IGNITRONS — GENERAL OPERATIONAL RECOMMENDATIONS

DEFINITIONS

Maximum average current

The rated maximum average anode current of an ignitron is based on full cycle conduction, regardless of whether phase control is used or not. It is the arithmetic mean current over a period not greater than the rated maximum averaging time.

Surge current

The figure given on each data sheet for maximum anode surge current is for fault protection only and is intended as a guide to equipment designers. It indicates the maximum value of current, resulting from a sudden overload or short circuit, which the ignitron will pass for a period not exceeding the time specified.

Demand current

The maximum demand current is the r.m.s. current conducted by a pair of ignitrons in inverse parallel, during a single cycle at mains frequency. For ratings purposes full cycle conduction must be assumed.

Demand kVA

The demand kVA is given by the product of demand r.m.s. current and the actual r.m.s. voltage applied to the ignitrons.

Arc voltage drop

This is the instantaneous potential difference between the anode and cathode during normal conduction.

Duty factor

The duty factor is the percentage ratio of conducting time to total time during a period not greater than the maximum averaging time. Thus a 100% duty factor specifies continuous conduction.

Maximum averaging time

A maximum averaging time is quoted for each supply voltage. This is the longest period of time during which it is permissible to compute the maximum average current.

Maximum conduction period

This is the maximum period within the maximum averaging time during which maximum demand may be conducted.

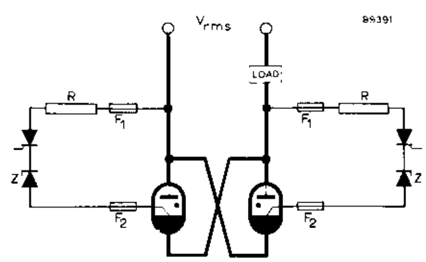
IGNITOR CIRCUIT REQUIREMENTS

To ignite an ignitron, a current pulse of short duration and preferably fast rise time must flow through the ignitor. Ignition has a certain energy requirement which,according to the ignitor characteristic, is a function of current, voltage and time. To ensure satisfactory ignition the total ignitor circuit must be able to deliver the required peak current within 100μs from the minimum specified voltage measured on the ignitor. If the load impedance, the series resistor or the losses across the switching device do not satisfy these requirements, the ignitor may not fire and may even become seriously damaged. Under no circumstances must the ignitor voltage be allowed to fall more negative than -5V with respect to the cathode as this will cause destruction of the ignitor.

Two systems of excitation are in common use:-

Anode excitation

This form of excitation is primarily used for resistance welding applications. The ignitor is fired from the anode circuit via a current limiting resistor, two fuses, a diode and a thyristor.



The "Min. peak ignitor voltage for ignition", must not be interpreted as the instantaneous value of mains voltage at the instant of ignition, but as the voltage measured between the ignitor lead-in and cathode. The values of the resistors in the ignition circuit and the level of supply voltage should be chosen so that the prescribed value of voltage is applied to the ignitor.

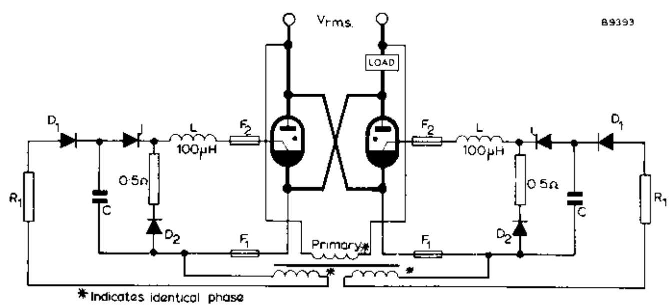
Recommended values of R are given in the data sheets. Deviations from these recommended values may impair the performance of the tube.

To ensure a short and reproducible delay between the firing of the ignitor and anode take-over, the rate of rise of ignition current must be sufficiently high. The rate of rise of current is mainly determined by the reactance of the load and at high load reactances it may be too small for proper ignition. In such circumstances separate excitation can be successfully used.

Separate excitation

Separate excitation enables the ignitor to be fired independently of anode circuit conditions. By this means it is possible to control a.c. circuits of lower voltages than is possible with anode excitation. It is also possible to control inductive loads, where the low power factor would preclude satisfactory anode excitation. Separate excitation is also necessary when ignitrons are used as rectifiers. In practice a capacitor is discharged into the ignitor via a thyristor and an inductor as in the diagram.

It is inadvisable to operate separate excitation in the absence of anode supply voltage.



Note:

In each circuit two fuses are recommended; F_1 safeguards the ignition circuit; F_2 is connected directly in series with the ignitor, protecting it against shorting between the main anode and ignition circuits or earth faults.

The ignitor must be connected to its control circuit by a screened lead which affords protection against r.f. fields.

The thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

AUXILIARY ANODE CIRCUIT

When a rectifier feeds a load which generates a back e.m.f., the available voltage between the main anode and cathode will often be insufficient to ensure takeover of the arc discharge when the tube is fired. Moreover, if the ignitron anode current is too small, the main discharge may cease prematurely.

For this reason ignitrons designed for use in rectifying equipment are provided with an auxiliary anode which maintains the arc discharge during the period when the main anode voltage falls below the minimum value necessary for continued conduction of the tube. The auxiliary anode should be connected to a low voltage a.c. source so that auxiliary anode current flows throughout tube conduction.

MAIN CIRCUIT

When the main discharge of an ignitron is interrupted voltage transients are produced in the transformer primary due to its self-inductance, which may puncture the insulation of the transformer.

In resistance welding circuits the transients may be reduced by a damping resistor mounted across the transformer primary terminals. The values of the current drawn by this resistor are determined by the duty factor of the machine.

In rectifier circuits damping is obtained by a series R.C. circuit shunted across the transformer primary.

Cathode or anode breakers are usually required in addition to the supply switches, particularly when a back e.m.f. is present.

RATINGS FOR RESISTANCE WELDING

In all cases these ratings are based on full cycle conduction of each half-cycle. No uprating is permissible when phase-shift control of conduction is used.

Demand kVA

The maximum demand kVA which may be obtained from a pair of ignitrons, connected in inverse parallel, is shown plotted against maximum average current per tube. It will be seen that max. kVA demand is constant up to the maximum average current per tube value, after which it diminishes to a point where it intersects the maximum average current ordinate, at the absolute maximum average current value.

Demand current

The maximum demand current varies with the supply voltage being used, and is plotted for voltages of 250, 440 and 500V against duty factor. Since 100% duty factor is actually the maximum averaging time, this is shown for each value of supply voltage. The maximum demand current refers to two tubes connected in inverse parallel.

RATINGS FOR FREQUENCY CHANGING DUTY

These ratings are given showing the relationship between maximum peak anode current per tube where the tube is suitable for this application. Curves are given for several anode voltages.

RATINGS FOR RECTIFIER DUTY

A curve is given showing the relationship between maximum peak anode current and maximum average current per tube and for several peak inverse voltages.

COOLING

The cooling water must satisfy the following requirements as regards the content of solids and soluble chemicals:

1. pH 7 to 9
2. Max. concentration of chlorides 15mg/l
   Max. concentration of nitrates 25mg/l
   Max. concentration of sulphates 25mg/l
   Max. concentration of insoluble solids 25mg/l
3. Max. total hardness: 10 German degrees, 18 French degrees, 12.5 English degrees, 10.5 U.S. degrees.
4. Min. specific resistance 2000Ωcm.

In most cases tap-water will satisfy these requirements. If the water locally available is unsuitable a system of cooling employing a heat exchanger with sufficient suitable water in circulation can alternatively be used.

The temperature of the cooling water should be at least 10°C.

The water-hoses must be of electrically insulating material and should be connected to the ignitrons so that the water enters the water jacket at the bottom and leaves it at the top. Up to 3 tubes may be cooled in series. The hoses should have a length of at least 50cm in order to ensure that the electrical resistance of the internal water column is sufficiently high. They should be fixed by means of clamps to the hose nipples, care being taken that no leakage can occur. The water must be allowed to flow freely from the last tube into a funnel, which enables the water flow to be easily checked and prevents the water pressure in the jackets from becoming excessive. The water pressure in the tube jackets should never exceed 3.5atm (50 pounds/square inch).

The water jackets of ignitrons are normally connected to the mains and thus have mains potential to earth. When thermostatic switches are used they must therefore be capable of withstanding this operating voltage. Should the thermostat not be rated for mains voltages an isolating step-down transformer can be used to protect it from damage.

The tubes should not be put into operation until all air is removed from the cooling system and filling completed. This is indicated by water flowing from the outlet pipe on the last tube.

The cooling system should be installed so that the water jackets are not emptied by the water flowing or syphoning away. As an aid to ensuring that the tubes have been correctly installed a useful test is to momentarily close the stop valve after filling and check that after a brief interval the outflow of water ceases. A continuous flow of water when the stop valve is closed is evidence of faulty installation and may result in the tubes being completely drained when the equipment is finally shut down. When recommencing operations, unless an interval is allowed for refilling, this may endanger the tubes.

Important note

In the ignitron data, ratings are given for the required waterflow as a function of the average tube current and water inlet temperature. It is often more economical to use continuous water cooling according to the reduced cooling ratings rather than a water saving thermostat and solenoid valve. This enables a more constant tube temperature to be obtained which, moreover, improves the life expectancy of the tube.

IGNITRON PROTECTION

Care must be taken to ensure that the prescribed temperature limits of ignitrons are never exceeded. When the tubes are cooled with tap water the temperature of which remains within the rated limits, it is generally sufficient to ensure that an adequate quantity of water flows through the jacket. To prevent the temperature of the tubes becoming excessive in the event of a failure of the water supply, e.g. stopped-up or defective hoses, insufficient pressure of the water mains, accidentally closed main cock etc. a protective thermostat should be used. If the temperature limit set by the protective thermostat is exceeded, either the ignition circuits of the ignitrons are interrupted or the main circuit breaker is tripped by means of a relay. The protective thermostat, which should be mounted on the last tube of a series, should not actuate its relay under normal operating conditions.

In three phase welding service using 6 tubes it is recommended that not more than 3 tubes are connected hydraulically in series for cooling purposes. When ignitrons are used for heavy power switching at a high duty factor the internal tube temperature rises very rapidly. Under such conditions it is advisable for the cooling water to circulate through the jackets as soon as the master switch is closed.

Note.

When ignitrons are used as rectifiers with the cathode not at earth potential, an electrolytic erosion target connected to the metal envelope may be used to avoid corrosion of tube parts.

SWITCHING

Before firing and during operation the anode and lead-in insulator should always be at a higher temperature than the cooling water. If necessary, a suitable heating device can be used to maintain the required temperature difference.

Care must be taken not to touch live parts, such as the water jackets which are at full line voltage. Some ignitron types have a plastic-coated water jacket which can withstand voltages up to 3kV. With this type water condensation on the jacket is kept to a minimum under conditions of high humidity and low cooling water temperature. The uncoated tube parts are at full line voltage.

To prevent mercury from re-condensing on the anode and the anode insulator when the installation is switched off, the cooling water should be allowed to flow through the tubes so that all internal parts are evenly cooled down; this normally takes from 15 to 30 minutes.

Incompletely cooled tubes must always be kept with the anode connection uppermost.

Mercury may also condense on the anode insulator as a result of cold air draught in the vicinity of the tube. It is then necessary either to prevent the occurence of the air flow or to ensure that the anode and anode insulator are not cooled down to a temperature below that of the cooling water.

SPARE IGNITRONS

In order to have some tubes available in a ready-for-use condition it is advisable to place an adequate number of tubes with the anodes uppermost under a lighted incandescent lamp. The heat produced by the lamp is sufficient to remove any mercury deposits on the anode insulator.

MECHANICAL REQUIREMENTS

All ignitrons should be supported by the cathode connection, vertically to within $\pm 3^{o}$ with the anode uppermost. The bolts used should be of mild steel to ensure that the current passes mainly through the contact surfaces and not through the bolt.

The ignitron should not be subjected to strong r.f. or magnetic fields.

Ignitrons should always be transported or handled in an upright position since otherwise particles of mercury could be trapped on or adjacent to the anode, and when put into service this could cause the tube to arc back. Should an ignitron be changed from a vertical position to the horizontal or anode down position, there is the possibility that the mercury will flow rapidly into the anode insulator, and damage it.

INSTALLATION

When an ignitron is installed, or if the tube has not been in a vertical position, it is recommended that the anode of the tube is gently heated for 30 minutes using a 250W infra-red lamp. During this period cooling water should flow.

The anode lead should be clamped so that no undue strain is imposed on the anode insulator. The equipment should be as free from vibration as possible since turbulence of the mercury cathode could cause unreliable operation.

Valve heating time

The time required for a valve to attain minimum operating temperature with normal voltage applied to the heating element. For a mercury vapour valve this time is generally much longer than that required to bring the cathode to the normal operating temperature.

Anode voltage drop

The potential difference between anode and cathode or midpoint of the filament during the time when the valve is conducting.

Critical grid voltage

The instantaneous value of grid voltage at which anode current commences to flow.

Control characteristic

The relationship between the critical grid voltage and the anode voltage. This is usually depicted graphically.

Positive current

Conventional current flowing into the valve through the electrode named.

Critical grid current

The instantaneous value of grid current immediately before anode current commences to flow.

Commutation factor

The product of rate of decay of anode current (A/μs) immediately prior to current extinction, and the initial rate of rise of the inverse anode voltage (V/μs) immediately following extinction of current.

Recovery time (Deionisation time)

The time between the cessation of anode current and the instant when the grid regains control.

Ionisation time

The time required for the anode current to rise to 90 per cent of its rated peak value, the time being measured from the instant of application of critical grid voltage (see also Anode Delay Time).

Maximum averaging time

The longest period of time over which it is permissible to compute the maximum average value of the characteristic under consideration.

Anode delay time

The interval between the time when the rising portion of the grid pulse would reach 26% of its full amplitude if it were unloaded and the instant when anode conduction takes place.

Jitter

The maximum variation of anode delay time from pulse to pulse.

Condensed mercury temperature

The temperature of the external surface of that part of the valve envelope at which the mercury is seen to condense during normal operation of the valve.

GENERAL OPERATIONAL RECOMMENDATIONS

The following recommendations should be interpreted in conjunction with British Standard Code of Practice No CP1005: Parts 1 and 2: 1954, 'The Use of Electronic Valves', upon which these notes have, in part, been based.

LIMITING VALUES

The operating limits quoted on data sheets for individual valves should on no account be exceeded. Two methods of specifying limiting values are used, the 'absolute' and 'design centre' systems, and these should be interpreted as follows:

Absolute Ratings

The equipment designer must ensure that these ratings are never exceeded and in arriving at the actual valve operating conditions variations caused by mains fluctuations, component tolerances and switching surges must be taken into account.

Design Centre Ratings

With a set of nominal valves inserted in an equipment connected to the highest permitted nominal supply voltage within a given tapping range, and in which all components have their nominal value, the valve operating conditions may at no time exceed the published maximum design centre value. The phrase 'at no time' in the above paragraph means that increases in the valve working conditions, due to operating changes in equipment (e.g. switching, etc.), should be taken into account by the equipment designer. Mains voltage variations (of up to $\pm 6\%$) are allowed for in the valve ratings, provided good practice is followed in the design of the equipment.

FILAMENT OR HEATER SUPPLY

Unless otherwise stated the filament or heater voltage of a thyratron should be set within $\pm 2{\cdot}5\%$ of the nominal value. Temporary mains fluctuations up to $\pm 6\%$ are permissible. To ensure maximum life from a directly heated valve the filament supply should be $90^\circ \pm 30^\circ$ out of phase with the anode supply unless otherwise specified. Measurement of the filament or heater voltage should be made at the valve pins.

VALVE TEMPERATURE LIMITATIONS

The ratings published for Mullard mercury vapour thyratrons apply only when they are operated within the limits stated for the temperature of the condensed mercury.

With the filament or heater voltage applied, the time required to reach the minimum permissible condensed mercury temperature is a function of the ambient temperature and can be determined from the heating and cooling characteristic. Thus a direct measurement of the condensed mercury temperature, although desirable, is not essential. Ideally, no cathode current should be drawn until the filament or heater supply has been on for this time, but in practice little damage is done if the current is drawn when the condensed mercury temperature is within 5 or 10°C of the minimum permissible value (see individual data sheets). Thus with normal usage, where the valve is started only two or three times per day, an adequate life can still be obtained with a reduced heating time. The ambient conditions, however, must be such that the minimum permissible condensed mercury temperature is eventually reached and the filament or heater voltage must be within the specified tolerances. In any case the heating time must not be less than the specified minimum cathode heating time.

It is necessary to provide adequate ventilation around the valve so that the maximum ambient or condensed mercury temperature is never exceeded for any condition of loading. This avoids the danger of arc-back. Whenever it may be necessary to check the condensed mercury temperature of thyratrons the following procedure is recommended. A temperature indicator of low thermal capacity, such as a fine-wire thermocouple, should be attached to the valve at the mercury condensation point by the minimum amount of adhesive. Care should be taken to ensure that other conditions of operation, such as load current, ambient temperature of the air outside the equipment, and the ventilation remain unchanged during the measurement.

With inert-gas thyratrons ambient temperature limitations are given and in general it is only necessary to employ the minimum cathode heating time before switching on.

CURRENT RATINGS

For each rating of maximum average current, a maximum averaging time is quoted. This is to ensure that current greater than the maximum permissible average value is not drawn for such a length of time as would give rise to an excessive temperature within the valve. For periods less than the maximum averaging time it is permissible to draw average currents greater than the maximum rated value provided that the product of this current and time does not exceed the product of the maximum rated average current and the maximum averaging time. When more than one value of peak current is quoted depending upon the frequency of operation, this must be taken into consideration.

SHORT CIRCUIT PROTECTION

The figure given on each data sheet for maximum surge (fault protection) cathode current is intended as a guide to equipment designers. It indicates the maximum value of current, resulting from a sudden overload or short circuit, which the thyratron will pass for a period not exceeding 0·1 second without resulting in its immediate destruction. Several overloads of this nature, will, however, appreciably reduce the life of the valve. When thyratrons are used as grid-controlled rectifiers it is advisable to include a fuse of suitable rating in the anode circuit of each valve.

POWER SUPPLY FREQUENCY LIMITATIONS

In general, when thyratrons are operated at frequencies below 25c/s, a lower maximum peak cathode current is applicable. This is necessary to ensure that cathode fatigue does not result. The maximum frequency at which a thyratron will operate satisfactorily is dependent upon the recovery time and therefore upon the conditions of operation. At higher frequencies the valve will fail to operate due to arc-back and loss of grid control. When operation at high frequencies is desired the commutation factor should be kept as low as possible in order to ensure satisfactory life.

EFFECTS OF POSITIVE ION CURRENT

When a thyratron is conducting, a positive ion current of magnitude proportional to the cathode current is generated. This current will, in general, flow to that electrode which is at the most negative potential during conduction. In order to prevent damage to the valve it is necessary to ensure that the voltage of this electrode is more positive than –10V during this phase. This precaution will prevent an increase in electrode emission due to excessive electrode dissipation, sputtering of electrode material, changes in the control characteristics caused by shift in contact potential and, in the case of inert gas-filled valves, a rapid gas clean-up. In circuits where the control grid is held negative during anode conduction, a suitable choice of resistor in series with the grid will maintain an effective grid bias more positive than –10V. The minimum value of the resistor may be determined from the grid ion current characteristic. If the instantaneous value of anode current is low then the restriction on grid bias does not apply. In general, the grid should be more positive than –10V for all values of anode current greater than 10 per cent of the rated maximum average current. In circuits where the anode potential changes from a positive to a negative value and the control-grid is at a positive potential, thereby drawing cathode current, a small positive ion current flows to the anode. In such a case the inclusion of a high value of anode resistor is precluded by circuit requirements, as the anode will usually reach a high negative potential. It is essential to limit the magnitude of the positive ion current by severely restricting the current flowing from cathode to grid. This may be effected by using the maximum permitted series grid resistor and/or alternatively, keeping the positive grid voltage swing as low as possible.

In those circuits where the anode potential changes very rapidly from a positive to a high negative value, such as with inductive loads fed from polyphase supplies, there will be residual positive ions within the valve which will be drawn towards the anode with considerable energy. In the case of an inert gas-filled valve this will result in excessive gas clean-up and it is therefore necessary to observe the limitations imposed by the appropriate commutation factor.

PARALLEL OPERATION OF THYRATRONS

Thyratrons cannot normally be operated directly in parallel. An alternative arrangement must be adopted if a higher current output is required. Information on suitable methods will be supplied on request.

USE OF CONTROL CHARACTERISTICS

In most cases the control characteristic given on the data sheets is shown by upper and lower boundary curves within which all valves may be expected to remain during life. The control characteristic of a particular valve may move within these boundaries although, as a rule, these limits should be considered as extreme cases. This should be taken into consideration when designing grid excitation circuits for thyratrons.

