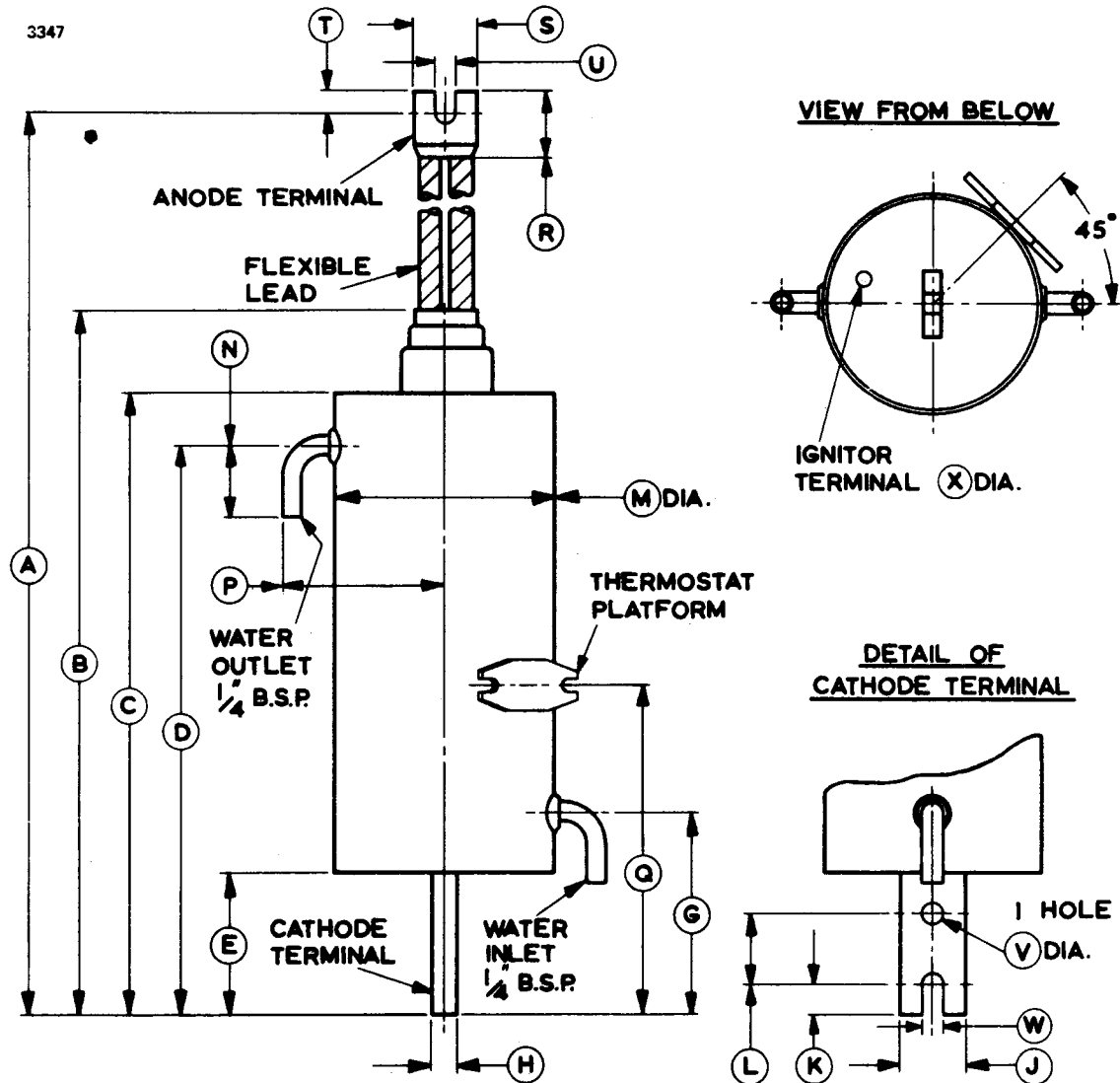


# PEAK CURRENT – AVERAGE CURRENT PER IGNITRON (MAXIMUM RATINGS)

Three-phase welder control service



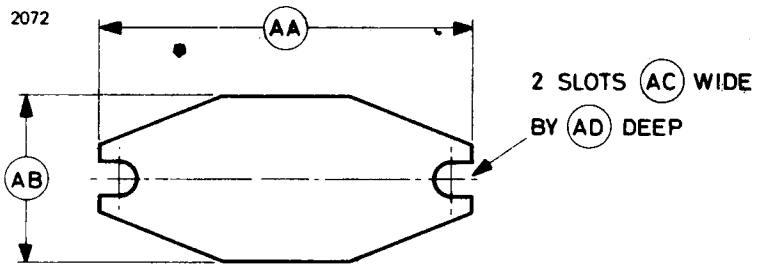
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	27.375 min	695.3 min	N	3.000 max	76.20 max
B	20.000 max	508.0 max	P	4.687 max	119.0 max
C	17.000 max	431.8 max	Q	8.125 ± 0.500	206.4 ± 12.7
D	14.000	355.6	R	3.750 max	95.25 max
E	3.125 min.	79.38 min	S	1.750 max	44.45 max
G	5.000	127.0	T	1.500 max	38.10 max
H	0.500 ± 0.031	12.70 ± 0.79	U	0.562 ± 0.062	14.27 ± 1.57
J	1.750 ± 0.062	44.45 ± 1.57	V	0.562 ± 0.031	14.27 ± 0.79
K	0.750 ± 0.062	19.05 ± 1.57	W	0.562 ± 0.031	14.27 ± 0.79
L	1.750 ± 0.031	44.45 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13
M	7.125 max	181.0 max			

Millimetre dimensions have been derived from inches.

**Thermostat Mounting Plate (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
AA	2.750	69.85
AB	1.250	31.75
AC	0.219	5.56
AD	0.375	9.53

Millimetre dimensions have been derived from inches.





# BK168/5822A

## IGNITRON

### Equivalent to 5822A

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size C, stainless-steel-jacketed, water-cooled ignitron intended primarily for three-phase (frequency-changing) resistance welding control applications. It has a platform for mounting a detachable thermostat for temperature control. For an electrically identical version with coaxial cathode terminal see BK468/7672.



Peak forward or inverse anode voltage . . . . .	1200	1500	V
Maximum peak anode current . . . . .	1500	1200	A
corresponding average . . . . .	20	16	A
Maximum average anode current . . . . .	70	56	A
corresponding peak . . . . .	420	336	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1	
cathode (mercury pool) . . . . .	1	
ignitor . . . . .	1	
Arc voltage drop (approx) at 1500A peak . . . . .	25	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	14.750 inches (374.7mm) max
Overall width . . . . .	7.250 inches (184.2mm) max
Body diameter . . . . .	4.625 inches (117.5mm) max
Net weight . . . . .	8½ pounds (3.9kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

**Accessories (Continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .					1.0 kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Three-phase (Frequency Changing) Welding Control  
or Power Rectifier Service (Intermittent Duty)**

**Anode**

	Peak anode voltage 1.2kV	Peak anode voltage 1.5kV	
Anode current (peak) . . . . .	1500	1200	A max
corresponding average . . . . .	20	16	A max
Anode current (average) . . . . .	70	56	A max
corresponding peak . . . . .	420	336	A max
Averaging time . . . . .	6.25	6.25	s max
Peak fault current . . . . .	18 750	15 000	A max
Duration of fault current . . . . .	0.15	0.15	s max
Frequency range . . . . .	50–60	50–60	Hz

**Ignitor**

Peak forward ignitor voltage . . . . .	anode voltage max
Peak inverse ignitor voltage . . . . .	5.0 V max
Ignitor current:	
peak . . . . .	100 A max
r.m.s. . . . .	10 A max
average . . . . .	1.0 A max
averaging time . . . . .	5.0 s max

**IGNITOR CIRCUIT REQUIREMENTS**

**Anode Firing**

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	μs max

**Continued on page 3**

## IGNITOR CIRCUIT REQUIREMENTS (Continued)

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s



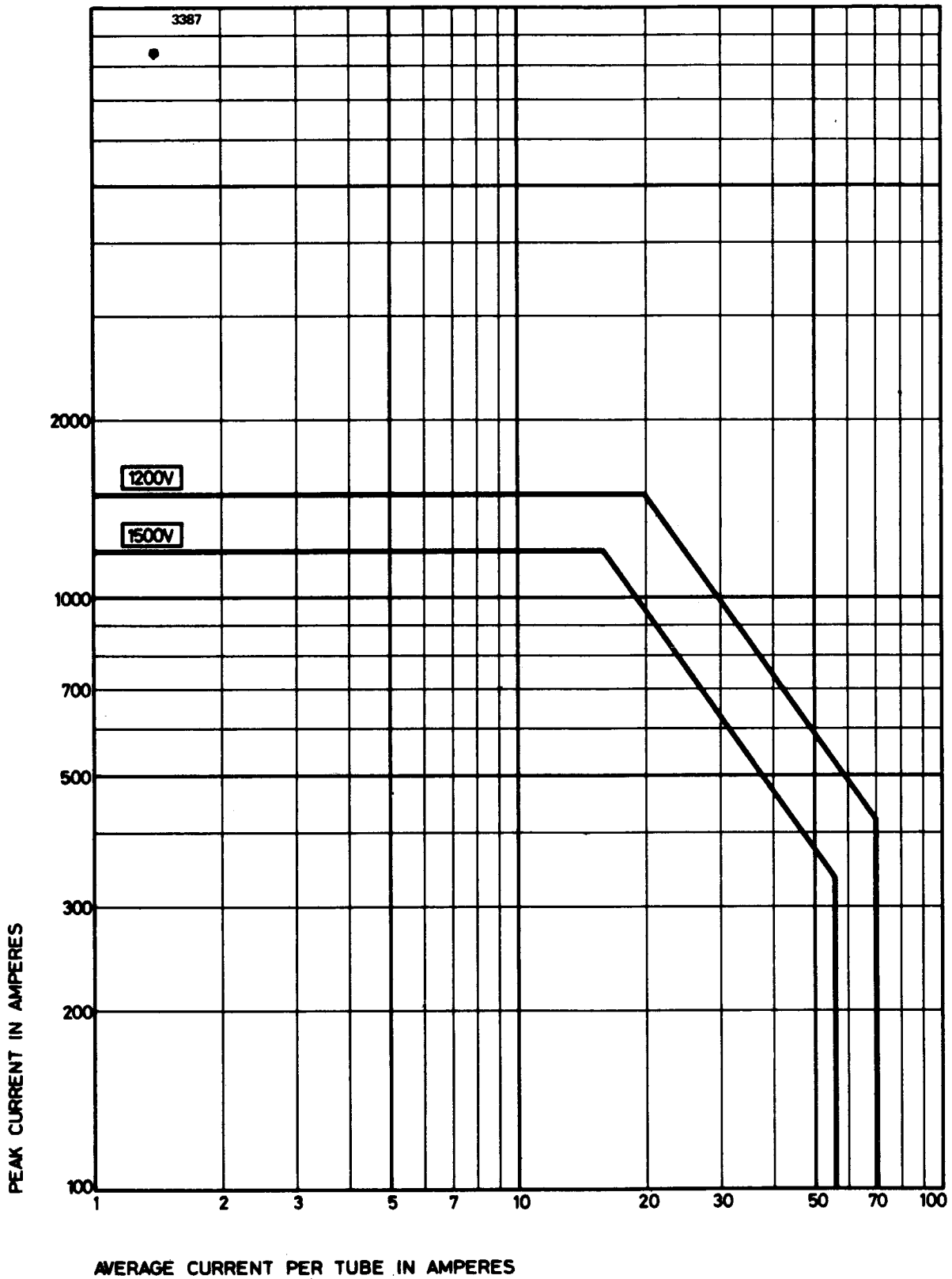
### COOLING

Minimum water flow rate (see note) . . . . .	1.5	imp.gal/min
	7.0	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	6.0	$^{\circ}$ C max

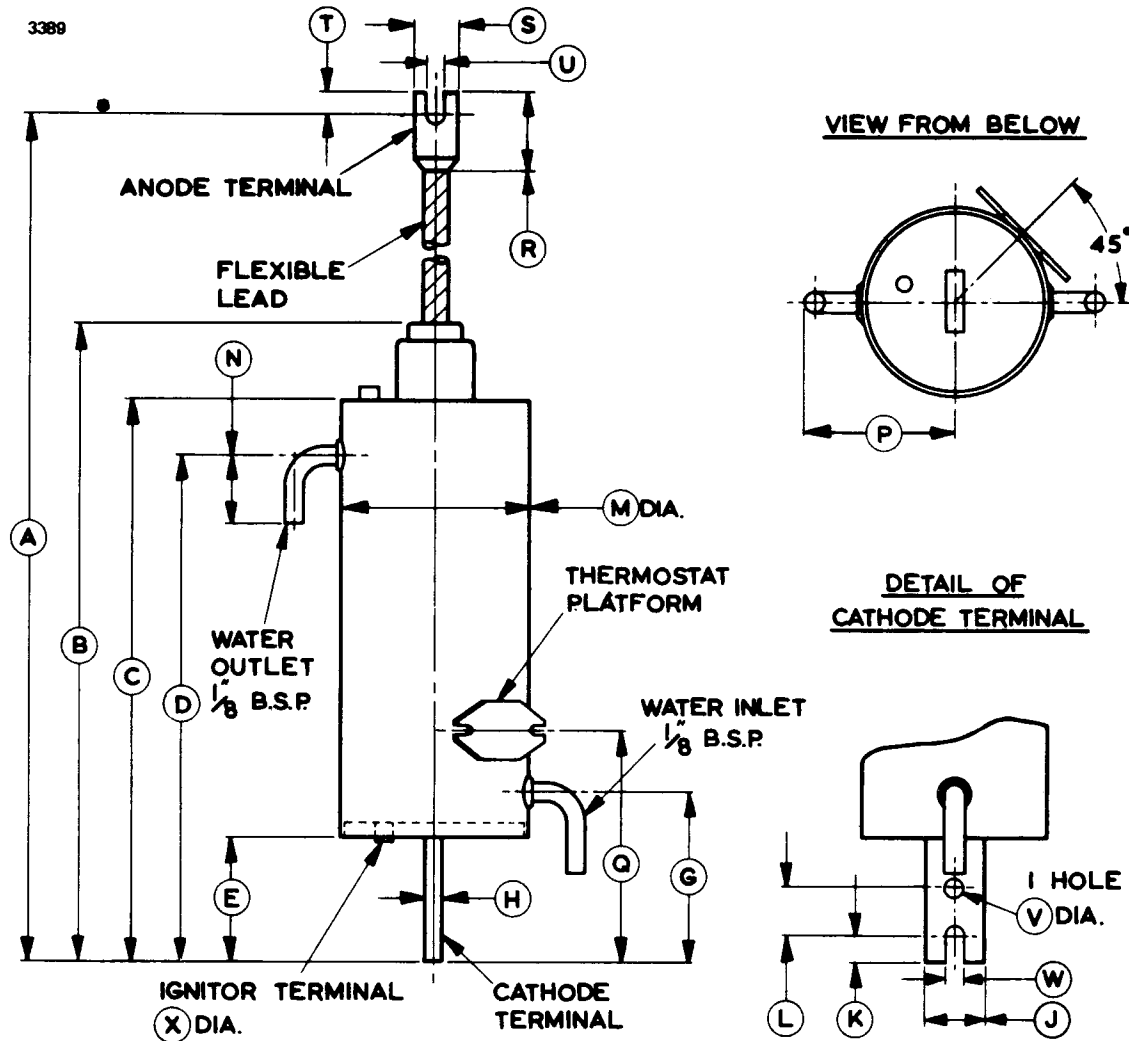
### Note

At the minimum flow rate of 1.5 imp.gal/min, the pressure drop across the jacket will be 4.5 lb/in<sup>2</sup> (0.32kg/cm<sup>2</sup>) approx. The water flow must be maintained for 15 minutes after switching off.

**PEAK CURRENT – AVERAGE CURRENT PER IGNITRON  
(MAXIMUM RATINGS)**



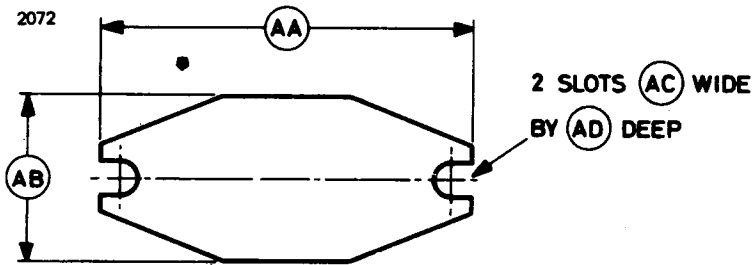
OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	24.250 min	617.0 min	N	2.500 max	63.50 max
B	14.750 max	374.7 max	P	3.625 max	92.08 max
C	12.500 max	317.5 max	Q	5.500 ± 0.375	139.7 ± 9.53
D	10.750	273.1	R	3.000 max	76.20 max
E	2.375 min	60.33 min	S	1.250 max	31.75 max
G	3.750	95.25	T	1.000 max	25.40 max
H	0.500 ± 0.031	12.70 ± 0.79	U	0.437 ± 0.062	11.10 ± 1.57
J	1.250 ± 0.062	31.75 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.625 ± 0.062	15.88 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13
M	4.625 max	117.5 max			

Millimetre dimensions have been derived from inches.

**Thermostat Mounting Plate (All dimensions are nominal)**



Ref	Inches	Millimetres
AA	2.750	69.85
AB	1.250	31.75
AC	0.219	5.56
AD	0.375	9.53

Millimetre dimensions have been derived from inches.



The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size D, stainless-steel-jacketed, water-cooled ignitron intended primarily for use as a switch in capacitor discharge circuits.

Maximum peak forward anode voltage . . . . .	25	kV
Maximum peak inverse anode voltage . . . . .	25	kV
Maximum peak anode current . . . . .	100	kA
Maximum ampere-seconds per pulse . . . . .	200	A.s
Maximum pulse repetition rate . . . . .	1 pulse per second	



### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitors . . . . .	2
auxiliary anode . . . . .	1

Arc voltage drop (approx):

instantaneous current . . . . .	5	10	20	30	40	kA
voltage drop . . . . .	20	25	35	45	60	V

#### Mechanical

Overall length . . . . .	21.000 inches (533.4mm) max
Overall width . . . . .	8.625 inches (219.1mm) max
Body diameter . . . . .	5.750 inches (146.1mm) max
Net weight . . . . .	21 pounds (9.5kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Ignitor lead . . . . .	ZD100222
Auxiliary anode lead . . . . .	ZD100222

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### CAPACITOR DISCHARGE SERVICE

#### Main Anode

Peak forward or inverse anode voltage . . . . .	25	kV max
Peak anode current . . . . .	100	kA max
Rate of rise of current . . . . .	1000	A/ $\mu$ s max
Ampere-seconds per pulse . . . . .	200	A.s max
Duration of pulse . . . . .	150	ms max
Pulse repetition rate . . . . .	1 pulse per second	max

#### Auxiliary Anode

Peak forward voltage . . . . .	160	V max
Peak inverse voltage:		
main anode conducting . . . . .	25	V max
main anode not conducting . . . . .	160	V max
Current:		
peak . . . . .	30	A max
r.m.s. . . . .	15	A max
average . . . . .	9.0	A max
averaging time . . . . .	10	s max

#### Ignitor Circuit Requirements

The recommended excitation circuit consists of a 0.25 $\mu$ F capacitor, charged to between 1500 and 4000 volts and discharged through the ignitor-cathode circuit and a current limiting resistor of 2 to 6 ohms. The peak inverse ignitor voltage must never exceed 5.0 volts.

#### Cooling

Minimum water flow rate (see note) . . . . .	1.0 imp. gal/min	
	4.5	l./min
Inlet water temperature . . . . .	15	$^{\circ}$ C min
Outlet water temperature . . . . .	30	$^{\circ}$ C max
Temperature rise across jacket . . . . .	4.0	$^{\circ}$ C max

#### Note

At the minimum flow rate of 1.0gal/min, the pressure drop across the jacket will be 0.5 lb/in<sup>2</sup> (0.04kg/cm<sup>2</sup>) approx.



## OPERATING INSTRUCTIONS

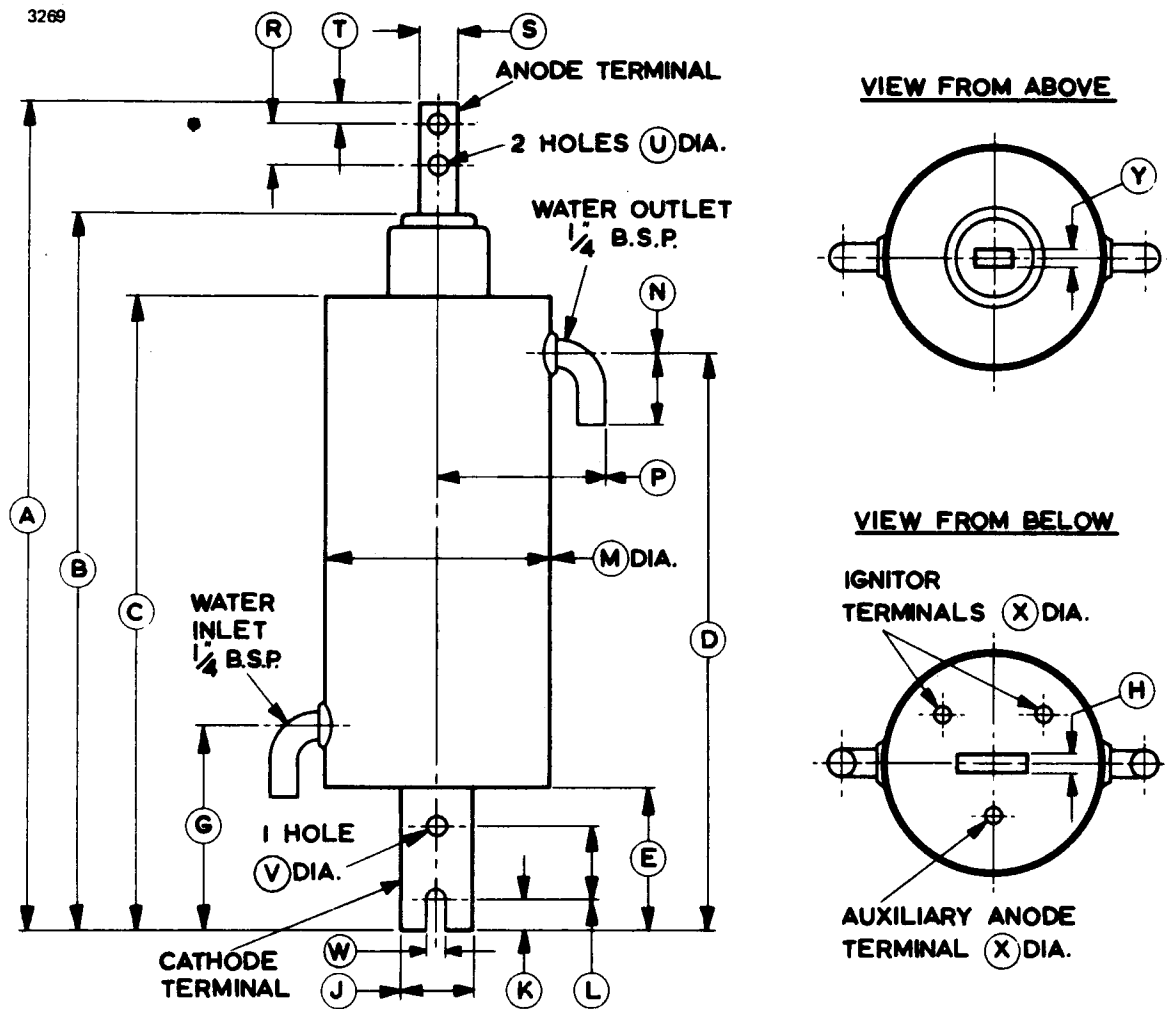
Care should be taken to keep the glass bushing, the anode lead and the stress shields free from mercury. The ignitron should always be kept upright and not tilted far enough to allow mercury to flow into the anode end. Before the ignitron is operated, the bushing and anode terminal assembly should be heated, for example by infra-red lamps, long enough to disperse any mercury condensed on or clinging to them; it may be desirable to continue the heating throughout the period of operation. During short shut-down periods, it may be advantageous to maintain the heating or to shield the anode bushing from draughts, in order to reduce the possibility of mercury condensation which would necessitate further heating.

It is recommended that before an ignitron is put into service, it should be aged to withstand a peak voltage of 30 to 35kV in either direction for one minute without breakdown. This may be accomplished by the application of a variable voltage, either a.c. or d.c., through a current limiting resistance of 0.1 to 0.2 megohm. It is useful to connect a capacitor of around 500pF between anode and cathode, and when the supply is d.c. the series resistance may be increased to some tens of megohms, to limit the frequency of breakdowns for convenience of observation.

In exceptional circumstances, for example when currents of excessive peak value have been carried, the ignitron may suffer deterioration in its ability to withstand high voltage. In such cases, it is often possible to restore the high voltage characteristics by operating the ignitron in a low-voltage circuit at supply frequency, so that it carries a mean current of 20 to 30A for 10 to 30 minutes; the flow of cooling water should be maintained at 0.5gal/min during this process. The ignitron should be allowed to cool to atmospheric temperature before high voltage is applied.

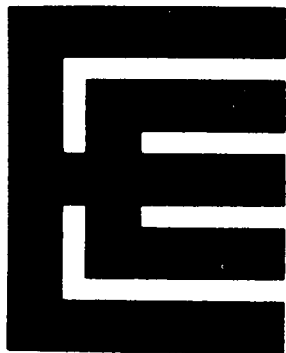


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	20.250 ± 0.750	514.4 ± 19.1	N	3.000 max	76.20 max
B	18.500 max	469.9 max	P	4.312 max	109.5 max
C	15.375 ± 0.750	390.5 ± 19.1	R	1.000 ± 0.031	25.40 ± 0.79
D	14.000	355.6	S	1.000 ± 0.062	25.40 ± 1.57
E	3.125 min	79.38 min	T	0.500 ± 0.062	12.70 ± 1.57
G	5.000	127.0	U	0.500 ± 0.031	12.70 ± 0.79
H	0.500 ± 0.031	12.70 ± 0.79	V	0.562 ± 0.031	14.27 ± 0.79
J	1.750 ± 0.062	44.45 ± 1.57	W	0.562 ± 0.031	14.27 ± 0.79
K	0.750 ± 0.062	19.05 ± 1.57	X	0.250 ± 0.005	6.35 ± 0.13
L	1.750 ± 0.031	44.45 ± 0.79	Y	0.500 ± 0.031	12.70 ± 0.79
M	5.750 max	146.1 max			

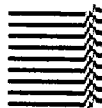
Millimetre dimensions have been derived from inches.



The data should be read in conjunction with the Ignitron Preamble.

### DESCRIPTION

Size C, stainless-steel-jacketed, water-cooled ignitron intended primarily for use as a switch in capacitor discharge circuits.



### GENERAL DATA

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

#### Mechanical

Overall length (excluding flexible lead) . . . . .	14.750 inches (374.7mm) max
Overall width . . . . .	7.250 inches (184.2mm) max
Body diameter . . . . .	4.625 inches (117.5mm) max
Net weight . . . . .	8½ pounds (3.9kg) approx
Mounting position . . . . .	vertical, anode terminal up

### MAXIMUM RATINGS (Absolute values)

#### CAPACITOR DISCHARGE SERVICE (Unidirectional current without reversal)

##### Main Anode

Peak forward anode voltage . . . . .	25	kV max
Peak inverse anode voltage . . . . .	25	kV max
Peak anode current . . . . .	100	kA max
Average anode current . . . . .	10	A max
Ampere-seconds per pulse . . . . .	50	A.s max
Pulse repetition rate . . . . .	1	p.p.s. max

### Ignitor Circuit Requirements

The recommended excitation circuit consists of a 0.25 $\mu$ F capacitor, charged to between 1500 and 4000V and discharged through the ignitor-cathode circuit and a current limiting resistor of 2 to 6 ohms. The peak inverse ignitor voltage must never exceed 5.0V.

### Cooling

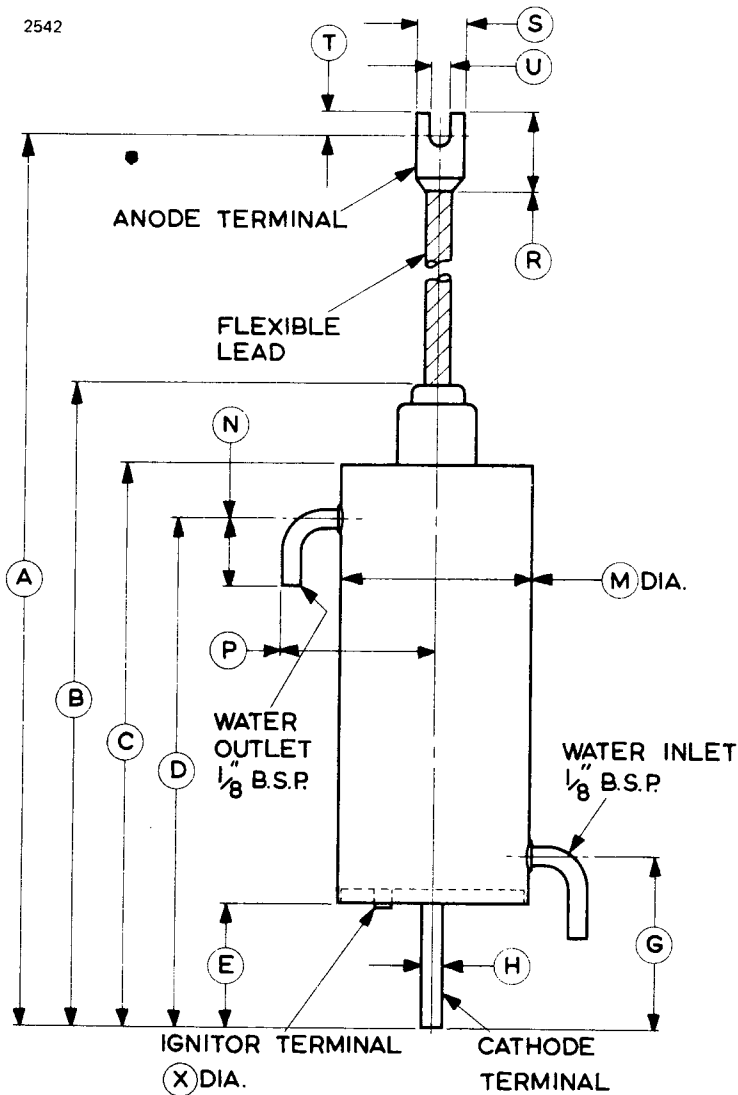
Minimum water flow rate	. . . . .	0.5	imp.gal/min
		2.3	l./min
Inlet water temperature	. . . . .	15	°C min
Outlet water temperature	. . . . .	30	°C max

### OPERATING INSTRUCTIONS

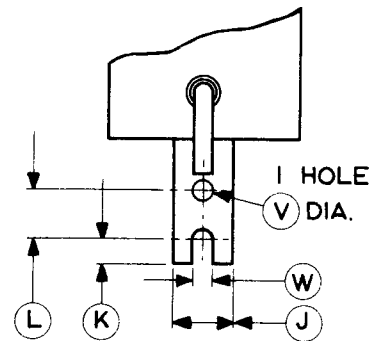
Before the ignitron is operated, the glass anode insulation should be heated, for example by infra-red lamps, long enough to disperse any mercury condensed in this region of the ignitron. It may be desirable to continue the heating during operation, especially if high anode voltages are used.

# OUTLINE

2542

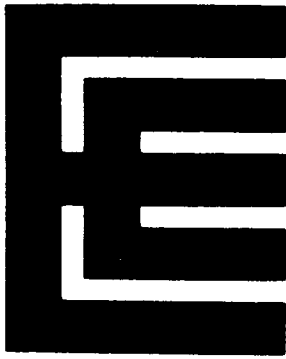


**DETAIL OF CATHODE TERMINAL**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	24.250 min	617.0 min	M	4.625 max	117.5 max
B	14.750 max	374.7 max	N	2.500 max	63.50 max
C	12.500 max	317.5 max	P	3.625 max	92.08 max
D	10.750	273.1	R	3.000 max	76.20 max
E	2.375 min	60.33 min	S	1.250 max	31.75 max
G	3.750	95.25	T	1.000 max	25.40 max
H	0.500 ± 0.031	12.70 ± 0.79	U	0.437 ± 0.062	11.10 ± 1.57
J	1.250 ± 0.062	31.75 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.625 ± 0.062	15.88 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13

Millimetre dimensions have been derived from inches.



## IGNITRON

Equivalent to 7669

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size B, stainless-steel-jacketed, water-cooled ignitron intended primarily for single-phase or three-phase (frequency changing) resistance welding control applications. It features a coaxial cathode terminal and has a platform for mounting a detachable thermostat for temperature control. It is electrically identical with BK42/5551A.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 30.2A) . . . . .	600	kVA
Maximum average anode current (for demand not exceeding 200kVA) . . . . .	56	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 150A peak current . . . . .	13	V
at 3400A peak current . . . . .	26	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	11.625 inches (295.3mm) max
Overall width . . . . .	8.125 inches (206.4mm) max
Body diameter . . . . .	3.250 inches (82.55mm) max
Net weight . . . . .	3¾ pounds (1.7kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

## Accessories (continued)

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .				1.0	kV max
Ignitor lead . . . . .					ZD100222

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### Single-phase Resistance Welding Control Service

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	Min	Max	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 30.2A) . . . . .	—	600	kVA
Anode current (average) (for demand not exceeding 200kVA) . . . . .	—	56	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	7.5	s
at 440V <sub>r.m.s.</sub> . . . . .	—	10.2	s
at 250V <sub>r.m.s.</sub> . . . . .	—	18	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	2800	A
at 250V <sub>r.m.s.</sub> . . . . .	—	6720	A
Duration of fault current . . . . .	—	0.15	s

### Three-phase (Frequency Changing) Welding Control or Power Rectifier Service (Intermittent Duty)

#### Anode

	Peak anode voltage 1.2kV	Peak anode voltage 1.5kV	
Anode current (peak) . . . . .	600	480	A max
corresponding average . . . . .	5.0	4.0	A max
Anode current (average) . . . . .	22.5	18	A max
corresponding peak . . . . .	135	108	A max
Averaging time . . . . .	10	10	s max
Peak fault current . . . . .	7500	6000	A max
Duration of fault current . . . . .	0.15	0.15	s max
Frequency range . . . . .	50–60	50–60	Hz

## MAXIMUM AND MINIMUM RATINGS (Continued)

### Ignitor

Peak forward ignitor voltage . . . . .	anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

## COOLING

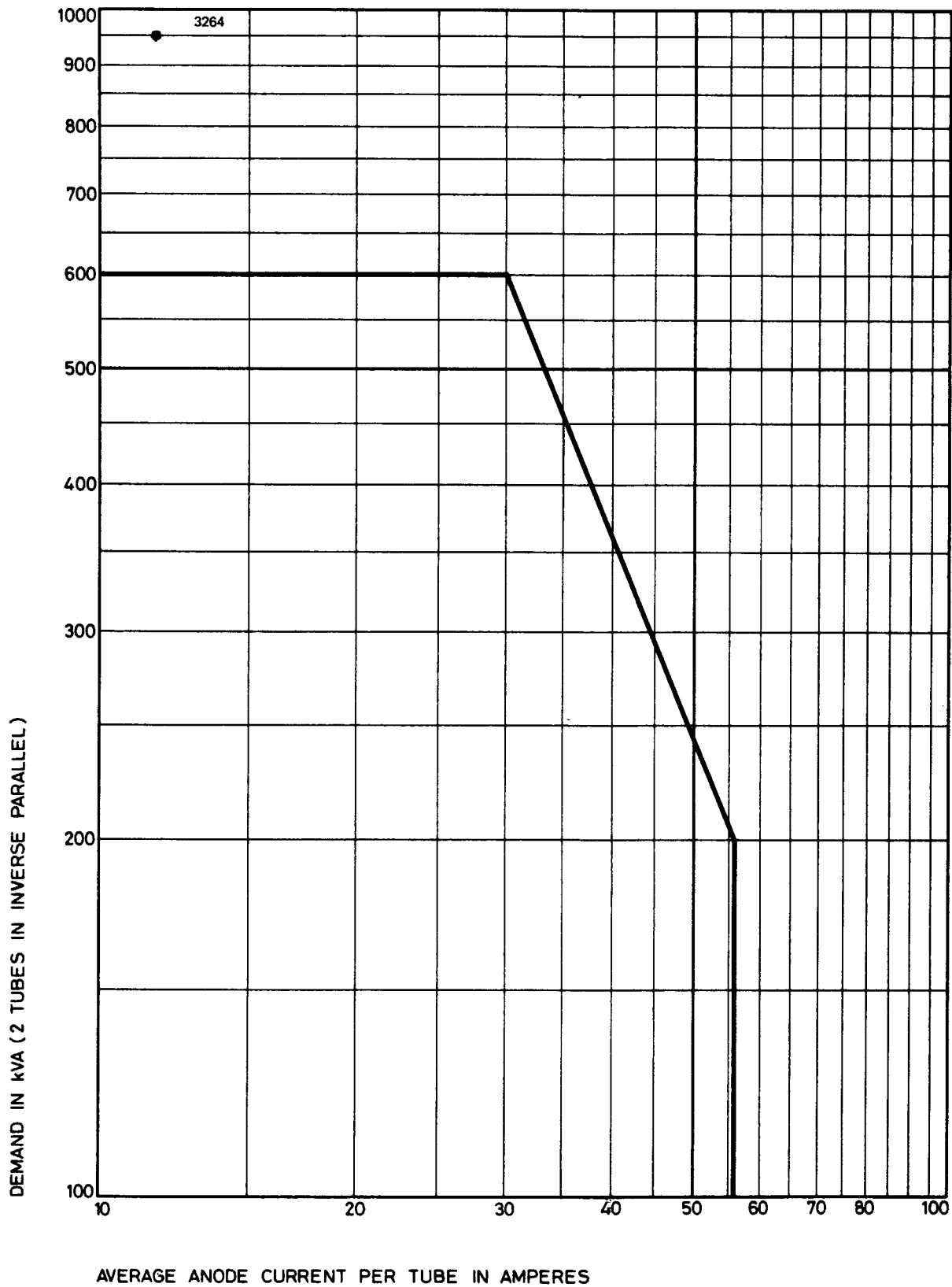
Minimum water flow rate (see note) . . . . .	1.0	imp.gal/min
	4.5	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	4.0	$^{\circ}$ C max

### Note

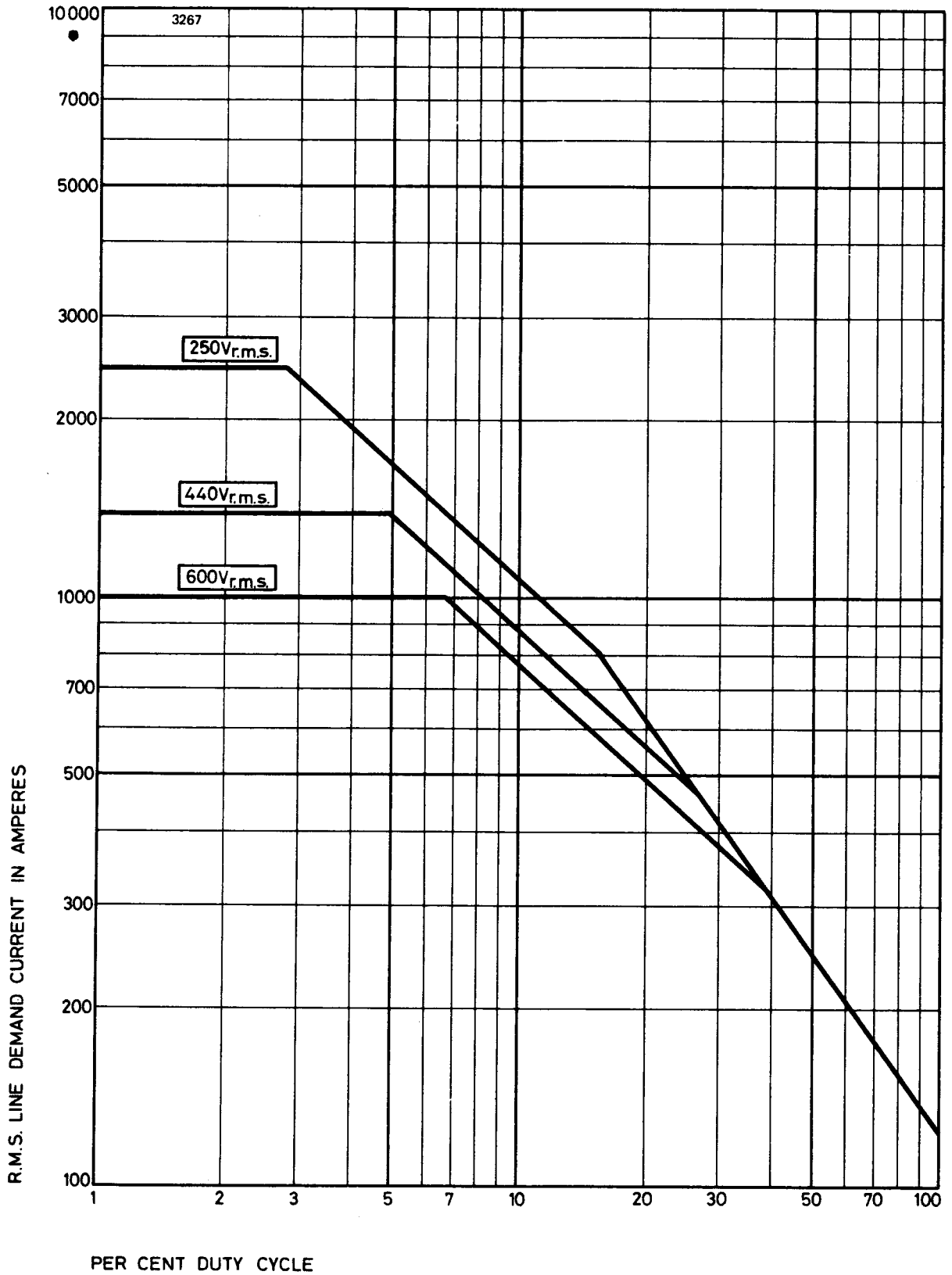
At the minimum flow rate of 1.0 imp.gal/min, the pressure drop across the jacket will be 1.8 lb/in<sup>2</sup> (0.13kg/cm<sup>2</sup>) approx. The water flow must be maintained for 10 minutes after switching off.



**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 250 to 600 volts**

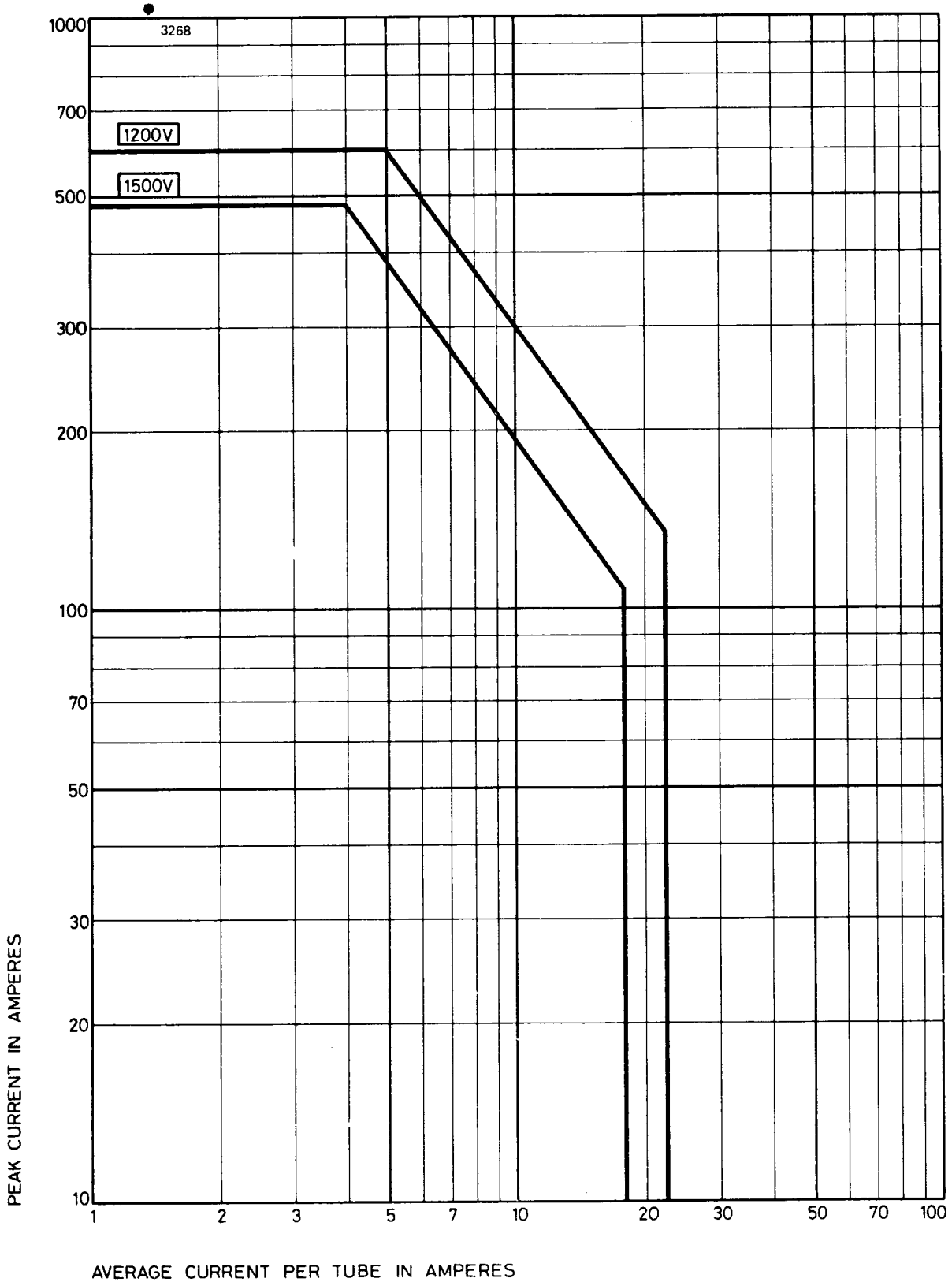


**LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control service**

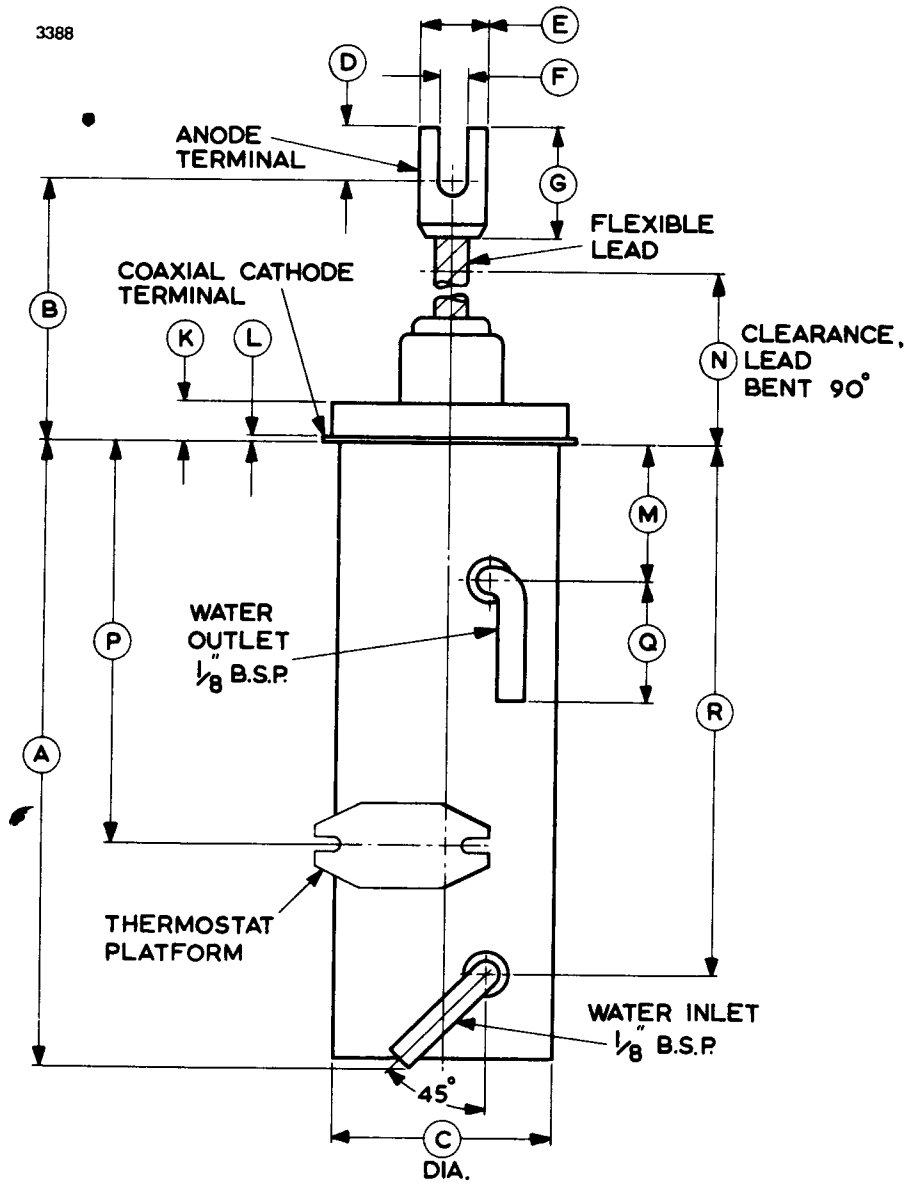


**PEAK CURRENT – AVERAGE CURRENT PER IGNITRON  
(MAXIMUM RATINGS)**

Three-phase welder control service



# OUTLINE (All dimensions without limits are nominal)

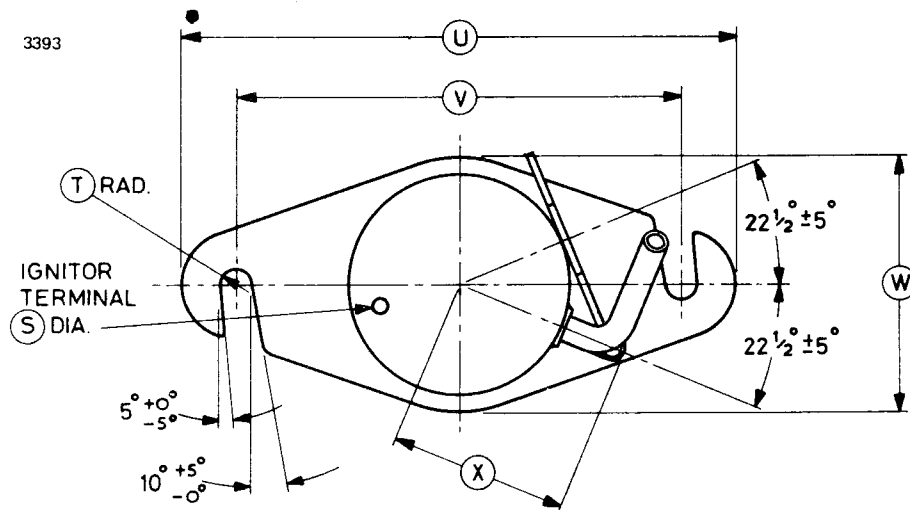


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.000 max	228.6 max	K	1.250 max	31.75 max
B	10.500 $\pm$ 0.500	266.7 $\pm$ 12.7	L	0.125	3.18
C	3.250 max	82.55 max	M	1.500	38.10
D	0.812 max	20.62 max	N	4.000 min	101.6 min
E	1.000 max	25.40 max	P	5.875 max	149.2 max
F	0.406 $\pm$ 0.031	10.31 $\pm$ 0.79	Q	2.500 max	63.50 max
G	2.375 max	60.33 max	R	6.250	158.8

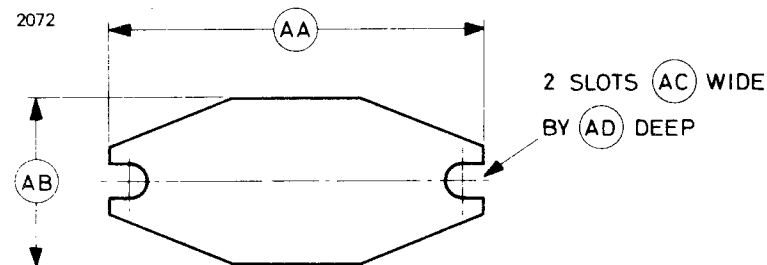
Millimetre dimensions have been derived from inches.

# OUTLINE DETAILS (All dimensions without limits are nominal)

View from below

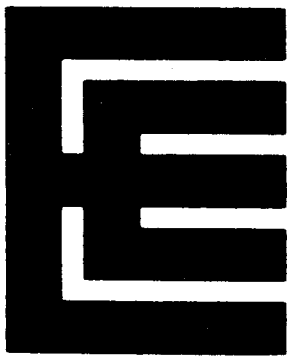


## Thermostat Mounting Plate



Ref	Inches	Millimetres	Ref	Inches	Millimetres
S	0.250 ± 0.005	6.35 ± 0.13	X	2.625 max	66.68 max
T	0.219	5.56	AA	2.750	69.85
U	8.125 max	206.4 max	AB	1.250	31.75
V	6.500 ± 0.032	165.1 ± 0.8	AC	0.219	5.56
W	3.750 max	95.25 max	AD	0.375	9.53

Millimetre dimensions have been derived from inches.



## IGNITRON

### Equivalent to 7671

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size C, stainless-steel-jacketed, water-cooled ignitron intended primarily for single-phase resistance welding control applications. It features a coaxial cathode terminal and has a platform for mounting a detachable thermostat for temperature control. It is electrically identical with BK24/5552A.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 75.6A) . . . . .	1200	kVA
Maximum average anode current (for demand not exceeding 400kVA) . . . . .	140	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 440A peak current . . . . .	14	V
at 6800A peak current . . . . .	28	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	12.750 inches (323.9mm) max
Overall width . . . . .	8.125 inches (206.4mm) max
Body diameter . . . . .	4.625 inches (117.5mm) max
Net weight . . . . .	8½ pounds (3.9kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36° C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52° C approx) . . . . .	ZD100551

Continued on page 2

**Accessories (continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
Voltage between switch contacts and ignitron envelope (peak) . . . . .					1.0 kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Single-phase Resistance Welding Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	<b>Min</b>	<b>Max</b>	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 75.6A) . . . . .	—	1200	kVA
Anode current (average) (for demand not exceeding 400kVA) . . . . .	—	140	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	5.9	s
at 440V <sub>r.m.s.</sub> . . . . .	—	8.0	s
at 250V <sub>r.m.s.</sub> . . . . .	—	14	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	5600	A
at 250V <sub>r.m.s.</sub> . . . . .	—	13 450	A
Duration of fault current . . . . .	—	0.15	s

**Ignitor**

Peak inverse ignitor voltage . . . . .	—	5.0	V
Ignitor current:			
peak . . . . .	—	100	A
r.m.s. . . . .	—	10	A
average . . . . .	—	1.0	A
averaging time . . . . .	—	5.0	s

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx sine wave) . . . . .	500	$\mu$ s

## COOLING

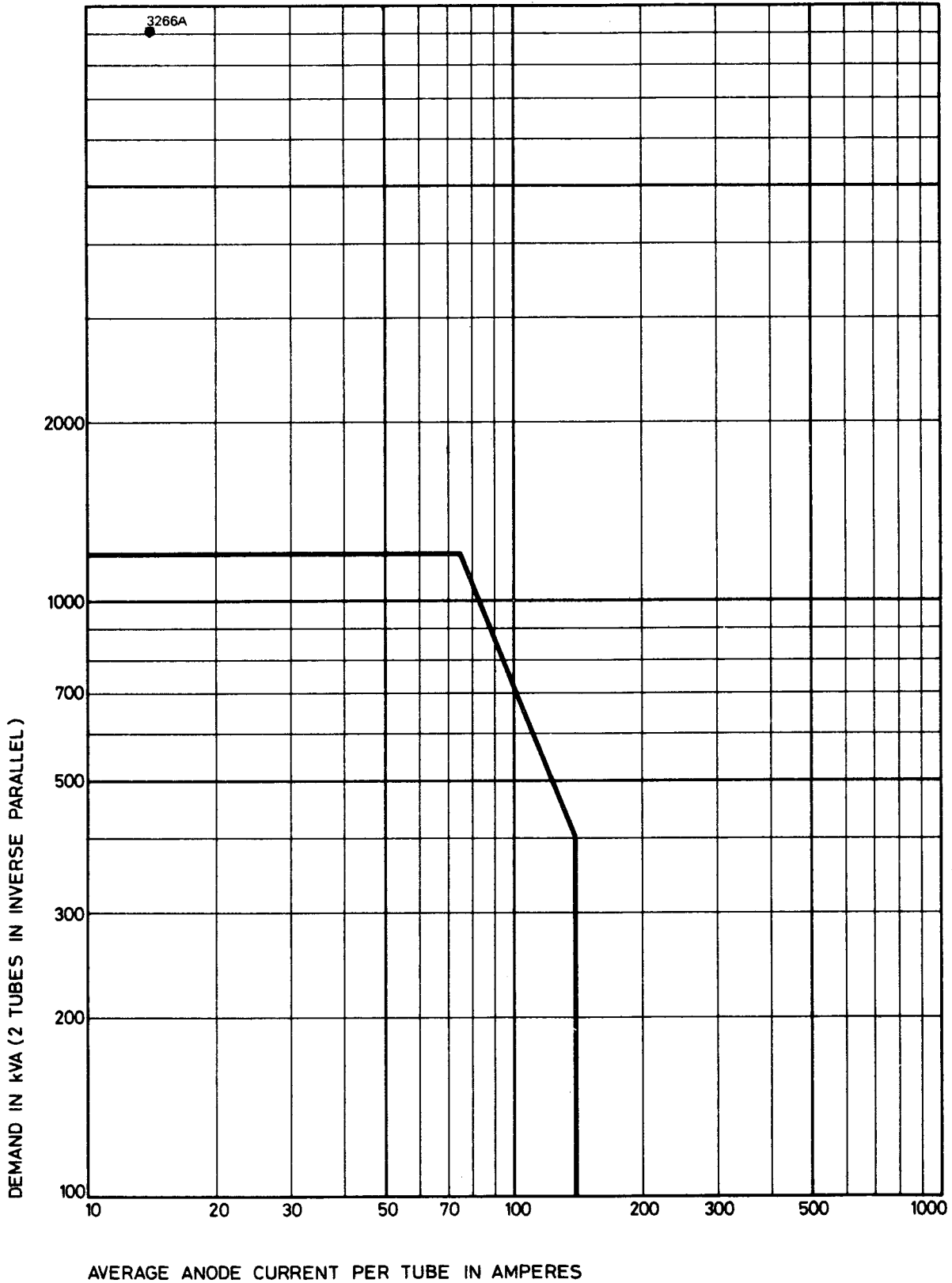
Minimum water flow rate (see note) . . . . .	1.5	imp.gal/min
	7.0	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	6.0	$^{\circ}$ C max

### Note

At the minimum flow rate of 1.5 imp.gal/min, the pressure drop across the jacket will be 4.5 lb/in<sup>2</sup> (0.32kg/cm<sup>2</sup>) approx. The water flow must be maintained for 15 minutes after switching off.

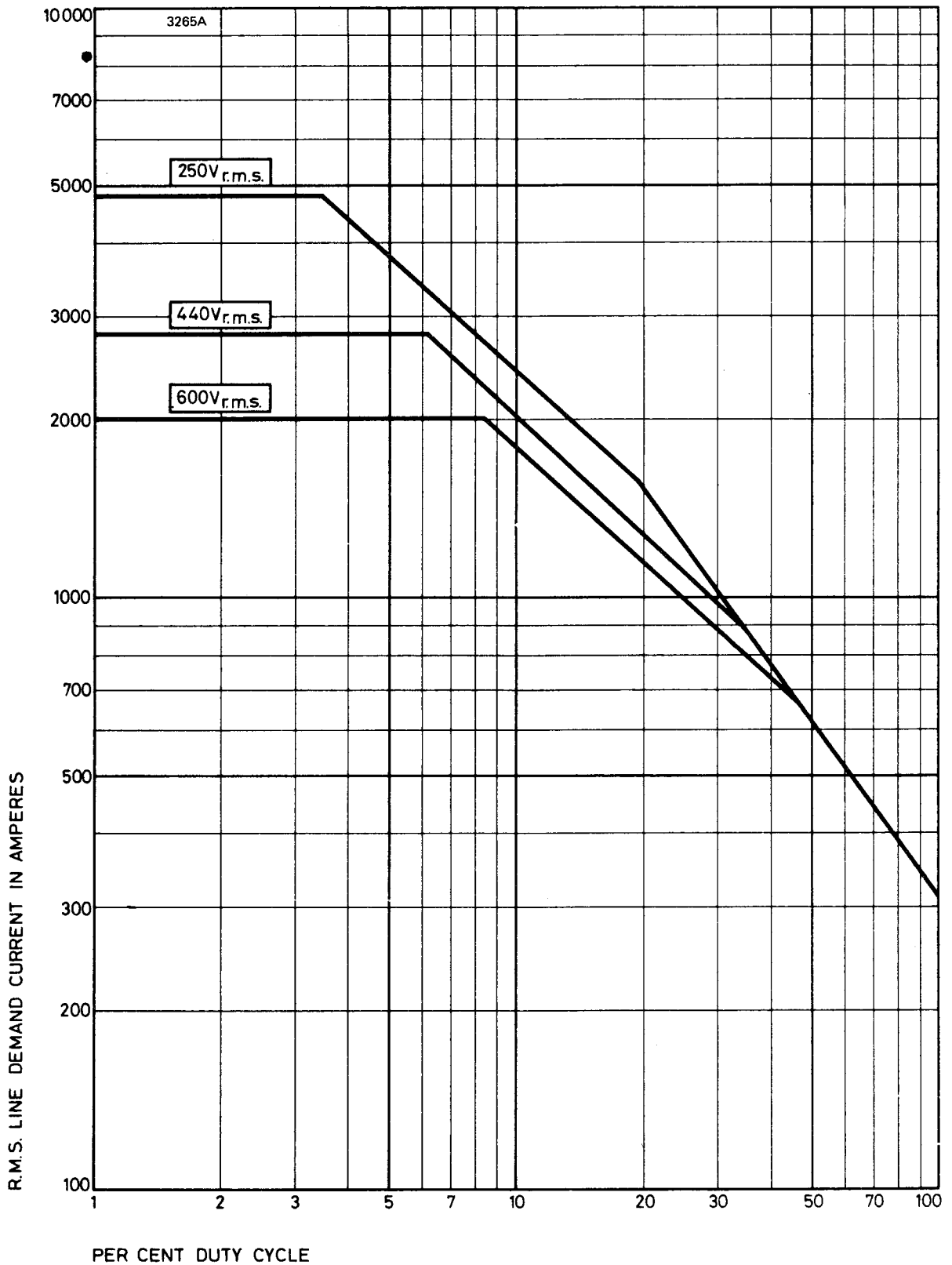


**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control at 250 to 600 volts**



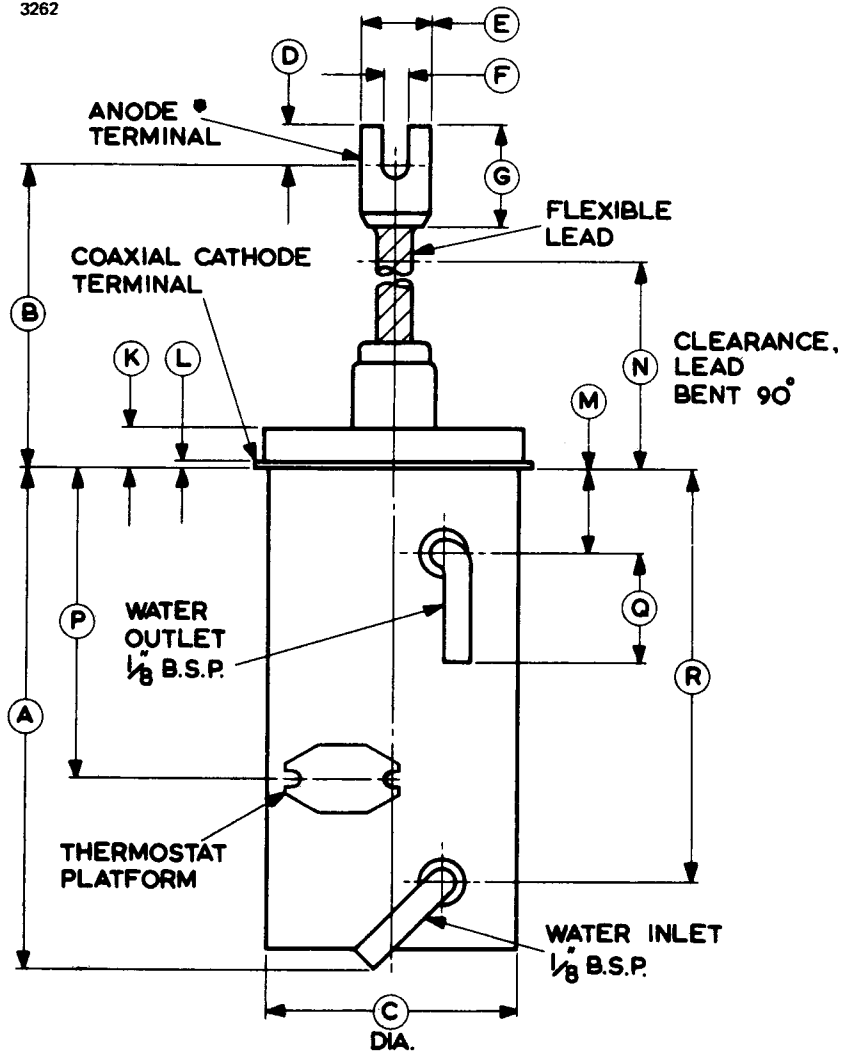
# LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)

Two ignitrons in inverse parallel for welder control



**OUTLINE (All dimensions without limits are nominal)**

3262

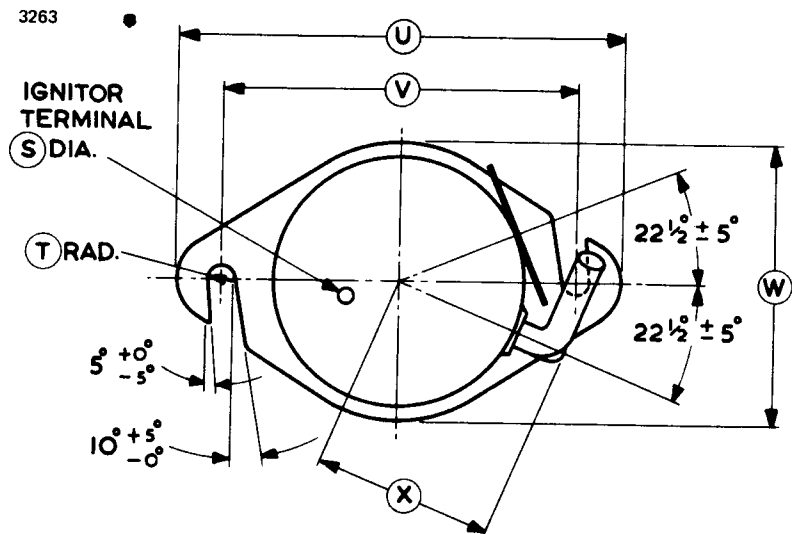


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.500 max	241.3 max	K	1.250 max	31.75 max
B	10.500 ± 0.500	266.7 ± 12.7	L	0.125	3.18
C	4.625 max	117.5 max	M	1.500	38.10
D	1.000 max	25.40 max	N	4.750 min	120.7 min
E	1.250 max	31.75 max	P	6.875 max	174.6 max
F	0.437 ± 0.062	11.10 ± 1.57	Q	2.500 max	63.50 max
G	3.000 max	76.20 max	R	7.500	190.5

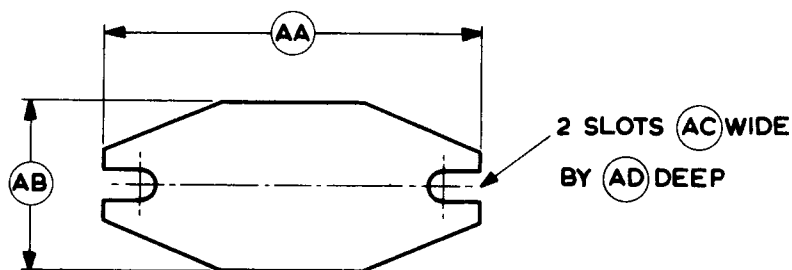
Millimetre dimensions have been derived from inches.

# OUTLINE DETAILS (All dimensions without limits are nominal)

View from below

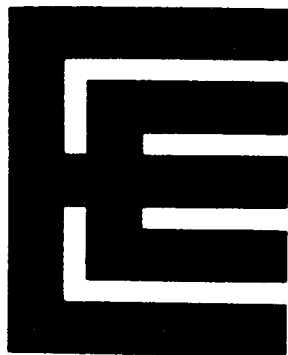


## Thermostat Mounting Plate



Ref	Inches	Millimetres	Ref	Inches	Millimetres
S	$0.250 \pm 0.005$	$6.35 \pm 0.13$	X	3.375 max	85.73 max
T	0.219	5.56	AA	2.750	69.85
U	8.125 max	206.4 max	AB	1.250	31.75
V	$6.500 \pm 0.032$	$165.1 \pm 0.8$	AC	0.219	5.56
W	5.125 max	130.2 max	AD	0.375	9.53

Millimetre dimensions have been derived from inches.



## IGNITRON

### Equivalent to 7673

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

Size D, stainless-steel-jacketed, water-cooled ignitron intended primarily for single-phase or three-phase (frequency changing) resistance welding control applications. It features a coaxial cathode terminal and has a platform for mounting a detachable thermostat for temperature control. It is electrically identical with BK146/5553B.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 192A) . . . . .	2400	kVA
Maximum average anode current (for demand not exceeding 800kVA) . . . . .	355	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 1115A peak current . . . . .	17	V
at 13 600A peak current . . . . .	36	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	16.875 inches (428.6mm) max
Overall width . . . . .	11.375 inches (288.9mm) max
Body diameter . . . . .	7.125 inches (181.0mm) max
Net weight . . . . .	21 pounds (9.5kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

**Accessories (continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .					1.0 kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Single-phase Resistance Welding Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	<b>Min</b>	<b>Max</b>	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 192A) . . . . .	—	2400	kVA
Anode current (average) (for demand not exceeding 800kVA) . . . . .	—	355	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	4.6	s
at 440V <sub>r.m.s.</sub> . . . . .	—	6.3	s
at 250V <sub>r.m.s.</sub> . . . . .	—	11	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	11.2	kA
at 250V <sub>r.m.s.</sub> . . . . .	—	27	kA
Duration of fault current . . . . .	—	0.15	s

**Three-phase (Frequency Changing) Welding Control  
or Power Rectifier Service (Intermittent Duty)**

**Anode**

	<b>Peak anode voltage 0.6kV</b>	<b>Peak anode voltage 1.2kV</b>	<b>Peak anode voltage 1.5kV</b>	
Anode current (peak) . . . . .	4.0	3.0	2.4	kA max
Corresponding average . . . . .	54	40	32	A max
Anode current (average) . . . . .	190	140	112	A max
Corresponding peak . . . . .	1140	840	672	A max
Averaging time . . . . .	6.25	6.25	6.25	s max
Peak fault current . . . . .	50	37.5	30	kA max
Duration of fault current . . . . .	0.15	0.15	0.15	s max
Frequency range . . . . .	50—60	50—60	50—60	Hz

## MAXIMUM AND MINIMUM RATINGS (Continued)

### Ignitor

Peak forward ignitor voltage . . . . .	anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

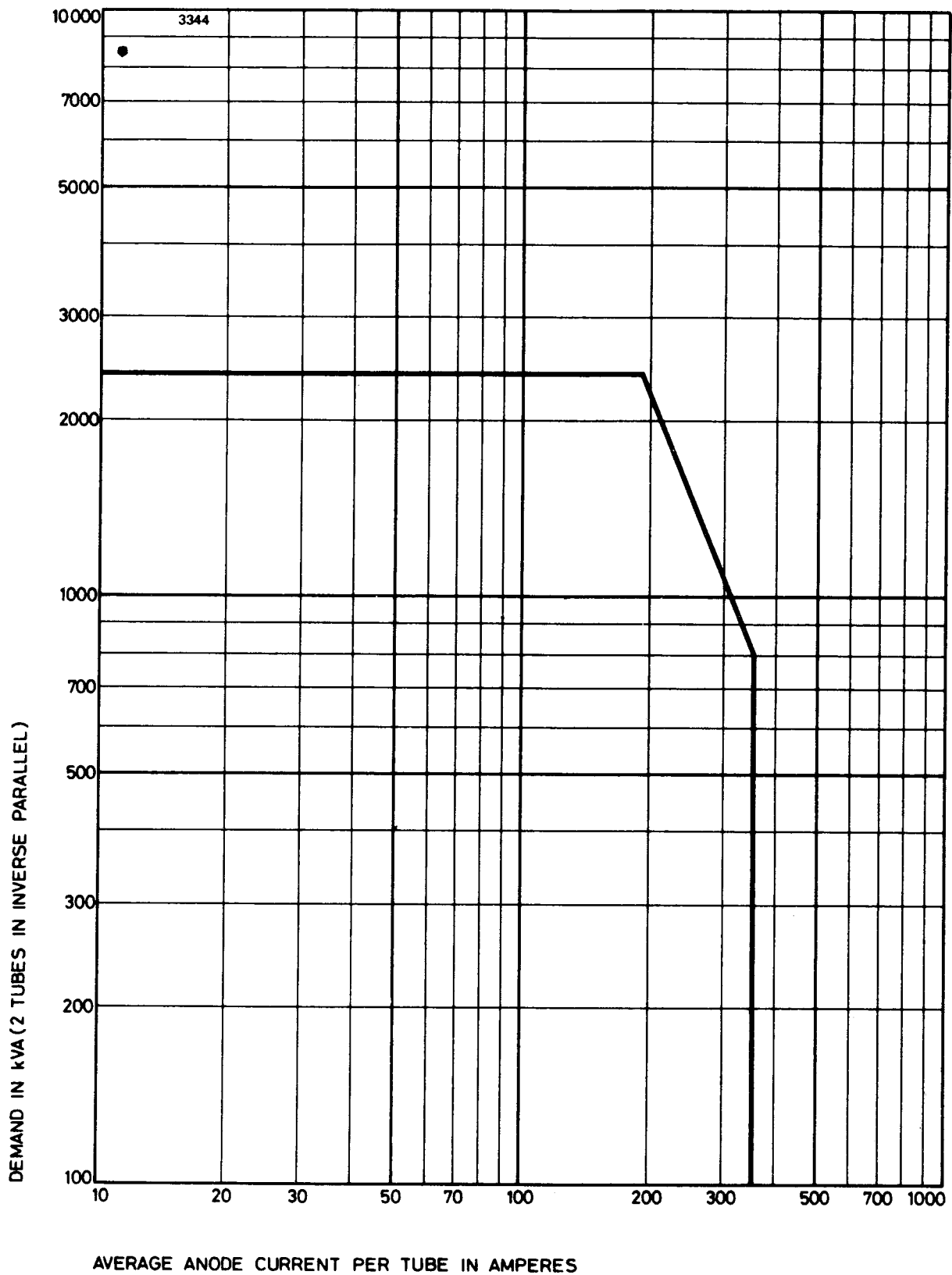
## COOLING

Minimum water flow rate (see note) . . . . .	3.0	imp.gal/min
	14	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	9.0	$^{\circ}$ C max

### Note

At the minimum flow rate of 3.0 imp. gal/min, the pressure drop across the jacket will be 5.0 lb/in<sup>2</sup> (0.35kg/cm<sup>2</sup>) approx. The water flow must be maintained for 30 minutes after switching off.

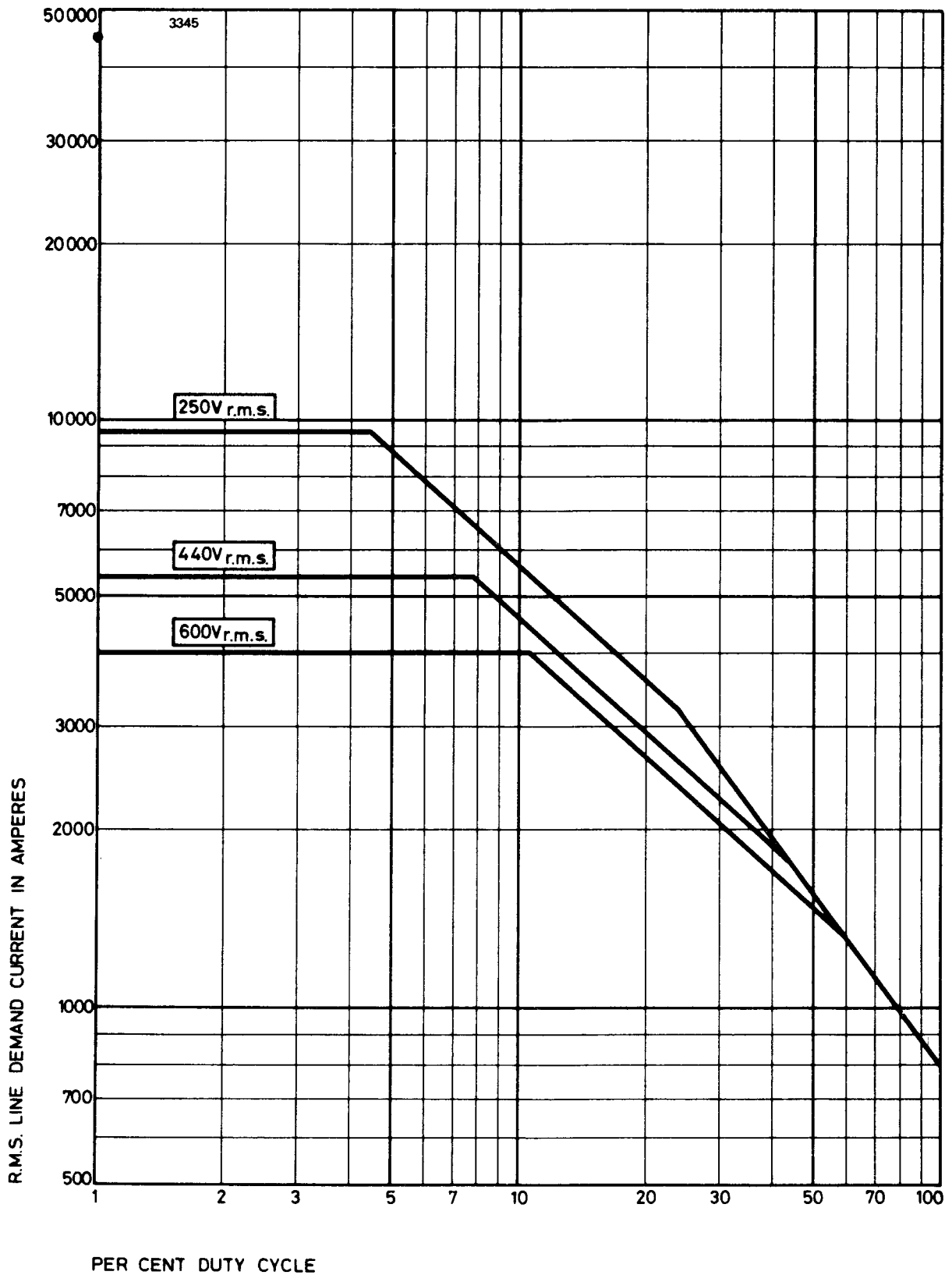
DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)  
Two ignitrons in inverse parallel for welder control at 250 to 600 volts





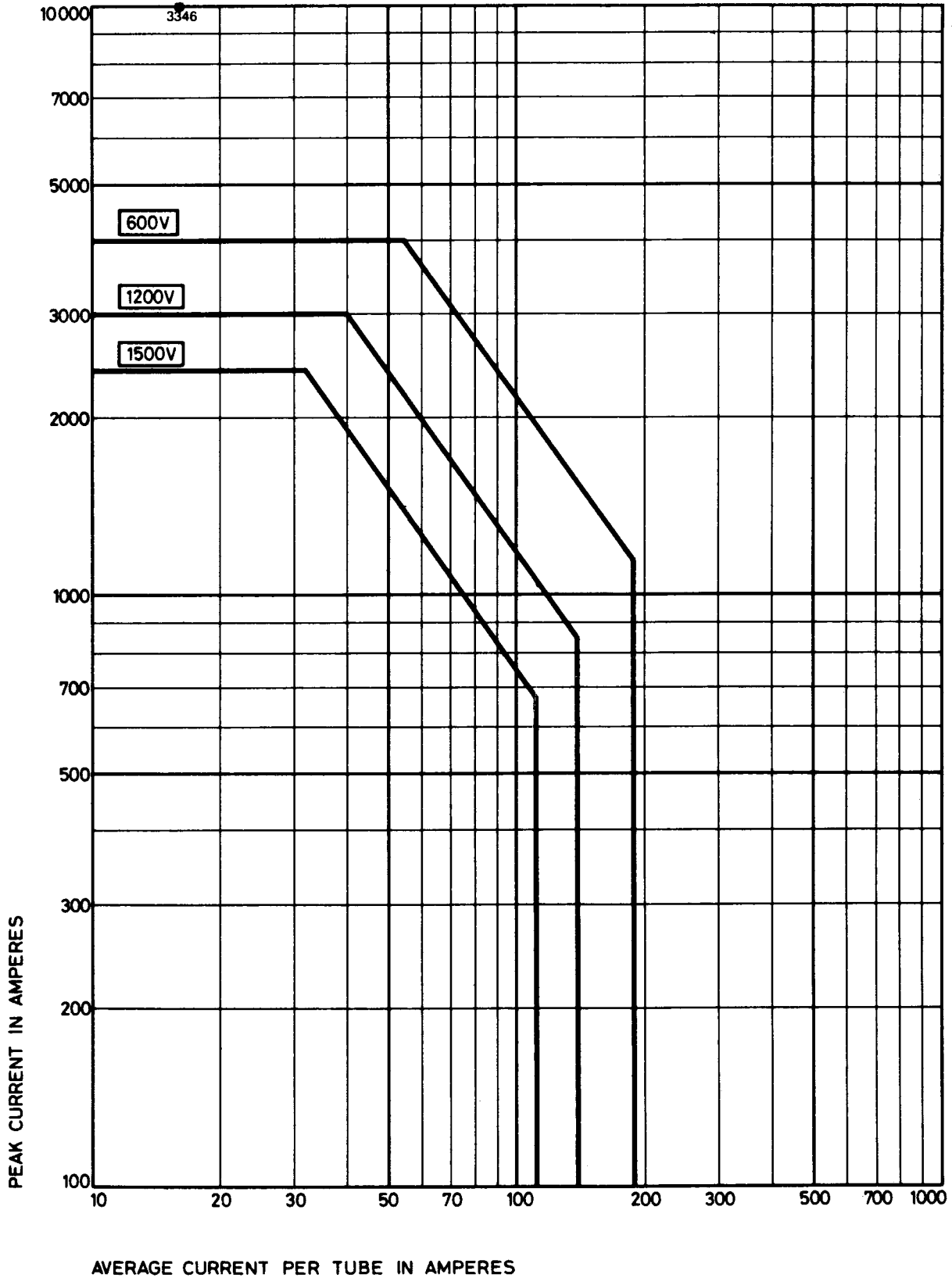
# LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)

Two ignitrons in inverse parallel for welder control service

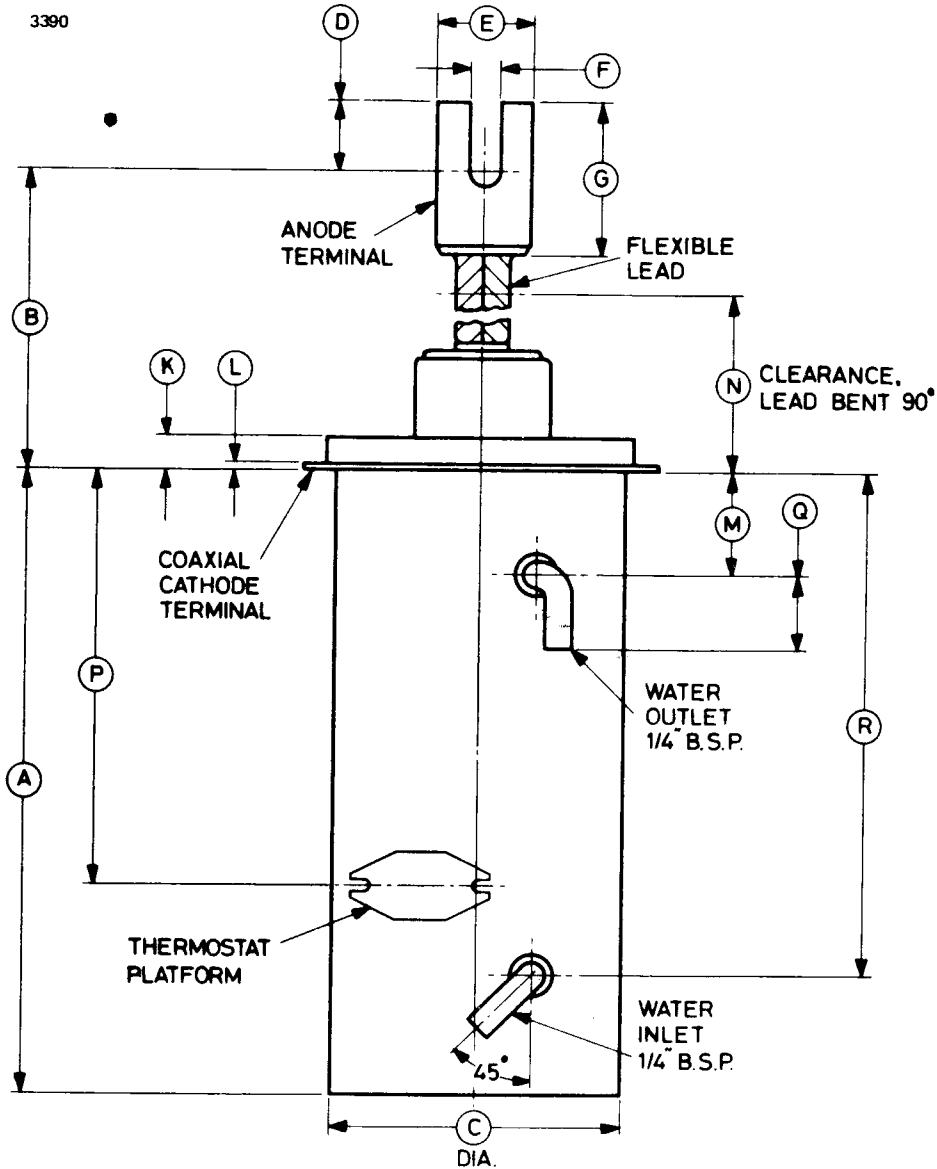


**PEAK CURRENT – AVERAGE CURRENT PER IGNITRON  
(MAXIMUM RATINGS)**

**Three-phase welder control service**



**OUTLINE (All dimensions without limits are nominal)**

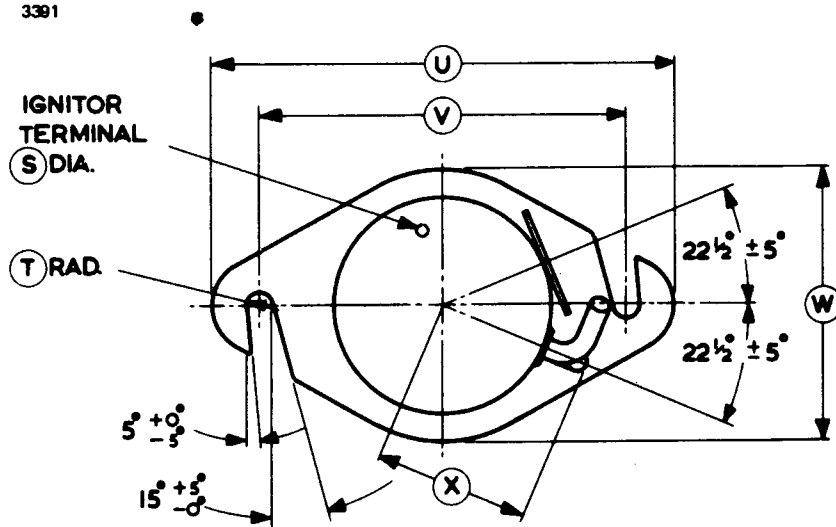


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	12.750 max	323.9 max	K	0.625 ± 0.125	15.88 ± 3.18
B	15.000 min	381.0 min	L	0.125	3.18
C	7.125 max	181.0 max	M	1.875	47.63
D	1.250 max	31.75 max	N	6.500 min	165.1 min
E	1.750 max	44.45 max	P	7.625 ± 0.500	193.7 ± 12.7
F	0.562 ± 0.032	14.27 ± 0.81	Q	3.000 max	76.20 max
G	3.500 max	88.90 max	R	9.312	236.5

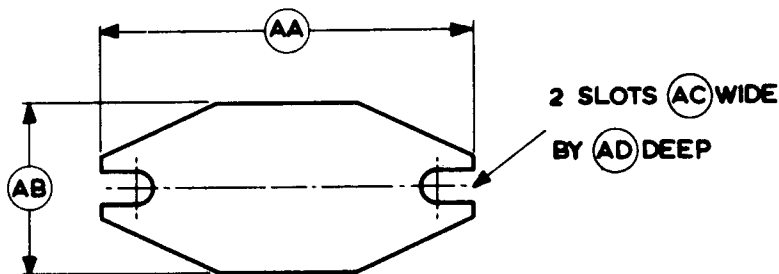
Millimetre dimensions have been derived from inches.

**OUTLINE DETAILS (All dimensions without limits are nominal)**

View from below

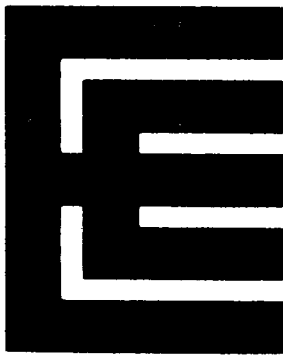


**Thermostat Mounting Plate**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
S	0.250 ± 0.005	6.35 ± 0.13	X	4.500 max	114.3 max
T	0.281	7.14	AA	2.750	69.85
U	11.375 max	288.9 max	AB	1.250	31.75
V	9.000 ± 0.032	228.6 ± 0.8	AC	0.219	5.56
W	7.125 max	181.0 max	AD	0.375	9.53

Millimetre dimensions have been derived from inches.



# BK448/5551A

## IGNITRON

### Electrically equivalent to 5551A

The data should be read in conjunction with the Ignitron Preamble.

#### ABRIDGED DATA

Size B, steel-jacketed, water-cooled ignitron intended primarily for single-phase resistance welding control applications. Cooling is by means of a copper tube attached in a coil to the envelope. A thermostat platform is fitted for temperature control. The BK448/5551A is particularly suitable for use where the quality of the cooling water is inferior to that recommended in the Ignitron Preamble. A plastic coated version is available.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 30.2A) . . . . .	600	kVA
Maximum average anode current (for demand not exceeding 200kVA) . . . . .	56	A

#### GENERAL

##### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 150A peak current . . . . .	13	V
at 3400A peak current . . . . .	26	V

##### Mechanical

Overall length (excluding flexible lead) . . . . .	13.000 inches (330.2mm) max
Overall width . . . . .	5.750 inches (146.1mm) max
Body diameter . . . . .	3.250 inches (82.55mm) max
Net weight . . . . .	3½ pounds (1.6kg) approx
Mounting position . . . . .	vertical, anode terminal up

##### Accessories

Water control thermostat (normally open, closes at 36°C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52°C approx) . . . . .	ZD100551

Continued on page 2

**Accessories (continued)**

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .				1.0	kV max
Ignitor lead . . . . .					ZD100222

**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

**Single-phase Resistance Welding Control Service**

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not.

	<b>Min</b>	<b>Max</b>	
<b>Anode</b>			
Supply voltage (r.m.s.) (frequency range 25 to 60Hz) . . . . .	250	600	V
Demand (for average current not exceeding 30.2A) . . . . .	—	600	kVA
Anode current (average) (for demand not exceeding 200kVA) . . . . .	—	56	A
Anode current averaging time:			
at 600V <sub>r.m.s.</sub> . . . . .	—	7.5	s
at 440V <sub>r.m.s.</sub> . . . . .	—	10.2	s
at 250V <sub>r.m.s.</sub> . . . . .	—	18	s
Fault current (peak):			
at 600V <sub>r.m.s.</sub> . . . . .	—	2800	A
at 250V <sub>r.m.s.</sub> . . . . .	—	6720	A
Duration of fault current . . . . .	—	0.15	s

**Three-phase (Frequency Changing) Welding Control  
or Power Rectifier Service (Intermittent Duty)**

<b>Anode</b>	<b>Peak anode voltage 1.2kV</b>	<b>Peak anode voltage 1.5kV</b>	
	Anode current (peak) . . . . .	600	480
corresponding average . . . . .	5.0	4.0	A max
Anode current (average) . . . . .	22.5	18	A max
corresponding peak . . . . .	135	108	A max
Averaging time . . . . .	10	10	s max
Peak fault current . . . . .	7500	6000	A max
Duration of fault current . . . . .	0.15	0.15	s max
Frequency range . . . . .	25–60	25–60	Hz

## MAXIMUM AND MINIMUM RATINGS (Continued)

### Ignitor

Peak forward ignitor voltage . . . . .	Anode voltage	max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak forward . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

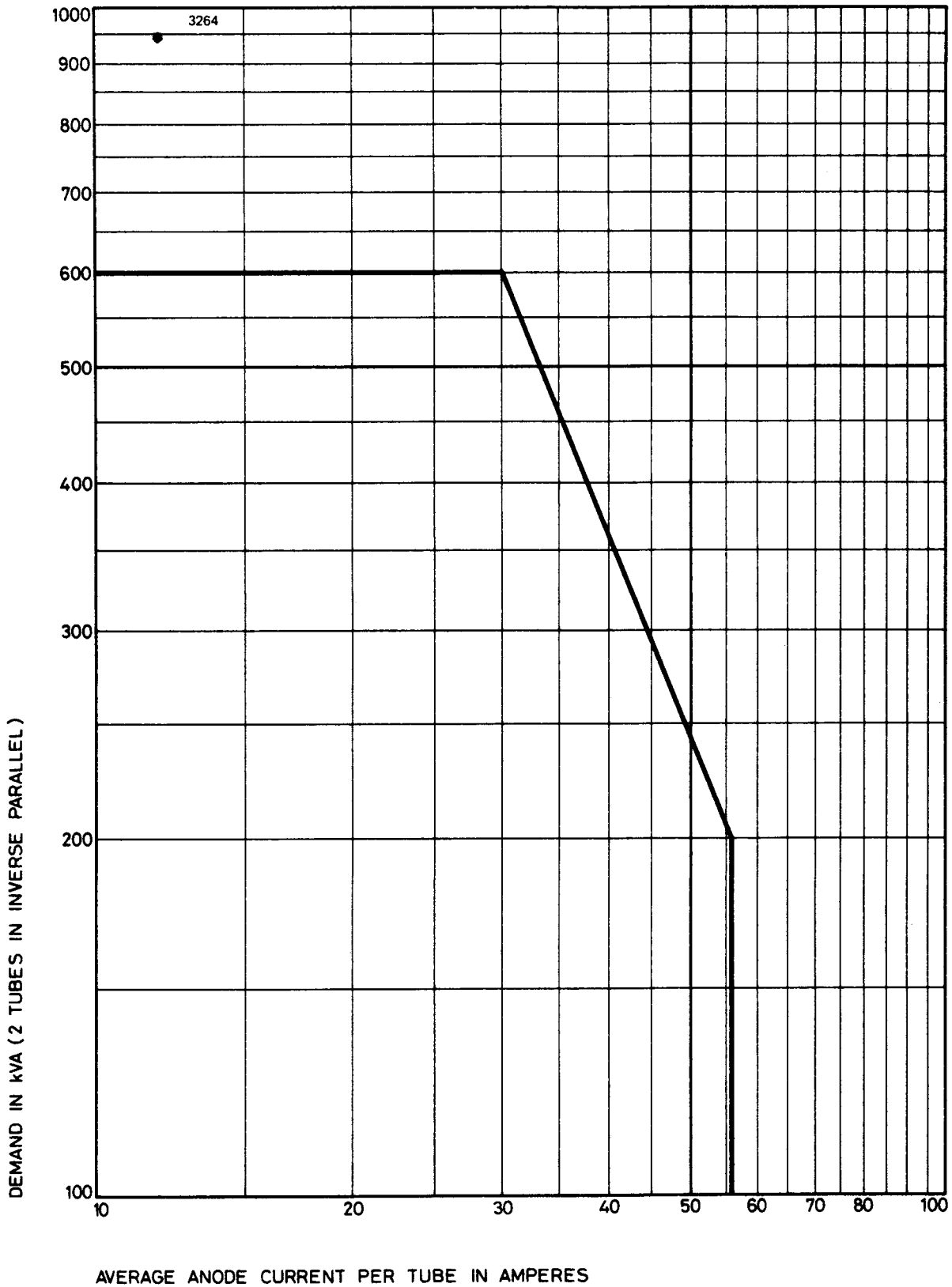
## COOLING

Minimum water flow rate (see note) . . . . .	1.0	imp.gal/min
	4.5	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	2.0	$^{\circ}$ C max

### Note

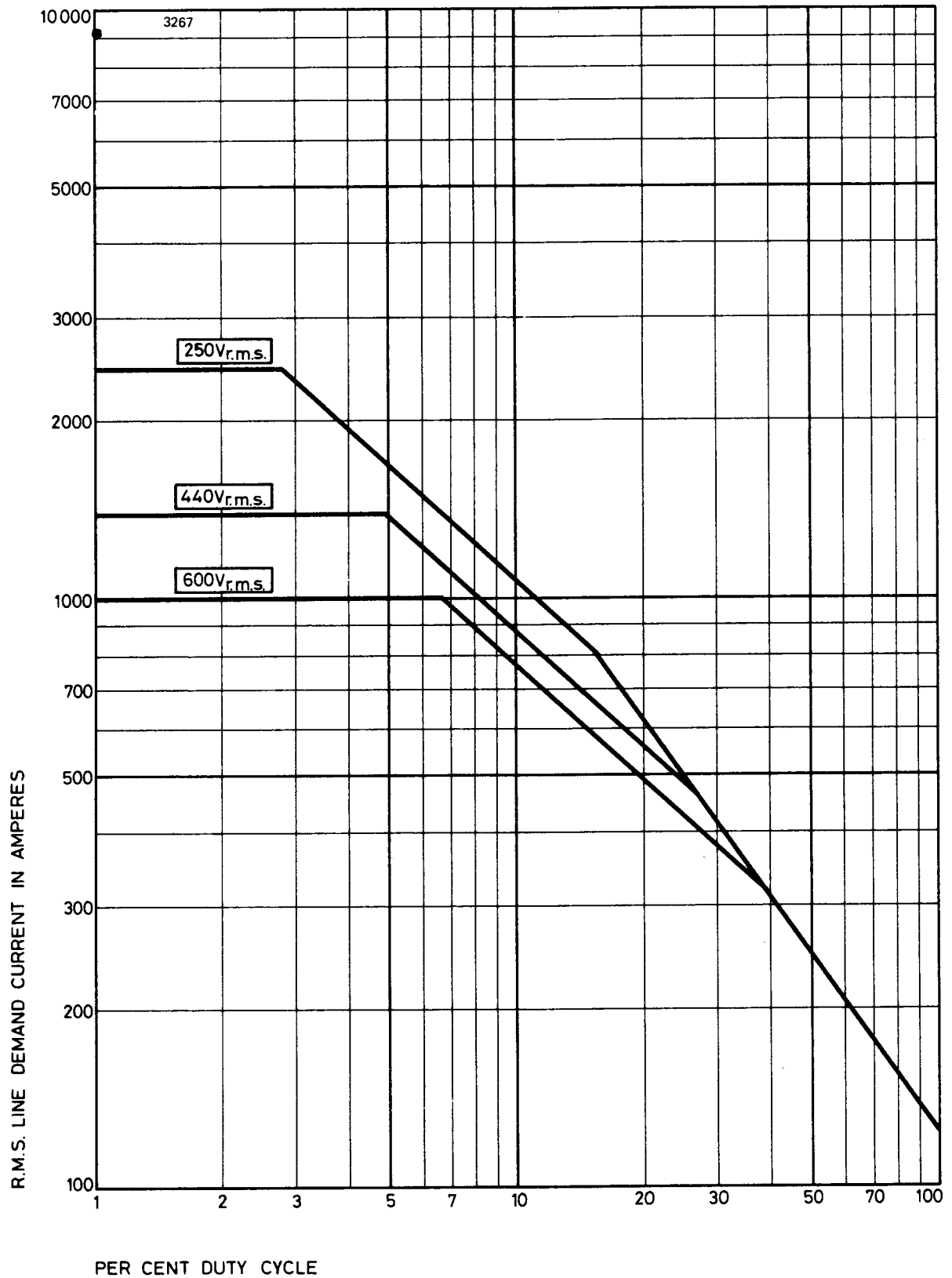
At the minimum flow rate of 1.0 imp.gal/min, the pressure drop across the jacket will be 5 lb/in<sup>2</sup> (0.35kg/cm<sup>2</sup>) approx. The water flow must be maintained for 10 minutes after switching off.

**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**  
Two ignitrons in inverse parallel for welder control at 250 to 600 volts



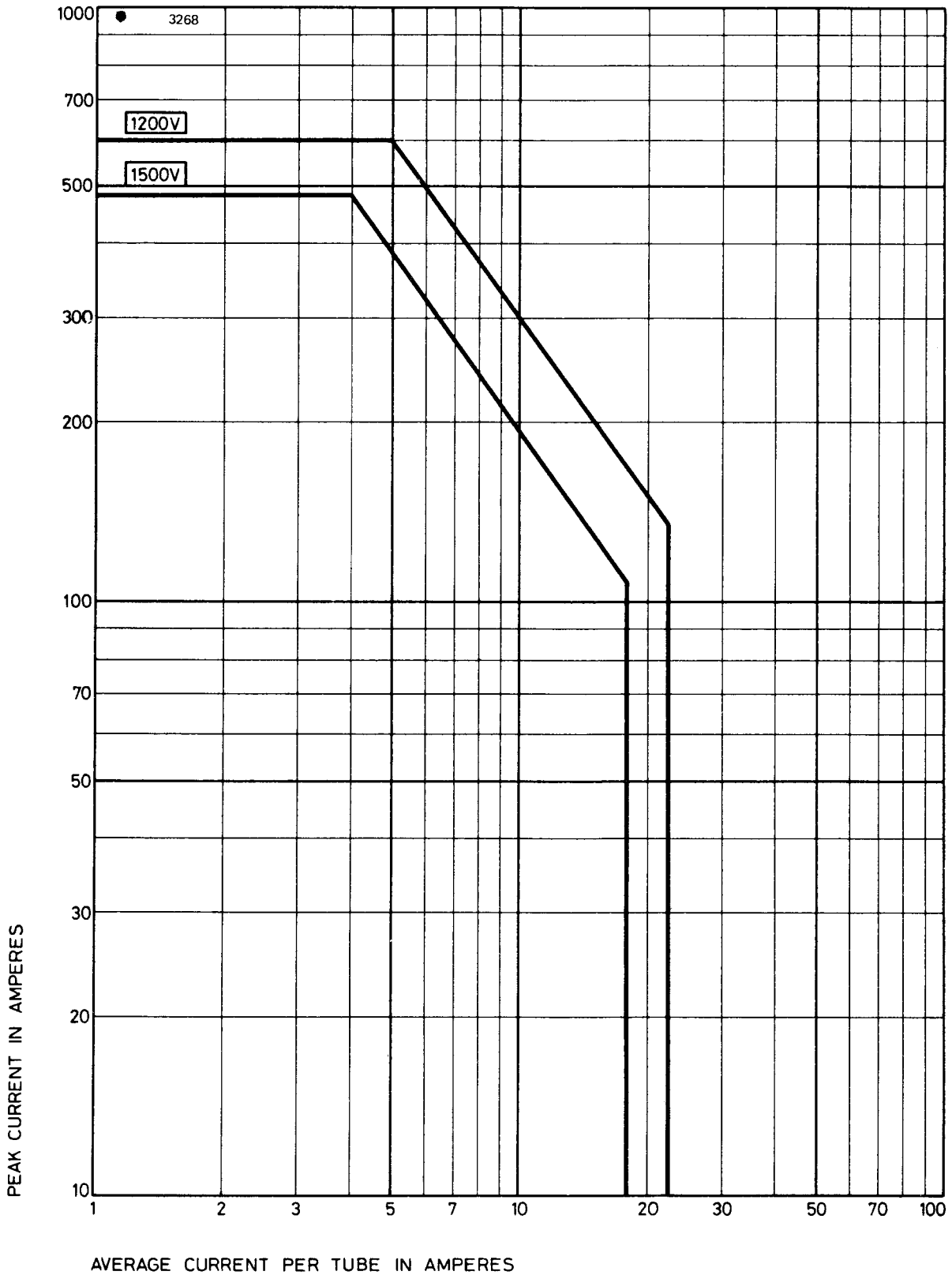


**LINE DEMAND CURRENT – DUTY CYCLE (MAXIMUM RATINGS)**  
**Two ignitrons in inverse parallel for welder control service**

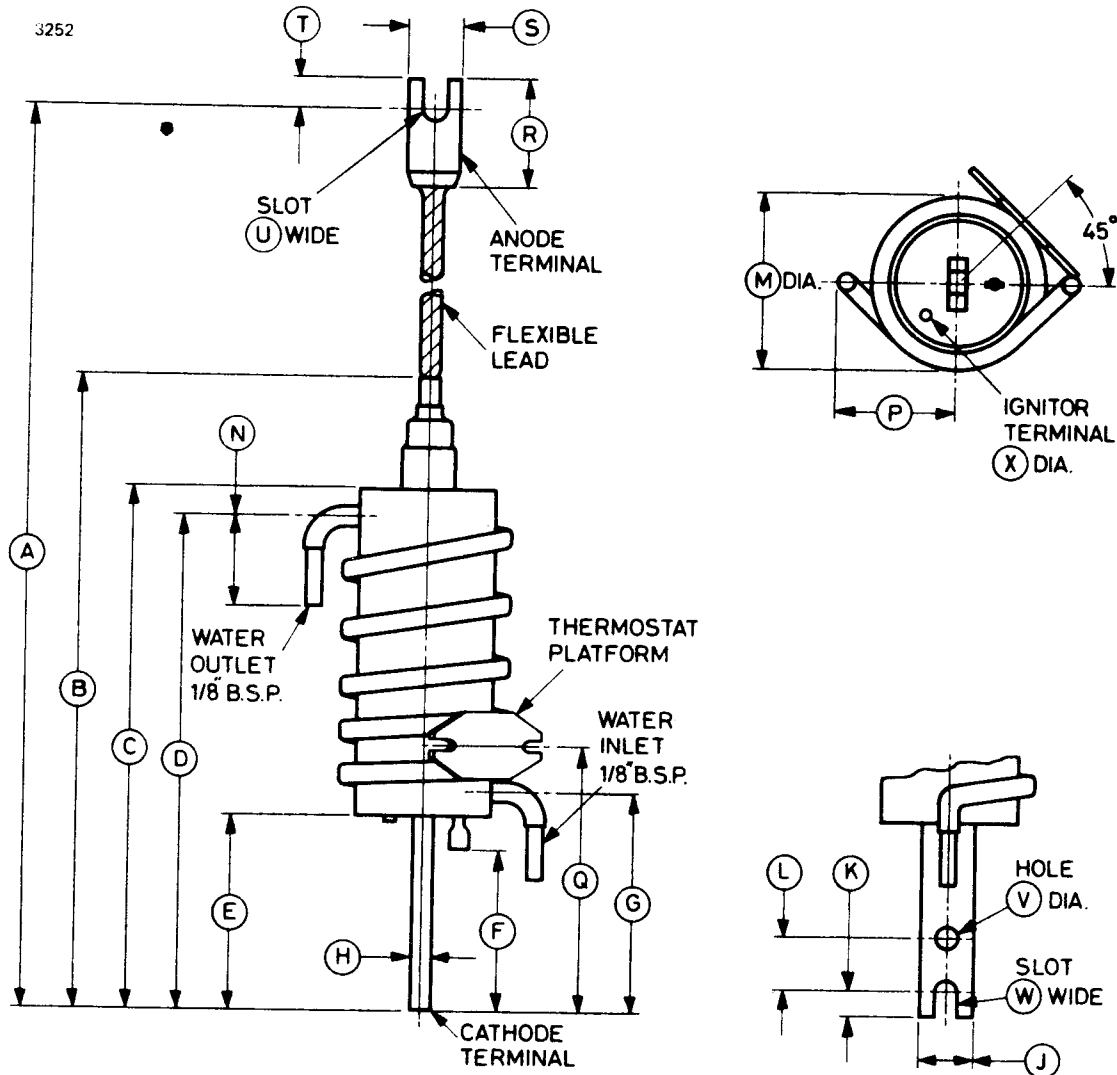


# PEAK CURRENT – AVERAGE CURRENT PER IGNITRON (MAXIMUM RATINGS)

Three-phase welder control service



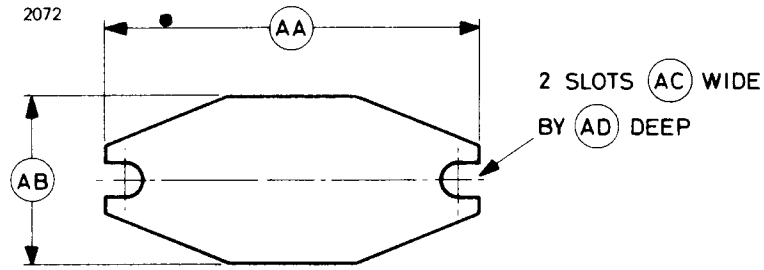
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	21.750 min	552.5 min	M	3.250 max	82.55 max
B	13.000 max	330.2 max	N	2.500 max	63.50 max
C	10.250 max	260.4 max	P	2.875 max	73.03 max
D	9.000	228.6	Q	5.125 ± 0.250	130.2 ± 6.4
E	3.125 min	79.38 min	R	2.375 max	60.33 max
F	2.750 min	69.85 min	S	1.000 max	25.40 max
G	4.000	101.6	T	0.812 max	20.62 max
H	0.375 ± 0.031	9.53 ± 0.79	U	0.406 ± 0.031	10.31 ± 0.79
J	1.000 ± 0.062	25.40 ± 1.57	V	0.437 ± 0.031	11.10 ± 0.79
K	0.500 ± 0.062	12.70 ± 1.57	W	0.437 ± 0.031	11.10 ± 0.79
L	1.000 ± 0.031	25.40 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13

Millimetre dimensions have been derived from inches.

**Thermostat Mounting Plate (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
AA	2.750	69.85
AB	1.250	31.75
AC	0.219	5.56
AD	0.375	9.53

Millimetre dimensions have been derived from inches.



## IGNITRON

### Equivalent to 1081

The data should be read in conjunction with the Ignitron Preamble.

### ABRIDGED DATA

High power size B, stainless-steel-jacketed, water cooled ignitron intended primarily for single-phase resistance welding control applications. It is capable of controlling 65% more power than the standard size B ignitron (5551A), while remaining within the same dimensions. It has a platform for mounting a detachable thermostat for temperature control.

Supply voltage (r.m.s.) . . . . .	250 to 600	V
Maximum demand (2 ignitrons in inverse parallel, average current not exceeding 43A) . . . . .	1000	kVA
Maximum average anode current (for demand not exceeding 200kVA) . . . . .	75	A

### GENERAL

#### Electrical

Number of electrodes:

main anode . . . . .	1
cathode (mercury pool) . . . . .	1
ignitor . . . . .	1

Arc voltage drop (approx):

at 150A peak current . . . . .	13	V
at 2828A peak current . . . . .	22	V

#### Mechanical

Overall length (excluding flexible lead) . . . . .	13.000 inches (330.2mm) max
Overall width . . . . .	5.750 inches (146.1mm) max
Body diameter . . . . .	3.250 inches (82.55mm) max
Net weight . . . . .	4 pounds (1.8kg) approx
Mounting position . . . . .	vertical, anode terminal up

#### Accessories

Water control thermostat (normally open, closes at 36° C approx) . . . . .	ZD100552
Over-temperature thermostat (normally closed, opens at 52° C approx) . . . . .	ZD100551

Continued on page 2

## Accessories (Continued)

Thermostat contact ratings:

a.c. voltage . . . . .	125	250	440	600	V max
a.c. current . . . . .	3.0	1.5	1.0	0.5	A max
voltage between switch contacts and ignitron envelope (peak) . . . . .				1.0	kV max
Ignitor lead . . . . .					ZD100222

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

### Maximum Operating Conditions for Single-phase Resistance Welding Control

Ratings are for two ignitrons connected in inverse parallel. Full cycle conduction must be assumed whether phase control is used or not. Frequency range 25 to 60Hz.

#### At maximum demand

Supply voltage (r.m.s.) . . . . .	250	440	500	600	V
Demand . . . . .	500	880	1000	1000	kVA
Demand current (r.m.s.) . . . . .	2000	2000	2000	1667	A
Average anode current . . . . .	54	45	43	43	A
Corresponding duty cycle . . . . .	6.0	5.0	4.8	5.8	%
Anode current averaging time . . . . .	27	15.4	13.5	11.25	s

#### At maximum average current per ignitron

Supply voltage (r.m.s.) . . . . .	250	440	500	600	V
Demand . . . . .	200	200	200	200	kVA
Demand current (r.m.s.) . . . . .	800	454	400	333	A
Average anode current . . . . .	75	75	75	75	A
Corresponding duty cycle . . . . .	21	37	42	50	%
Anode current averaging time . . . . .	27	15.4	13.5	11.25	s

### Ignitor Ratings

Peak forward ignitor voltage . . . . .		anode voltage max
Peak inverse ignitor voltage . . . . .	5.0	V max
Ignitor current:		
peak . . . . .	100	A max
r.m.s. . . . .	10	A max
average . . . . .	1.0	A max
averaging time . . . . .	5.0	s max

## IGNITOR CIRCUIT REQUIREMENTS

### Anode Firing

Ignitor voltage required to fire . . . . .	200	V min
Ignitor current required to fire . . . . .	12	A min
Typical current at ignition . . . . .	5 to 8	A
Starting time at required voltage or current . . . . .	100	$\mu$ s max

### Separate Excitation

Open-circuit voltage of excitation circuit . . . . .	450	V min
Short-circuit current of excitation circuit . . . . .	45	A min
Firing pulse length (approx. sine wave, average anode current greater than 20A) . . . . .	150	$\mu$ s min
Recommended pulse length (approx. sine wave) . . . . .	500	$\mu$ s

## COOLING

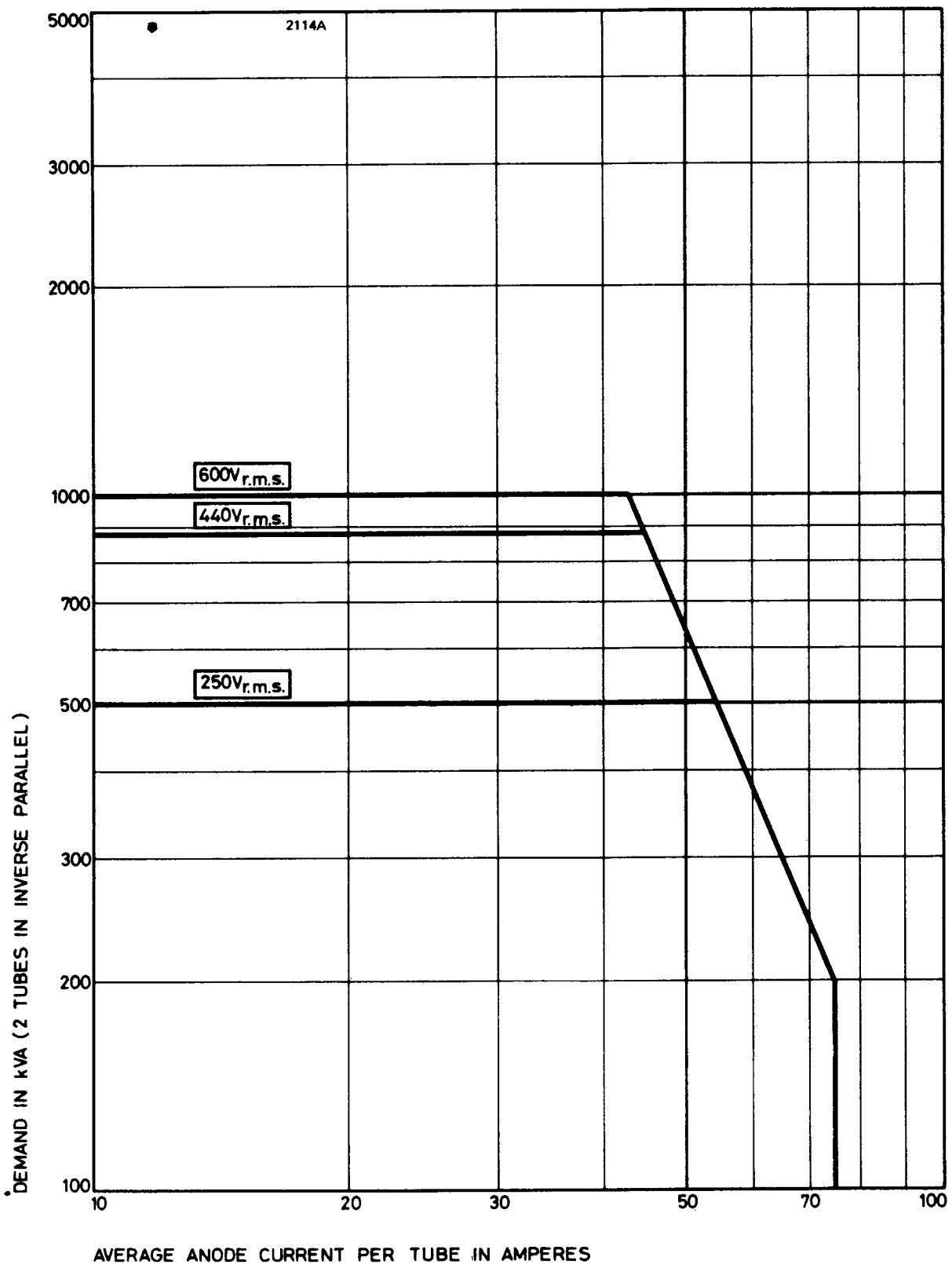
Minimum water flow rate (see note) . . . . .	1.0	imp.gal/min
	4.5	l./min
Inlet water temperature . . . . .	10	$^{\circ}$ C min
Outlet water temperature . . . . .	40	$^{\circ}$ C max
Temperature rise across jacket . . . . .	4.0	$^{\circ}$ C max

### Note

At the minimum flow rate of 1.0 imp.gal/min, the pressure drop across the jacket will be 1.8 lb/in<sup>2</sup> (0.13kg/cm<sup>2</sup>) approx. The water flow must be maintained for 10 minutes after switching off.

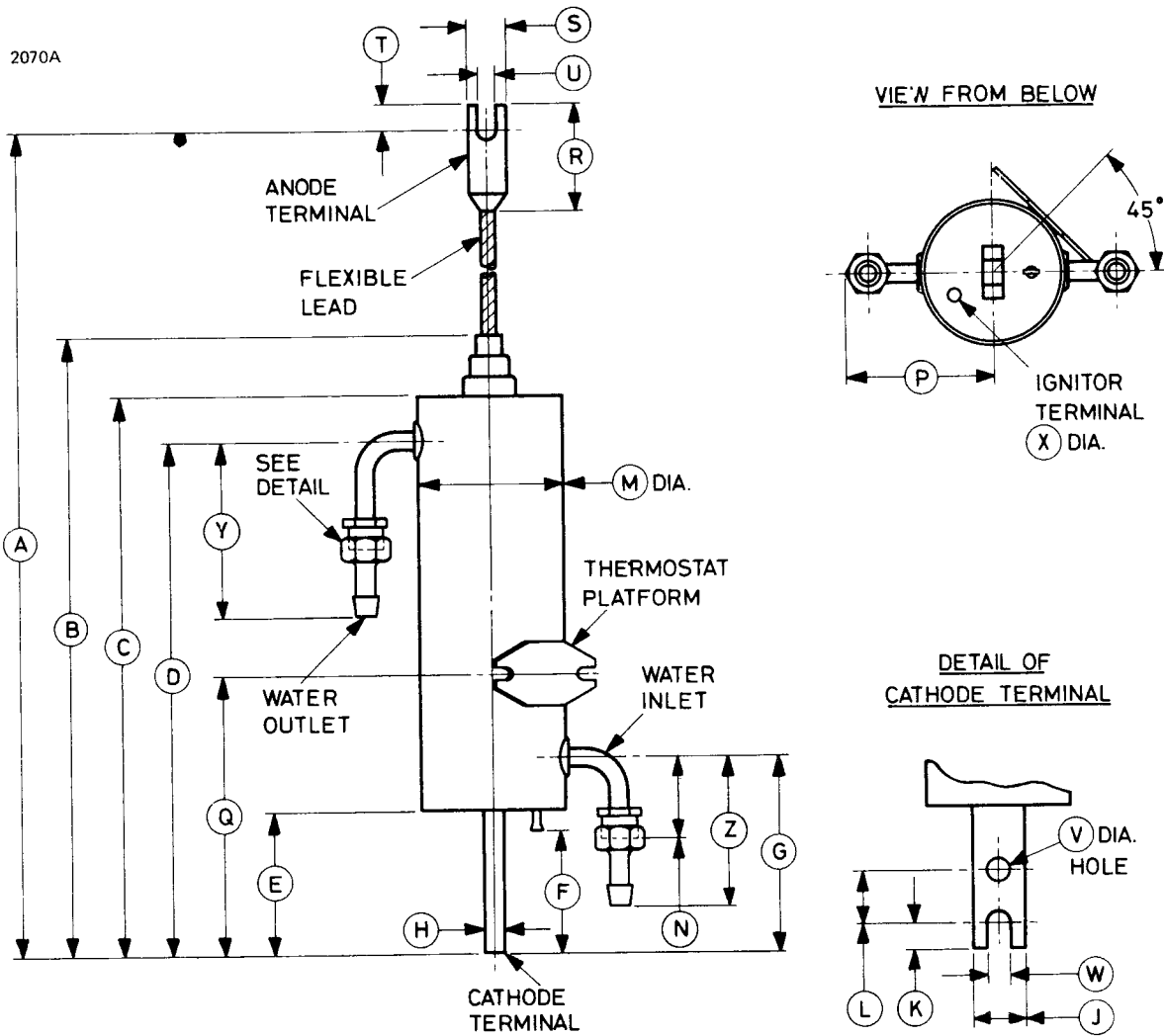
**DEMAND kVA – AVERAGE ANODE CURRENT (MAXIMUM RATINGS)**

Two ignitrons in inverse parallel for welder control at 250 to 600 volts

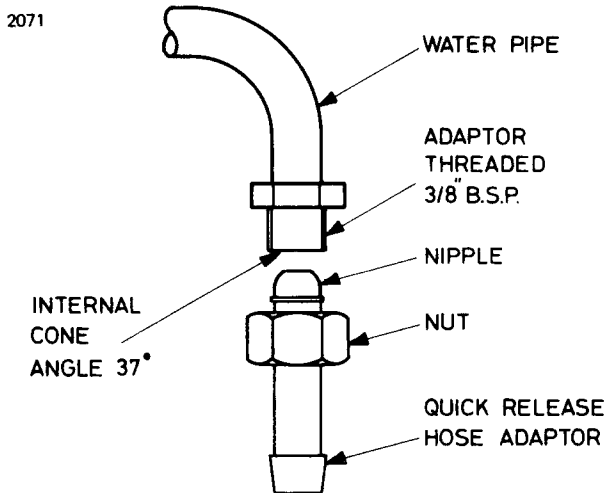




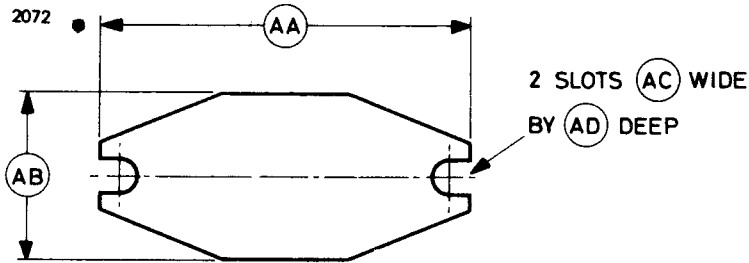
# OUTLINE



## Detail of Quick Release Hose Adaptors supplied with Ignitron



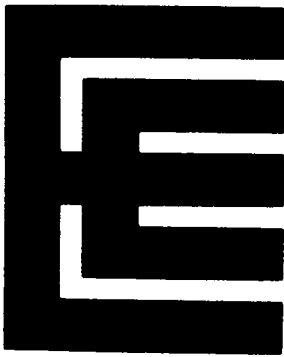
## Thermostat Mounting Plate



### Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	21.750 min	552.5 min	Q	5.125 ± 0.250	130.2 ± 6.4
B	13.000 max	330.2 max	R	2.375 max	60.33 max
C	11.000 max	279.4 max	S	1.000 max	25.40 max
D	9.500	241.3	T	0.812 max	20.62 max
E	2.375 min	60.33 min	U	0.406 ± 0.031	10.31 ± 0.79
F	2.000 min	50.80 min	V	0.437 ± 0.031	11.10 ± 0.79
G	3.625	92.08	W	0.437 ± 0.031	11.10 ± 0.79
H	0.375 ± 0.031	9.53 ± 0.79	X	0.250 ± 0.005	6.35 ± 0.13
J	1.000 ± 0.062	25.40 ± 1.57	Y	3.375 max	85.73 max
K	0.500 ± 0.062	12.70 ± 1.57	Z	2.875 max	73.03 max
L	1.000 ± 0.031	25.40 ± 0.79	AA	2.750	69.85
M	3.250 max	82.55 max	AB	1.250	31.75
N	1.500	38.10	AC	0.219	5.56
P	2.875 max	73.03 max	AD	0.375	9.53

Millimetre dimensions have been derived from inches.



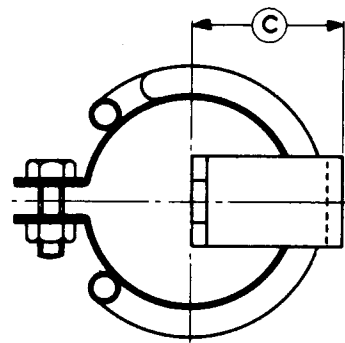
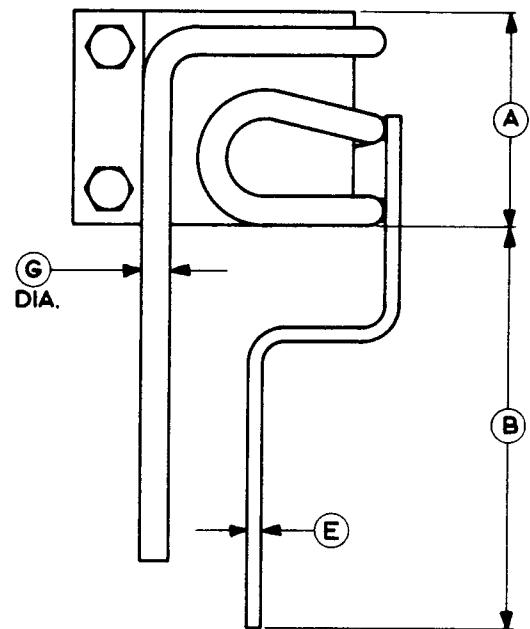
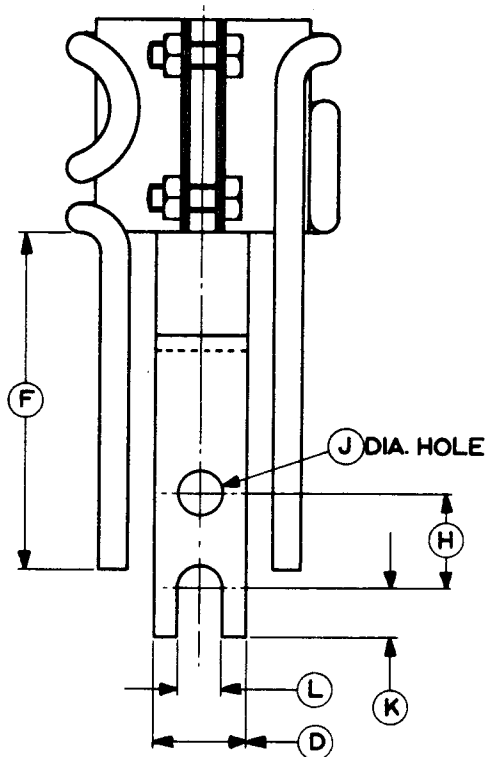
# ZD100365

## WATER COOLED CLAMP

### DESCRIPTION

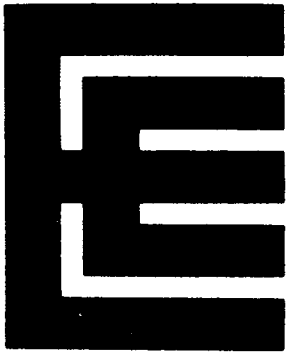
ZD100365 is a water cooled clamp for use with size A ignitrons.

3392



Ref	Inches	Millimetres
A	2.250	57.15
B	4.250	107.9
C	1.687	42.85
D	1.000	25.40
E	0.187	4.75
F	3.500 min	88.90 min
G	0.344	8.74
H	1.000	25.40
J	0.437	11.10
K	0.562	14.27
L	0.437	11.10

Millimetre dimensions have been derived from inches.



# ZD100551 ZD100552

## THERMOSTATS

The data should be read in conjunction with the Ignitron Preamble.

### INTRODUCTION

Two types of thermostat are available for use with those ignitrons fitted with thermostat platforms. One (ZD100551) is for over temperature protection, and the other (ZD100552) is for water control.

Provision is made for clamping the thermostat to a copper platform brazed to the side of the ignitron and making thermal contact with the inner envelope.

Where more than one ignitron is using the same water supply in series, the over temperature thermostat should be fitted to the last ignitron in the chain. Only one thermostat can be mounted on each ignitron.

### TEMPERATURE RATINGS

Over temperature thermostat type

ZD100551 (normally closed):

opens at . . . . . 52 °C approx

Water control thermostat type

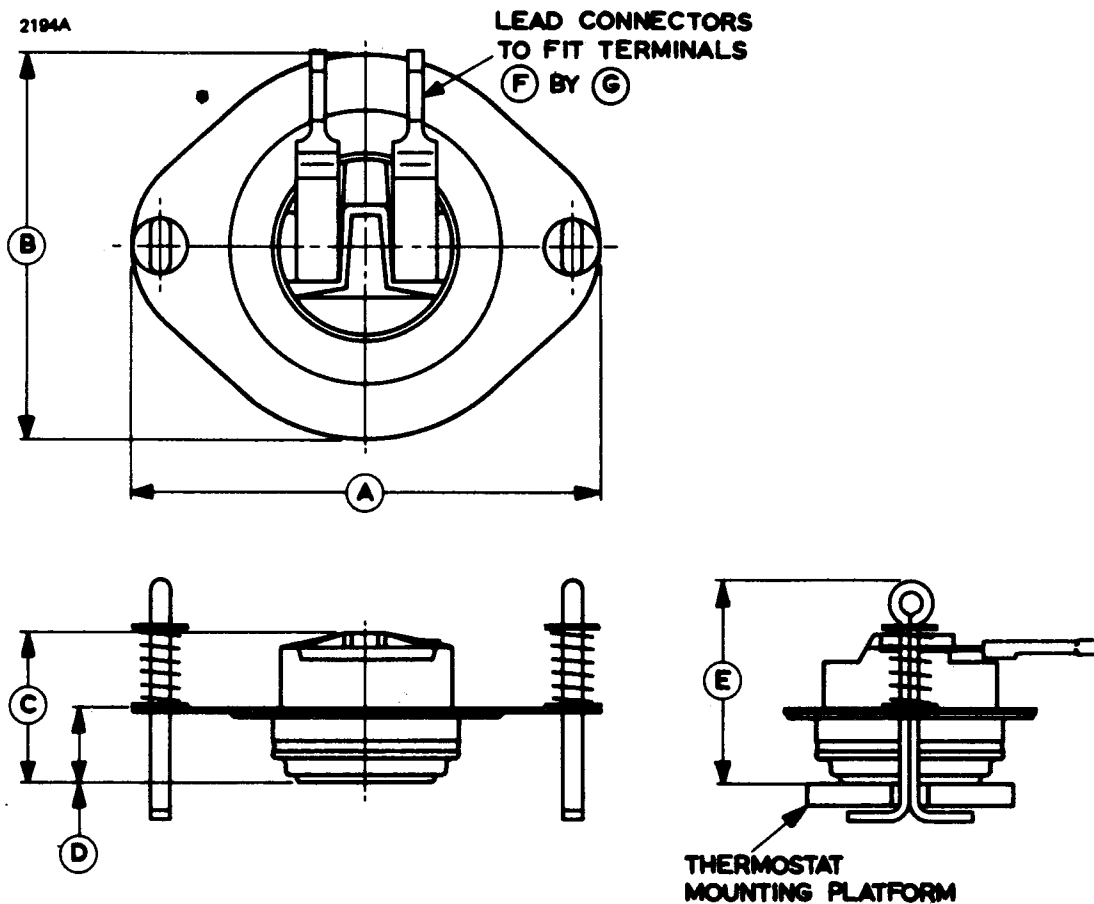
ZD100552 (normally open):

closes at . . . . . 36 °C approx

### ELECTRICAL RATINGS (Both types)

A.C. voltage . . . . .	125	250	440	600	V max
A.C. current . . . . .	3.0	1.5	1.0	0.5	A max
Maximum peak voltage between switch contacts and ignitron envelope . . . . .	1000				V

**OUTLINE (All dimensions without limits are nominal)**

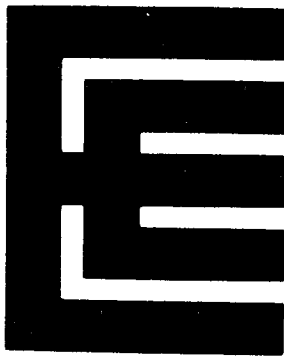


Ref	Inches	Millimetres
A	2.750 max	69.85 max
B	2.250 max	57.15 max
C	0.875 approx	22.23 approx
D	0.437 approx	11.10 approx
E	1.312 max	33.32 max
F	0.250	6.35
G	0.030	0.76

Millimetre dimensions have been derived from inches.

**Rectifiers and  
Industrial Thyratrons**





# TABULATED DATA

## RECTIFIERS AND INDUSTRIAL THYRATRONS

### MERCURY VAPOUR AND GAS FILLED RECTIFIERS

EEV type	Fila- ment voltage (V)	Fila- ment current (A)	Peak inverse voltage max (kV)	Peak anode current max (A)	Mean anode current max (A)	Max d.c. output 3-phase full wave		
						Voltage (kV)	Current (A)	
<b>869B</b>	5.0	19	20	10	2.5	19	7.5	
<b>68506†</b>	2.3	18	75V, 6.0A d.c. output as half wave rectifier					
<b>AH200</b>	2.5	40	20	10	2.5	19	7.5	
<b>AH205/ 857B</b>	5.0	30	22	40	10	21	30	
<b>AH211A</b>	2.5	30	16	8.0	2.0	15.2	6.0	
<b>AH221</b>	4.0	11	20	5.0	1.25	19	3.75	
<b>AH238</b>	4.0	7.0	13	5.0	1.25	12.4	3.75	
<b>AH2511</b>	5.0	11.5	15 2.5	12 20	3.0 5.0	14.4 2.38	9.0 15.0	
<b>BD10</b>	5.0	9.0	1.0	25	8.0	0.95	24	
<b>BD12‡</b>	5.0	35	1.0	2 x 50	2 x 16.5	0.95	49.5	

† Gas filled tungar rectifier

‡ Full wave rectifier

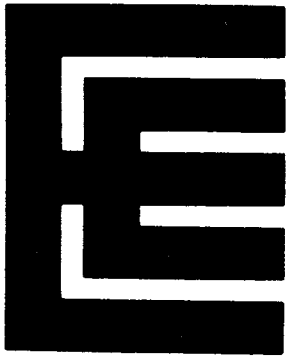
## HIGH VACUUM RECTIFIERS

EEV type	Filament voltage (V)	Filament current (A)	Peak inverse voltage max (kV)	Peak anode current max (A)	Mean anode current max (mA)	Nominal impedance ( $\Omega$ )
<b>3B24W</b>	5.0	3.0	20	0.3	60	1490
<b>A207</b>	4.0	12	45	1.1	350	600
<b>A237</b>	4.0	12	65	1.5	250	1000

## INDUSTRIAL THYRATRONS

EEV type	Filling	Peak inverse voltage max (kV)	Peak forward voltage max (kV)	Peak anode current max (A)	Mean anode current max (A)	Tube voltage drop approx (V)
<b>5557</b>	M.V.	5.0	2.5	2.0	0.5	16
<b>5559</b>	M.V.	1.5	1.0	15	2.5	16
<b>AFX203</b>	Gas	0.34	0.17	7.7	0.64	11
<b>BT5</b>	M.V.	1.5	1.0	12.5	2.5	16
<b>BT17</b>	M.V.	1.5	1.0	40	6.0	16
<b>BT19</b>	M.V.	2.5	2.5	2.0	0.5	16
<b>BT29</b>	M.V.	2.0	2.0	75	12.5	16
<b>BT69</b>	M.V.	15	15	75	12.5	16
<b>BT89</b>	Gas	1.5	1.0	2.0	0.5	12
<b>BT95</b>	M.V.	15	15	12	1.5	16





## RECTIFIERS AND THYRATRONS

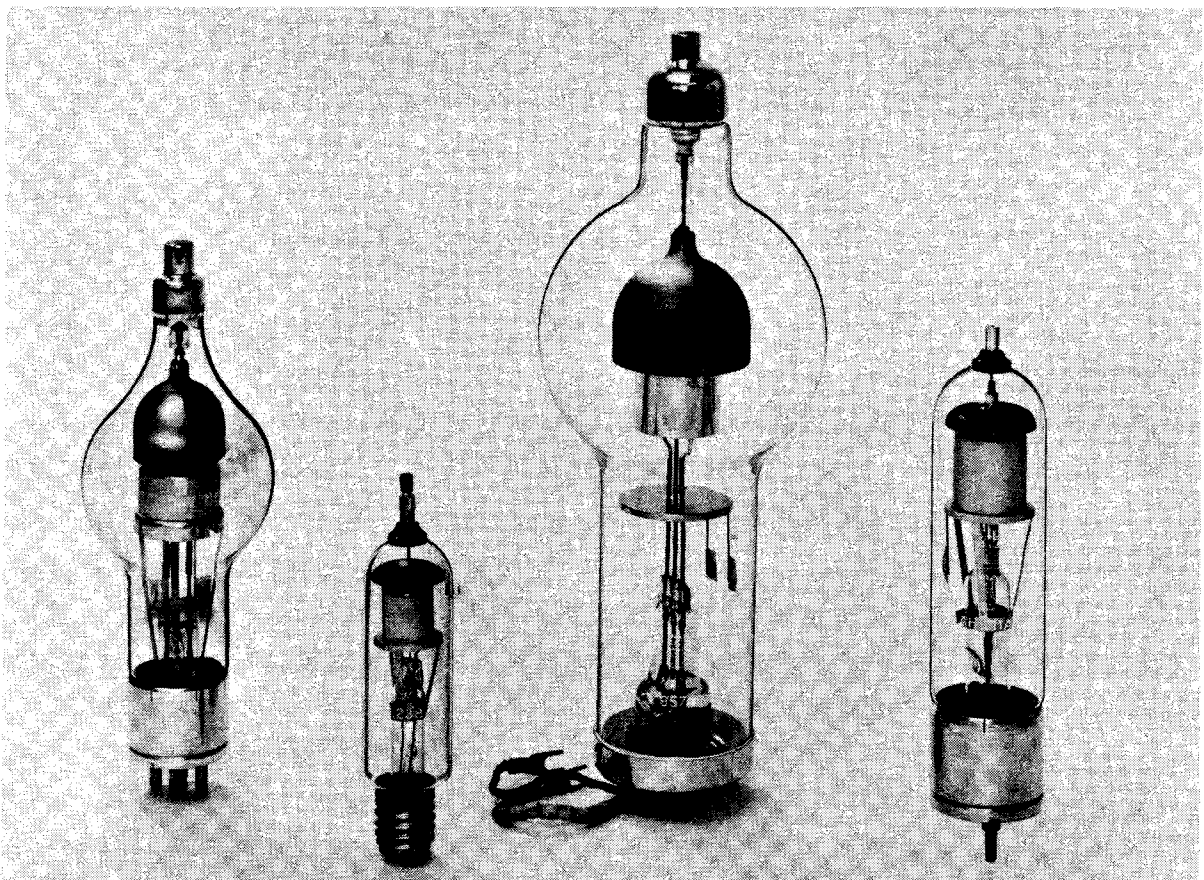
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### INTRODUCTION

Hot cathode rectifiers and thyratrons are widely used in high voltage, high current rectifier circuits where they give reliable and efficient service over very long periods.

EEV offers a range of mercury vapour rectifiers, with peak ratings up to 22kV inverse voltage and 40A anode current, together with a series of mercury vapour and xenon thyratrons which provide an economic means of rectification with control of output. High vacuum rectifiers are available for extremely high voltage applications at lower current levels.

This preamble is intended as a guide to assist users of rectifiers and industrial thyratrons to make the best use of the published data for these tubes and thereby obtain optimum performance and life.



A selection from the range of EEV rectifiers

## MERCURY VAPOUR RECTIFIERS

### Installation

Mercury vapour rectifiers must always be mounted vertically with the cathode connections at the bottom. They should be mounted sufficiently far apart to allow free air circulation; the published heating and cooling characteristics are only applicable to tubes so mounted.

Surrounding r.f. fields may cause spurious ionization within the tube, giving rise to flashovers, and it may be necessary to provide screening, due regard being paid to tube cooling. Similar effects may result from r.f. voltages in the associated wiring and r.f. filters in the supply leads may be required. These precautions will also reduce any r.f. interference by the rectifier on adjacent circuits.

When a mercury vapour rectifier is first installed it should be operated for at least 30 minutes at normal filament voltage before anode voltage is applied. This is to ensure that any mercury deposited on the anode or cathode structure during transit has vaporized. The same precaution should be taken if the tube has been out of use or in store for a considerable period.

### Filament Voltage

The filament voltage should always be kept as close as possible to the correct value given in the data sheets. Any long-term variations from this value, particularly reductions in voltage, are liable to reduce the life of the tube and, unless otherwise specified in the data sheets, such long term variations from the correct voltage should not exceed  $\pm 2.5\%$ . Temporary variations up to 5% should not seriously affect the life of the tube. In some cases, temporary variations over 5% are permissible and are indicated in the data sheet. The voltage at the pins or leads of the tube (not at the transformer) should be checked regularly on a high grade meter.

Because of the low voltage drop across mercury vapour rectifiers, the low potential end of the filament at any instant will contribute more than its fair share of the anode current. If the anode and filament supplies are either in-phase or  $180^\circ$  out of phase with each other then throughout each conducting period it will be the same portion of the filament which is overworked. If, however, the filament supply is  $90^\circ$  out of phase with the anode supply then the two ends of the filament will be equally utilized since each in turn becomes the more negative during conducting periods. For given loading conditions, such quadrature operation will give longer trouble-free life

although with small tubes or light loading the improvement will not be so readily apparent as in the case of the higher power rectifiers operating in polyphase circuits. Whilst true quadrature operation is preferable, phase differences of  $60^\circ$  to  $120^\circ$  give worthwhile improvement over in-phase operation. •

### **Condensed Mercury Temperature**

The condensed mercury temperature is, for all practical purposes, the temperature of the outside of the envelope in the region where the mercury condenses. This region lies  $\frac{1}{4}$  to  $\frac{1}{2}$  inch above the top of the base. The condensed mercury temperature can best be measured with a fine wire thermocouple attached to the envelope at the condensing point. The safe operation and long life of mercury vapour rectifiers depend largely upon the condensed mercury temperature, and the limiting temperature range is published for each type.

If the condensed mercury temperature is too low, and if normal currents are drawn, the voltage drop across the rectifier will be high enough to damage the cathode surface.

If the condensed mercury temperature is too high, the peak inverse voltage that the tube can withstand will be reduced and arc-backs may occur.

Thus, it is most important to keep the condensed mercury temperature within the specified limits. With some rectifiers, two or even three ratings are given for different temperature ranges, the maximum peak inverse voltage varying with the temperature range.

### **Warming up time**

With mercury vapour rectifiers the heating time before the h.t. may be switched on is dependent upon two factors:

1. The heating time necessary to ensure full emission from the filament. This is usually 1 minute.
2. The temperature of the condensed mercury, which must be within the limits given in the individual data sheets. The time required to reach this temperature may well be considerably in excess of the filament heating time.

Of the above two heating times, that which is the greater determines the time which must elapse between switching on the filament and applying the h.t. voltage.

Where no air blast is employed and heating is by filament power only, the time necessary to reach the minimum condensed mercury temperature from cold may be obtained from the curves of total heating time versus ambient temperature\* which are included in the tube data. If the tube is not being started from cold, the heating and cooling curves should be consulted. These curves are given in the data for each mercury vapour rectifier and their use is illustrated in the following example.

Assume that a rectifier type AH205/857B is to be started up from cold and the ambient temperature is 20°C. The curve of total heating time versus ambient temperature shows that 20 minutes must elapse before full h.t. may be applied.

If the rectifier then runs under full load until maximum envelope temperature is reached, the heating and cooling curve shows that the final rise of temperature above ambient will be 15°C. Thus if the ambient temperature remains constant at 20°C then the condensed mercury temperature is given by  $20 + 15 = 35^{\circ}\text{C}$ . This is within the published working temperature limits. If the filament supply and h.t. were then switched off, for say 5 minutes, the cooling curve shows that the temperature above ambient would drop to 13°C. Since the ambient temperature remains 20°C the condensed mercury temperature would then be 33°C. This is again within the working temperature range and hence re-application of h.t. would only need to be delayed 1 minute for filament heating.

In the example quoted above, the ambient temperature was such that no external heating or forced-air cooling was necessary to maintain the required condensed mercury temperature. Quite often, however, circumstances require some such additional control of temperature. In this case a thermostatically controlled air blast may be directed on to the rectifier envelope in the condensation region.

A ½ to ¾ inch bore pipe with its open end about ½ inch from the envelope is often satisfactory. This pipe should include at least a 3-inch length of insulating material to prevent flashovers. Normally a pressure of about ½ inch water gauge will provide sufficient air flow although the higher the rate of flow the nearer the condensed mercury temperature will approach that of the air blast irrespective of the ambient temperature.

\* The ambient temperature is best checked with an alcohol thermometer hung about 6 inches from the rectifier, with the bulb of the thermometer about ½ inch above the top of the tube base. It should, of course, always be checked under equilibrium conditions.

If the air blast is heated in order to raise the condensed mercury temperature then it is desirable to employ a shield tube surrounding the lower part of the rectifier in order to maintain the whole of this region at or near the air-blast temperature. If no shield is used the mercury will condense at some point diametrically opposite to that being blown due to the lower temperature at that point.

### **Anode Voltage Drop**

The value published for the voltage between anode and cathode during conduction is a typical figure and slight variations will be encountered according to load conditions. For a new rectifier the voltage drop will be of the order of 9 to 14 volts but at the end of life it will have risen to the region of 20 volts.

### **Parallel Operation**

Mercury vapour rectifiers may be operated in parallel but a series resistor or reactor must be connected in each anode lead to prevent the rectifier with the lowest voltage drop being overloaded.

### **Frequency**

The ratings apply to operation at frequencies in the range 25 to 60Hz unless otherwise stated. At very low frequencies the anode current stays at or near its peak value for longer periods and at high frequencies the period between positive half cycles allows insufficient time for de-ionization.

### **Absolute Ratings**

All the maximum ratings specified in the data sheets are absolute ratings. This means that the equipment designer is responsible for seeing that they are not exceeded, even momentarily, under any conditions of mains fluctuations, surges or component tolerances. See British Standard Code of Practice CP 1005 (1962) 'The Use of Electronic Valves'.

### **Peak Inverse Voltage**

In determining the peak inverse voltage appearing across a rectifier, allowance must be made for transients, such as mains or switching surges and oscillations in the inverse voltage. Since calculation of inverse voltage is difficult, the true value should be determined by measurement with an oscilloscope.

## Anode Current

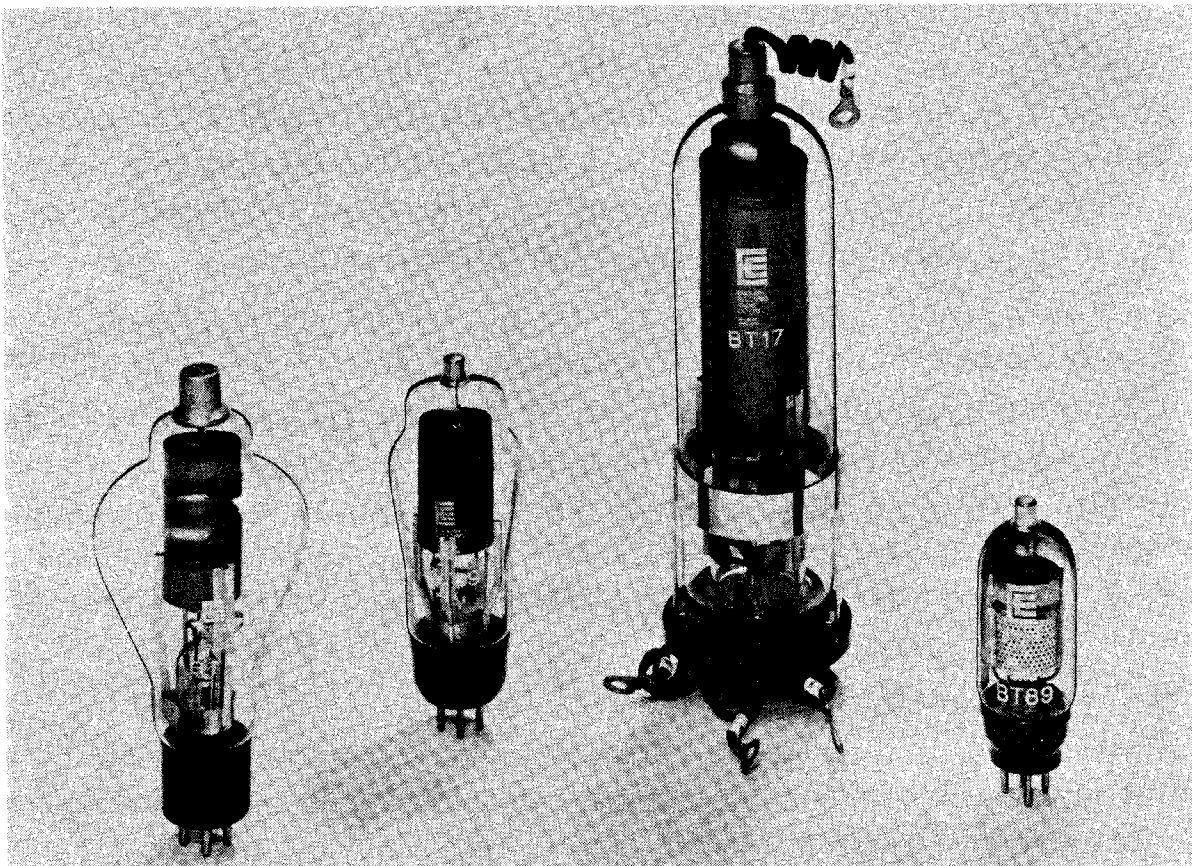
The peak anode current must never exceed the rated value.

A maximum averaging time is specified with the published rating for average anode current. It is permissible to exceed the average current rating  $I_{a \text{ max}}$  for periods less than the maximum averaging time  $t_{av \text{ max}}$  provided the product of average anode current and time does not exceed  $I_{a \text{ max}} \times t_{av \text{ max}}$ .

The surge current rating applies to a transient condition such as a short circuit and exceeding the specified value will probably destroy the rectifier. A number of surges within the maximum rating may reduce the life of the tube. It is recommended that the surge current should be limited by means of a series resistance or reactance in the anode circuit.

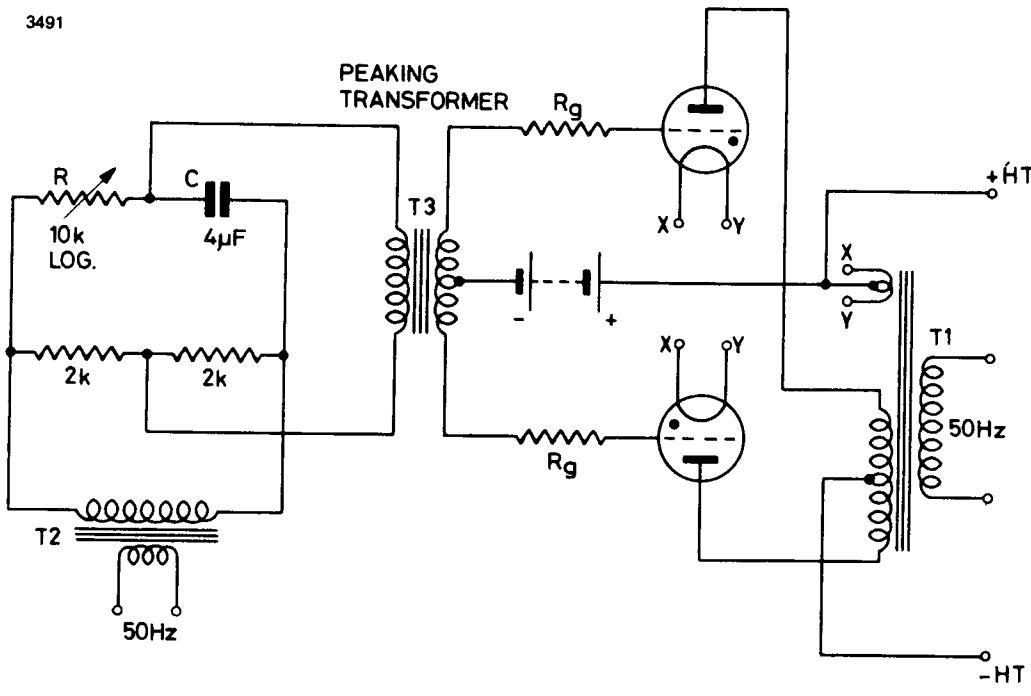
## INDUSTRIAL THYRATRONS

In industrial thyratrons, which may be filled with mercury vapour, xenon, or argon, the application of a suitable bias to the grid maintains the tube in the non-conducting condition even when the anode is positive. The grid voltage necessary to fire the thyatron is critical and is dependent to some extent upon the anode voltage, as shown in the published control characteristics.



A selection from the range of EEV industrial thyratrons

If the grid voltage becomes more positive than the critical value corresponding to the anode voltage at that instant, the thyatron fires and continues to conduct for as long as the anode remains positive, regardless of what happens to the grid voltage. From the moment of firing, the grid has no control whatever over the magnitude or duration of the anode current – this almost immediately becomes dependent upon the anode voltage and anode circuit impedance.

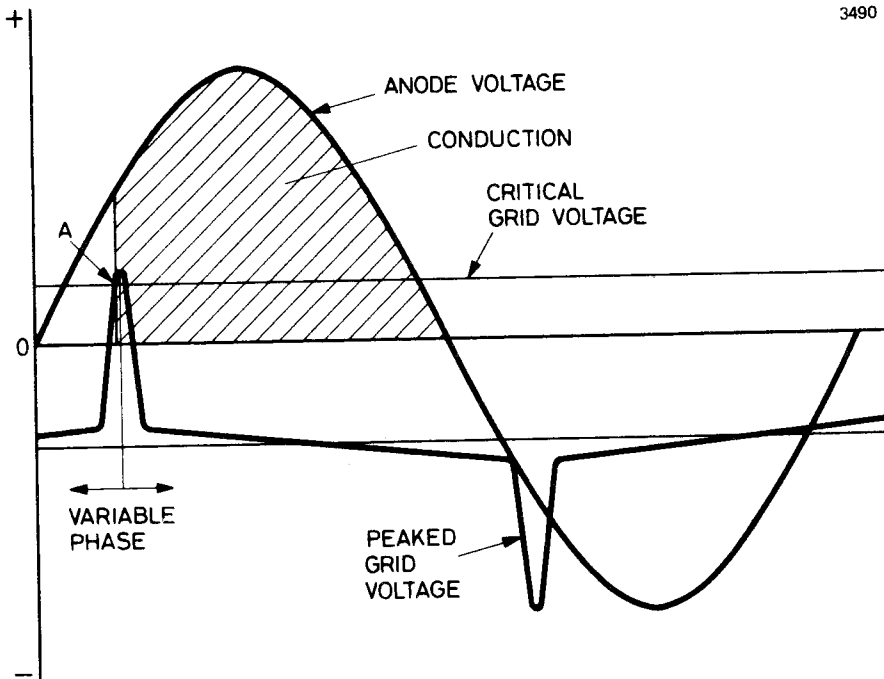


**Fig. 1** Typical thyatron trigger circuit using peaking transformer

In practical rectifying circuits the tube is fired at the desired instant during each positive half cycle of anode voltage by the application to the grid of a voltage pulse of short duration. This is conveniently obtained, as shown in Figs. 1 and 2, by the use of a peaking transformer supplied from a phase shifting network. In Fig. 1 two thyatrons are used in single phase full wave operation. Transformer T<sub>1</sub> is a conventional transformer supplying the anodes and filaments. Transformer T<sub>2</sub> supplies a voltage to a phase shifting network RC, R being variable to provide a phase adjustment in the voltage supplied to T<sub>3</sub>. This latter is a peaking transformer which provides a peaked waveform from its secondary. Such a waveform is desirable for good control

of firing as can be appreciated from Fig. 2. A peak in excess of the critical grid voltage is provided and striking takes place at point A on the steep leading edge where the instantaneous grid voltage is equal to the critical grid voltage. The position of the striking point, and hence the average output voltage, is varied by changing the phase of the peaked voltage.

3490



**Fig. 2** Voltage relationships in a thyatron using variable phase control and a peaking transformer.

### Control Characteristics

The published control characteristics show the relationship between the critical grid voltage and the anode voltage and give upper and lower limit curves between which all tubes will operate within the normal temperature limits.

### Positive Ion Current

During conduction, a positive ion current proportional to the anode current is produced and normally this flows through the negatively biased grid. To avoid excessive grid current, the grid voltage during conduction must be more positive than  $-10V$ . This may be effected by the use of a suitable series grid resistor within the range specified on the tube data sheet.



## Recovery Time

After anode current ceases to flow, a recombination of electrons and positive ions takes place and the gas inside the thyatron becomes de-ionized. The elapsed time between the cessation of conduction and the re-application of a positive anode voltage without conduction occurring is the recovery time. It is a function of the degree of ionization present initially, gas pressure and electrode design. The recovery time can be reduced by making the grid more negative or reducing the grid circuit impedance.

## SMOOTHING FILTERS

In many industrial applications, particularly when three phase full wave circuits are used, smoothing of the d.c. output by filters is not necessary. When filters are used with mercury vapour rectifiers, these are usually of the choke input type in order to limit the peak currents. The filter inductance must have a value at least equal to the critical inductance if conduction is to be continuous. Since the theoretical values of the critical inductance are based on certain assumptions which do not hold in practice (e.g. that there is no ripple at the output from the first section of the filter) it is advisable in practice to multiply them by a factor of about 1.25. Both of these values are given in Table 1 (Columns 3 and 4) on page 11.

When a tube is operated at considerably less than maximum ratings, an inductance smaller than the critical value may be used, without damage to the tube, provided that the peak current rating is not exceeded. This would mean that conduction would not be continuous, a condition usually avoided where filters are used.

It is necessary, when operating at or near the maximum ratings, to pay attention to the ratio of peak to mean anode currents. All EEV mercury vapour rectifiers have maximum ratings based on a ratio of 4:1 peak to mean anode current. With single phase operation it so happens that, when the critical inductance is used, the ratio is just 4:1 so that this is a satisfactory condition of operation. Under these conditions the tube will reach both peak and mean rating limits simultaneously.

When the critical inductance is used with 3 phase operation it results in a peak to mean current ratio of 6:1 which is not permissible if the maximum value of mean current is desired.

Column 5 in Table 1 gives the inductance for a peak to mean current ratio of 4:1.

The filter inductance should be proportional to the load resistance. With a varying load resistance it is usual to adopt a swinging choke which can generally be designed to give an inductance not less than the desired value at maximum output and not less than the critical value at all higher values of the load resistance. In extreme cases where it is impracticable to design a suitable swinging choke, some other load may be added or a bleed resistor.

The ratio of actual peak to mean anode currents in a tube is given by

$$\text{Ratio } \frac{\text{peak current}}{\text{mean current}} = K_1 K_2$$

where  $K_1$  = theoretical value of peak to mean anode currents with infinite filter inductance as given in Table 2, namely:  
 2.0 for Circuits A and B and 3.0 for Circuits C and D.

$$\text{and } K_2 = \frac{\text{peak current with actual filter inductance}}{\text{peak current with infinite filter inductance}}$$

given in Fig. 3 as a function of  $K_3$ .

$$\text{where } K_3 = \frac{\text{actual filter inductance}}{\text{critical filter inductance}}$$

In Fig. 3 the points corresponding to a 4:1 current ratio for both single and three phase operation are marked.

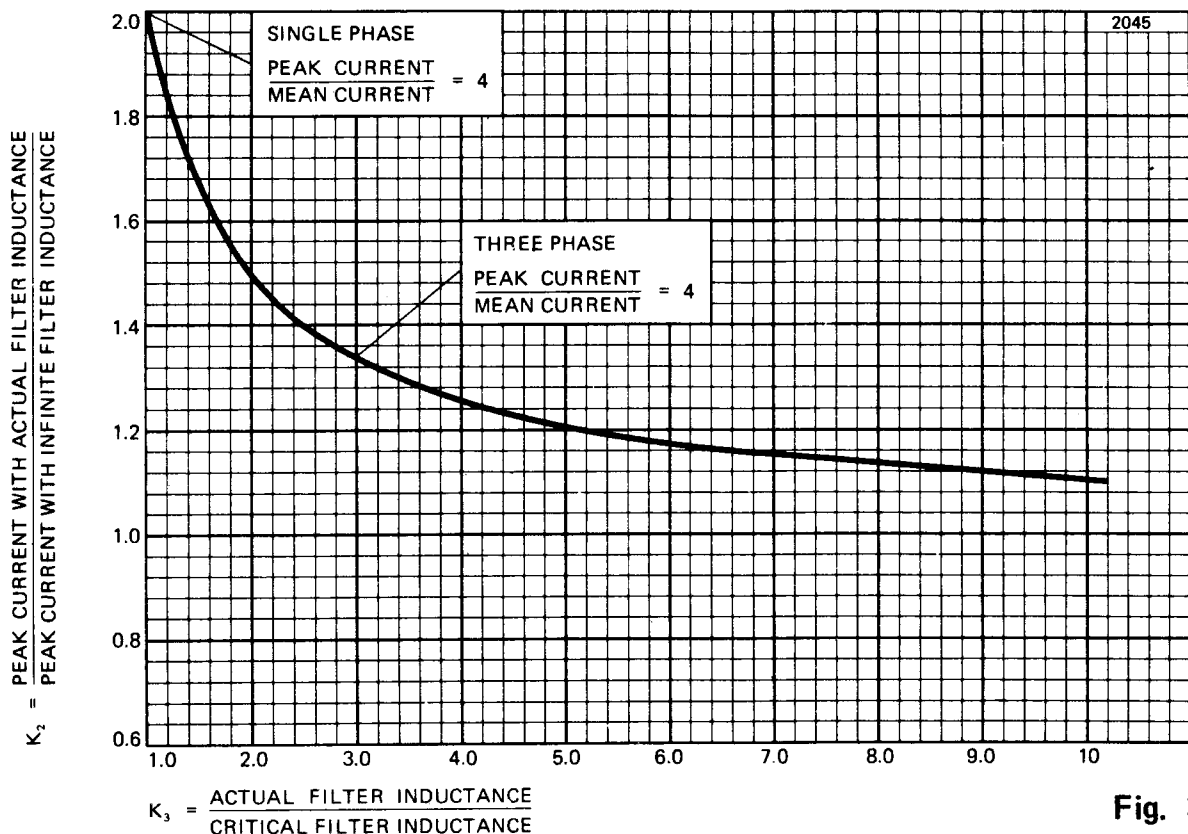


Fig. 3

**TABLE 1 Input Inductance in Choke Input Filters**  
**(Mains frequency 50Hz,  $L_{crit}$  = critical inductance)**

Column 1	2	3	4	5
Circuit	Diagram	$L_{crit}$ (H)	$L_{crit} \times 1.25$ (H)	Inductance for peak/mean anode current = 4:1 (H)
Single Phase Full Wave	A	$R_L/950$	$R_L/760$	$R_L/760$
Single Phase Bridge	B	$R_L/950$	$R_L/760$	$R_L/760$
Three Phase Half Wave	C	$R_L/3800$	$R_L/3000$	$R_L/1000$
Three Phase Full Wave	D	$R_L/31\ 000$	$R_L/25\ 000$	$R_L/8300$

where  $R_L$  = load resistance = output voltage/output current.

The design of smoothing filters is given in detail by Lee (Ref. 1, pp. 133–138). With grid controlled rectifiers the value of the critical inductance is very much increased – see Overbeck (Ref. 2).

#### References to Rectifiers and Filters

1. Reuben Lee, 'Electronic Transformers and Circuits', John Wiley & Sons Inc., Chapman & Hall Ltd., 2nd ed. 1955.
2. Overbeck, W.P., 'Critical inductance and control rectifiers', **Proc. I.R.E.**, Vol. 10, October 1939, p. 655.