SCREENING AND R.F. FILTER CIRCUITS

(*a*) In order to prevent spurious ionisation of the gas or mercury vapour (and consequent flash-over) due to strong r.f. fields, it may be necessary to enclose the thyratrons in a separate screening box. For the same reason r.f. filters should be used to prevent high frequency current circulating in the thyratron circuits via the wiring.

(*b*) High frequency disturbances, usually due to oscillation in the transformer windings and associated wiring, are often produced by gaseous valves, and may cause interference in apparatus situated near the thyratron unit. Small r.f. chokes or resistors in the anode leads will generally reduce the interference, and screening as recommended in paragraph (*a*) above may also be adopted, with r.f. filters in all leads emerging from the screen.

INSTALLATION

Mercury vapour thyratrons should always be mounted vertically with the cathode connections at the lower end. When a mercury vapour thyratron is first installed, and before it is put into service, it should be run for at least half an hour at its normal heater or filament voltage but without any other electrode voltages applied in order to vaporise any mercury which may have been deposited upon the electrode assembly during transit. This precaution should also be taken before putting into service a mercury vapour valve which has been out of use for any considerable time.

The mounting requirements for inert gas thyratrons are less stringent and are specified for each valve.

ADDITIONAL NOTES FOR HYDROGEN THYRATRONS

HEATER AND REPLENISHER VOLTAGES

The heater and replenisher voltages should be maintained within the rated limits, to avoid abnormal hydrogen or gas pressure. This might cause premature failure of cathode emission, gas clean-up, excessive anode dissipation or continuous conduction.

CURRENT RATINGS

For each rating of maximum average current a maximum averaging time is quoted. This is to ensure that an anode current greater than the maximum average value is not drawn for such a length of time as would give rise to excessive temperature within the valve. The maximum peak anode current is determined by the safe cathode emission, whereas the average current is limited by its heating effects.

SHORT CIRCUIT PROTECTION

Failure of the thyratron to regain control at the end of a current pulse may occur at the first or second attempt of instantaneous starting or as a result of an adverse mismatch occurring between the pulse forming network and load impedance; for example this may occur when a magnetron fails to oscillate. In the event of such a failure the thyratron mean current will rise considerably and a circuit breaker or fuse which will act within 0·1s with 200% current overload should be incorporated to avoid the destruction of the thyratron.

RATINGS INTER-RELATION PRODUCT

A limitation placed on the product of peak anode voltage, peak anode current and pulse repetition frequency which is designed to avoid excessive power dissipation in the valve.

COMMUTATION

When the thyratron is conducting, the number of positive ions generated is proportional to the cathode current. After the cessation of anode conduction several microseconds elapse before the number of positive ions has substantially diminished.

If the anode develops a high negative potential immediately after the current pulse, these ions will bombard the anode and this may result in excessive anode dissipation and gas clean-up. A special inverse voltage rating, applicable for a period of 25μs after each current pulse, is therefore specified for each valve type.

RECOVERY TIME

A delay must be allowed between the cessation of the current pulse and the re-application of anode voltage. This will ensure that the concentration of ions has decayed to a level which will not cause spurious anode firing. The recovery time may be minimised by providing a low impedance d.c. path from grid to cathode (e.g. the secondary coil of a suitable pulse transformer) or by applying a negative bias to the grid. The necessary delay between the cessation of anode current and the rise of anode voltage may, in many applications, be produced by allowing the anode voltage to swing negative after the current pulse. A minimum overswing of 5% of the peak forward voltage is normally specified. (The danger of an excessive overswing has already been mentioned under Commutation.)

The rapid rise of anode voltage is delayed further if the pulse-forming network is charged through an inductor rather than through a resistor.

GRID EXCITATION CIRCUIT

Hydrogen thyratrons are usually designed with positive firing characteristics so that a negative bias is not essential. Normally a grid current of several milliamperes must be drawn before anode conduction is initiated. A steeply rising grid voltage derived from a source of low impedance should ensure a small and steady anode delay time. A maximum rise time and source impedance are specified on individual data sheets.

INSTALLATION

Hydrogen thyratrons may be mounted in any position and, if desired, the valve may be clamped, preferably on the base. If the clamp is applied to the envelope it should have a low thermal inertia and should not be applied above the point specified on the individual data sheet. The anode lead should be arranged so that it is not close to the glass envelope and the valve should be screened from r.f. fields.

An air blast may be used to cool the anode lead if necessary but it must not be directed upon the glass envelope of the valve.

Hydrogen thyratrons may emit harmful X-radiation and should be suitably screened to protect personnel.

THYRATRON WITH SHIELD GRID

CST1-6000

This data should be read in conjunction with "Operating Notes on Mercury Vapour Rectifiers"

OPERATING CONDITIONS

Heater	Voltage	5.0	V
	Current	10.5	A approx.
Mounting position		Vertical, base down	

CHARACTERISTICS

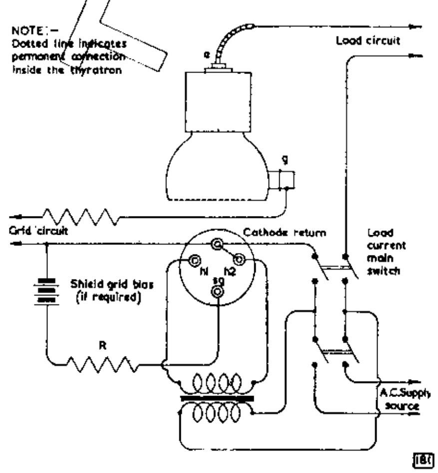
Valve voltage drop		10–20	V
Deionisation time		1,000	µS approx.
Control (measured at ambient temperature 20° C and with shield grid connected to cathode)			
Anode voltage	100 500	1,000	V
Critical grid voltage	−1 −7	−11	V approx.

LIMITING VALUES

Max. peak forward anode voltage	1,000	V
Max. peak inverse anode voltage	1,000	V
Max. instantaneous anode current — below 25 c/s	12	A
Max. instantaneous anode current — 25 c/s and above	25	A
Max. mean anode current—averaged over 30 seconds	6	A
Max. instantaneous shield grid current	1.0	A
Max. mean shield grid current	0.25	A
Max. instantaneous control grid current	1.0	A
Max. mean control grid current	0.25	A
Min. cathode heating time	5	minutes
Working ambient temperature	10–40	°C

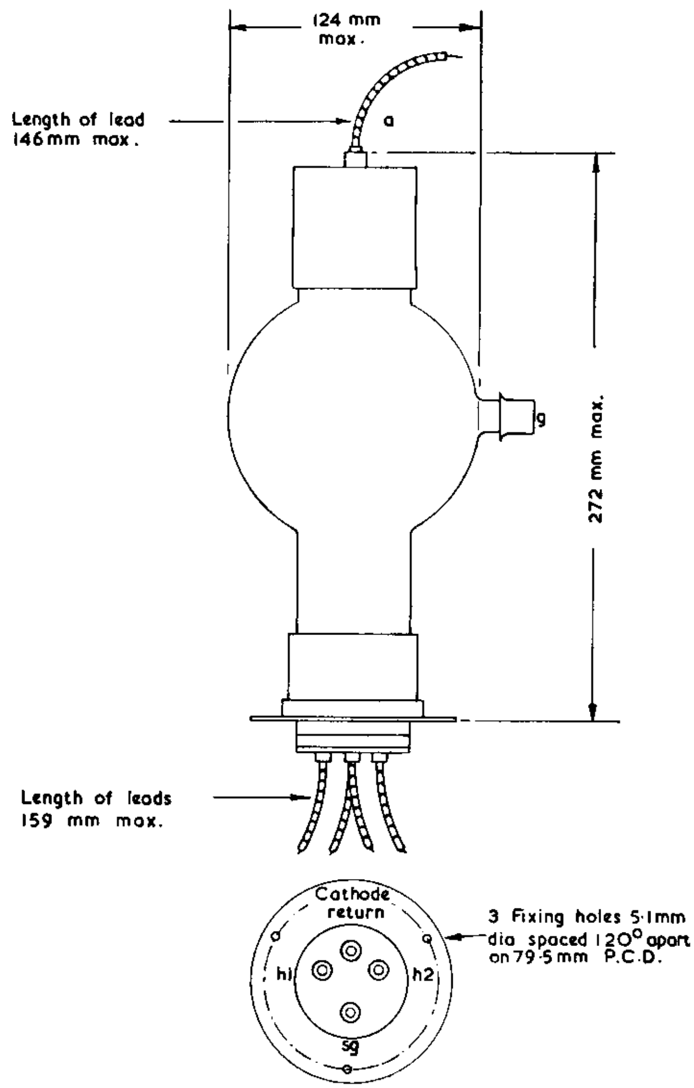
The diagram shows the recommended method of connecting the CST1-6000, the connections to the special base cap being as viewed from below.

The shield grid may be connected to the cathode, preferably through a current limiting resistance of not more than 10,000 ohms, or it may be given a positive or negative bias as shown. Such a bias will alter the control characteristic of the valve.



CST1-6000

THYRATRON WITH SHIELD GRID



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TETRODE THYRATRON

CST2-12

Tetrode, mercury vapour thyratron with negative control characteristic.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	2.0	kV
Forward	2.0	kV
Max. cathode current		
Peak (25 c/s and above)	75	A
Peak (below 25 c/s)	25	A
Average (Max. averaging time 30 secs.)	12.5	A
Max. average positive control-grid current for anode voltage more positive than –10V (averaging time 30 secs.)	250	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than –10V	1.0	A
Max. average positive shield-grid current for anode voltage more positive than –10V (averaging time 30 secs.)	500	mA
Max. peak positive shield-grid current during the time that the anode is more positive than –10V	2.0	A
Max. shield-grid resistor	10	kΩ
Heater voltage limits	4.8 to 5.2	V
*Min. cathode heating time	5	mins
Ambient temperature limits	10 to 40	°C

*For an ambient temperature below 15°C a delay of 15 minutes is advisable before applying the anode voltage.

CHARACTERISTICS

Electrical

Heater voltage		5.0	V
Heater current at 5.0 V		20	A
Deionisation time (approx.)		1,000	μs
Anode voltage drop		10 to 20	V
**Critical grid voltage	V_a = 50V	20	V
	V_a = 100V	–1.0	V
	V_a = 500V	–7.5	V
	V_a = 2.0kV	–28	V

Mechanical

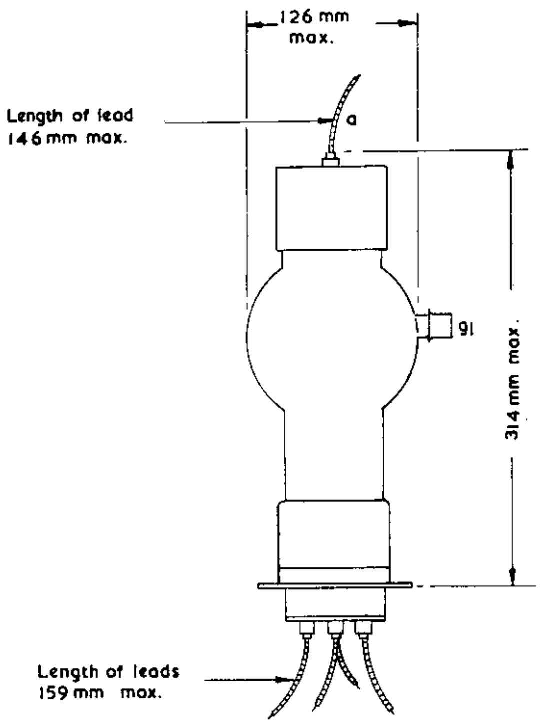
Type of cooling	Convection
Mounting position	Vertical, base down

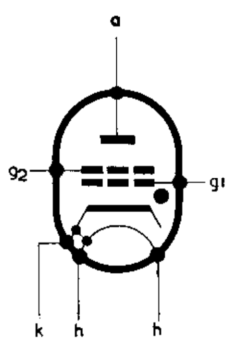
**Measured at ambient temperature 20°C and with shield grid connected to cathode.

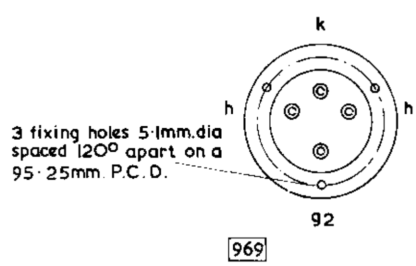
CST2-12

TETRODE THYRATRON

Tetrode, mercury vapour thyratron with negative control characteristic.







TRIODE THYRATRON CT10-12

This data should be read in conjunction with "Operating Notes on Thyratrons"

OPERATING CONDITIONS

Heater	Voltage	5.0	V
	Current (approx.)	20	A
Mounting position		Vertical, base down	

CHARACTERISTICS

Valve voltage drop	10 to 24	V
Deionisation time (approx.)	100	µs

Control (measured at ambient temperature 20° C)

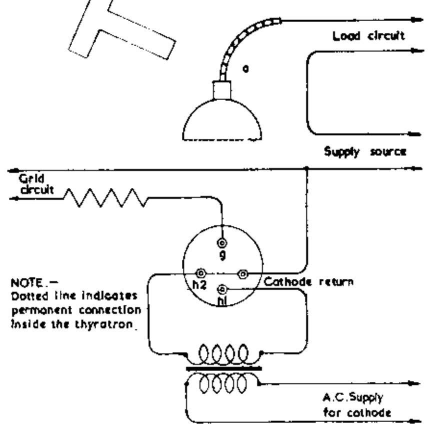
Anode voltage	500	1,000	2,000	10	kV
Critical grid voltage	0	−1	−2.5	−7	V approx.

LIMITING VALUES

Max. peak forward anode voltage		10	kV
Max. peak inverse anode voltage		10	kV
Max. instantaneous anode current	below 25 c/s	25	A
	25 c/s and above	75	A
Max. mean anode current—averaged over 30 seconds		12.5	A
Max. instantaneous grid current		1.0	A
Min. cathode heating time		15	minutes
Working ambient temperature		10 to 40	°C

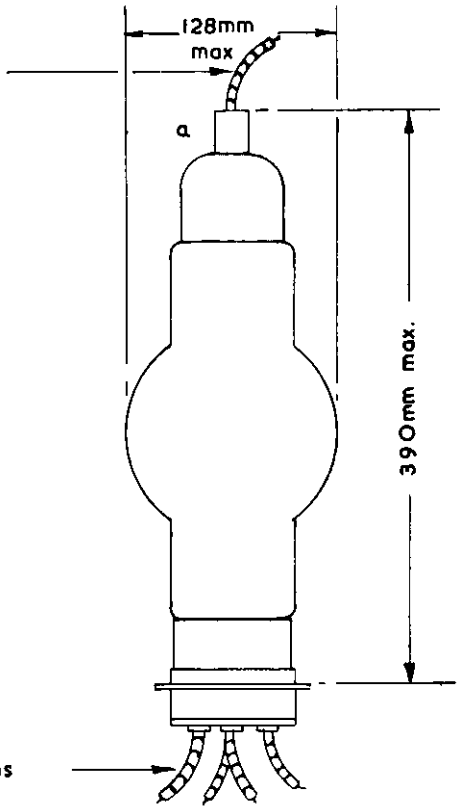
The diagram shows the recommended method of connecting the CT10-12, the connections to the special base cap being as viewed from below.

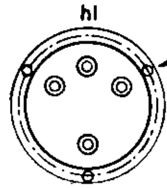
A resistance of 10 to 100 kΩ should be connected in series with the grid, as close to the socket as possible.



CT10-12

TRIODE THYRATRON





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TRIODE THYRATRON

XG1-2500

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

This data should be read in conjunction with DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS, preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage			
*Inverse	1.5	1.0	kV
Forward	1.0	1.0	kV
*Condensed mercury temperature limits	40 to 75	40 to 80°	C
Max. cathode current			
Peak (25 c/s and above)		15	A
Peak (below 25c/s)		5.0	A
Peak (ignitor firing service)		40	A
Average (max. averaging time 15s)		2.5	A
Average (ignitor firing service)		1.0	A
Surge (fault protection max. duration 0.1s)		200	A
Max. negative control-grid voltage			
Before conduction		500	V
During conduction		10	V
Max. average positive control-grid current for anode voltage more positive than −10V (averaging time, 15s)		250	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than −10V		1.0	A
Max. peak positive control-grid current during the time that the anode voltage is more negative than −10V		100	mA
Max. control-grid resistor (Recommended min. control-grid resistor 10kΩ)		100	kΩ
Heater voltage limits		4.5 to 5.5	V
Min. valve heating time (See heating and cooling characteristics on pages 2 and 6)			
Max. power supply frequency		150	c/s

*Max. condensed mercury temperature rating for intermediate anode voltages may be determined by linear interpolation.

XG1-2500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

CHARACTERISTICS

Electrical

Heater voltage	5.0	V
Heater current at 5.0V		
Average	4.5	A
Maximum	4.8	A
Anode to control-grid capacitance	4.0	pF
Control-grid to cathode capacitance	8.0	pF
Recovery (deionisation) time approx.	1,000	µs
Ionisation time (approx.)	10	µs
Anode voltage drop	16	V
Critical grid current at $V_a = 1.0$ kV	<20	µA

Mechanical

Type of cooling	Convection	
Equilibrium condensed mercury temperature rise above ambient		
At full load (approx.)	42	°C
At no load (approx.)	33	°C
Mounting position	Vertical, base down	
Max. net weight	6.0	oz.
	170	g

HEATING-UP TIME ←

The preferred minimum value of the valve heating-up time can be obtained from the heating and cooling curve on page 6. This shows how the condensed mercury temperature rises above the ambient temperature from the instant of switching on the heater supply.

Under normal conditions, however, cathode current may be drawn when the condensed mercury temperature is within approximately 7°C of the minimum quoted value. (See appropriate section of 'General Operational Recommendations—Thyratrons'.) The total heating-up time under this duty can be obtained from the curve on page 7.

Minimum cathode heating time	5.0	min

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

XG1-2500

Control characteristic (see page 4)

The shaded area between the curves indicates the spread in characteristics due to:

(*a*) Initial differences between individual valves.

(*b*) Variations in characteristics during life.

(*c*) Variations in characteristics due to changes in heater voltage.

(*d*) The effects of circuit loading.

The effects of different values of series grid resistor have been ignored.