**TABLE 2 Voltage, Current and Power Relationships**

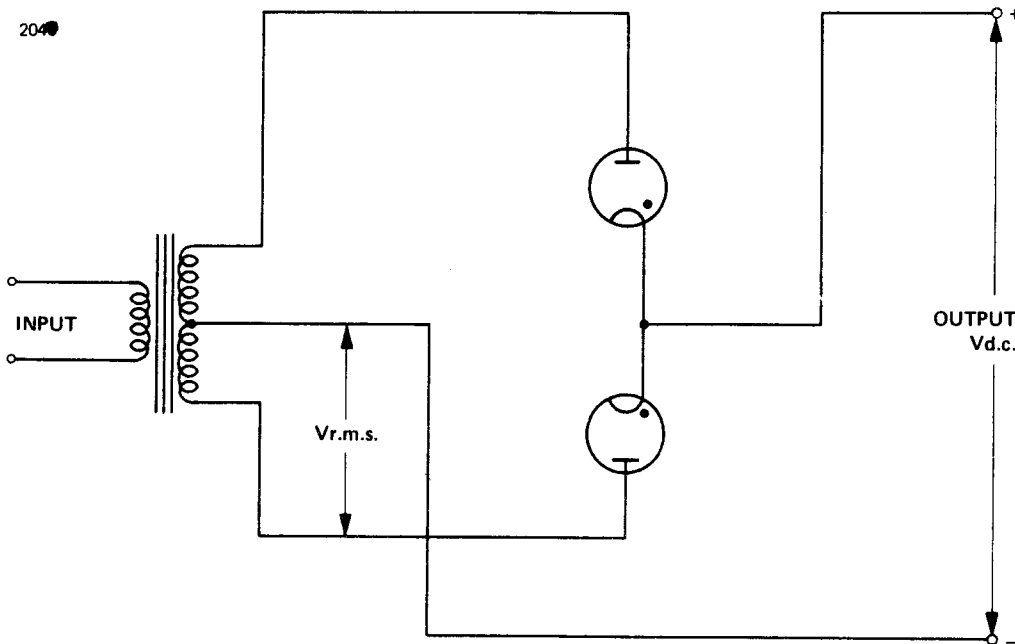
	Circuit A	Circuit B	Circuit C		Circuit D
			Full Load	Zero Load	
<b>Voltage</b> ( $V_{d.c.} = 1$ )					
$V_{r.m.s.}$	1.11	1.11	0.855	Note 4	0.428
$V_i$	3.14	1.57	2.09	Note 4	1.05
$V_i/V_{r.m.s.}$	2.83	1.42	2.45	2.83	2.45
<b>Current</b>					
$I_L/I_{mean}$	2.0	2.0	3.0		3.0
<b>Power</b> (Output kVA = 1)					
Primary kVA	1.11	1.11	1.21		1.05
Secondary kVA	1.57	1.11	1.48		1.05

- $V_{d.c.}$  = Output voltage to filter.
- $V_{r.m.s.}$  = Transformer secondary voltage per leg.
- $V_i$  = Maximum peak inverse voltage across any tube.
- $I_L$  = Load current.
- $I_{mean}$  = Average anode current per tube.

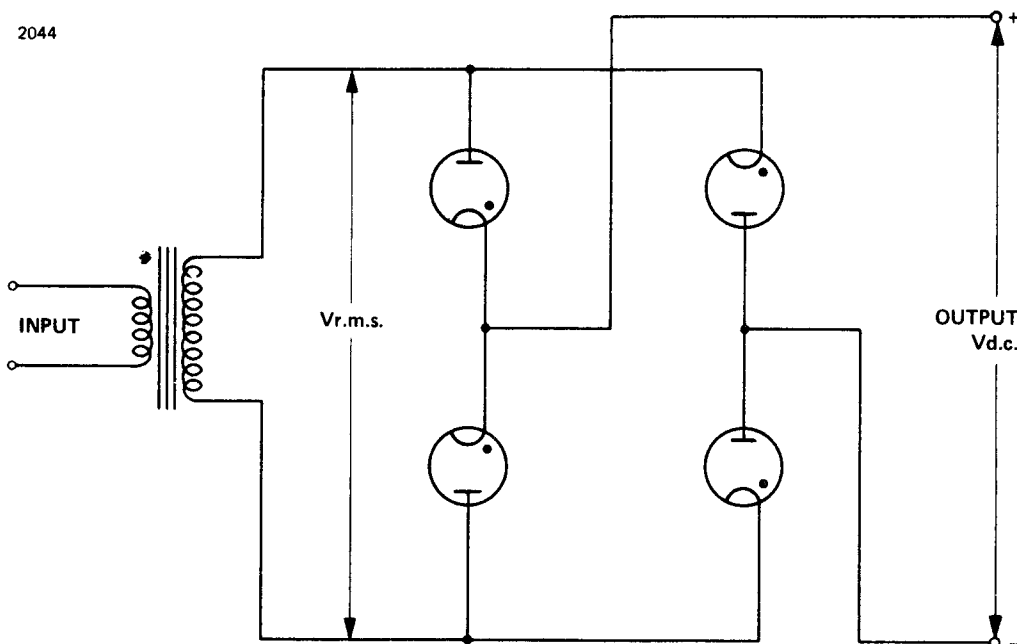
**Notes**

1. Above values are for choke input filter with infinite inductance choke.
2. Voltage drops in rectifiers and transformers are neglected.
3. Sinusoidal input waveform.
4. When, in circuits A, B, C and D, the load current falls to zero there is no voltage drop across the choke and the voltage across the capacitor following the choke builds up to the peak value of the transformer voltage. In circuits A, B and D this does not increase the peak inverse voltage across the tubes but in circuit C it increases the peak inverse voltage from  $2.45V_{r.m.s.}$  to  $2.83V_{r.m.s.}$ . For practical purposes the value of  $V_i/V_{r.m.s.}$  for intermediate values of load may be obtained by linear interpolation.

## TYPICAL RECTIFIER CIRCUITS FOR CHOKE INPUT FILTERS



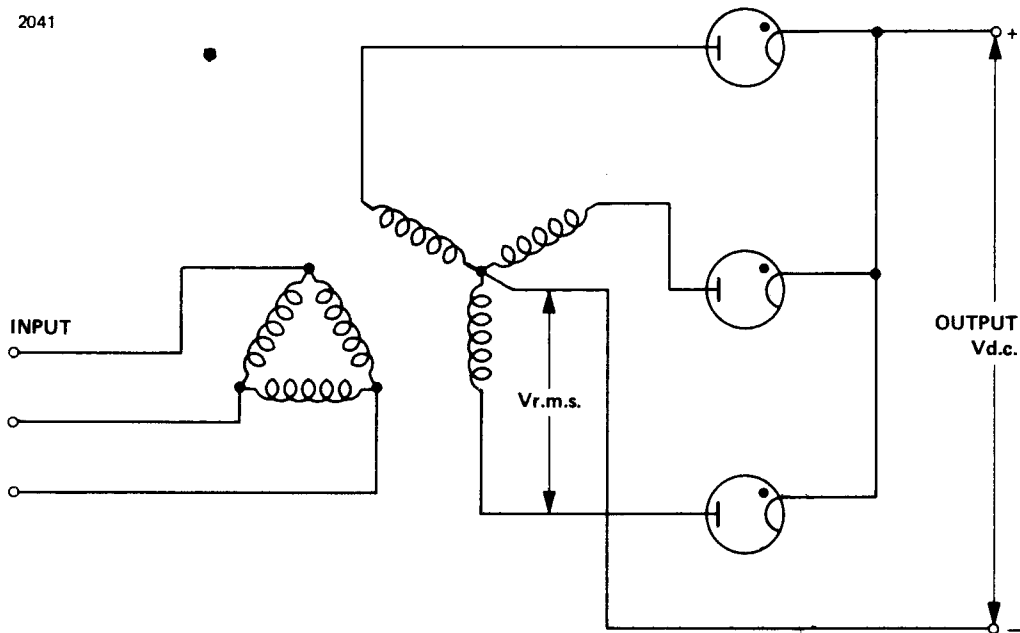
**Circuit A** Single phase full wave



**Circuit B** Single phase full wave bridge

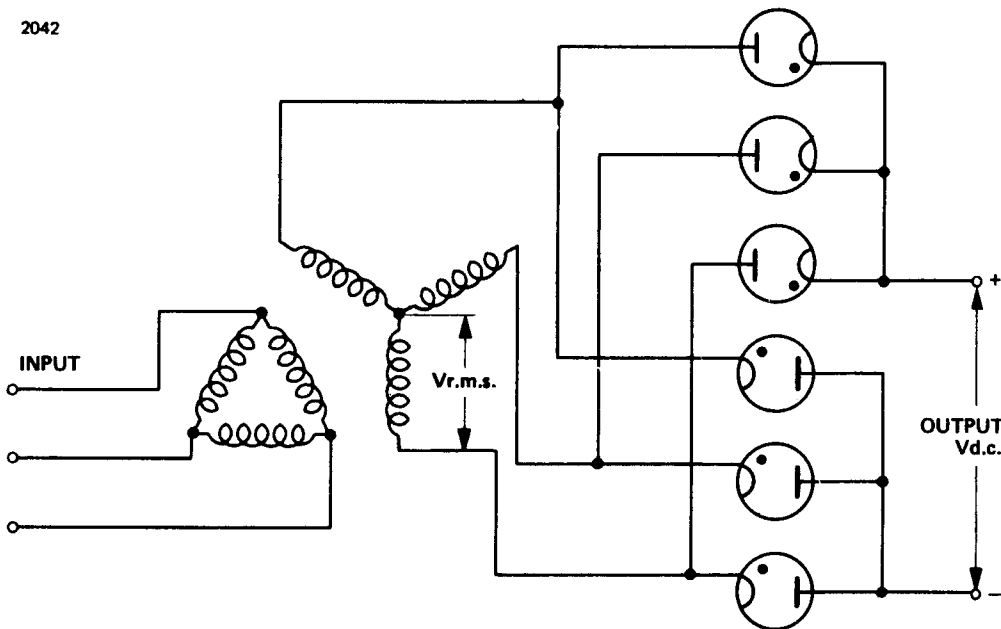
# TYPICAL RECTIFIER CIRCUITS FOR CHOKE INPUT FILTERS

2041

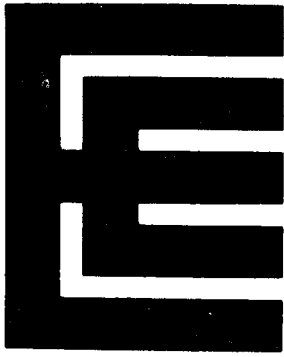


**Circuit C** Three phase half wave

2042



**Circuit D** Three phase full wave



# 3B24W

## HIGH VACUUM RECTIFIER

**Service Type CV2858**

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

3B24W is a high vacuum rectifier featuring small size and extremely rugged construction. It is suitable for use in airborne and similar applications where vibration and shock are encountered.

### MAXIMUM RATINGS

Peak inverse anode voltage . . . . .	20	kV max
Peak anode current . . . . .	300	mA max
Mean anode current . . . . .	60	mA max
Bulb temperature . . . . .	200	°C max

### GENERAL DATA

#### Electrical

Filament (centre-tapped) . . . . .	thoriated tungsten		
	<b>Series</b>	<b>Parallel</b>	
Filament voltage . . . . .	5.0	2.5	V
Filament current . . . . .	3.0	6.0	A

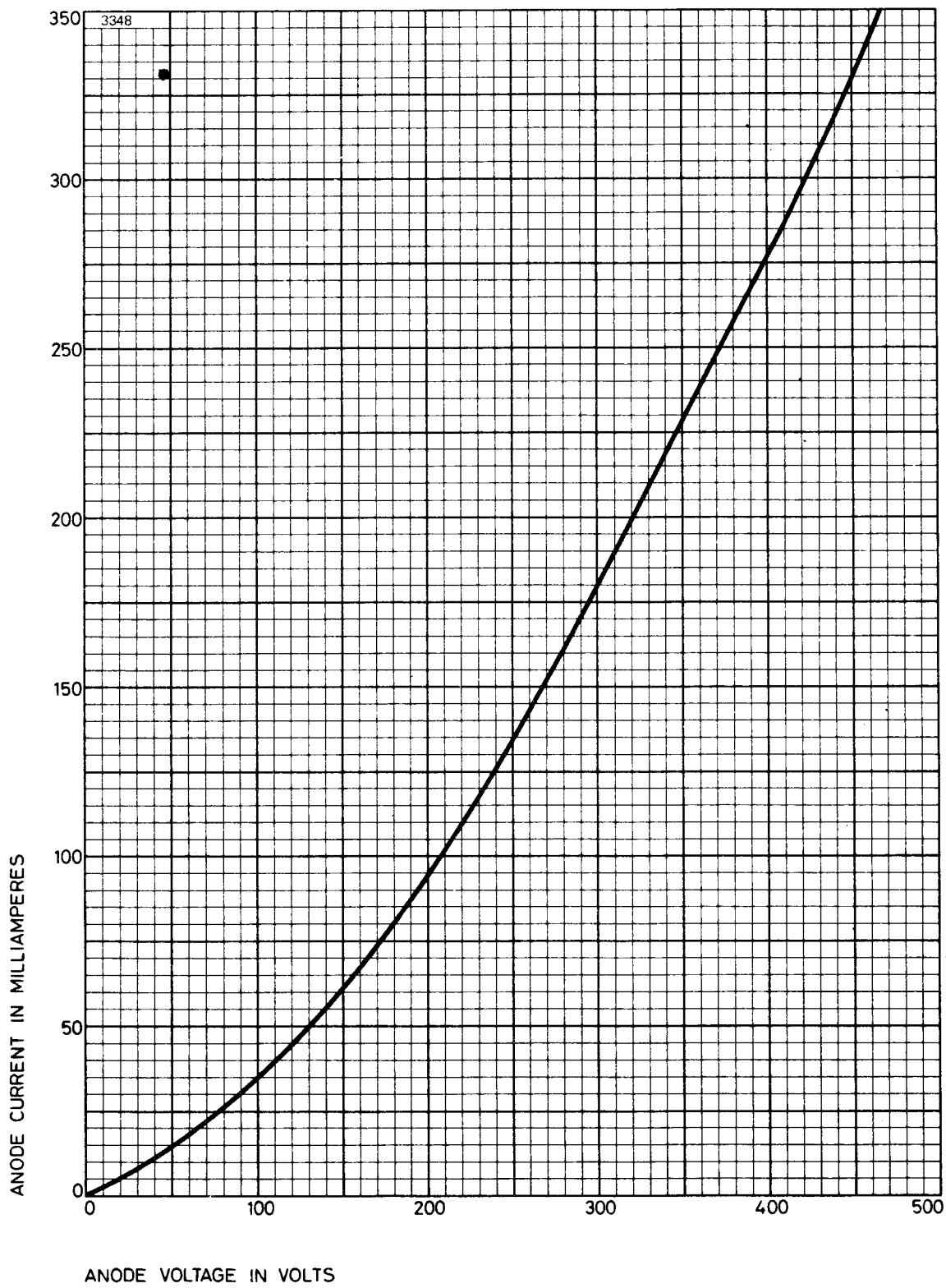
#### Mechanical

Overall length . . . . .	4.812 inches (122.2mm) max
Overall diameter . . . . .	1.562 inches (39.7mm) max
Net weight . . . . .	2 ounces (57g) approx
Mounting position . . . . .	vertical, base up or down
Base . . . . .	B.S.448-B4G (JEDEC A4-10)

#### Cooling

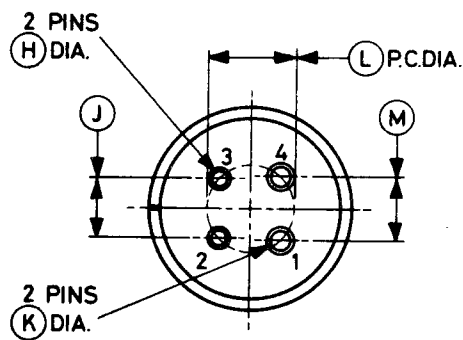
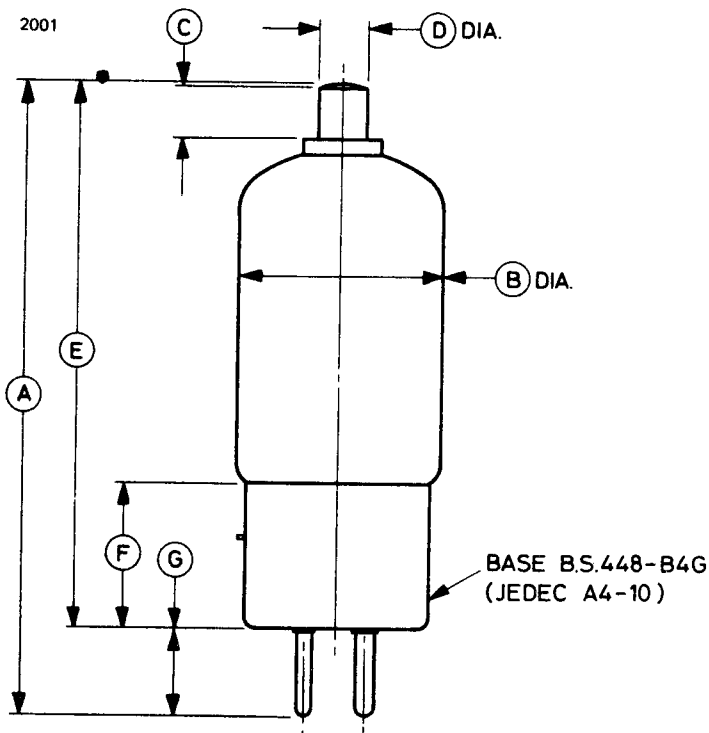
If the tube is mounted away from other hot components and free circulation of cool air is not impeded, natural cooling should be adequate; the use of a shrouded anode connector is not recommended. If these conditions cannot be met, forced-air cooling will be necessary.

# TYPICAL ANODE CHARACTERISTIC





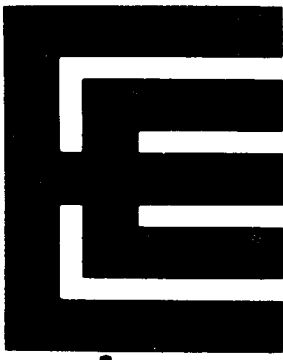
# OUTLINE (All dimensions without limits are nominal)



Pin	Element
1	Filament centre tap
2	Filament
3	No connection
4	Filament
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	$4.656 \pm 0.156$	$118.3 \pm 4.0$	G	0.629 max	15.98 max
B	1.562 max	39.67 max	H	$0.125 \pm 0.003$	$3.175 \pm 0.076$
C	$0.390 \pm 0.010$	$9.91 \pm 0.25$	J	0.437	11.10
D	$0.360 \pm 0.005$	$9.14 \pm 0.13$	K	$0.156 \pm 0.003$	$3.962 \pm 0.076$
E	$4.000 \pm 0.125$	$101.6 \pm 3.2$	L	0.640	16.26
F	1.087 max	27.61 max	M	0.468	11.89

Millimetre dimensions have been derived from inches.



## MERCURY VAPOUR RECTIFIER

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage . . . . .	20	kV max
Peak anode current (at 20kV p.i.v.) . . . . .	10	A max
Mean anode current (at 20kV p.i.v.) . . . . .	2.5	A max
Fault anode current (0.1s max) . . . . .	100	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	5.0 V
Filament current . . . . .	19 A
Filament pre-heating time (minimum) . . . . .	1.0 min

#### Mechanical

Overall length . . . . .	14.437 inches (366.7mm) max
Overall diameter . . . . .	5.125 inches (130.2mm) max
Net weight . . . . .	1¾ pounds (800g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	3-pin Jumbo A3-20
Top cap . . . . .	C1-9

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

Circuit*	Condensed ● mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output	
			peak	mean◆		(kV)	(A)
<b>A</b>	30–40	20	10	2.5	7.0	6.3	5.0
Single phase	30–50	15	10	2.5	5.3	4.7	5.0
full wave	30–60	10	10	2.5	3.5	3.1	5.0
<b>B</b>	30–40	20	10	2.5	14.0	12.6	5.0
Single phase	30–50	15	10	2.5	10.6	9.5	5.0
bridge	30–60	10	10	2.5	7.0	6.3	5.0
<b>C</b>	30–40	20	10	2.5	8.1†	9.5†	7.5
Three phase	30–50	15	10	2.5	6.1†	7.1†	7.5
half wave	30–60	10	10	2.5	4.1†	4.7†	7.5
<b>D§</b>	30–40	20	10	2.5	8.1	19.0	7.5
Three phase	30–50	15	20	5.0	6.1	14.2	15
full wave	30–60	10	20	5.0	4.1	9.5	15

\* See Typical Rectifier Circuits for Choke input filters in the Rectifier and Thyatron Preamble.

† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

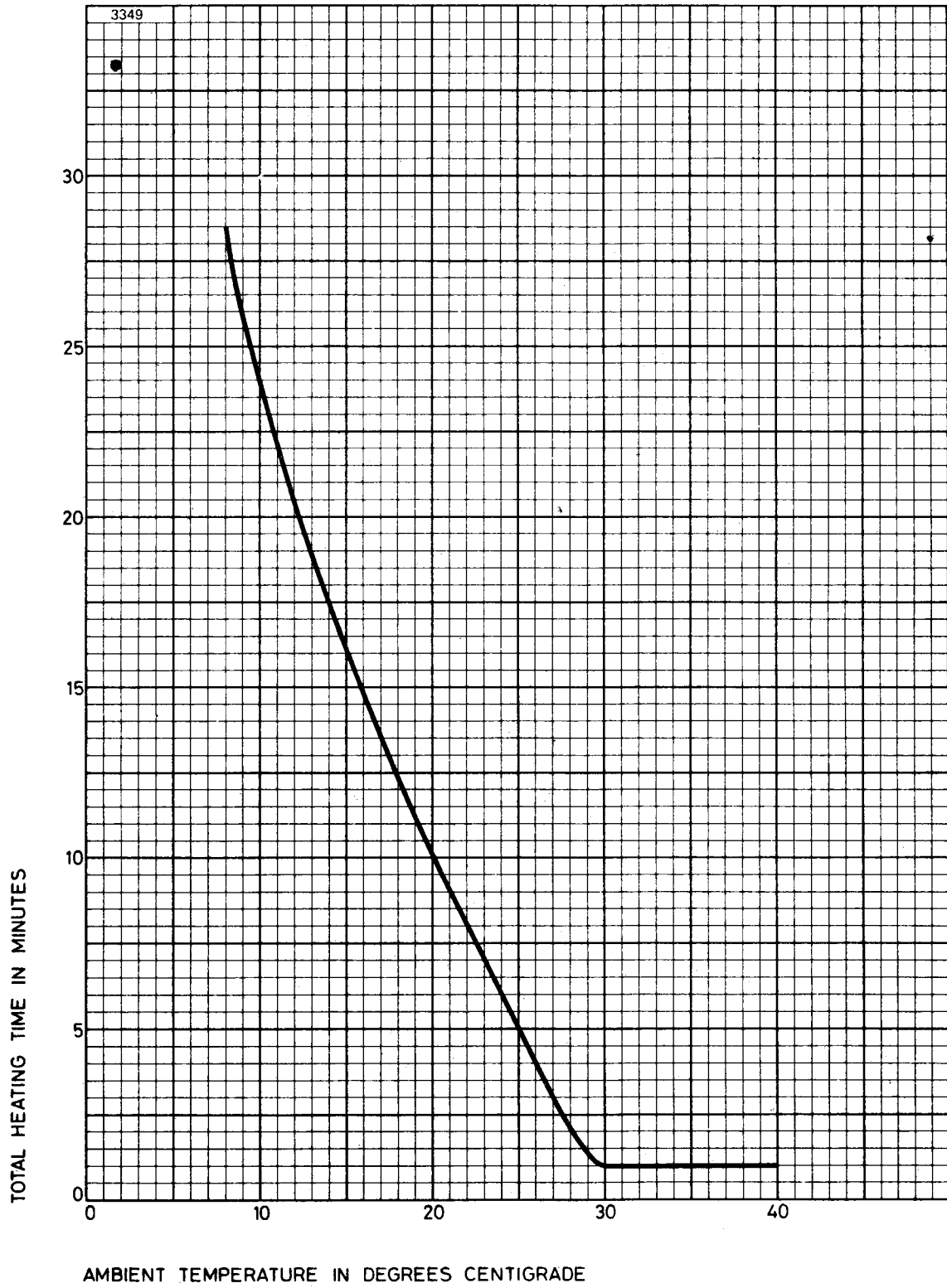
◆ Averaging time 30 seconds maximum.

§ With filament and anode supplies out of phase by 60 to 120°.

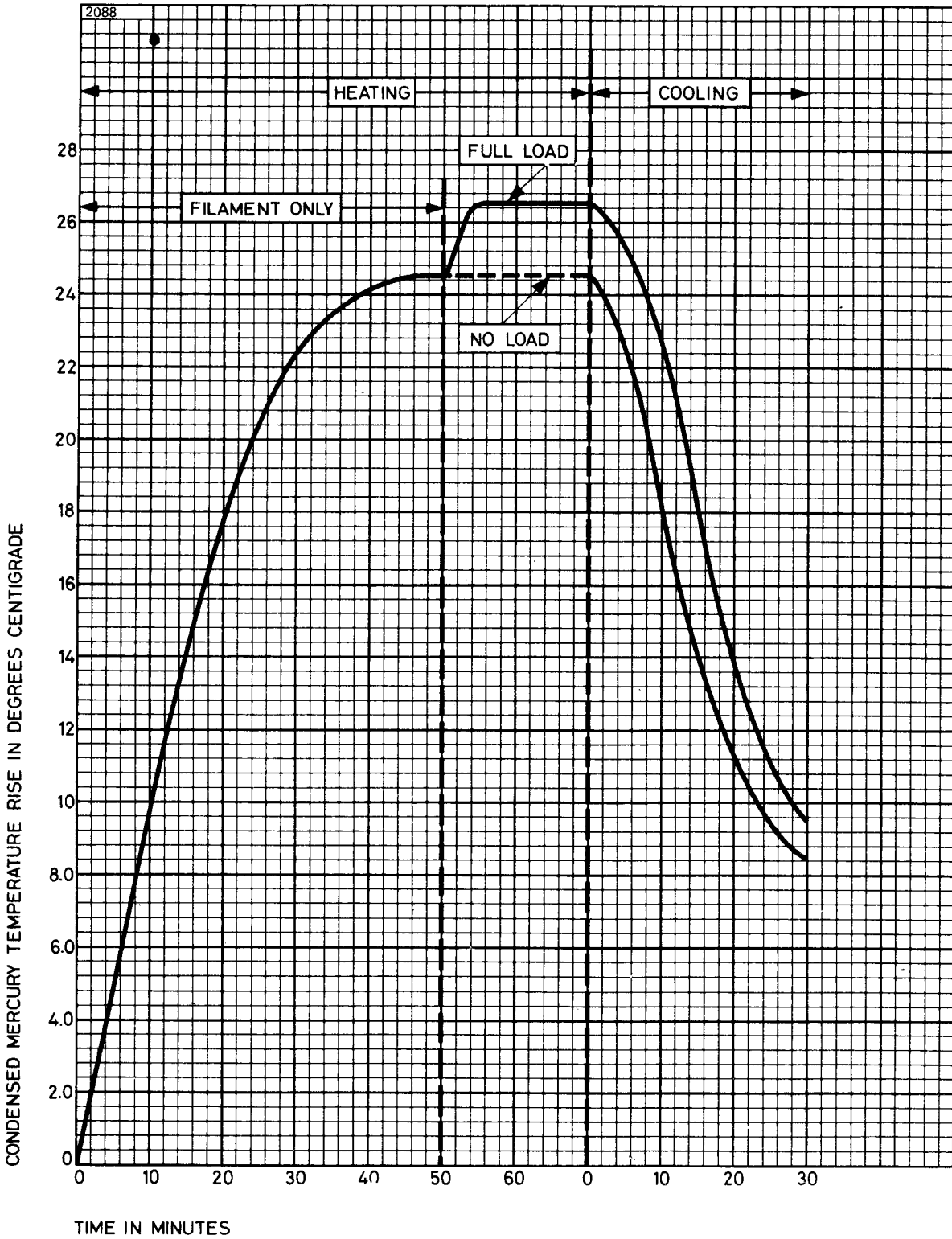
### X-RAY WARNING

The 869B emits X-rays when it is operated with a peak inverse anode voltage above 16kV absolute. These rays can constitute a health hazard unless adequate shielding is provided. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

# TOTAL HEATING TIME CHARACTERISTIC

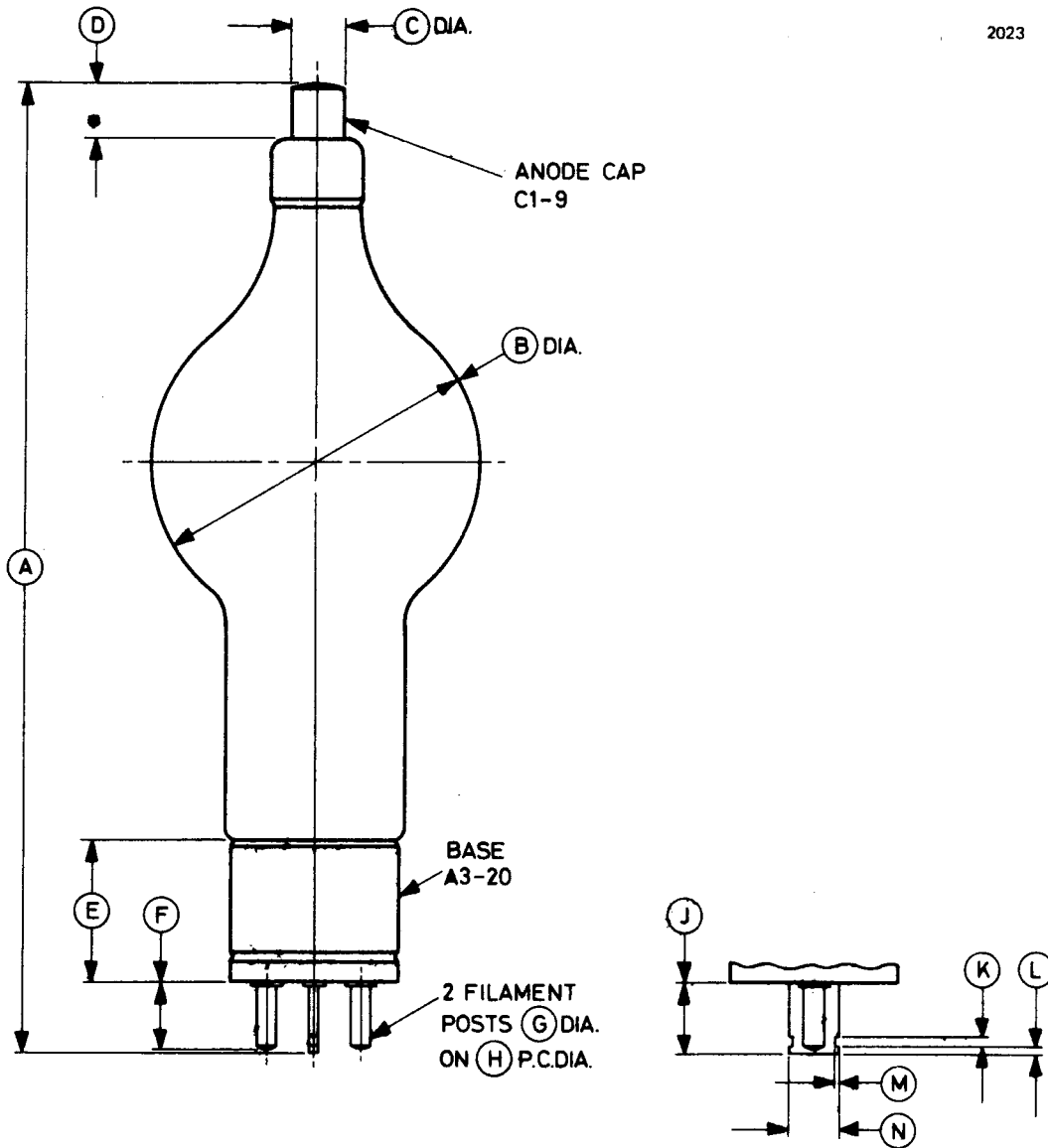


# TYPICAL HEATING AND COOLING CHARACTERISTIC



**OUTLINE (All dimensions without limits are nominal)**

2023



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	14.250 ± 0.187	362.0 ± 4.8	H	1.375	34.93
B	5.125 max	130.2 max	J	1.031	26.19
C	0.800 ± 0.005	20.32 ± 0.13	K	0.125	3.18
D	0.813 ± 0.010	20.65 ± 0.25	L	0.125	3.18
E	2.094	53.19	M	0.063	1.60
F	1.000	25.40	N	0.750	19.05
G	0.312	7.92			

Millimetre dimensions have been derived from inches.



MERCURY VAPOUR  
THYRATRON

Service Type CV2957

To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Mercury vapour thyatron for industrial control applications

Peak forward anode voltage . . . . .	2.5	kV max
Peak inverse anode voltage . . . . .	5.0	kV max
Peak anode current . . . . .	2.0	A max
Mean anode current . . . . .	0.5	A max

**GENERAL**

**Electrical**

Filament . . . . .		oxide coated
Filament voltage . . . . .	2.5	V
Filament current . . . . .	5.0	A
Filament pre-heating time (minimum) . . . . .	10	s
Inter-electrode capacitances:		
grid to anode . . . . .	4.0	pF
grid to filament . . . . .	8.0	pF

**Mechanical**

Overall length . . . . .	6.250 inches (158.8mm) max
Overall diameter . . . . .	2.156 inches (54.76mm) max
Net weight . . . . .	3 ounces (85g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	B.S.448-B4G
Top cap . . . . .	B.S.448-CT3

**Cooling** . . . . . natural

**CHARACTERISTICS**

Voltage drop . . . . .	16	V approx
Ionization time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	20	°C approx
at full load . . . . .	22	°C approx

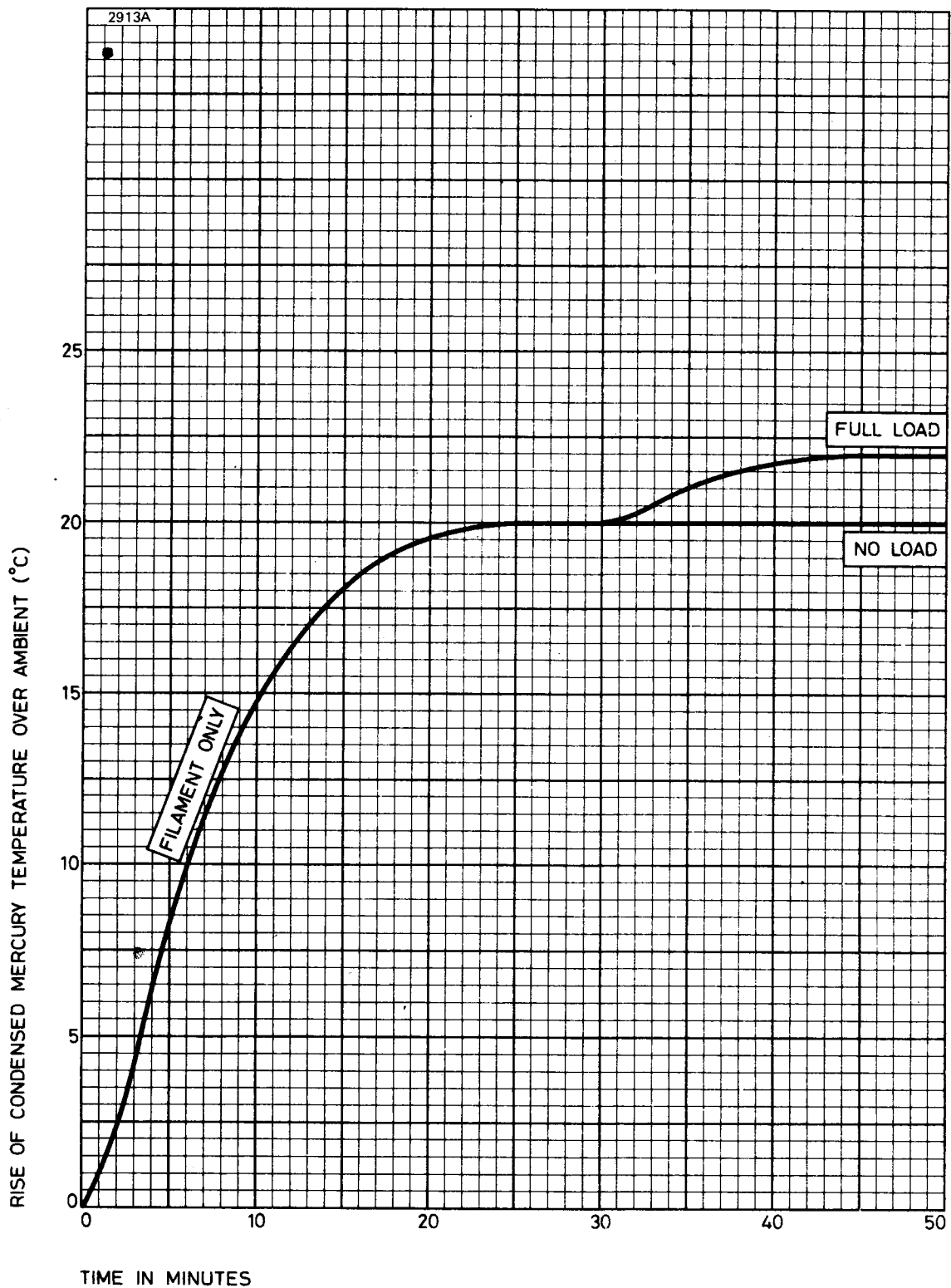
**MAXIMUM AND MINIMUM RATINGS (Absolute values)**

	<b>Min</b>	<b>Max</b>	
Peak forward anode voltage . . . . .	—	2.5	kV
Peak inverse anode voltage . . . . .	—	5.0	kV
Peak anode current . . . . .	—	2.0	A
Mean anode current (averaging time 15s max) . . . . .	—	0.5	A
Fault anode current (peak) . . . . .	—	40	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	80	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Mean grid current . . . . .	—	50	mA
Recommended grid resistor . . . . .	10	100	kΩ
Filament pre-heating time . . . . .	10	—	s
Power supply frequency . . . . .	—	150	Hz

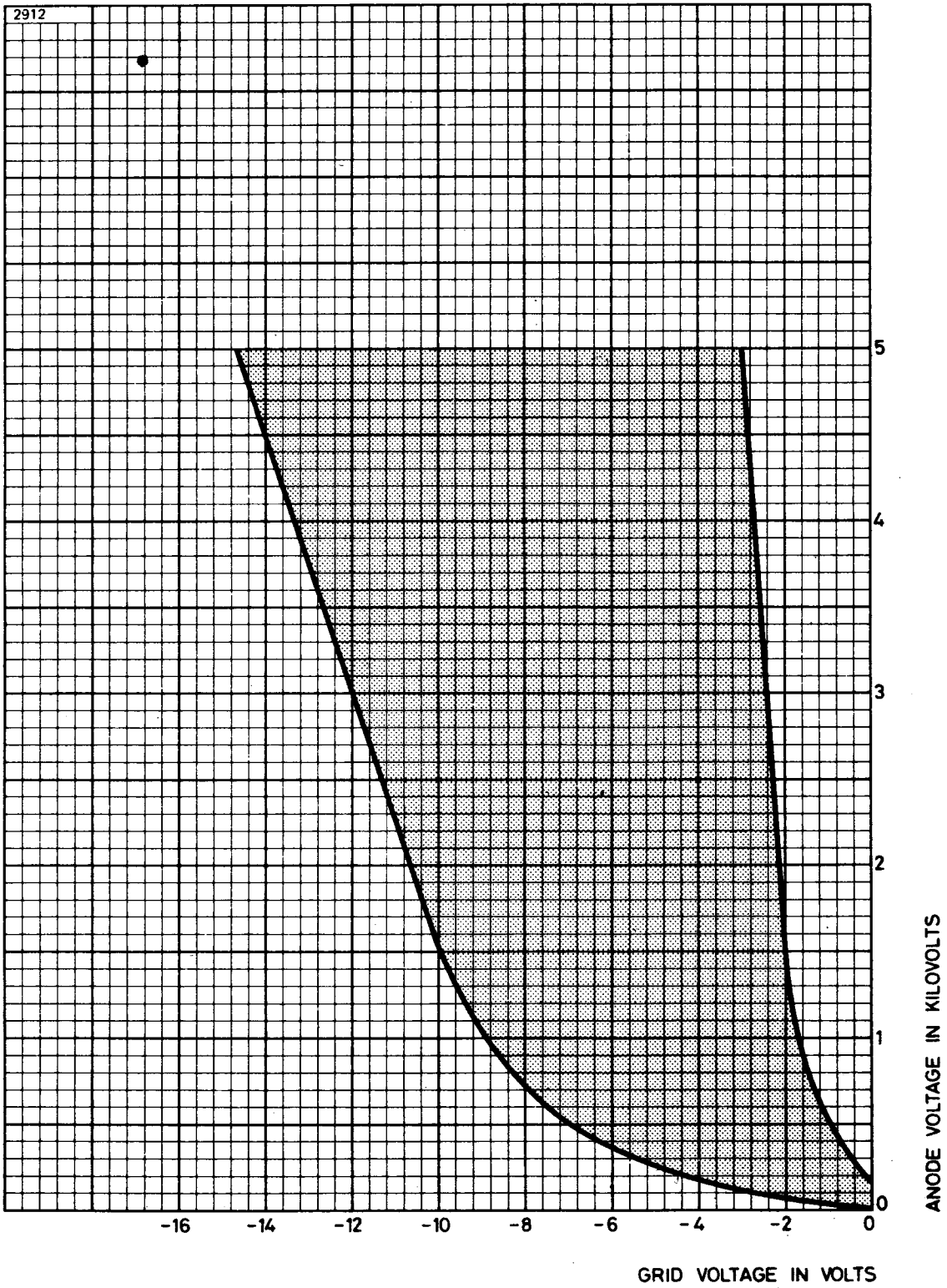




# TYPICAL HEATING CHARACTERISTIC



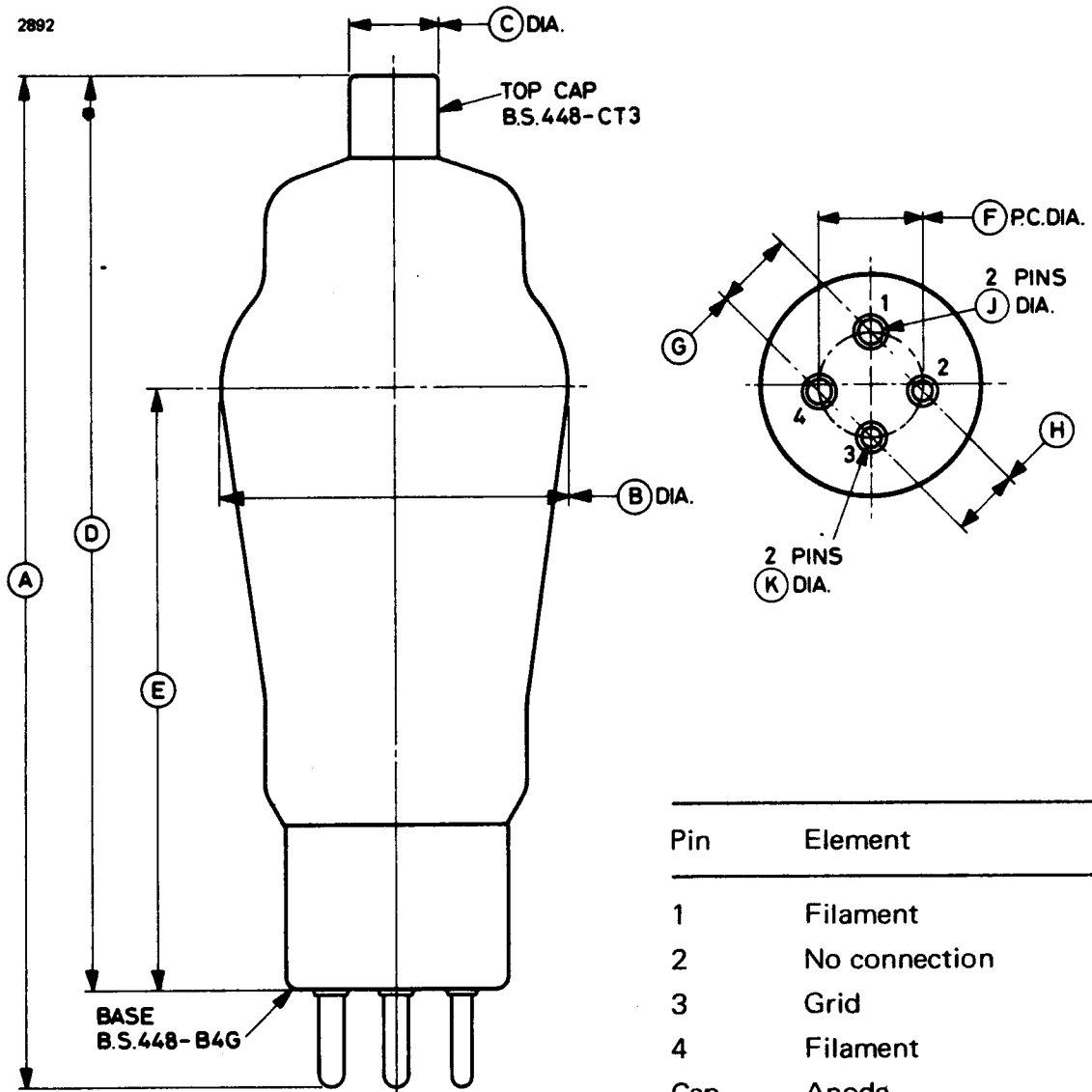
# CONTROL CHARACTERISTIC



ANODE VOLTAGE IN KILOVOLTS

GRID VOLTAGE IN VOLTS

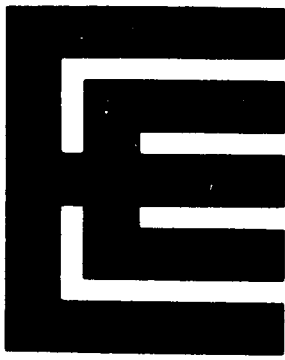
**OUTLINE (All dimensions without limits are nominal)**



Pin	Element
1	Filament
2	No connection
3	Grid
4	Filament
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.250 max	158.8 max	F	0.640	16.26
B	2.125 ± 0.031	53.98 ± 0.79	G	0.468	11.89
C	0.566	14.38	H	0.437	11.10
D	5.625 ± 0.250	142.9 ± 6.4	J	0.156	3.96
E	3.625	92.08	K	0.125	3.18

Millimetre dimensions have been derived from inches.



MERCURY VAPOUR  
THYRATRON

Service Type CV5027

To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Mercury vapour thyatron for industrial control or ignitor firing applications.

Peak forward anode voltage . . . . .	1.0	kV max
Peak inverse anode voltage . . . . .	1.5	kV max
Peak anode current . . . . .	15	A max
Mean anode current . . . . .	2.5	A max

**GENERAL**

**Electrical**

Cathode . . . . .	indirectly heated, oxide coated
Heater voltage . . . . .	5.0 V
Heater current (average) . . . . .	4.7 A
Cathode pre-heating time (minimum) . . . . .	5.0 min
Inter-electrode capacitances:	
grid to anode . . . . .	3.0 pF
grid to cathode . . . . .	6.0 pF

**Mechanical**

Overall length . . . . .	184mm (7.244 inches) max
Overall diameter . . . . .	65mm (2.559 inches) max
Net weight . . . . .	5 ounces (140g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	B.S.448-B4G (USM4B)
Top cap . . . . .	B.S.448-CT3

<b>Cooling</b> . . . . .	natural
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## MAXIMUM AND MINIMUM RATINGS

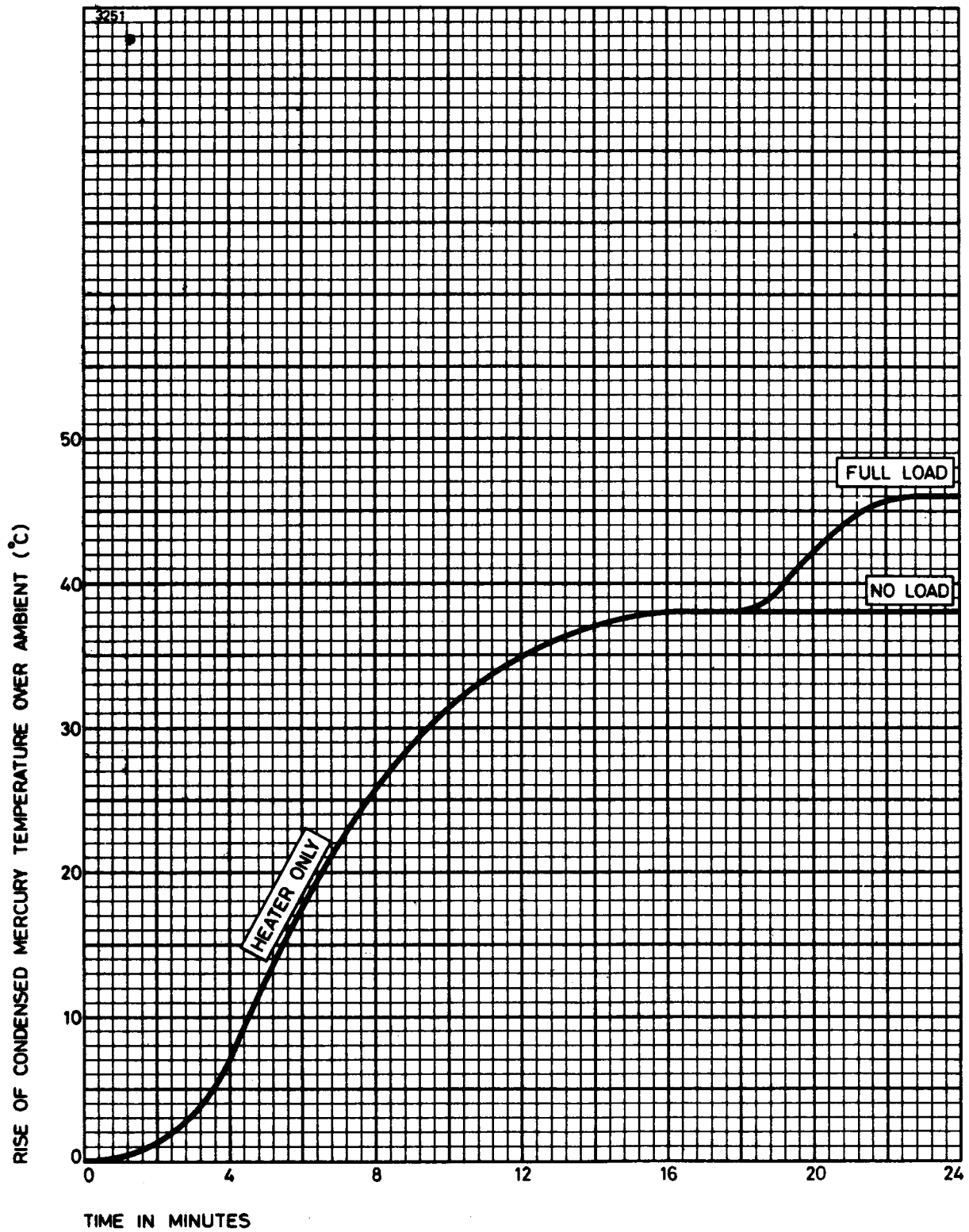
	Min	Max	
Peak forward anode voltage . . . . .	—	1.0	kV
Peak inverse anode voltage . . . . .	—	1.5	kV
Peak anode current (see note) . . . . .	—	15	A
Mean anode current (averaging time 15s max) . . . . .	—	2.5	A
Fault anode current (peak) . . . . .	—	200	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	80	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Mean grid current . . . . .	—	250	mA
Recommended grid resistor . . . . .	10	100	kΩ
Cathode pre-heating time . . . . .	5.0	—	min

## CHARACTERISTICS

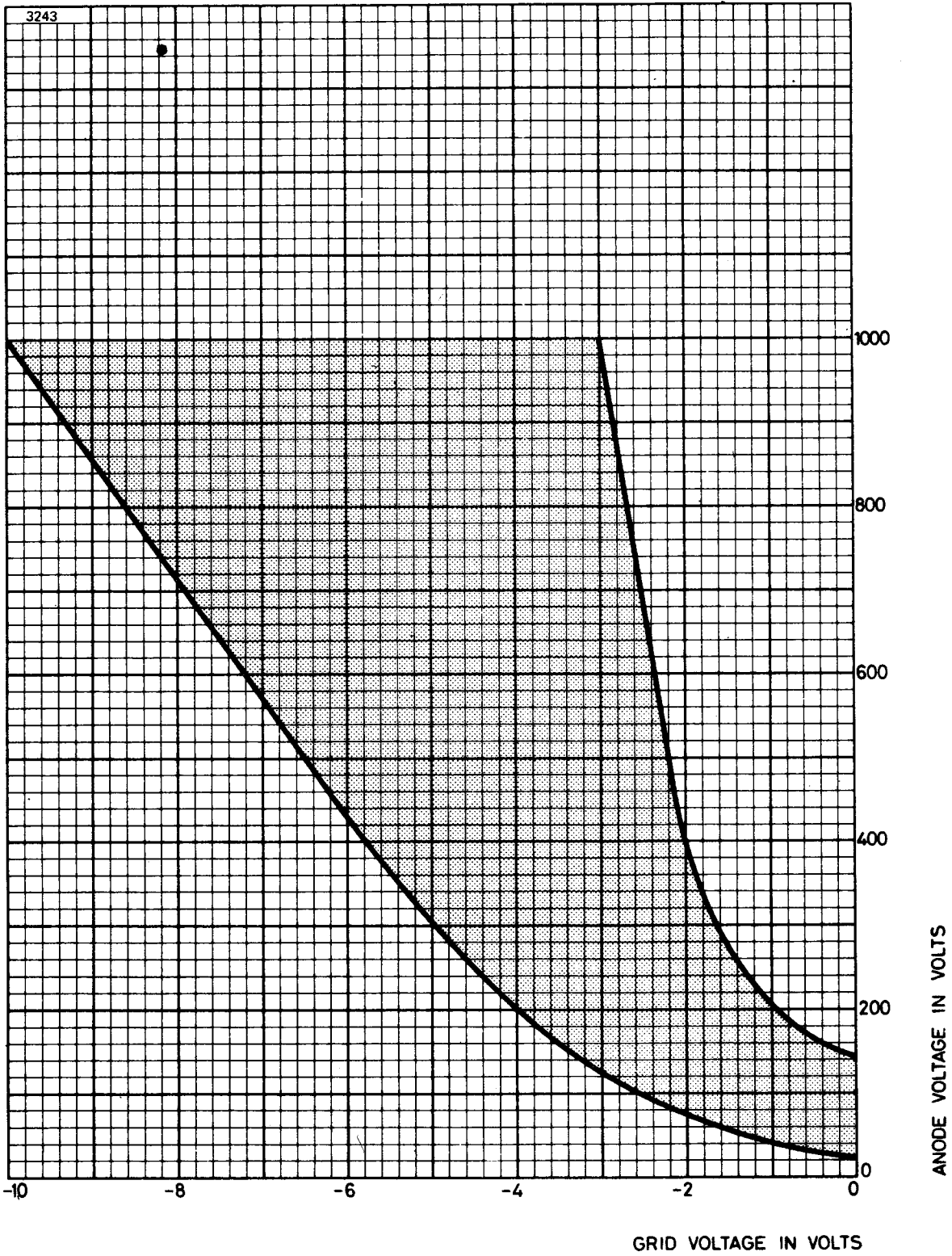
Voltage drop . . . . .	16	V approx
Ionization time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	38	°C approx
at full load . . . . .	46	°C approx

**Note** For ignitor firing service, the peak anode current rating is 40A max.

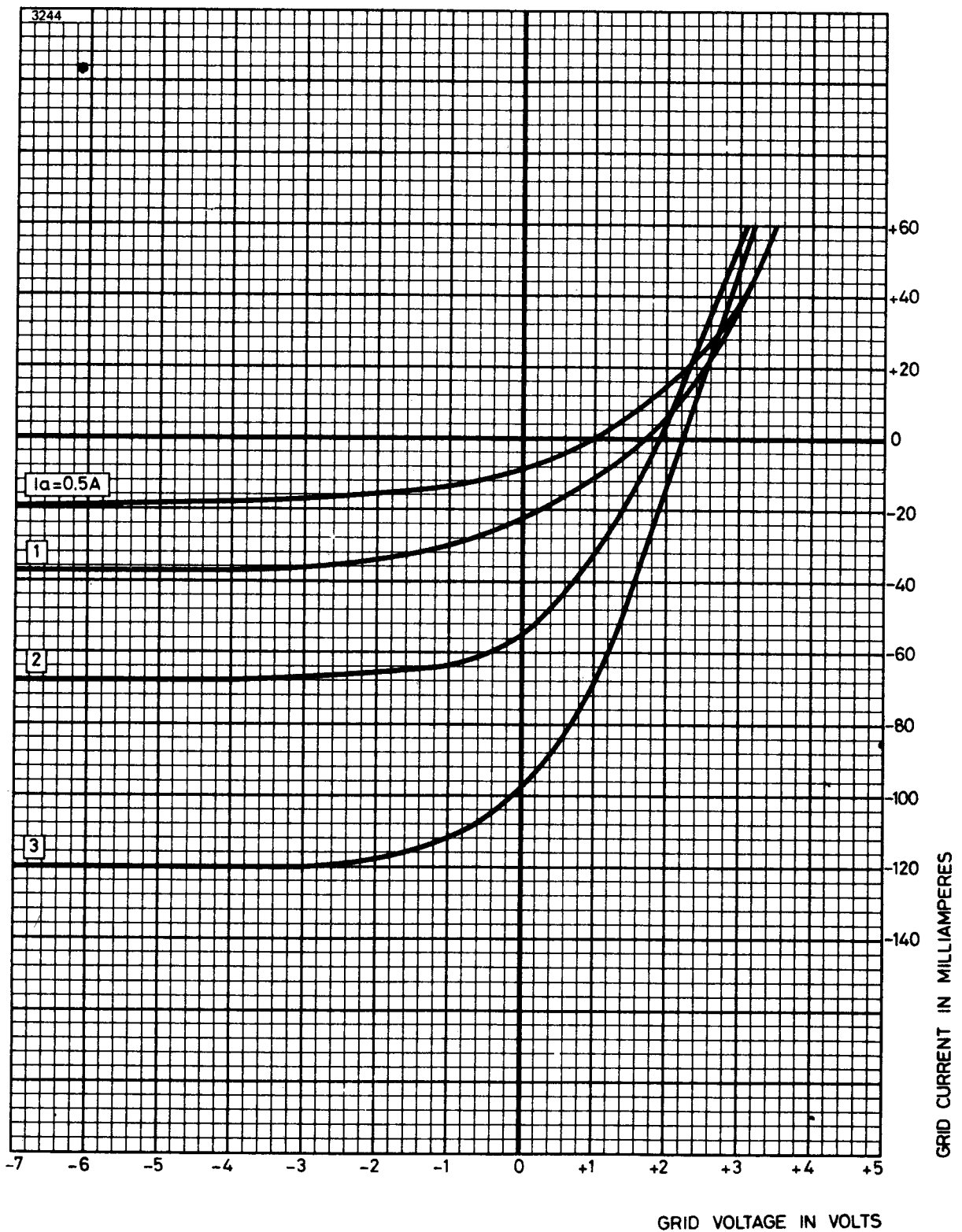
# TYPICAL HEATING CHARACTERISTIC



# CONTROL CHARACTERISTIC

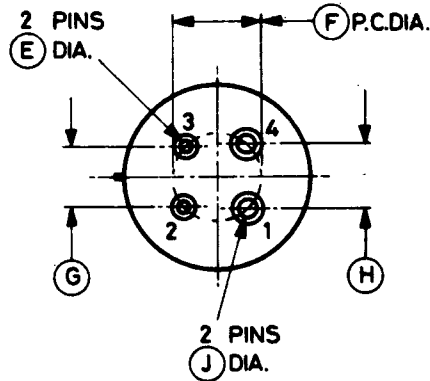
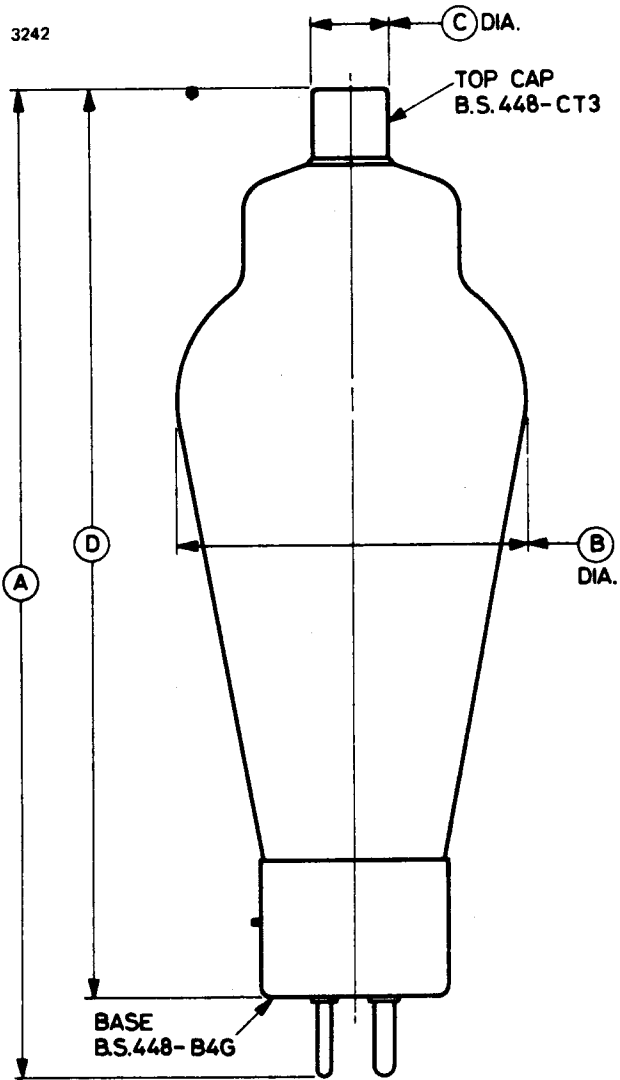


# TYPICAL GRID CURRENT CHARACTERISTICS





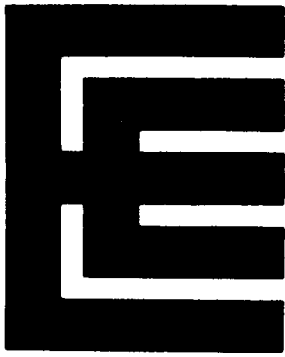
**OUTLINE (All dimensions without limits are nominal)**



Pin	Element
1	Heater
2	Cathode
3	Grid
4	Heater, cathode
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	7.244 max	184.0 max	F	0.640	16.26
B*	2.559 max	65.0 max	G	0.437	11.10
C	0.566	14.38	H	0.468	11.89
D*	6.654 max	169.0 max	J	0.156	3.96
E	0.125	3.18			

Millimetre dimensions have been derived from inches except where marked\*



68506

TUNGAR  
RECTIFIER

To be read in conjunction with the Rectifier and Thyatron Preamble.

**DESCRIPTION**

The 68506 is a hot cathode, half-wave, gas-filled rectifier designed for use in low voltage battery charging equipment.

**GENERAL DATA**

**Electrical**

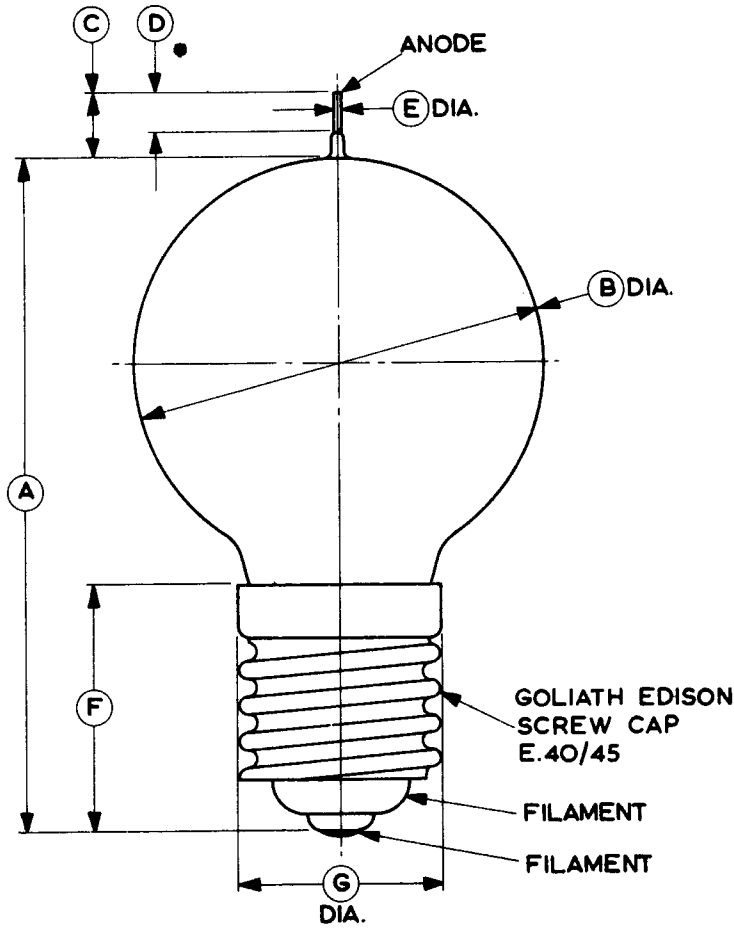
Cathode . . . . .	oxide coated filament	
Filament voltage . . . . .	2.3	V
Filament current . . . . .	18 ± 2	A
Cathode pre-heating time (minimum) . . . . .	30	s
Voltage drop (approx) . . . . .	10	V
Ambient temperature range . . . . .	-55 to +70	°C
D.C. output as half-wave rectifier:		
voltage . . . . .	75	V max
current . . . . .	6.0	A max

**Mechanical**

Overall length . . . . .	145mm (5.710 inches) max
Overall diameter . . . . .	77mm (3.031 inches) max
Net weight . . . . .	112g (4 ounces) approx
Mounting position . . . . .	any
Base . . . . .	Goliath Edison screw E40/45
Cooling . . . . .	convection

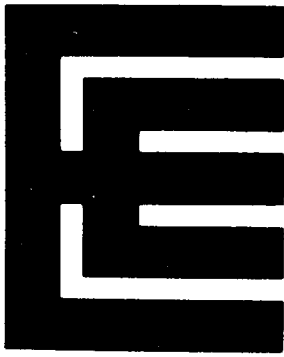
**OUTLINE (All dimensions without limits are nominal)**

3469



Ref	Millimetres	Inches
A	115.0 ± 10.0	4.528 ± 0.394
B	77.0 max	3.032 max
C	12.0 ± 5.0	0.472 ± 0.197
D	7.0 min	0.276 min
E	1.5	0.059
F	46.0 max	1.811 max
G	39.2 max	1.543 max

Inch dimensions have been derived from millimetres.



## HIGH VACUUM RECTIFIER

Service Types CV2160, CV8051

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

High vacuum half-wave rectifier.

### MAXIMUM RATINGS

Peak inverse anode voltage . . . . .	45	kV max
Peak anode current . . . . .	1.1	A max
Mean anode current . . . . .	350	mA max
Anode dissipation . . . . .	130	W max
Bulb temperature . . . . .	200	°C max

### GENERAL DATA

#### Electrical

Filament . . . . .	thoriated tungsten
Filament voltage . . . . .	4.0 V
Filament current . . . . .	12 A
Nominal impedance (at 300mA) . . . . .	600 Ω

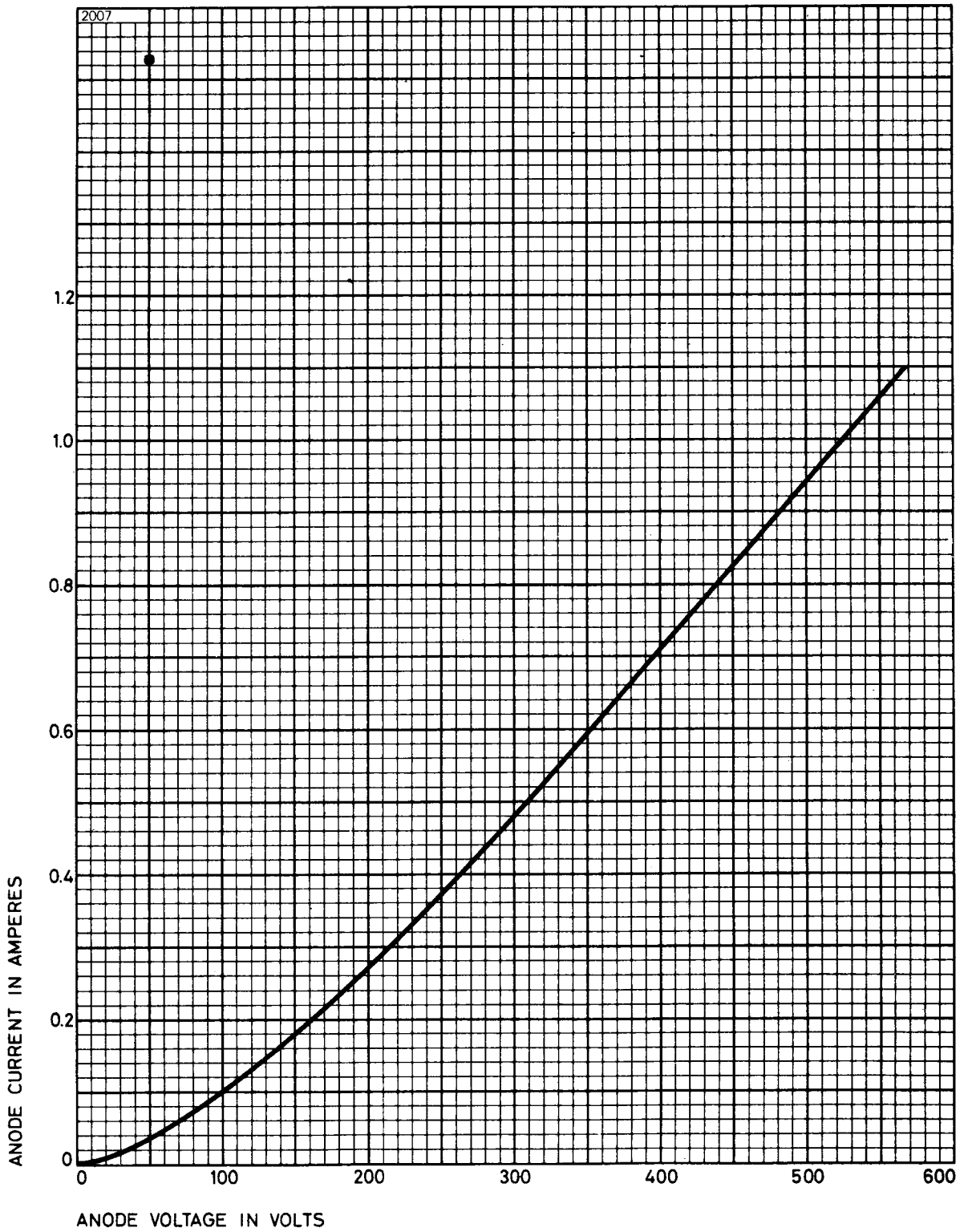
#### Mechanical

Overall length . . . . .	9.842 inches (250mm) max
Overall diameter . . . . .	2.362 inches (60mm) max
Net weight . . . . .	11 ounces (310g) approx
Mounting position . . . . .	vertical, base up or down
Base . . . . .	Goliath Edison screw E40/45
Cooling . . . . .	natural

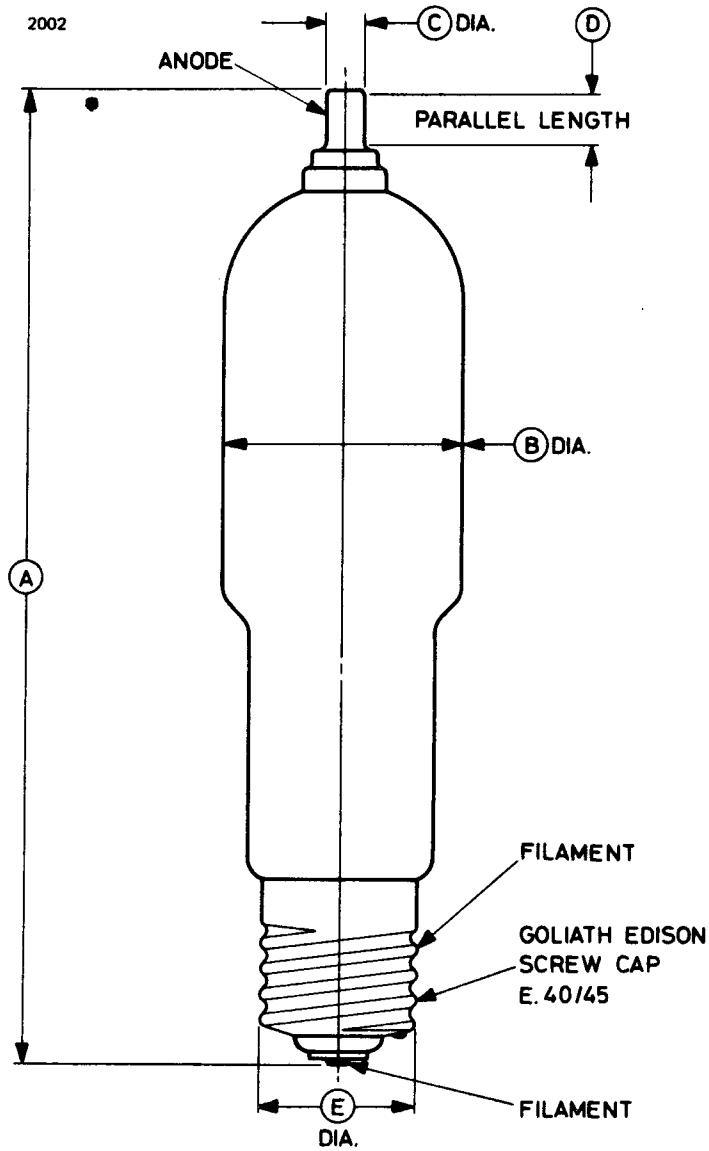
#### X-ray Warning

X-rays are emitted from the A207 if the peak inverse anode voltage exceeds 16kV. These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

# TYPICAL ANODE CHARACTERISTIC

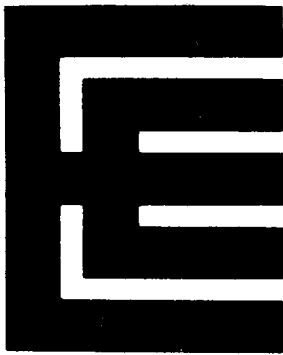


# OUTLINE



Ref	Inches	Millimetres
A	9.842 max	250.0 max
B	2.362 max	60.0 max
C	$0.375 \pm 0.002$	$9.525 \pm 0.051$
D	0.500 min	12.70 min
E	1.531	38.89

Millimetre dimensions have been derived from inches.



## HIGH VACUUM RECTIFIER

Service Type CV482

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

High vacuum half-wave rectifier.

### MAXIMUM RATINGS

Peak inverse voltage . . . . .	40	65	kV
Continuous anode dissipation:			
with natural cooling . . . . .	120	100	W
with forced-air cooling (see note 1) . . . . .	160	100	W
Peak anode current . . . . .	1.5	1.5	A
Mean anode current (see note 2) . . . . .	250	250	mA
Bulb temperature . . . . .	200	200	°C

### GENERAL DATA

#### Electrical

Filament . . . . .	thoriated tungsten
Filament voltage . . . . .	4.0 V
Filament current . . . . .	12 A
Nominal impedance (at 350mA) . . . . .	1000 Ω

#### Mechanical

Overall length . . . . .	9.842 inches (250mm) max
Overall diameter . . . . .	2.362 inches (60mm) max
Net weight . . . . .	9 ounces (260g) approx
Mounting position (see note 3) . . . . .	vertical
Base . . . . .	Goliath Edison screw E40/45

### NOTES

1. With forced-air cooling the continuous anode dissipation may be increased up to the absolute maximum of 160W provided that the peak inverse voltage does not exceed 40kV. Above 40kV the continuous anode dissi-

pation must not exceed 100W. The airflow must be such that all-round cooling is achieved and no part of the glass envelope must attain a temperature greater than 200°C. Normally the hottest part is the area round the anode, but the anode seal may also require attention.

2. The mean value of the anode current is a function of the waveform. It should be determined for each particular application and must be such that the maximum anode dissipation is not exceeded.
3. The tube should be operated in a vertical position, with the base screw at the bottom. The reversed position is permitted if overheating of the base can be avoided. The tube holder should be sprung to avoid the transmission of sharp shocks which might break the thoriated tungsten filament.

In view of the low voltage high current filament supply it is essential that the tube is screwed tightly into the socket and that a very good contact is always maintained.

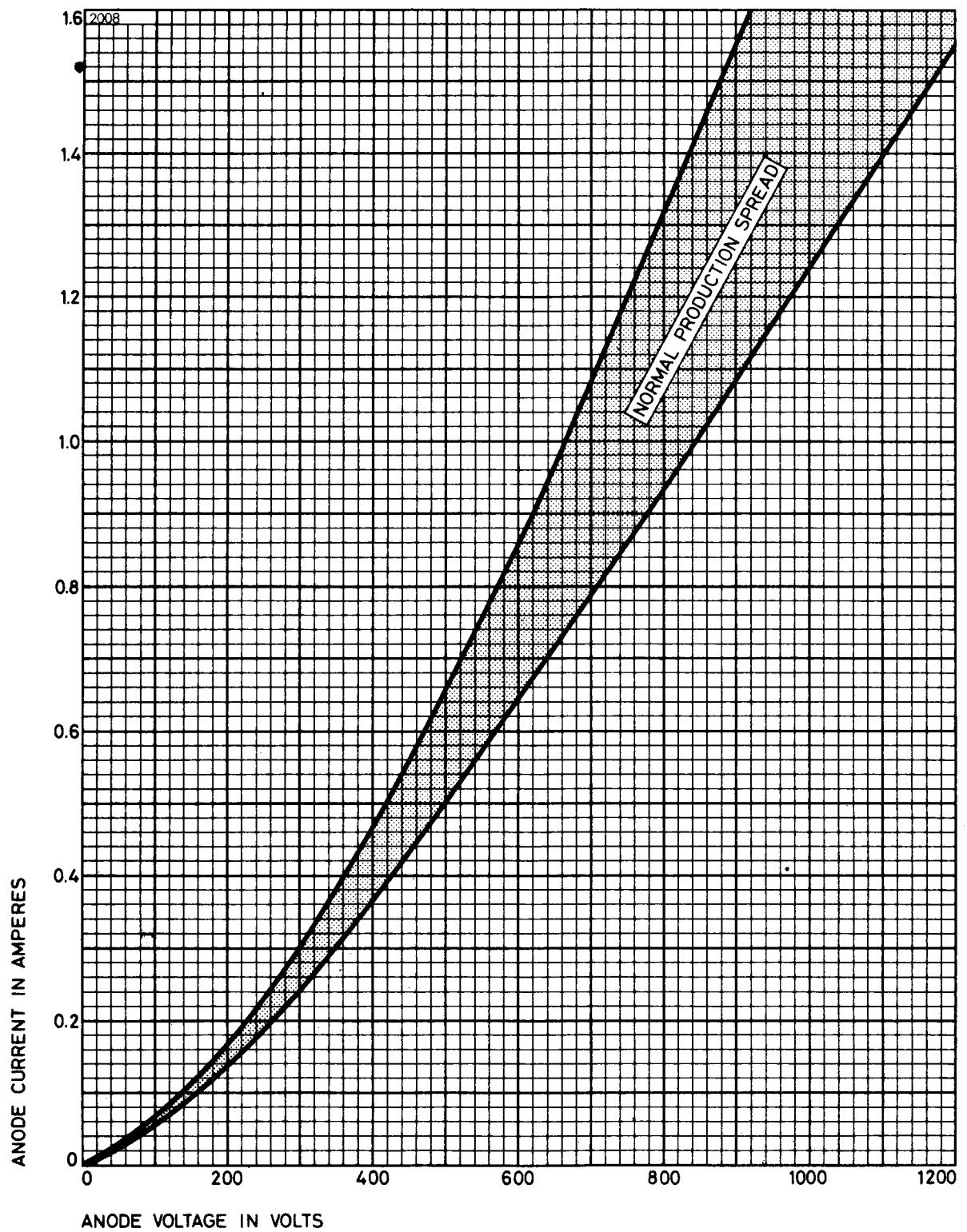
Sufficient clearance must be allowed to avoid sparking or corona at high voltages. Free circulation of air round the tube is essential to dissipate the heat generated. When working at or near the maximum rating for natural cooling it is advisable to provide channels in order to increase the convection by chimney effect.

### **X-RAY WARNING**

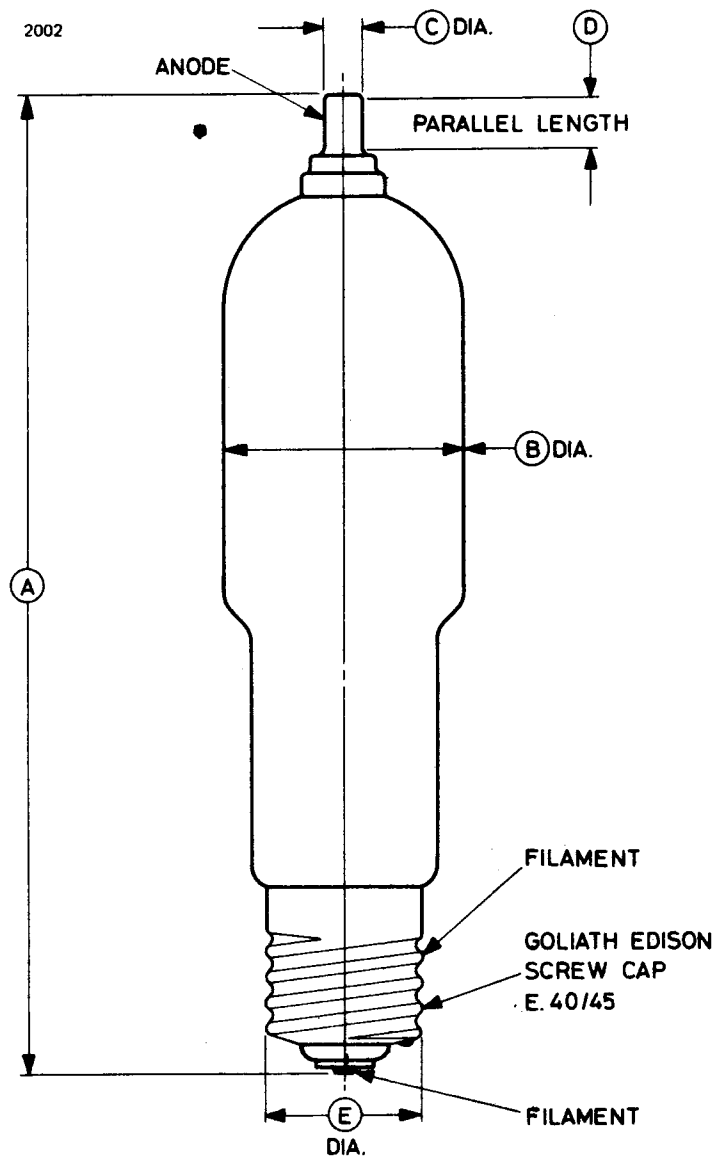
X-rays are emitted from the A237 if the peak inverse anode voltage exceeds 16kV. These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.



# ANODE CHARACTERISTIC

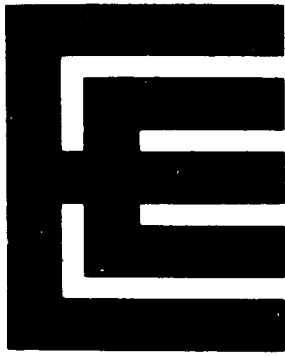


# OUTLINE



Ref	Inches	Millimetres
A	9.842 max	250.0 max
B	2.362 max	60.0 max
C	0.375 ± 0.002	9.525 ± 0.051
D	0.500 min	12.70 min
E	1.531	38.89

Millimetre dimensions have been derived from inches.



## HIGH VACUUM RECTIFIER

Service Type CV5998

### ABRIDGED DATA

External-anode rectifier for charging diode or overswing diode service in high power pulse modulators.

Peak inverse anode voltage . . . . .	40	kV max
Peak anode current . . . . .	75	A max
Mean anode current . . . . .	1.5	A max

### GENERAL

#### Electrical

Cathode . . . . .	indirectly heated
Heater voltage . . . . .	12 V
Heater current . . . . .	14 ± 1 A

#### Mechanical

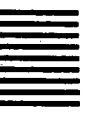
Overall length . . . . .	16.250 inches (412.8mm) max
Overall diameter . . . . .	2.133 inches (54.18mm) max
Net weight . . . . .	5¼ pounds (2.4kg) approx
Mounting position . . . . .	any
Cooling (see note 1) . . . . .	water or forced-air

### MAXIMUM AND MINIMUM RATINGS (Absolute values)

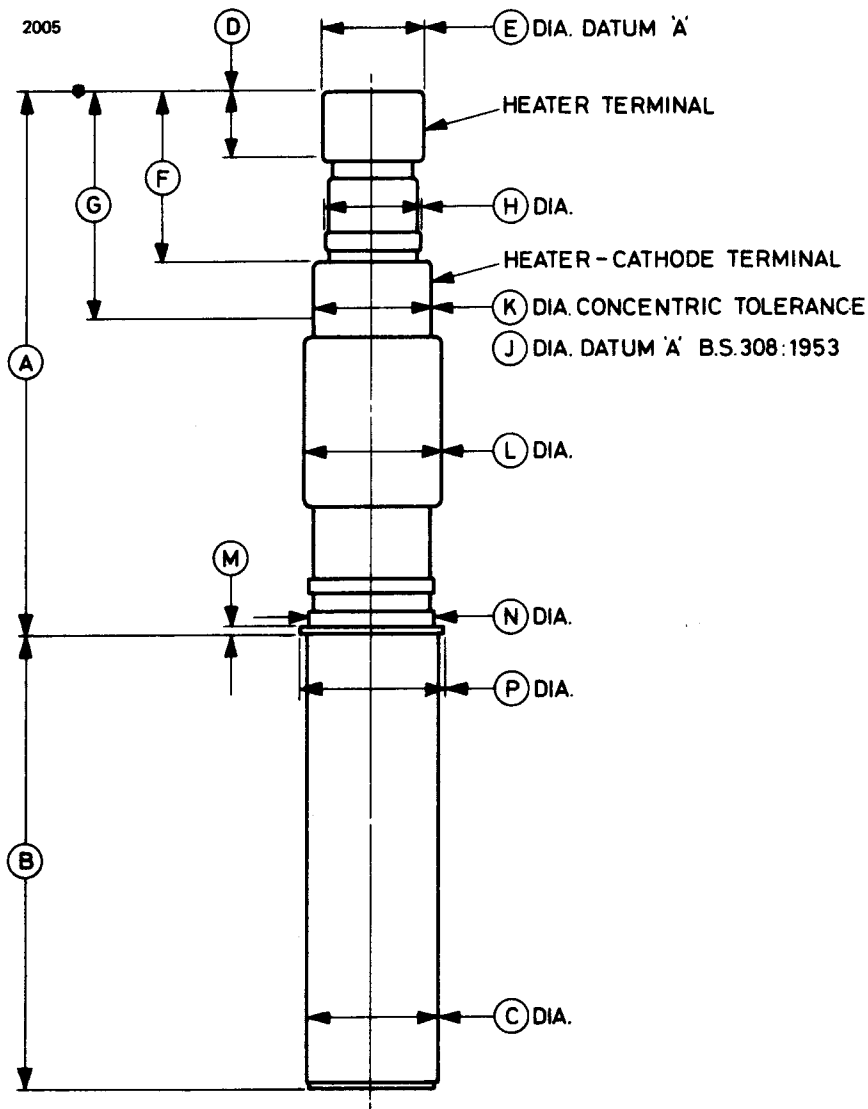
	Min	Max	
Heater voltage . . . . .	11.4	12.6	V
Heater starting current (peak) . . . . .	—	40	A
Cathode pre-heating time . . . . .	6.0	—	min
Peak inverse anode voltage (see note 2) . . . . .	—	40	kV
Anode current:			
peak (see note 3) . . . . .	—	75	A
mean (see note 4) . . . . .	—	1.5	A
Anode dissipation (see note 1) . . . . .	—	2.0	kW
Anode temperature (see note 5) . . . . .	—	150	°C
Cathode terminal temperature (see note 5) . . . . .	—	150	°C

## NOTES

1. The anode must be fitted in a cooling cylinder as described on page 4.
2. The cathode terminal must be fitted with a corona shield as described on page 4.
3. For overswing diode service.
4. For charging diode service.
5. Measured at the point specified on page 4.



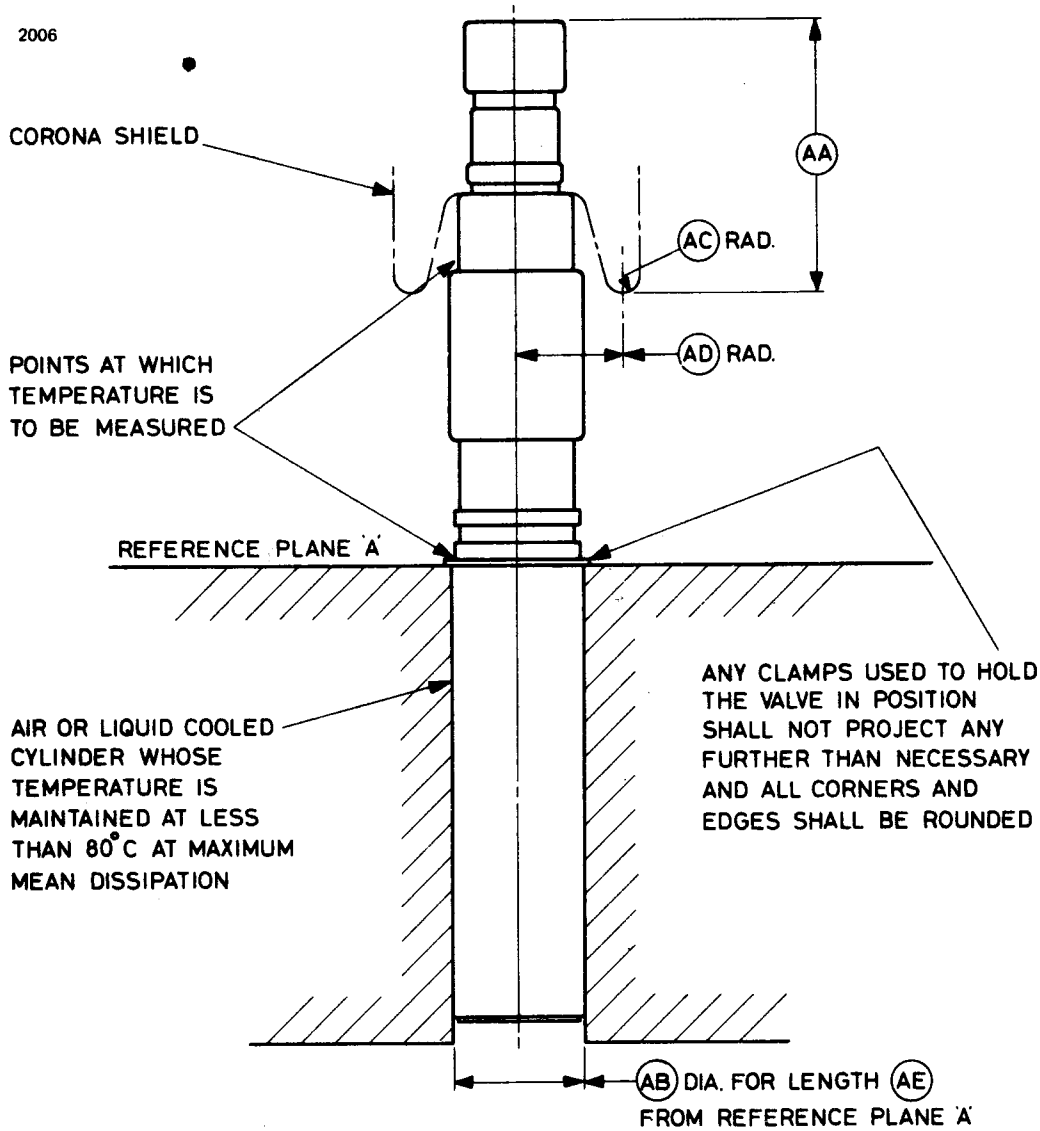
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.500 max	241.3 max	H	1.550 max	39.37 max
B	6.750 max	171.5 max	J	0.050	1.27
C	1.946 max	49.43 max	K	1.750	44.45
D	0.375 min	9.53 min	L	1.937 max	49.20 max
E	1.500	38.10	M	0.125 ± 0.005	3.18 ± 0.13
F	3.063 max	77.80 max	N	1.820 max	46.23 max
G	3.563 min	90.50 min	P	2.125 ± 0.008	53.98 ± 0.20

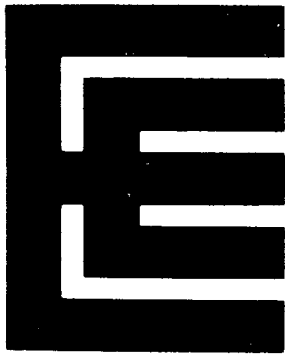
Millimetre dimensions have been derived from inches.

**COOLING CYLINDER AND CORONA SHIELD**  
 (All dimensions without limits are nominal)



Ref	Inches	Millimetres
AA	4.000	101.6
AB	1.950 max	49.53 max
AC	0.250 min	6.35 min
AD	1.250 min	31.75 min
AE	6.750	171.5

Millimetre dimensions have been derived from inches.



# AFX203

## GAS-FILLED THYRATRON

American Equivalent C1A (near)

Service Type CV2868

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

The AFX203 is a directly-heated gas-filled triode thyatron.

### GENERAL DATA

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	2.5 V
Filament current . . . . .	5.0 A
Filament pre-heating time (minimum) . . . . .	40 s
Tube voltage drop . . . . .	11 V approx

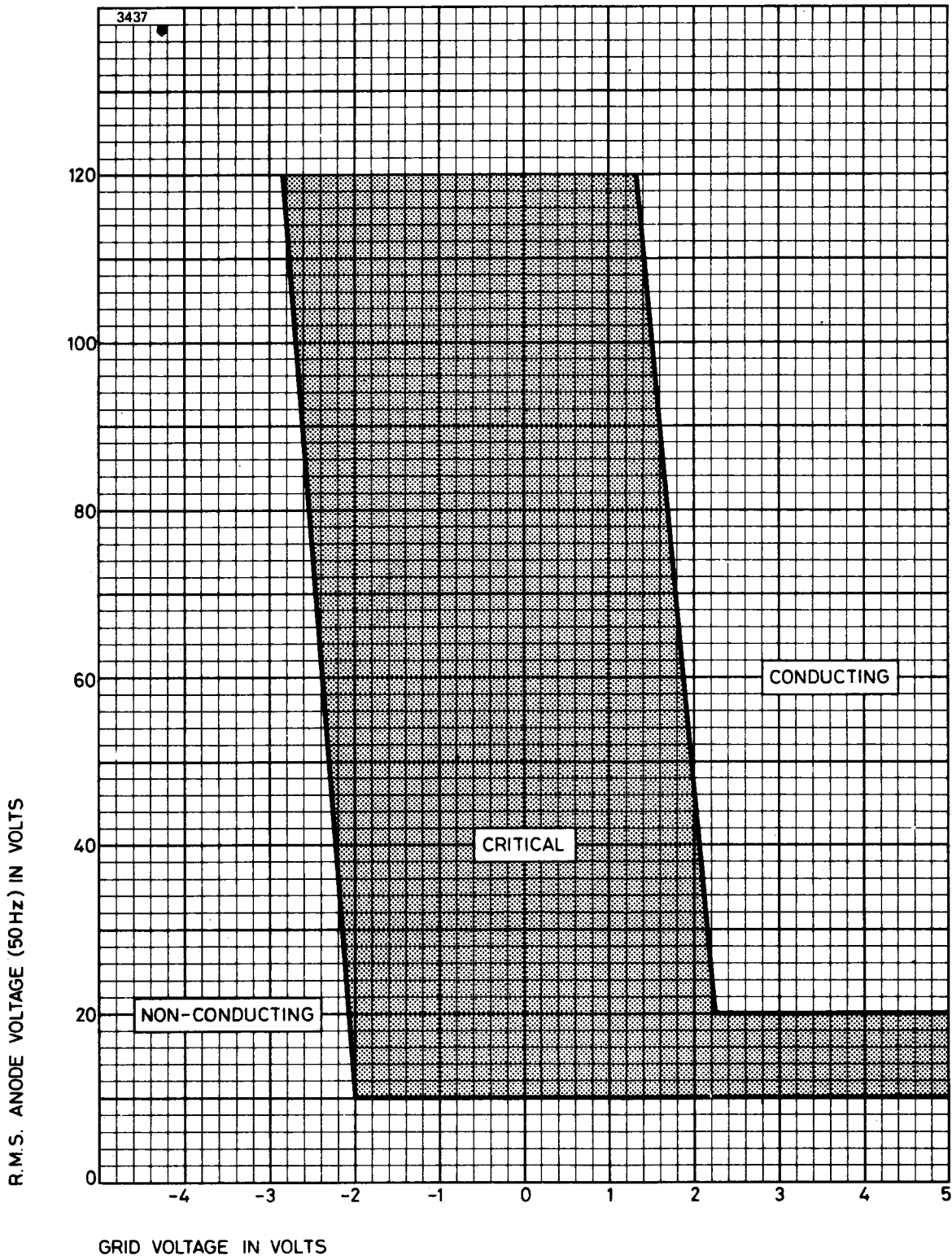
#### Mechanical

Overall length . . . . .	7.000 inches (177.8mm) max
Overall diameter . . . . .	2.250 inches (57.15mm) max
Mounting position . . . . .	any
Base . . . . .	B4G (USM4B)
Top cap . . . . .	B.S.448-CT3
Cooling . . . . .	natural

### MAXIMUM AND MINIMUM RATINGS (Absolute values)

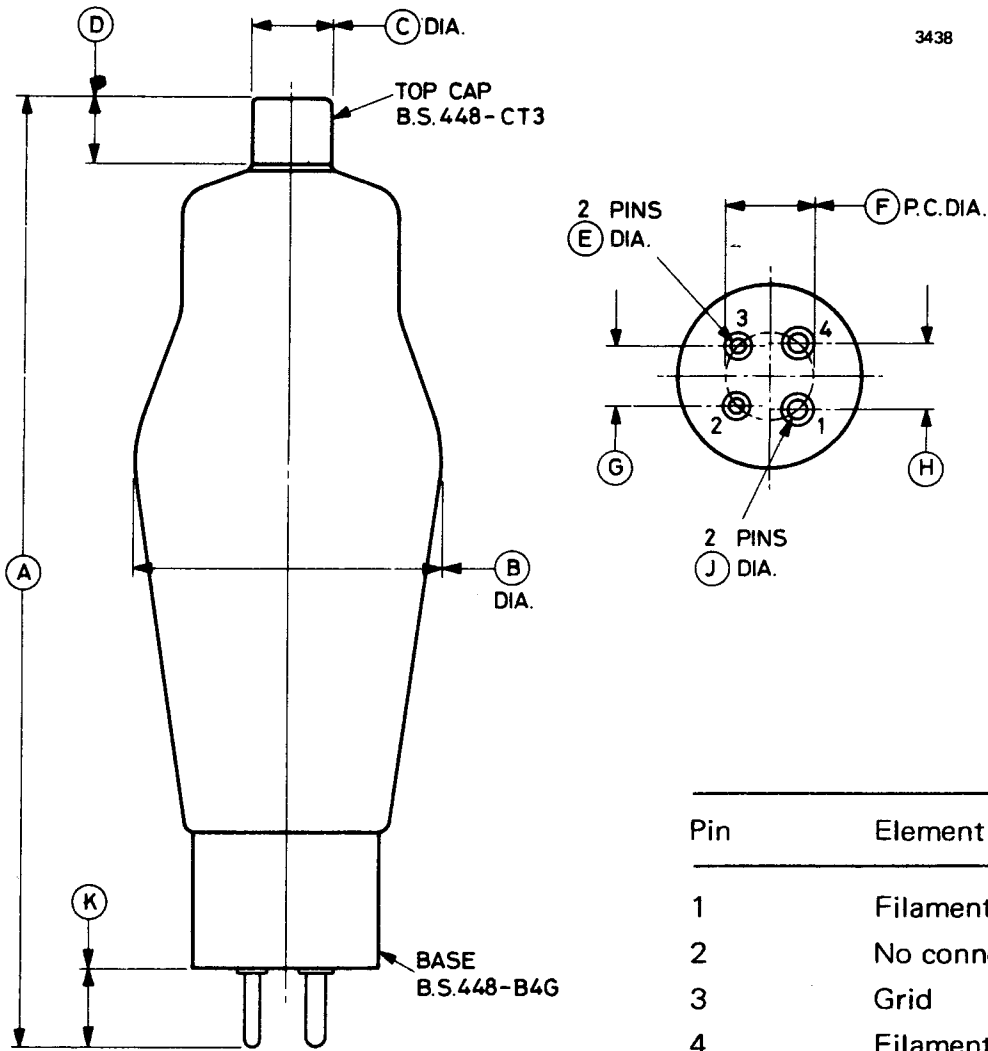
	Min	Max	
Filament voltage . . . . .	2.25	2.75	V
Ambient temperature . . . . .	-55	+70	°C
Peak inverse anode voltage . . . . .	-	340	V
Peak forward anode voltage . . . . .	-	170	V
Anode current:			
peak . . . . .	-	7.7	A
mean . . . . .	-	0.64	A
under fault conditions (0.1s max duration) . . . . .	-	77	A
Operating frequency . . . . .	-	380	Hz

# CONTROL CHARACTERISTIC





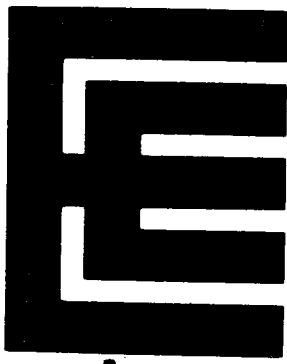
**OUTLINE (All dimensions without limits are nominal)**



Pin	Element
1	Filament
2	No connection
3	Grid
4	Filament
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	7.000 max	177.8 max	F	0.640	16.26
B	2.250 max	57.15 max	G	0.437	11.10
C	0.566	14.38	H	0.468	11.89
D	0.500	12.70	J	0.156	3.96
E	0.125	3.18	K	0.629 max	15.98 max

Millimetre dimensions have been derived from inches.



## MERCURY VAPOUR RECTIFIER

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage	20	kV max
Peak anode current (at 20kV p.i.v.)	10	A max
Mean anode current (at 20kV p.i.v.)	2.5	A max
Fault anode current (0.1s max)	100	A max

### GENERAL

#### Electrical

Filament		oxide coated
Filament voltage	2.5	V
Filament current	40	A
Filament pre-heating time (minimum)	1.0	min

#### Mechanical

Overall length	18.000 inches (457mm) max
Overall diameter	5.250 inches (133.4mm) max
Net weight	1¾ pounds (800g) approx
Mounting position	vertical, base down
Base	see outline drawing
Top cap	see outline drawing

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current in amperes		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output	
			peak	mean♦		(kV)	(A)
<b>A</b>	30–40	20	10	2.5	7.0	6.3	5.0
Single phase	30–50	15	10	2.5	5.3	4.7	5.0
full wave	30–60	10	10	2.5	3.5	3.1	5.0
<b>B</b>	30–40	20	10	2.5	14.0	12.6	5.0
Single phase	30–50	15	10	2.5	10.6	9.5	5.0
bridge	30–60	10	10	2.5	7.0	6.3	5.0
<b>C</b>	30–40	20	10	2.5	8.1†	9.5†	7.5
Three phase	30–50	15	10	2.5	6.1†	7.1†	7.5
half wave	30–60	10	10	2.5	4.1†	4.7†	7.5
<b>D</b>	30–40	20	10	2.5	8.1	19.1	7.5
Three phase	30–50	15	20	5.0	6.1	14.2	15
full wave	30–60	10	20	5.0	4.1	9.5	15

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

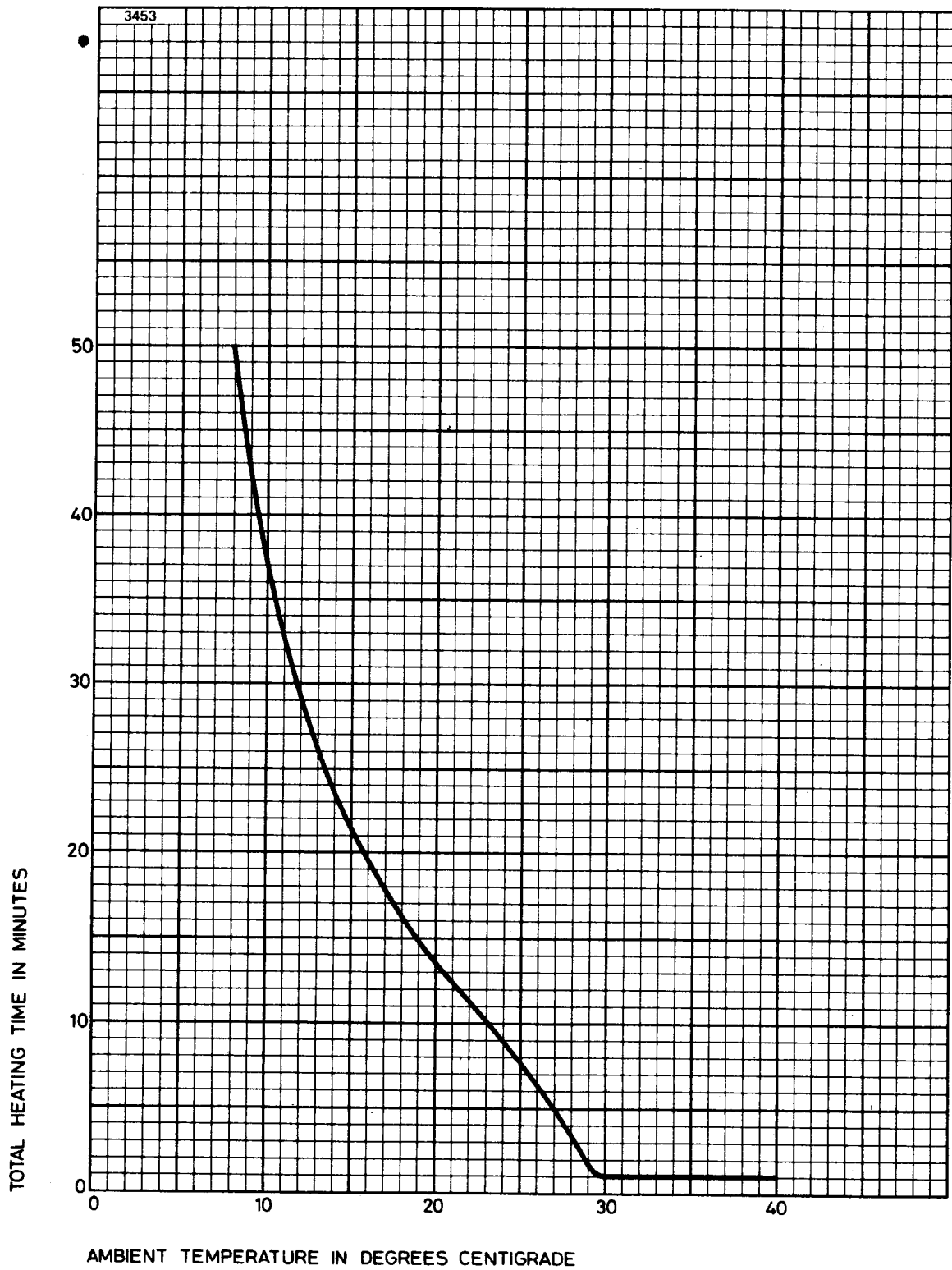
♦ Averaging time 30 seconds maximum.

§ With filament and anode supplies out of phase by 60 to 120°.

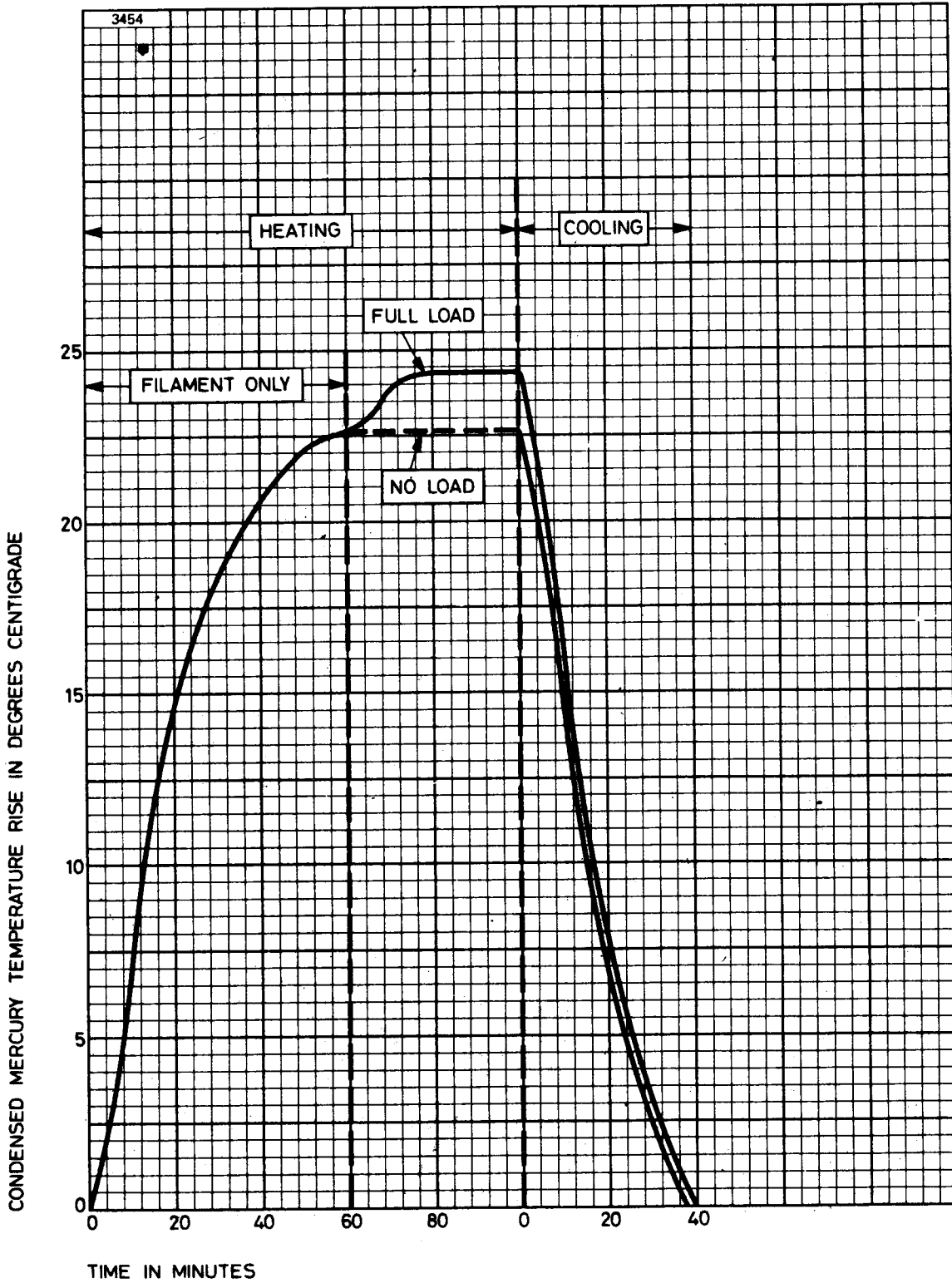
### X-RAY WARNING

The AH200 emits X-rays when it is operated with a peak inverse anode voltage above 16kV absolute. These rays can constitute a health hazard unless adequate shielding is provided. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.

# TOTAL HEATING TIME CHARACTERISTIC

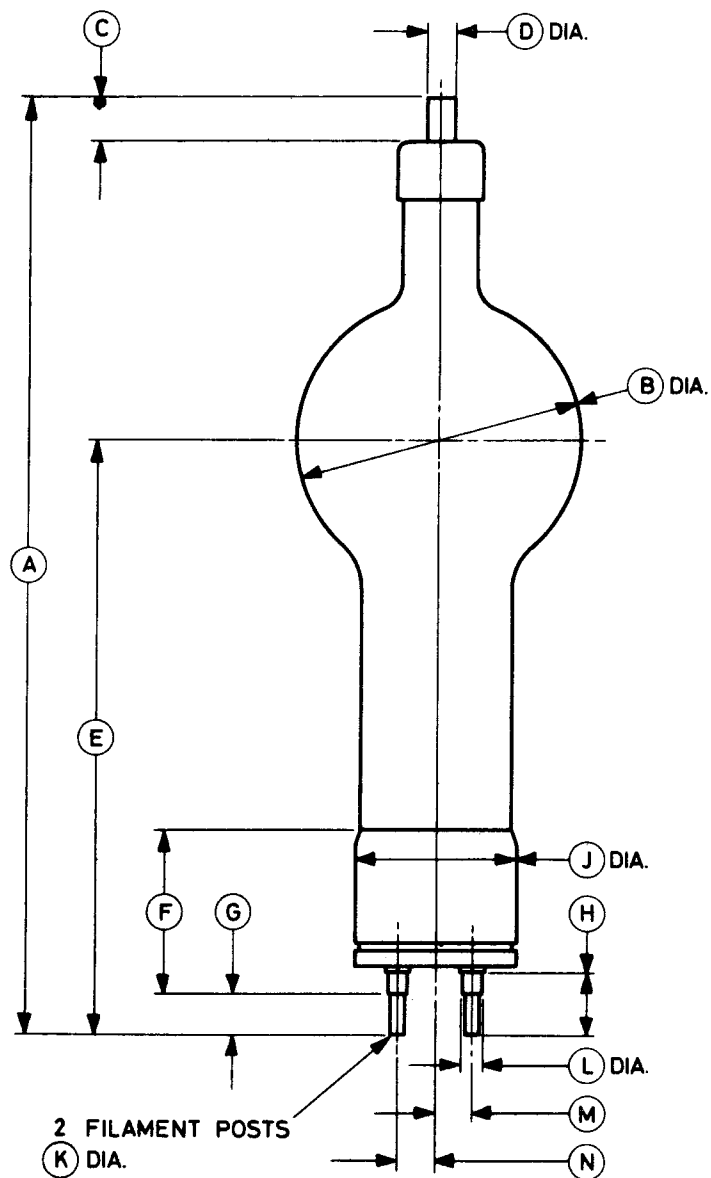


# TYPICAL HEATING AND COOLING CHARACTERISTIC



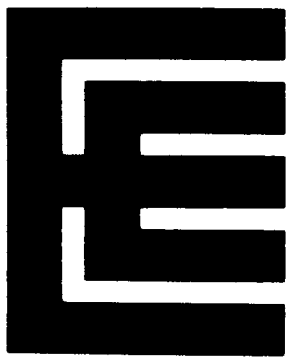
# OUTLINE (All dimensions without limits are nominal)

2046



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	17.187 ± 0.812	436.5 ± 20.6	H	1.125	28.58
B	5.250 max	133.4 max	J	2.875	73.03
C	0.812	20.62	K	0.281 ± 0.005	7.14 ± 0.13
D	0.562 ± 0.005	14.27 ± 0.13	L	0.375	9.53
E	10.875 ± 0.250	276.2 ± 6.4	M	0.687	17.45
F	3.000	76.20	N	0.687	17.45
G	0.750	19.05			

Millimetre dimensions have been derived from inches.



# AH205/857B

## MERCURY VAPOUR RECTIFIER

**American Equivalent 857B**

**Service Type CV2673**

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage . . . . .	22	kV max
Peak anode current (at 22kV p.i.v.) . . . . .	40	A max
Mean anode current (at 22kV p.i.v.) . . . . .	10	A max
Fault anode current (0.2s max) . . . . .	400	A max

### GENERAL

#### Electrical

Filament . . . . .		oxide coated
Filament voltage . . . . .	5.0	V
Filament current . . . . .	30	A
Filament pre-heating time (minimum) . . . . .	1.0	min

#### Mechanical

Overall length . . . . .	19.875 inches (504.8mm) max
Overall diameter . . . . .	7.625 inches (193.7mm) max
Net weight . . . . .	4 pounds (1.8kg) approx
Mounting position . . . . .	vertical, base down
Base connections . . . . .	flexible leads
Top cap . . . . .	see outline

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

Circuit*	Condensed mercury temp (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output (kV) (A)	
			peak	mean♦		(kV)	(A)
<b>A</b>							
Single phase full wave	30–40 25–60	22 10	40 40	10 10	7.7 3.5	7.0 3.1	20 20
<b>B</b>							
Single phase bridge	30–40 25–60	22 10	40 40	10 10	15.5 7.0	14.0 6.3	20 20
<b>C</b>							
Three phase half wave	30–40 25–60	22 10	40 40	10 10	9.0† 4.1†	10.5† 4.7†	30 30
<b>D</b>							
Three phase full wave	30–40 25–60	22 10	40 40	10 10	9.0 4.1	21.0 9.5	30 30

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

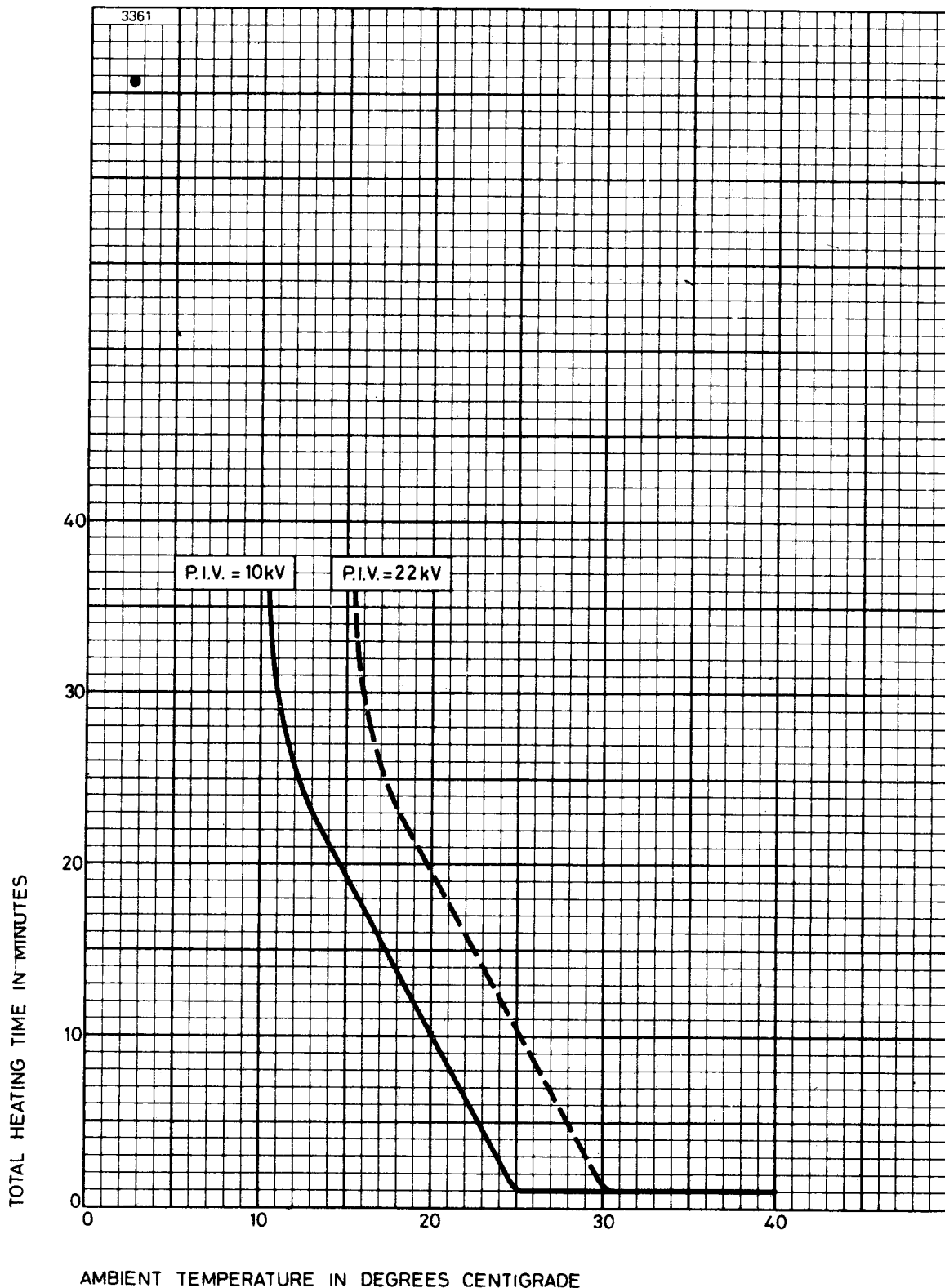
♦ Averaging time 30 seconds maximum.

### X-RAY WARNING

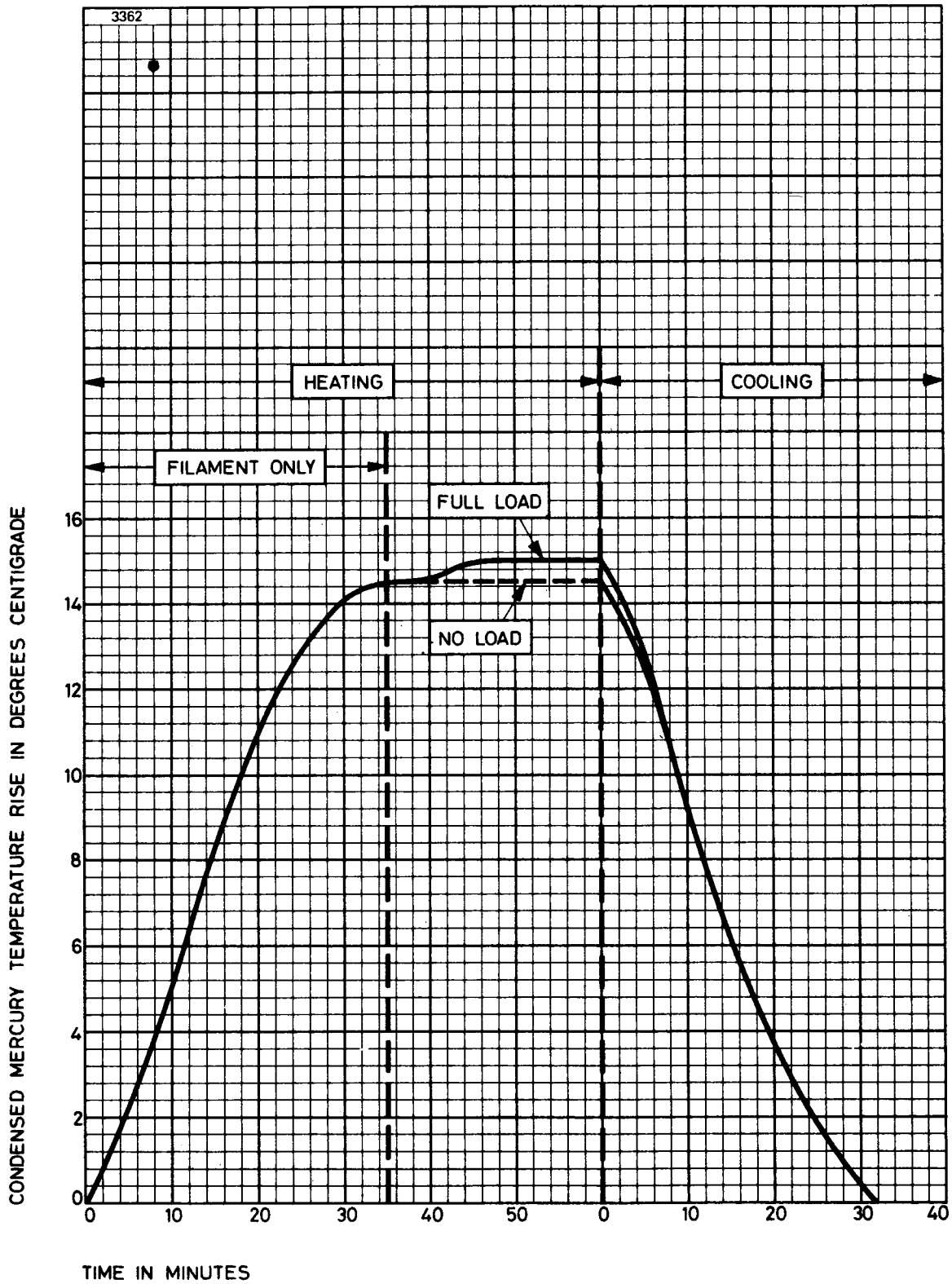
The AH205/857B emits X-rays when it is operated with a peak inverse anode voltage above 16kV absolute. These rays can constitute a health hazard unless adequate shielding is provided. This is entirely a function of high voltage devices and does not reflect upon the design of the tube.



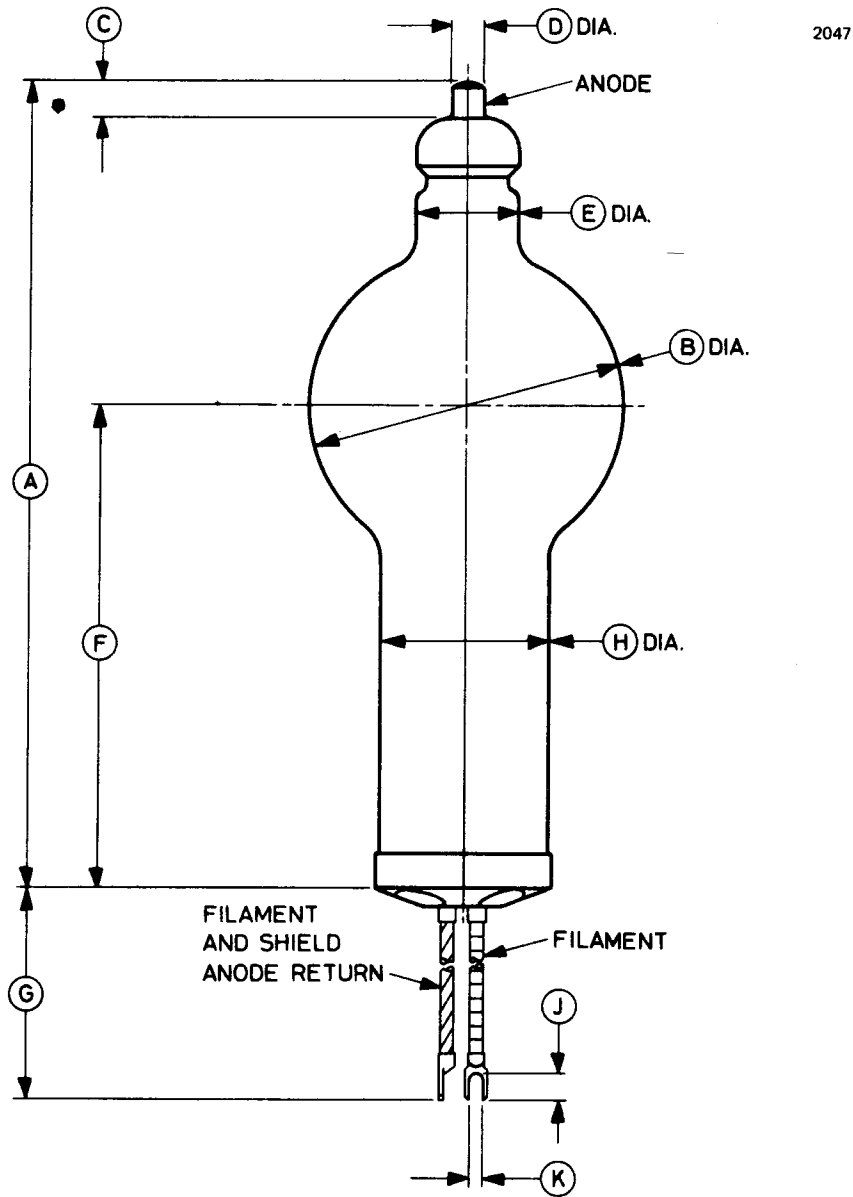
# TOTAL HEATING TIME CHARACTERISTIC



# TYPICAL HEATING AND COOLING CHARACTERISTIC



**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	19.875 max	504.8 max	F	11.625	295.3
B	7.625 max	193.7 max	G	10.625 max	269.9 max
C	0.812	20.62	H	4.125 max	104.8 max
D	0.812	20.62	J	0.625	15.88
E	2.500	63.50	K	0.347	8.81

Millimetre dimensions have been derived from inches.



# AH211A

## MERCURY VAPOUR RECTIFIER

**Service Type CV532**

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage . . . . .	16	kV max
Peak anode current (at 16kV p.i.v.) . . . . .	8.0	A max
Mean anode current (at 16kV p.i.v.) . . . . .	2.0	A max
Fault anode current (0.1s max) . . . . .	100	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	2.5 V
Filament current . . . . .	30 A
Filament pre-heating time (minimum) . . . . .	1.0 min

#### Mechanical

Overall length . . . . .	13.375 inches (339.7mm) max
Overall diameter . . . . .	2.875 inches (73.0mm) nom
Net weight . . . . .	1¼ pounds (0.5kg) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	B.S.448-B2D
Top cap . . . . .	B.S.448-CT9

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating time and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

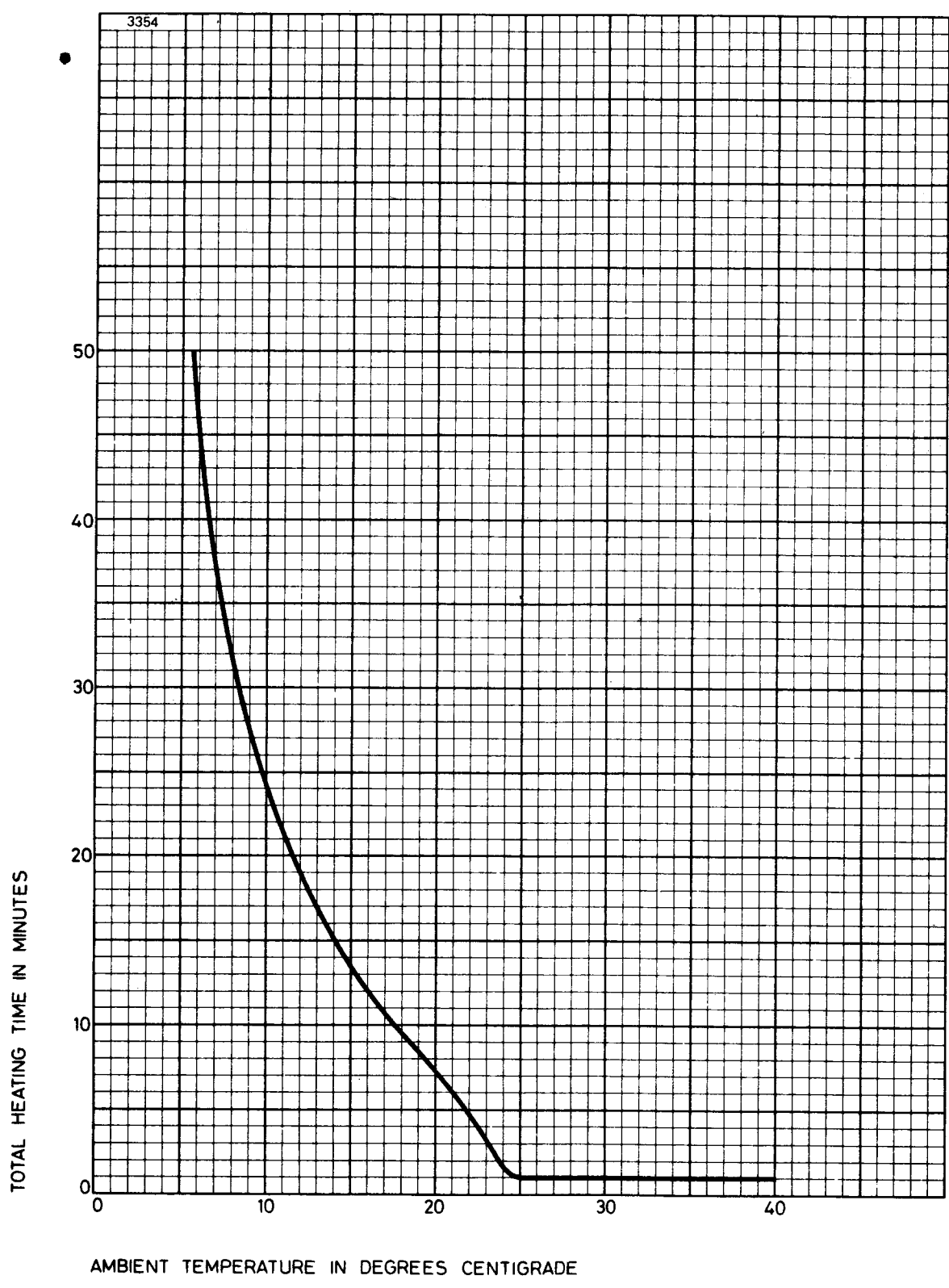
Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output		
			peak	mean♦		(kV)	(A)	
<b>A</b>								
Single phase full wave	25–50	16	8.0	2.0	5.6	5.0	4.0	
<b>B</b>								
Single phase bridge	25–50	16	8.0	2.0	11.2	10.1	4.0	
<b>C</b>								
Three phase half wave	25–50	16	8.0	2.0	6.5†	7.6†	6.0	
<b>D</b>								
Three phase full wave	25–50	16	8.0	2.0	6.5	15.2	6.0	

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

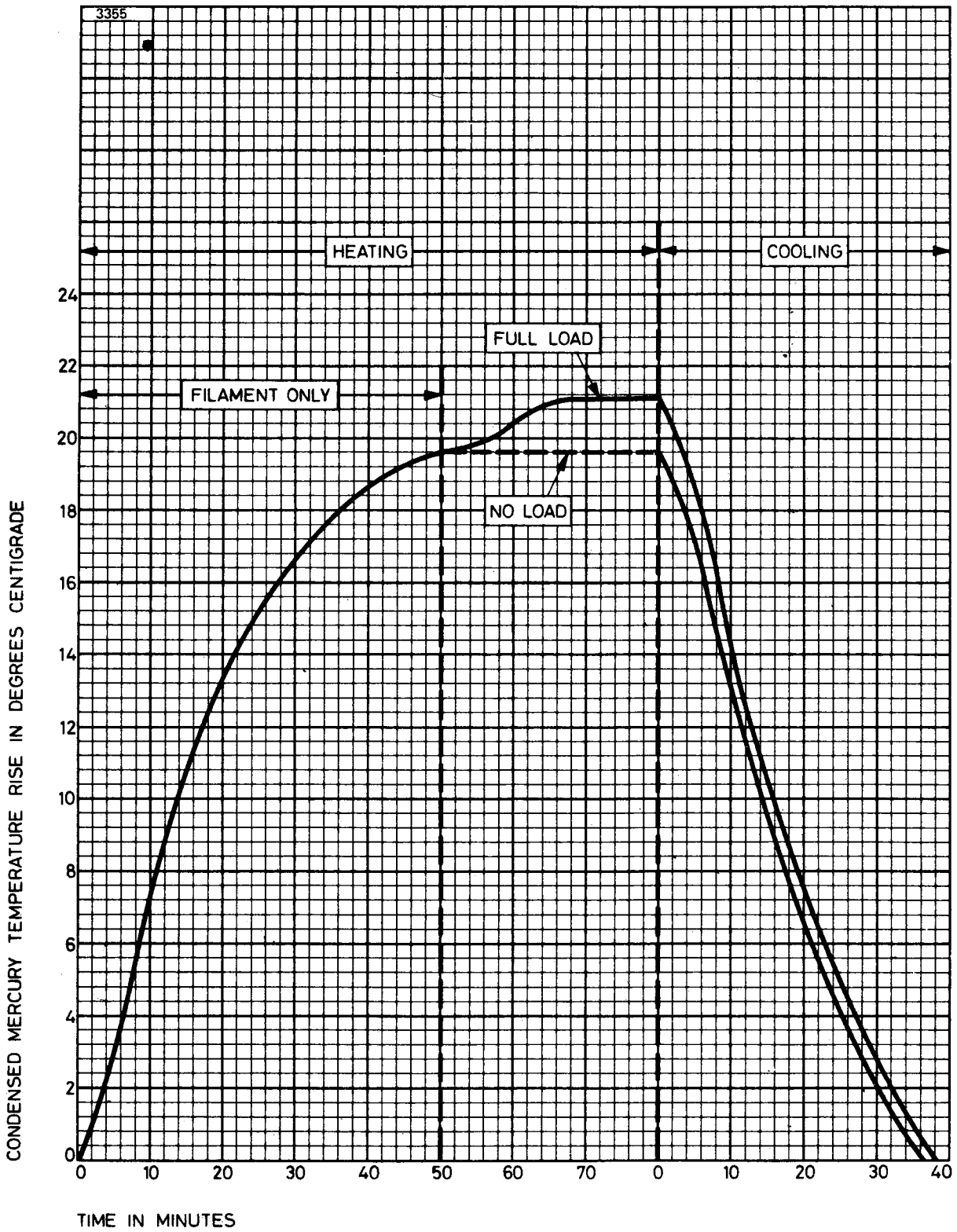
† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

♦ Averaging time 30 seconds maximum.

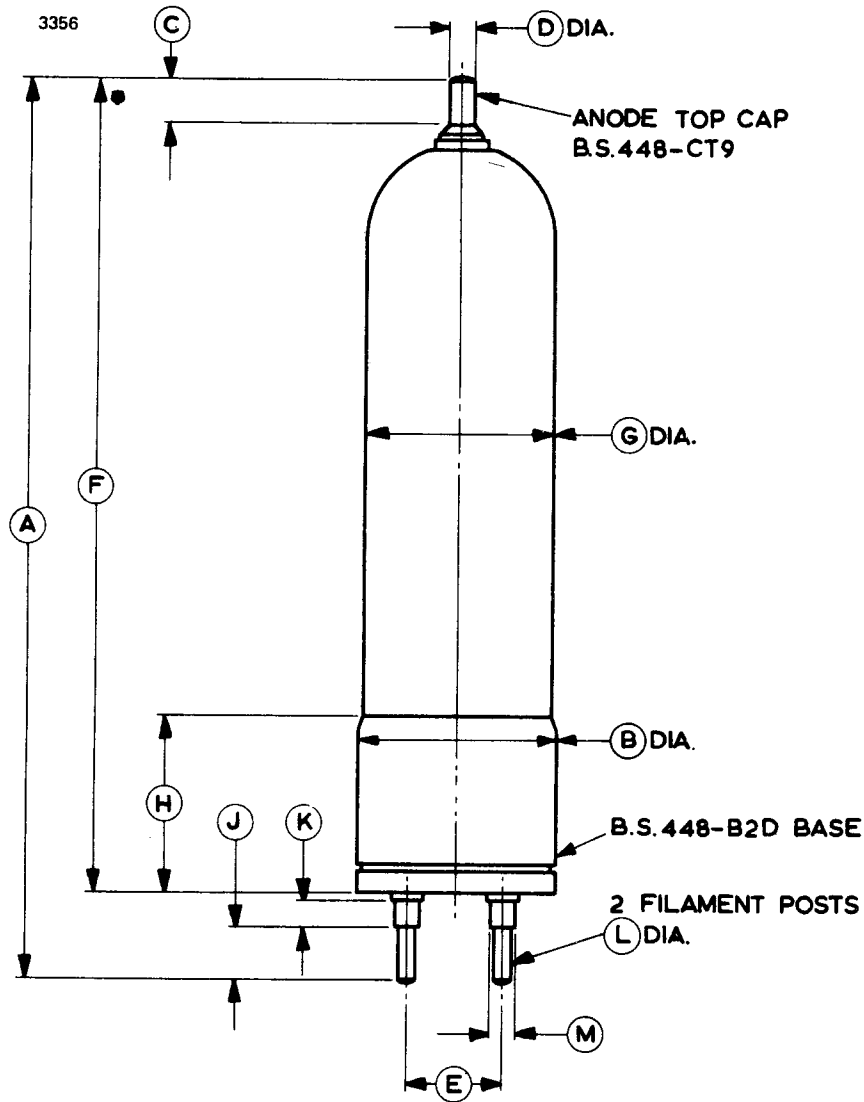
# TOTAL HEATING TIME CHARACTERISTIC



# TYPICAL HEATING AND COOLING CHARACTERISTIC



**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	12.937 ± 0.437	328.6 ± 11.10	G	2.860 max	72.64 max
B	2.875	73.03	H	2.563	65.10
C	0.591 max	15.01 max	J	0.750	19.05
D	0.375 ± 0.002	9.525 ± 0.051	K	0.375	9.53
E	1.375	34.93	L	0.281 ± 0.005	7.14 ± 0.13
F	11.687 ± 0.437	296.8 ± 11.1	M	0.375	9.53

Millimetre dimensions have been derived from inches.





## MERCURY VAPOUR RECTIFIER

Service Types CV5 and CV1435

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage . . . . .	20	kV max
Peak anode current (at 20kV p.i.v.) . . . . .	5.0	A max
Mean anode current (at 20kV p.i.v.) . . . . .	1.25	A max
Fault anode current (0.2s max) . . . . .	50	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	4.0 V
Filament current . . . . .	11 A
Filament pre-heating time (minimum) . . . . .	1.0 min

#### Mechanical

Overall length . . . . .	10.630 inches (270mm) max
Overall diameter . . . . .	2.312 inches (58.72mm) max
Net weight . . . . .	8 ounces (230g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	Goliath Edison screw E40/45
Top cap . . . . .	B.S.448-CT9 with adaptor

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

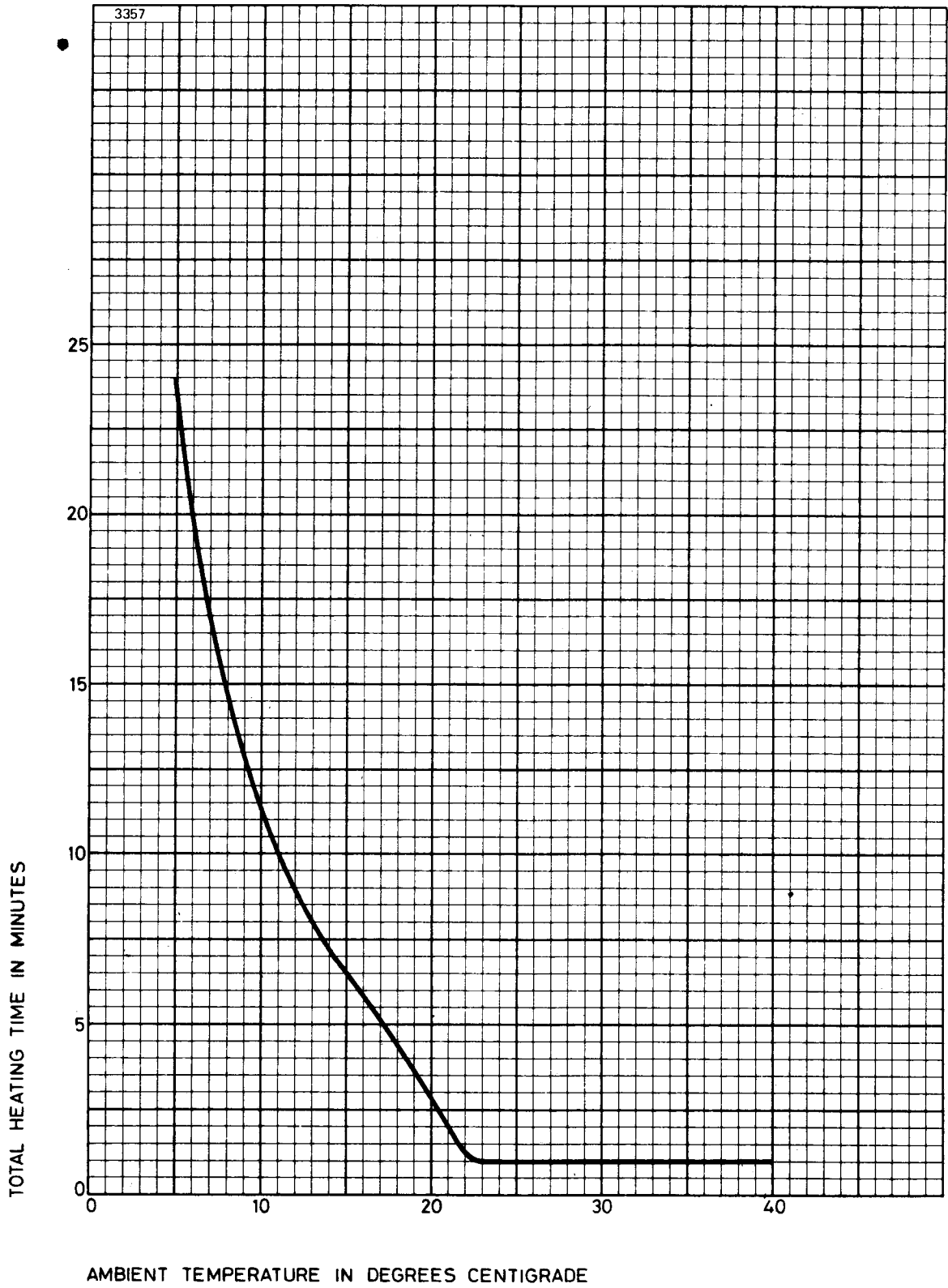
Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output	
			peak	mean♦		(kV)	(A)
<b>A</b>							
Single phase	20–40	20	5.0	1.25	7.0	6.3	2.5
full wave	20–50	11	5.0	1.25	3.9	3.5	2.5
<b>B</b>							
Single phase	20–40	20	5.0	1.25	14.0	12.6	2.5
bridge	20–50	11	5.0	1.25	7.75	7.0	2.5
<b>C</b>							
Three phase	20–40	20	5.0	1.25	8.1†	9.5†	3.75
half wave	20–50	11	5.0	1.25	4.4†	5.2†	3.75
<b>D</b>							
Three phase	20–40	20	5.0	1.25	8.1	19.0	3.75
full wave	20–50	11	5.0	1.25	4.4	10.4	3.75

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

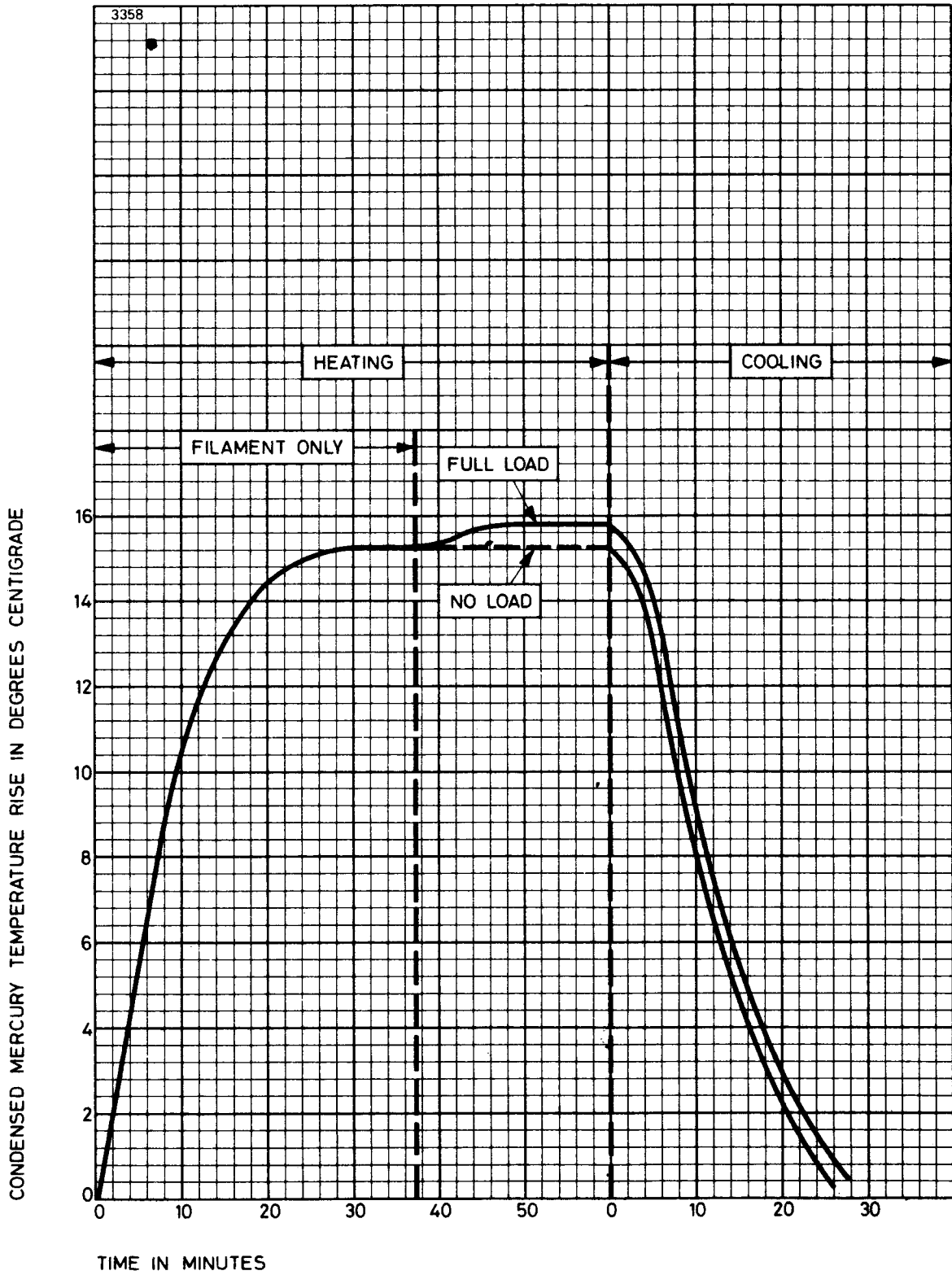
† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

♦ Averaging time 15 seconds maximum.

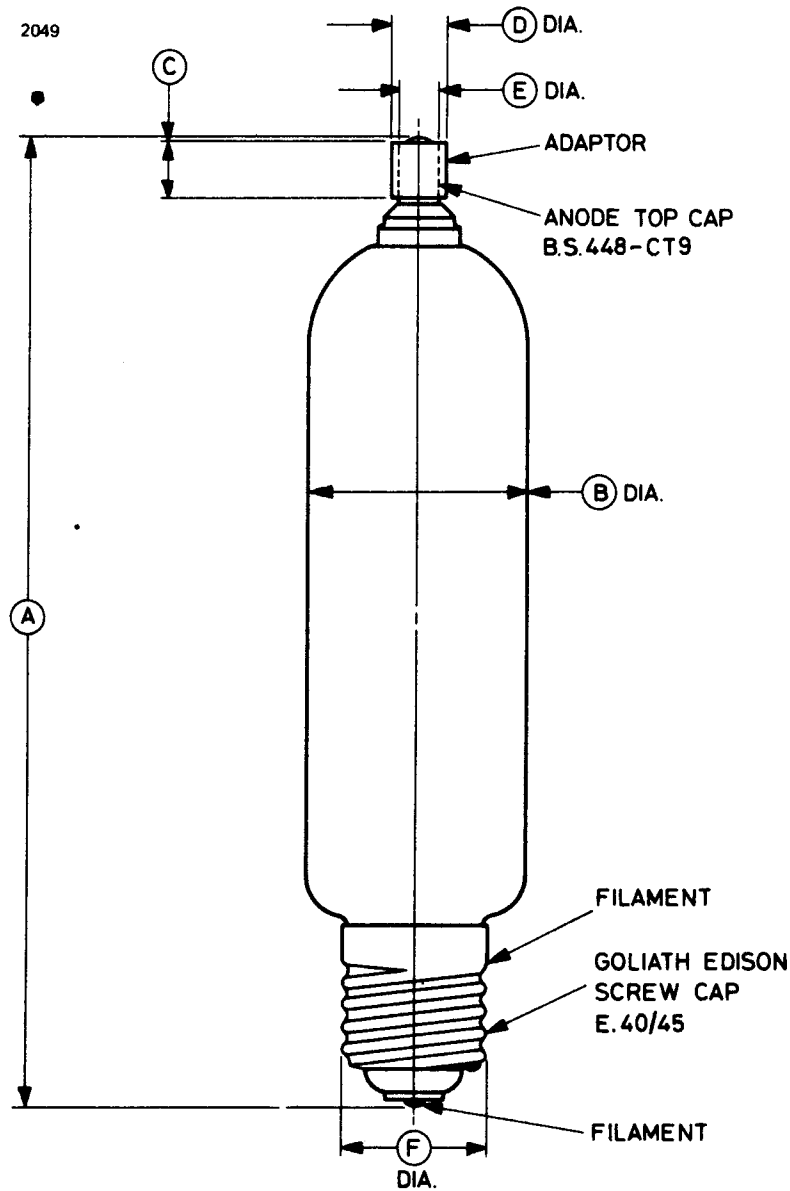
# TOTAL HEATING TIME CHARACTERISTIC



# TYPICAL HEATING AND COOLING CHARACTERISTIC

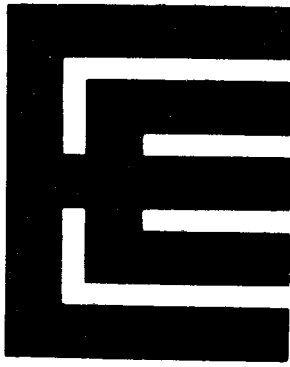


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.842 ± 0.787	250.0 ± 20.0	D	0.563	14.30
B	2.312 max	58.72 max	E	0.375 ± 0.002	9.525 ± 0.051
C	0.591 max	15.01 max	F	1.531	38.89

Millimetre dimensions have been derived from inches.



## MERCURY VAPOUR RECTIFIER

Service Type CV1629

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier

Peak inverse anode voltage . . . . .	13	kV max
Peak anode current (at 13kV p.i.v.) . . . . .	5.0	A max
Mean anode current (at 13kV p.i.v.) . . . . .	1.25	A max
Fault anode current (0.1s max) . . . . .	100	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	4.0 V
Filament current . . . . .	7.0 A
Filament pre-heating time (minimum) . . . . .	1.0 min

#### Mechanical

Overall length . . . . .	9.488 inches (241mm) max
Overall diameter . . . . .	2.312 inches (58.72mm) max
Net weight . . . . .	7 ounces (200g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	Goliath Edison screw E40/45
Top cap . . . . .	B.S.448-CT9 fitted with screw terminal adaptor

### CONTROL OF CONDENSED MERCURY TEMPERATURE

On the following pages two curves are given showing:

1. Total heating time for any value of ambient temperature. This is for use when the tube is being switched on from cold.
2. Rise of condensed mercury temperature above ambient plotted against heating and cooling time. This can be used as indicated by the example in the Rectifier and Thyatron Preamble.

## MAXIMUM OPERATING CONDITIONS (Absolute values)

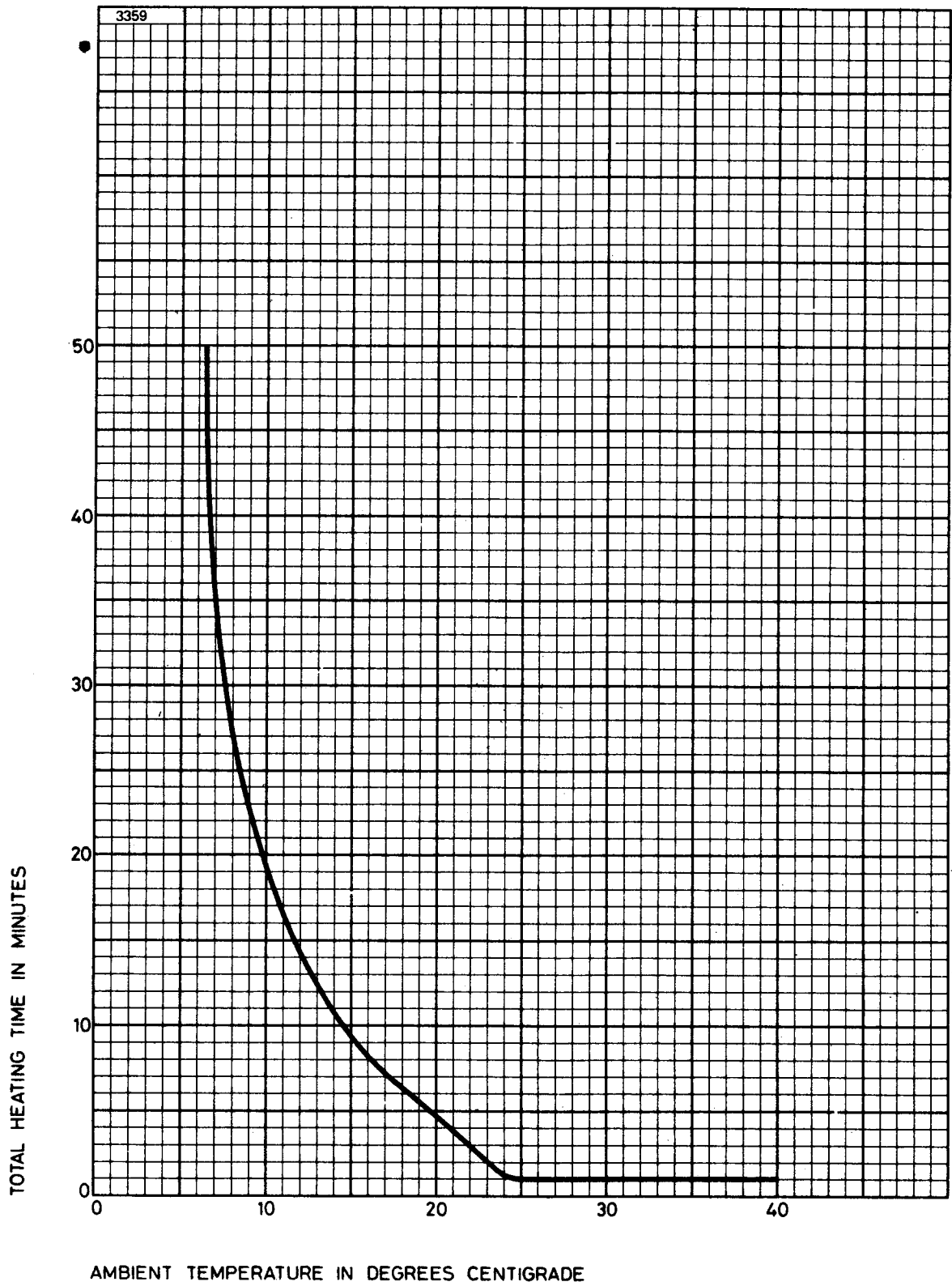
Circuit*	Condensed • mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output	
			peak	mean◆		(kV)	(A)
<b>A</b>	25–55	13	5.0	1.25	4.5	4.1	2.5
Single phase	25–60	10	5.0	1.25	3.5	3.1	2.5
full wave	25–65	8.0	5.0	1.25	2.8	2.5	2.5
<b>B</b>	25–55	13	5.0	1.25	9.1	8.2	2.5
Single phase	25–60	10	5.0	1.25	7.0	6.3	2.5
bridge	25–65	8.0	5.0	1.25	5.6	5.0	2.5
<b>C</b>	25–55	13	5.0	1.25	5.3†	6.2†	3.75
Three phase	25–60	10	5.0	1.25	4.1†	4.7†	3.75
half wave	25–65	8.0	5.0	1.25	3.2†	3.7†	3.75
<b>D</b>	25–55	13	5.0	1.25	5.3	12.4	3.75
Three phase	25–60	10	5.0	1.25	4.1	9.5	3.75
full wave	25–65	8.0	5.0	1.25	3.2	7.5	3.75

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

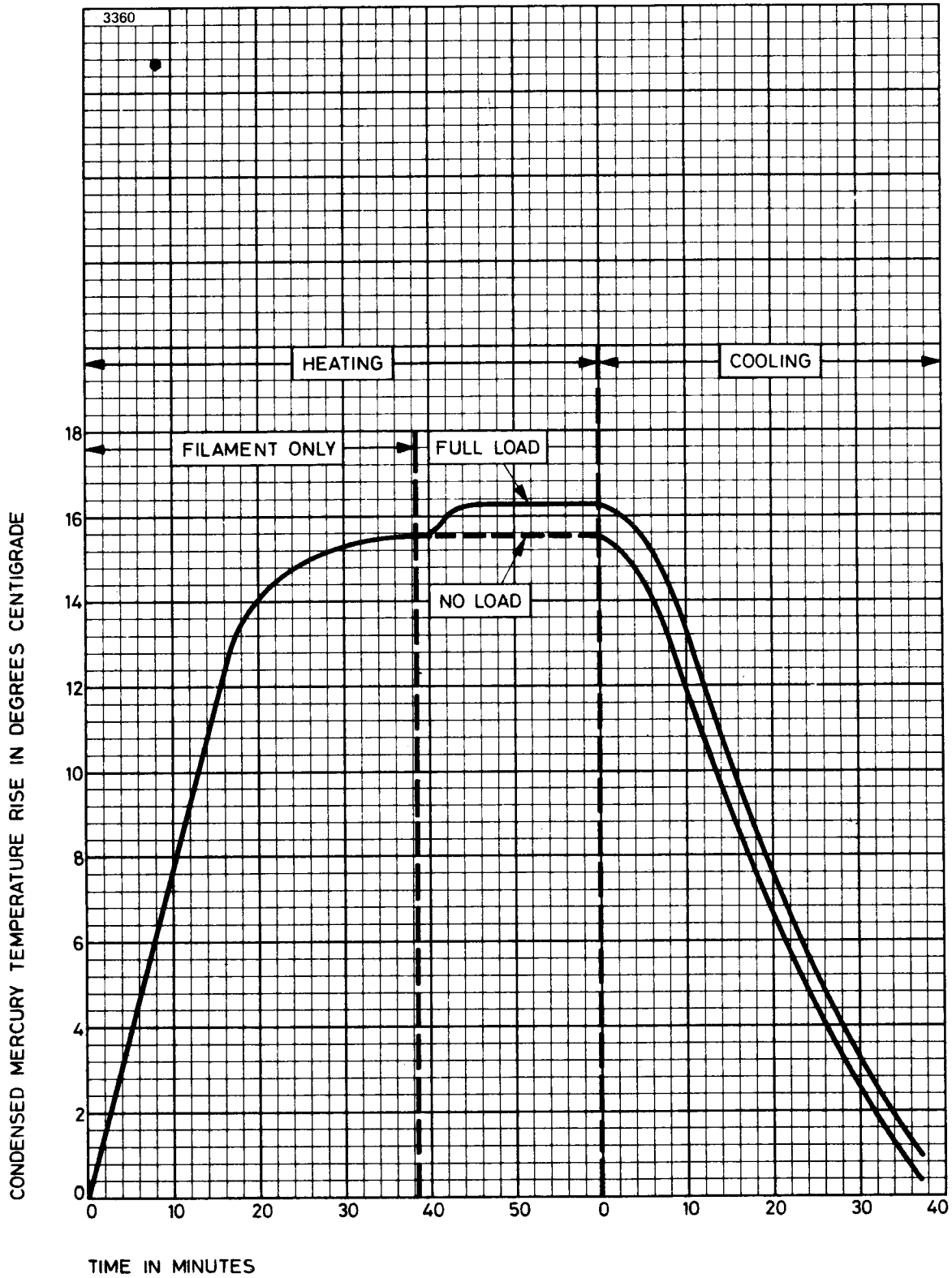
◆ Averaging time 15 seconds maximum.

# TOTAL HEATING TIME CHARACTERISTIC

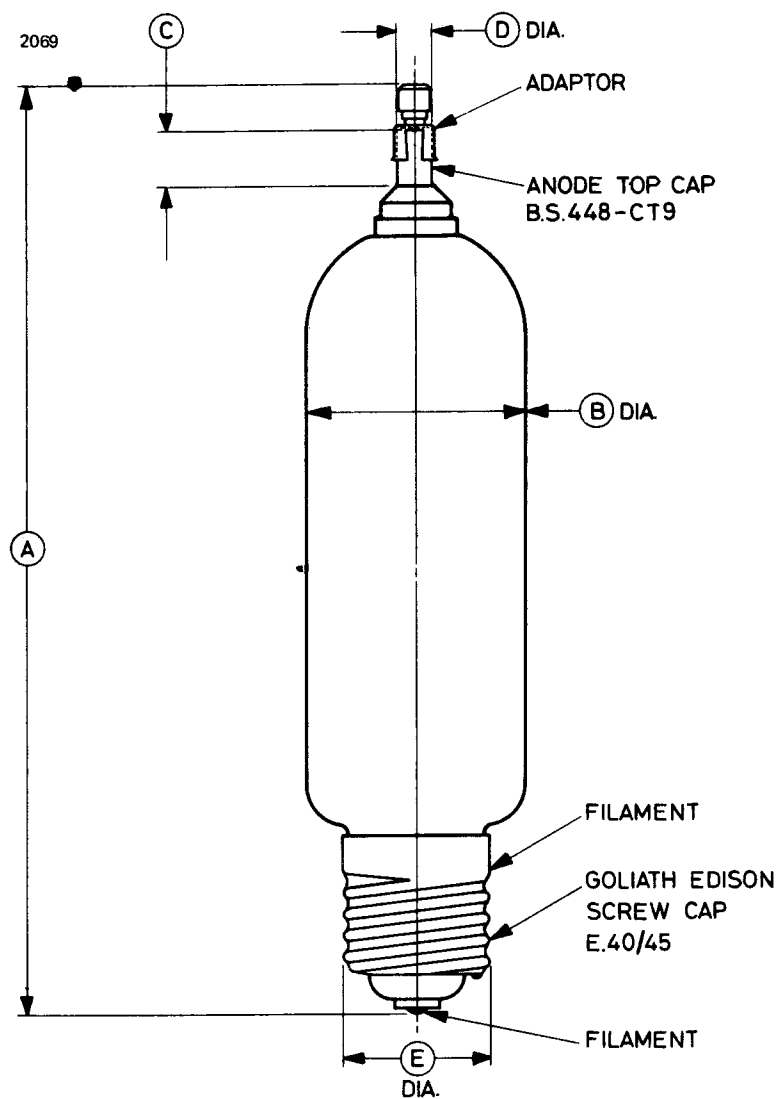




# TYPICAL HEATING AND COOLING CHARACTERISTIC

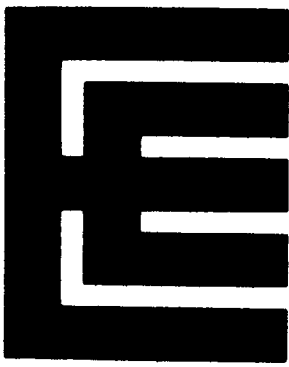


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	9.488 max	241.0 max
B	2.312 max	58.72 max
C	0.591 max	15.01 max
D	0.375 ± 0.002	9.525 ± 0.051
E	1.531	38.89

Millimetre dimensions have been derived from inches.