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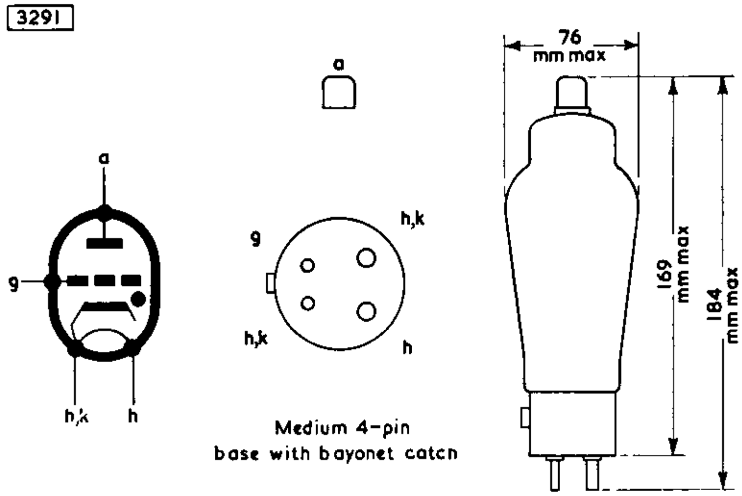
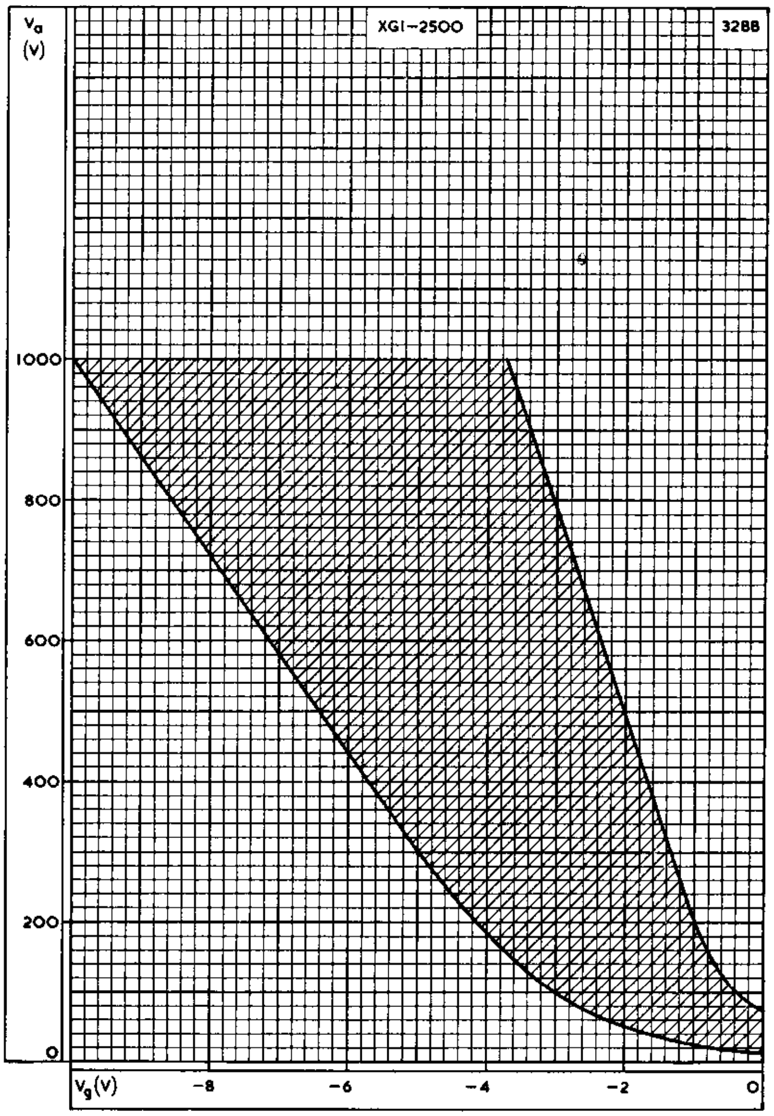


XG1-2500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

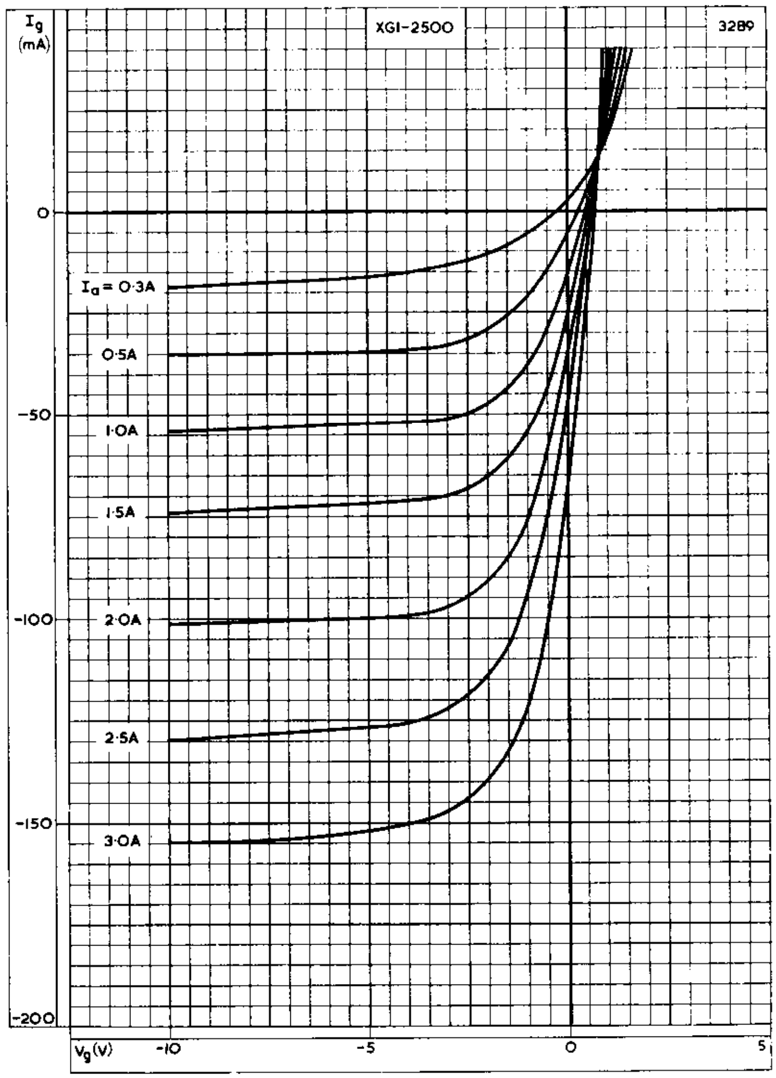


CONTROL CHARACTERISTIC
(See note on page 3)

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.

XG1-2500

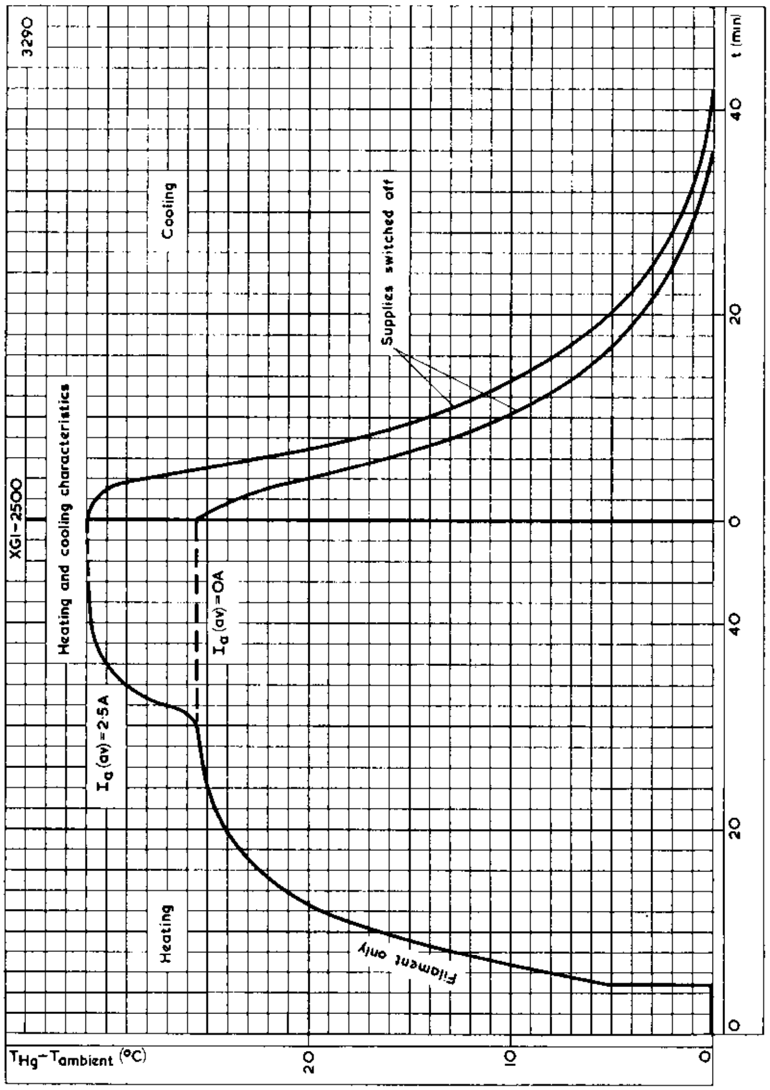


GRID ION CURRENT CHARACTERISTIC

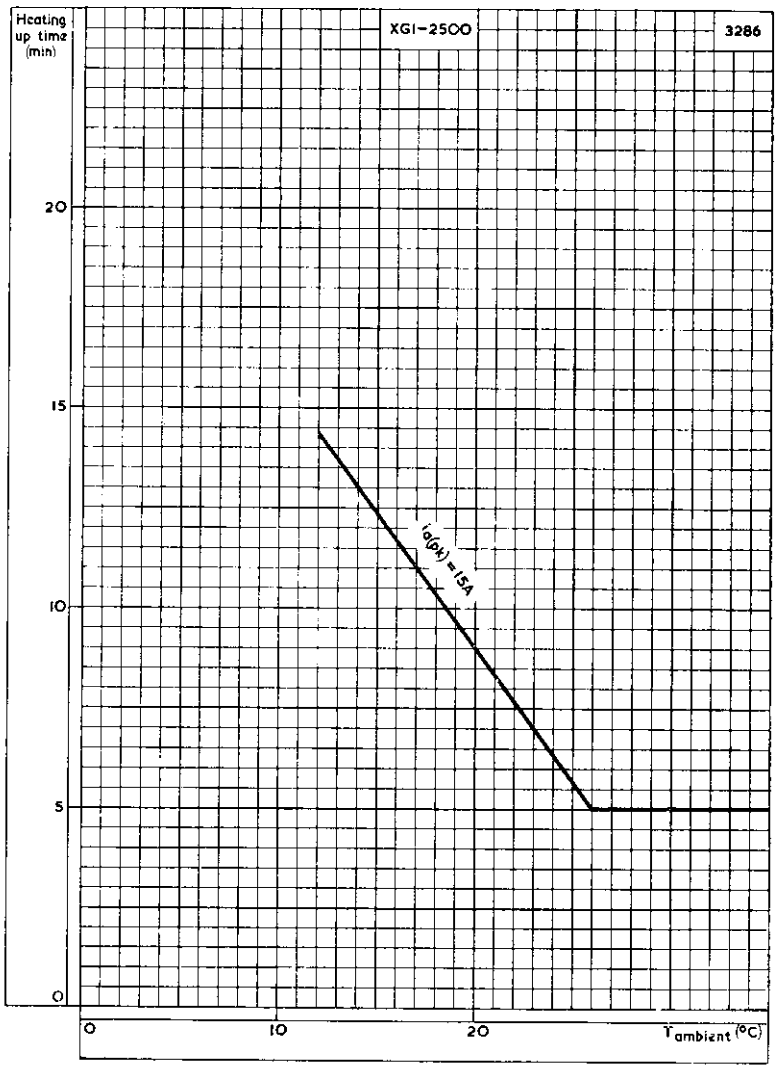
XG1-2500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for motor control and other industrial applications.



HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME



TOTAL HEATING-UP TIME PLOTTED AGAINST AMBIENT TEMPERATURE

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

XG2-12

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS, preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into account in arriving at the actual valve operating conditions.

Continuous duty

Max. peak anode voltage				
Inverse			2.5	kV
Forward			1.5	kV
Max. cathode current				
Peak	80	100	*160	A←
Average	12.5	10	*20	A
†R.M.S.	30	30	*50	A
(At max. averaging time)	15	15	(1 cycle)	s
Surge (fault protection max. duration 0.1s)	1500	1500	1500	A
Condensed mercury temperature limits	35 to 75	35 to 75	40 to 75	°C

Recommended condensed mercury temperature 60°C during operation.

Max. negative grid voltage		
Before conduction	−300	V
During conduction	−10	V
Max. average positive grid current (Anode voltage more positive than −10V)	250	mA
Max. peak positive grid current (Anode voltage more positive than −10V)	1.0	A
Max. peak positive grid current (Anode voltage more negative than −10V)	100	mA
Max. grid resistor	50	kΩ
(Recommended value)	10	kΩ

*Permissible overload for max. duration of 5s once in any 5min operating period.

†Under delayed firing conditions.

XG2-12

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

Additional data for a.c. and welder operation (two valves in inverse parallel, firing over complete cycle)

Max. peak anode voltage				
Forward			750	V
Inverse			750	V
Duty cycle	10	50	100	%
Max. cathode current				
Peak (per valve)	156	78	39	A
Average (per valve)	5.0	12.5	12.5	A
R.M.S. (total)	110	55	27.5	A
Max. averaging time	5.0	5.0	15	s
Condensed mercury temperature range			40 to 80	°C

HEATING UP TIME ←

The preferred minimum value of the total valve heating up time can be obtained from the heating and cooling curve on page 5. This shows how the condensed mercury temperature rises above the ambient temperature from the instant of switching on the heater supply.

Under normal conditions, however, cathode current may be drawn when the condensed mercury temperature is approximately within 7°C of the minimum quoted value (See page 6 and also appropriate section of 'General operational recommendations—thyratrons').

During long shut down periods, i.e. overnight, the heater supply may be lowered to 60 to 80% of normal instead of being switched off. This greatly reduces the minimum delay required after restoring the heater supply to normal. The total heating up time under this duty can be obtained from the curve on page 6.

Minimum cathode heating time	5.0	min

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

XG2-12

CHARACTERISTICS

Electrical

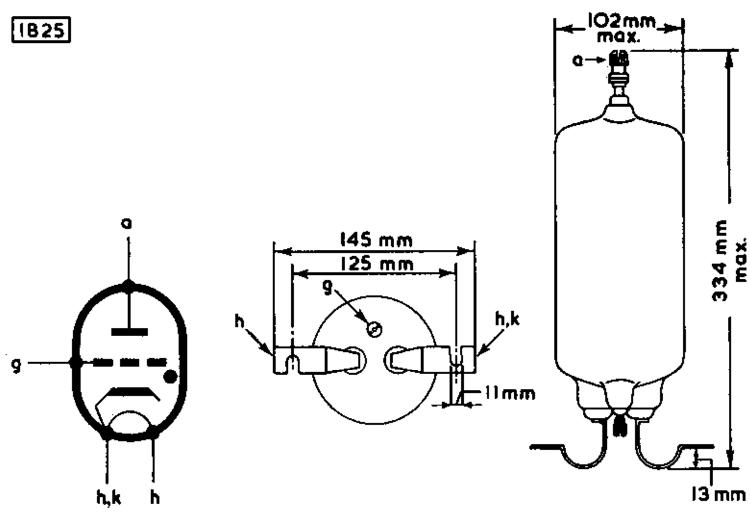
Heater voltage	5.0	V
Heater current at 5.0V Average	14	A
Deionisation time (approx.)	1000	µs
Ionisation time (approx.)	10	µs
Anode voltage drop	10	V
Max. operating frequency	150	c/s
Anode-to-grid capacitance	15	pF
Grid-to-cathode capacitance	60	pF

Mechanical

Type of cooling	Convection	
Max. net weight	1.6	kg
	3.5	lb
Mounting position	Vertical, base down.	

The valve should only be secured by the heater lugs and the anode connector should be flexible.

IB25

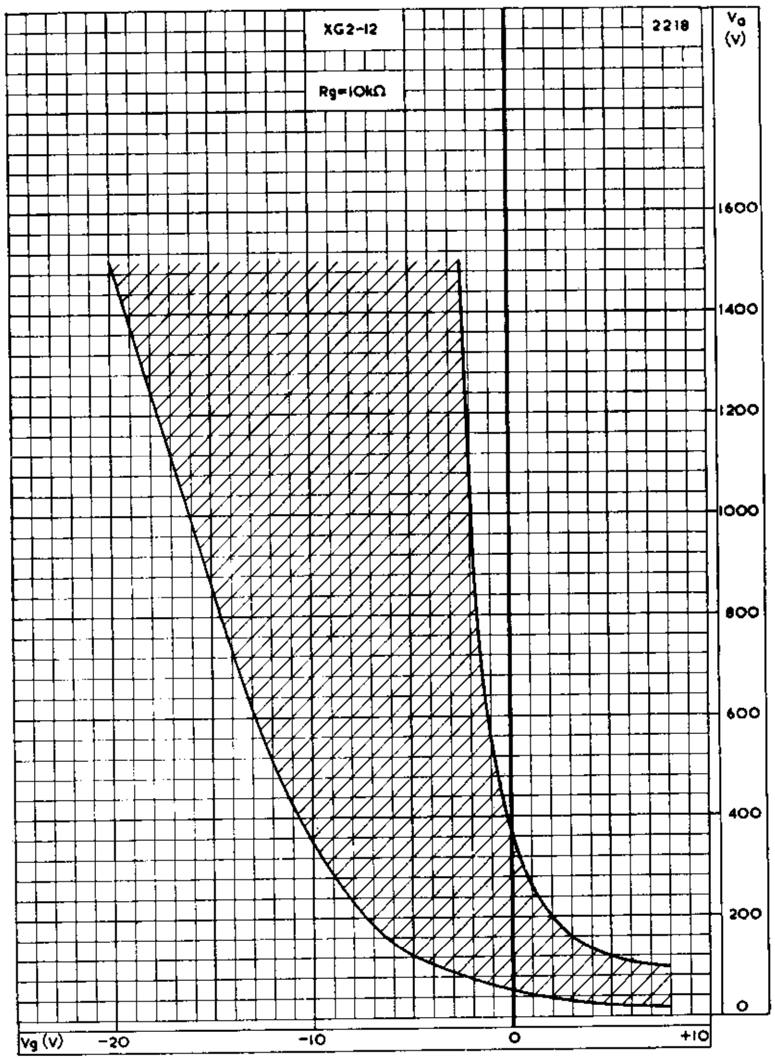


The h,k terminal is marked with a red dot.

XG2-12

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

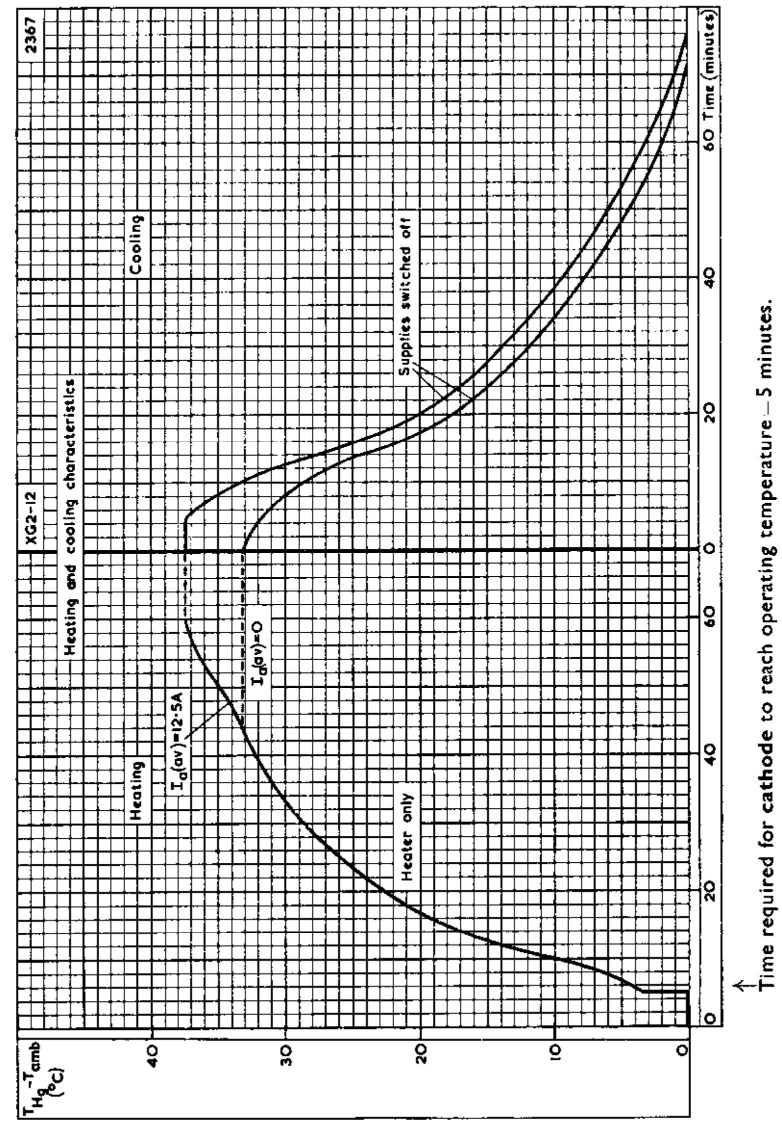


CONTROL CHARACTERISTIC

TRIODE THYRATRON

XG2-12

Triode mercury vapour thyratron with negative/positive control characteristics.