# AH2511

## MERCURY VAPOUR RECTIFIER

JEDEC Type 6693

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Hot cathode mercury vapour rectifier.

Peak inverse anode voltage . . . . .	15	kV max
Peak anode current (at 15kV p.i.v.) . . . . .	12	A max
Mean anode current (at 15kV p.i.v.) . . . . .	3.0	A max
Fault anode current (0.1s max) . . . . .	120	A max
Frequency . . . . .	150	Hz max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	5.0 V
Filament current . . . . .	11.5 A
Filament pre-heating time (minimum) . . . . .	1.0 min
Voltage drop (approx) . . . . .	12 V
Condensed mercury temperature rise above ambient (approx):	
at no load . . . . .	13 °C
at 2.5A load . . . . .	23 °C

#### Mechanical

Overall length . . . . .	308mm (12.126 inches) max
Overall diameter . . . . .	72mm (2.835 inches) max
Net weight . . . . .	450g (1 pound) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	B4D with bayonet
Top cap . . . . .	B.S.448-CT9 fitted with screw terminal adaptor

## MAXIMUM OPERATING CONDITIONS (Absolute values)

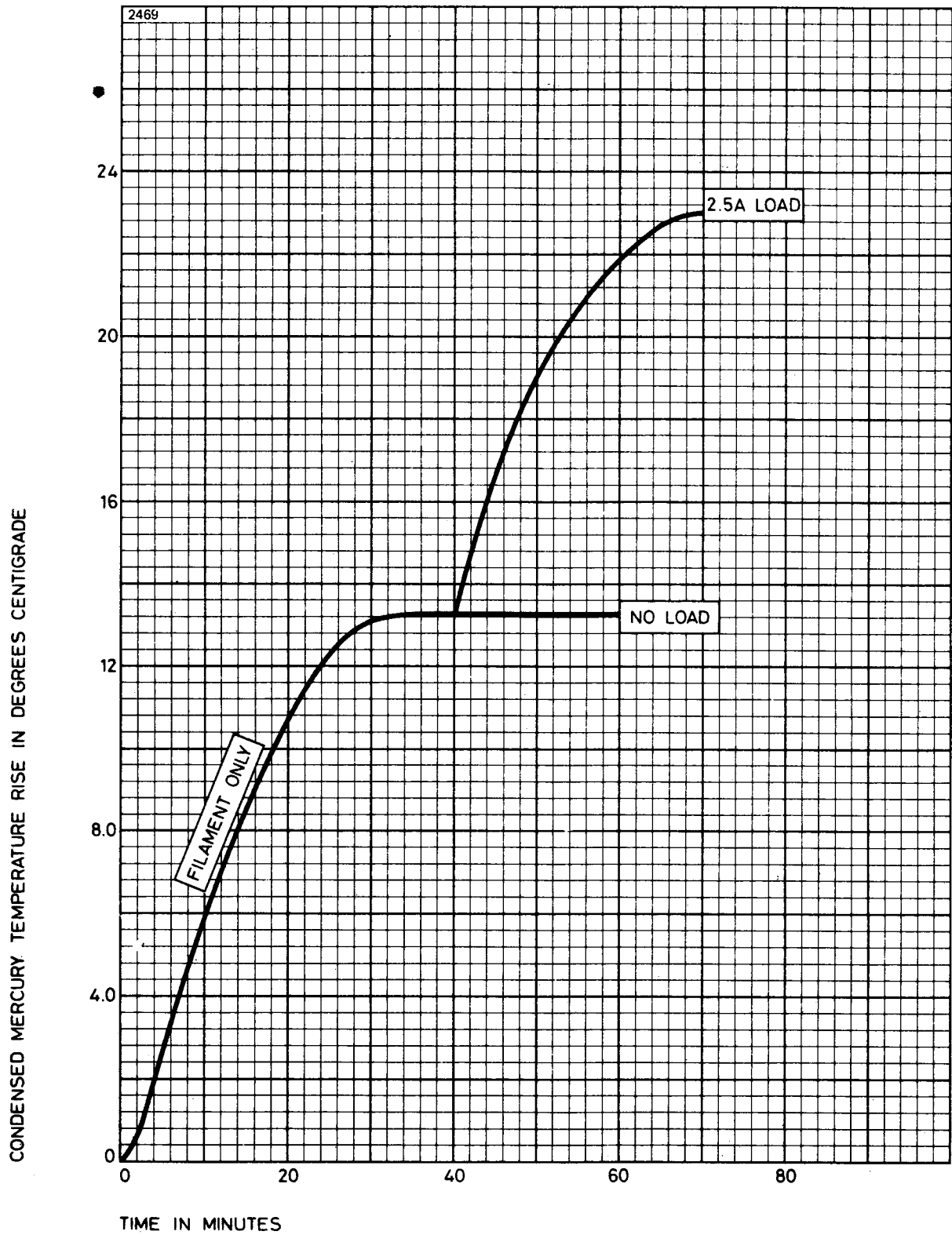
Circuit*	Condensed mercury temp. (°C)	Peak inverse voltage (50–60Hz) (kV)	Anode current (A)		Transformer secondary voltage (r.m.s.) (kV)	Maximum d.c. output	
			peak	mean♦		(kV)	(A)
<b>A</b>	25–55	15	12	3.0	5.3	4.8	6.0
Single phase	25–60	10	12	3.0	3.5	3.1	6.0
full wave	25–75	2.5	20	5.0	0.88	0.8	10
<b>B</b>	25–55	15	12	3.0	10.6	9.6	6.0
Single phase	25–60	10	12	3.0	7.0	6.3	6.0
bridge	25–75	2.5	20	5.0	1.77	1.6	10
<b>C</b>	25–55	15	12	3.0	6.1†	7.2†	9.0
Three phase	25–60	10	12	3.0	4.1†	4.7†	9.0
half wave	25–75	2.5	20	5.0	1.02†	1.2†	15
<b>D</b>	25–55	15	12	3.0	6.1	14.3	9.0
Three phase	25–60	10	12	3.0	4.1	9.5	9.0
full wave	25–75	2.5	20	5.0	1.02	2.4	15

\* See Typical Rectifier Circuits for Choke Input Filters in the Rectifier and Thyatron Preamble.

† For operation at constant full load. If the load resistance is increased, the peak inverse voltage on the tubes will exceed the ratings unless the transformer secondary voltage is reduced. The total reduction required is 14% at no load and the d.c. output voltage will be correspondingly reduced.

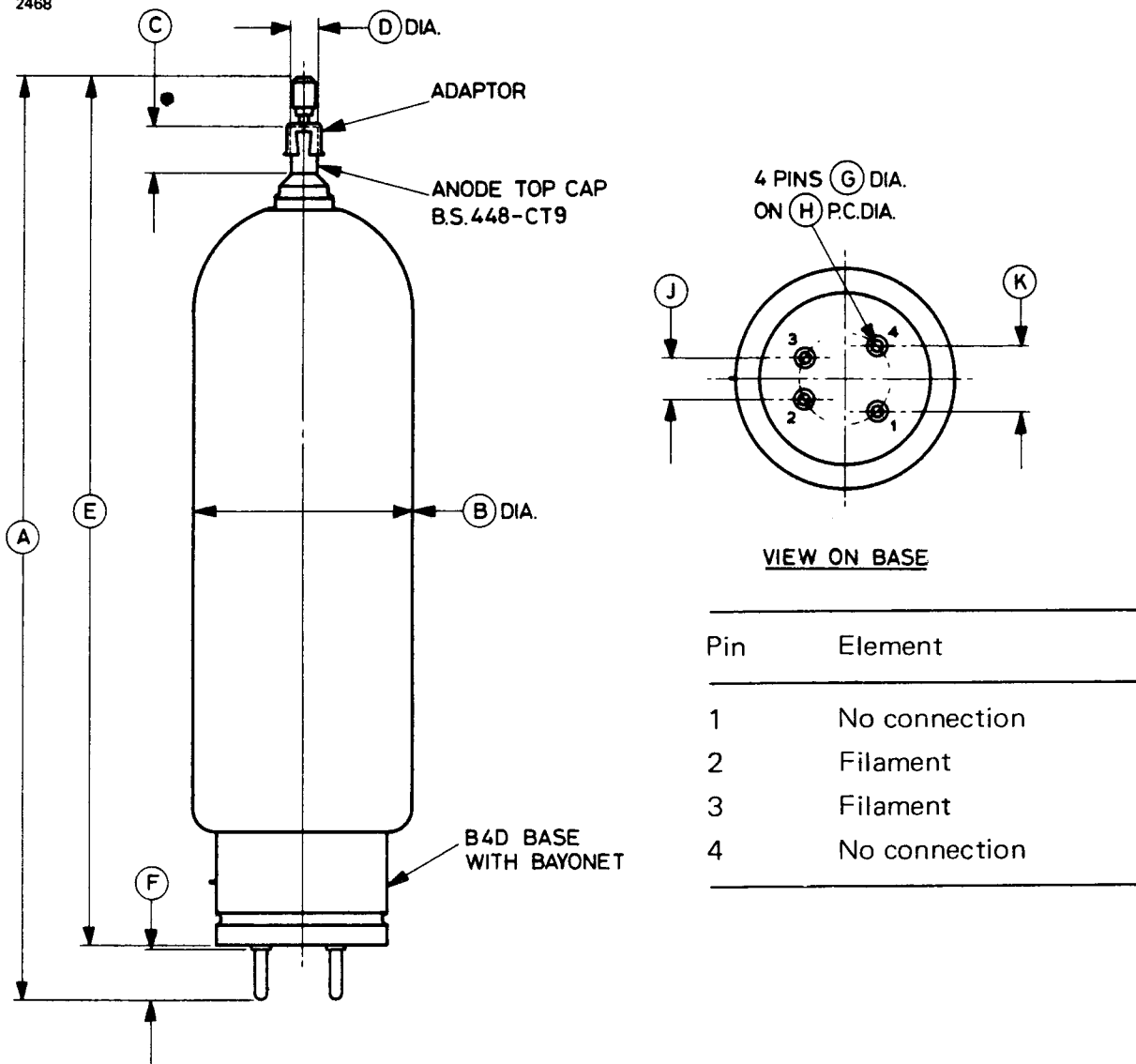
♦ Averaging time 15 seconds maximum.

# HEATING CHARACTERISTIC



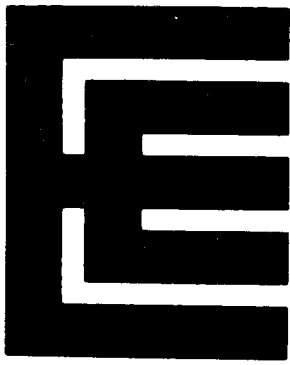
# OUTLINE (All dimensions without limits are nominal)

2468



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A*	11.811 ± 0.315	300.0 ± 8.0	F	0.625	15.88
B*	2.835 max	72.0 max	G	0.187 ± 0.003	4.750 ± 0.076
C	0.591 max	15.01 max	H	1.000	25.40
D	0.375 ± 0.002	9.525 ± 0.051	J	0.562	14.27
E*	11.122 ± 0.236	282.5 ± 6.0	K	0.750	19.05

Millimetre dimensions have been derived from inches except where marked \*



# BD10

## MERCURY VAPOUR RECTIFIER

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

Hot cathode half-wave mercury vapour rectifier.

### GENERAL DATA

#### Electrical

Cathode . . . . .	indirectly heated	
Heater voltage . . . . .	5.0	V
Heater current . . . . .	9.0	A
Cathode pre-heating time (minimum) . . . . .	5.0	min
Voltage drop (approx) . . . . .	12	V
Condensed mercury temperature rise above ambient (approx):		
at no load . . . . .	36	°C
at full load . . . . .	43	°C

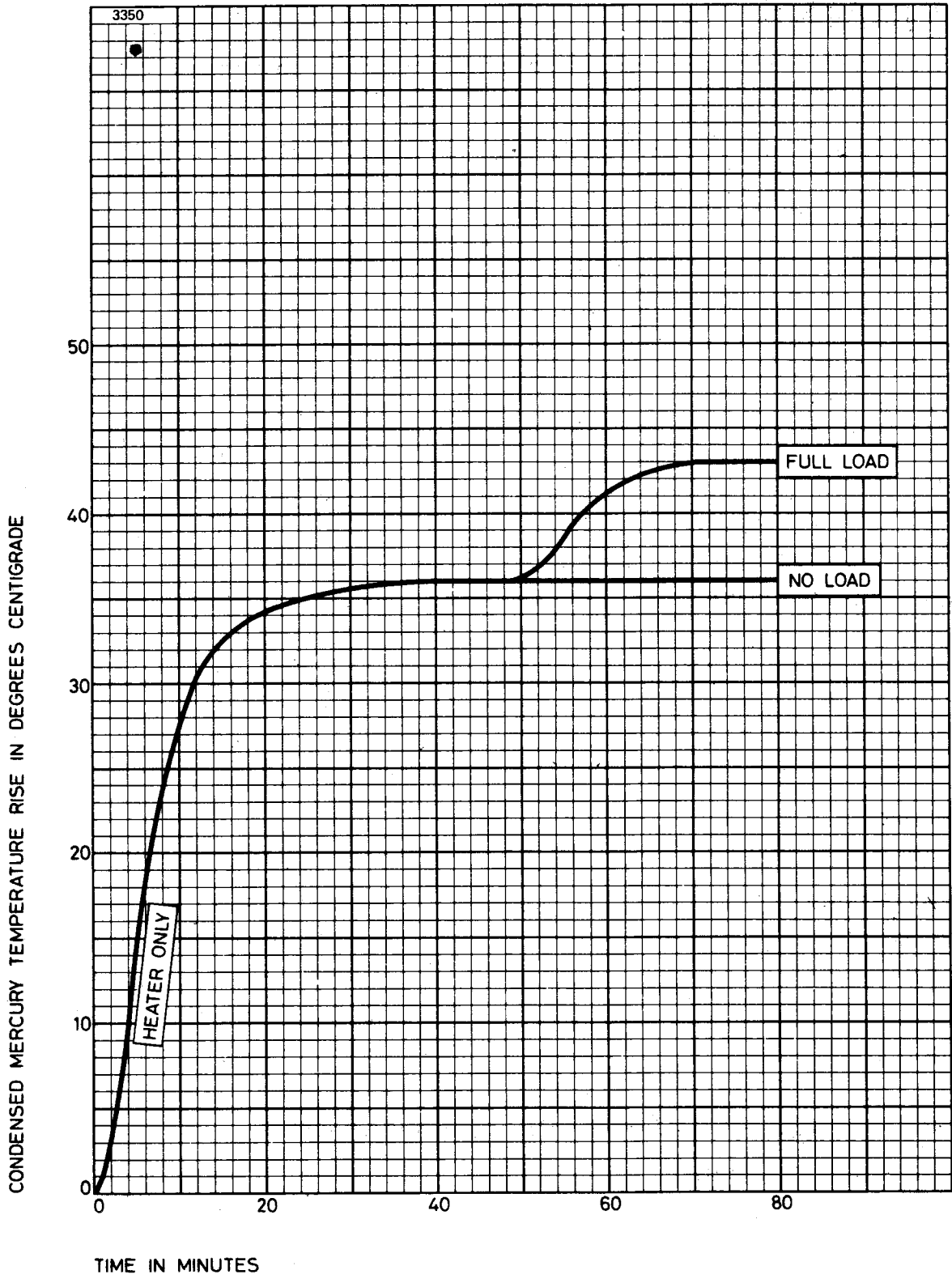
#### Mechanical

Overall length . . . . .	9.375 inches (238.2mm) max
Overall diameter . . . . .	3.812 inches (96.8mm) max
Net weight . . . . .	8½ ounces (240g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	Goliath Edison screw E40/45
Anode connection . . . . .	flexible lead

### MAXIMUM AND MINIMUM RATINGS (Absolute values)

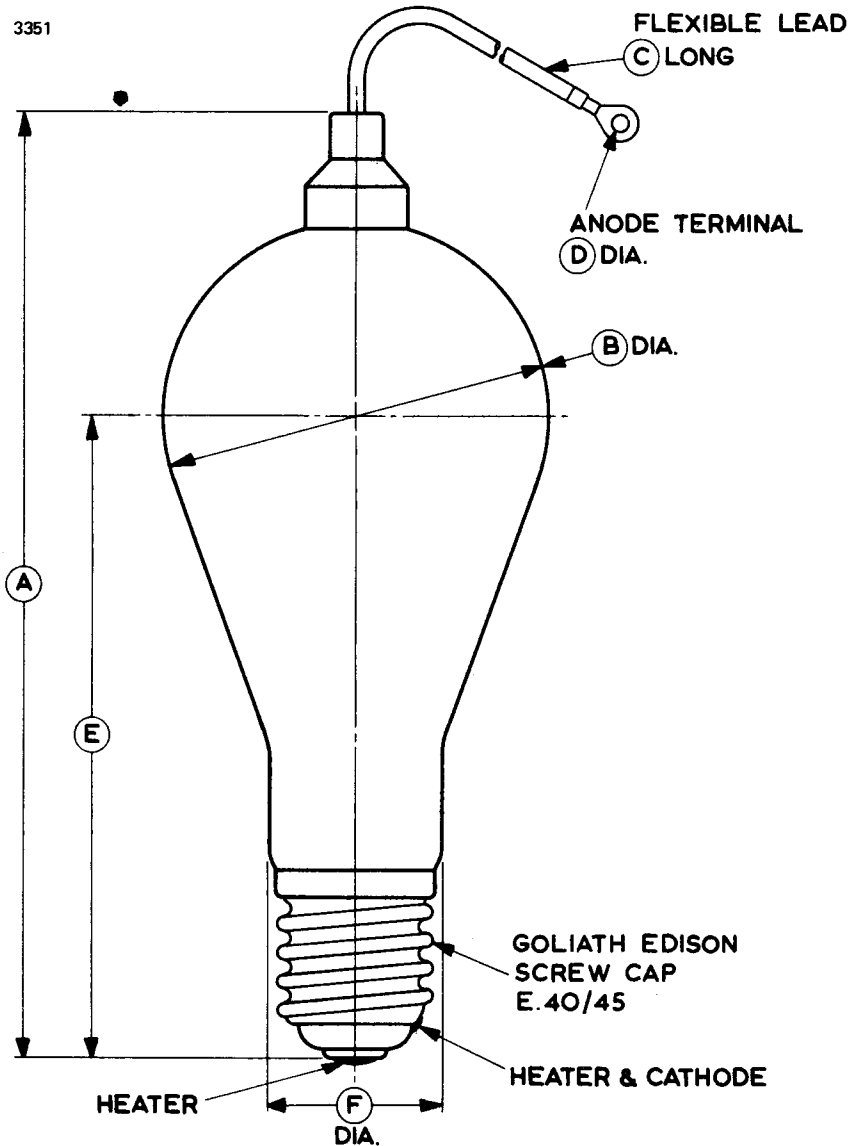
Peak inverse anode voltage . . . . .	1.0	kV max
Peak anode current . . . . .	25	A max
Mean anode current (averaging time 15s max) . . . . .	8.0	A max
Surge anode current (0.1s maximum duration) . . . . .	400	A max
Condensed mercury temperature (on load) . . . . .	40	°C min
	85	°C max

# TYPICAL HEATING CHARACTERISTIC



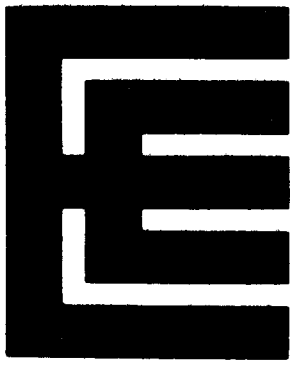


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	9.125 ± 0.250	231.8 ± 6.4
B	3.812 max	96.82 max
C	5.375 ± 0.250	136.5 ± 6.4
D	0.265	6.73
E	6.250 ± 0.250	158.8 ± 6.4
F	1.687	42.85

Millimetre dimensions have been derived from inches.



## MERCURY VAPOUR RECTIFIER

To be read in conjunction with the Rectifier and Thyatron Preamble.

### DESCRIPTION

Hot cathode full-wave mercury vapour rectifier.

### GENERAL DATA

#### Electrical

Cathode . . . . .	indirectly heated	
Heater voltage . . . . .	5.0	V
Heater current . . . . .	35	A
Cathode pre-heating time (minimum) . . . . .	5.0	min
Voltage drop (approx) . . . . .	12	V
Condensed mercury temperature rise above ambient (approx):		
at no load . . . . .	52	°C
at full load . . . . .	60	°C

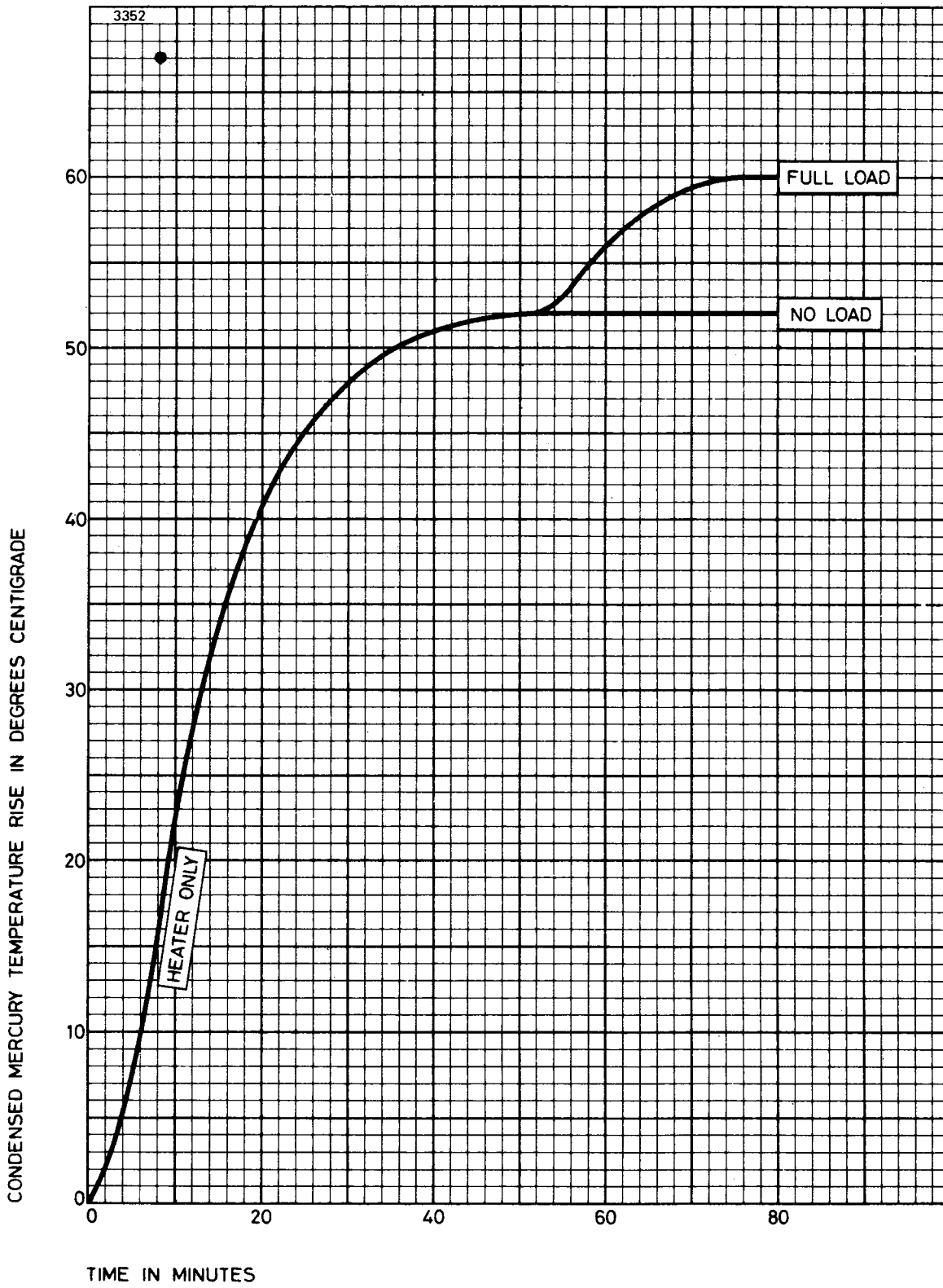
#### Mechanical

Overall length (excluding leads) . . . . .	16.437 inches (417.5mm) max
Overall diameter . . . . .	6.437 inches (163.5mm) max
Net weight . . . . .	3½ pounds (1.6kg) approx
Mounting position . . . . .	vertical, base down
Connections . . . . .	flexible leads

### MAXIMUM AND MINIMUM RATINGS (Absolute values)

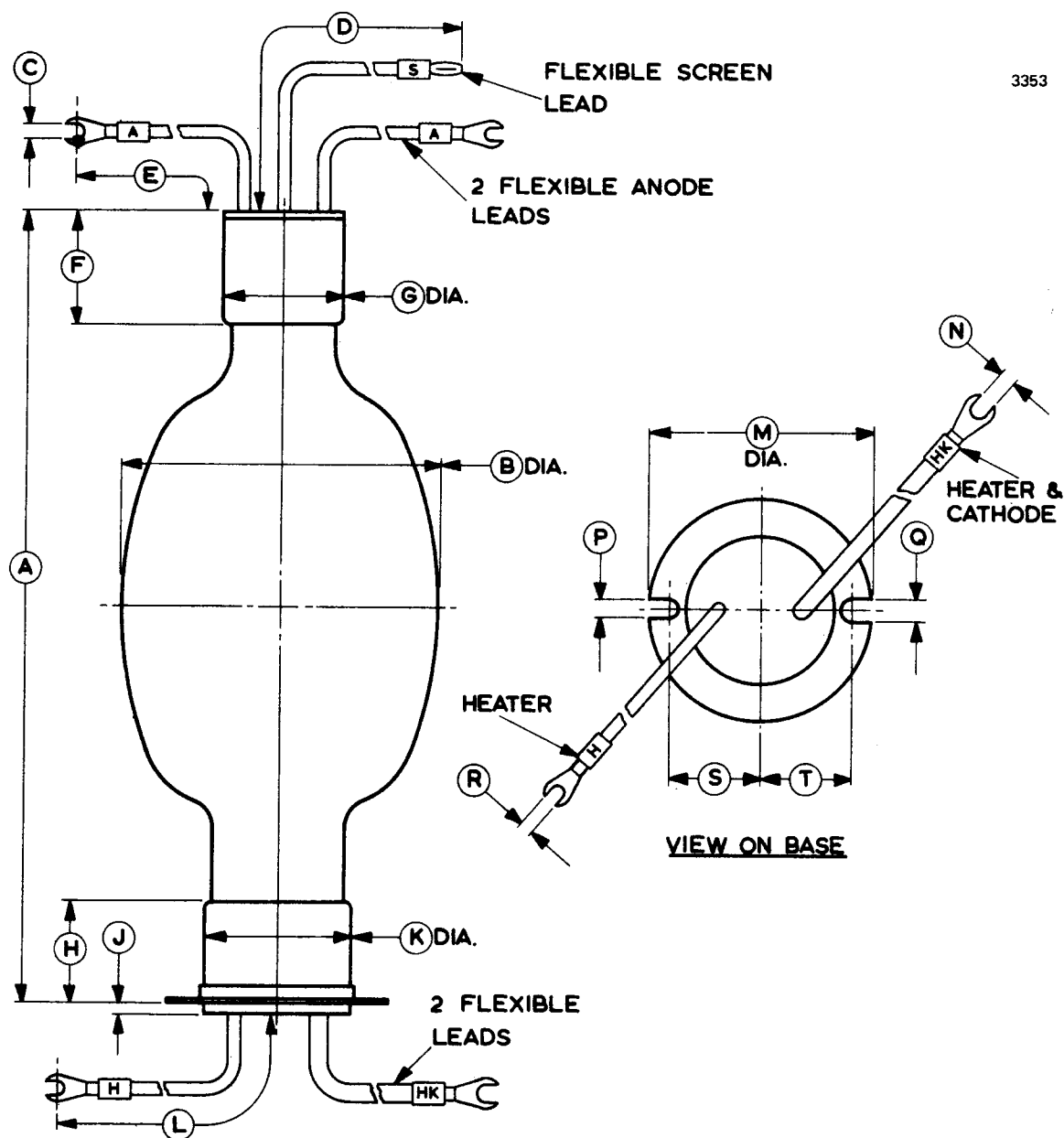
Peak inverse anode voltage . . . . .	1.0	kV max
R.M.S. voltage between anodes . . . . .	250	V max
Peak anode current (per anode) . . . . .	50	A max
Mean anode current (per anode) (averaging time 30s max) . . . . .	16.5	A max
Surge anode current (per anode) (0.1s maximum duration) . . . . .	500	A max
Condensed mercury temperature (on load) . . . . .	40	°C min
	100	°C max

# TYPICAL HEATING CHARACTERISTIC



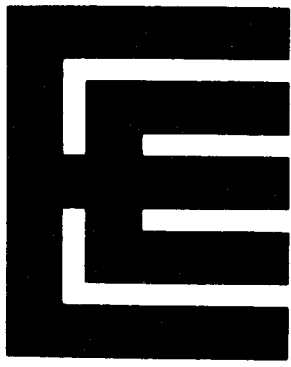
**OUTLINE (All dimensions without limits are nominal)**

3353



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.625 ± 0.500	396.9 ± 12.7	K	2.875 max	73.03 max
B	6.437 max	163.5 max	L	7.750 ± 0.250	196.9 ± 6.4
C	0.265	6.73	M	4.375 max	111.1 max
D	6.250 ± 0.250	158.8 ± 6.4	N	0.328	8.33
E	7.750 ± 0.250	196.9 ± 6.4	P	0.344	8.74
F	2.250	57.15	Q	0.437	11.10
G	2.875 max	73.03 max	R	0.265	6.73
H	2.000	50.80	S	1.813	46.05
J	0.250 ± 0.062	6.35 ± 1.57	T	1.813	46.05

Millimetre dimensions have been derived from inches.



**MERCURY VAPOUR  
THYRATRON**

**Service Type CV1147**

To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Mercury vapour thyatron for industrial control or ignitor firing applications.

Peak forward anode voltage . . . . .	1.0	kV max
Peak inverse anode voltage . . . . .	1.5	kV max
Peak anode current . . . . .	12.5	A max
Mean anode current . . . . .	2.5	A max

**GENERAL**

**Electrical**

Cathode . . . . .	indirectly heated, oxide coated
Heater voltage . . . . .	5.0 V
Heater current . . . . .	4.7 A
Cathode pre-heating time (minimum) . . . . .	5.0 min
Inter-electrode capacitances:	
grid to anode . . . . .	4.0 pF
grid to cathode . . . . .	9.0 pF

**Mechanical**

Overall length . . . . .	7.750 inches (196.9mm) max
Overall diameter . . . . .	3.187 inches (80.95mm) max
Net weight . . . . .	5 ounces (140g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	B.S.448-B4G (USM4B)
Top cap . . . . .	see outline, page 6

**Cooling** . . . . . natural

## MAXIMUM AND MINIMUM RATINGS

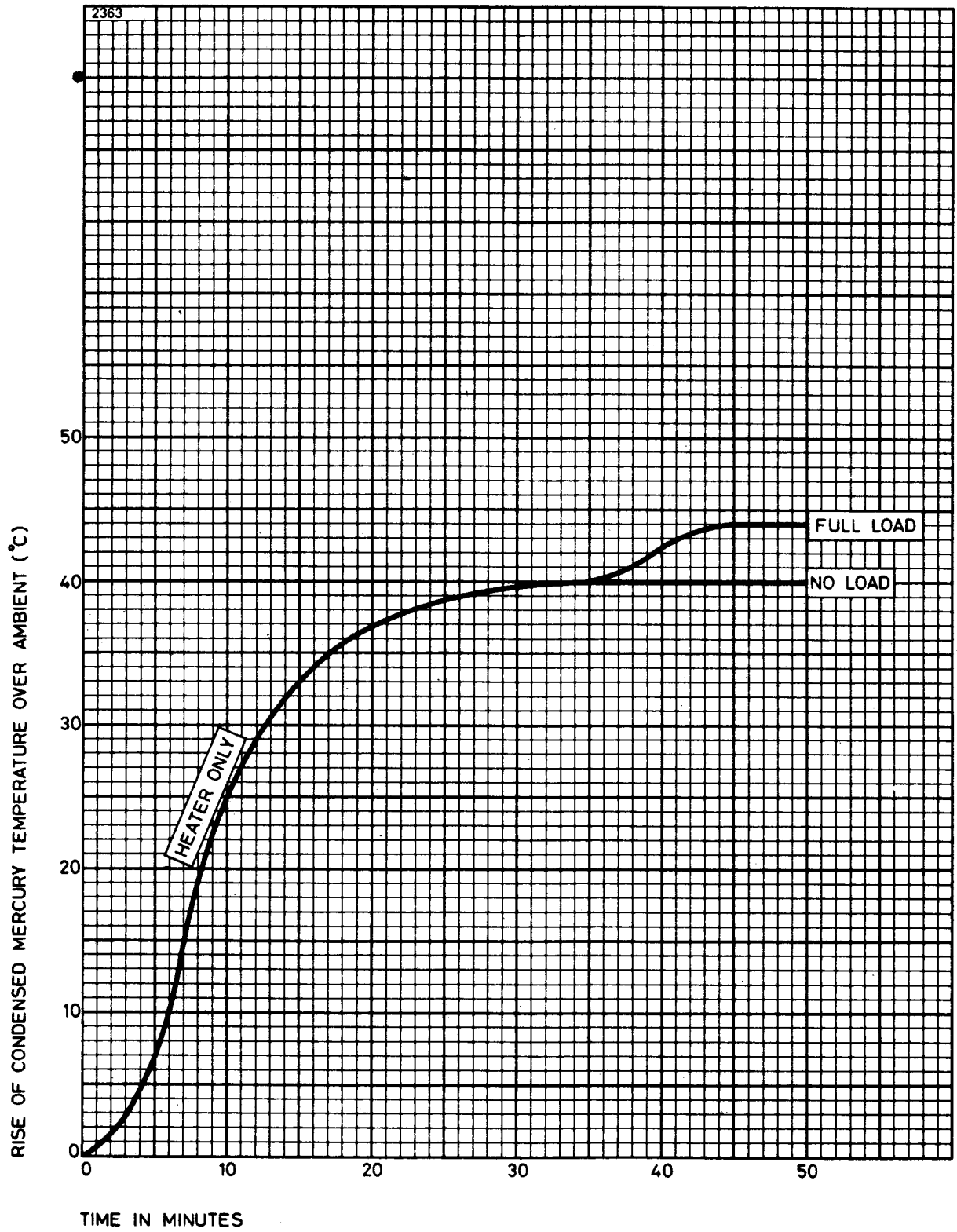
	Min	Max	
Peak forward anode voltage . . . . .	—	1.0	kV
Peak inverse anode voltage . . . . .	—	1.5	kV
Peak anode current (see note) . . . . .	—	12.5	A
Mean anode current (averaging time 15s max) . . . . .	—	2.5	A
Fault anode current (peak) . . . . .	—	200	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	80	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Mean grid current . . . . .	—	250	mA
Recommended grid resistor . . . . .	10	220	kΩ
Cathode pre-heating time . . . . .	5.0	—	min

## CHARACTERISTICS

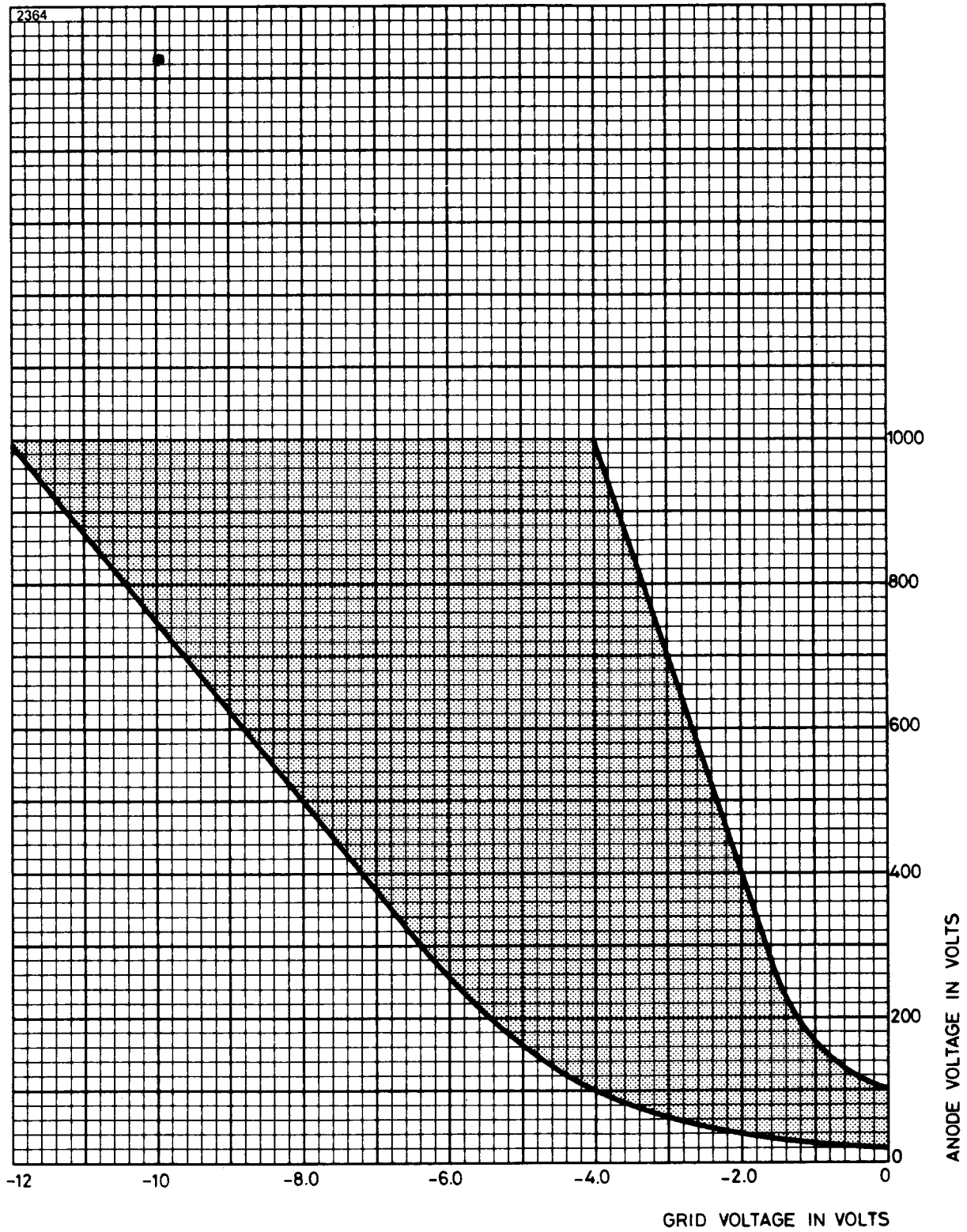
Voltage drop . . . . .	16	V approx
Ionization time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	40	°C approx
at full load . . . . .	44	°C approx

**Note** For ignitor firing service, the peak anode current rating is 30A max.

# TYPICAL HEATING CHARACTERISTIC

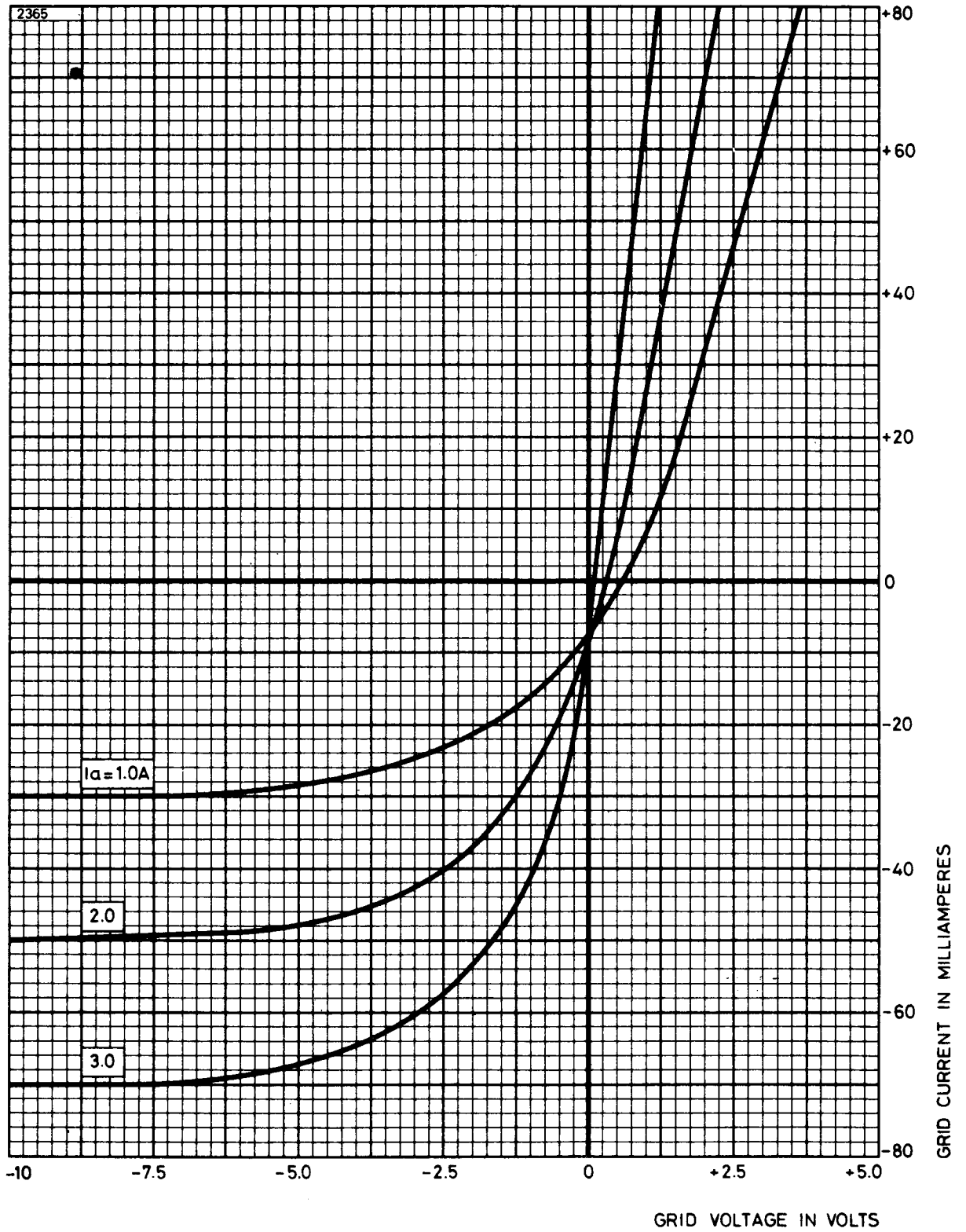


# CONTROL CHARACTERISTIC

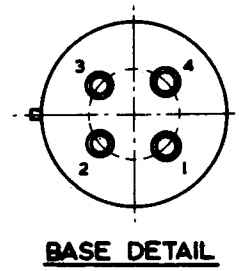
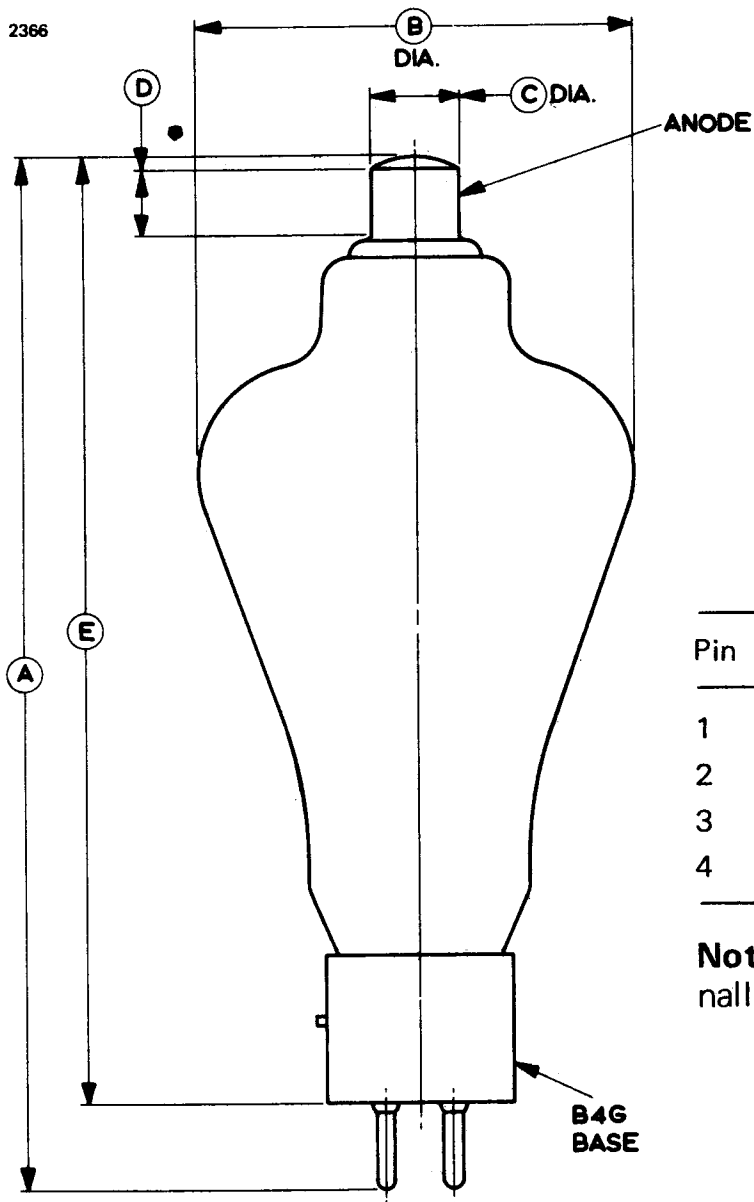




# TYPICAL GRID CURRENT CHARACTERISTICS



# OUTLINE

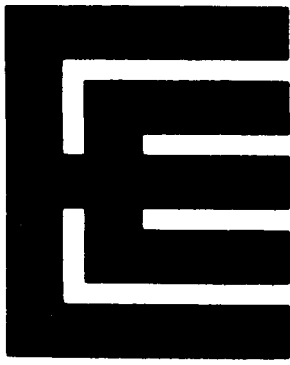


Pin	Element
1	Heater
2	Cathode
3	Grid
4	Heater

**Note** Pin 2 (cathode) is internally connected to pin 4.

Ref	Inches	Millimetres
A	7.500 ± 0.250	190.5 ± 6.35
B	3.187 max	80.95 max
C	0.641 ± 0.015	16.28 ± 0.38
D	0.420 min	10.67 min
E	6.875 ± 0.250	174.6 ± 6.35

Millimetre dimensions have been derived from inches.



**MERCURY VAPOUR  
THYRATRON**

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To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Mercury vapour thyatron for industrial control applications.

Peak forward anode voltage . . . . .	1.0	kV max
Peak inverse anode voltage . . . . .	1.5	kV max
Peak anode current . . . . .	40	A max
Average anode current . . . . .	6.0	A max

**GENERAL**

**Electrical**

Cathode . . . . .	indirectly heated, oxide coated	
Heater voltage . . . . .	5.0	V
Heater current . . . . .	10.5	A
Cathode pre-heating time (minimum) . . . . .	5.0	min
Inter-electrode capacitances:		
grid to anode . . . . .	6.0	pF
grid to cathode . . . . .	15	pF

**Mechanical**

Overall length (excluding flexible leads) . . . . .	10.250 inches (260.4mm) max
Overall diameter . . . . .	3.157 inches (80.19mm) max
Net weight . . . . .	1.2 pounds (540g) approx
Mounting position . . . . .	vertical, base down
Connections . . . . .	flying leads

<b>Cooling</b> . . . . .	natural
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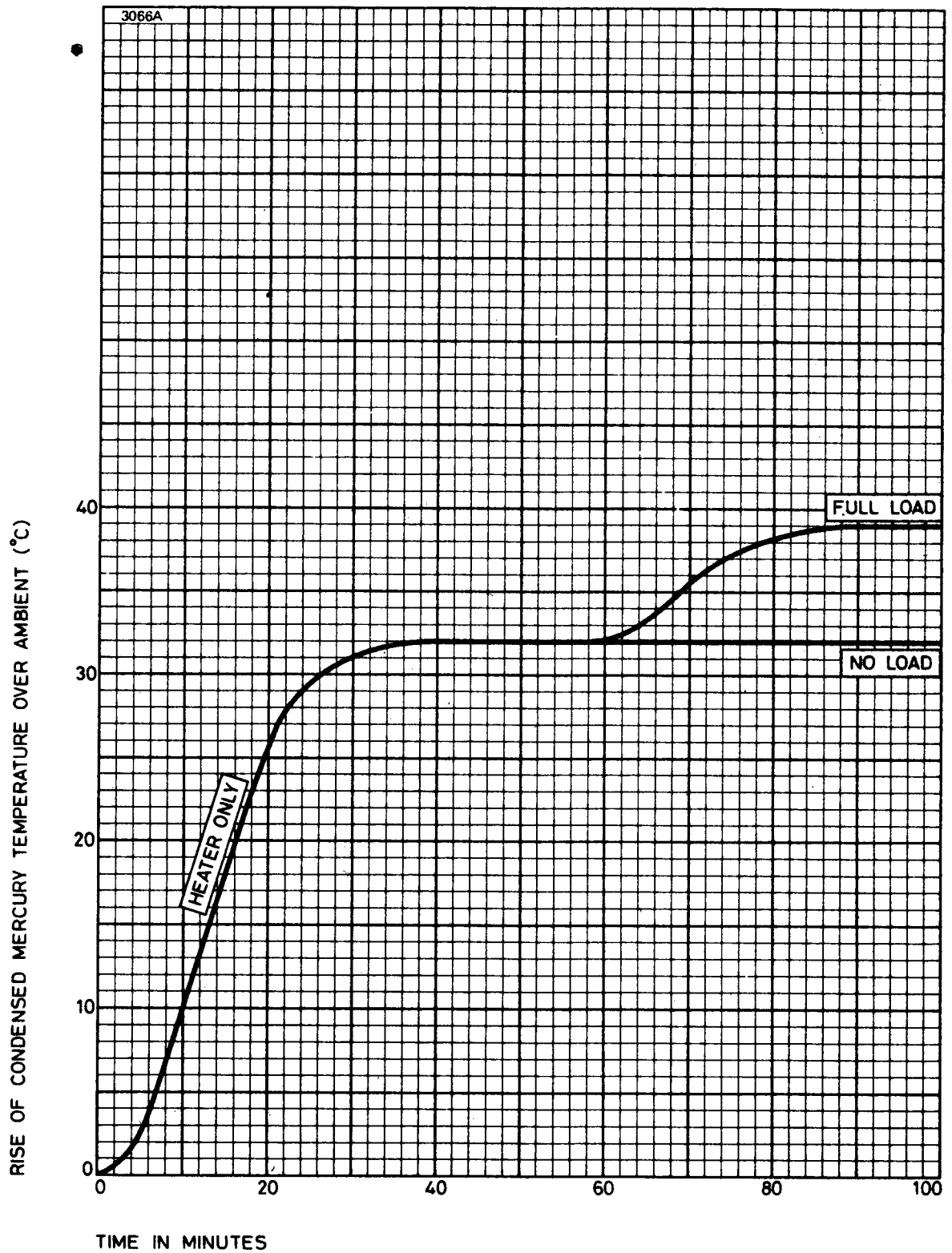
## MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Peak forward anode voltage . . . . .	—	1.0	kV
Peak inverse anode voltage . . . . .	—	1.5	kV
Peak anode current . . . . .	—	40	A
Average anode current (averaging time 15s max) . . . . .	—	6.0	A
Fault anode current (peak) . . . . .	—	400	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	80	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Average grid current . . . . .	—	250	mA
Recommended grid resistor . . . . .	10	100	kΩ
Cathode pre-heating time . . . . .	5.0	—	min

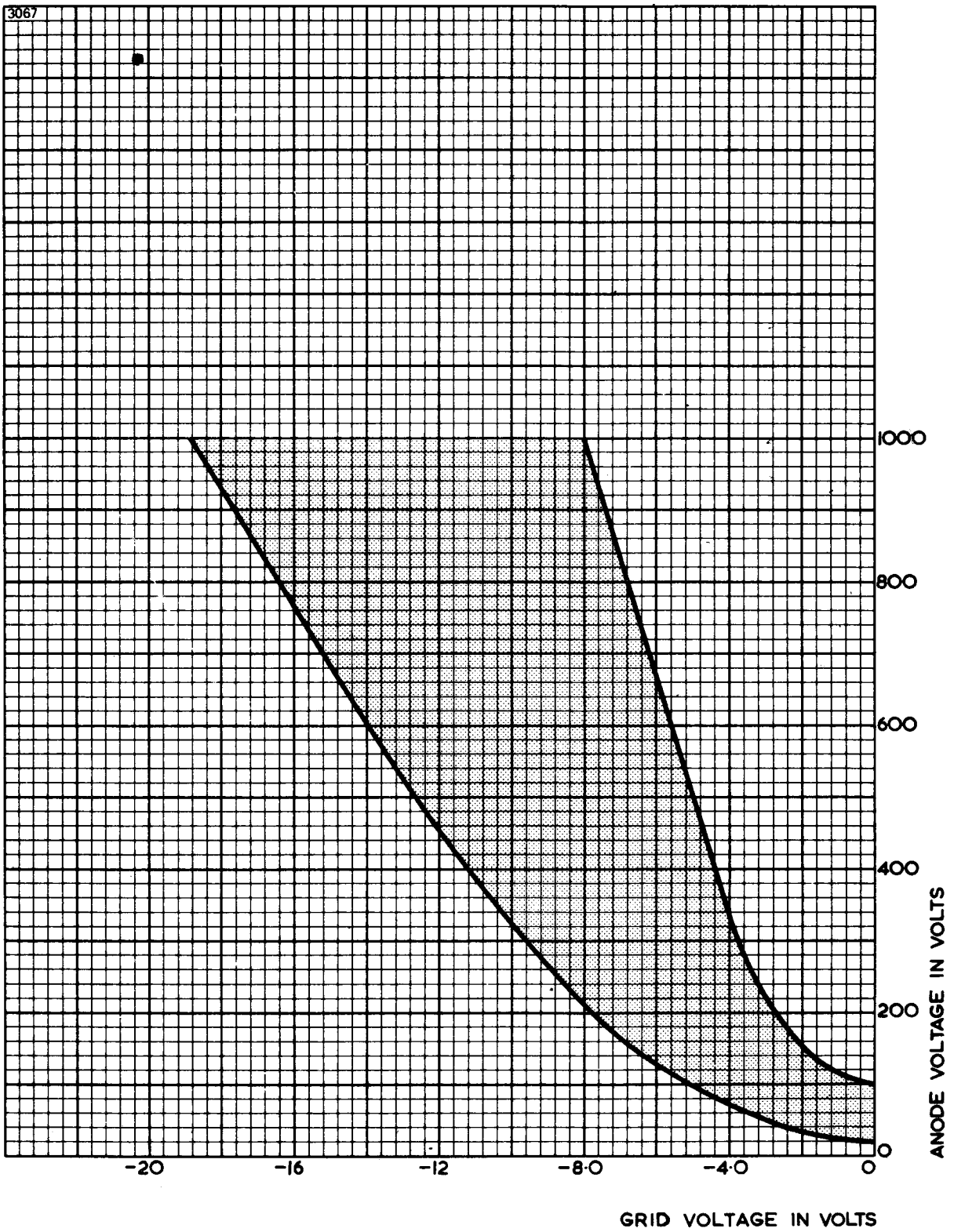
## CHARACTERISTICS

Voltage drop . . . . .	16	V approx
Ionisation time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	32	°C approx
at full load . . . . .	39	°C approx

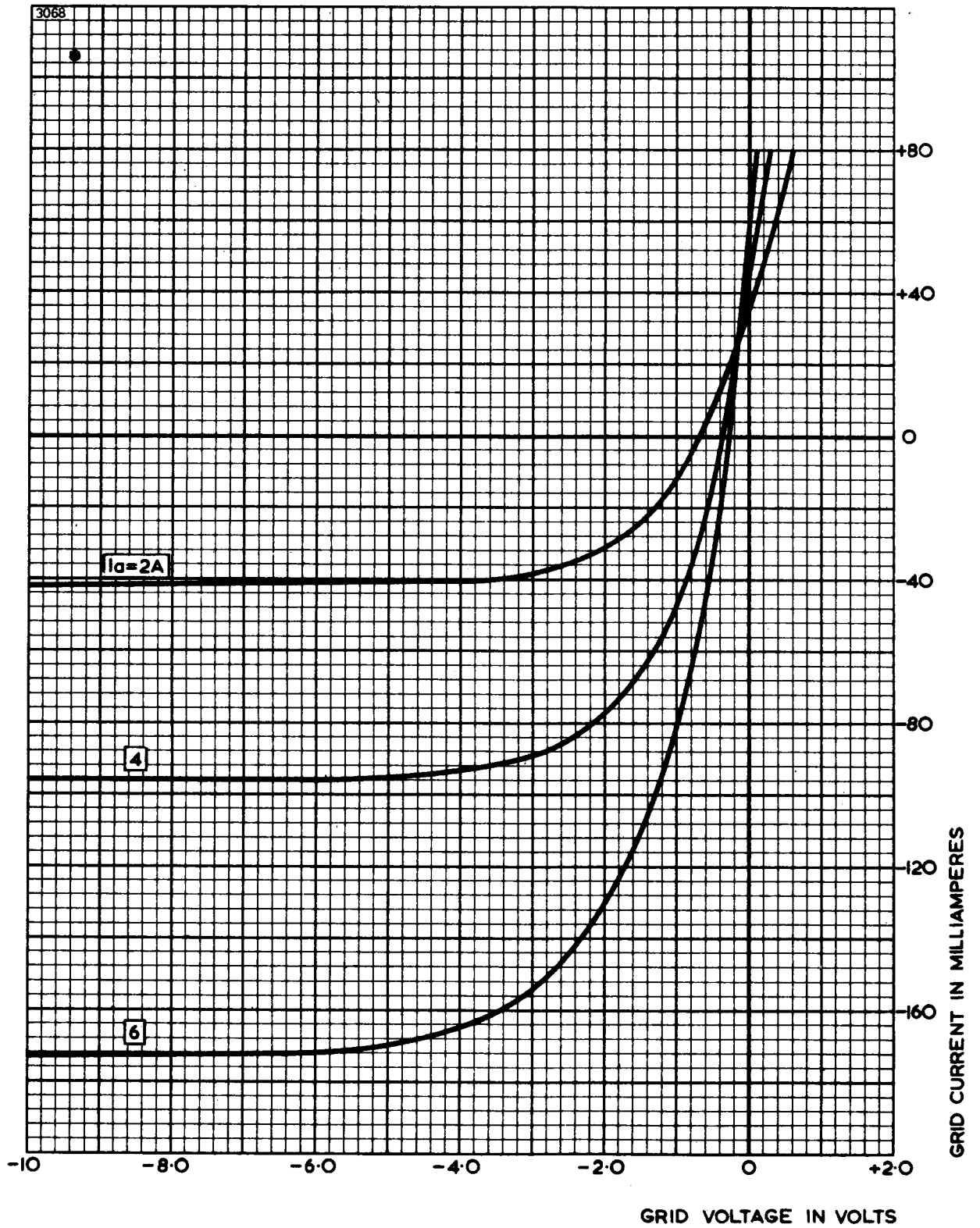
# TYPICAL HEATING CHARACTERISTIC



# CONTROL CHARACTERISTIC

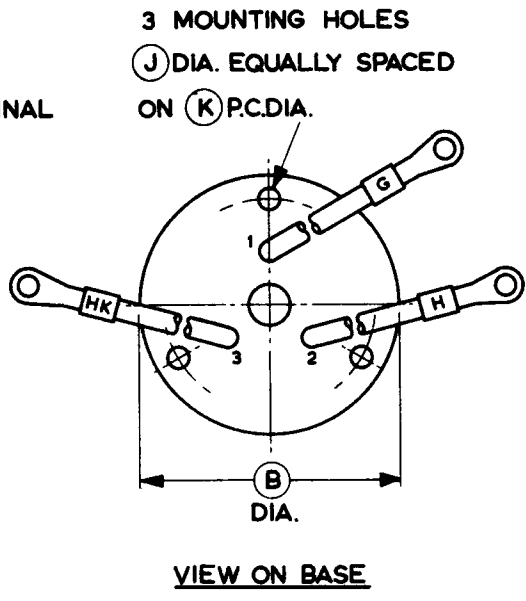
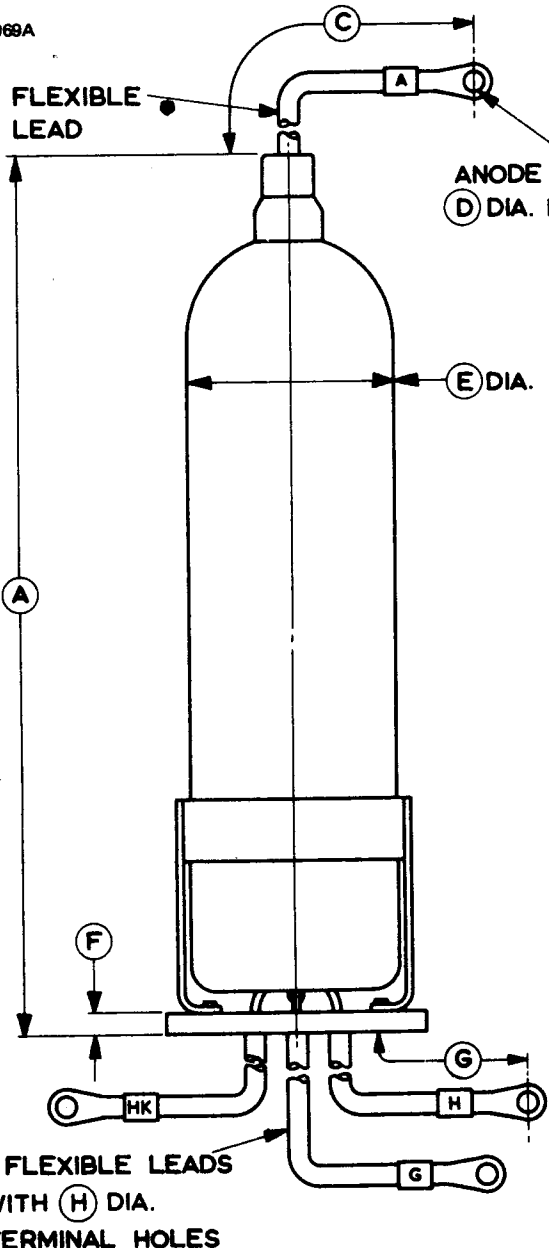


# TYPICAL GRID CURRENT CHARACTERISTICS



**OUTLINE (All dimensions without limits are nominal)**

3068A

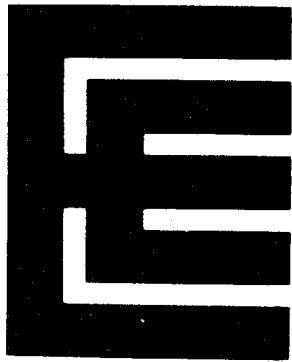


Lead	Colour	Element
1	Red	Grid
2	Green	Heater
3	Black	Heater, cathode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	10.000 ± 0.250	254.0 ± 6.4	F	0.250	6.35
B	3.157 max	80.19 max	G	7.500 ± 0.250	190.5 ± 6.4
C	6.500 ± 0.250	165.1 ± 6.4	H	0.266	6.76
D	0.265	6.73	J	0.250 ± 0.002	6.350 ± 0.051
E	2.500	63.5	K	2.625 ± 0.010	66.68 ± 0.25

Millimetre dimensions have been derived from inches.





## MERCURY VAPOUR THYRATRON

Service Type CV1144

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Mercury vapour thyatron for industrial control applications.

Peak forward anode voltage . . . . .	2.5	kV max
Peak inverse anode voltage . . . . .	2.5	kV max
Peak anode current . . . . .	2.0	A max
Average anode current . . . . .	0.5	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	2.5 V
Filament current . . . . .	5.0 A
Filament pre-heating time (minimum) . . . . .	10 s
Inter-electrode capacitances:	
grid to anode . . . . .	4.0 pF
grid to filament . . . . .	8.0 pF

#### Mechanical

Overall length . . . . .	6.250 inches (158.8mm) max
Overall diameter . . . . .	2.156 inches (54.76mm) max
Net weight . . . . .	3 ounces (85g) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	British 4-pin
Top cap . . . . .	B.S.448-CT2

<b>Cooling</b> . . . . .	natural
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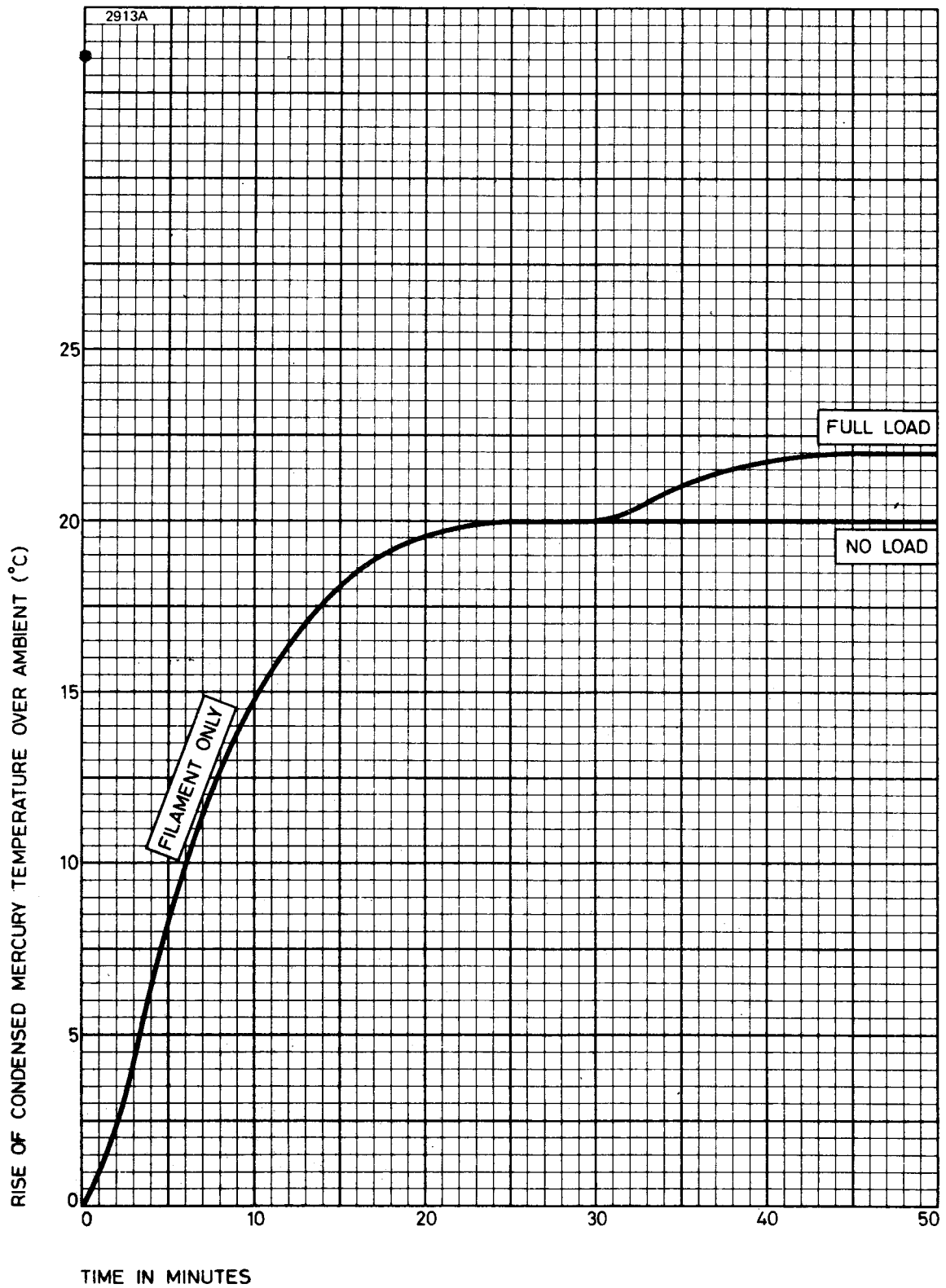
## MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Peak forward anode voltage . . . . .	—	2.5	kV
Peak inverse anode voltage . . . . .	—	2.5	kV
Peak anode current . . . . .	—	2.0	A
Average anode current (averaging time 15s max) . . . . .	—	0.5	A
Fault anode current (peak) . . . . .	—	40	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	35	70	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Average grid current . . . . .	—	50	mA
Recommended grid resistor . . . . .	10	220	kΩ
Filament pre-heating time . . . . .	10	—	s

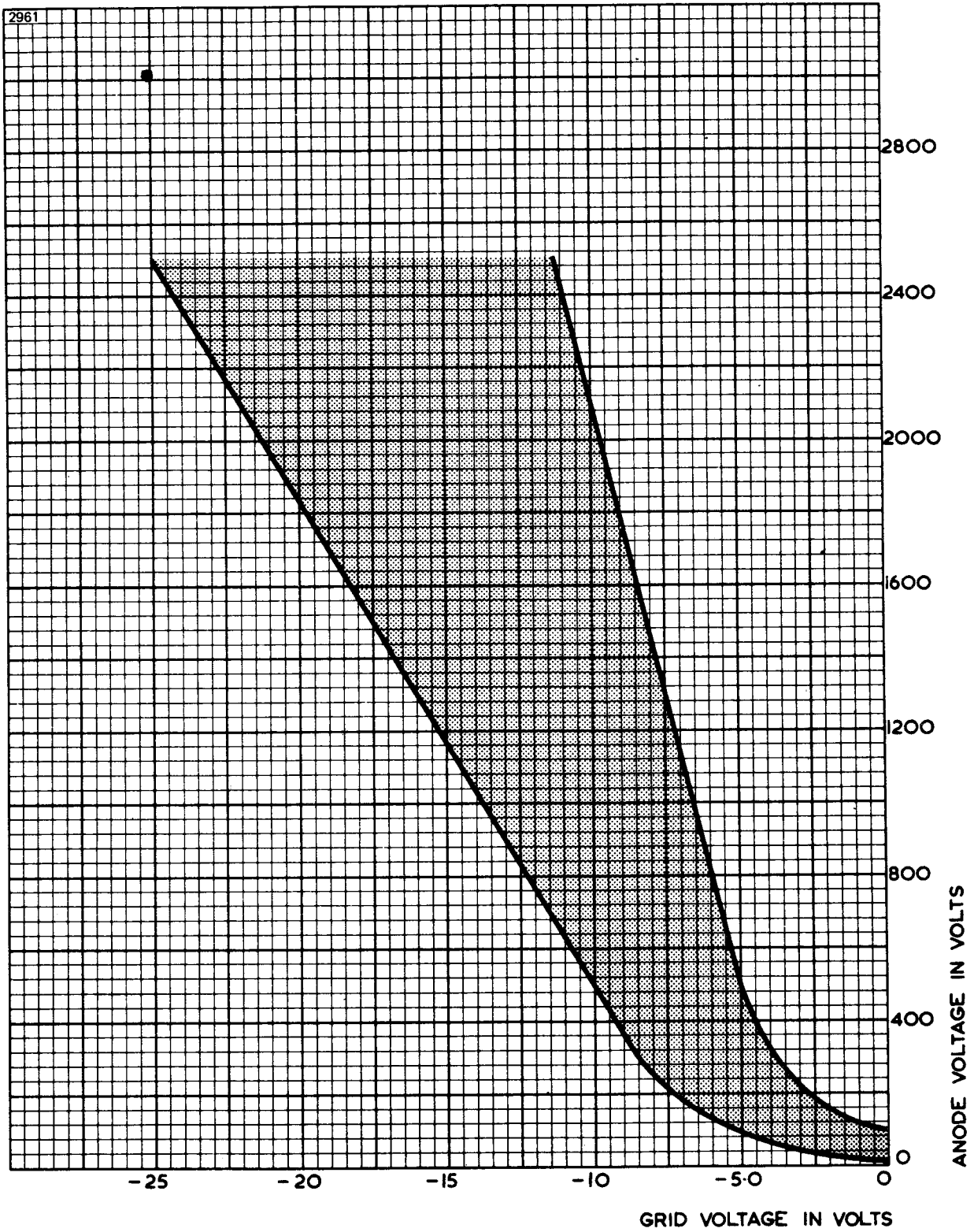
## CHARACTERISTICS

Voltage drop . . . . .	16	V approx
Ionisation time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	20	°C approx
at full load . . . . .	22	°C approx

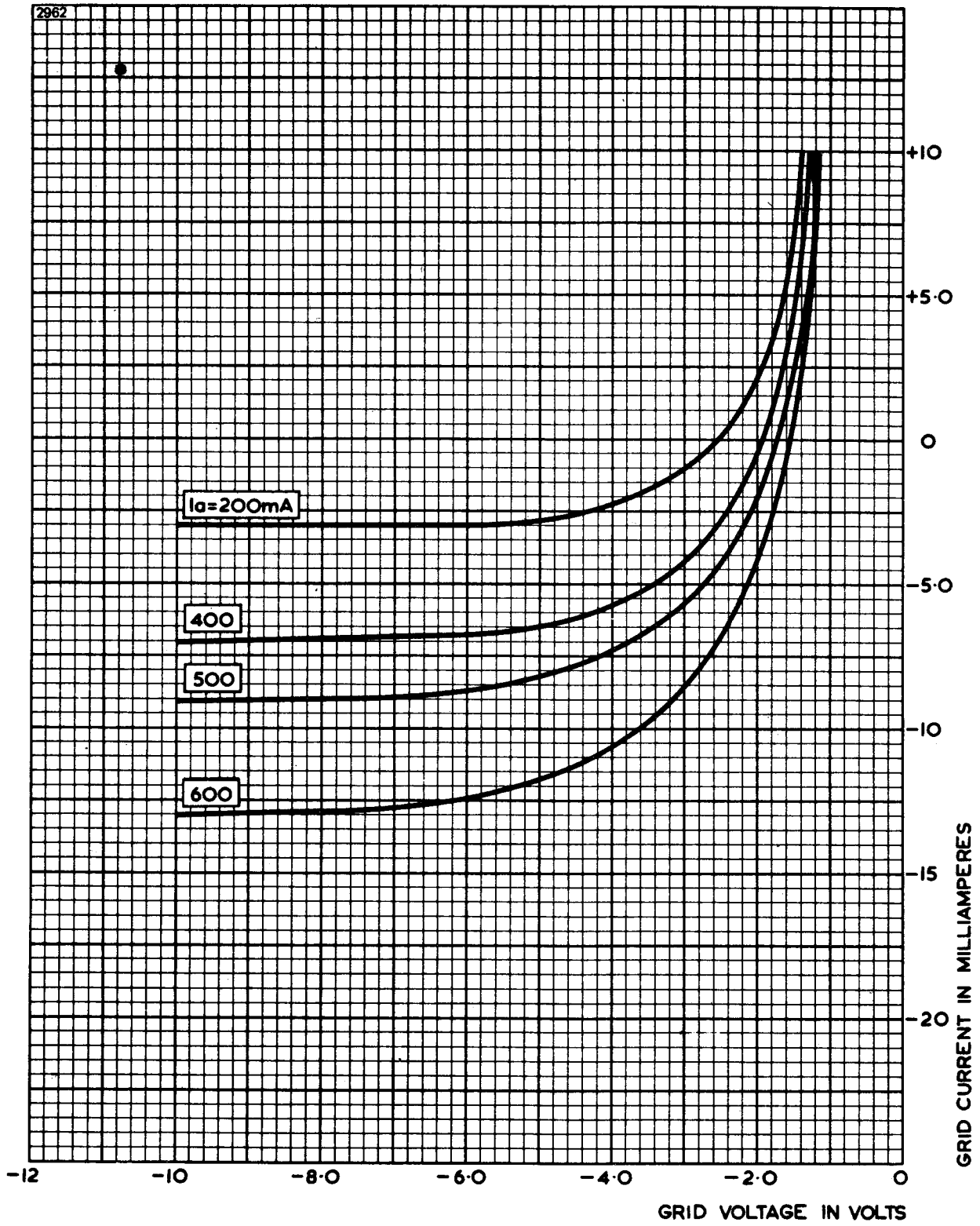
# TYPICAL HEATING CHARACTERISTIC



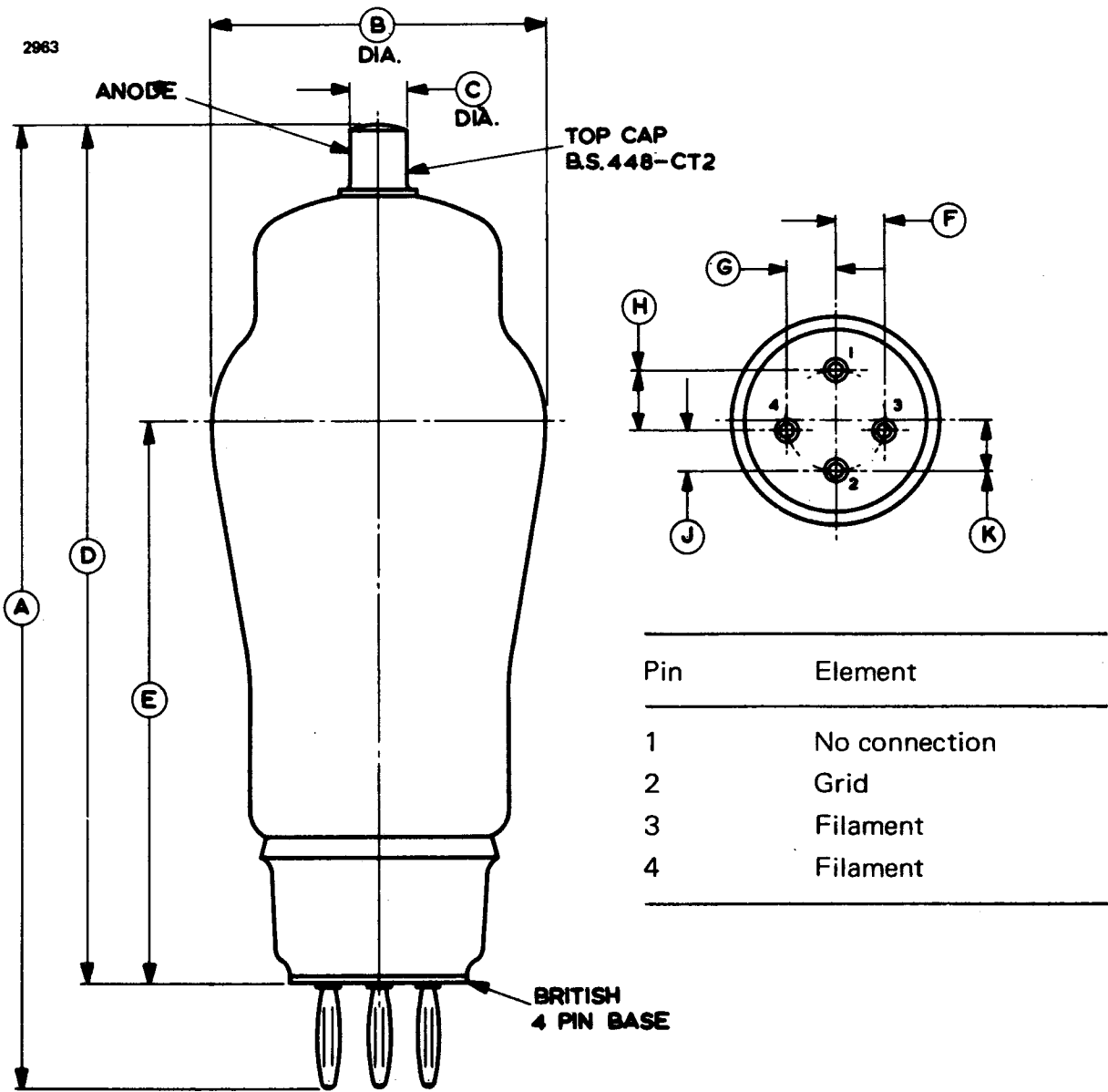
# CONTROL CHARACTERISTIC



# TYPICAL GRID CURRENT CHARACTERISTICS

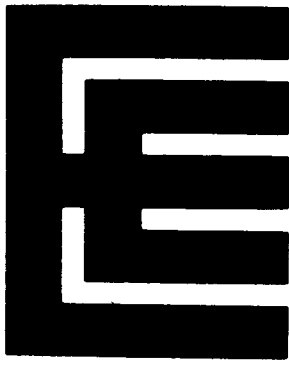


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	6.000 ± 0.250	152.4 ± 6.4	F*	0.315	8.00
B	2.125 ± 0.031	53.98 ± 0.79	G*	0.315	8.00
C	0.360	9.14	H*	0.400	10.15
D	5.375 ± 0.250	136.5 ± 6.4	J*	0.240	6.10
E	3.500	88.90	K*	0.320	8.13

Millimetre dimensions have been derived from inches except where indicated \*



**MERCURY VAPOUR  
THYRATRON**

To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Mercury vapour thyatron with shield grid, for industrial control applications.