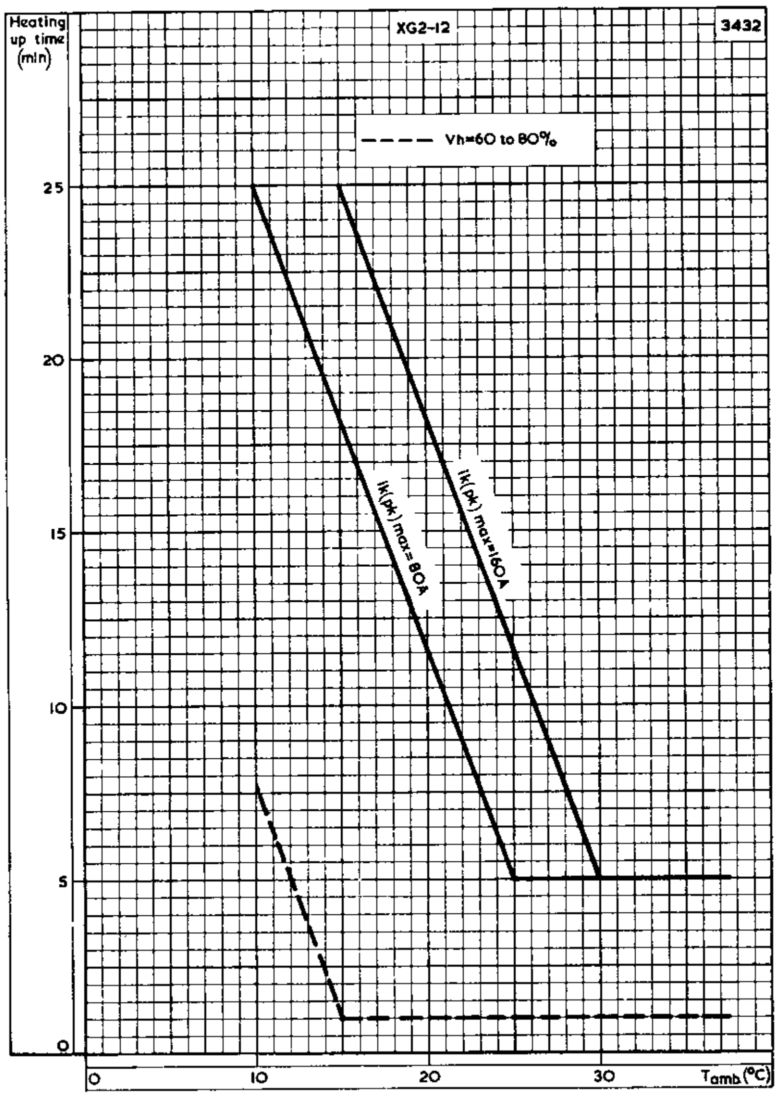


HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME

XG2-12

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.



TOTAL HEATING UP TIME PLOTTED AGAINST AMBIENT TEMPERATURE

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

XG2-25

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS, preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into account in arriving at the actual valve operating conditions.

Continuous duty

Max. peak anode voltage				
Inverse			2.5	kV
Forward			1.5	kV
Max. cathode current				
Peak	160	200	*300	A
Average	25	20	*40	A
†R.M.S.	60	60	*100	A
(At max. averaging time)	15	15	(1 cycle)	s
Surge (fault protection max. duration 0.1s)	2500	2500	2500	A
Condensed mercury temperature limits	35 to 75	35 to 75	40 to 75	°C

Recommended condensed mercury temperature 60°C during operation.

Max. negative grid voltage		
Before conduction	−300	V
During conduction	−10	V
Max. average positive grid current (Anode voltage more positive than −10V)	250	mA
Max. peak positive grid current (Anode voltage more positive than −10V)	1.0	A
Max. peak positive grid current (Anode voltage more negative than −10V)	100	mA
Max. grid resistor	20	kΩ
(Recommended value)	10	kΩ

*Permissible overload for max. duration of 5s once in any 5min operating period.

†Under delayed firing conditions.

XG2-25

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristics.

Additional data for a.c. and welder operation (two valves in inverse parallel, firing over complete cycle)

Max. peak anode voltage				
Forward			750	V
Inverse			750	V
Duty cycle	10	50	100	%
Max. cathode current				
Peak (per valve)	285	156	78	A
Average (per valve)	9.0	25	25	A
R.M.S. (total)	200	110	55	A
Max. averaging time	5.0	5.0	15	s
Condensed mercury temperature range			40 to 80	°C

HEATING UP TIME ←

The preferred minimum value of the total valve heating up time can be obtained from the heating and cooling curve on page 5. This shows how the condensed mercury temperature rises above ambient temperature from the instant of switching on the heater supply.

Under normal conditions however, cathode current may be drawn when the condensed mercury temperature is approximately within 7°C of the minimum quoted value. (See page 6 and also appropriate section of 'General operational recommendations—thyratrons').

During long shut down periods, i.e. overnight, the heater supply may be lowered to 60 to 80% of normal instead of being switched off. This greatly reduces the minimum delay required after restoring the heater supply to normal. The total heating up time under this duty can be obtained from the curve on page 6.

Minimum cathode heating time	10	min

IGNITION CONDITIONS

A positive grid current of at least 3mA is needed to ensure reliable firing. If a sinusoidal control grid voltage is used it should have a minimum value of $60V_{r.m.s.}$

TRIODE THYRATRON

XG2-25

Triode mercury vapour thyratron with negative/positive control characteristics.

CHARACTERISTICS

Electrical

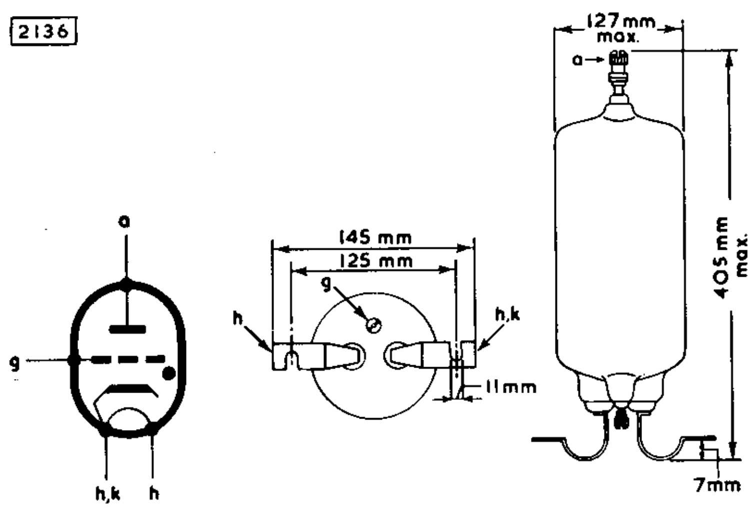
Heater voltage	5.0	V
Heater current at 5.0V		
Average	25	A
Maximum	27.5	A
Deionisation time (approx.)	1000	μs
Ionisation time (approx.)	10	μs
Anode voltage drop	10	V
Max. operating frequency	150	c/s
Anode-to-grid capacitance	15	pF
Grid-to-cathode capacitance	60	pF

Mechanical

Type of cooling	convection	
Max. net weight	1.6	kg
	3.5	lb
Mounting position	Vertical, base down	

The valve should only be secured by the heater lugs and the anode connector should be flexible.

2136

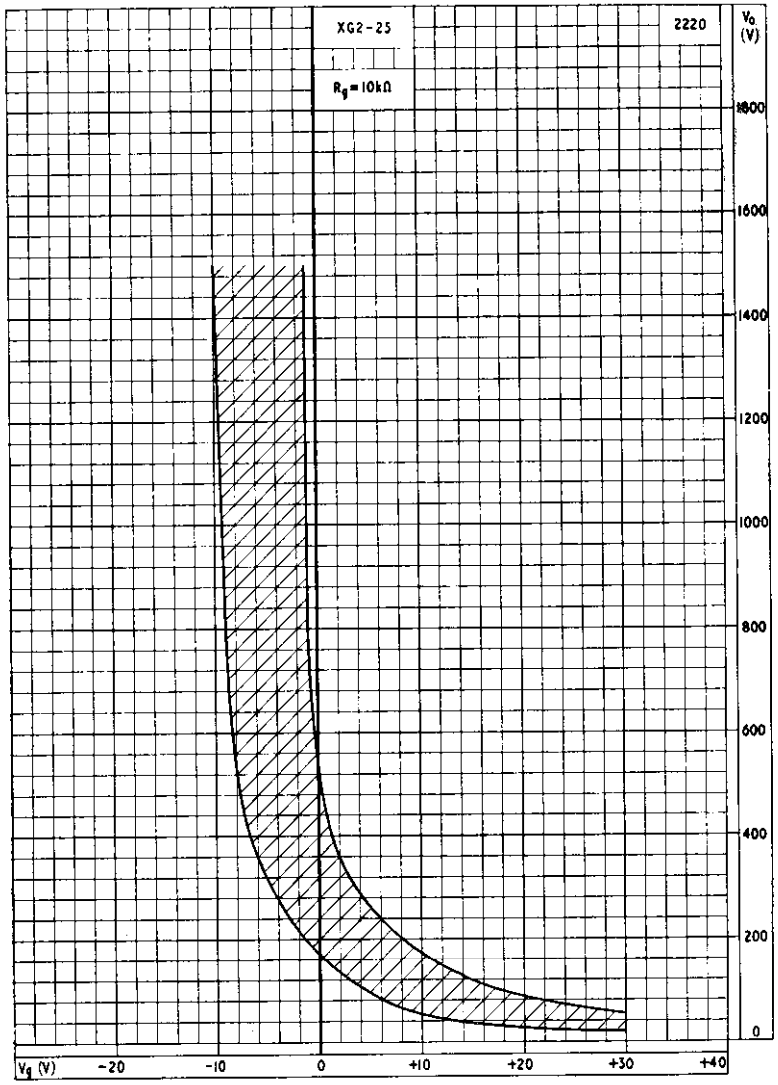


The h,k terminal is marked with a red dot.

XG2-25

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristic.

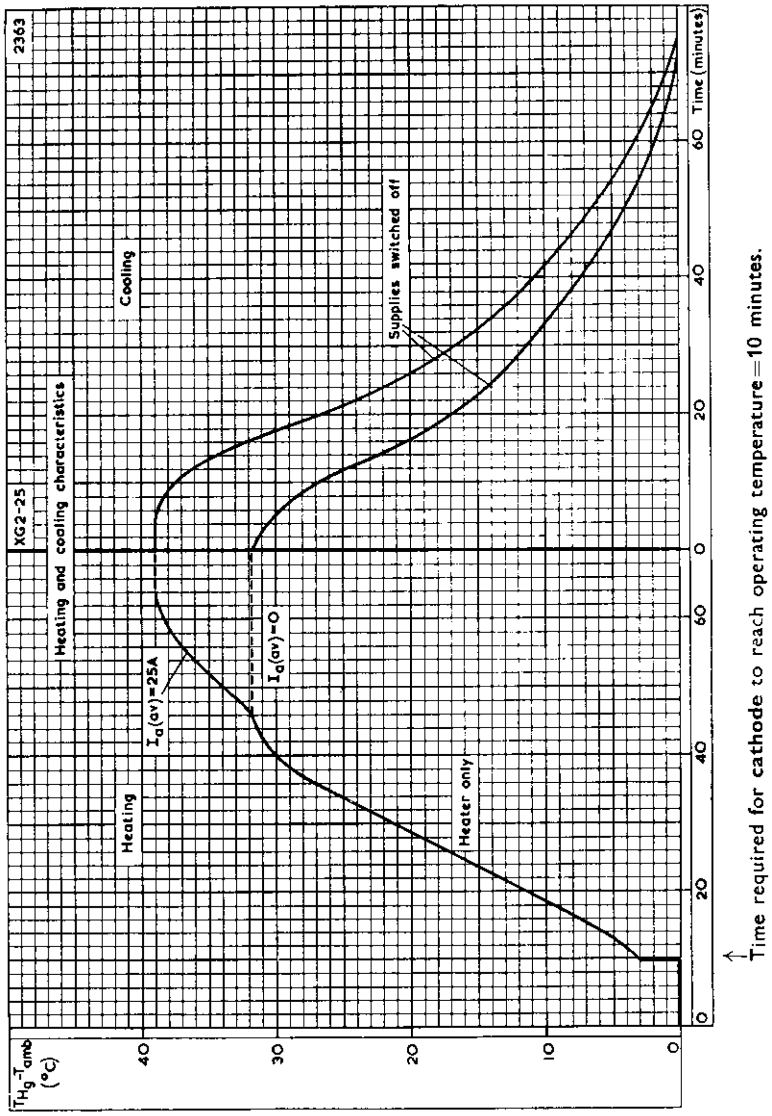


CONTROL CHARACTERISTIC

TRIODE THYRATRON

XG2-25

Triode mercury vapour thyratron with negative/positive control characteristic.

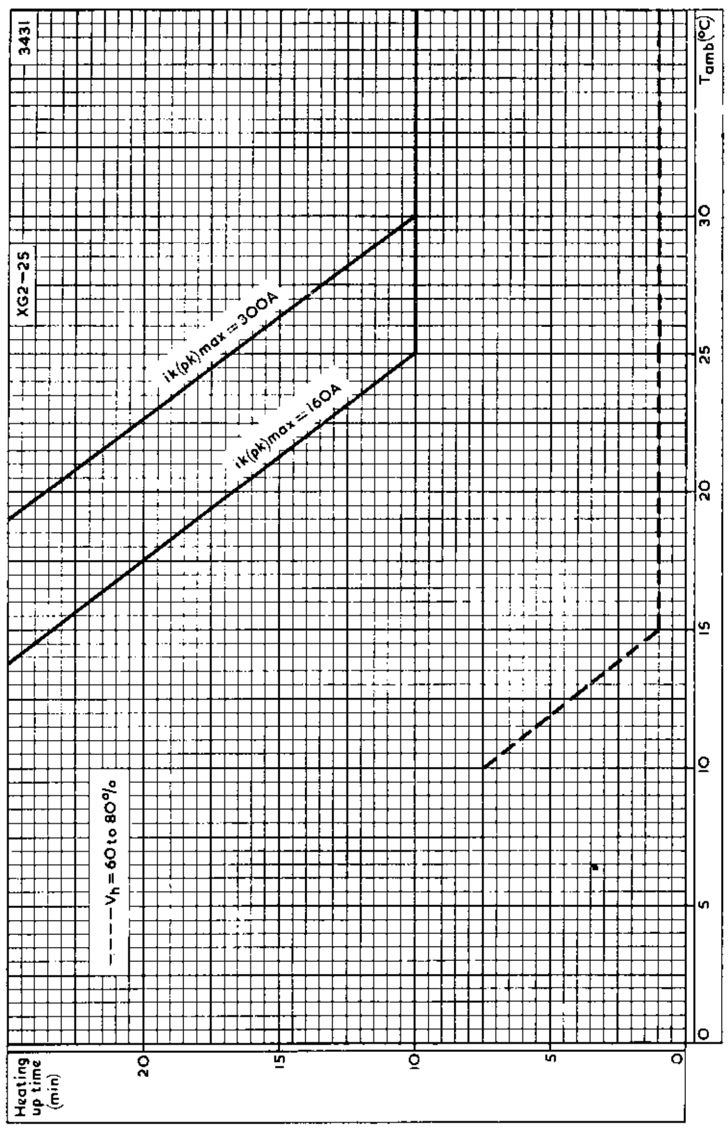


HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME

XG2-25

TRIODE THYRATRON

Triode mercury vapour thyratron with negative/positive control characteristic.



TOTAL HEATING-UP TIME PLOTTED AGAINST AMBIENT TEMPERATURE

TRIODE THYRATRON

XG2-6400

6.4 amp triode mercury vapour thyratron with negative control characteristic. Designed for industrial power control applications.

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS – THYRATRONS, which precede this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	2.5	kV
Forward	2.5	kV
Max. cathode current		
Peak (25c/s and above)	40	A
Average (Max. averaging time 15s)	6.4	A
Surge (Fault protection max. duration 0.1s)	400	A
Max. negative grid voltage		
Before conduction	1.0	kV
During conduction	10	V
Max. average positive grid current for anode voltage more positive than −10V (averaging time 15s)	250	mA
Max. peak positive grid current during the time that the anode voltage is more positive than −10V	1.0	A
Max peak positive grid current during the time that the anode voltage is more negative than −10V	15	mA
Grid resistor		
Maximum	100	kΩ
Recommended minimum	10	kΩ
Condensed mercury temperature limits	35 to 80	°C

CHARACTERISTICS

Electrical

Heater voltage	5.0	V
Heater current at 5.0V		
Average	10	A
Maximum	11.5	A
Anode-to-grid capacitance	< 0.1	pF
Grid-to-cathode capacitance	15	pF
Recovery time (approx.)	1000	µs
Ionisation time (approx.)	10	µs
Anode voltage drop	16	V
Critical grid current at $V_a = 2.5$kV	<20	µA

Mechanical

Type of cooling	Convection	
Mounting position	Vertical, base down	
Max. net weight	400	g ←
	14	oz
Weight of thyratron in packing	1150	g ←
	2 lb	9 oz
Dimensions of packing	12.5 × 6.25 × 6.25	in ←
	317.5 × 158.8 × 158.8	mm

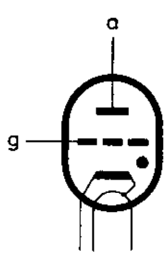
HEATING-UP TIME

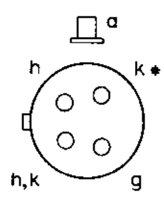
The minimum value of the total valve heating-up time can be obtained from the heating and cooling curve on page C3. This shows how the condensed mercury temperature rises above ambient temperature from the instant of switching on the heater supply.

Under normal conditions, however, cathode current may be drawn when the condensed mercury temperature is approximately within 7°C of the minimum quoted value. See appropriate section 'General operational recommendations – thyratrons'.

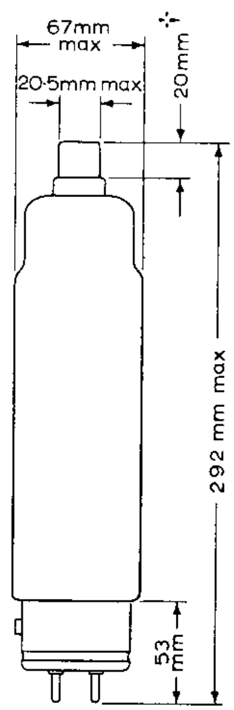
During long shut down periods e.g. overnight, the heater supply may be reduced to 60 to 80% of normal instead of being switched off. This greatly reduces the minimum delay required after restoring the heater supply to normal. The total heating-up time under this duty can be obtained from the curve on page C4.