Peak forward anode voltage . . . . .	2.0	kV max
Peak inverse anode voltage . . . . .	2.0	kV max
Peak anode current . . . . .	75	A max
Average anode current . . . . .	12.5	A max

**GENERAL**

**Electrical**

Cathode . . . . .	indirectly heated, oxide coated
Heater voltage . . . . .	5.0 V
Heater current . . . . .	20 A
Cathode pre-heating time (minimum) . . . . .	5.0 min
Inter-electrode capacitances:	
grid to anode . . . . .	4.0 pF
grid to cathode . . . . .	8.0 pF

**Mechanical**

Overall length (excluding flexible leads) . . . . .	14.312 inches (363.5mm) max
Overall diameter . . . . .	5.063 inches (128.6mm) max
Net weight . . . . .	2 pounds (0.9kg) approx
Mounting position . . . . .	vertical, base down
Connections . . . . .	flexible leads

<b>Cooling</b> . . . . .	natural
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## MAXIMUM AND MINIMUM RATINGS (Absolute values)

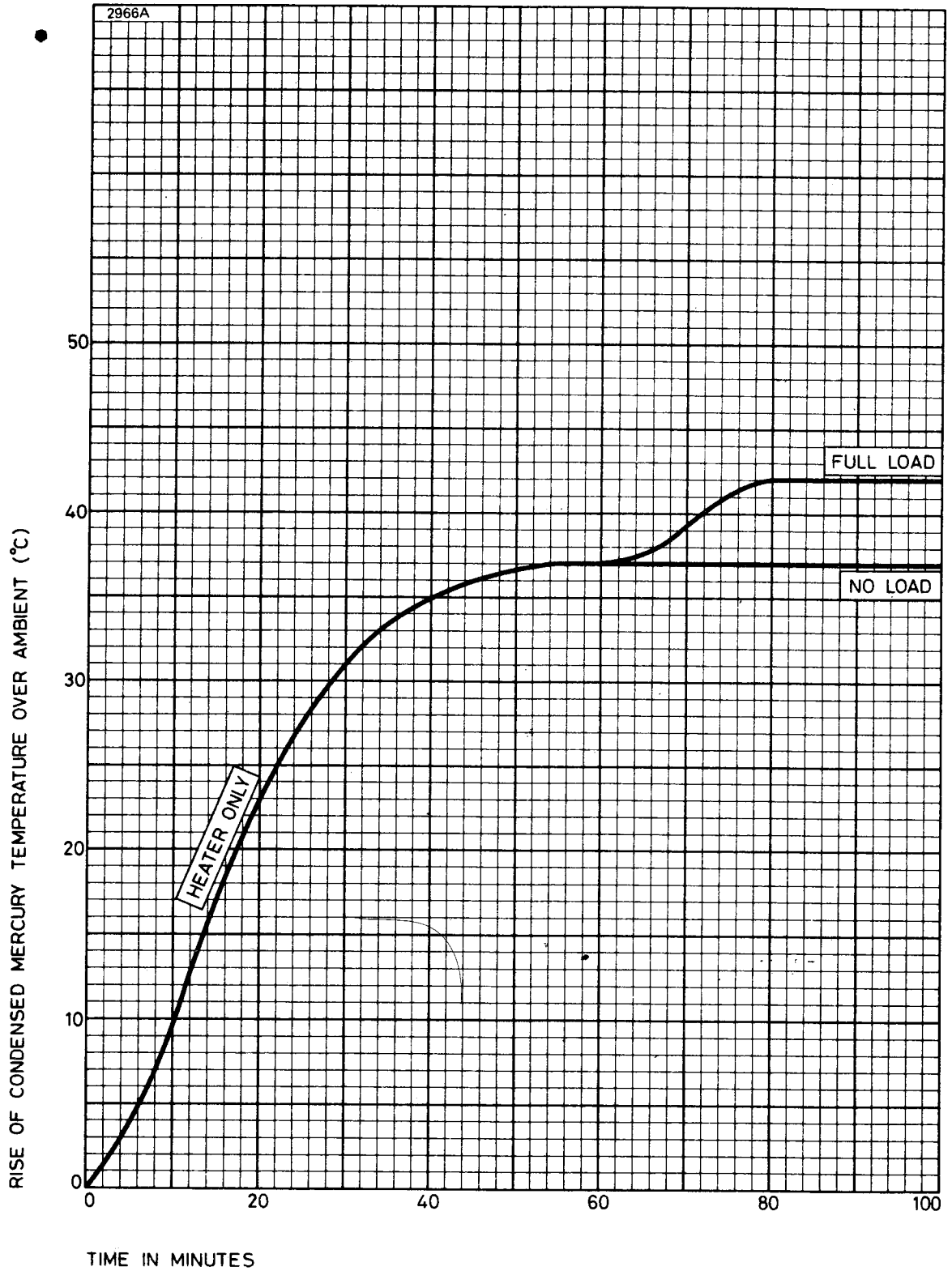
	Min	Max	
Peak forward anode voltage . . . . .	—	2.0	kV
Peak inverse anode voltage . . . . .	—	2.0	kV
Peak anode current . . . . .	—	75	A
Average anode current (averaging time 30s max) . . . . .	—	12.5	A
Fault anode current (peak) . . . . .	—	750	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	80	°C
Negative control grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Average control grid current . . . . .	—	250	mA
Recommended control grid resistor . . . . .	10	220	kΩ
Negative shield grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Average shield grid current . . . . .	—	500	mA
Shield grid resistor . . . . .	—	10	kΩ
Cathode pre-heating time . . . . .	5.0	—	min

## CHARACTERISTICS

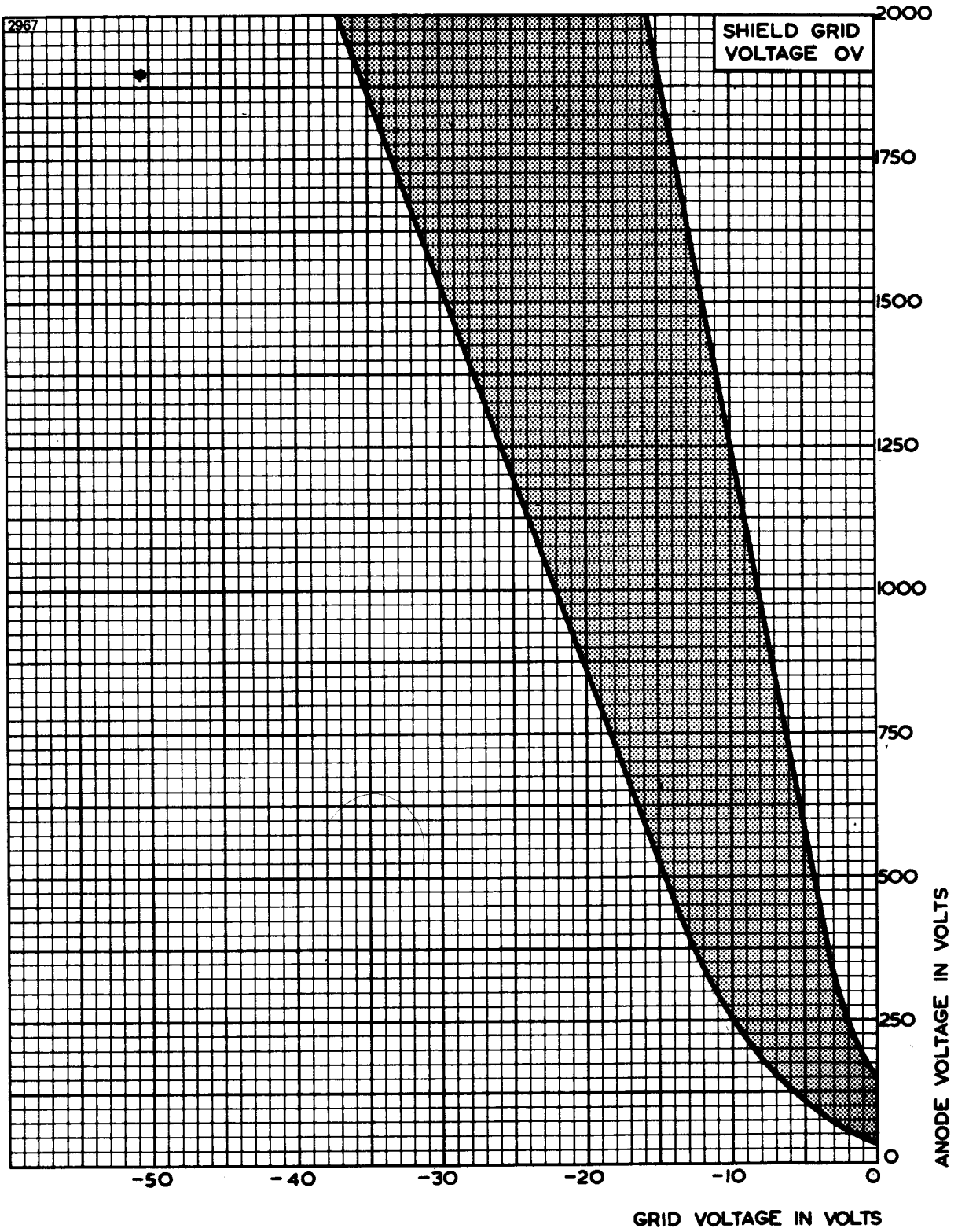
Voltage drop . . . . .	16	V approx
Ionisation time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	37	°C approx
at full load . . . . .	42	°C approx



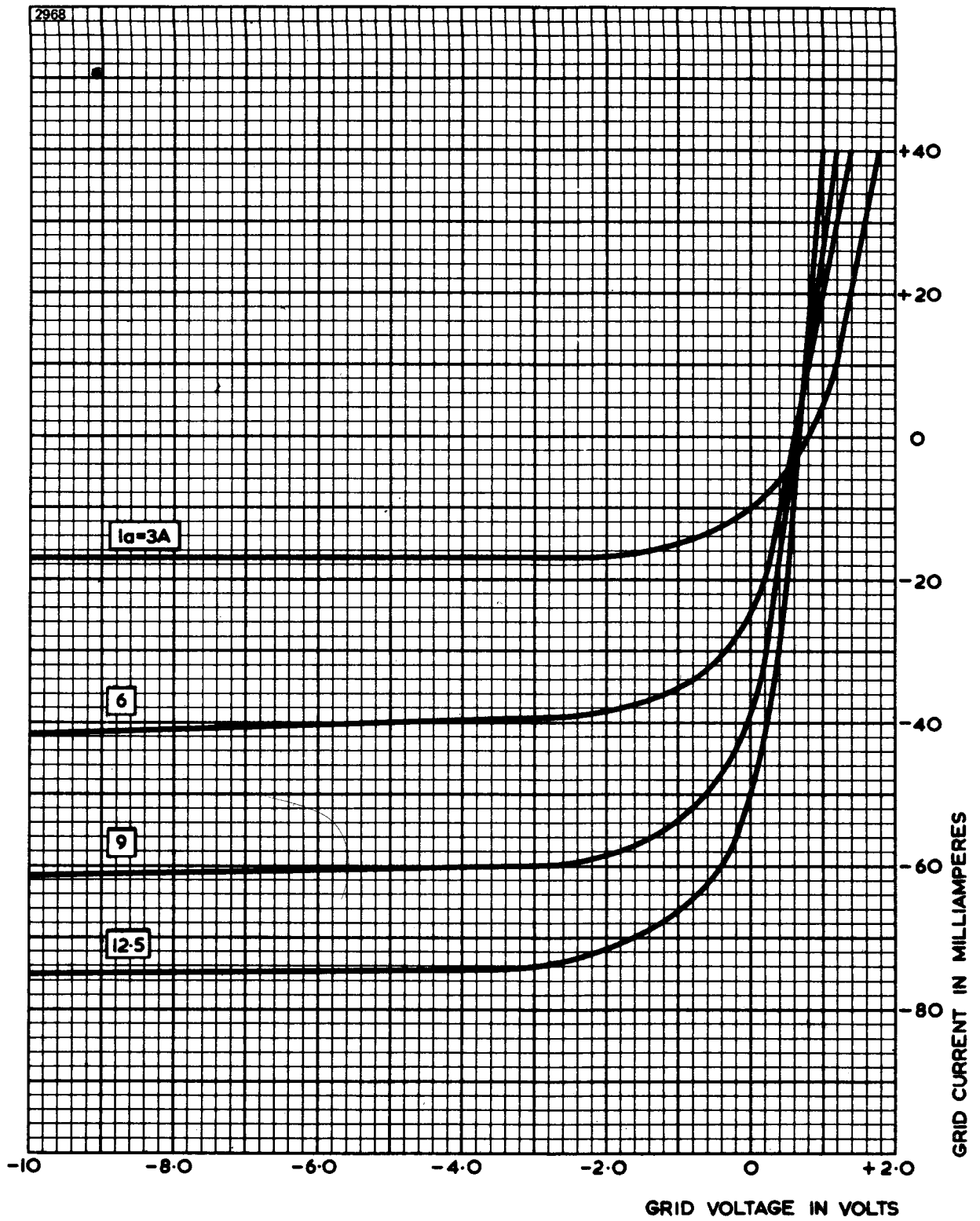
# TYPICAL HEATING CHARACTERISTIC



# CONTROL CHARACTERISTIC

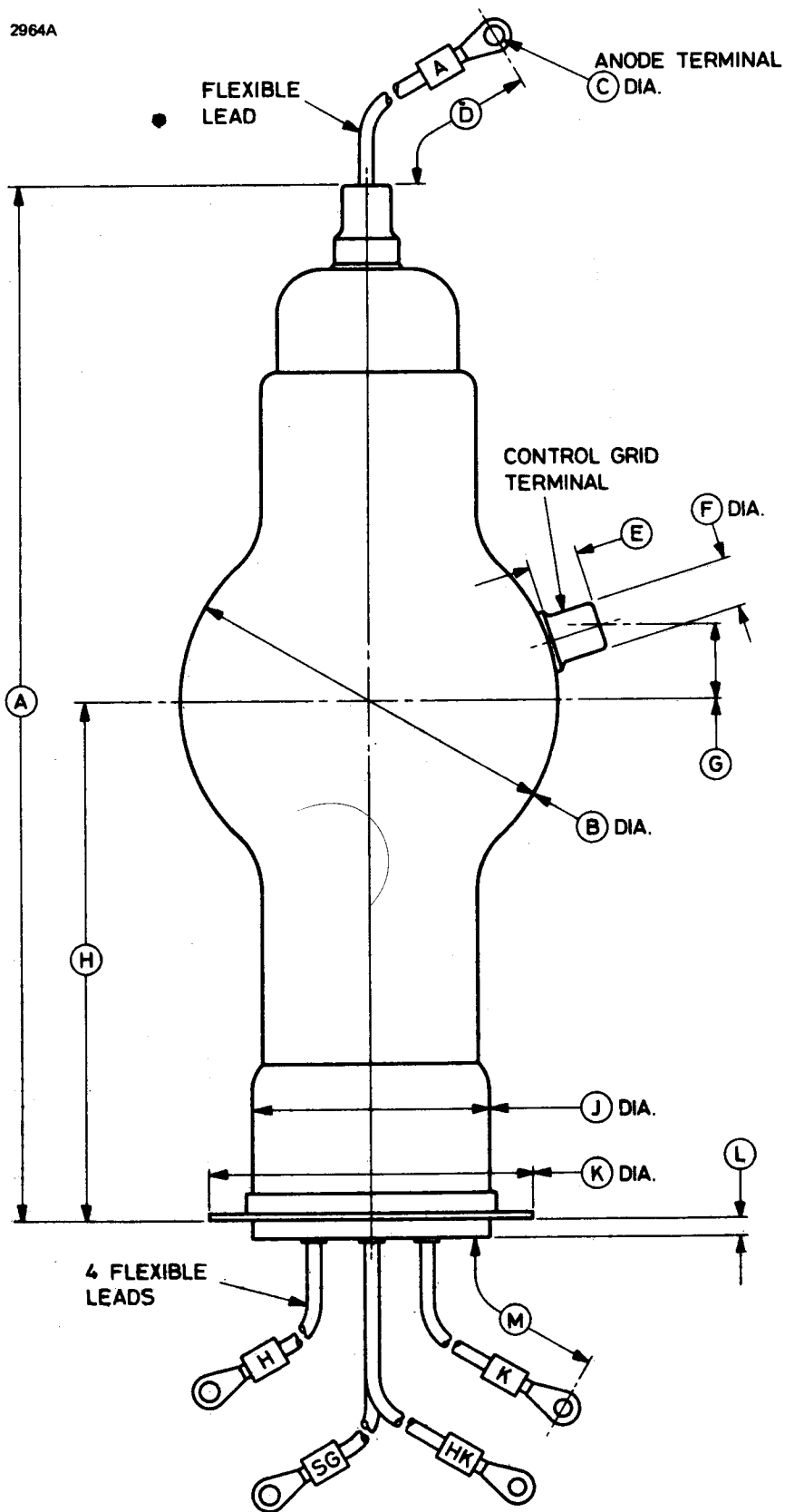


# TYPICAL GRID CURRENT CHARACTERISTICS

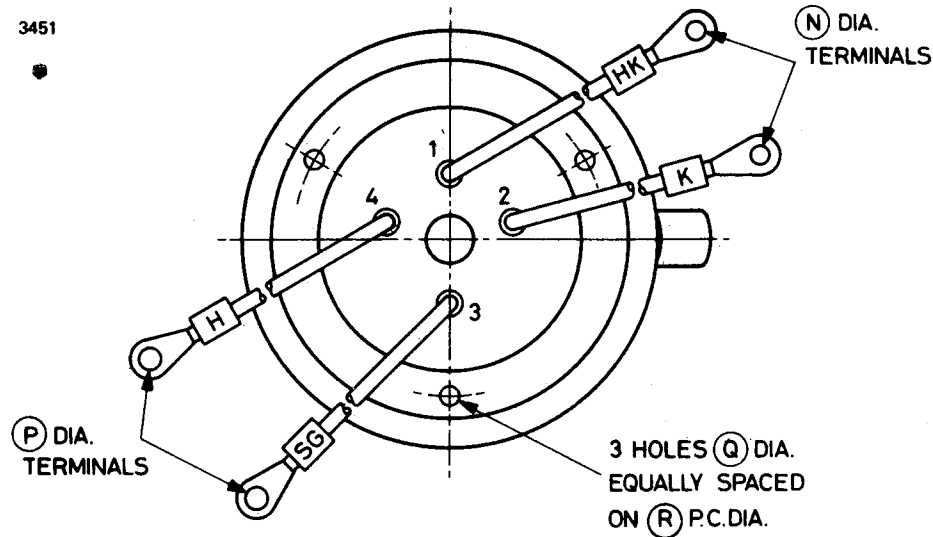


# OUTLINE

2964A



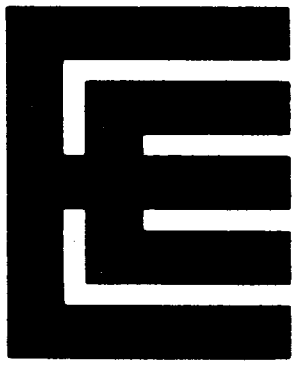
**OUTLINE (All dimensions without limits are nominal)**



Lead	Element
1	Heater and Cathode
2	Cathode
3	Shield Grid
4	Heater

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	13.750 ± 0.250	349.3 ± 6.4	J	3.188 max	80.98 max
B	5.063 max	128.6 max	K	4.281 max	108.7 max
C	0.265	6.73	L	0.250 ± 0.063	6.35 ± 1.60
D	7.000 ± 0.250	177.8 ± 6.4	M	7.000 ± 0.250	177.8 ± 6.4
E	0.420 min	10.67 min	N	0.200	5.08
F	0.641 ± 0.015	16.28 ± 0.38	P	0.265	6.73
G	1.000	25.40	Q	0.203 ± 0.002	5.156 ± 0.051
H	6.875 ± 0.250	174.6 ± 6.4	R	3.750 ± 0.010	95.25 ± 0.25

Millimetre dimensions have been derived from inches.



## MERCURY VAPOUR THYRATRON

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Mercury vapour thyatron for high voltage industrial control applications.

Peak forward anode voltage . . . . .	15	kV max
Peak inverse anode voltage . . . . .	15	kV max
Peak anode current . . . . .	75	A max
Average anode current . . . . .	12.5	A max

### GENERAL

#### Electrical

Cathode . . . . .	indirectly heated, oxide coated
Heater voltage . . . . .	5.0 V
Heater current . . . . .	20 A
Cathode pre-heating time (minimum) . . . . .	5.0 min
Inter-electrode capacitances:	
grid to anode . . . . .	7.0 pF
grid to cathode . . . . .	25 pF

#### Mechanical

Overall length (excluding flexible leads) . . . . .	15.750 inches (390.1mm) max
Overall diameter . . . . .	6.125 inches (155.6mm) max
Net weight . . . . .	2¼ pounds (1.0kg) approx
Mounting position . . . . .	vertical, base down
Connections . . . . .	flexible leads

**Cooling** . . . . . natural

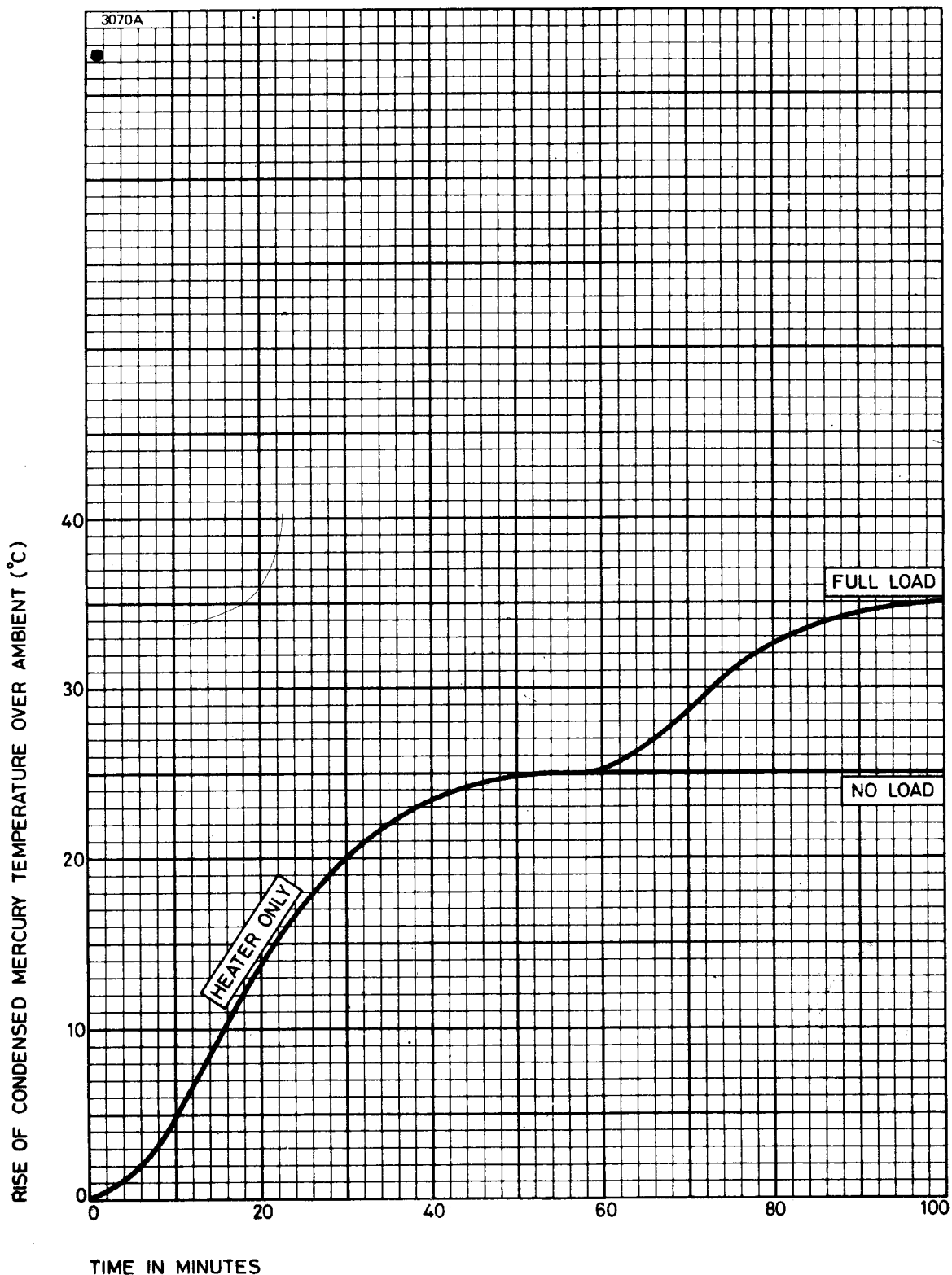
## MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Peak forward anode voltage . . . . .	—	15	kV
Peak inverse anode voltage . . . . .	—	15	kV
Peak anode current . . . . .	—	75	A
Average anode current (averaging time 30s max) . . . . .	—	12.5	A
Fault anode current (peak) . . . . .	—	750	A
Duration of fault current . . . . .	—	0.1	s
Condensed mercury temperature . . . . .	40	70	°C
Negative grid voltage:			
before conduction . . . . .	—	500	V
during conduction . . . . .	—	10	V
Average grid current . . . . .	—	250	mA
Recommended grid resistor . . . . .	5.0	20	kΩ
Cathode pre-heating time . . . . .	5.0	—	min

## CHARACTERISTICS

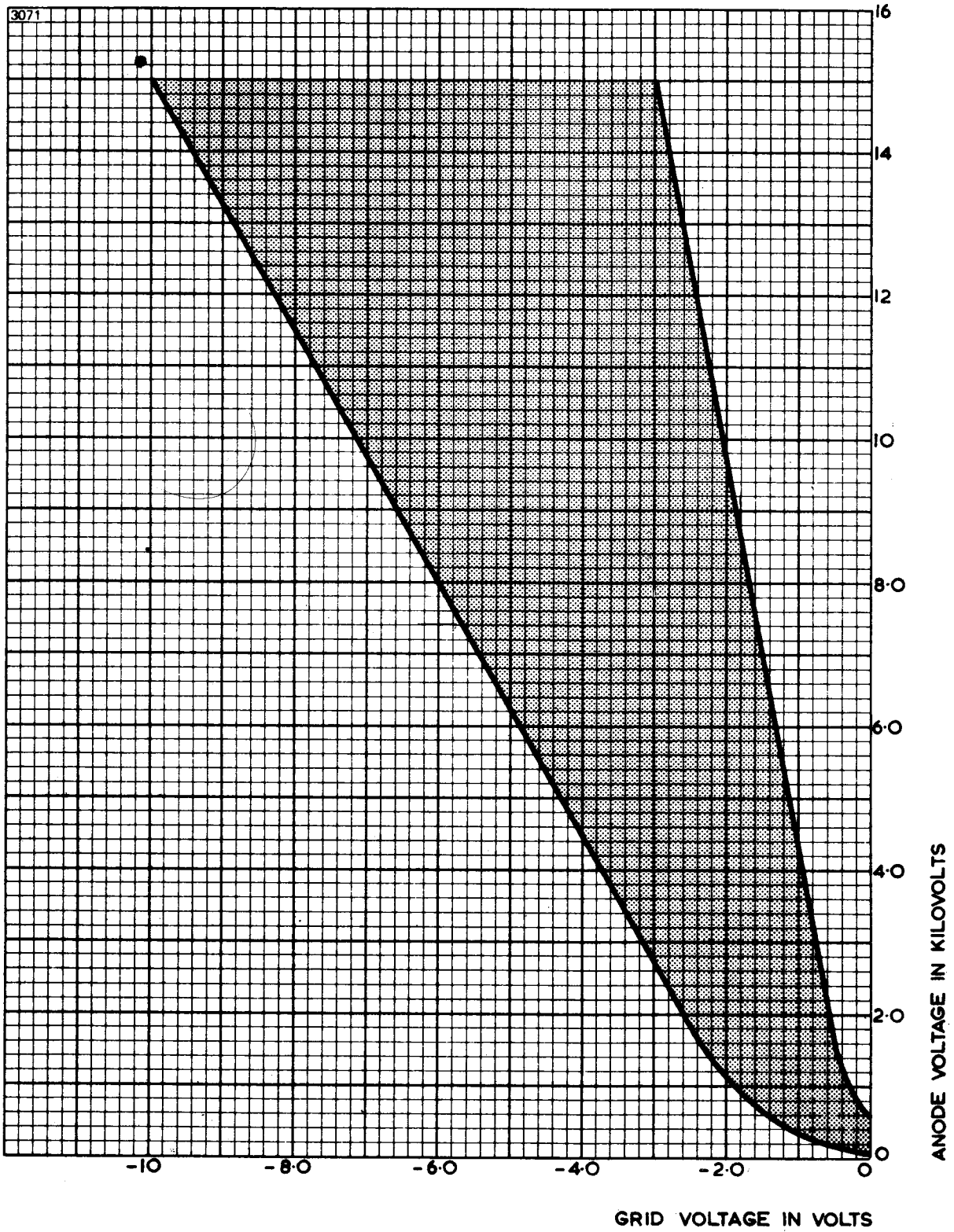
Voltage drop . . . . .	16	V approx
Ionisation time . . . . .	10	μs approx
Recovery time . . . . .	1.0	ms approx
Condensed mercury temperature rise:		
at no load . . . . .	25	°C approx
at full load . . . . .	35	°C approx

# TYPICAL HEATING CHARACTERISTIC

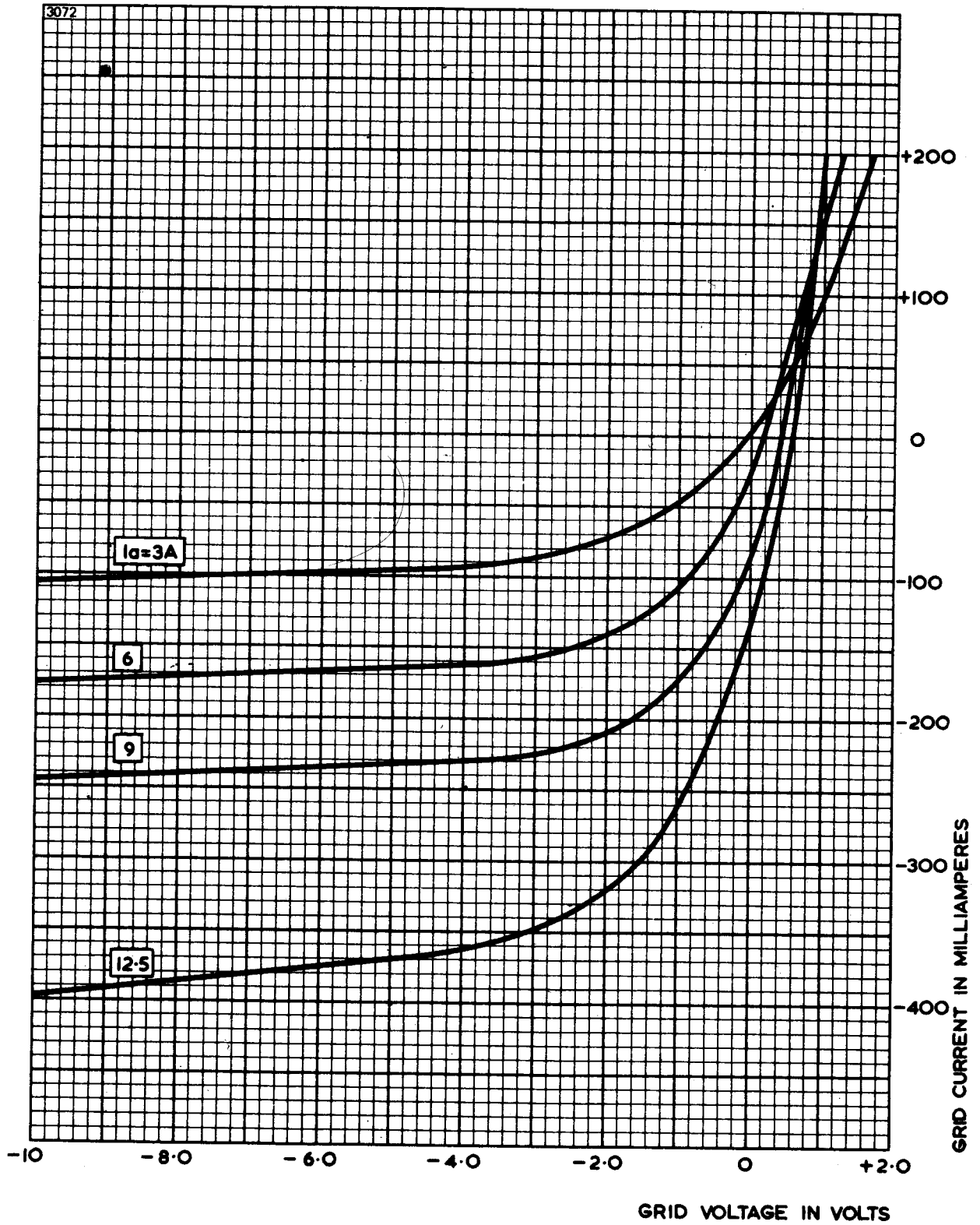




# CONTROL CHARACTERISTIC

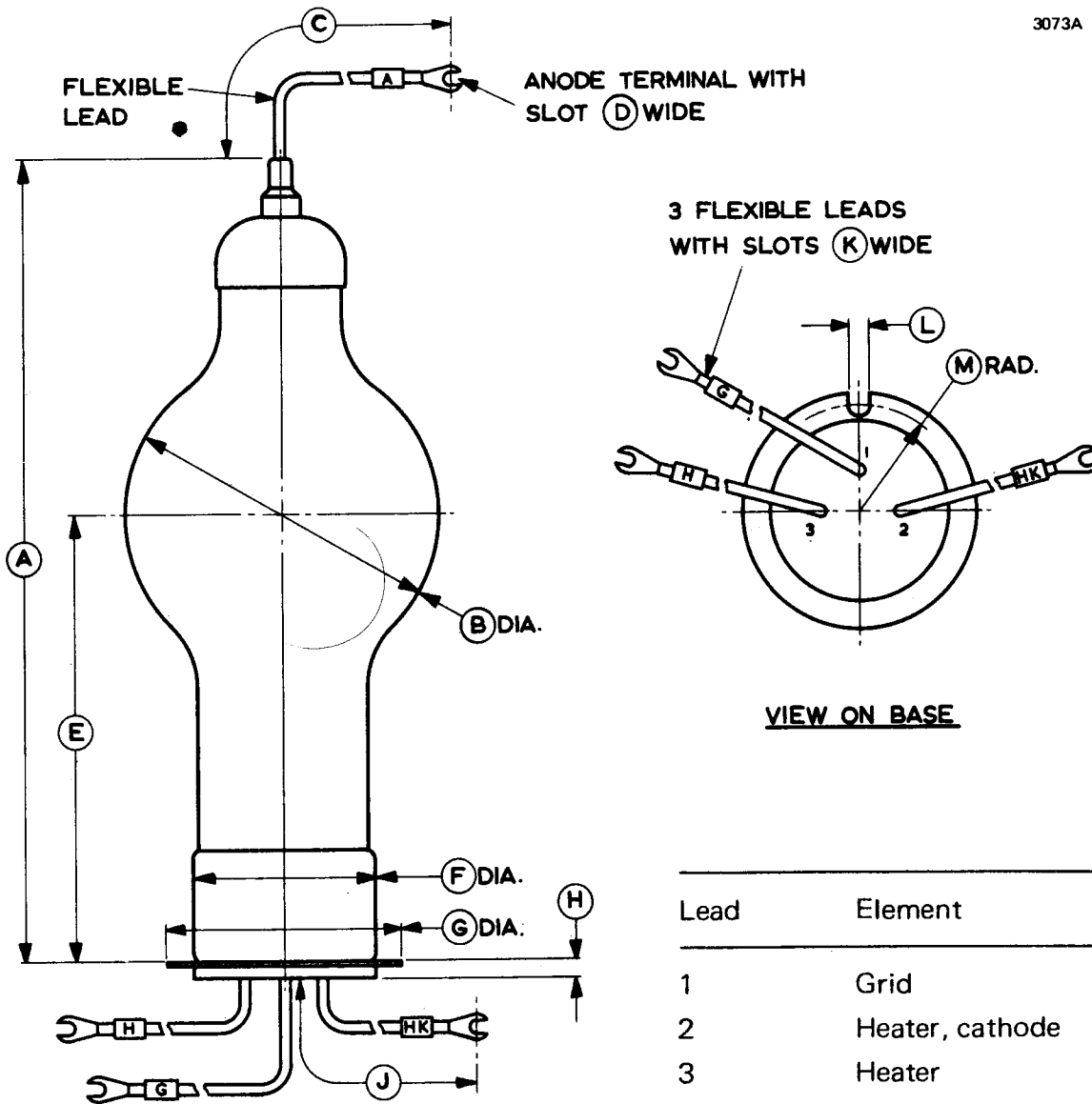


# TYPICAL GRID CURRENT CHARACTERISTICS



**OUTLINE (All dimensions without limits are nominal)**

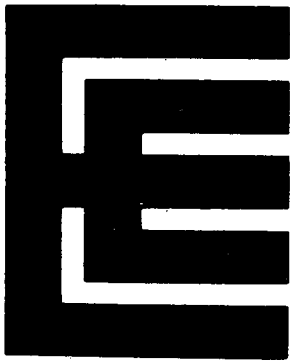
3073A



Lead	Element
1	Grid
2	Heater, cathode
3	Heater

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	15.125 ± 0.375	384.2 ± 9.5	G	4.563 max	115.9 max
B	6.125 max	155.6 max	H	0.250	6.35
C	5.875 ± 0.250	149.2 ± 6.4	J	6.500 ± 0.250	165.1 ± 6.4
D	0.265	6.73	K	0.265	6.73
E	8.375 ± 0.500	212.7 ± 12.7	L	0.344 ± 0.063	8.74 ± 1.60
F	3.500 max	88.90 max	M	2.000 ± 0.016	50.80 ± 0.41

Millimetre dimensions have been derived from inches.



**XENON FILLED  
THYRATRON**

**Service Type CV2109**

To be read in conjunction with the Rectifier and Thyatron Preamble.

**ABRIDGED DATA**

Xenon filled thyatron for industrial control applications.

Peak forward anode voltage . . . . .	1.0	kV max
Peak inverse anode voltage . . . . .	1.5	kV max
Peak anode current . . . . .	2.0	A max
Average anode current . . . . .	0.5	A max

**GENERAL**

**Electrical**

Filament . . . . .	oxide coated
Filament voltage . . . . .	2.5 V
Filament current . . . . .	5.0 A
Filament pre-heating time (minimum) . . . . .	10 s
Inter-electrode capacitances:	
grid to anode . . . . .	4.0 pF
grid to filament . . . . .	10 pF

**Mechanical**

Overall length . . . . .	4.875 inches (123.8mm) max
Overall diameter . . . . .	1.560 inches (39.6mm) max
Net weight . . . . .	2 ounces (60g) approx
Mounting position . . . . .	any
Base . . . . .	British 4-pin
Top cap . . . . .	B.S.448-CT2

**Cooling** . . . . . natural

## MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Peak forward anode voltage . . . . .	—	1.0	kV
Peak inverse anode voltage . . . . .	—	1.5	kV
Peak anode current . . . . .	—	2.0	A
Average anode current (averaging time 15s max) . . . . .	—	0.5	A
Fault anode current (peak) . . . . .	—	40	A
Duration of fault current . . . . .	—	0.1	s
Ambient temperature . . . . .	-55	+70	°C
Negative grid voltage:			
before conduction . . . . .	—	250	V
during conduction . . . . .	—	10	V
Average grid current . . . . .	—	50	mA
Recommended grid resistor . . . . .	10	100	kΩ
Commutation factor (see note) . . . . .	—	10	
Filament pre-heating time . . . . .	10	—	s

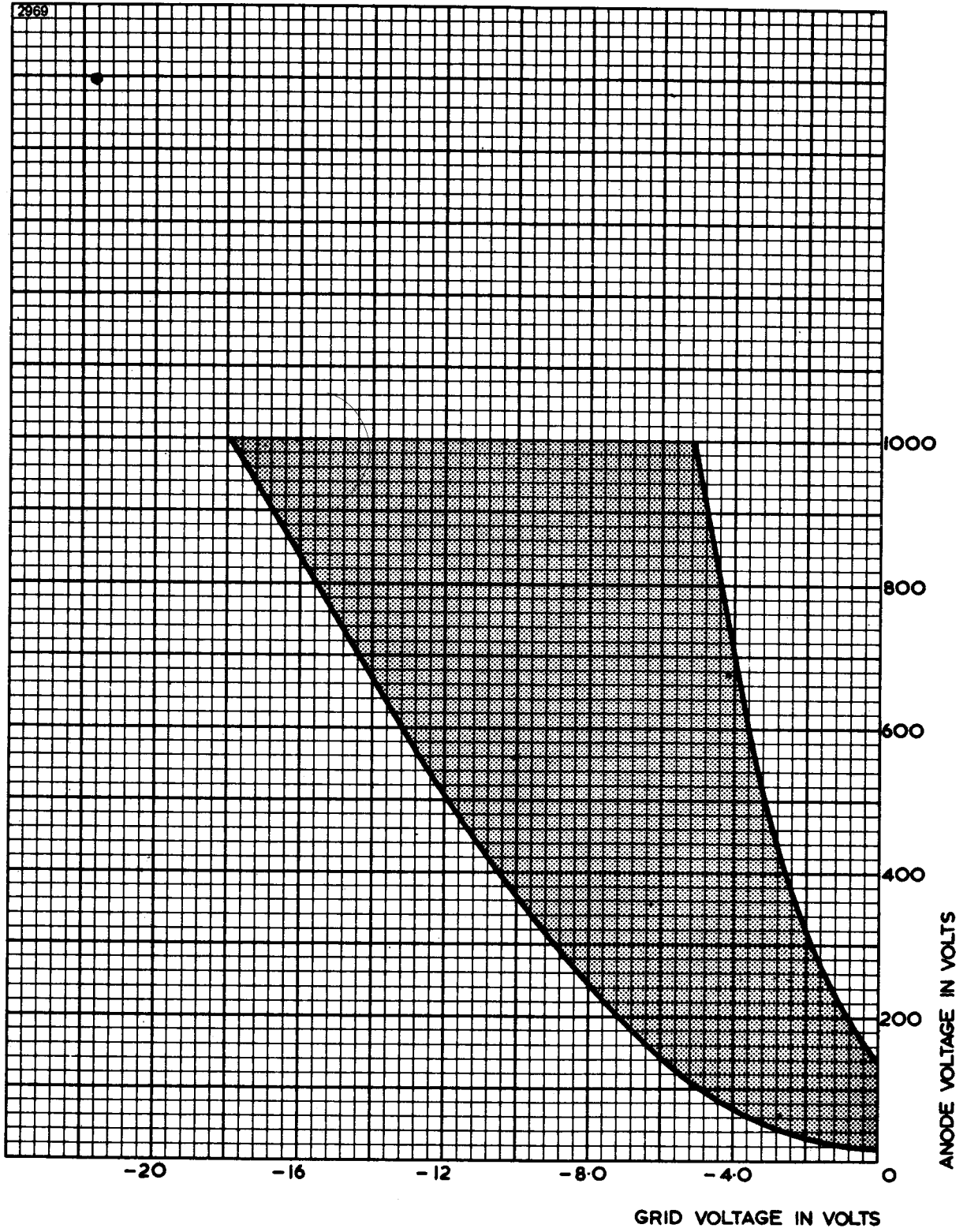
## CHARACTERISTICS

Voltage drop . . . . .	12	V approx
Ionisation time . . . . .	10	μs approx
Recovery time . . . . .	500	μs approx

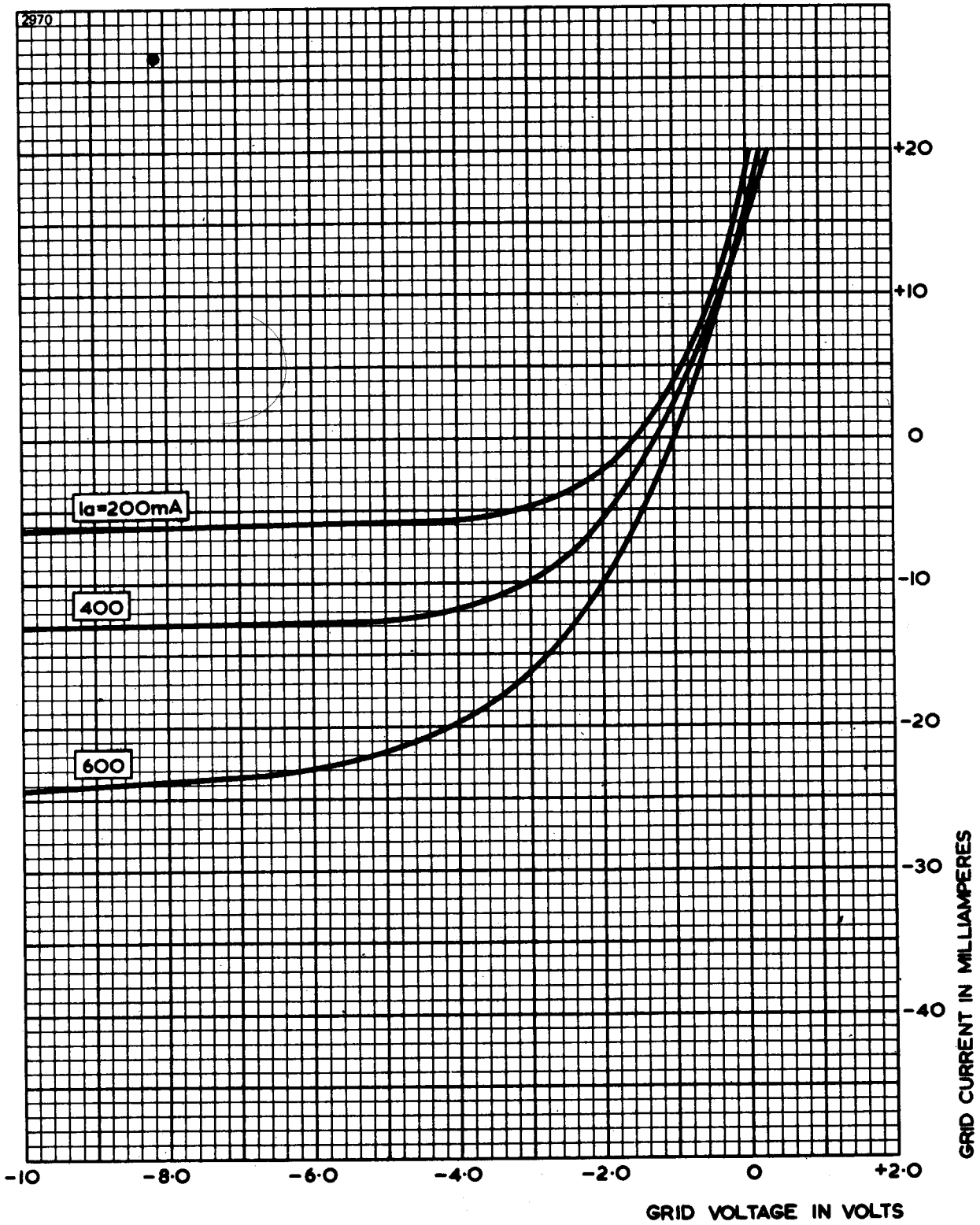
### Note

The product of the rate of decrease of anode current in amperes per microsecond immediately prior to current extinction and the rate of increase of inverse voltage in volts per microsecond immediately after current extinction.

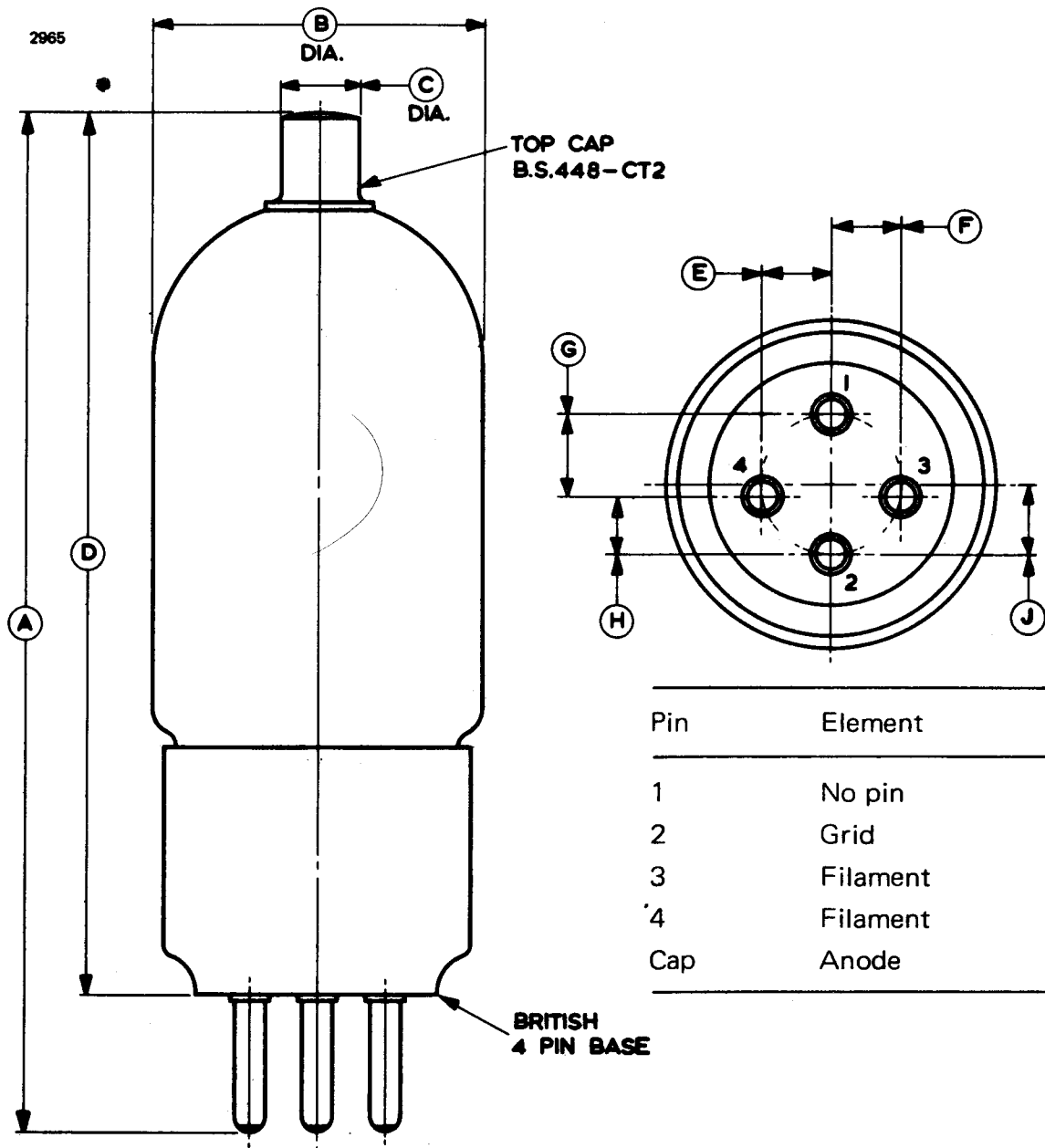
# CONTROL CHARACTERISTIC



# TYPICAL GRID CURRENT CHARACTERISTICS



**OUTLINE (All dimensions without limits are nominal)**

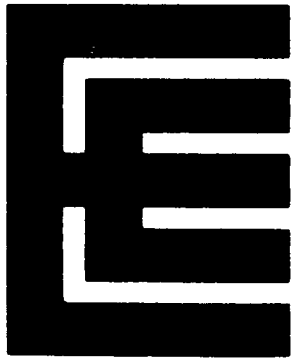


Pin	Element
1	No pin
2	Grid
3	Filament
4	Filament
Cap	Anode

Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	4.625 ± 0.250	117.5 ± 6.4	F*	0.315	8.00
B	1.560 max	39.62 max	G*	0.400	10.15
C	0.360	9.14	H*	0.240	6.10
D	4.000 ± 0.250	101.6 ± 6.4	J*	0.320	8.13
E*	0.315	8.00			

Millimetre dimensions have been derived from inches except where indicated \*





## MERCURY VAPOUR THYRATRON

### Service Type CV5141

To be read in conjunction with the Rectifier and Thyatron Preamble.

### ABRIDGED DATA

Mercury vapour thyatron for high voltage industrial control applications.

Peak forward anode voltage . . . . .	15	kV max
Peak inverse anode voltage . . . . .	15	kV max
Peak anode current . . . . .	12	A max
Average anode current . . . . .	1.5	A max

### GENERAL

#### Electrical

Filament . . . . .	oxide coated
Filament voltage . . . . .	2.5 V
Filament current . . . . .	20 A
Filament pre-heating time (minimum) . . . . .	5.0 min
Inter-electrode capacitances:	
grid to anode . . . . .	8.0 pF
grid to filament . . . . .	18 pF

#### Mechanical

Overall length (excluding flexible leads) . . . . .	11.000 inches (279.4mm) max
Overall width . . . . .	4.000 inches (101.6mm) nom
Net weight . . . . .	1 pound (0.5kg) approx
Mounting position . . . . .	vertical, base down
Base . . . . .	flying leads
Top cap . . . . .	see outline

<b>Cooling</b> . . . . .	natural
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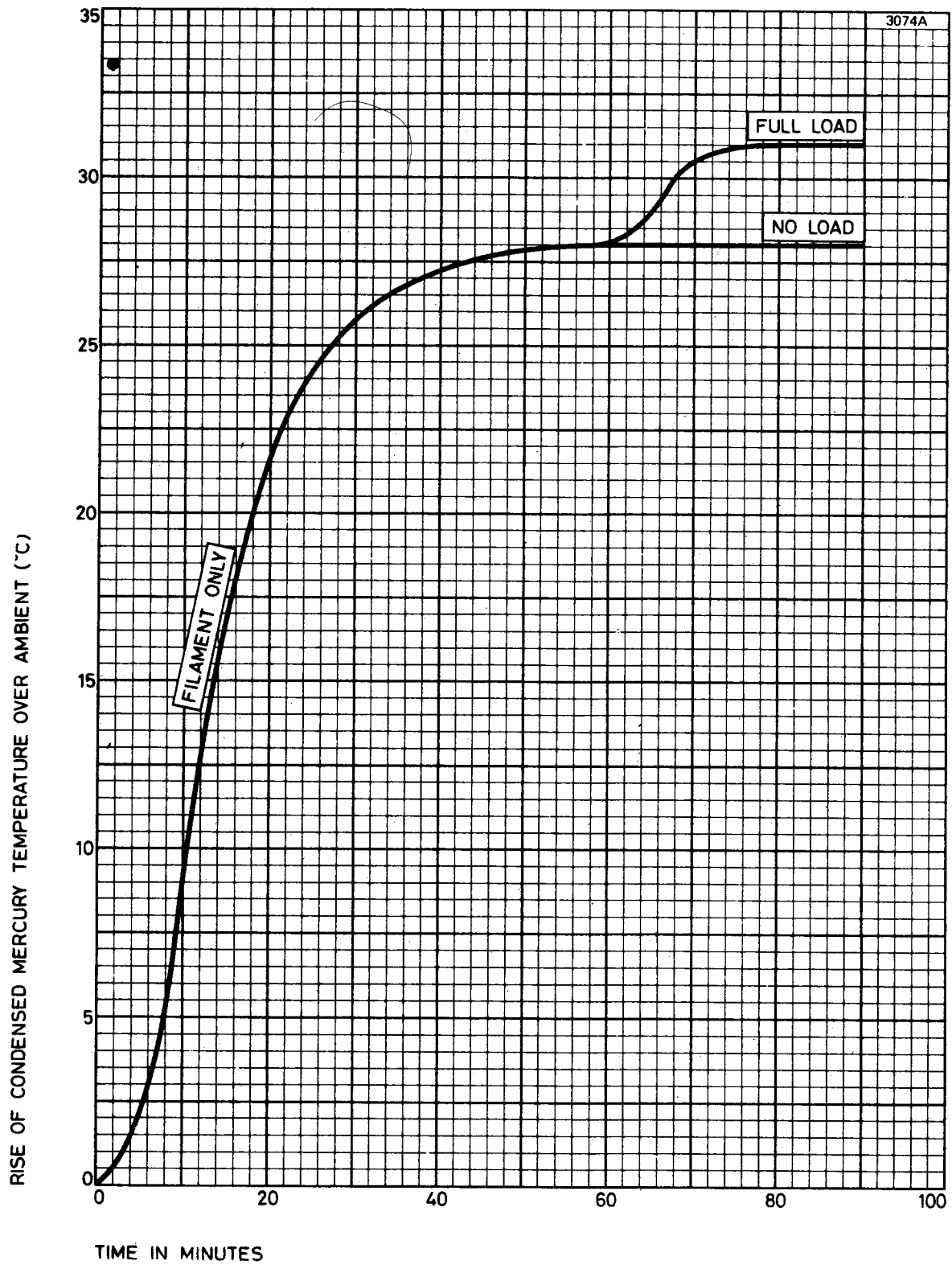
## MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	Min	Max	
Peak forward anode voltage . . . . .	—	10	—	15	kV
Peak inverse anode voltage . . . . .	—	10	—	15	kV
Peak anode current . . . . .	—	16	—	12	A
Average anode current (averaging time 15s max) . . . . .	—	2.0	—	1.5	A
Fault anode current (peak) . . . . .	—	200	—	200	A
Duration of fault current . . . . .	—	0.1	—	0.1	s
Condensed mercury temperature . . . . .	40	75	40	70	°C
Negative grid voltage:					
before conduction . . . . .			—	500	V
during conduction . . . . .			—	10	V
Average grid current . . . . .			—	250	mA
Recommended grid resistor . . . . .			5.0	50	kΩ
Filament pre-heating time . . . . .			5.0	—	min

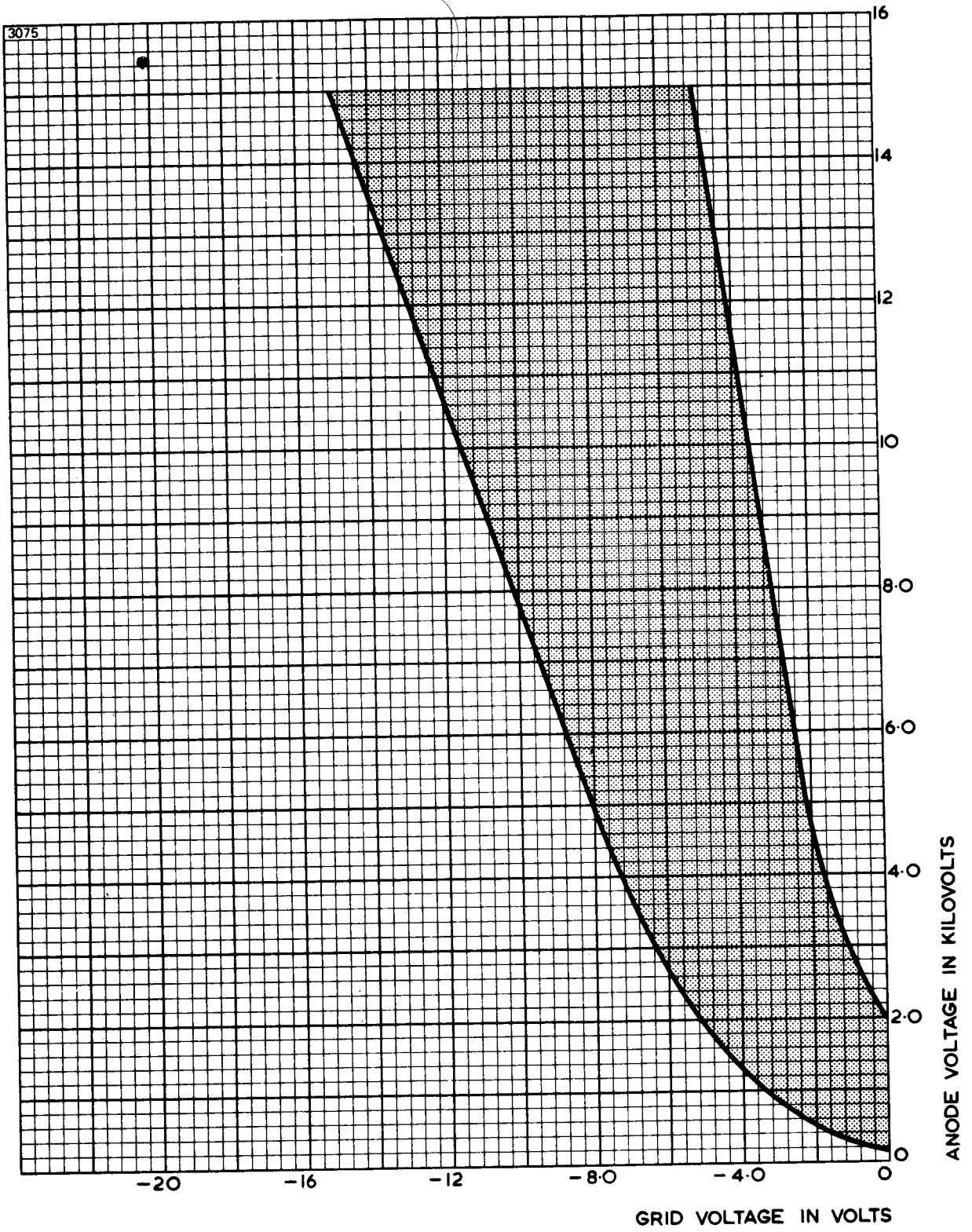
## CHARACTERISTICS

Voltage drop (approx) . . . . .	16	V
Ionization time (approx) . . . . .	10	μs
Recovery time (approx) . . . . .	1.0	ms
Condensed mercury temperature rise:		
at no load (approx) . . . . .	28	°C
at full load (approx) . . . . .	31	°C

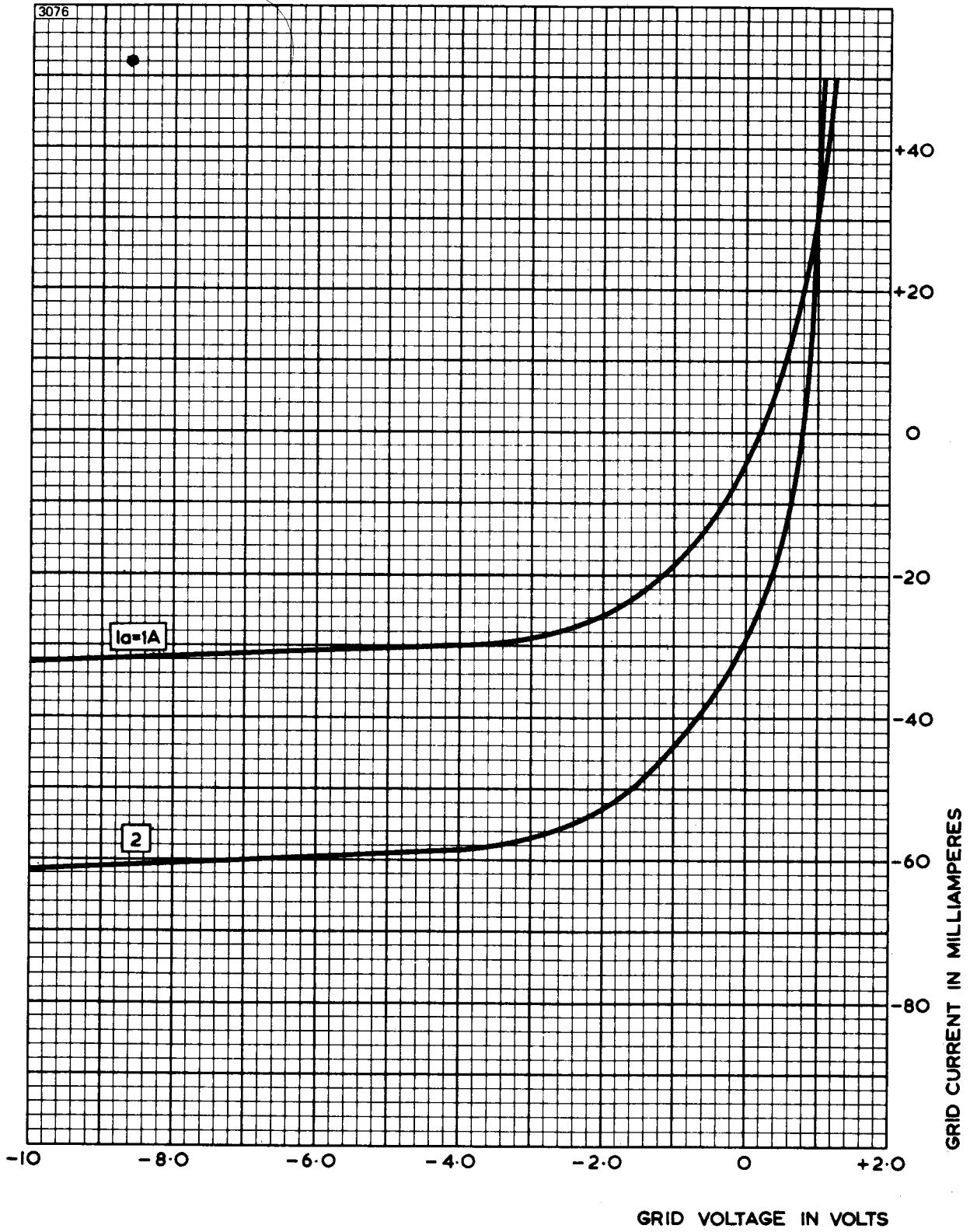
# TYPICAL HEATING CHARACTERISTIC



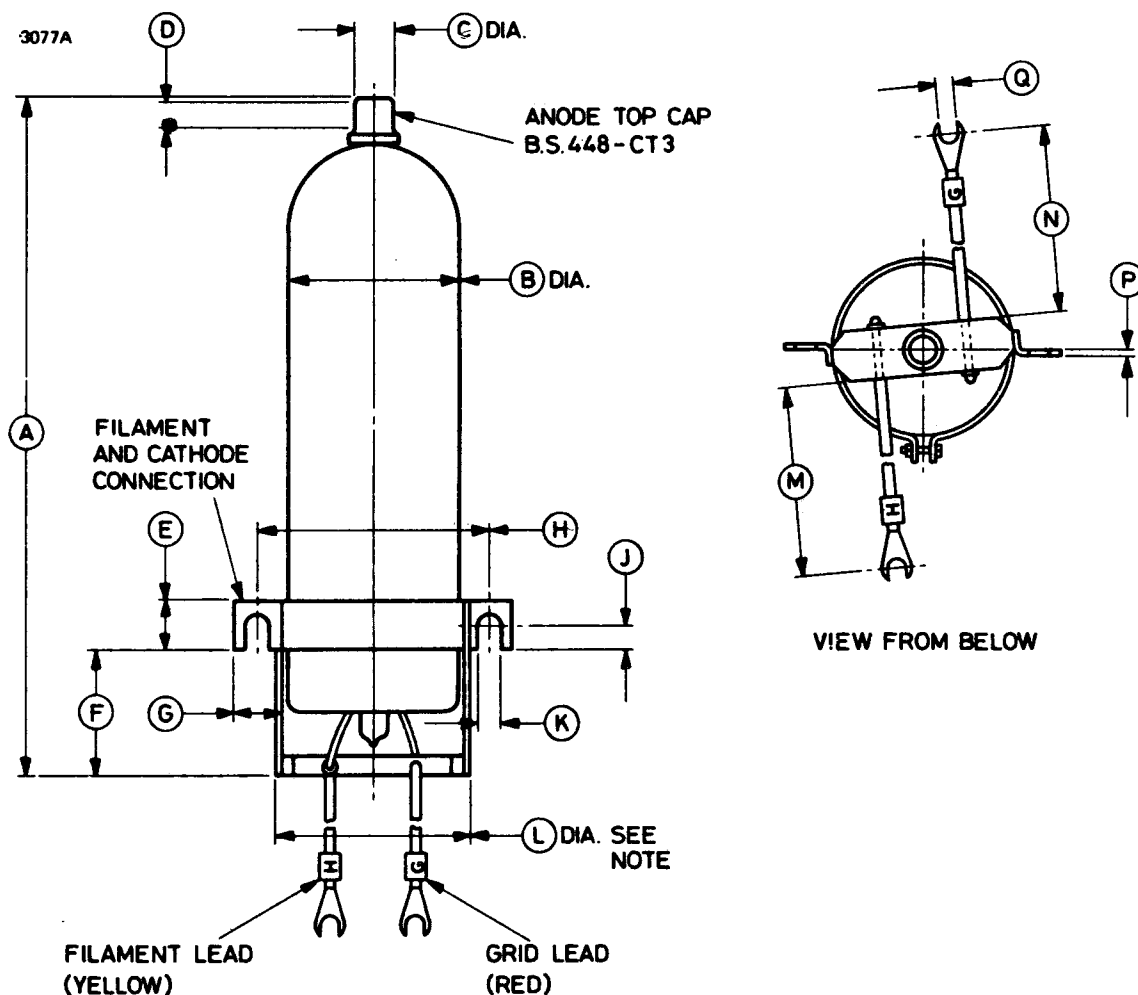
# CONTROL CHARACTERISTIC



# TYPICAL GRID CURRENT CHARACTERISTICS



**OUTLINE (All dimensions without limits are nominal)**

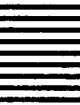


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	9.750 ± 0.500	247.7 ± 12.7	J	0.375	9.53
B	2.500	63.50	K	0.250	6.35
C	0.566 ± 0.015	14.38 ± 0.38	L	2.875	73.03
D	0.380 min	9.65 min	M	4.312 ± 0.250	109.5 ± 6.4
E	0.750 ± 0.031	19.05 ± 0.79	N	4.562 ± 0.250	115.9 ± 6.4
F	1.750	44.45	P	0.080	2.03
G	0.750	19.05	Q	0.265	6.73
H	3.406 ± 0.062	86.51 ± 1.57			

Millimetre dimensions have been derived from inches.

**Note** The base will pass through a hole of this diameter up to the terminal lugs.

# Voltage Stabilizers





# TABULATED DATA

## VOLTAGE STABILIZERS

EEV type	Striking voltage (V)		Operating voltage approx (V)	Tube current range (mA)	Regulation max (V)
	○	●			
0A2	185	225	150	5-30	6.0
0A2WA‡	165	165	150	5-30	5.0
0B2	127	210	108	5-30	3.5
0B2WA‡	130	130	108	5-30	3.0
0C2	115	145	75	5-30	4.5
75C1	115	115	78	2-60	8.0
150C4	185	185	150	5-30	5.0
QS75/20	110	160	75	2-20	6.0
QS75/60	117	—	75	5-60	5.0
QS95/10	110	—	95	2-10	5.0
QS108/45	120	—	108	5-45	5.0
QS150/15	170	—	150	2-15	5.0
QS150/45	170	—	150	5-45	5.0
QS1200†	180	225	150	5-15	5.0
QS1203‡	180	225	150	2-15	4.5
QS1209/ 5651†	115	160	85	1-10	4.0
QS1212†	115	115	85	1-10	4.0
QS1213†	115	115	85	1-10	4.0
QS1215	115	115	90	1-40	12

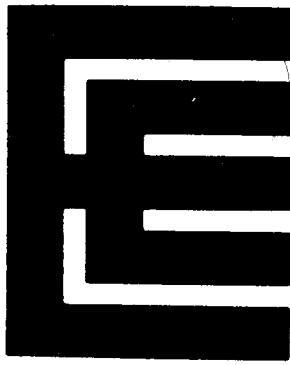
○ In normal lighting

● In total darkness

‡ Rugged and reliable type

† Voltage reference tube





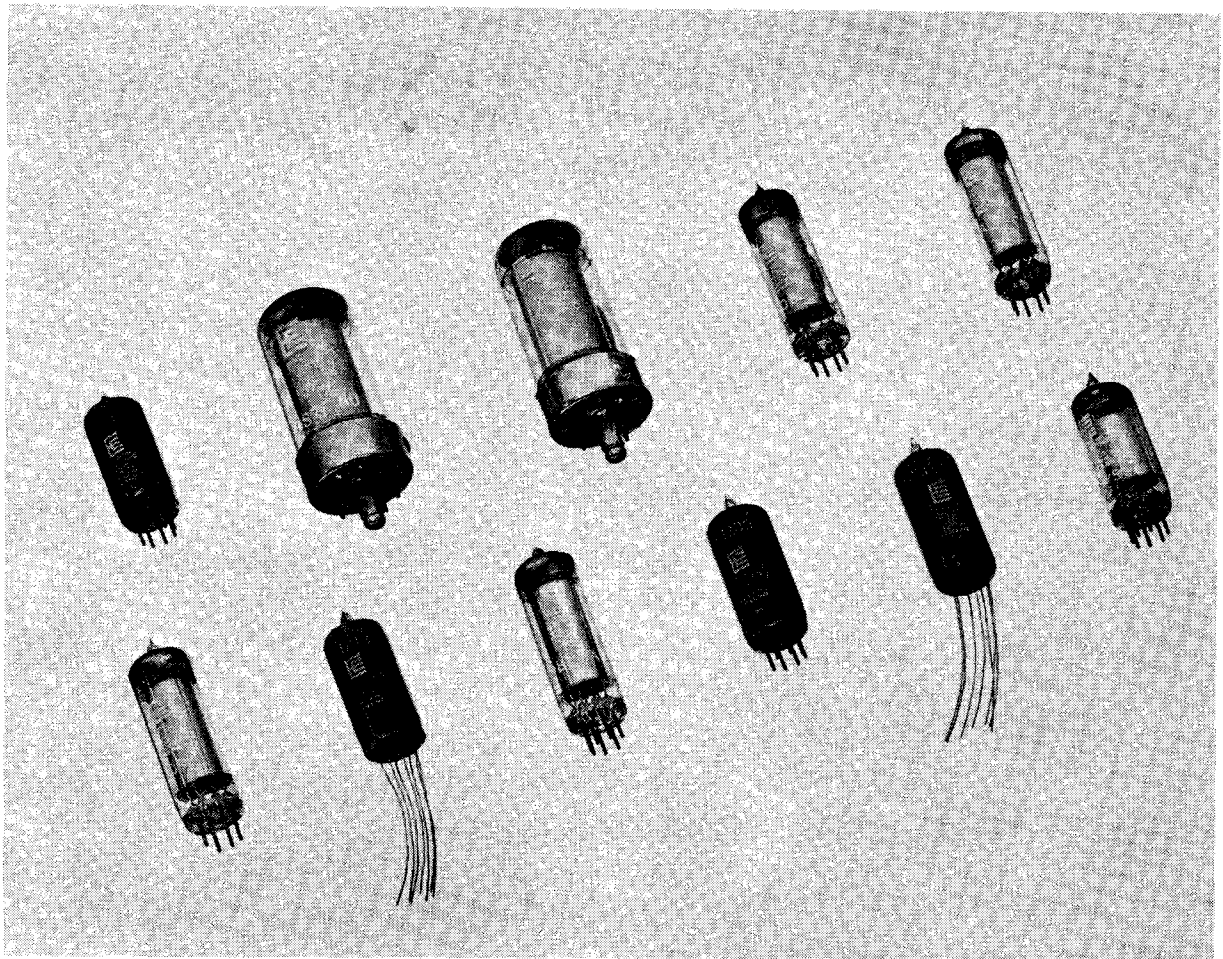
## VOLTAGE STABILIZERS

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### INTRODUCTION

The performance of many electronic circuits is closely linked with the stability of their associated power supplies, which are often required to give very stable d.c. output voltages over wide ranges of load current.

For the majority of applications, it is convenient to derive the d.c. supply from the standard a.c. mains, and rectifier units incorporating smoothing circuits to reduce ripple superimposed on the output voltage are widely used for this purpose. With this type of circuit, however, large variations of output voltage usually result from changes in load current, depending upon the characteristics of the smoothing circuit employed, and fluctuations in the a.c.



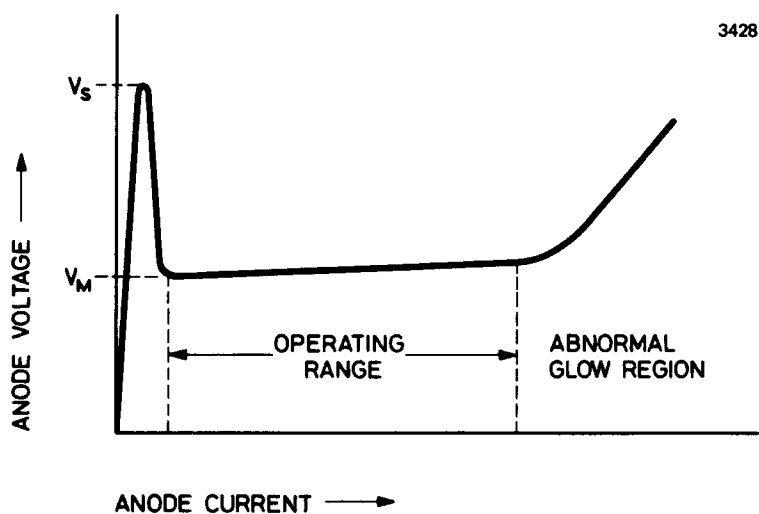
A group of EEV voltage stabilizer and reference tubes

supply voltage also have adverse effects on the stability of the output. Some form of d.c. voltage stabilization is usually essential therefore and the cold cathode stabilizer tube, used in conjunction with a conventional rectified a.c. supply, affords a very simple and inexpensive method for achieving this. The voltage stabilizer and its associated circuit behave as a low impedance source of voltage which is maintained at a sensibly constant value over a range of load currents and supply voltages; by using two or more voltage stabilizers in series across the supply, various voltages may be tapped off without increasing the total loading and without affecting the regulation of the output.

Cold cathode tubes for voltage stabilizer applications are characterized by their relatively large current range, low impedance and substantially constant voltage-current characteristic. Some types of stabilizer, however, are designed specifically for use as voltage reference sources and in these cases special attention is paid to minimizing variations in output voltage during tube life. Such tubes are operated at a constant current and provided that variations in ambient temperature are limited, changes in operating voltage during life after an initial running period of 1000 hours are usually less than 0.1%.

## PRINCIPLES OF OPERATION

The voltage stabilizer is a cold cathode gas-filled tube, designed to give a sensibly constant voltage drop between its cathode and anode when current within a specified range flows through the tube. See Fig. 1.



**Fig. 1** Anode voltage — anode current characteristic

When a d.c. voltage is applied across such a tube and slowly increased from zero, the free electrons always present in the gas are accelerated to the anode and produce an anode current of a few microamperes. At a critical voltage

$V_S$ , the striking voltage, the free electrons attain sufficient energy to cause ionization of the gas and the voltage drop across the tube falls to a characteristic level  $V_M$ , the operating voltage. Since the tube has a negative resistance characteristic in this region, the current flowing through the tube must be limited by a series resistor.

When the gas is ionized a glow is seen on the surface of the cathode, the colour of the glow depending on the nature of the gas filling. The area of cathode covered with glow is an indication of the current passing. The majority of voltage stabilizers are designed to operate in the region of normal fall of cathode potential, i.e. with the cathode not completely covered by glow, and in this region the output voltage is almost independent of the current flowing through the tube. If the current rises above the value required to cover the cathode completely with glow, the tube is said to be operating in the region of abnormal glow, where the internal impedance of the tube rapidly increases and its regulating properties are lost; too low an operating current causes instability and possibly extinction. Voltage stabilizers should therefore be operated within the specified current limits.

## **INTERPRETATION OF RATINGS AND CHARACTERISTICS**

### **Ratings**

All the maximum and minimum ratings specified in this section are absolute ratings. This means that the equipment designer is responsible for ensuring that operation outside these ratings is not possible, even momentarily, under any conditions arising from mains fluctuations, surges or tolerances on component values. (See British Standard Code of Practice CP1005: Parts 1, 2 and 8: 1962).

### **Striking Voltage**

The anode supply voltage should always exceed the published maximum striking voltage for a stabilizer to ensure breakdown under all conditions, due consideration being given to the ambient light falling on the tube under normal operating conditions.

Ambient light has a considerable influence on the striking voltage of some tubes and the supply voltage required to bring about breakdown under conditions of total darkness in these cases considerably exceeds that required with normal illumination.

An increasing number of types now have the same maximum striking voltage under normal lighting or in total darkness. This is achieved by the addition of a small quantity of radioactive material (usually tritium) as part of the gas

filling. The amount of radioactive material used is sufficiently small to enable the classification of 'non-radioactive' to be applied under the definition given in Radioactive Substances (Electronic Valves) Exemption Order.

### **Operating Voltage**

Since the operating voltage characteristic depends upon the current flowing through the tube, an approximate figure is usually quoted at the normal operating current, with limiting values that will be encountered at each end of the current range. Alternatively, the range of operating voltages to be expected from tube to tube and during life, measured at a stated value of current, may be specified. Normally, operating voltage increases slightly with operating current.

### **Current Range**

The limits of current range are set to ensure that the tube operates in the region of normal glow. Intermittent operation, or even extinction, results if the operating current falls below the minimum limit. If the operating current exceeds the maximum limit, the operating voltage rises and the consequent increase in dissipation may result in permanent damage to the tube.

### **Regulation**

This is the change in operating voltage over a specified current range. The regulation quoted for a normal stabilizer tube applies to operation over the complete current range, or a substantial part of it, but for tubes which have applications as voltage reference elements, an additional regulation characteristic applying to a very limited current range may be specified.

### **Noise Voltage**

An inherent characteristic of gas filled voltage stabilizer tubes is their ability to generate noise voltages, which increase in magnitude as the operating current tends towards the minimum limit. The maximum r.m.s. or peak to peak value of noise voltage in a given frequency range, usually between 50Hz and 5000Hz, is specified for the normal current range.

### **Temperature Coefficient**

The operating voltage at a fixed operating current varies with ambient temperature, and temperature coefficient over a given temperature range is defined as the change in operating voltage per °C. The ambient temperature range for the majority of voltage stabilizers and reference tubes is from -55°C to +90°C and for reference tubes, where this characteristic is of particular importance, temperature coefficient figures are normally quoted for ambient temperature ranges from -55°C to +25°C and from +25°C to +90°C.

### **Tube Impedance**

The impedance presented by a stabilizer to alternating voltages contains a large inductive component which it is sometimes convenient to shunt with a capacitor to bypass ripple voltages of high frequency. The value of the capacitor should be minimized to prevent the onset of relaxation oscillations. A value of  $0.2\mu\text{F}$  is usually adequate.

### **Voltage Jumps**

Due to variations in the work function of the cathode surface, the glow may jump from one part of the cathode to another as the current through the tube is changed. These jumps cause small changes in the output voltages. The current at which a jump may occur will depend on whether it is being increased or decreased and is seldom the same for either direction. It is an inherent feature of reference tubes that the magnitude of these jumps is kept to a minimum.

## **RUGGED AND RELIABLE TUBES**

Several of the voltage stabilizers and reference tubes in the EEV range have been designed and manufactured to meet the rigorous requirements of the Services' specifications for reliable tubes, which ensure that these types will give continuity of operation superior to ordinary tubes when used under conditions of shock and vibration.

In addition to the normal electrical and mechanical tests applied to all the devices, a number of tubes selected on a sampling basis from each production batch are subjected to a series of destructive and non-destructive tests to detect incipient faults which would not be found normally during the early life of the tube. The production batch is acceptable only if the percentage of tubes rejected in these severe tests is below a specific acceptance quality level.

A brief description of the special tests applied to reliable stabilizers and reference tubes is given below.

## **NON-DESTRUCTIVE TESTS**

### **Glass Envelope Strain Test**

In this test the entire tube is immersed in boiling water at a temperature between  $97^{\circ}\text{C}$  and  $100^{\circ}\text{C}$  for 15 seconds and plunged immediately into ice-cold water for 5 seconds.

The glass envelope is then inspected for cracks.

### **Resonance Search Test**

Sample tubes are rigidly mounted on a vibration machine and vibrated over a specified frequency range with an acceleration of not less than 2g.

The tubes are vibrated in three mutually perpendicular planes and limits for noise output over given frequency ranges are specified.

### **DESTRUCTIVE TESTS**

Tubes which have been subjected to destructive tests are subsequently destroyed to obviate the possibility of their being supplied to customers.

#### **Base Strain Test for Pinned Types**

The pins of sample tubes are forced over cones of specified dimensions and the tubes and cones are then completely immersed in boiling water at a temperature between 97°C and 100°C for 10 seconds. After cooling to room temperature, the tubes are examined for glass cracks.

#### **Lead Fragility Test for Flying Lead Types**

A weight of not less than 1-lb is freely suspended from each flexible lead in turn of the vertically mounted sample tube. The tube is then slowly inclined so as to bend the lead through 45°, returned to normal, inclined in the opposite direction to 45° and returned to the vertical position.

The tube is then examined for damage to the leads or glass.

#### **Fatigue Test**

In this test, sample tubes are rigidly mounted on a vibration machine and vibrated at a frequency of not less than 100Hz in three mutually perpendicular planes, the acceleration, time of treatment and subsequent tests being governed by individual tube specifications.

#### **Shock Test**

Sample tubes, mounted in approved holders, are subjected to five hammer blows in each of four different directions after which they are tested for changes in characteristics.

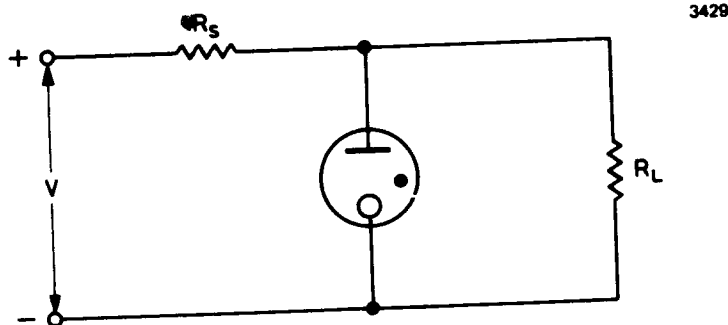
#### **Life Test**

In this test, sample tubes are operated for 1000 hours under specified conditions, after which their characteristics are rechecked.