Minimum cathode heating time	5	min



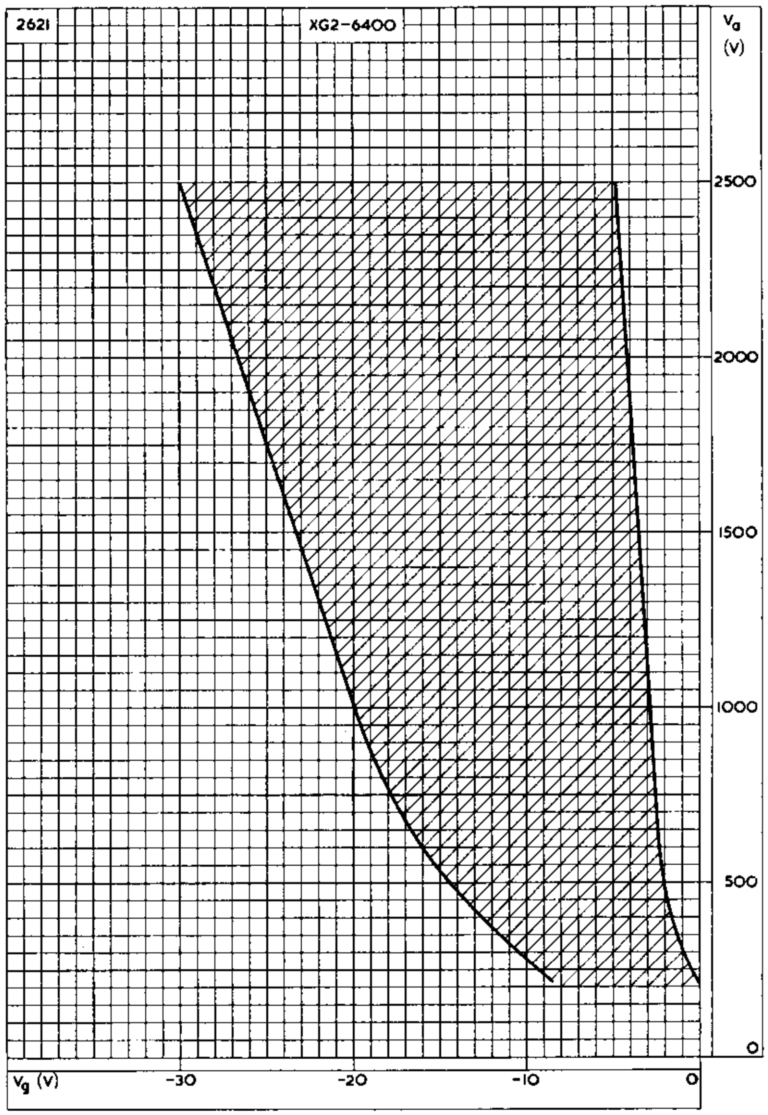


B4D Base

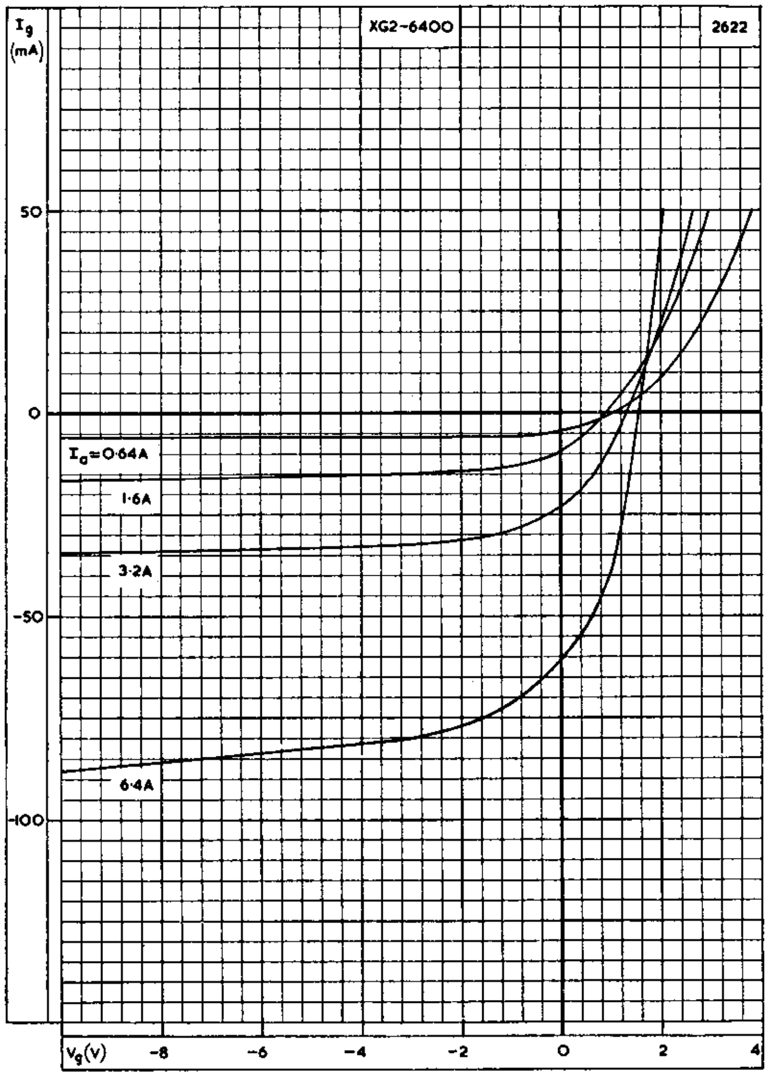


*Return lead of grid and anode circuits
†Contact length 17·5mm min

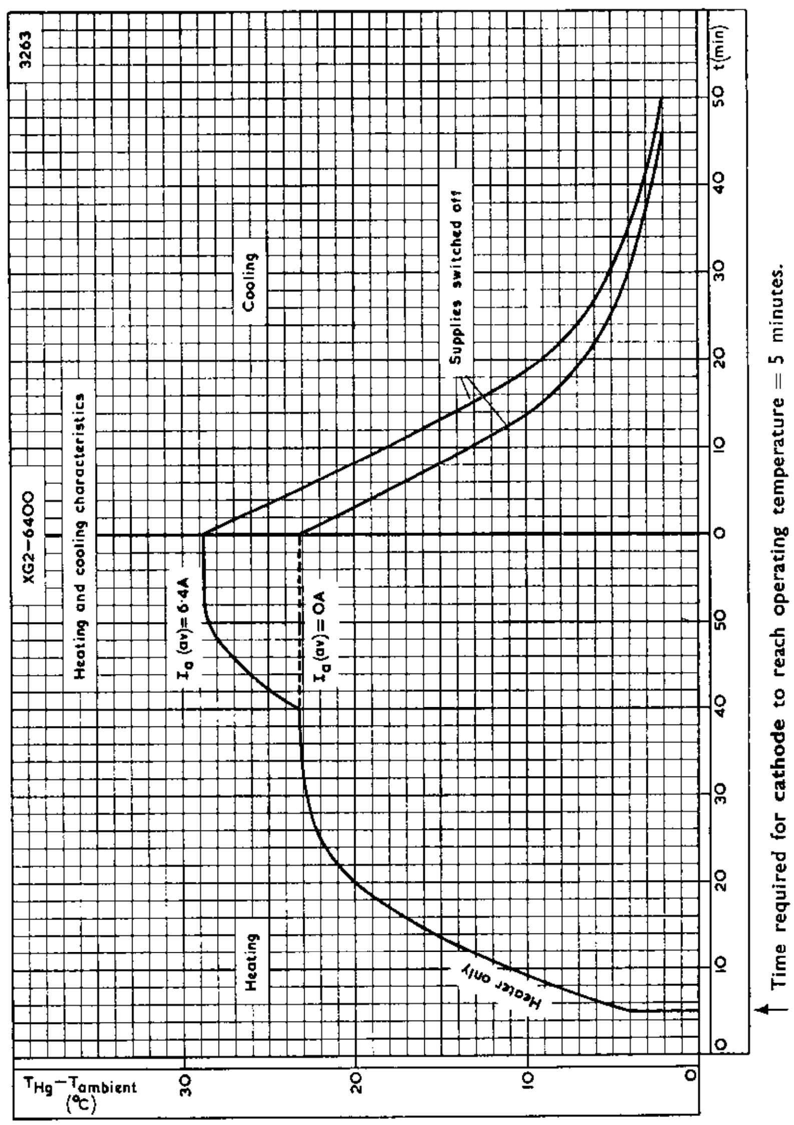
B405



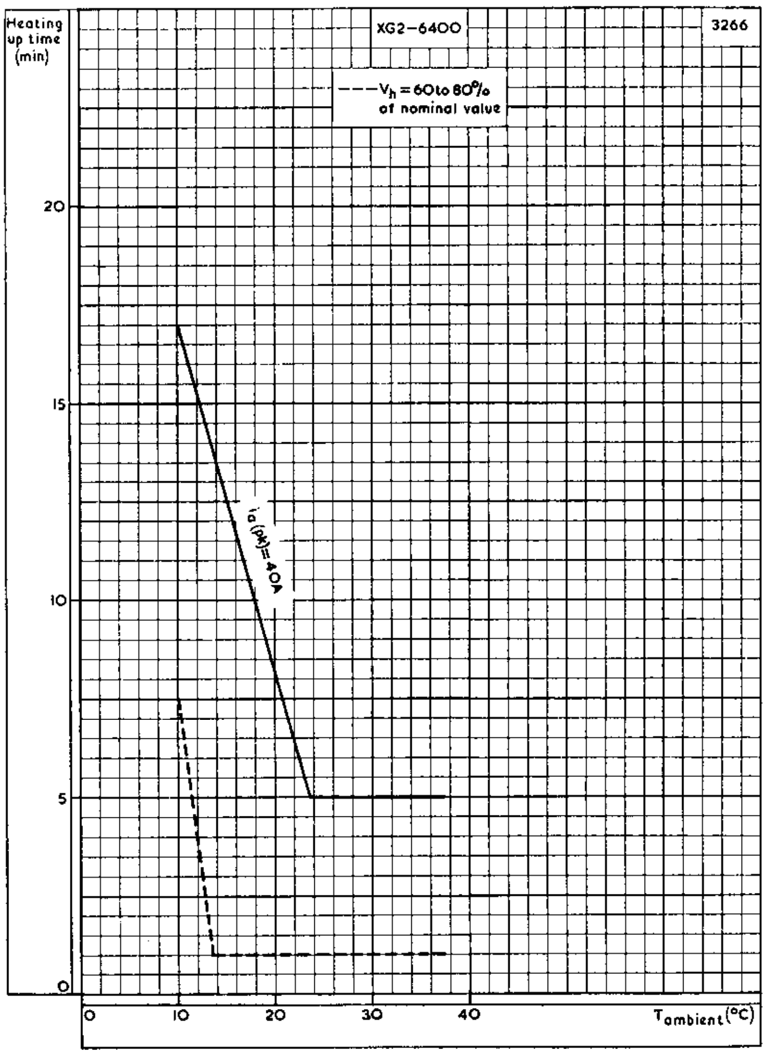
CONTROL CHARACTERISTIC



GRID ION CURRENT CHARACTERISTIC



HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME



TOTAL HEATING-UP TIME PLOTTED AGAINST AMBIENT TEMPERATURE
(See notes on page D2)

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

XG5-500

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	5.0	kV
Forward	2.5	kV
Max. cathode current		
Peak (25c/s and above)	2.0	A
Peak (below 25c/s)	1.0	A
Average (max. averaging time 15s)	500	mA
Surge (fault protection max. duration 0.1s)	40	A
Max. negative control-grid voltage		
Before conduction	500	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than −10V (averaging time 15s)	50	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than −10V	250	mA
Max. peak positive control-grid current during the time that the anode voltage is more negative than −10V	50	mA
Max. control-grid resistor (Recommended min. control-grid resistor 10kΩ)	100	kΩ
Filament voltage limits	2.25 to 2.75	V
Max. power supply frequency	150	c/s
Condensed mercury temperature limits	35 to 70	°C

XG5-500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

CHARACTERISTICS

Electrical

Filament voltage	2.5	V
Filament current at 2.5V		
Average	5.0	A
Maximum	5.4	A
Anode to control-grid capacitance	4.0	pF
Control-grid to cathode capacitance	8.0	pF
Recovery (deionisation) time (approx.)	1,000	µs
Ionisation time (approx.)	10	µs
Anode voltage drop	16	V
Critical grid current at $V_a = 2.5kV$	<20	µA

Mechanical

Type of cooling	Convection	
Equilibrium condensed mercury temperature rise above ambient		
At full load (approx.)	28	°C
At no load (approx.)	20	°C
Mounting position	Vertical, base down	
Max. net weight	4.0	oz
	114	g

HEATING UP TIME

The preferred minimum value of the total valve heating up time can be obtained from the heating and cooling curve on page 6. This shows how the condensed mercury temperature rises above the ambient temperature from the instant of switching on the filament supply.

Under normal conditions, however, cathode current may be drawn when the condensed mercury temperature is approximately within 7°C of the minimum quoted value. (See page 7 and also appropriate section of 'General operational recommendations—thyratrons').

Minimum cathode heating time 5.0s

TRIODE THYRATRON

XG5-500

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

CONTROL CHARACTERISTIC (see page 4)

The shaded area between the curves indicates the spread in characteristics due to:

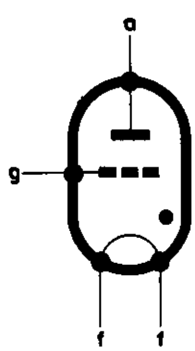
(*a*) Initial differences between individual valves.

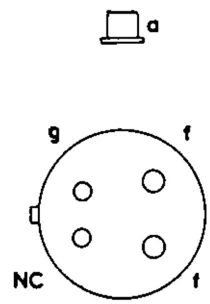
(*b*) Variations in characteristics during life.

(*c*) Variations in characteristics due to changes in heater voltage.

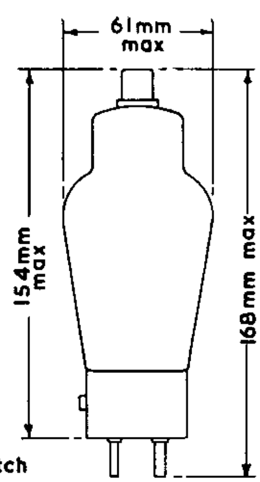
(*d*) The effects of circuit loading.

The effects of different values of series grid resistor have been ignored.





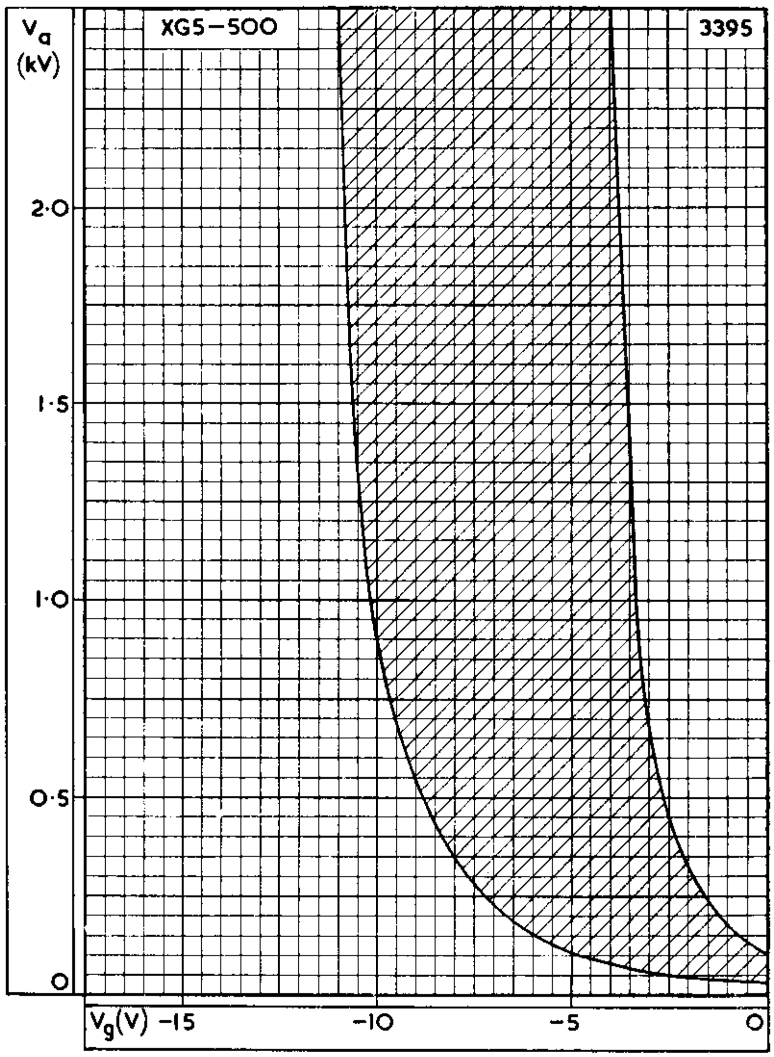
Medium 4-pin base with bayonet catch



XG5-500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

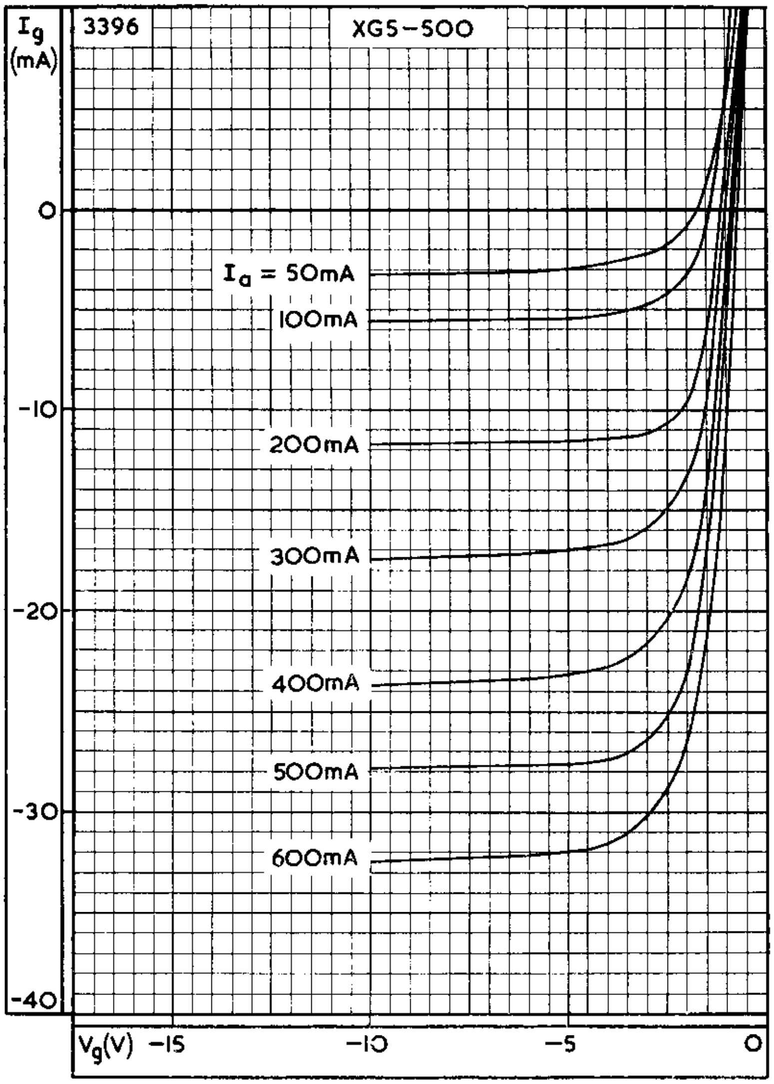


CONTROL CHARACTERISTIC
(See note on page 3)

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

XG5-500

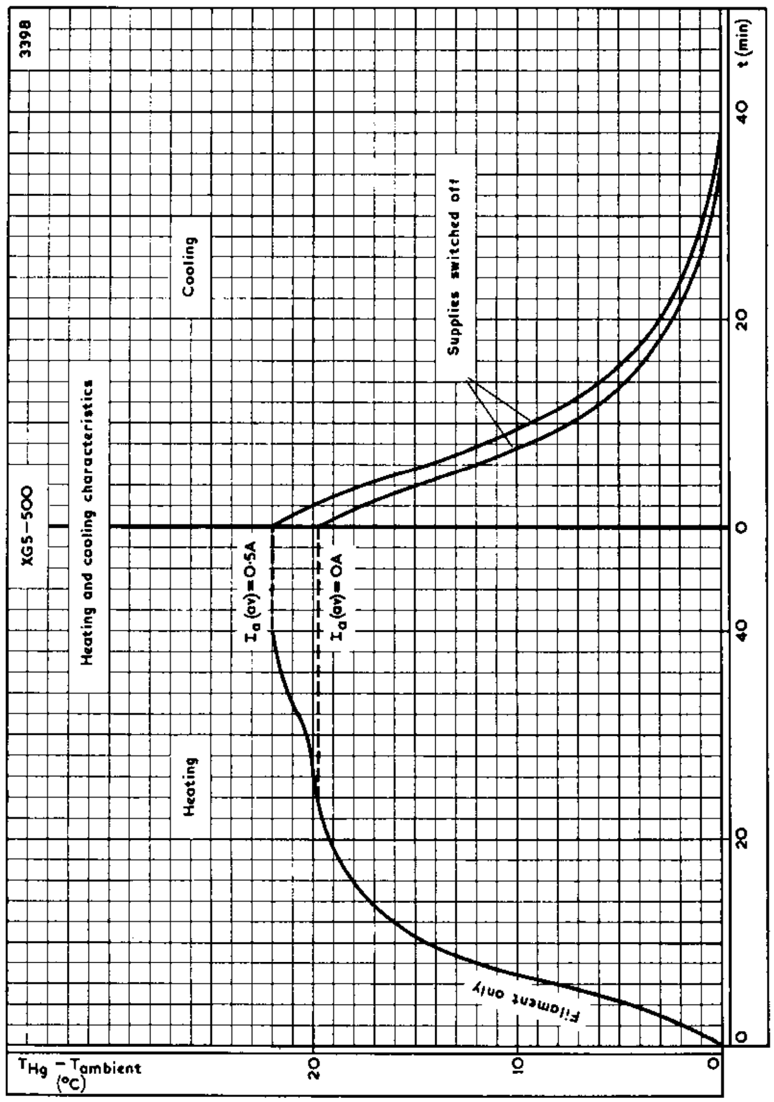


GRID ION CURRENT CHARACTERISTIC

XG5-500

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

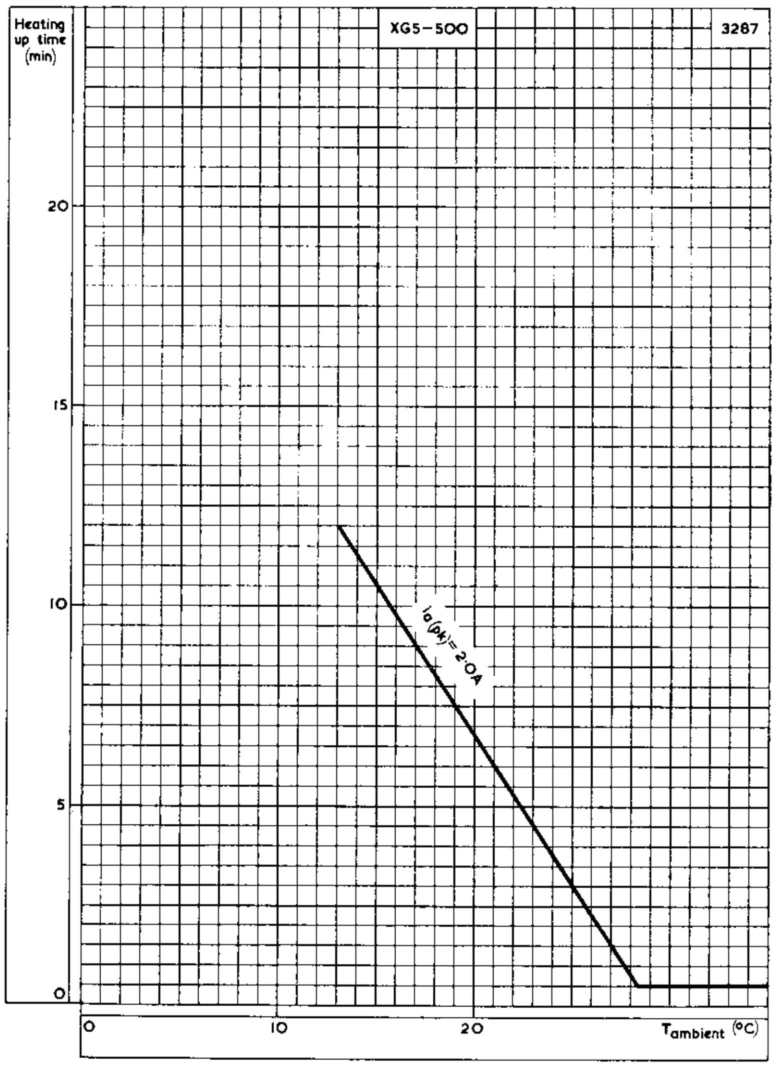


HEATING AND COOLING CHARACTERISTICS

TRIODE THYRATRON

Triode mercury vapour thyratron with negative control characteristic. Primarily designed for industrial control applications.

XG5-500



TOTAL HEATING UP TIME PLOTTED AGAINST AMBIENT TEMPERATURE

QUICK REFERENCE DATA (maximum values)

Mercury-vapour triode for high voltage power control applications

Peak anode voltage	15	kV
Cathode current		
Peak	45	A
Average	10	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS – THYRATRONS, which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations.

Anode		
Maximum peak anode voltage		
Forward	15	kV
Inverse	15	kV
Anode voltage drop (approx.)	12	V
Grid		
Maximum peak positive grid voltage	600	V
Maximum grid resistor	20	kΩ
Cathode		
Heater voltage	5.0	V
Maximum heater current at 5.0V	20	A
Minimum cathode heating time (see note 1 and curve on page C2)	10	min
Maximum cathode current		
Average (max. averaging time = 10s)	10	A
Peak	45	A
Surge (fault protection, max. duration = 0.1s)	600	A
Ionisation and recovery time		
Nominal ionisation time	10	µs
Nominal recovery time	1	ms
Temperature		
Equilibrium condensed mercury temperature rise above ambient		
At full load	30	°C
At no load	27	°C

XG15-10

THYRATRON

Mechanical

Type of cooling	convection
Mounting position	vertical, base down
Net weight (approx.)	1.2 kg 2 lb 11 oz
Weight of valve in carton (approx.)	3.76 kg 8 lb 5 oz
Nominal dimensions of carton	310 × 310 × 620 mm 12.2 × 12.2 × 24.4 in

FULL LOAD OPERATING CONDITIONS AS RECTIFIER (for a P.I.V. of 15kV and $i_{k(pk)}$ of 45A)

These figures are based upon the absolute maximum ratings of the valve and no account has been taken of mains variations or transformer, valve and choke losses. In practice, due consideration must be given to these factors.

Circuit	No. of valves	Full load d.c. output (kV)	(A)	Applied a.c. volts ($kV_{r.m.s.}$)
Single phase full-wave	2	4.8	20	5.3 (per valve)
Single phase bridge	4	9.6	20	10.6 (total)
Three phase half-wave	3	6.2* (7.2)	30	5.3* (6.1) (per phase)
Three phase full-wave	6	14.4	30	6.1 (per phase)

*These figures take into account the increase in peak inverse voltage which occurs if the power supply is lightly loaded. For operation with a constant load the voltages may be increased to the value shown in brackets.

ABSOLUTE MAXIMUM RATINGS

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into account in arriving at the actual valve operating conditions.

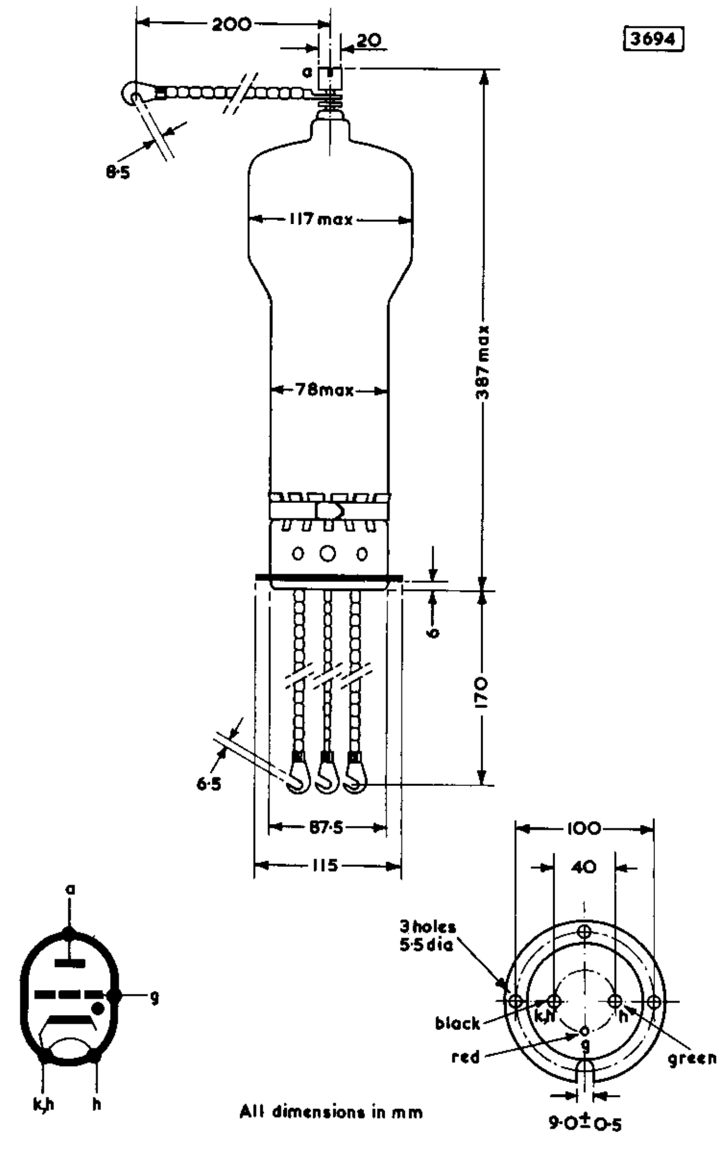
Maximum operating frequency		150	c/s
Anode			
Maximum peak anode voltage			
Forward	10	15	kV
Inverse	10	15	kV
Condensed mercury temperature limits	25 to 65	25 to 60	°C
Grid			
Maximum peak positive grid voltage		600	V
Cathode			
Maximum cathode current			
Average (max. averaging time = 10s)		10	A
Peak		45	A
Surge (fault protection, max. duration = 0.1s)		600	A

OPERATING NOTE

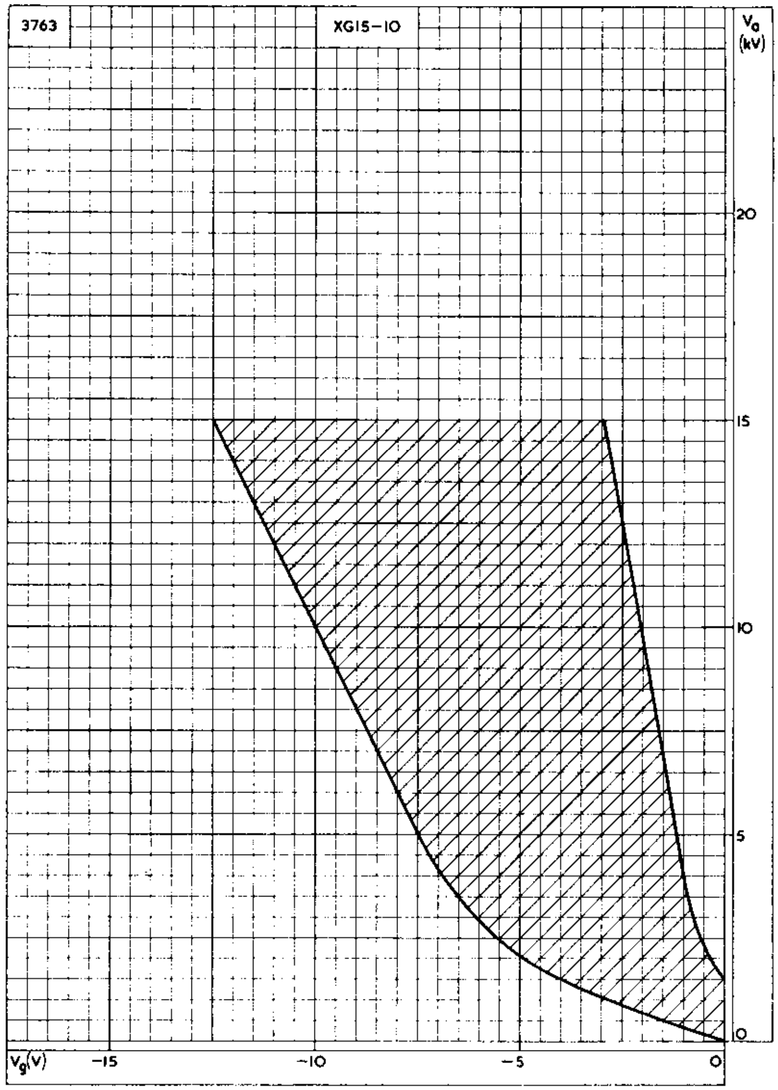
1. The preferred minimum value of the total valve heating-up time can be obtained from the heating curve on page C2. This shows how the condensed-mercury temperature rises above ambient temperature from the instant of switching on the heater supply.

XG15-10

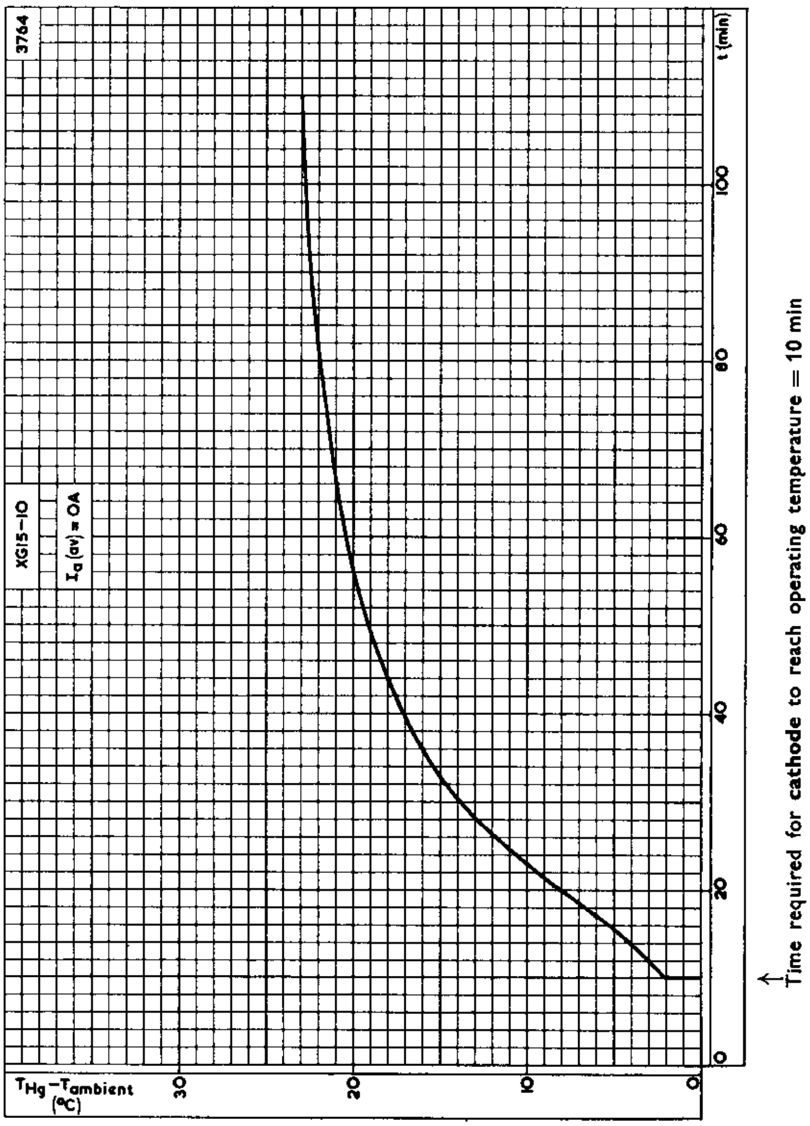
THYRATRON



All dimensions in mm



CONTROL CHARACTERISTIC



HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME

TRIODE THYRATRON

XG15-10

10 amp triode mercury vapour thyratron with negative control characteristic. Primarily designed for use in high voltage rectifier circuits.

PRELIMINARY DATA

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS — THYRATRONS, preceding this section of the handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into account in arriving at the actual valve operating conditions.

Max. peak anode voltage			
Inverse	10	15	kV
Forward	10	15	kV
Condensed mercury temperature limits	25 to 65	25 to 60	°C
Max. cathode current			
Peak		45	A
Average (max. averaging time 10s)		10	A
Surge (fault protection max. duration 0.1s)		600	A
Max. peak positive grid voltage		600	V
Max. grid resistor		20	kΩ

CHARACTERISTICS

Electrical

Heater voltage	5.0	V
Max. heater current at 5.0V	20	A
Anode voltage drop	12	V
Max. operating frequency	150	c/s
Recovery (deionisation) time (approx.)	1	ms
Ionisation time (approx)	10	μs

Mechanical

Type of cooling	convection	
Mounting position	Vertical, base down	
Max. net weight	1.2	kg
	42	oz
Equilibrium condensed mercury temperature rise above ambient		
At full load	30	°C
At no load	27	°C

XG15-10

TRIODE THYRATRON

10 amp triode mercury vapour thyratron with negative control characteristic. Primarily designed for use in high voltage rectifier circuits.

FULL LOAD OPERATING CONDITIONS (for peak inverse anode voltage of 15kV and a peak cathode current of 45A)

Circuit	No. of valves	Full load d.c. output (kV)	Full load d.c. output (A)	Applied a.c. volts ($kV_{r.m.s.}$)	Initial filter elements Lmin. (H)	Initial filter elements Cmax. (μF)
Single phase full-wave	2	4.8	20	5.3 (per valve)	0.5	50
Single phase bridge	4	9.6	20	10.6 (total)	1.0	25
Three phase half-wave	3	6.2* (7.2)	30	5.3* (6.1) (per phase)	0.2	25
Three phase full-wave	6	14.4	30	6.1 (per phase)	0.4	10

*These figures take into account the increase in peak inverse voltage which occurs if the power supply is lightly loaded. For operation with a constant load the voltages may be increased to the value shown in brackets.

HEATING UP TIME

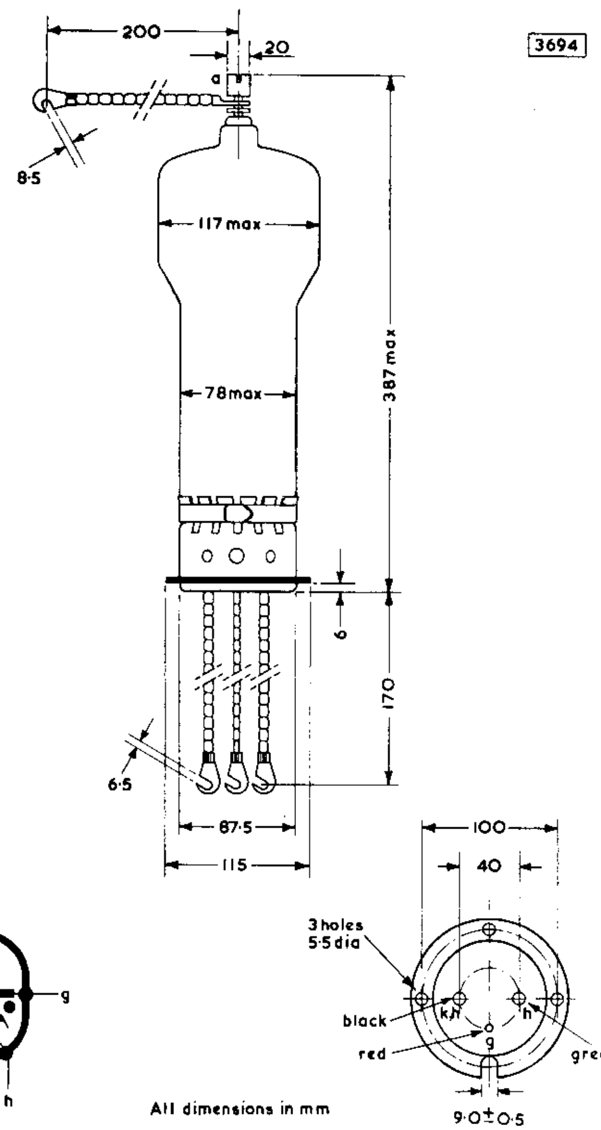
The preferred minimum value of the total valve heating up time can be obtained from the heating curve on page 5. This shows how thecon densed mercury temperature rises above ambient temperature from the instant of switching on the heater supply.

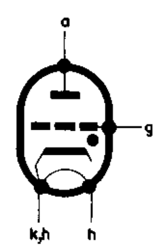
Minimum cathode heating time	10	min

TRIODE THYRATRON

XG15-10

10 amp triode mercury vapour thyratron with negative control characteristic. Primarily designed for use in high voltage rectifier circuits.



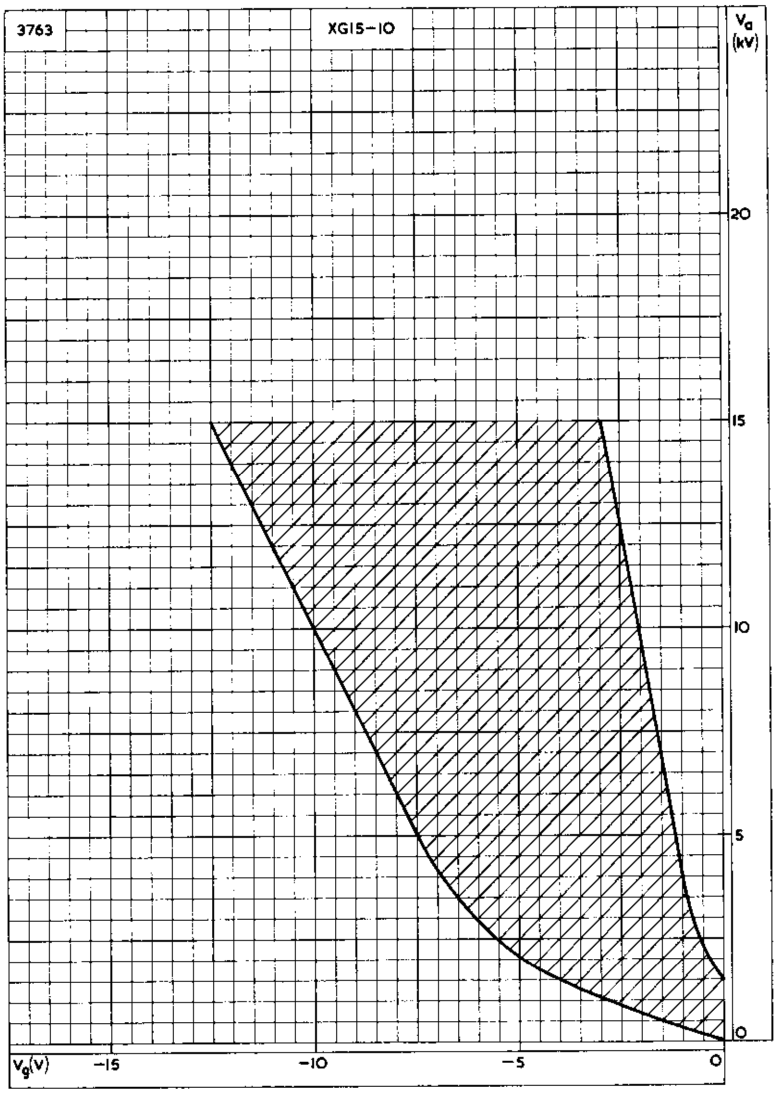


All dimensions in mm

XG15-10

TRIODE THYRATRON

10 amp triode mercury vapour thyratron with negative control characteristic. Primarily designed for use in high voltage rectifier circuits.