## TYPICAL APPLICATIONS

### Basic Circuit

A basic stabilizer circuit is shown in Fig. 2.



**Fig. 2** Basic stabilizer circuit

- Let  $V$  = Applied d.c. voltage
- $R_S$  = Anode series resistor
- $R_L$  = Load resistor
- $V_S$  = Striking voltage of tube
- $V_M$  = Operating voltage of tube
- $I_T$  = Current through tube after striking
- $I_{L0}$  = Current through load before tube strikes
- $I_{L1}$  = Current through load after tube strikes

The effects of variations in load current or input voltage on the load voltage are absorbed by the combined action of the series resistor  $R_S$  and the stabilizer tube.

At the instant  $V$  is applied, the effective load is  $R_S + R_L$ , the tube not having struck. Thus there will be a voltage drop across  $R_S$  of  $(R_S \cdot I_{L0})$  volts. The voltage across the tube will be  $V - (R_S \cdot I_{L0})$  volts and this must equal, or be greater than,  $V_S$  if the tube is to strike.

$$\text{Thus we have } V - (R_S \cdot I_{L0}) > V_S \quad \dots \dots \dots (1)$$

$$V = I_{L0}(R_S + R_L) \quad \dots \dots \dots (2)$$

$$V - V_M = R_S(I_T + I_{L1}) \quad \dots \dots \dots (3)$$

$$V_M = R_L \cdot I_{L1} \quad \dots \dots \dots (4)$$

From the above we have the following relationships:

$$I_{L0} \cdot R_L > V_S \quad \dots \dots \dots (5)$$

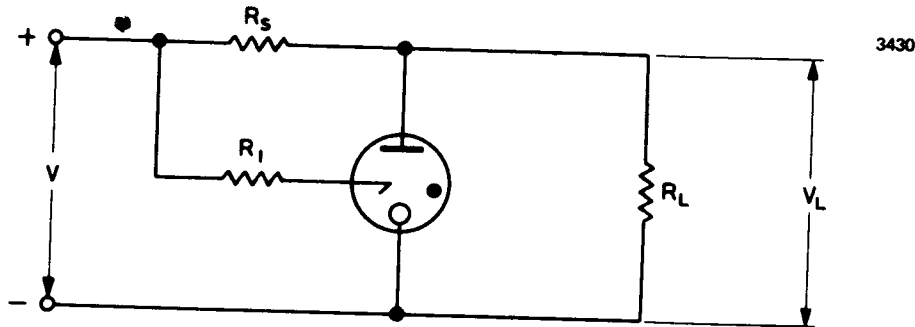
$$V = I_{L1}(R_S + R_L) + R_S \cdot I_T \quad \dots \dots \dots (6)$$

$$\left[ \frac{R_S}{R_S + R_L} \right] I_T = I_{L0} - I_{L1} \quad \dots \dots \dots (7)$$

In general,  $V_M$ ,  $V_S$ ,  $R_L$ ,  $I_{L1}$  and  $I_T$  are known, and thus the remaining values may be calculated.

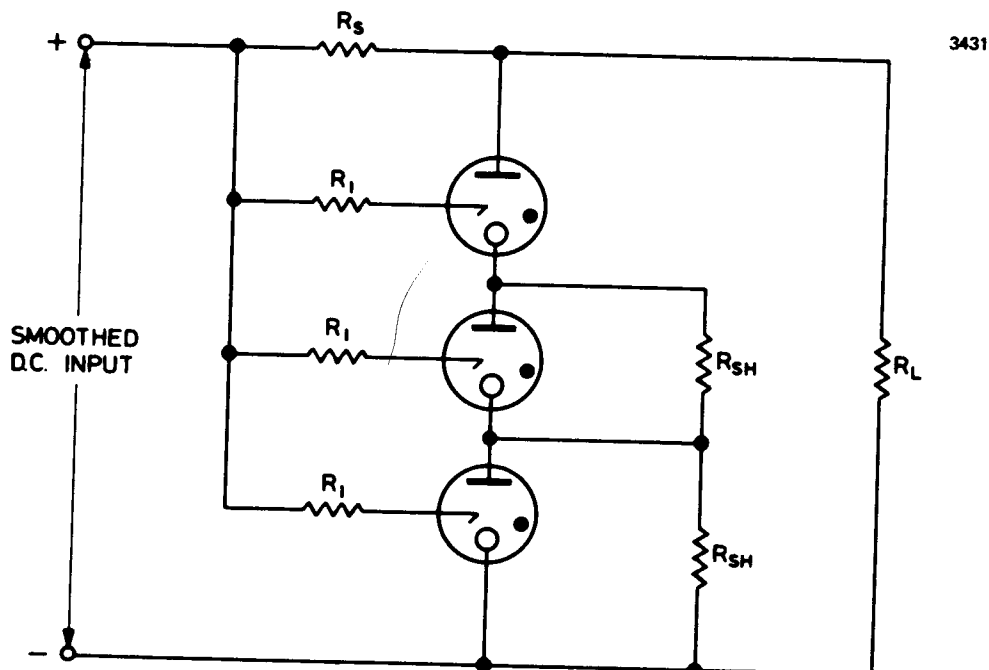
### Tubes with Ignition Electrodes

In some tubes an ignition electrode is provided. This may be regarded as an auxiliary anode and must be connected to the main h.t. supply via a high resistance. See Fig. 3.



**Fig. 3** Basic circuit for tube with ignition electrode

Before the tube strikes, the trigger electrode voltage is equal to the main h.t. voltage  $V$  and is necessarily higher than the main anode voltage which is determined by the voltage divider formed by  $R_S$  and  $R_L$ . If the h.t. voltage  $V$  exceeds the ignition electrode striking voltage, breakdown of the trigger to cathode gap occurs. Sufficient ionization of the gas is produced to effect a considerable reduction in the main anode striking voltage, and the main anode takes over at a voltage only slightly in excess of the operating voltage.



$R_S$  = Series Resistor

$R_I$  = Ignition Electrode Resistors

$R_L$  = Load Resistor

$R_{SH}$  = Ignition or Load Resistors

**Fig. 4** Series connection of tubes



For a given input voltage, the ignition electrode enables a higher value of series resistor  $R_S$  to be used, with a consequent improvement in stability. The trigger electrode current is normally less than 0.5mA.

### Series Connection of Tubes

Voltage stabilizers may be connected in series, as shown in Fig. 4, to provide output voltages exceeding those obtained with single tubes. In the case illustrated, a number of different stabilized voltages are available for supplying several loads.

Stabilizers of different voltages may be used in combination in this way, within their ratings, care being taken to ensure that the sum of the load and tube currents at any point from which output voltage is taken does not exceed the maximum cathode current of the tubes through which these currents pass.

To facilitate striking of each individual tube, shunt resistors should be connected as shown. Ignition electrodes should be connected via individual high value resistors of the order of  $0.25M\Omega$  to the positive side of the h.t. supply.

### Cascade Connection of Tubes

To obtain a greater reduction in output voltage fluctuations than is possible with a single tube, stabilizers may be used in cascade, or in a combination of series and cascade connection.

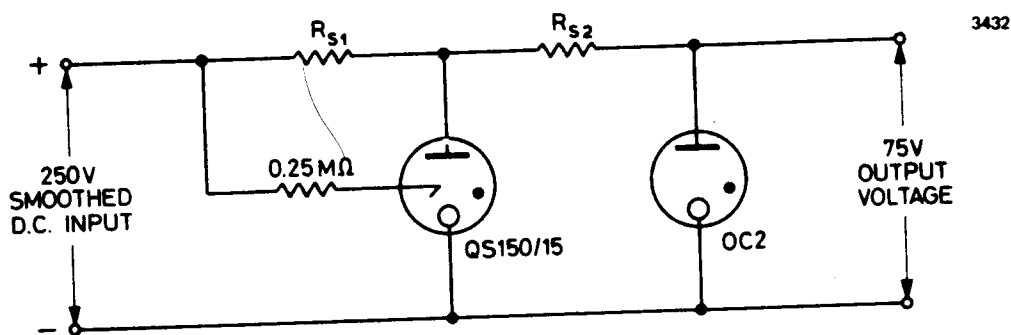


Fig. 5 Cascade connection of tubes

The output voltage from the first tube can be applied to the second tube via a series resistor  $R_{S2}$ , as shown in Fig. 5, to obtain a second stage of stabilization. The circuit shown is recommended where a very stable output voltage of about 75 volts is required.

## Complex Connection of Tubes

Stabilized voltages other than those obtainable from single tubes are often required, and in such cases it may be possible to obtain the desired voltage by one of the methods illustrated in Fig. 6 which give output voltages equal to the sum or the difference of the operating voltages of individual tubes.

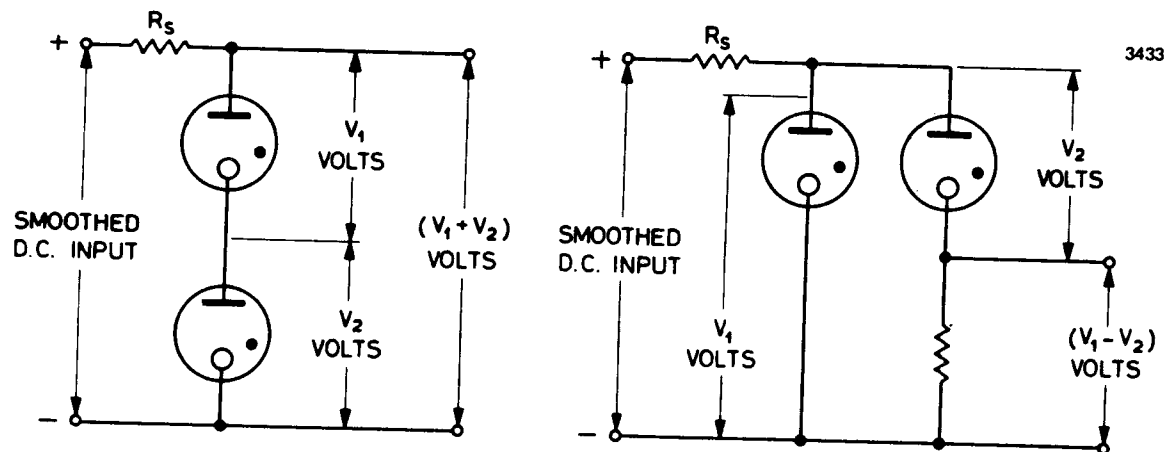
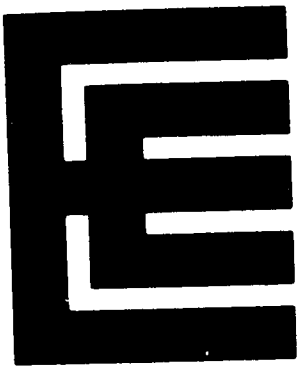


Fig. 6 Voltage sum and difference circuits

Various other combinations of standard tubes can be used to obtain a range of stabilized voltage values.

## REFERENCES TO VOLTAGE STABILIZERS

1. F. A. Benson, 'The Characteristics of some Miniature High-Stability Glow-Discharge Voltage Regulator Tubes', **Journal of Scientific Instruments**, Vol. 28, pp. 339-341, November 1951.
2. Bache and Benson, 'Peak Noise Characteristics of Glow-Discharge Voltage Regulator Tubes', **Electronic Engineering**, Vol. 24, p. 278, June 1952.
3. Bache and Benson, 'Peak Noise Characteristics of Glow-Discharge Tubes', **Journal of Scientific Instruments**, Vol. 30, p. 124, April 1953.
4. Benson and Mayo, 'Effects of Ambient Temperature Variations on Glow-Discharge Tube Characteristics', **Journal of Scientific Instruments**, Vol. 31, p. 118, April 1954.
5. Benson and Mayo, 'Running-Voltage/Current Characteristics of some Glow-Discharge Tubes', **Electronic Engineering**, Vol. 27, p. 540, December 1955.
6. Benson and Mayo, 'Impedance-Frequency Measurements of some Glow-Discharge Tubes', **Electronic Engineering**, Vol. 28, p. 124, March 1956.
7. Benson, 'Voltage Stabilizers', **Electronic Engineering**, London, 1950.
8. Benson, 'Voltage Stabilized Supplies', McDonald, London, 1957.



## VOLTAGE STABILIZER

Service Types CV1832, CV8161

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The 0A2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 30mA.

### GENERAL DATA

#### Characteristics

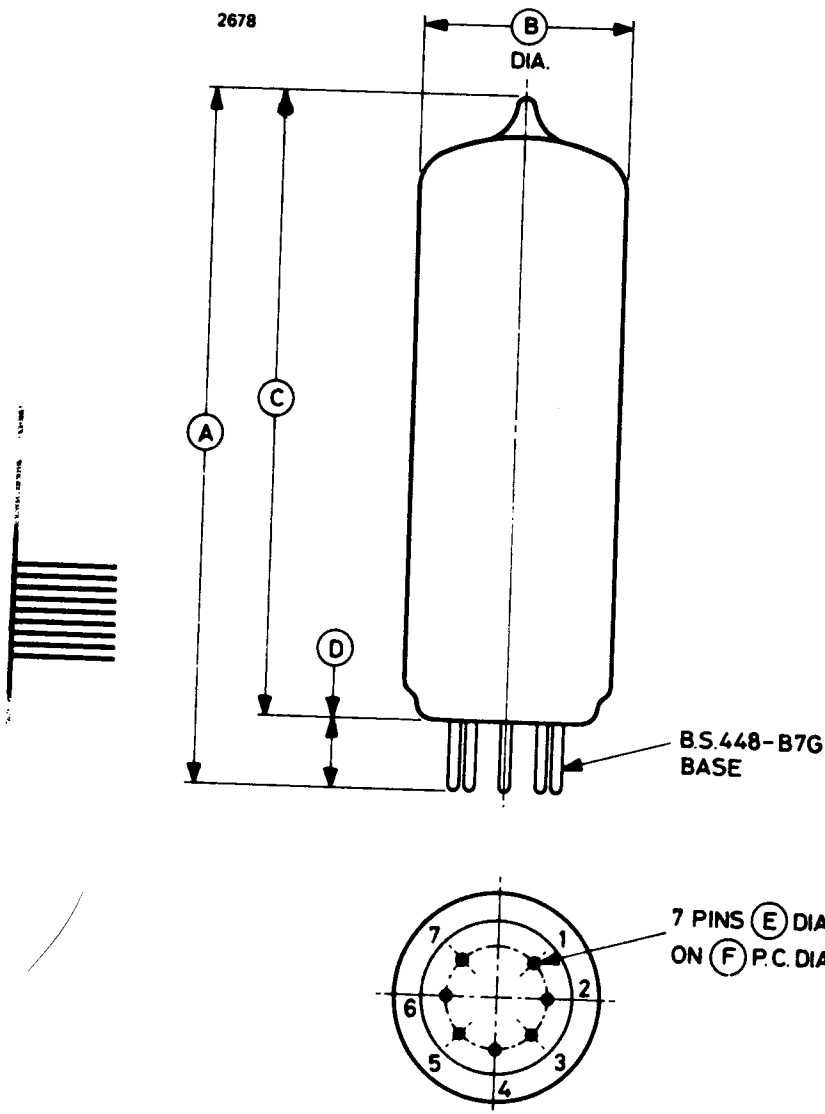
Striking voltage in normal lighting . . . . .	185	V max
Striking voltage in total darkness . . . . .	225	V max
Operating voltage (approx) . . . . .	150	V
Operating voltage at 30mA . . . . .	165	V max
Operating voltage at 5.0mA . . . . .	142	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range 5.0 to 30mA . . . . .	6.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA . . . . .	5.0	mV max
Ambient temperature range . . . . .	-55 to +90	°C



#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

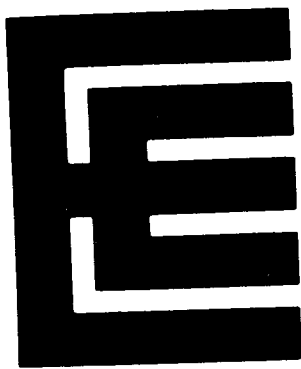
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



# OA2WA

## VOLTAGE STABILIZER

Service Types CV4020, CV4100, CV8168

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The OA2WA is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 30mA.

It is essentially a rugged and reliable version of the OA2.

### GENERAL DATA

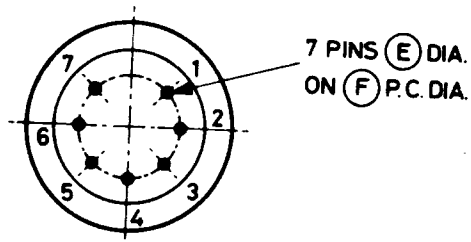
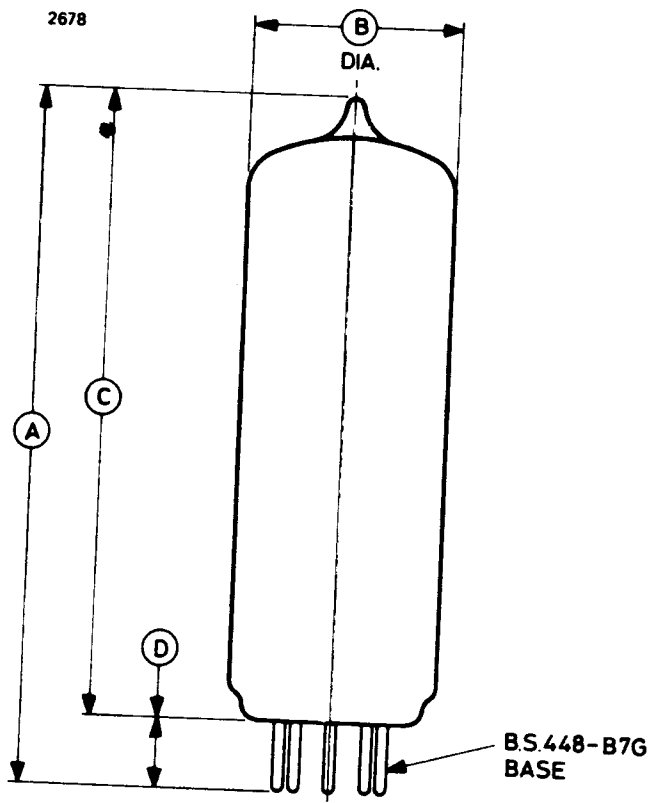
#### Characteristics

Striking voltage in normal lighting . . . . .	165	V max
Striking voltage in total darkness . . . . .	165	V max
Operating voltage (approx) . . . . .	150	V
Operating voltage at 30mA . . . . .	158	V max
Operating voltage at 5.0mA . . . . .	142	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range 5.0 to 30mA . . . . .	5.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA . . . . .	5.0	mV max
Acceleration (continuous) . . . . .	2.5	g max
Shock (short duration) . . . . .	500	g max
Ambient temperature range . . . . .	-55 to +90	°C
Bulb temperature . . . . .	150	°C max
Altitude . . . . .	120 000	ft max
	36.6	km max

#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

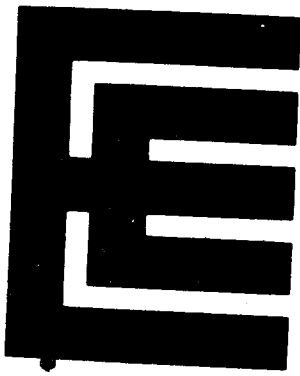
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



# OB2

## VOLTAGE STABILIZER

**Service Types CV1833, CV8162**

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The OB2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 108 volts over the current range 5.0 to 30mA.

### GENERAL DATA

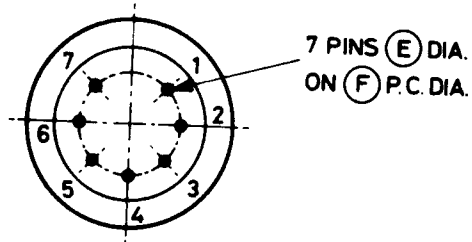
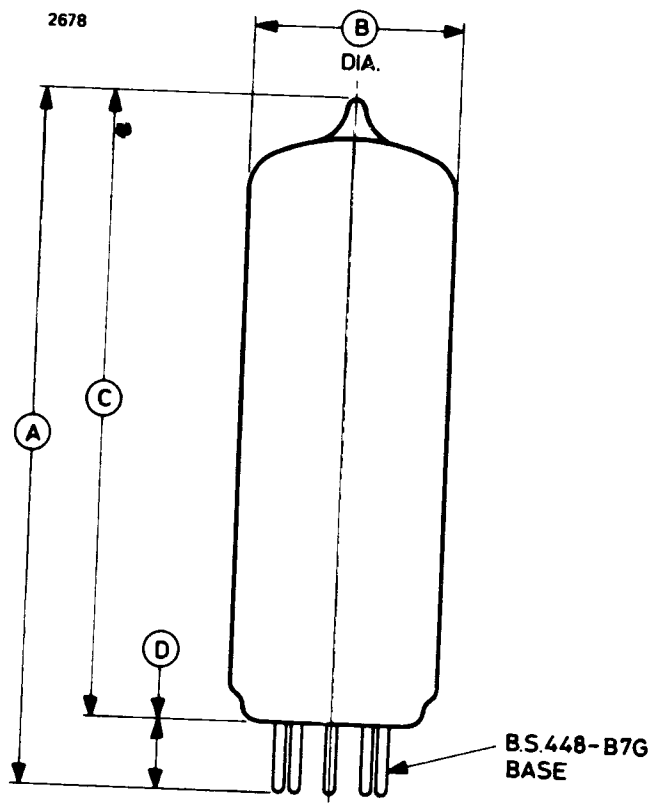
#### Characteristics

Striking voltage in normal lighting . . . . .	127	V max
Striking voltage in total darkness . . . . .	210	V max
Operating voltage (approx) . . . . .	108	V
Operating voltage at 30mA . . . . .	112	V max
Operating voltage at 5.0mA . . . . .	105	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range . . . . .	3.5	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA . . . . .	5.0	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode





# OB2

## VOLTAGE STABILIZER

Service Types CV1833, CV8162

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The OB2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 108 volts over the current range 5.0 to 30mA.

### GENERAL DATA

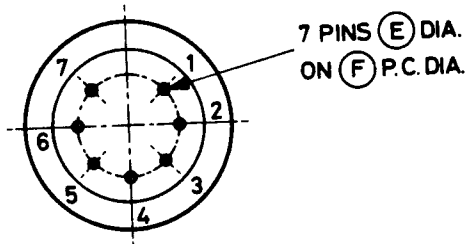
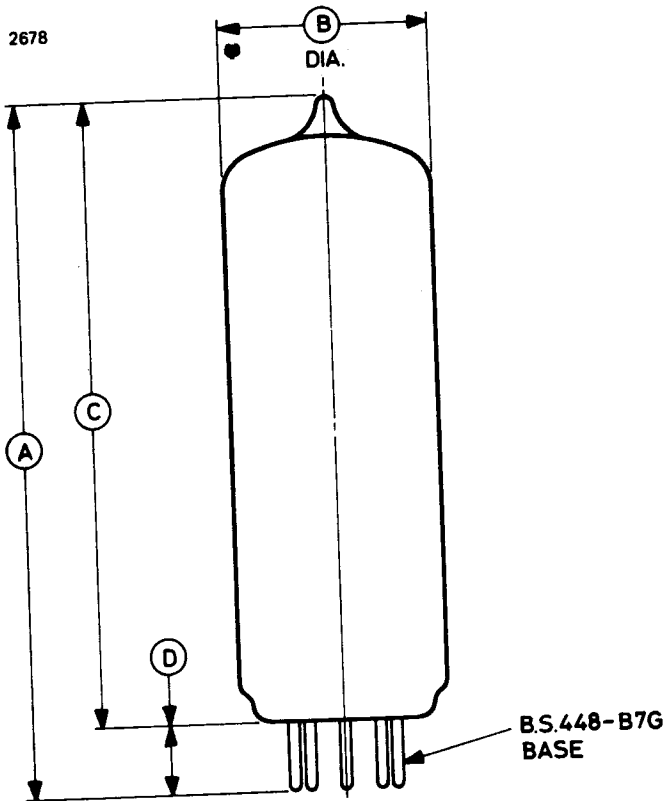
#### Characteristics

Striking voltage in normal lighting . . . . .	127	V max
Striking voltage in total darkness . . . . .	210	V max
Operating voltage (approx) . . . . .	108	V
Operating voltage at 30mA . . . . .	112	V max
Operating voltage at 5.0mA . . . . .	105	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range . . . . .	3.5	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA . . . . .	5.0	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

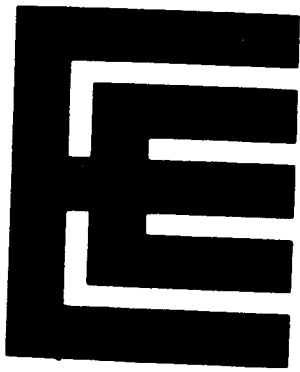
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



# OB2WA

## VOLTAGE STABILIZER

**Service Types CV4028, CV4101**

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The OB2WA is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 108 volts over the current range 5.0 to 30mA.

It is essentially a rugged and reliable version of the OB2.

### GENERAL DATA

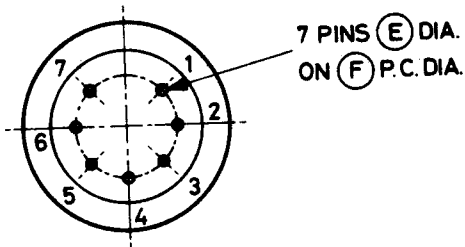
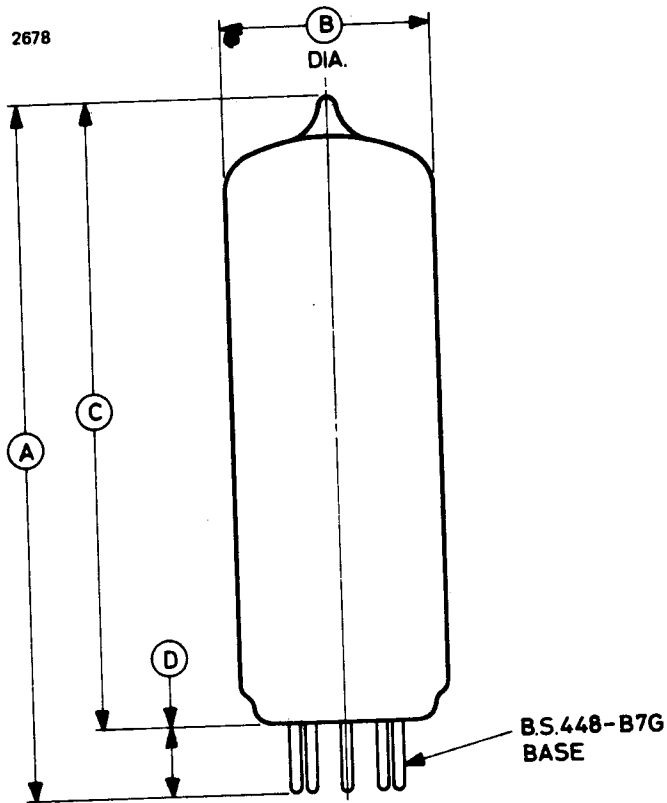
#### Characteristics

Striking voltage in normal lighting . . . . .	130	V max
Striking voltage in total darkness . . . . .	130	V max
Operating voltage (approx) . . . . .	108	V
Operating voltage at 30mA . . . . .	113	V max
Operating voltage at 5.0mA . . . . .	103	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range . . . . .	3.0	V max
Acceleration (continuous) . . . . .	2.5	g max
Shock (short duration) . . . . .	500	g max
Ambient temperature range . . . . .	-55	°C min
Bulb temperature . . . . .	150	°C max
Altitude . . . . .	120 000	ft max
	36.6	km max

#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

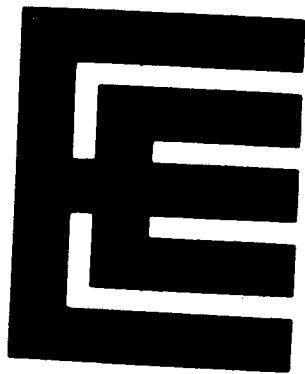
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



**OC2**

**VOLTAGE  
STABILIZER**

**Service Type CV8766**

The data to be read in conjunction with the Voltage Stabilizer Preamble.

**DESCRIPTION**

The OC2 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 75 volts over the current range 5.0 to 30mA.

**GENERAL DATA**

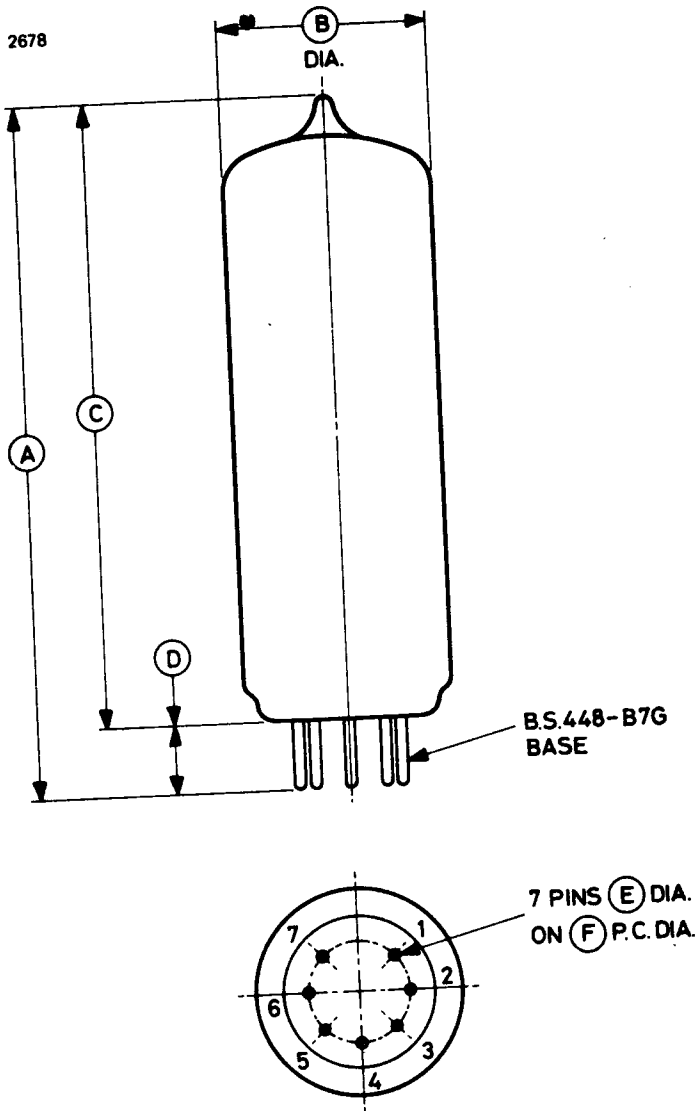
**Characteristics**

Striking voltage in normal lighting . . . . .	115	V max
Striking voltage in total darkness . . . . .	145	V max
Operating voltage (approx) . . . . .	75	V
Operating voltage at 30mA . . . . .	83	V max
Operating voltage at 5.0mA . . . . .	68	V min
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range . . . . .	4.5	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 30mA . . . . .	10	mV max
Voltage jumps over the current range 5.0 to 30mA . . . . .	1.0	V max
Ambient temperature range . . . . .	-55 to +90	°C

**Mechanical**

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



# 75C1

## VOLTAGE STABILIZER

**Service Type CV4080**

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The 75C1 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 75 volts over the current range 2.0 to 60mA.

### GENERAL DATA

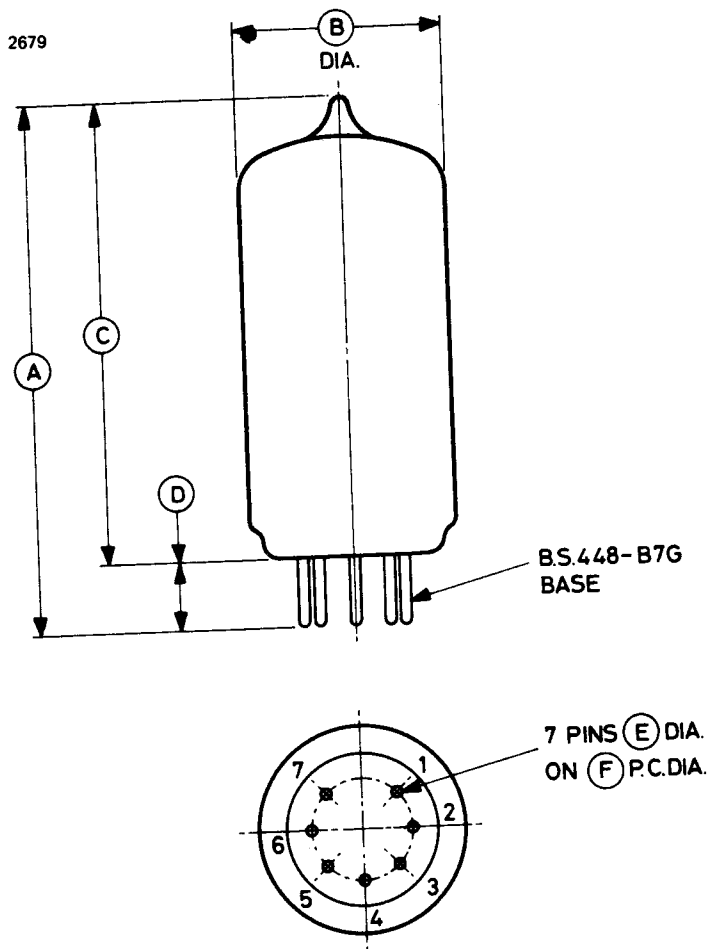
#### Characteristics

Striking voltage in normal lighting . . . . .	115	V max
Striking voltage in total darkness . . . . .	115	V max
Operating voltage at 30mA:		
maximum . . . . .	81	V
nominal . . . . .	78	V
minimum . . . . .	75	V
Cathode current range . . . . .	2.0 to 60	mA
Regulation over current range:		
maximum . . . . .	8.0	V
nominal . . . . .	5.0	V
Voltage jumps:		
over the range 2 to 20mA . . . . .	100	mV max
over the range 20 to 60mA . . . . .	15	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

# OUTLINE (All dimensions without limits are nominal)

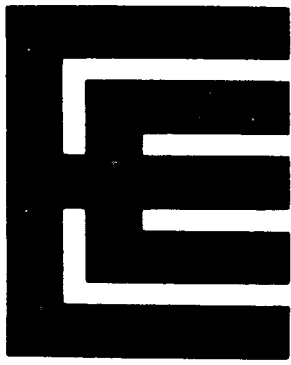


Ref	Inches	Millimetres
A	2.126 max	54.0 max
B	0.748 max	19.0 max
C	1.874 max	47.6 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Internal connection
5	Internal connection
6	Internal connection
7	Internal connection





# 150C4

## VOLTAGE STABILIZER

Similar to 0A2WA

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The 150C4 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 30mA.

### GENERAL DATA

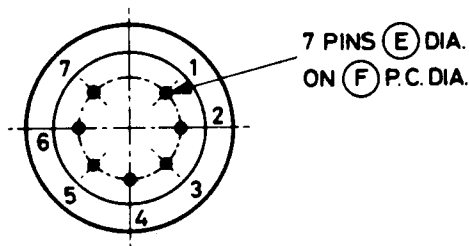
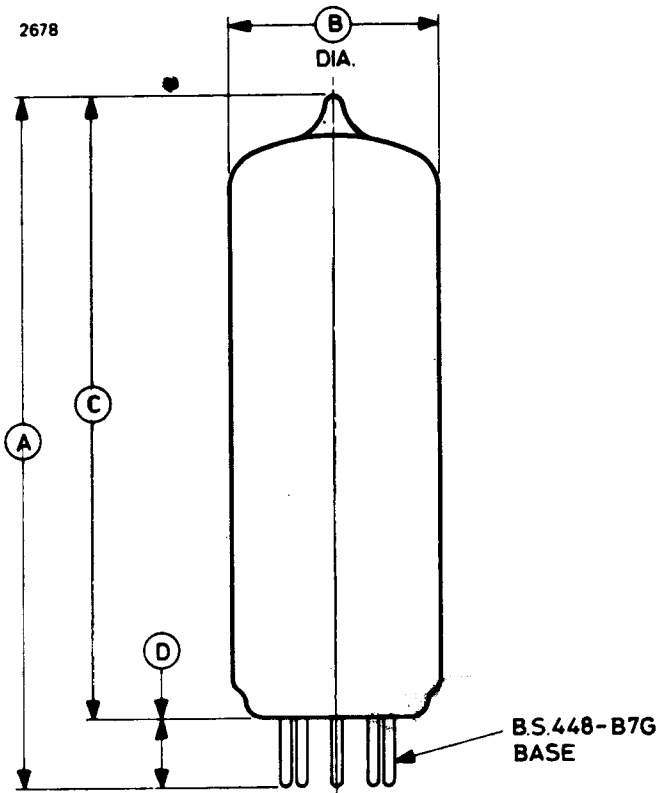
#### Characteristics

Striking voltage in lighting or darkness . . . . .	185	V max
Operating voltage (approx) . . . . .	150	V
Operating voltage at 30mA . . . . .	156	V max
Operating voltage at 5.0mA . . . . .	143	V min
Negative anode voltage . . . . .	125	V max
Surge current (max. duration 30s per 8 hour period) . . . . .	75	mA max
Cathode current range . . . . .	5.0 to 30	mA
Regulation over current range 5.0 to 30mA . . . . .	5.0	V max
Variation of operating voltage during 1000 hours life at 30mA (room temperature):		
typical . . . . .	±1.0	%
maximum . . . . .	+1.5, -4.0	%
Regulation over current range during life . . . . .	8.0	V max
Ambient temperature range . . . . .	-55 to +100	°C
Bulb temperature . . . . .	150	°C max

#### Mechanical

Overall length . . . . .	2.618 inches (66.5mm) max
Seated height . . . . .	2.366 inches (60.1mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

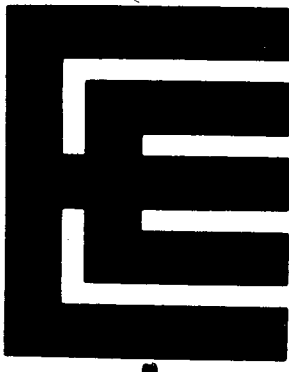
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A	2.618 max	66.5 max
B	0.748 max	19.0 max
C	2.366 max	60.1 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode



# QS75/20

## VOLTAGE STABILIZER

Service Type CV284†

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS75/20 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 75 volts over the current range 2.0 to 20mA.

### GENERAL DATA

#### Characteristics

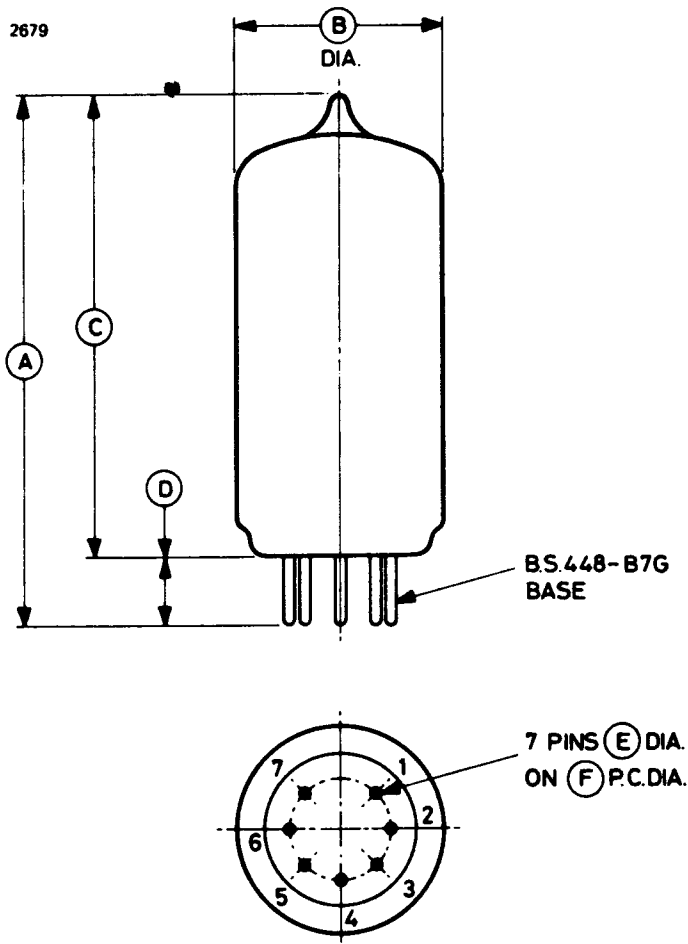
Striking voltage in normal lighting . . . . .	110	V max
Striking voltage in total darkness . . . . .	160	V max
Operating voltage at 10mA† . . . . .	$75 \pm 5$	V
Cathode current range . . . . .	2.0 to 20	mA
Regulation over current range 2.0 to 20mA . . . . .	6.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 2.0 to 20mA . . . . .	10	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

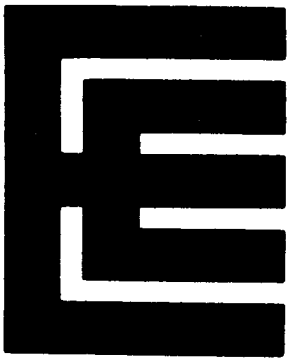
† Tubes with operating voltage of 70V can be supplied (CV5083).

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Cathode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Cathode
D	0.281 max	7.14 max	4	Anode
E	0.040	1.02	5	Anode
F	0.375	9.53	6	Anode
			7	Anode

Millimetre dimensions have been derived from inches.



# QS75/60

## VOLTAGE STABILIZER

### Service Type CV434

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS75/60 is a single gap cold cathode gas-filled voltage stabilizer with a B8G base. It is designed to provide a sensibly constant voltage output of 75 volts over the current range from 5.0 to 60mA.

### GENERAL DATA

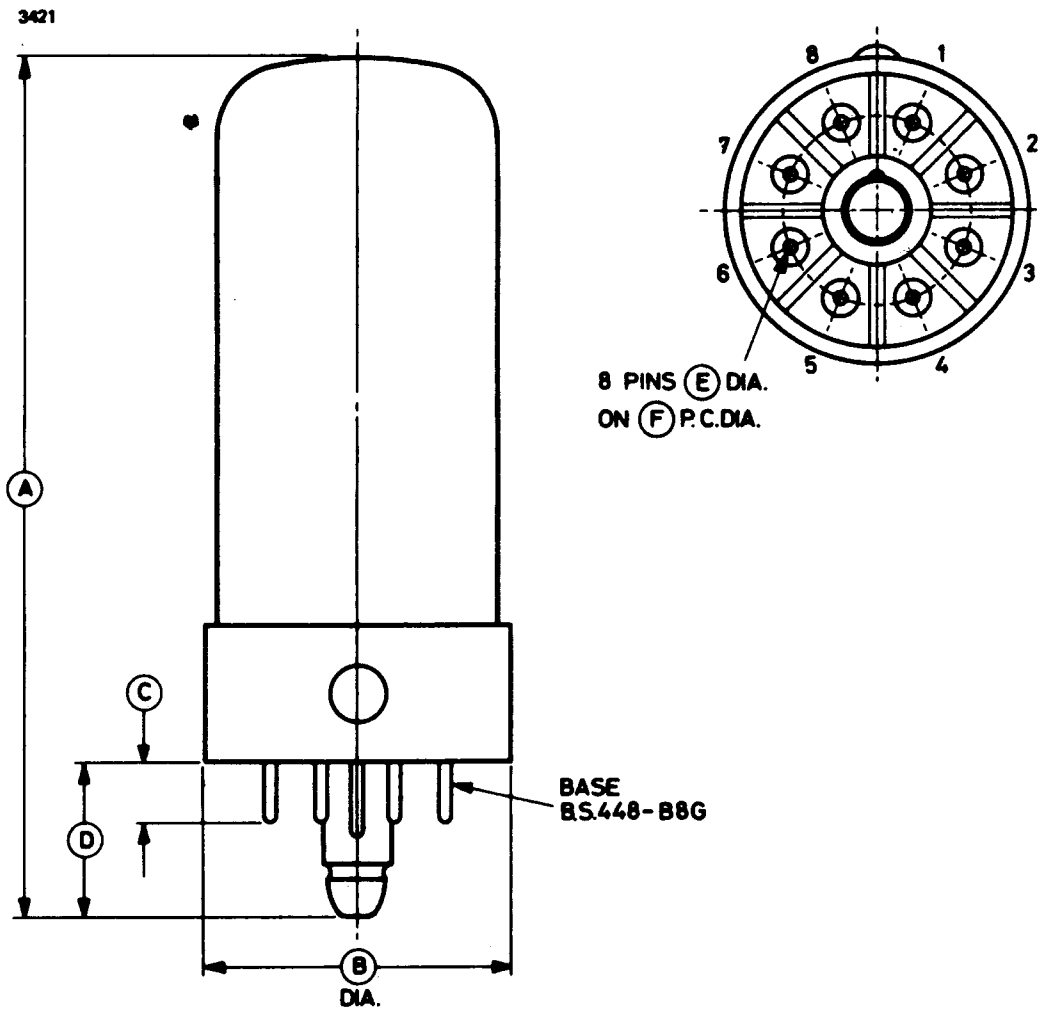
#### Characteristics

Striking voltage in normal lighting . . . . .	117	V max
Operating voltage at 30mA . . . . .	75 ± 5	V
Cathode current range . . . . .	5.0 to 60	mA
Regulation over current range 5.0 to 30mA . . . . .	3.0	V max
Regulation over current range 5.0 to 60mA . . . . .	5.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 60mA) . . . . .	10	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

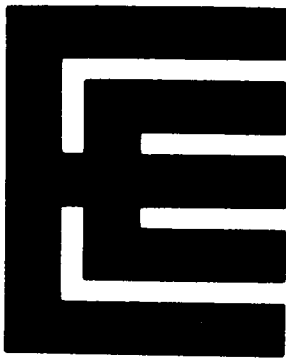
Overall length . . . . .	3.150 inches (80.0mm) max
Overall diameter . . . . .	1.187 inches (30.15mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B8G

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	3.150 max	80.01 max	1	Anode
B	1.187 max	30.15 max	2	Anode
C	0.220 max	5.59 max	3	Anode
D	0.561 max	14.25 max	4	Cathode
E	0.050	1.27	5	Cathode
F	0.687	17.45	6	Cathode
			7	Cathode
			8	Cathode

Millimetre dimensions have been derived from inches.



# QS95/10

## VOLTAGE STABILIZER

### Service Type CV286

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS95/10 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 95 volts over the current range 2.0 to 10mA.

### GENERAL DATA

#### Characteristics

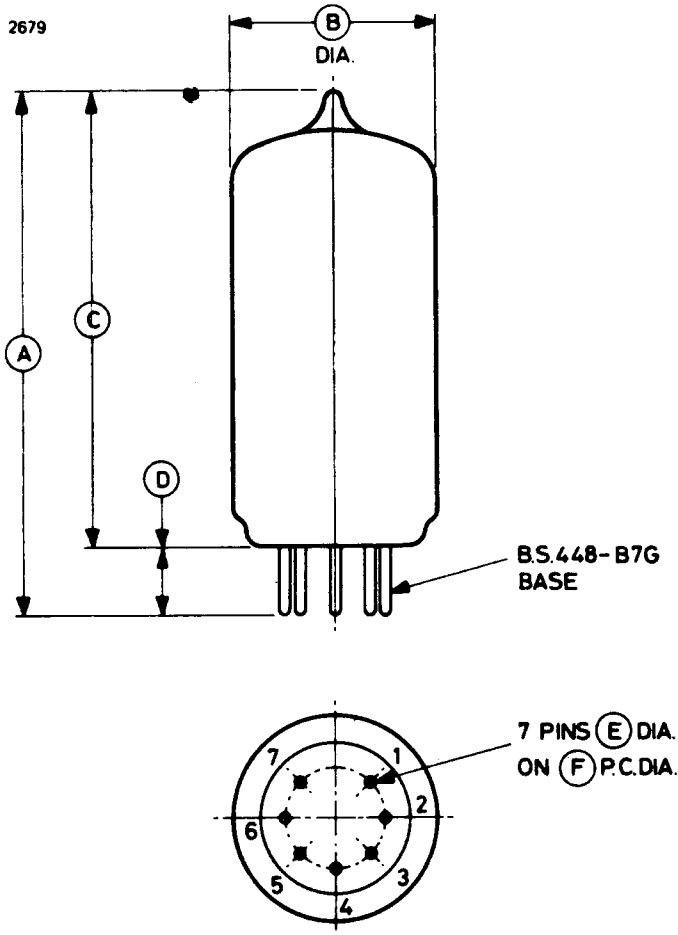
Ignition electrode voltage . . . . .	150	V
Ignition electrode series resistance . . . . .	0.25	MΩ
Striking voltage in normal lighting (see note) . . . . .	110	V max
Operating voltage at 5.0mA . . . . .	95 ± 5	V
Cathode current range . . . . .	2.0 to 10	mA
Regulation over current range . . . . .	5.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 2.0 to 10mA . . . . .	10	mV max

#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

**Note** The striking voltage in the case of a tube provided with an ignition electrode is the voltage at which the anode takes over control of the discharge from the ignition electrode.

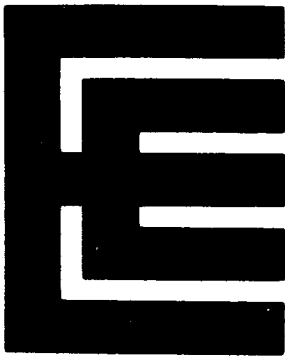
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Cathode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Cathode
D	0.281 max	7.14 max	4	Ignition electrode
E	0.040	1.02	5	Anode
F	0.375	9.53	6	Anode
			7	Anode

Millimetre dimensions have been derived from inches.





# QS108/45

## VOLTAGE STABILIZER

### Service Type CV422

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS108/45 is a single gap cold cathode gas-filled voltage stabilizer with a B8G base. It is designed to provide a sensibly constant voltage output of 108 volts over the current range 5.0 to 45mA.

### GENERAL DATA

#### Characteristics

Ignition electrode voltage . . . . .	150	V
Ignition electrode series resistance . . . . .	0.1	MΩ
Striking voltage in normal lighting (see note) . . . . .	120	V max
Operating voltage at 25mA . . . . .	108 ± 5	V
Cathode current range . . . . .	5.0 to 45	mA
Regulation over current range 5.0 to 45mA . . . . .	5.0	V max
Regulation over current range 5.0 to 25mA . . . . .	2.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 45mA . . . . .	10	mV max

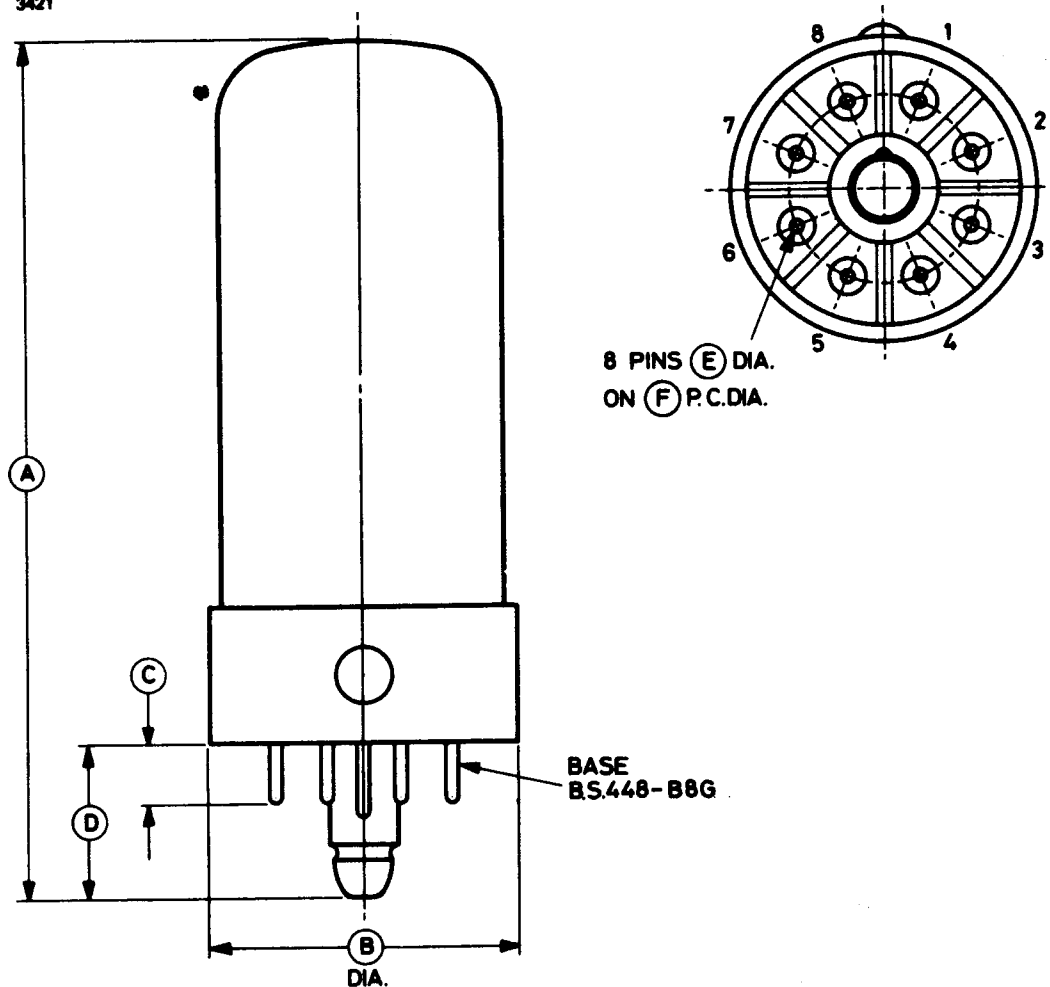
#### Mechanical

Overall length . . . . .	3.150 inches (80.0mm) max
Overall diameter . . . . .	1.187 inches (30.15mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B8G

**Note** The striking voltage in the case of a tube provided with an ignition electrode is the voltage at which the anode takes over control of the discharge from the ignition electrode.

**OUTLINE (All dimensions without limits are nominal)**

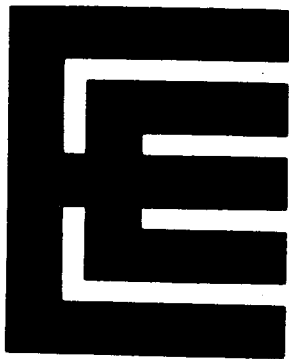
3421



Ref	Inches	Millimetres
A	3.150 max	80.01 max
B	1.187 max	30.15 max
C	0.220 max	5.59 max
D	0.561 max	14.25 max
E	0.050	1.27
F	0.687	17.45

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Anode
3	Ignition electrode
4	Cathode
5	Cathode
6	Cathode
7	Cathode
8	Cathode



# QS150/15

## VOLTAGE STABILIZER

### Service Type CV287

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS150/15 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 2.0 to 15mA.

### GENERAL DATA

#### Characteristics

Ignition electrode voltage . . . . .	240	V
Ignition electrode series resistance . . . . .	0.25	MΩ
Striking voltage in normal lighting (see note) . . . . .	170	V max
Operating voltage at 10mA . . . . .	150 ± 5	V
Cathode current range . . . . .	2.0 to 15	mA
Regulation over current range 2.0 to 15mA . . . . .	5.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 2.0 to 15mA . . . . .	10	mV max
Ambient temperature range . . . . .	-55 to +90	°C

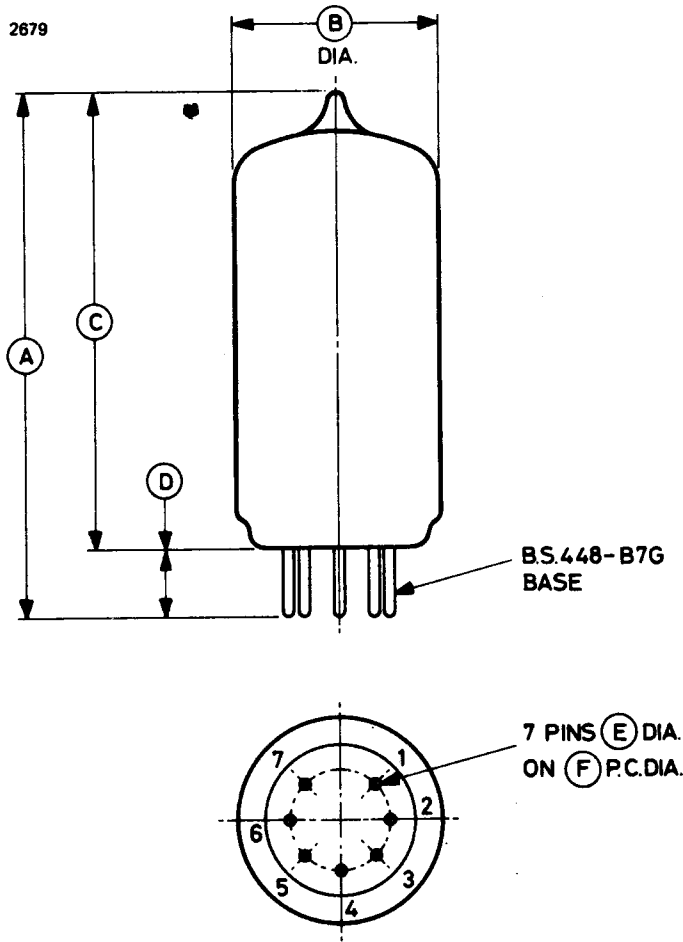


#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

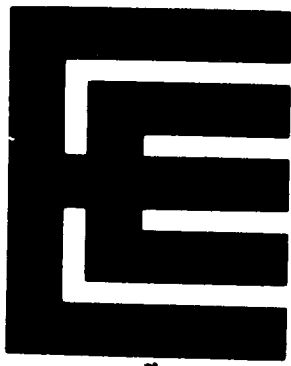
**Note** The striking voltage in the case of a tube provided with an ignition electrode is the voltage at which the anode takes over control of the discharge from the ignition electrode.

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Cathode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Cathode
D	0.281 max	7.14 max	4	Ignition electrode
E	0.040	1.02	5	Anode
F	0.375	9.53	6	Anode
			7	Anode

Millimetre dimensions have been derived from inches.



# QS150/45

## VOLTAGE STABILIZER

### Service Type CV395

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS150/45 is a single gap cold cathode gas-filled voltage stabilizer with a B8G base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 5.0 to 45mA.

### GENERAL DATA

#### Characteristics

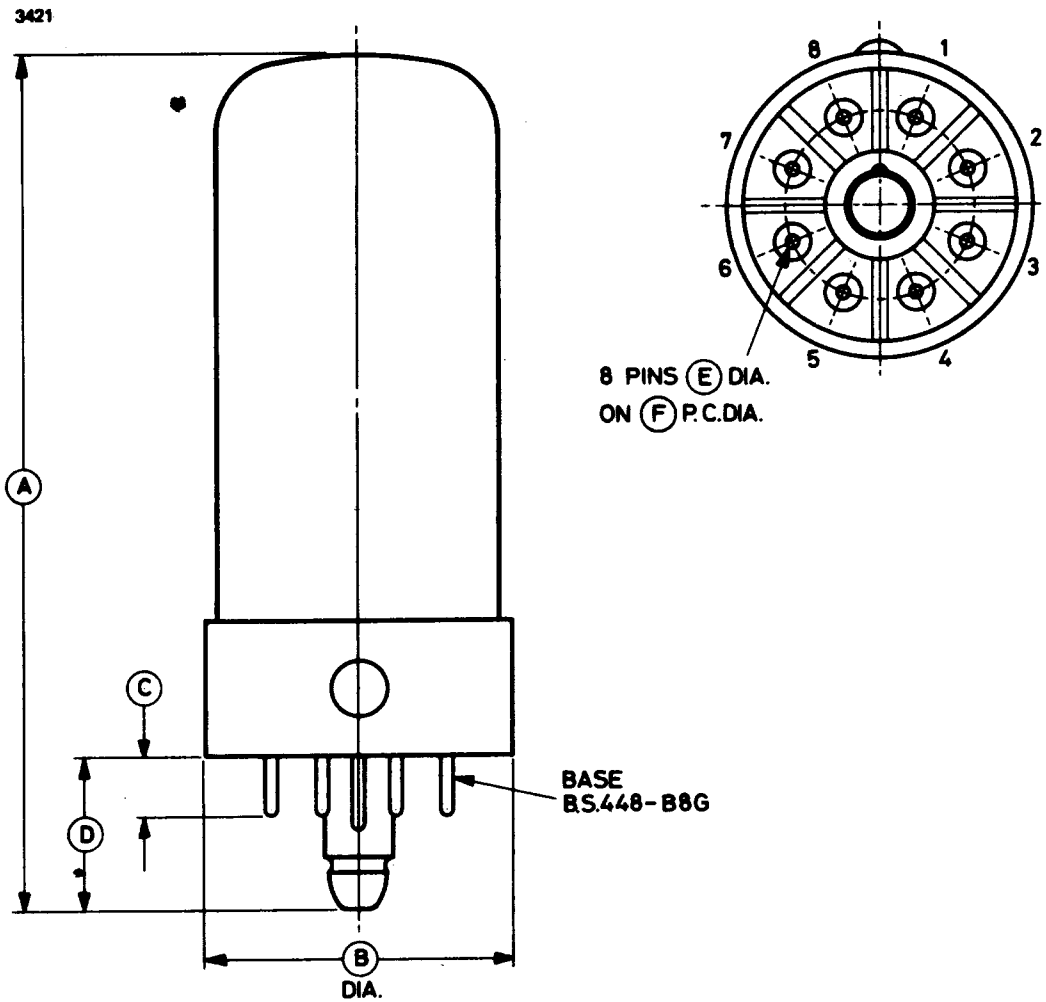
Ignition electrode voltage . . . . .	200	V
Ignition electrode series resistance . . . . .	0.1	MΩ
Striking voltage in normal lighting (see note) . . . . .	170	V max
Operating voltage at 25mA . . . . .	150 ± 5	V
Cathode current range . . . . .	5.0 to 45	mA
Regulation over current range 5.0 to 45mA . . . . .	5.0	V max
Regulation over current range 5.0 to 25mA . . . . .	2.0	V max
Noise (r.m.s.) (50 to 5000Hz) over the current range 5.0 to 45mA . . . . .	10	mV max

#### Mechanical

Overall length . . . . .	3.150 inches (80.0mm) max
Overall diameter . . . . .	1.187 inches (30.15mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B8G

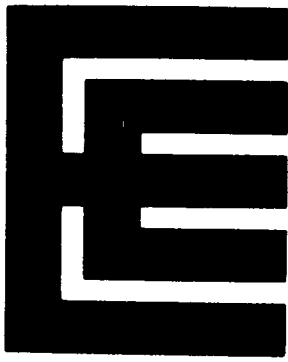
**Note** The striking voltage in the case of a tube provided with an ignition electrode is the voltage at which the anode takes over control of the discharge from the ignition electrode.

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	3.150 max	80.01 max	1	Anode
B	1.187 max	30.15 max	2	Anode
C	0.220 max	5.59 max	3	Ignition electrode
D	0.561 max	14.25 max	4	Cathode
E	0.050	1.27	5	Cathode
F	0.687	17.45	6	Cathode
			7	Cathode
			8	Cathode

Millimetre dimensions have been derived from inches.



# QS1200

## VOLTAGE REFERENCE TUBE

### Service Type CV2225

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1200 is a single gap cold cathode gas-filled voltage reference tube with a B7G base. It is designed to provide a very stable voltage output of 150 volts over long periods, and may be used as a source of reference voltage.

### GENERAL DATA

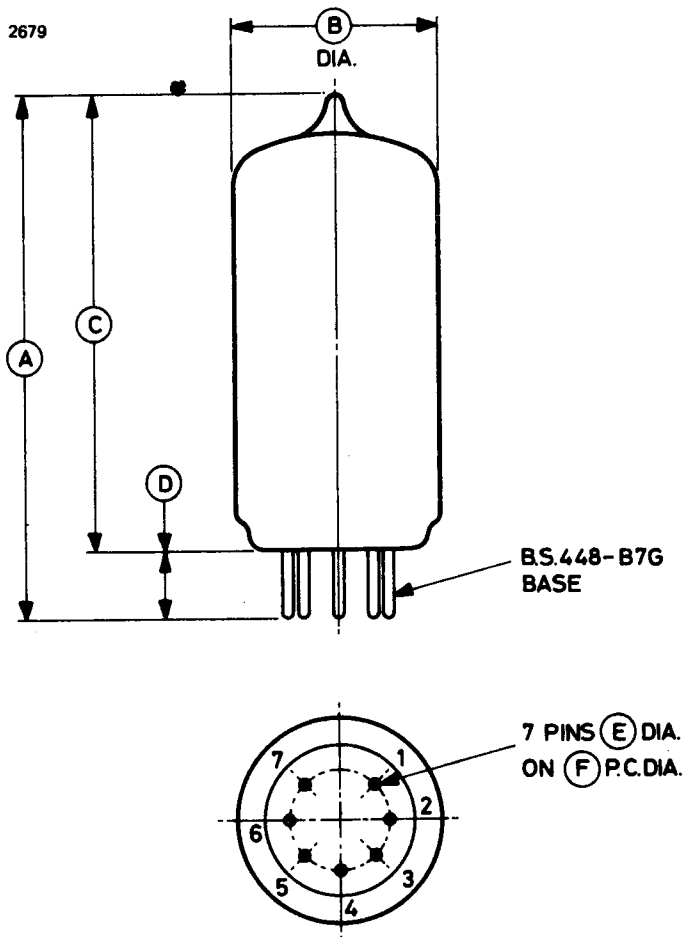
#### Characteristics

Striking voltage in normal lighting . . . . .	180	V max
Striking voltage in total darkness . . . . .	225	V max
Operating voltage at 10mA . . . . .	150 ± 4	V
Cathode current range . . . . .	5.0 to 15	mA
Regulation over current range . . . . .	5.0	V max
Variation of operating voltage with life during the first 2000 hours at 10mA . . . . .	±1.0	% max
Noise (peak to peak) (50 to 5000Hz) over the current range 5.0 to 15mA) . . . . .	250	mV max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

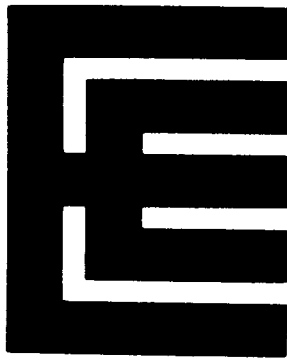
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Anode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Internal connection
D	0.281 max	7.14 max	4	Internal connection
E	0.040	1.02	5	Internal connection
F	0.375	9.53	6	Internal connection
			7	Internal connection

Millimetre dimensions have been derived from inches.





# QS1203

## VOLTAGE STABILIZER

### Service Type CV4053

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1203 is a single gap cold cathode gas-filled voltage stabilizer with a B7G/F flying lead base. It is designed to provide a sensibly constant voltage output of 150 volts over the current range 2.0 to 15mA. The tube is a rugged and reliable type, designed to have a low impedance and to give a stable voltage output over long periods.

### GENERAL DATA

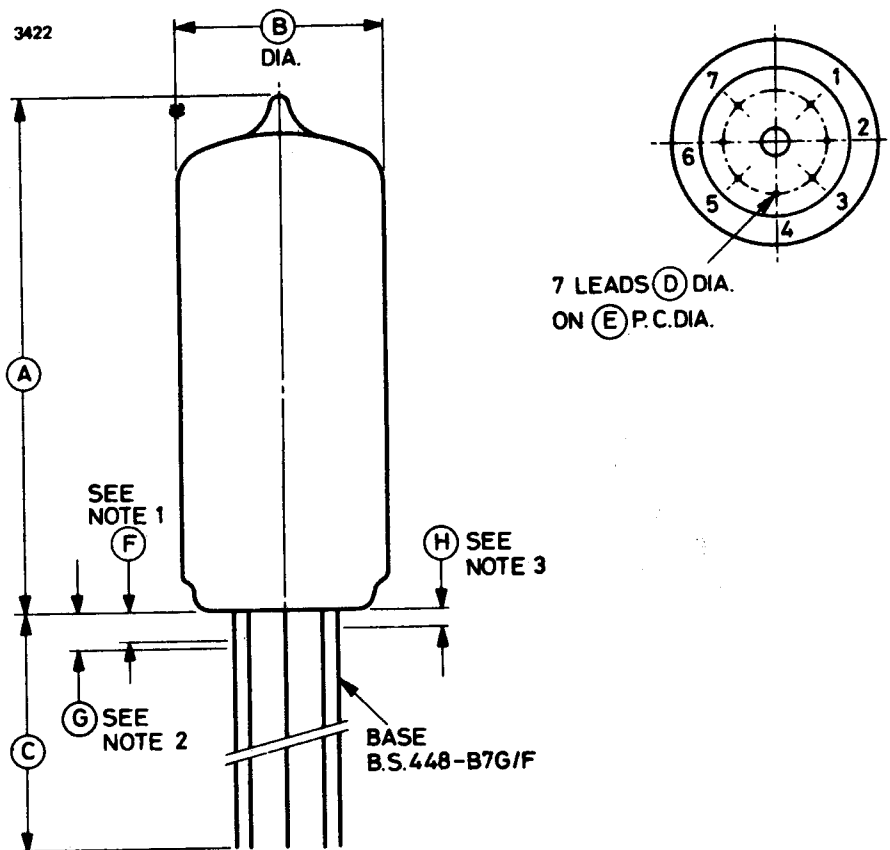
#### Characteristics

Striking voltage in normal lighting . . . . .	180	V max
Striking voltage in total darkness . . . . .	225	V max
Operating voltage at 10mA . . . . .	150 ± 4	V
Cathode current range . . . . .	2.0 to 15	mA
Regulation over current range . . . . .	4.5	V max
Variation of operating voltage with life:		
during first 200 hours at constant current (10mA) . . . . .	±2.0	V max
during any subsequent 1000 hours . . . . .	±1.5	V max
Voltage jumps over the range 2.0 to 15mA . . . . .	1.0	V max
Noise (peak to peak) (25 to 5000Hz) over the range 2.0 to 15mA . . . . .	50	mV max
Acceleration (continuous) . . . . .	2.5	g max
Shock (short duration) . . . . .	500	g max
Ambient temperature range . . . . .	-55 to +90	°C

#### Mechanical

Overall length (excluding leads) . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G/F

**OUTLINE (All dimensions without limits are nominal)**

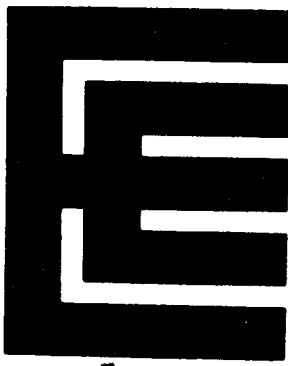


Ref	Inches	Millimetres	Lead	Element
A	1.874 max	47.6 max	1	Anode
B	0.748 max	19.0 max	2	Cathode
C	1.500 min	38.1 min.	3	Internal connection
D	0.017	0.432	4	Cathode
E	0.375	9.53	5	Anode
F	0.118 max	3.0 max	6	Internal connection
G	0.125	3.18	7	Cathode
H	0.062	1.58		

Millimetre dimensions have been derived from inches except dimension F.

**Outline Notes**

1. All leads will be tinned except for this length.
2. No soldered connection may be made in this length.
3. No bend may be made in this length.



# QS1209/5651

## VOLTAGE REFERENCE TUBE

Service Types CV449, CV2012

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1209/5651 is a single gap cold cathode gas-filled voltage reference tube with a B7G base. It is designed to provide a very stable voltage output of 85 volts over long periods, and may be used as a reference voltage source.

### GENERAL DATA

#### Characteristics

Striking voltage in normal lighting . . . . .	115	V max
Striking voltage in total darkness . . . . .	160	V max
Operating voltage at 6.0mA . . . . .	85 ± 2	V
Cathode current range . . . . .	1.0 to 10	mA
Regulation over current range 1.0 to 10mA . . . . .	4.0	V max
Regulation over current range 5.8 to 6.2mA . . . . .	0.18	V max
Variation of operating voltage with life (see note 1) (after 3 minutes running at 6.0mA):		
during the first 300 hours . . . . .	0.3	% max
during the first 1000 hours . . . . .	0.5	% max
during any 100 hour period after 300 hours . . . . .	0.1	% max
during any 1000 hour period after 300 hours . . . . .	0.2	% max
Repeatability of operating voltage in successive switchings (see note 2) . . . . .		
	10	mV max
Noise (peak to peak) (50 to 5000Hz) over the current range 1.0 to 10mA . . . . .		
	5.0	mV max
Voltage jumps (peak) over the current range 1.0 to 10mA . . . . .		
	100	mV max
Ambient temperature range . . . . .	-55 to +90	°C
Temperature coefficient (approx) . . . . .	-2.7	mV/°C

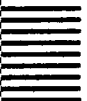
Continued on page 2

**Mechanical**

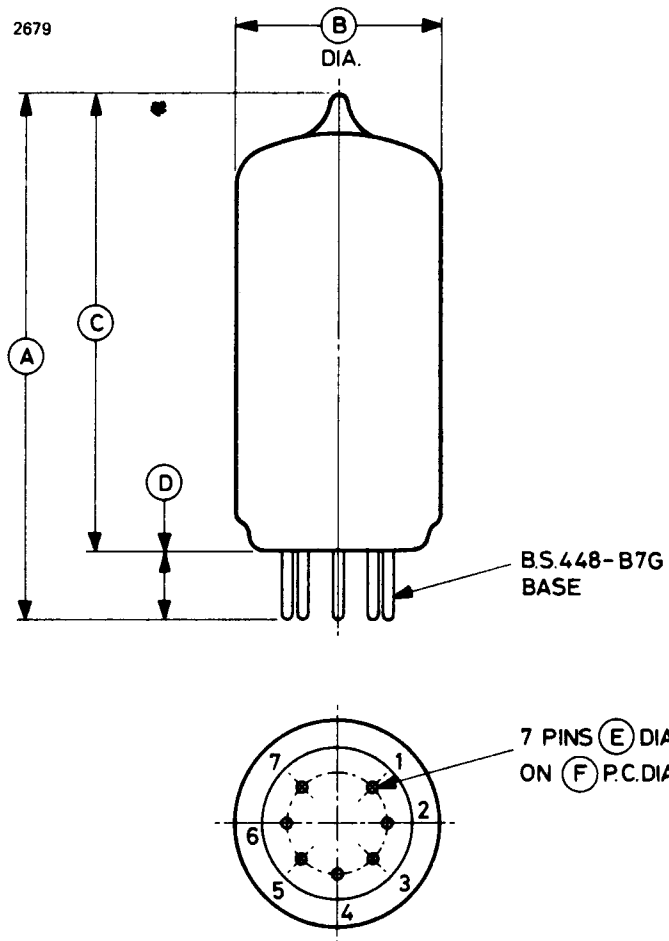
Overall length . . . . .	2.126 inches (54.0mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

**NOTES**

1. For minimum variation of operating voltage with life, the current should be as nearly constant as possible, preferably 6.0mA.
2. In assessing repeatability the operating voltage is measured at 6.0mA after each of five successive switchings of 1 minute On, 1 minute Off. The maximum difference between any two of these readings is taken as the measure of repeatability.

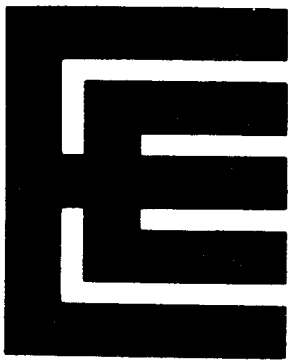


**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Anode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Internal connection
D	0.281 max	7.14 max	4	Cathode
E	0.040	1.02	5	Anode
F	0.375	9.53	6	Internal connection
			7	Cathode

Millimetre dimensions have been derived from inches.



# QS1212

## VOLTAGE REFERENCE TUBE

Service Types CV4048, CV5285

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1212 is a single gap cold cathode gas-filled voltage reference tube with a B7G base. It is rugged and reliable and is designed to provide a very stable voltage output of 85 volts over long periods. Radioactive material is used to give the same maximum striking voltage in total darkness and normal lighting.

### GENERAL DATA

#### Characteristics

Striking voltage in normal lighting or total darkness . . . . .	115	V max
Operating voltage at 6.0mA . . . . .	85 ± 2	V
Cathode current range . . . . .	1.0 to 10	mA
Regulation:		
over current range of 1.0 to 10mA . . . . .	4.0	V max
over current range of 5.8 to 6.2mA . . . . .	0.18	V max
Variation of operating voltage with life (see note):		
during the first 300 hours . . . . .	0.3	% max
during subsequent 1000 hours . . . . .	0.2	% max
during any 1000 hour period after the first 1000 hours . . . . .	0.1	% max
Acceleration (continuous) . . . . .	2.5	g max
Shock (short duration) . . . . .	500	g max
Noise (peak to peak) (50 to 5000Hz) over the current range 1.0 to 10mA . . . . .	5.0	mV max
Voltage jumps over the current range 1.0 to 10mA . . . . .	100	mV max

Continued on page 2

**Characteristics (Continued)**

Ambient temperature range . . . . .	-55 to +90	°C
Temperature coefficient:		
between -55°C and +25°C . . . . .	-10	mV/°C max
between †25°C and +90°C . . . . .	-5.0	mV/°C max

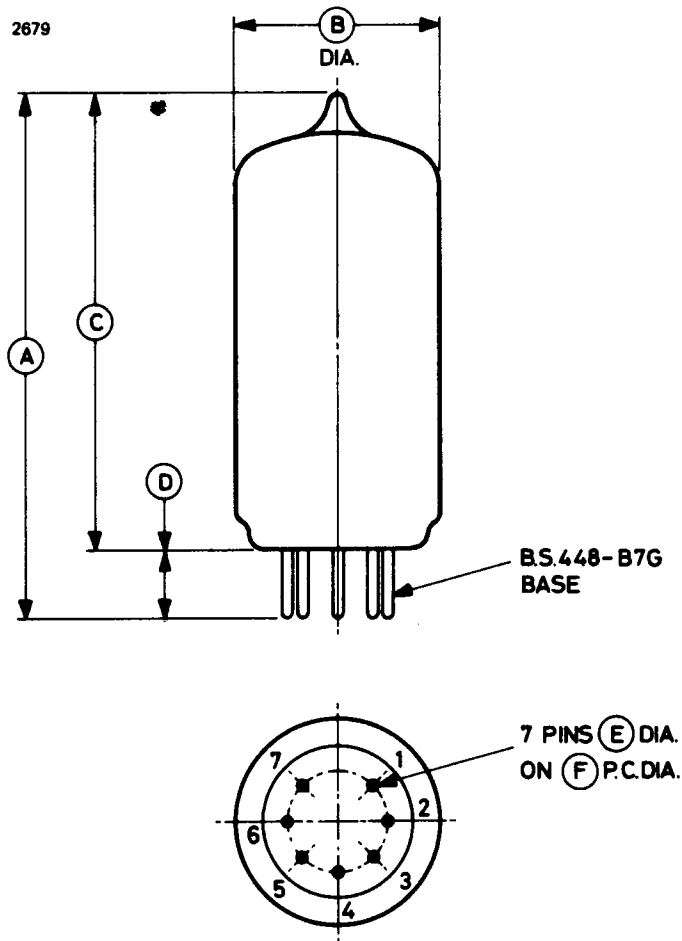
**Mechanical**

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G

**Note** For minimum variation of operating voltage with life the current should be as nearly constant as possible, preferably 6.0mA.



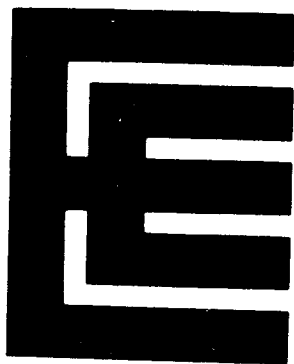
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres	Pin	Element
A	2.126 max	54.0 max	1	Anode
B	0.748 max	19.0 max	2	Cathode
C	1.874 max	47.6 max	3	Internal connection
D	0.281 max	7.14 max	4	Cathode
E	0.040	1.02	5	Anode
F	0.375	9.53	6	Internal connection
			7	Cathode

Millimetre dimensions have been derived from inches.





# QS1213

## VOLTAGE REFERENCE TUBE

Service Type CV4054

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1213 is a single gap cold cathode gas-filled voltage reference tube with a B7G/F flying lead base. It is rugged and reliable and is designed to provide a very stable voltage output of 85 volts over long periods. Radioactive material is used to give the same maximum striking voltage in total darkness and normal lighting.

### GENERAL DATA

#### Characteristics

Striking voltage in normal lighting or total darkness . . . . .	115	V max
Operating voltage at 6.0mA . . . . .	85 ± 2	V
Cathode current range . . . . .	1.0 to 10	mA
Regulation:		
over current range of 1.0 to 10mA . . . . .	4.0	V max
over current range of 5.8 to 6.2mA . . . . .	0.18	V max
Variation of operating voltage with life (see note):		
during the first 300 hours . . . . .	0.3	% max
during subsequent 1000 hours . . . . .	0.2	% max
during any 1000 hour period after the first 1000 hours . . . . .	0.1	% max
Acceleration (continuous) . . . . .	2.5	g max
Shock (short duration) . . . . .	500	g max
Noise (peak to peak) (50 to 5000Hz) over the current range 1.0 to 10mA) . . . . .	5.0	mV max
Voltage jumps over the current range 1.0 to 10mA . . . . .	100	mV max

Continued on page 2

**Characteristics (Continued)**

Ambient temperature range . . . . .	-55 to +90	°C
Temperature coefficient:		
between -55°C and +25°C . . . . .	-10	mV/°C max
between +25°C and +90°C . . . . .	-5.0	mV/°C max

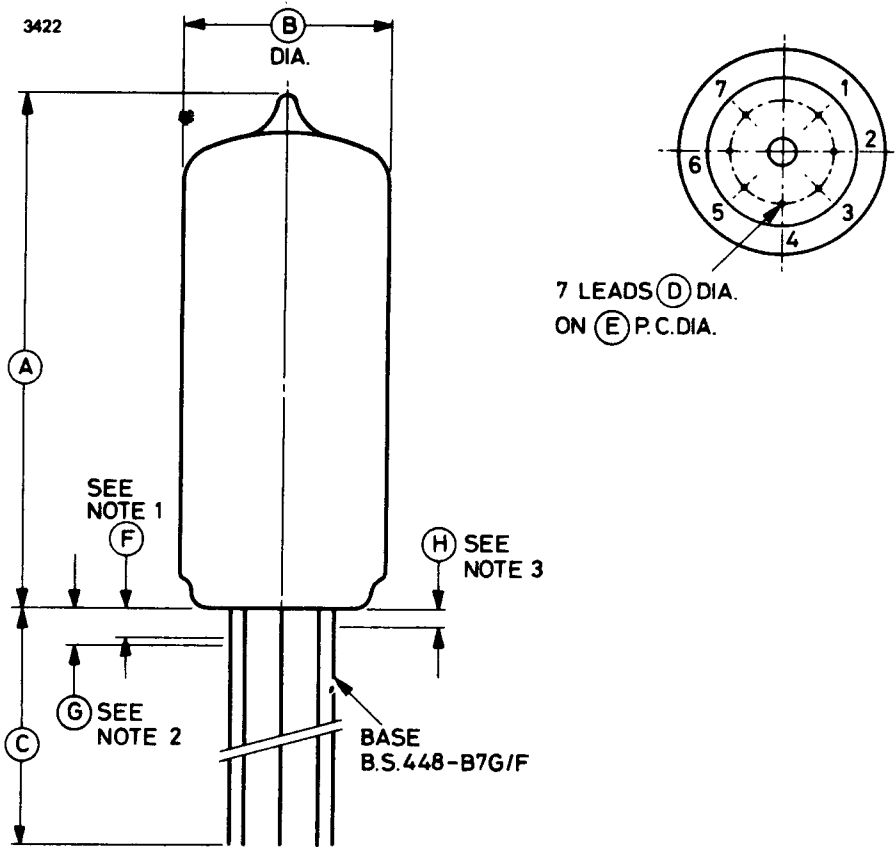
**Mechanical**

Overall length (excluding leads) . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G/F

**Note** For minimum variation of operating voltage with life the current should be as nearly constant as possible, preferably 6.0mA.