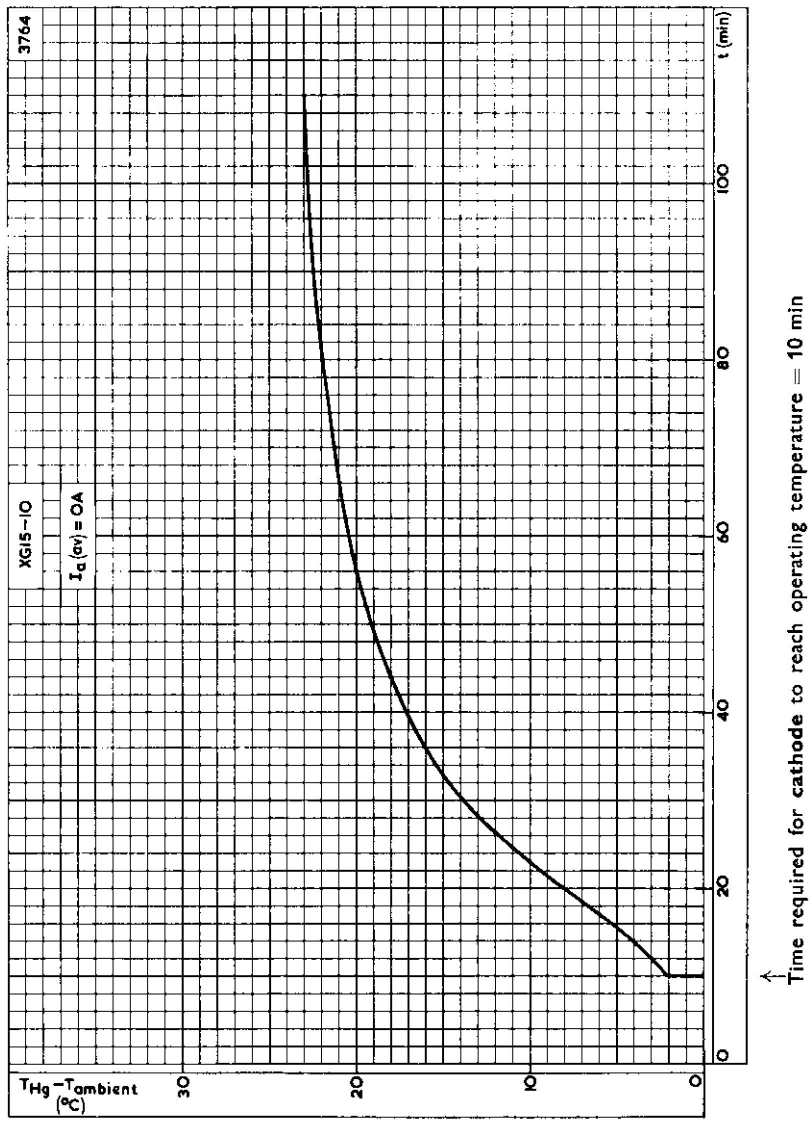


CONTROL CHARACTERISTIC

TRIODE THYRATRON

XG15-10

10 amp triode mercury vapour thyratron with negative control characteristic. Primarily designed for use in high voltage rectifier circuits.



HEATING AND COOLING CHARACTERISTIC. EXCESS TEMPERATURE OVER AMBIENT PLOTTED AGAINST TIME

TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

XH3-045

(3C45)

PRELIMINARY DATA

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak pulse anode voltage (pulse modulator service).		
*Inverse	3.0	kV
†Forward	3.0	kV
Min. anode supply voltage	800	V
Min. peak inverse voltage	5.0	% of forward anode voltage
Max. cathode current		
Peak	35	A
Average	45	mA
Averaging time	1.0	cycle
Max. negative control-grid voltage	200	V
Control-grid drive limits (measured with grid disconnected)		
Min. peak grid voltage	175	V
Max. time of rise	0.5	μs
Min. grid pulse duration	2.0	μs
Max. impedance of drive circuit	1.5	kΩ
Max. pulse repetition frequency	See Note ‡	
Heater voltage limits	5.7 to 6.6	V
Min. valve heating time	120	s
Ambient temperature limits	−50 to +90	°C

*In pulsed operation, the peak inverse anode voltage should not exceed 1.5 kV during the first 25μs after the pulse.

†For instantaneous starting applications where the anode voltage is applied instantaneously the maximum initial permissible forward voltage is 3.0 kV and shall not be obtained in less than 0.04 seconds.

‡The product of pulse repetition frequency, peak forward anode voltage and peak cathode current must be not greater than 0.3×10^9.

XH3-045

(3C45)

TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

CHARACTERISTICS

Electrical

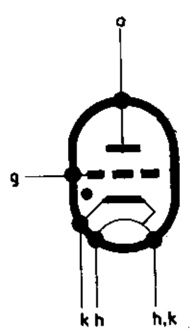
Heater voltage	6.3	V
Heater current		
Minimum	2.0	A
Maximum	2.5	A

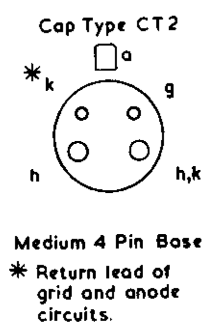
Mechanical

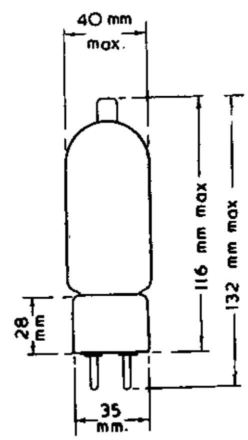
Type of cooling	Convection
Mounting position	Any

Clamping at base and/or bulb only in the region up to 2 inches above the top of the base.

1526







TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

XH8-100

(4C35)

PRELIMINARY DATA

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions

Max. peak pulse anode voltage (pulse modulator service)		
*Inverse	8.0	kV
†Forward	8.0	kV
Min. anode supply voltage	2.5	kV
Min. peak inverse anode voltage	5.0 of forward voltage.	%
Max. cathode current		
Peak	90	A
Average	100	mA
Max. negative control grid voltage	200	V
Control grid drive limits (measured with grid disconnected).		
Min. peak grid voltage	175	V
Max. time of rise	0.5	µs
Min. grid pulse duration	2.0	µs
Max. impedance of drive circuit	1.5	kΩ
Max. pulse repetition frequency.	See Note ‡	
Heater voltage limits	5.7 to 6.6	V
Min. valve heating time	180	s
Ambient temperature limits	-50 to +90	°C

*In pulsed operation, the peak inverse anode voltage should not exceed 2.5kV during the first 25 µs after the pulse.

†For instantaneous starting applications where the anode voltage is applied instantaneously the maximum initial permissible forward voltage is 7kV and shall not be obtained in less than 0.04 seconds.

‡The product of pulse repetition frequency, peak forward anode voltage and peak cathode current must be not greater than 2.0×10^9.

XH8-100

(4C35)

TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

CHARACTERISTICS

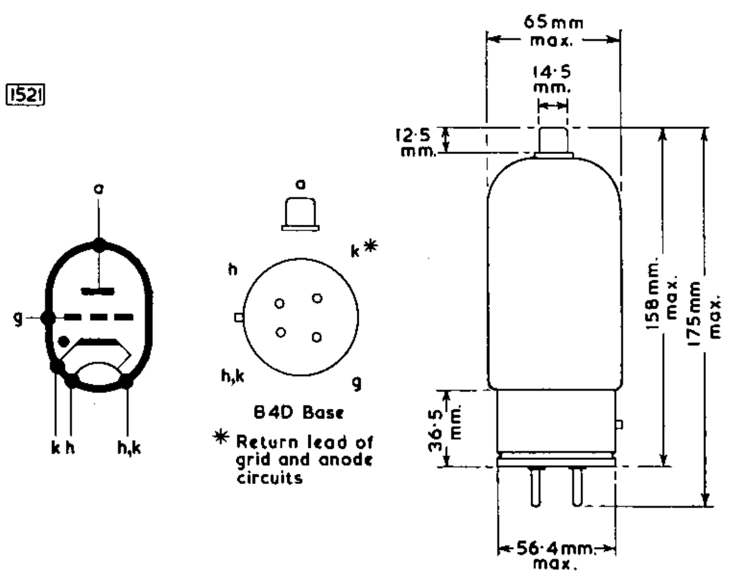
Electrical

Heater voltage	6.3	V
Heater current at 6.3V		
Minimum	5.5	A
Maximum	6.7	A

Mechanical

Type of cooling	Convection Cooling of the anode lead is permissible but no air blast should be directly applied to the valve envelope.
Mounting position	Any Clamping at base and/or bulb only in the region up to 2.5 inches above the top of the base.

1521



TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

XH16-200

(5C22)

PRELIMINARY DATA

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken in consideration in arriving at actual valve operating conditions.

Max. peak pulse anode voltage (pulse modulator service) ←		
*Inverse	16	kV
†Forward	16	kV
Min. anode supply voltage	4.5	kV
Min. peak inverse anode voltage	5.0	% of forward voltage
Max. cathode current		
Peak	325	A
Average	200	mA
Max. negative control grid voltage	200	V
Control grid drive limits (measured with grid disconnected).		
Min. peak grid voltage	200	V
Max. time of rise	0.5	µs
Min. grid pulse duration	2.0	µs
Max. impedance of drive circuit	500	Ω
Max. pulse repetition frequency.	See Note ‡	
Heater voltage limits	5.8 to 6.8	V
Min. valve heating time	300	s
Ambient temperature limits	−50 to +90	°C

*In pulsed operation, the peak inverse anode voltage should not exceed 5kV during the first 25µs after the pulse.

†For instantaneous starting applications where the anode voltage is applied instantaneously the maximum initial permissible forward voltage is 13.5kV and shall not be obtained in less than 0.04 seconds.

‡The product of pulse repetition frequency, peak forward anode voltage and peak cathode current must be not greater than 3.2×10^9

XH16-200

(5C22)

TRIODE THYRATRON

Triode, hydrogen-filled thyratron primarily designed for pulse operation at high repetition frequencies, high peak currents and high voltages.

CHARACTERISTICS

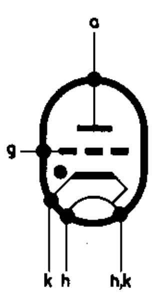
Electrical

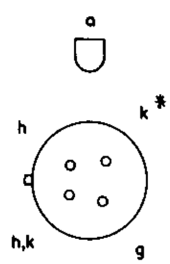
Heater voltage	6.3	V
Heater current at 6.3V		
Minimum	9.6	A
Maximum	11.6	A

Mechanical

Type of cooling	Convection Cooling of the anode lead is permissible but no air blast should be directly applied to the valve envelope.
Mounting position	Any Clamping at base and/or bulb only in the region up to 4.25 inches above the top of the base

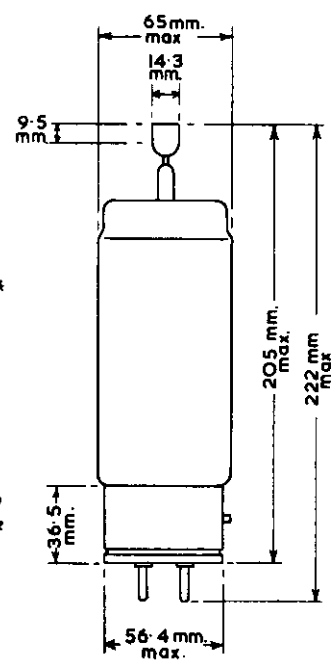
1522





B4D BASE

* Return lead of grid and anode circuits.



HYDROGEN THYRATRON **XH25-500**

QUICK REFERENCE DATA

Triode for pulse modulator duty

Peak pulse power	6.25	MW
Maximum peak forward anode voltage	25	kV
Maximum peak cathode current	500	A
Maximum jitter time	10	ns
*Maximum operation factor	6.25×10^9	V.A.p.p.s.

*This is the product of pulse repetition frequency, peak forward anode voltage and peak cathode current.

This data should be read in conjunction with DEFINITIONS and GENERAL OPERATIONAL RECOMMENDATIONS – THYRATRONS which precede this section of the handbook. It is based on operation in pulse modulator duty. The valve is not recommended for use in d.c. or mains supply frequency operation.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variations.

Anode

Peak anode operating voltage range (*see notes 1 and 2*)		
Forward		
500 p.p.s.	10 to 25	kV
1000 p.p.s.	10 to 20	kV
Inverse	5% of forward voltage to 25	kV
Anode delay-time		
Maximum	1.0	µs
Average	300	ns
Maximum initial anode delay-time drift (*see note 3*)	250	ns
Maximum jitter time	10	ns

Grid

Recommended grid bias voltage	0	V
Grid drive requirements (measured with respect to cathode and grid disconnected)		
Peak forward grid pulse voltage range	550 to 1000	V
Minimum rate of rise	1.8	kV/µs
Minimum grid pulse duration	2.0	µs
Effective impedance of drive circuit	50 to 200	Ω

XH25-500 HYDROGEN THYRATRON

Cathode

Maximum cathode current		
Peak	500	A
Average	500	mA
Maximum rate of rise of cathode current	2500	A/μs
Minimum cathode heating time	15	min
Heater voltage	6.3±5%	V
Heater current range at 6.3V	15 to 22	A

Replenisher

Specified replenisher voltage	marked on valve	
Maximum variation in replenisher voltage from specified value	5	%
Range of specified replenisher voltage	3 to 5.5	V
Replenisher current range at 4.5V	2 to 5	A

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode

Maximum peak forward anode voltage (*see note 1*)		
500 p.p.s.	25	kV
1000 p.p.s.	20	kV
Maximum peak inverse anode voltage (*see note 1*)	25	kV

Grid

Maximum peak grid supply voltage (grid disconnected)	1.0	kV
Maximum negative grid voltage	450	V
Minimum impedance of grid drive circuit	50	Ω

Cathode

Maximum cathode current		
Peak	500	A
Average	500	mA
Maximum rate of rise of cathode current	2500	A/μs
Minimum cathode heating time	15	min
Heater voltage		
Minimum	6.0	V
Maximum	6.6	V

Replenisher

Maximum variation from specified replenisher voltage	±5	%
Maximum operation factor	6.25×10^9	
Ambient temperature		
Minimum	−55	°C
Maximum	+75	°C

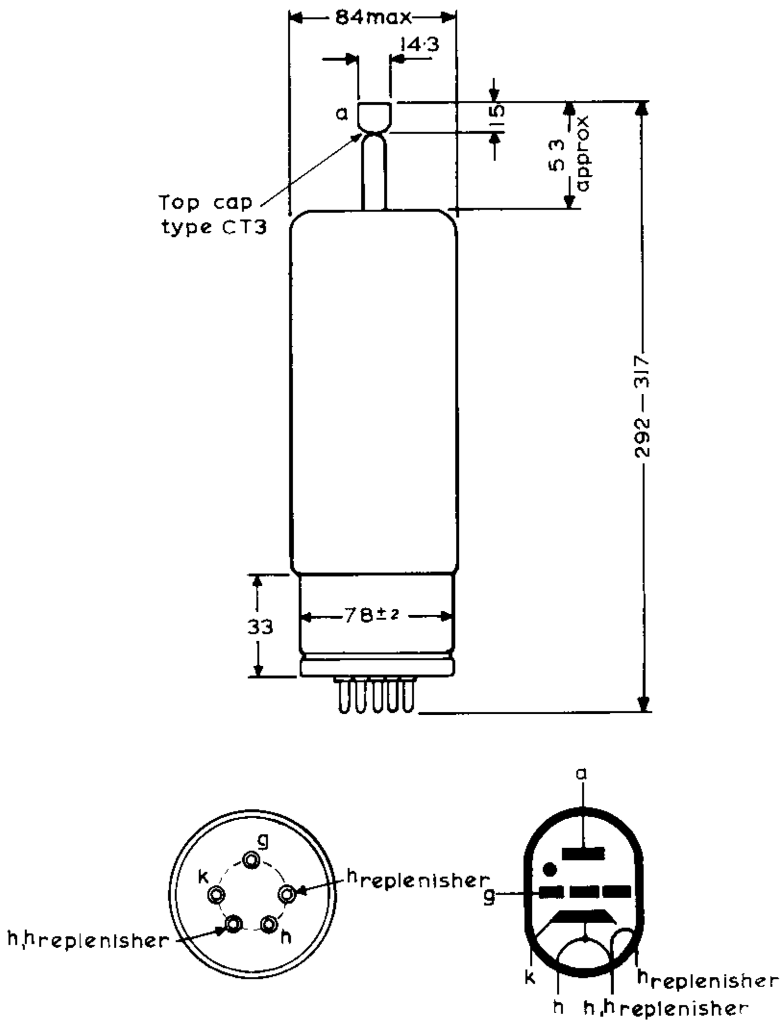
OPERATING NOTES

1. For 'instantaneous starting' applications, where the anode voltage is applied instantaneously, the maximum initial permissible forward voltage is 18kV and shall not be attained in less than 40ms.

   In pulsed operation the peak inverse anode voltage should not exceed 5kV during the first 25μs after the anode current pulse.

   In a voltage doubling circuit, a d.c. anode supply voltage of 5kV is sufficient for starting.
2. The product of pulse repetition frequency, peak forward anode voltage and peak cathode current must not be greater than 6.25×10^9.
3. This is the difference in the anode delay time at 2 minutes and the anode delay time at 7 minutes from the start of operation.

XH25-500 HYDROGEN THYRATRON



All dimensions in mm

B071

B5F BASE

TRIODE THYRATRON

XR1-12

12 amp triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for industrial power control applications.

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS, which precede this section of the handbook.

ABSOLUTE MAXIMUM RATINGS

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Maximum peak anode voltage		
Inverse	1.5	kV
Forward	1.5	kV
Maximum cathode current		
Peak		
Occasional (see operating note 1)	160	A
Recurrent	40	A
Average		
*Maximum averaging time = 7s	12.5	A
*Maximum averaging time = 15min	9.0	A

**These ratings apply simultaneously*

Maximum negative grid voltage		
Before conduction	250	V
During conduction	10	V
Maximum average positive grid current during the time that the anode voltage is more positive than –10V (averaging time 1 cycle)	500	mA
Grid circuit resistance		
Maximum	20	kΩ
Recommended minimum	1	kΩ
Maximum commutation factor	50	VA/μs²
Maximum ambient temperature	+70	°C
Minimum valve heating time	see page C4	

XR1-12

TRIODE THYRATRON

CHARACTERISTICS

Electrical

Filament voltage	2.5	V
Maximum filament current at 2.5V	43	A
Anode-to-grid capacitance	50	pF
Grid-to-cathode capacitance	25	pF
Recovery (deionisation) time (approx.)	1	ms
Ionisation time (approx.)	10	μs
Nominal anode voltage drop	16	V

Measurement of the filament voltage should be made at the shoulder of the lug immediately above the connecting hole.

When two or more valves are used with one filament transformer, the centre tap of the filament transformer must be used for circuit returns. This may also be connected to the filament centre taps.

When quadrature operation is used, the voltage of filament lug No. 1 should be crossing zero from positive towards negative when the anode voltage is at the peak of the positive half cycle. When quadrature operation is not practicable, filament lug No. 1 should be negative when the anode is positive. In three phase systems, each valve should be connected so that its anode and filament voltages approximate as nearly as possible to quadrature phasing, i.e. filament voltage $90° \pm 30°$ out of phase with the anode voltage.

Mechanical

Type of cooling	Convection
Recommended mounting position	Vertical with the filament lugs downwards

The valve should be mounted and ventilated in such a manner that adequate cooling by free convection is ensured.

It is recommended that the valve should be supported from the anode connector only. If it is necessary to mount the valve on the filament lugs, both the connectors must be flexible.

Spacing

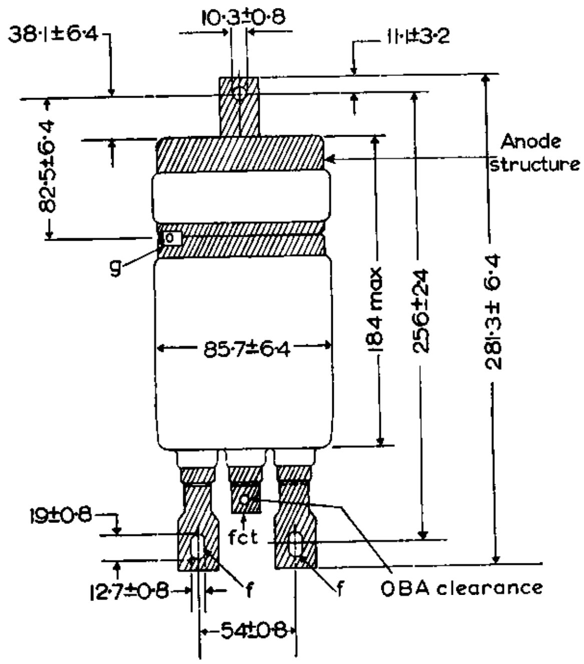
A cylindrical volume of radius 130mm about the axis must be kept free of appreciable obstructions or heat producing components. When two or more valves are mounted in close proximity the distance between centres should not be less than 180mm.