**OUTLINE (All dimensions without limits are nominal)**

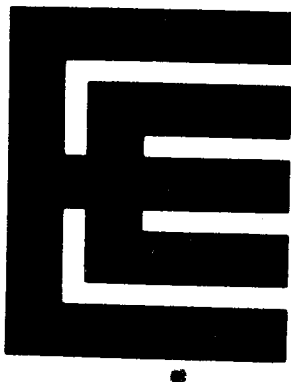


Ref	Inches	Millimetres	Lead	Element
A	1.874 max	47.6 max	1	Anode
B	0.748 max	19.0 max	2	Cathode
C	1.500 min	38.1 min	3	Internal connection
D	0.017	0.432	4	Cathode
E	0.375	9.53	5	Anode
F	0.118 max	3.0 max	6	Internal connection
G	0.125	3.18	7	Cathode
H	0.062	1.58		

Millimetre dimensions have been derived from inches except dimension F.

**Outline Notes**

1. All leads will be tinned except for this length.
2. No soldered connection may be made in this length.
3. No bend may be made in this length.



# QS1215

## VOLTAGE STABILIZER

Service Type CV5173

The data to be read in conjunction with the Voltage Stabilizer Preamble.

### DESCRIPTION

The QS1215 is a single gap cold cathode gas-filled voltage stabilizer with a B7G base. It is designed to provide a sensibly constant voltage output of 90 volts over the current range 1.0 to 40mA. Radio-active material is used in the tube to give the same maximum striking voltage in total darkness and normal room lighting.

### GENERAL DATA

#### Characteristics

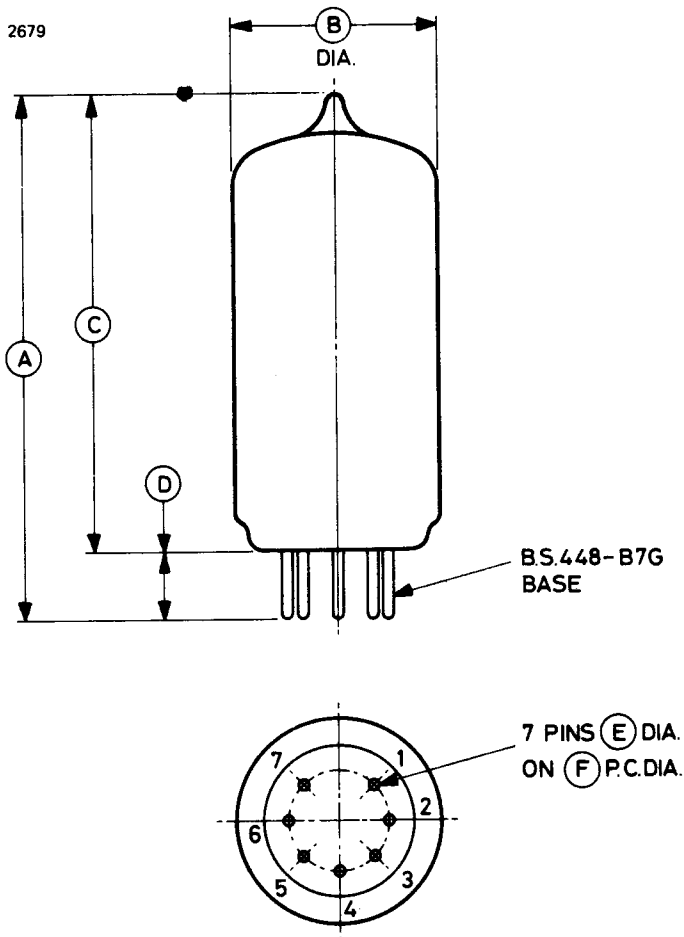
Striking voltage in normal lighting . . . . .	115	V max
Striking voltage in total darkness . . . . .	115	V max
Operating voltage at 20mA . . . . .	90 <sup>+2</sup> -4	V
Cathode current range . . . . .	1.0 to 40	mA
Regulation over current range . . . . .	12	V max
Variation of operating voltage with life during 1000 hours at 20mA . . . . .	±1.0	% max
Ambient temperature range . . . . .	-55 to +70	°C
Inverse voltage . . . . .	80	V max
Shunt capacitance . . . . .	0.1	μF max

#### Mechanical

Overall length . . . . .	2.126 inches (54.0mm) max
Seated height . . . . .	1.874 inches (47.6mm) max
Overall diameter . . . . .	0.748 inch (19.0mm) max
Mounting position . . . . .	any
Base . . . . .	B.S.448-B7G



**OUTLINE (All dimensions without limits are nominal)**

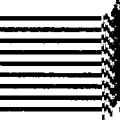


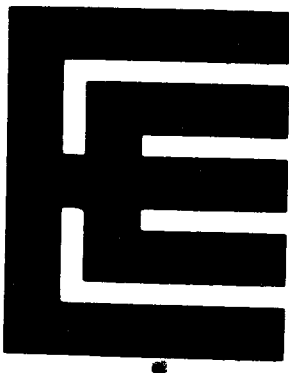
Ref	Inches	Millimetres
A	2.126 max	54.0 max
B	0.748 max	19.0 max
C	1.874 max	47.6 max
D	0.281 max	7.14 max
E	0.040	1.02
F	0.375	9.53

Millimetre dimensions have been derived from inches.

Pin	Element
1	Anode
2	Cathode
3	Internal connection
4	Cathode
5	Anode
6	Internal connection
7	Cathode

## Other Products





# 24B9

## TRIGATRON

Service types CV6008 and CV6173

### INTRODUCTION

The 24B9 is a gas-filled triggered spark gap intended for use in line-discharge modulators. It may be used as a direct replacement for the 24B1, with improved life.

### GENERAL DATA

Overall length	156mm (6.142 inches) max
Overall diameter	70mm (2.756 inches) max
Base	CL3
Top cap	B.S.448-CT5
Mounting position	any
Net weight	7 ounces (200g) approx
Cooling	natural



### MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

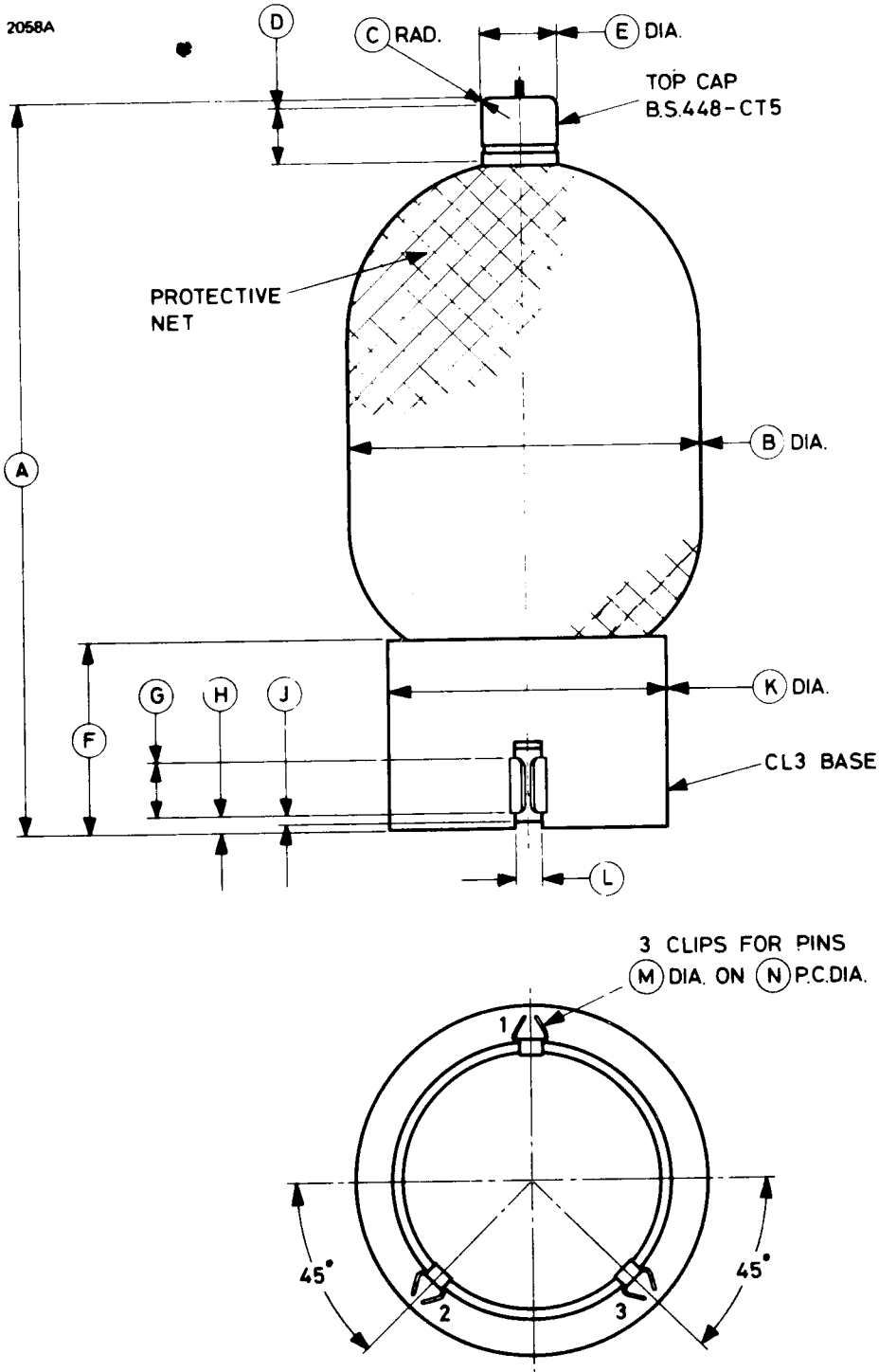
	Min	Max	
Main gap pulse voltage (anode positive)	6.6	10.5	kV
Pulse length	—	1.0	μs
Pulse repetition frequency	—	3000	p.p.s.

### TYPICAL OPERATION

Main gap pulse voltage (anode positive)	7.2	kV
Average trigger voltage (see note)	3.2	kV
Peak power output	160	kW
Jitter	0.2	μs
Pulse length	0.5	μs
Pulse repetition frequency	1200	p.p.s.

**Note** With an open circuit voltage of 8.5kV, having a rise time of approximately 0.67μs.

# OUTLINE





## Outline Dimensions

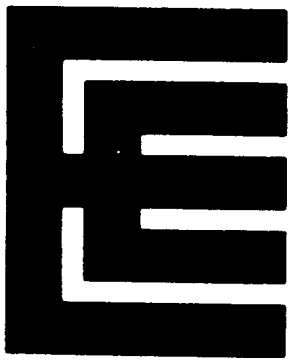
Ref	Millimetres	Inches
A	145.8 max	5.740 max
B	70.00 max	2.756 max
C*	1.78 max	0.070 max
D*	11.94 min	0.470 min
E*	14.99 ± 0.13	0.590 ± 0.005
F	36.5 ± 2.5	1.437 ± 0.098
G	11.00 ± 0.20	0.433 ± 0.008
H	4.00 max	0.157 max
J	1.50 max	0.059 max
K	55.50 ± 0.30	2.185 ± 0.012
L	5.50 ± 0.13	0.217 ± 0.005
M	4.20	0.165
N	60.60 ± 0.25	2.386 ± 0.010

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



## Base Connections

Ref	Element
1	Trigger
2	Anode
3	No connection
Top cap	Cathode



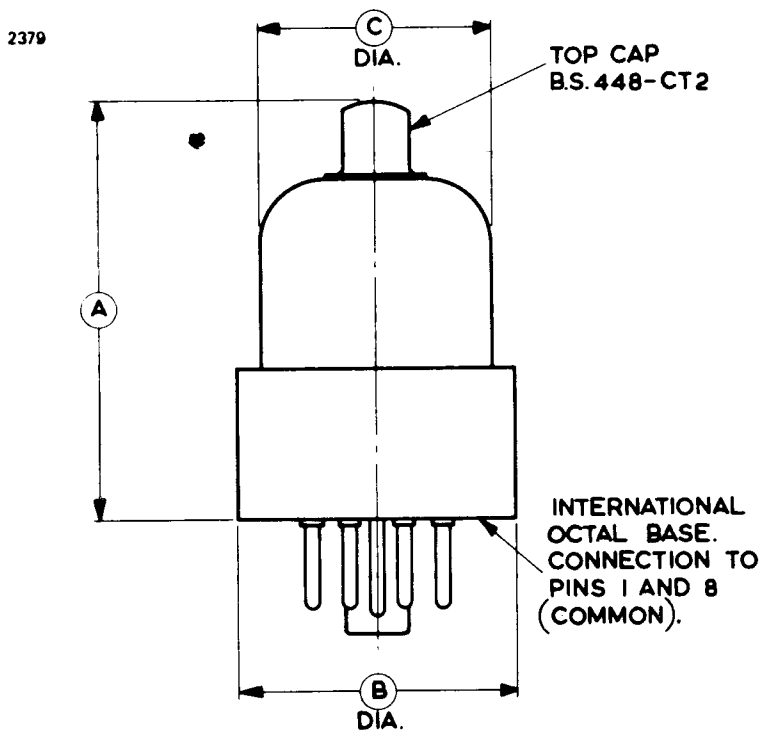
### INTRODUCTION

The following list gives examples of the present range of spark gaps in the GX series. The types listed can be manufactured with other values of breakdown voltage, in multiples of 100V.

Type	CV number	Previously known as	Breakdown voltage (V)	Tolerance ( $\pm$ V)	See page
GXA50	233	BS5	5000*	500	2
GXA60	1743	BS112	6000*	500	
GXA80	402	BS68	8000*	500	
GXA85	295	BS54	8500*	500	
GXA95	488	BS90	9500*	500	
GXA160	1859	BS4A	16 000*	1000	
GXB160	8296	BS142	16 000*	1000	3
GXE8	—	BS136	800	50	4
GXE15	—	BS208	1500	150	
GXE30	—	BS470	3000	150	
GXF5	—	BS192	500	50	5
GXF15	—	BS408	1500	75	
GXF17	—	BS598	1700	85	
GXF22	—	BS436	2200	110	
GXF25	—	BS422	2500	125	

\* Measured under the following pulse conditions; pulse length  $1.0\mu\text{s}$ , repetition rate 1000p.p.s., rate of rise of voltage 50 to  $100\text{kV}/\mu\text{s}$ .

## STYLE A OUTLINE



### Dimensions for GXA50, GXA60, GXA80, GXA85, GXA95

Ref	Millimetres	Inches
A	62.5 max	2.461 max
	56.0 min	2.205 min
B	35.0 max	1.378 max
C	30.0 $\pm$ 1.0	1.181 $\pm$ 0.039

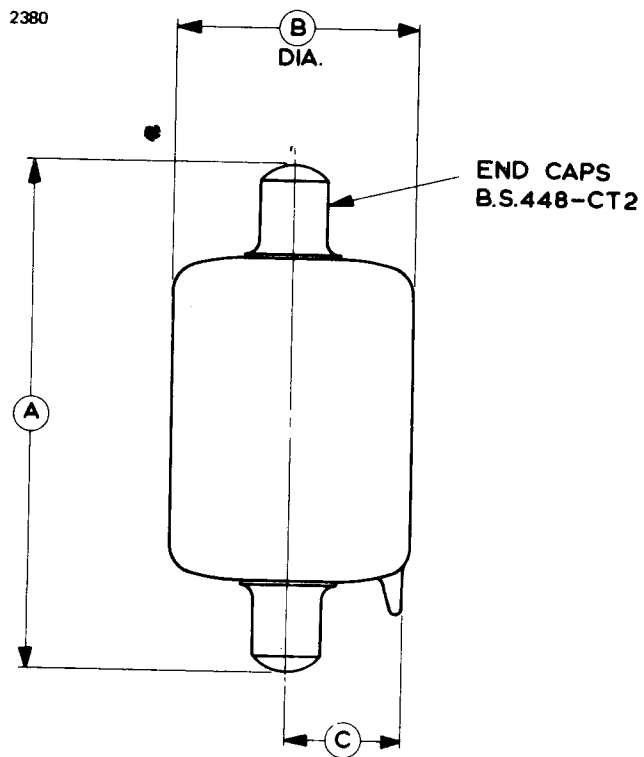
Inch dimensions have been derived from millimetres.

### Dimensions for GXA160

Ref	Millimetres	Inches
A	67.0 $\pm$ 3.0	2.638 $\pm$ 0.118
B	35.0 max	1.378 max
C	30.0 $\pm$ 1.0	1.181 $\pm$ 0.039

Inch dimensions have been derived from millimetres.

## STYLE B OUTLINE



### Dimensions for GXB160

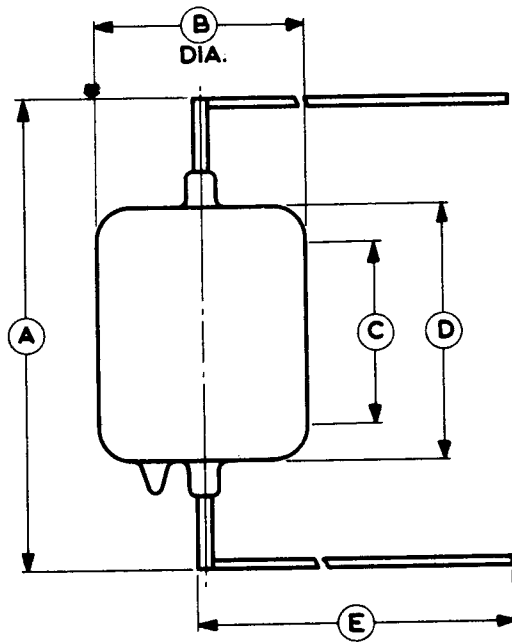
Ref	Millimetres	Inches
A	$63.5 \pm 5.0$	$2.500 \pm 0.197$
B	$30.0 \pm 1.0$	$1.181 \pm 0.039$
C	17.5 max	0.689 max

Inch dimensions have been derived from millimetres.



# STYLE E OUTLINE

2381

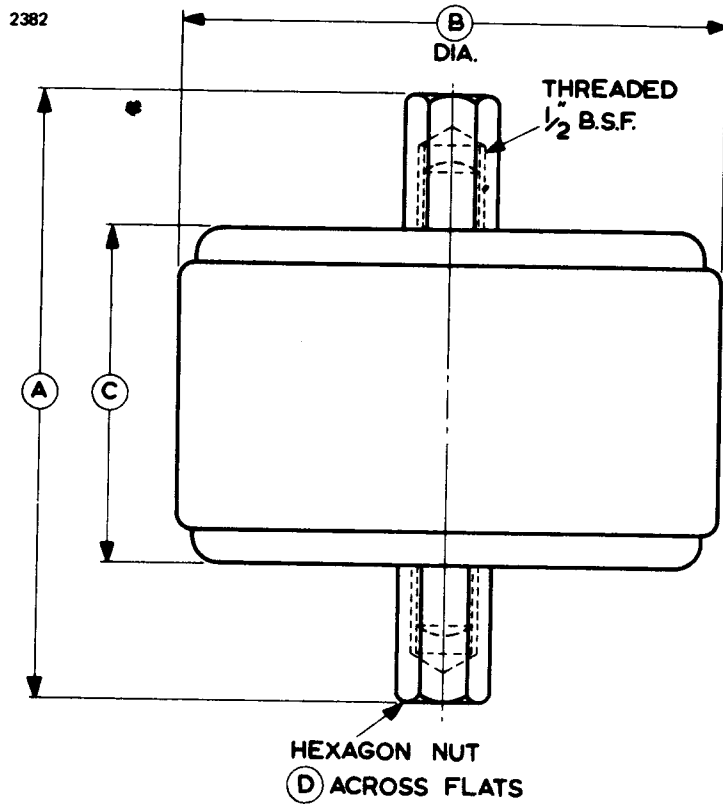


## Dimensions for GXE8, GXE15, GXE30

Ref	Inches	Millimetres
A	1.750 max	44.45 max
B	0.780 max	19.81 max
C	0.500 min	12.70 min
D	0.960 ± 0.080	24.38 ± 2.03
E	2.000 ± 0.120	50.80 ± 3.05

Millimetre dimensions have been derived from inches.

# STYLE F OUTLINE



## Dimensions for GXF5, GXF15, GXF17, GXF22, GXF25

Ref	Inches	Millimetres
A	4.750 ± 0.250	120.7 ± 6.4
B	4.000 ± 0.062	101.6 ± 1.6
C	3.000 max	76.20 max
D	0.600	15.24

Millimetre dimensions have been derived from inches.

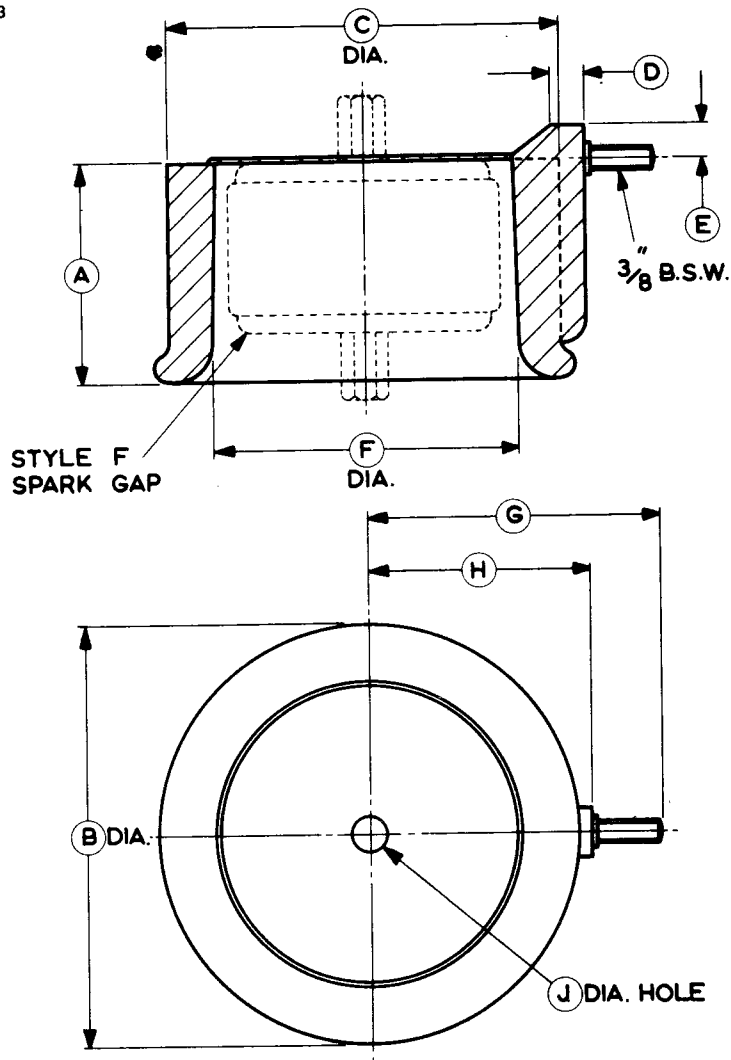
See page 6 for details of stabilizing coil.



# STABILIZING COIL FOR STYLE F GAPS

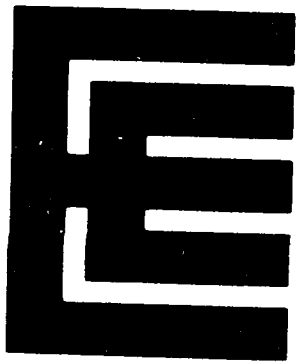
(All dimensions are nominal)

2383



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	3.250	82.55	F	4.500	114.3
B	6.250	158.8	G	4.312	109.5
C	5.750	146.1	H	3.250	82.55
D	0.500	12.70	J	0.516	13.11
E	0.500	12.70			

Millimetre dimensions have been derived from inches.



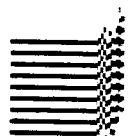
# GX/SG Series

## 2-ELECTRODE AND 3-ELECTRODE SPARK GAPS

### DESCRIPTION

A range of gas-filled spark gaps, untriggered (2-electrode) and triggered (3-electrode), for use in one-shot pulse generators, voltage surge protection and 'crowbar' circuits.

Type	Number of electrodes	Main gap voltage (kV)	Main gap energy (J)
GX/SG4	2	0.8-5.0	10
GX/SG5	3	0.8-5.0	10
GX/SG10	3	25-45	10
GX/SG11	2	5.0-10	10
GX/SG12	3	5.0-10	10
GX/SG13	2	25-45	10
GX/SG14	3	11-24	10
GX/SG15	2	11-24	10



### MAXIMUM RATINGS (Absolute values)

	2-electrode	3-electrode	
Main gap energy (500 arcs)	10	10	J
Trigger gap energy (500 arcs)	—	1	J
Main gap energy (5000 arcs)	0.5	0.5	J
Trigger gap energy (5000 arcs)	—	0.05	J

The main gap hold-off voltage generally falls during life. It will not change by more than 10% for the number of arcs shown above, provided the energy dissipated in the device in each arc is kept within the appropriate value, and also provided the arcs are not repeated at intervals of less than 30 seconds. Operation at shorter intervals may reduce the hold-off voltage.

### CHARACTERISTICS

#### Main Gap DC Hold-off Voltage (Untriggered)

The hold-off voltage appears in the type number and all new tubes will withstand this voltage without firing. The last figure of the type number indicates the hold-off voltage in hundreds of volts. For example:

GX/SG4/8 and GX/SG5/8	0.8kV hold-off voltage
GX/SG11/80 and GX/SG12/80	8.0kV hold-off voltage

There are no standard or preferred voltages. Tubes can be supplied to order for any voltage in the ranges specified above.

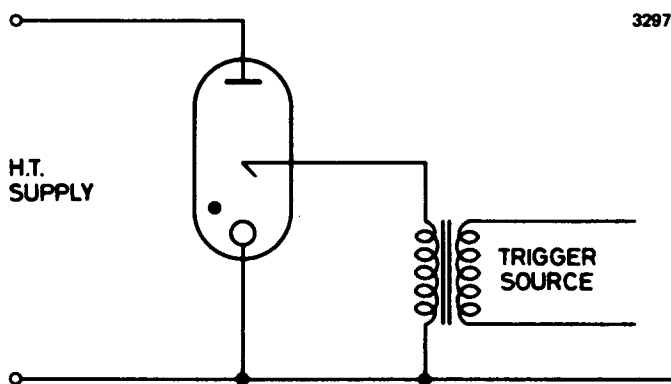


## Main Gap DC Breakdown Voltage (Untriggered)

In each type the main gap will break down untriggered at a voltage not more than 10% higher than the hold-off voltage.

## Triggering (See Fig. 1)

In the case of 3-electrode spark gaps, if a trigger gap discharge occurs with an energy of 0.05 joule or greater the main gap will break down at a lower voltage than that obtained in the untriggered condition. The trigger voltage required will be approximately 20% less than this reduced main gap breakdown voltage.



**Fig. 1** Typical Trigger Circuit

The main gap discharge can be initiated by a trigger discharge as low as 0.4 millijoule, in which case the voltages required may be slightly higher than those using a trigger energy of 0.05 joule.

The polarities of the applied voltage are not important.

## Breakdown Time

The breakdown time for all tubes is approximately  $100\mu\text{s}$ .

This is a typical figure. If the trigger pulse is a fast-rising voltage step of greater amplitude than the minimum triggering voltage, the overall breakdown time may be less than this.

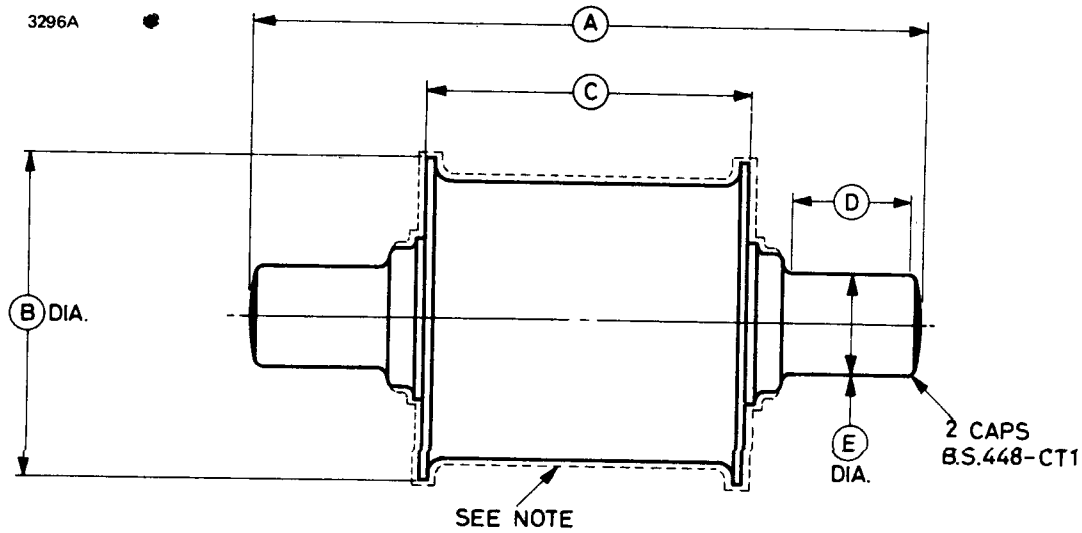
## Temperature

All tubes will operate satisfactorily with body temperatures in the range  $-10$  to  $+50^{\circ}\text{C}$ .

## Radioactivity

To ensure consistency of operation, these spark gaps have been made slightly radio-active. The resulting radiation intensity at the surface will not exceed 1.5 milliröntgens per hour.

**OUTLINE FOR 2-ELECTRODE TYPES**  
**All dimensions without limits are nominal**

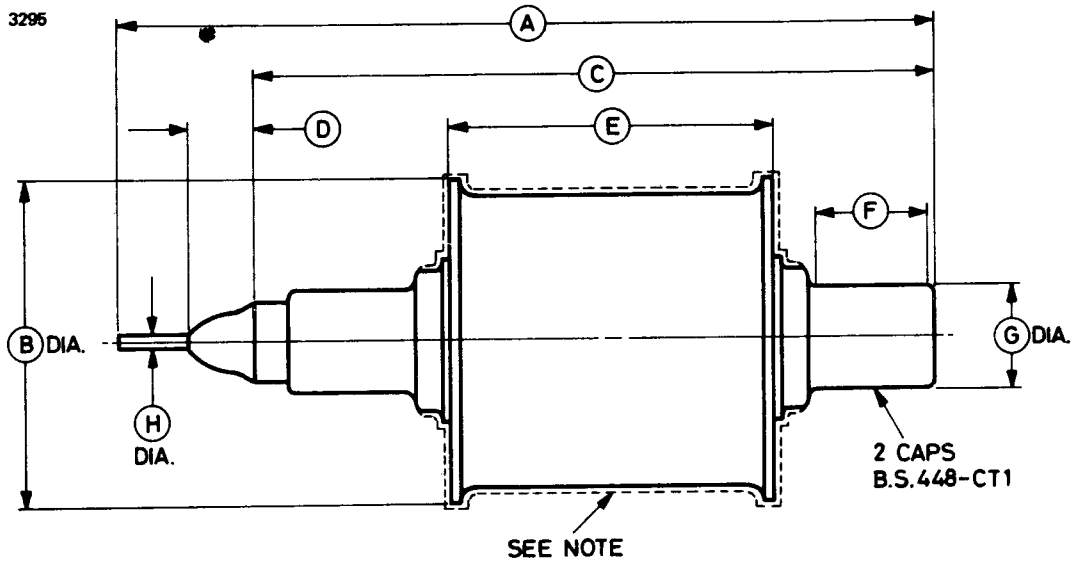


Ref	GX/SG4	GX/SG11	GX/SG13	GX/SG15
A	41.0 max 38.0 min	44.0 max 40.0 min	63.0 max 44.0 min	47.0 max 44.0 min
B	20.0 max 19.5 min	20.0 max 19.5 min	20.0 max 19.5 min	20.0 max 19.5 min
C	20.0 max 17.5 min	23.0 max 19.0 min	42.0 max 24.0 min	26.0 max 23.5 min
D	5.34 min	5.34 min	5.34 min	5.34 min
E	6.35	6.35	6.35	6.35

All dimensions in millimetres

**Note** GX/SG13 is covered with a plastic sleeve as shown.

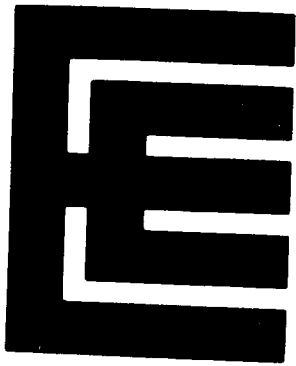
**OUTLINE FOR 3-ELECTRODE TYPES**  
**All dimensions without limits are nominal**



Ref	GX/SG5	GX/SG10	GX/SG12	GX/SG14
A	52.0 max 49.0 min	74.0 max 55.0 min	55.0 max 51.0 min	58.0 max 53.0 min
B	20.0 max 19.5 min	20.0 max 19.5 min	20.0 max 19.5 min	20.0 max 19.5 min
C	42.0 max 39.0 min	64.0 max 45.0 min	45.0 max 41.0 min	48.0 max 43.0 min
D	6.5 max 3.0 min	6.5 max 3.0 min	6.5 max 3.0 min	6.5 max 3.0 min
E	20.0 max 17.5 min	42.0 max 25.0 min	23.5 max 20.0 min	26.0 max 23.0 min
F	5.34 min	5.34 min	5.34 min	5.34 min
G	6.35	6.35	6.35	6.35
H	1.0	1.0	1.0	1.0

All dimensions in millimetres.

**Note** GX/SG10 is covered with a plastic sleeve as shown.

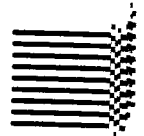


# TYPE H, TYPE J OZOTRONS

## INTRODUCTION

The ozotron is a device which will detect minute quantities of halogen or halogen compound gases in the atmosphere. It consists of two concentric cylindrical electrodes, the inner cylinder being heated to approximately 800°C by an internal heater. The air to be tested is drawn through the annular space between the electrodes and a voltage applied across the gap, the heated inner cylinder being the anode. The electrodes are enclosed in a protective envelope; type H has a glass envelope and type J, ceramic. The ceramic type may be dismantled so that the electrodes can be cleaned.

Under clean air conditions and with an anode voltage of 240 volts d.c., a very small ion current flows in the anode circuit. However, if air containing halogen vapour such as freon or trichlorethylene is introduced into the ozotron the positive ion current is increased. The increase in anode current provides a measure of the halogen vapour concentration in the air being sampled, and can be amplified to operate either an alarm signal or a meter. The principal application of the ozotron is in leak detection equipments. The vessel or system to be tested is filled with a halogen vapour slightly above atmospheric pressure and any leaks may be traced by monitoring the ozotron current while sampling air from the suspect areas.



## OPERATION

### Operational Conditions

Heater voltage (a.c. or d.c.)	5.5	V
Heater current	7.0	A nom
Anode voltage (d.c.)	200 to 250	V
Air flow rate (nominal)	250	cm <sup>3</sup> /min

### Performance

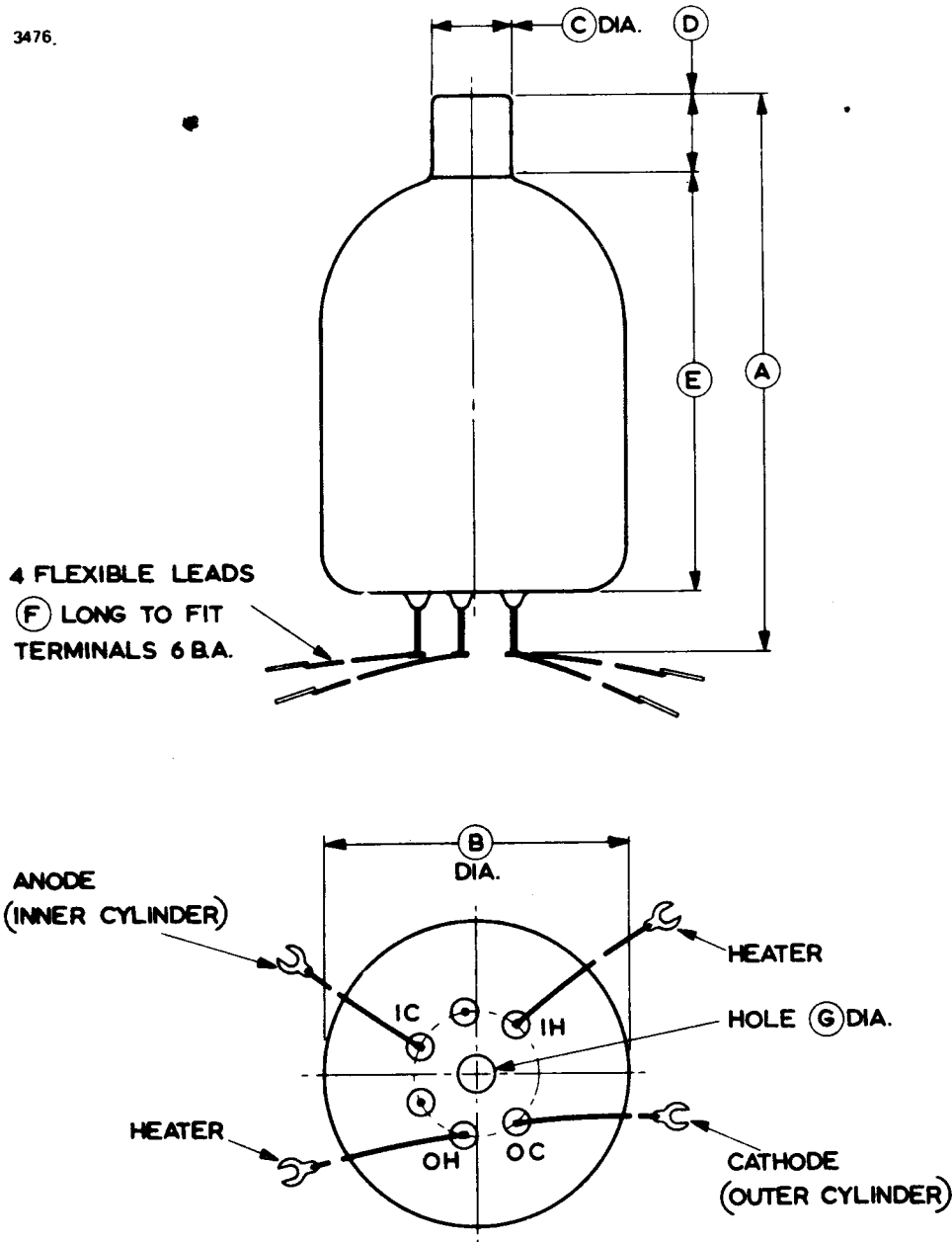
Anode current in clean air	12	μA max
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Sensitivity:—

The ozotron is capable of detecting halogen concentrations of 1 part in 1 500 000. A leakage of Arcton (dichlorodifluoromethane) at the rate of 1.5 milligrams per day (0.02 ounce per year) can be located.

# OUTLINE FOR TYPE H

3476.

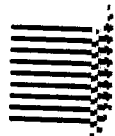
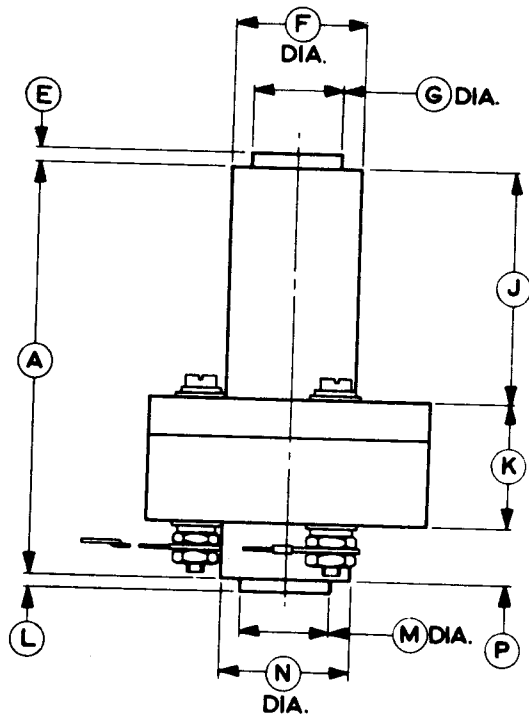
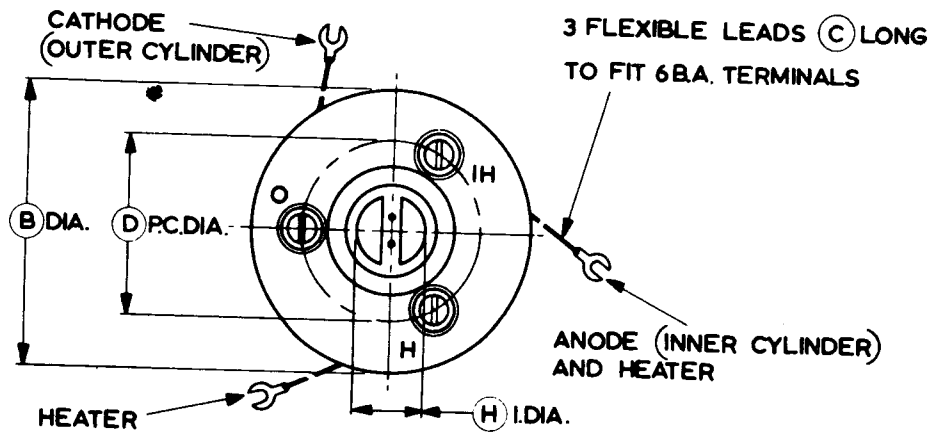


Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	$2.750 \pm 0.125$	$69.85 \pm 3.18$	E	$2.062 \pm 0.125$	$52.37 \pm 3.18$
B	$1.500 \pm 0.062$	$38.10 \pm 1.57$	F	$1.375 \pm 0.125$	$34.93 \pm 3.18$
C	0.415 max	10.54 max	G	0.276 max	7.00 max
	0.350 min	8.89 min		0.226 min	5.75 min
D	$0.375 \pm 0.062$	$9.53 \pm 1.57$			

Millimetre dimensions have been derived from inches.

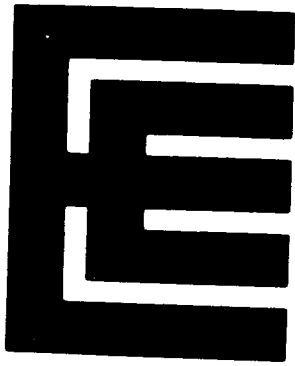
# OUTLINE FOR TYPE J (All dimensions without limits are nominal)

3477



Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	2.000 ± 0.040	50.80 ± 1.02	H	0.348	8.84
B	1.375 ± 0.020	34.93 ± 0.51	J	1.125	28.58
C	1.500 ± 0.125	38.10 ± 3.18	K	0.600	15.24
D	0.875	22.23	L	0.065	1.65
E	0.065	1.65	M	0.450	11.43
F	0.625	15.88	N	0.625	15.88
G	0.450	11.43	P	0.275	6.99

Millimetre dimensions have been derived from inches.



# NFT Series

## NERNST FILAMENTS

### INTRODUCTION

The nernst filament is an infra-red radiation source which may be operated at high temperatures in air. Since it has no transparent envelope, none of the radiation is absorbed by the device.

The filament is a sintered tube with two leads for direct electrical heating; at normal ambient temperatures it is non-conducting and will only become conducting, and self heating, at temperatures above about 880°C. To avoid thermal stress and possible cracking, it is important to heat the filament uniformly, preferably by radiation heating. Alternatively, a 'soft' coal-gas/air flame may be used with care. The use of a draught shield is recommended. It is also necessary to keep the filament current above the minimum value quoted in order to maintain stable operation. The recommended power supply is 200/250V a.c. with a suitable series resistance or barretter.

The life of the filament is dependent upon the operating temperature; above 1750°C the life will be considerably reduced and in general the temperature should be the lowest that will give satisfactory results.

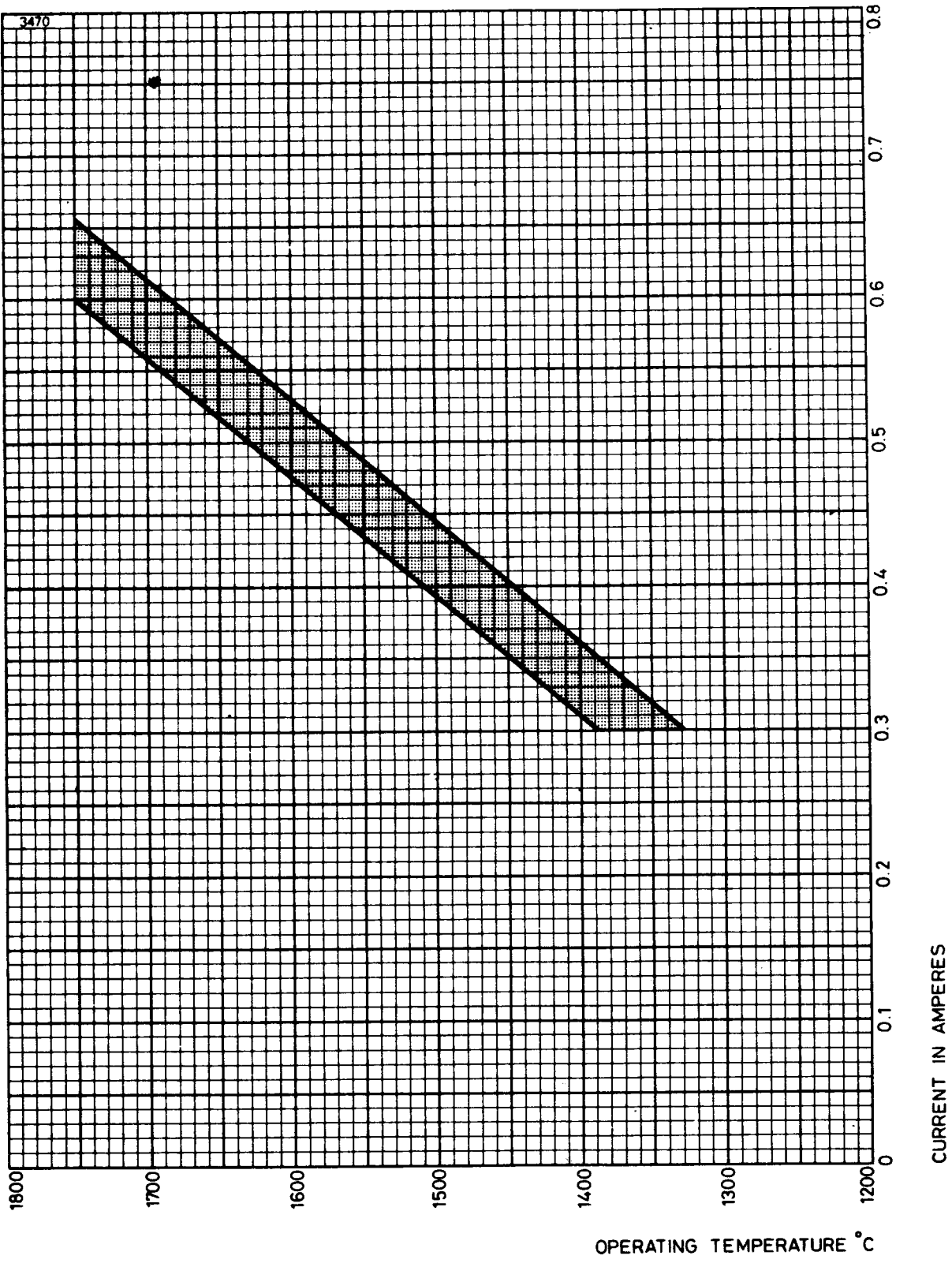
The temperatures referred to above, and in the graphs of temperature against current, are brightness temperatures as measured with an optical pyrometer.

### GENERAL DATA

Dimensions . . . . . see outline drawings  
Mounting position (supported by leads) . . . . . any

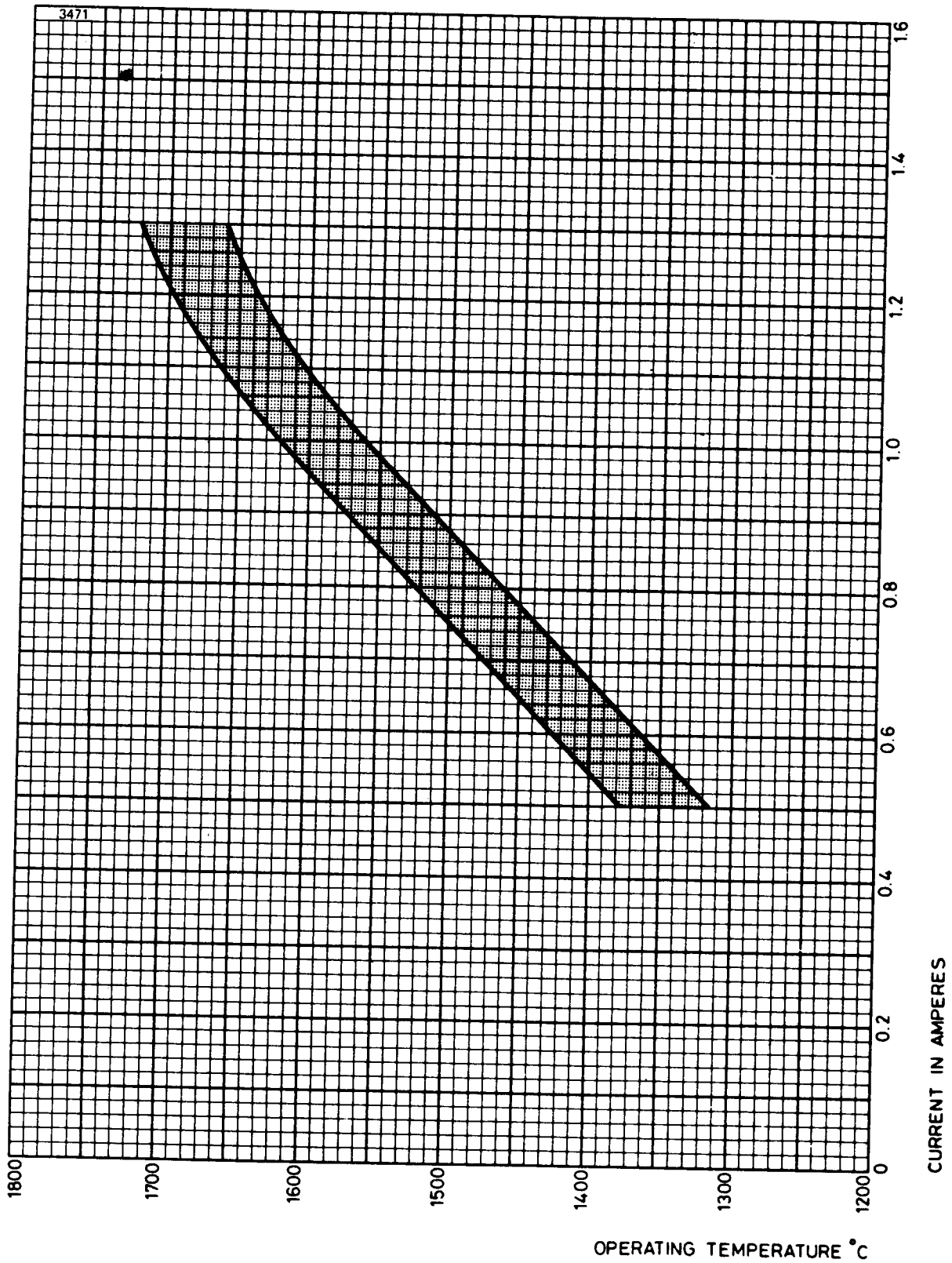
Type	Minimum operating current (A <sub>r.m.s.</sub> )	Operating voltage drop (V)
NFT1	0.3	90 to 110
NFT2	0.5	70 to 90
NFT3	0.4	70 to 95
NFT4	0.5	95 to 130
NFT5	0.2	70 to 100

# OPERATING RANGE OF NFT1

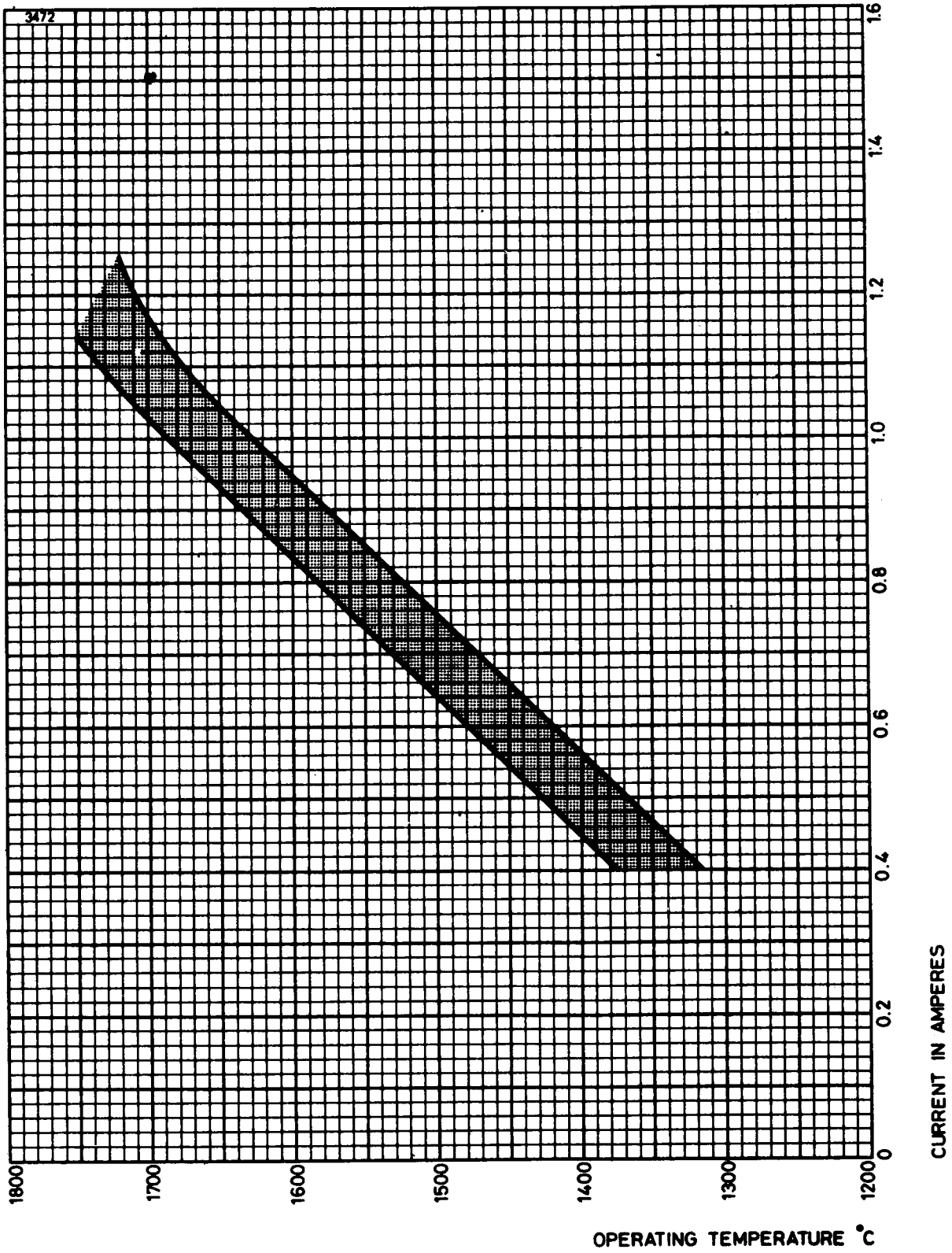




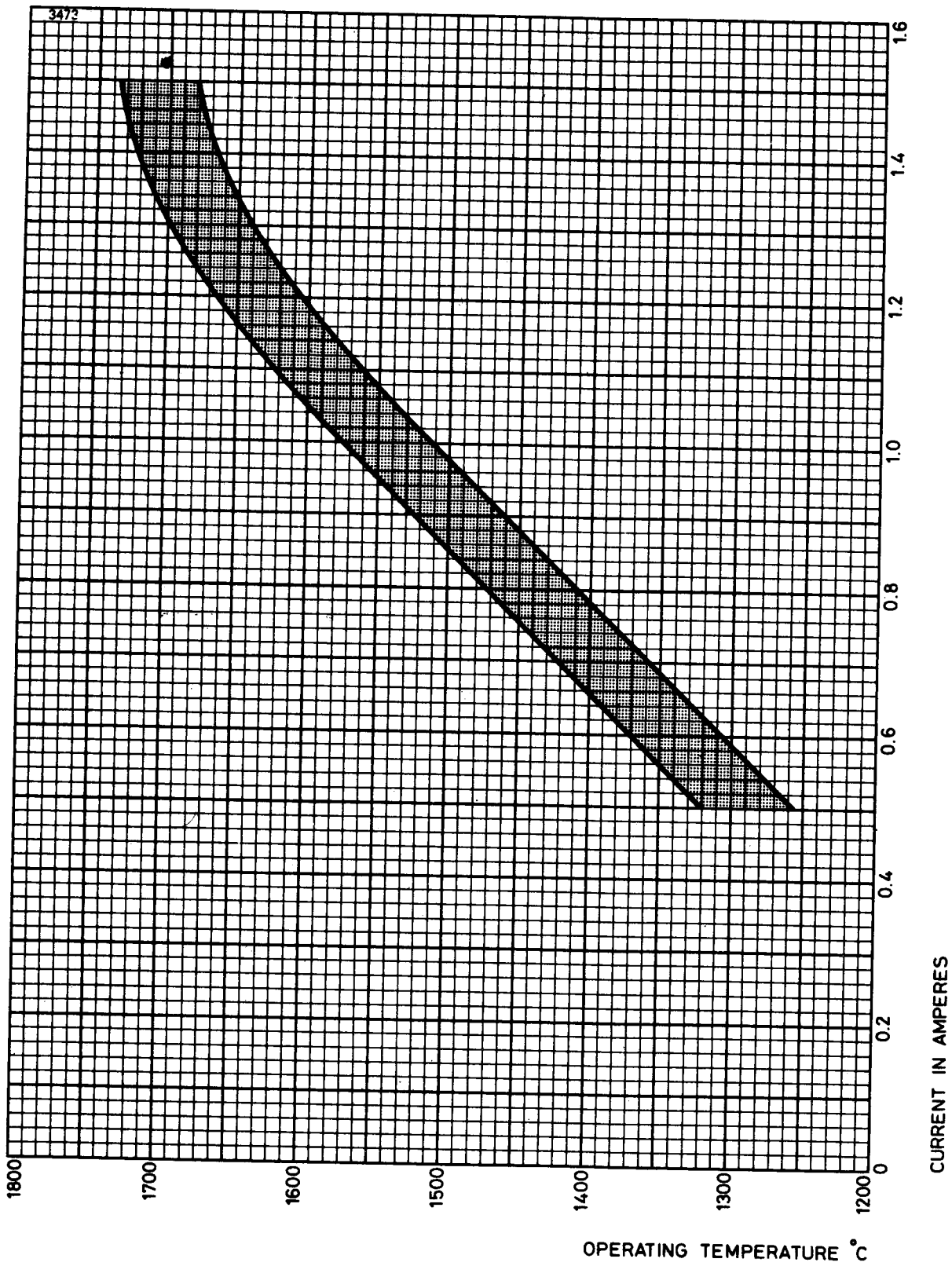
# OPERATING RANGE OF NFT2



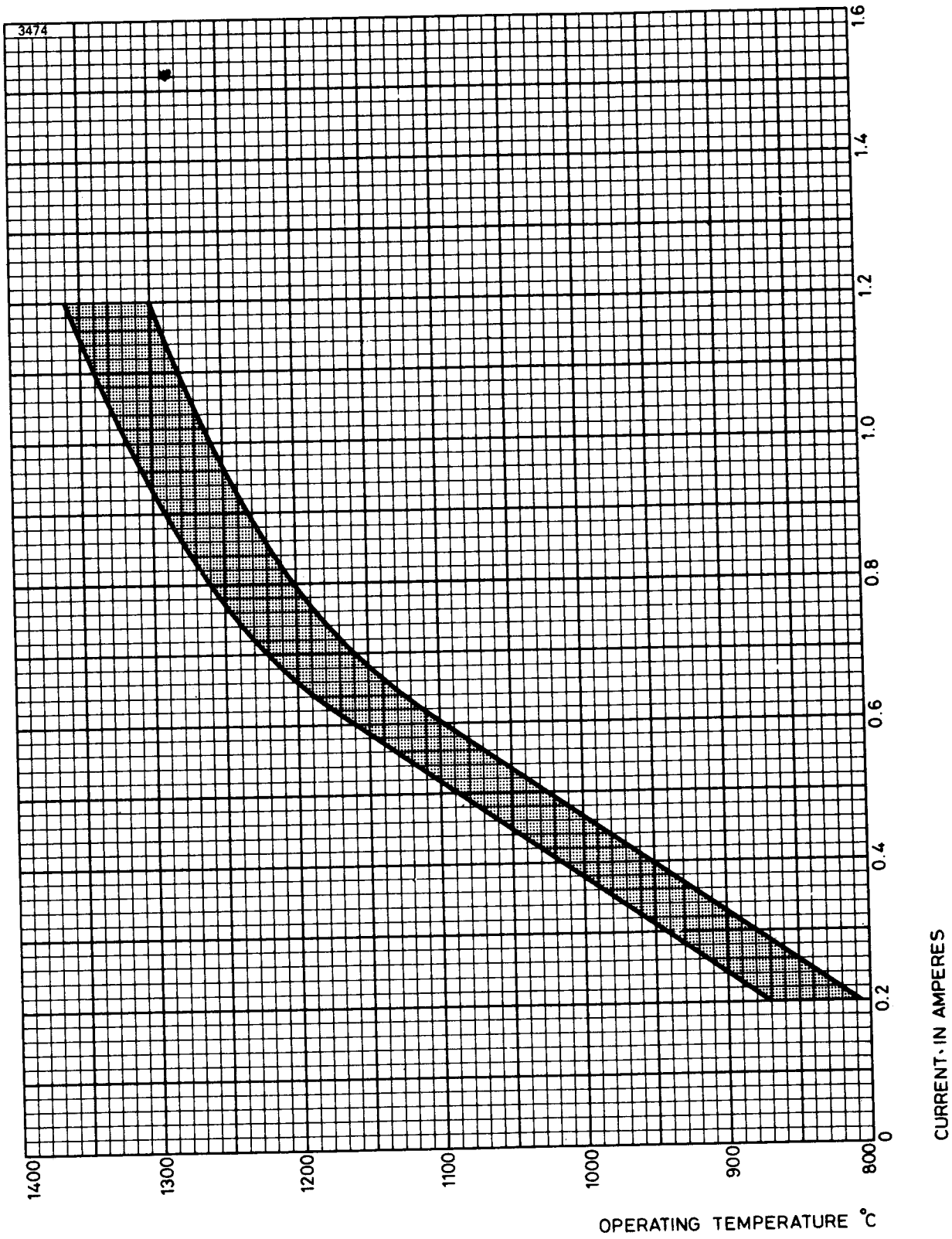
# OPERATING RANGE OF NFT3



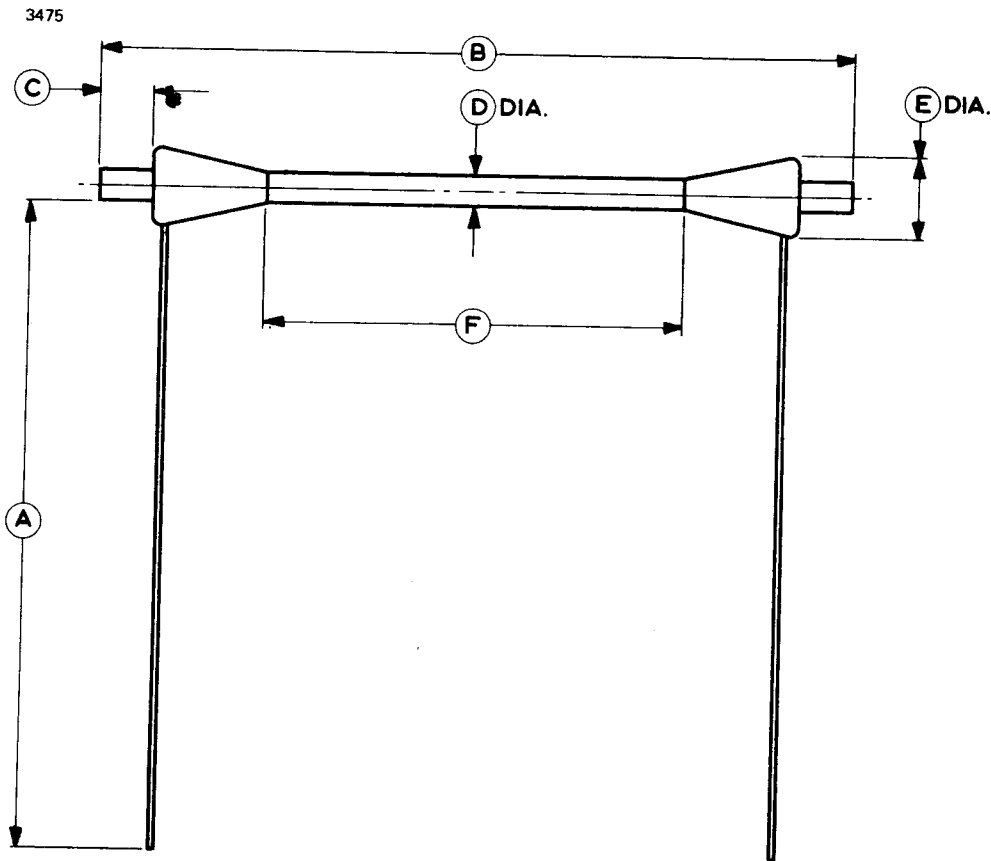
# OPERATING RANGE OF NFT4



# OPERATING RANGE OF NFT5



# OUTLINE FOR NFT SERIES



## NFT1

Ref	Millimetres	Inches
A	29.0 min	1.142 min
B	35.0 ± 1.0	1.378 ± 0.039
C	2.5	0.098
D	1.5 ± 0.1	0.059 ± 0.004
E	4.0 max	0.157 max
F	19.5 ± 1.0	0.768 ± 0.039

## NFT2

Ref	Millimetres	Inches
A	29.0 min	1.142 min
B	35.0 ± 1.0	1.378 ± 0.039
C	2.5	0.098
D	2.6 ± 0.1	0.102 ± 0.004
E	2.5 ± 0.1	0.098 ± 0.004
F	19.5 ± 1.0	0.768 ± 0.039

Inch dimensions have been derived from millimetres.

See page 8 for NFT3, NFT4 and NFT5 dimensions.

## Outline Dimensions (See page 7 for outline)

### NFT3

Ref	Millimetres	Inches
A	29.0 min	1.142 min
B	31.0 $\pm$ 1.0	1.220 $\pm$ 0.039
C	2.5	0.098
D	2.2 $\pm$ 0.1	0.087 $\pm$ 0.004
E	3.9 max	0.154 max
F	16.0 $\pm$ 1.0	0.630 $\pm$ 0.039

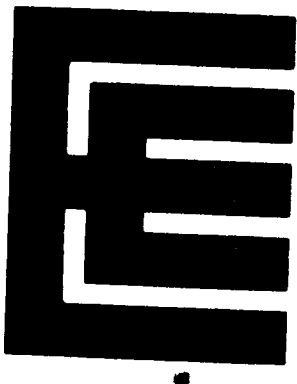
### NFT4

Ref	Millimetres	Inches
A	29.0 min	1.142 min
B	46.0 $\pm$ 2.0	1.811 $\pm$ 0.079
C	2.5	0.098
D	2.6 $\pm$ 0.3	0.102 $\pm$ 0.012
E	4.45 max	0.175 max
F	29.0 $\pm$ 1.0	1.142 $\pm$ 0.039

### NFT5

Ref	Millimetres	Inches
A	29.0 min	1.142 min
B	35.0 $\pm$ 1.0	1.378 $\pm$ 0.039
C	3.0	0.118
D	4.1 $\pm$ 0.2	0.161 $\pm$ 0.008
E	6.0 max	0.236 max
F	20.0 $\pm$ 1.0	0.787 $\pm$ 0.039

Inch dimensions have been derived from millimetres.



# QT1256

## TOUCH BUTTON TUBE

### DESCRIPTION

The QT1256 is a cold cathode tube designed for use as a self-indicating electronic switch; it is actuated by touch.

### RATINGS

Minimum anode-cathode d.c. breakdown voltage . . . . .	475	V
Anode-cathode d.c. maintaining voltage at 10mA . . . . .	185	V
Maximum continuous cathode current . . . . .	25	mA
Maximum peak cathode current . . . . .	100	mA

### OPERATION

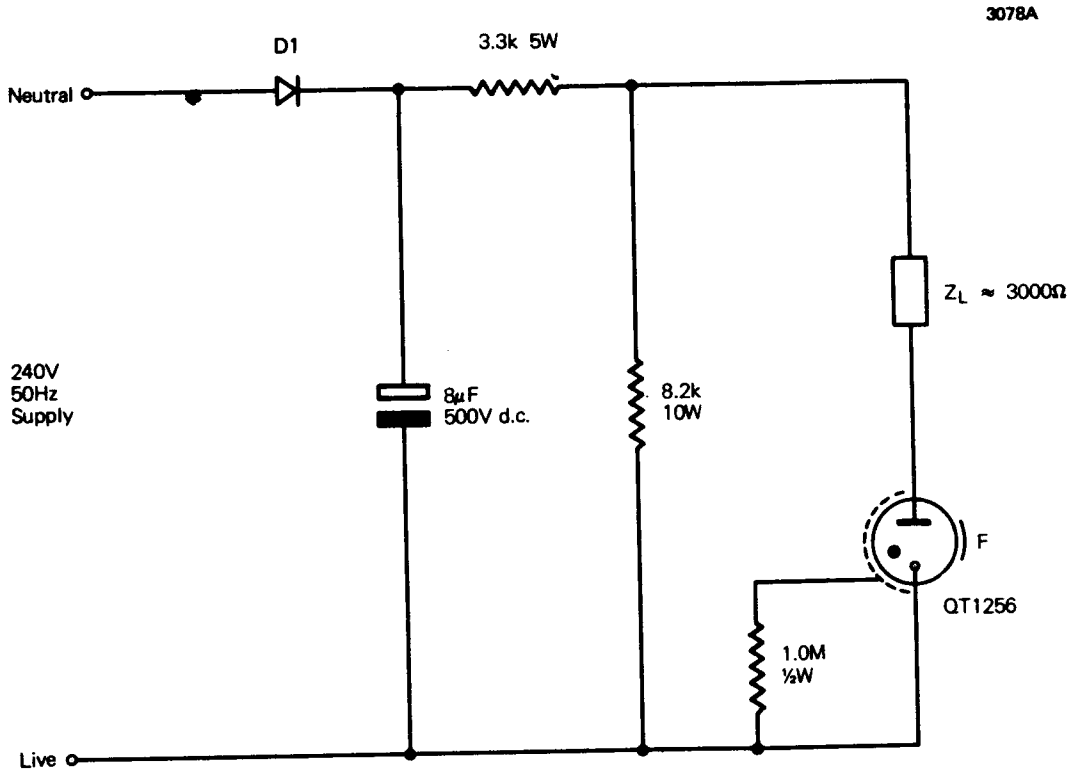
The Electronic Touch Button is a special type of trigger tube which is switched to the conducting state by the touch of a person's finger on an external control electrode which is placed at the end of the tube. After the electrode has been touched, the tube emits a visible glow until the h.t. supply is momentarily interrupted for a time exceeding the tube deionisation time. The current flowing through the tube may be used to operate a relay.

A typical application of this tube is its use in the control panel of lifts for selecting the floor at which the passenger wishes to alight. When the tube corresponding to the selected floor is touched, it continues to glow until the lift reaches that floor.

A typical circuit is shown on page 2. The external screening\* around the touch tube is connected to the live lead of the mains supply via a 1 megohm resistor. When the external control electrode F is touched by the hand, or is earthed, there is an alternating voltage of 240 volts between this electrode and the tube cathode. The current which flows produces enough ions to ignite the main gap. Even if the tube is touched by a hand covered with a glove, the capacitance between the external electrode and earth normally exceeds 5pF and this is adequate to fire the tube.

\* The external screening may be coated with insulating material.

# TYPICAL CIRCUIT



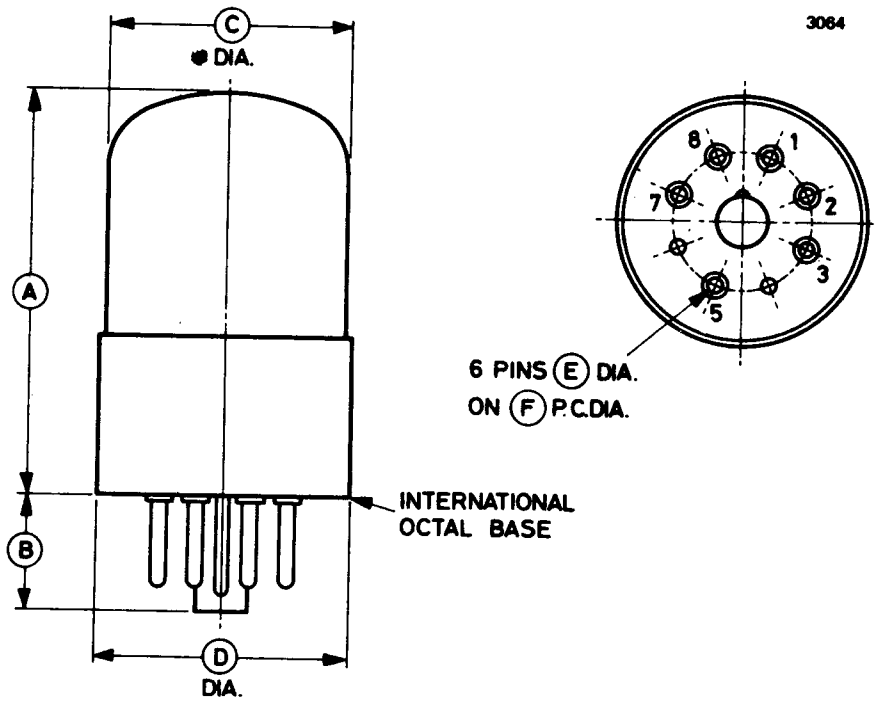
Nominal load current 10mA

D<sub>1</sub> Silicon rectifier, such as:—  
 AEI type SJ1003-F  
 ITT type RAS310AF

Z<sub>L</sub> Relay; suggested types for use as load are:—  
 Radiospares type 46  
 STC types 25 or 25HD  
 Keyswitch types MH2 or MH2P (2500Ω coil)  
 Potter and Brumfield type KCP11 (10mA coil)



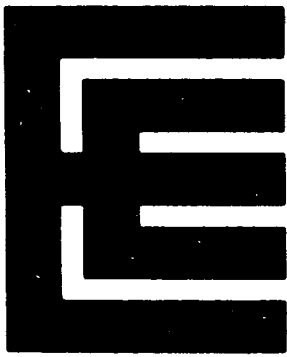
**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A*	1.969 max	50.0 max
B	0.560 max	14.22 max
C*	1.181 max	30.0 max
D	1.253 max	31.83 max
E	0.093	2.36
F	0.687	17.45

Millimetre dimensions have been derived from inches except where marked \*

Pin	Element
1	No connection
2	Cathode
3	No connection
4	Omitted
5	Anode
6	Omitted
7	No connection
8	No connection



## TOUCH BUTTON TUBE

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### DESCRIPTION

The QT1257 is a cold cathode tube designed for use as a self-indicating electronic switch; it is actuated by touch.

### RATINGS

Minimum anode-cathode d.c. breakdown voltage . . . . .	325	V
Anode-cathode d.c. maintaining voltage at 10mA . . . . .	80	V
Maximum continuous cathode current . . . . .	25	mA
Maximum peak cathode current . . . . .	100	mA

### OPERATION

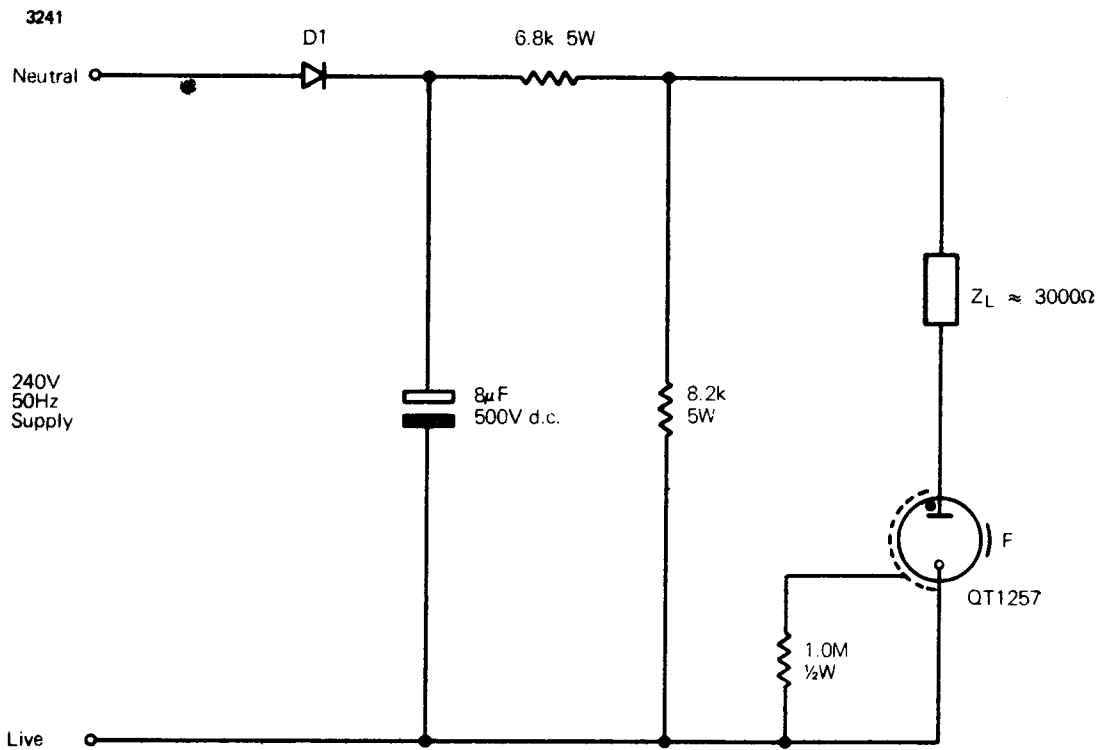
The Electronic Touch Button is a special type of trigger tube which is switched to the conducting state by the touch of a person's finger on an external control electrode which is placed at the end of the tube. After the electrode has been touched, the tube emits a visible glow until the h.t. supply is momentarily interrupted for a time exceeding the tube deionization time. The current flowing through the tube may be used to operate a relay.

A typical application of this tube is its use in the control panel of lifts for selecting the floor at which the passenger wishes to alight. When the tube corresponding to the selected floor is touched, it continues to glow until the lift reaches that floor.

A typical circuit is shown on page 2. The external screening\* around the touch tube is connected to the live lead of the mains supply via a 1 megohm resistor. When the external control electrode F is touched by the hand, or is earthed, there is an alternating voltage of 240 volts between this electrode and the tube cathode. The current which flows produces enough ions to ignite the main gap. Even if the tube is touched by a hand covered with a glove, the capacitance between the external electrode and earth normally exceeds 5pF and this is adequate to fire the tube.

\* The external screening may be coated with insulating material.

## TYPICAL CIRCUIT

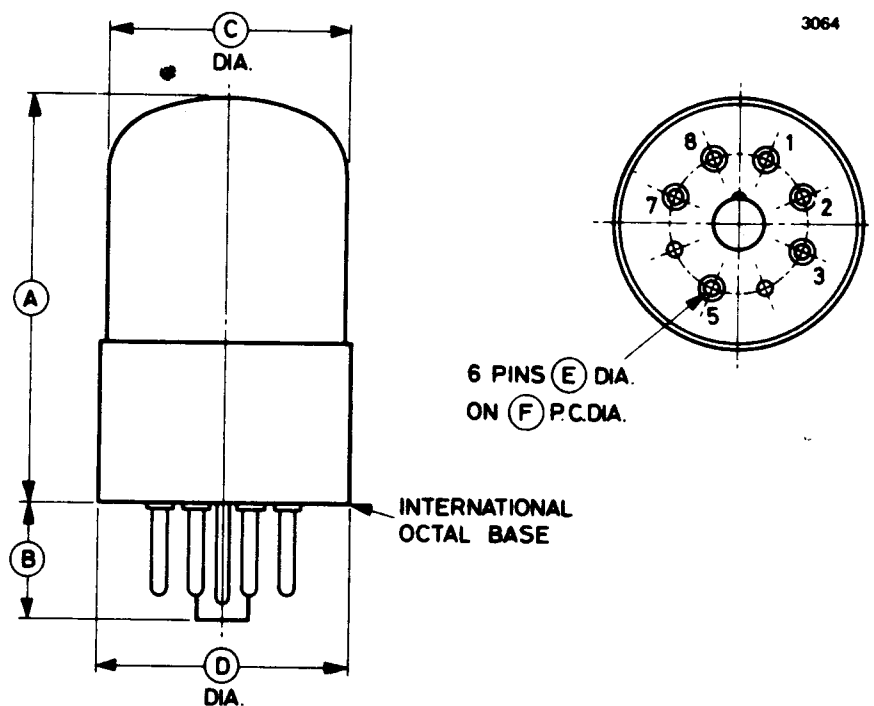


Nominal load current 12–15mA.

D1 Silicon rectifier, such as:—  
AEI type SJ803–F

Z<sub>L</sub> Relay; suggested types for use as load are:—  
Radiospares type 46  
STC types 25 or 25HD  
Keyswitch types MH2 or MH2P (2500Ω coil)  
Potter and Brumfield type KCP11 (10mA coil)

**OUTLINE (All dimensions without limits are nominal)**



Ref	Inches	Millimetres
A*	1.969 max	50.0 max
B	0.560 max	14.22 max
C*	1.181 max	30.0 max
D	1.253 max	31.83 max
E	0.093	2.36
F	0.687	17.45

Pin	Element
1	No connection
2	Cathode
3	No connection
4	Omitted
5	Anode
6	Omitted
7	No connection
8	No connection

Millimetre dimensions have been derived from inches except where marked \*

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**GENERAL SECTION**

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**IGNITRONS**

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**RECTIFIERS AND  
INDUSTRIAL THYRATRONS**

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**VOLTAGE STABILIZERS**

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**OTHER PRODUCTS**

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