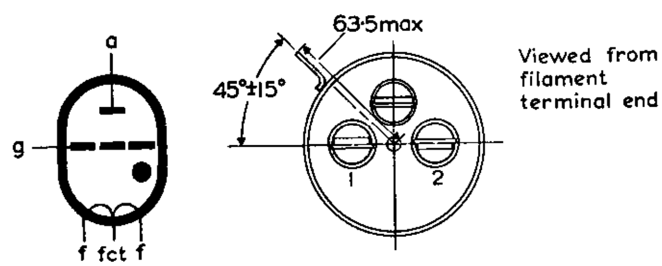
Maximum net weight	1 lb 12 oz	
	860	g
Nominal weight of valve in carton	5 lb 3 oz	
	2.4	kg
Nominal dimensions of carton	8.25 × 8.25 × 23	in
	210 × 210 × 585	mm

OPERATING NOTES

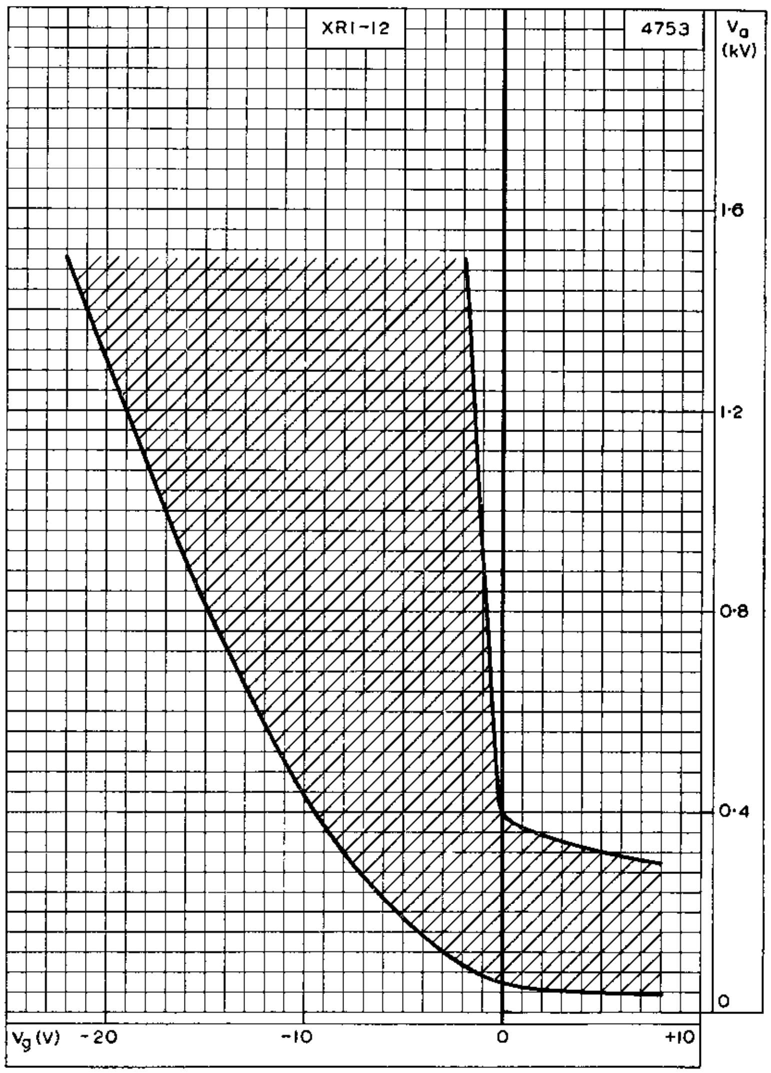
1. When the peak cathode current exceeds 40A, the ratio of peak-to-average cathode current must not exceed 30 (minimum averaging time = 1s, see page C2). The total number of cycles (50c/s operation) in any 15 minute period during which peak currents in excess of 40A are drawn is limited (see page C3).
2. In order to prevent spurious ignition due to anode-to-grid coupling, it may be necessary to connect a capacitor of the order of 5000pF between grid and cathode.

3826

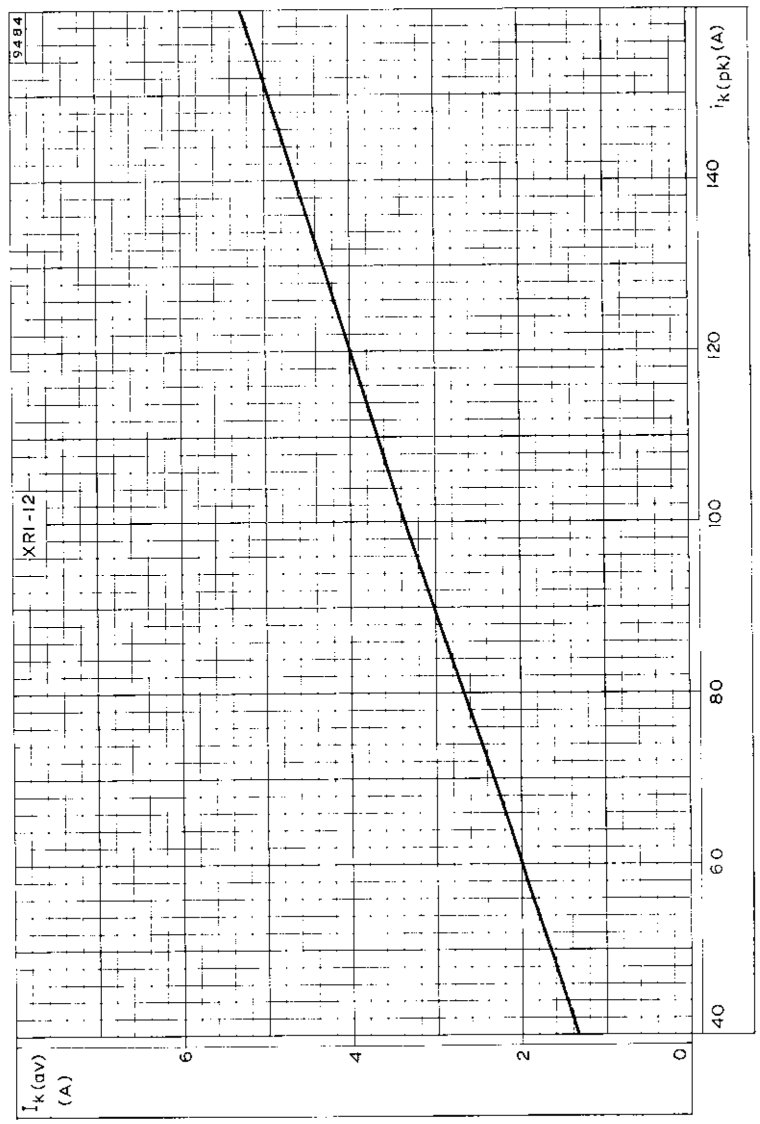




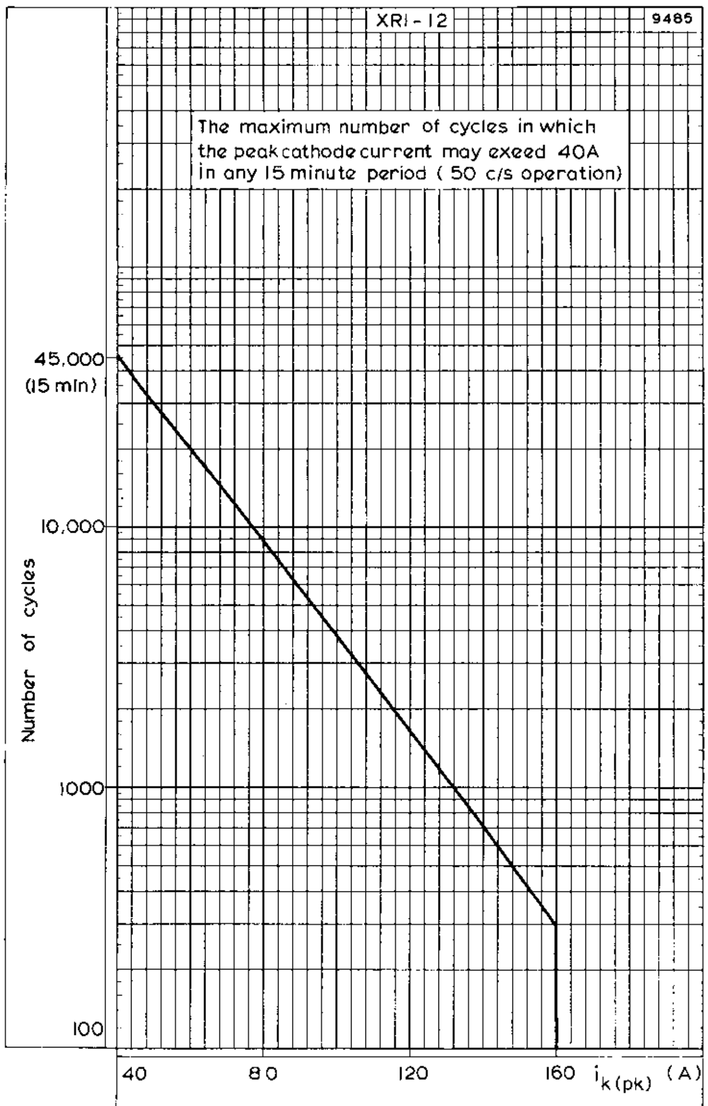
All dimensions in mm



CONTROL CHARACTERISTIC



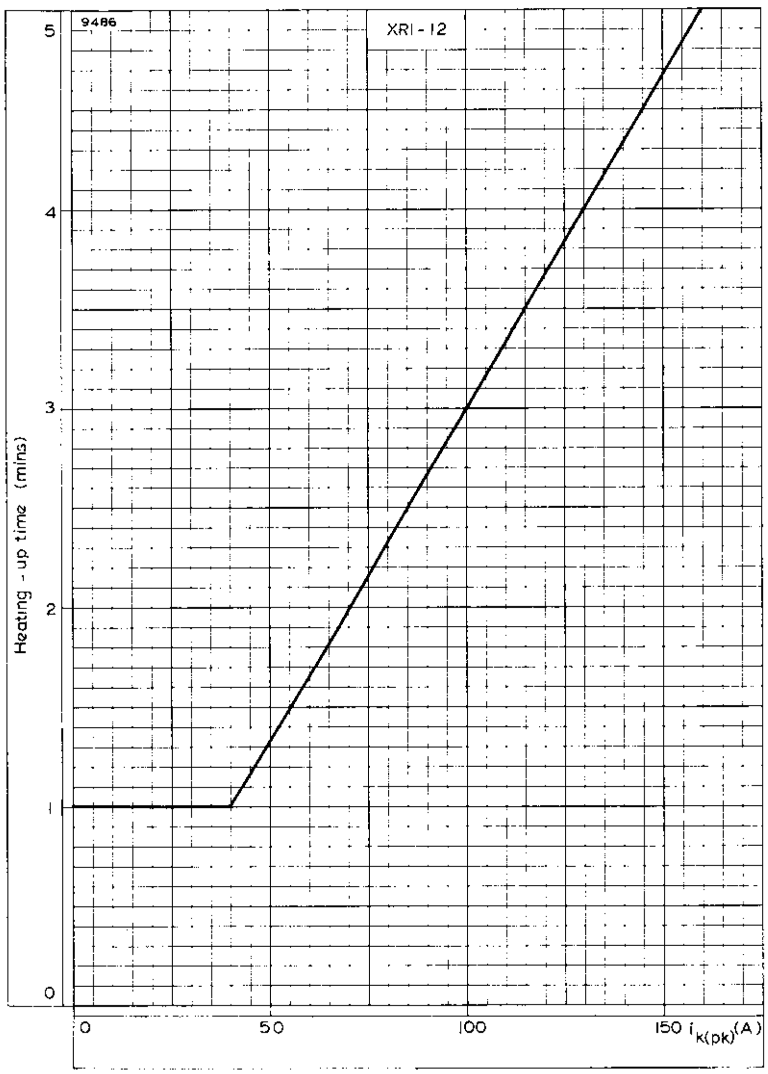
MINIMUM AVERAGE CATHODE CURRENT (MINIMUM AVERAGING TIME = 1s) PLOTTED AGAINST PEAK CATHODE CURRENT EXCEEDING 40A



MAXIMUM NUMBER OF CYCLES IN WHICH THE PEAK CATHODE CURRENT MAY EXCEED 40A IN ANY 15 MINUTE PERIOD (50c/s OPERATION)

XR1-12

TRIODE THYRATRON



MINIMUM VALVE HEATING TIME

THYRATRON # XR1-12A

PRELIMINARY DATA

QUICK REFERENCE DATA (maximum values)

Inert gasfilled triode for power control applications

Peak anode voltage	1.5	kV
Cathode current		
Peak	160	A
Average	12.5	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variations.

Anode

Peak anode operating voltage (forward and inverse)	1.5	kV
Anode voltage drop (approx. instantaneous value)		
i_k = 12.5A	16	V
i_k = 160A	20	V
Maximum commutation factor (*note 1*)	50	VA/μs^2
Anode-to-grid capacitance (*note 2*)	50	pF
Ignition delay time	see page C1	
Recovery (deionisation) time (approx.)	1.3	ms

Grid

Control characteristic	see page C1	
Maximum negative grid voltage		
Before conduction	−250	V
During conduction	−10	V
Maximum positive grid current for anode voltage more positive than −10V		
Peak	5	A
Average (maximum averaging time = 20ms)	500	mA
Maximum peak positive grid current for anode voltage more negative than −10V	25	mA
Grid resistance		
Maximum	20	kΩ
Minimum	see page C2	
Maximum critical grid current	40	µA
Grid-to-cathode capacitance	25	pF

XR1-12A

THYRATRON

Cathode (*note 3*)

Maximum cathode current		
Peak	160	A
Average (maximum averaging time = 7s) See page C3	12.5	A
Surge (fault protection only, maximum duration = 0.1s)	1400	A
Minimum cathode heating time	60	s
Filament voltage (*note 4*)	2.5	V
Filament current range at 2.5V (I_k = 0A)	36 to 43	A

Mechanical

Type of cooling	Convection
Mounting position (*note 5*)	Vertical with the filament lugs downwards
Net weight (approx.)	2 lb 10 oz / 1.2 kg

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode

Maximum peak anode voltage (forward and inverse)	1.5	kV

Grid

Maximum negative grid voltage		
Before conduction	−250	V
During conduction	−10	V
Maximum positive grid current for voltage more positive than −10V		
Peak	5	A
Average (maximum averaging time = 20ms)	500	mA
Maximum peak positive grid current for anode voltage more negative than −10V	25	mA

Cathode

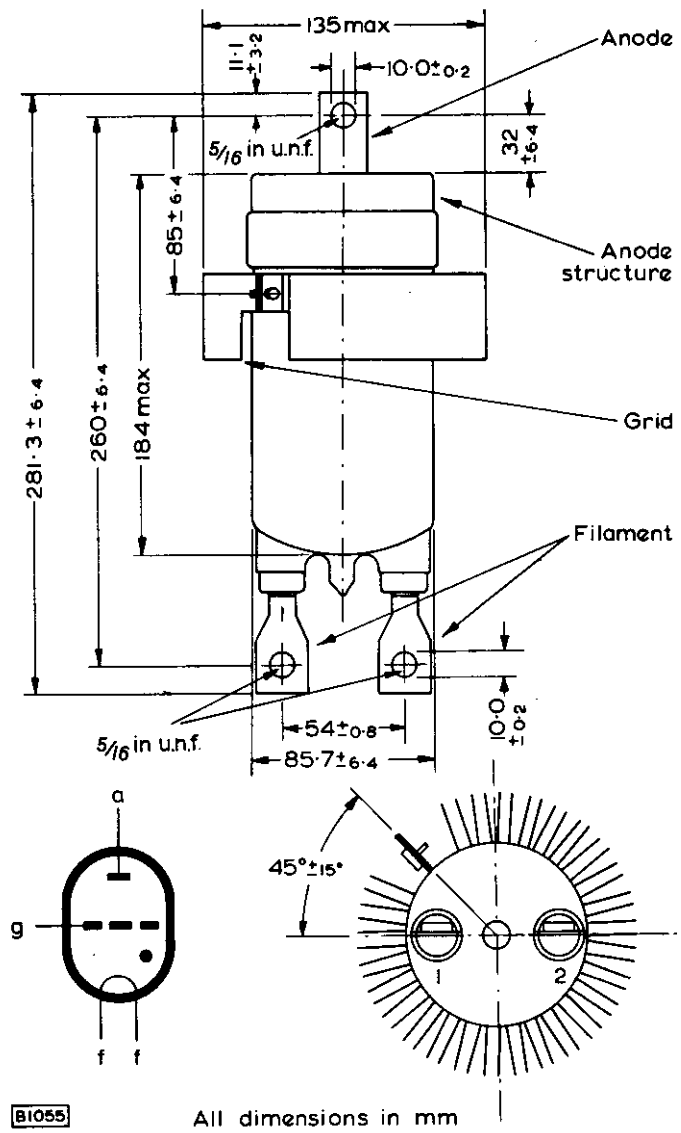
Maximum cathode current		
Peak	160	A
Average (maximum averaging time = 7s) See page C3	12.5	A
Surge (fault protection only, maximum duration = 0.1s)	1400	A
Minimum cathode heating time	60	s
Filament voltage		
Minimum	2.3	V
Maximum	2.7	V
Ambient temperature		
Minimum	−55	°C
Maximum	+70	°C

OPERATING NOTES

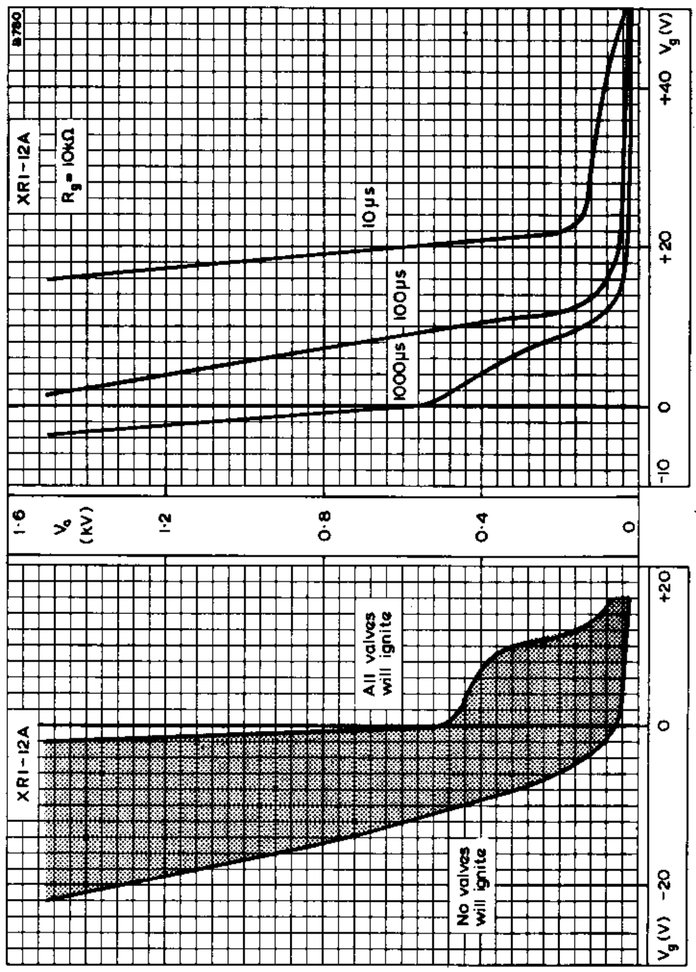
1. In order to minimise gas clean-up, the inverse voltage applied across the valve should be kept to a minimum during the immediate post conduction period. Therefore, the inverse voltage should not exceed 250V during the first 500µs after the cessation of anode current.
2. In order to prevent spurious ignition due to anode-to-grid coupling, a capacitor of approximately 5000pF should be connected between grid and cathode.
3. The anode and grid circuit returns should be made to the centre tap of the filament transformer. If the valve is to replace an XR1-12 and the filament transformer does not have a centre tap, the circuit returns should be connected to the filament lug marked 1.
4. Quadrature operation of the filament is recommended.
   When quadrature operation is used, the voltage of filament lug 1 should be crossing zero from positive towards negative when the anode voltage is at the peak of the positive half cycle.
   In three phase systems, each valve should be connected so that its anode and filament voltages approximate to quadrature phasing, i.e. filament voltage $90 \pm 30°$ out of phase with the anode voltage.
   When quadrature operation is not practicable, filament lug 1 should be negative when the anode is positive.
   Measurement of the filament voltage should be made at the shoulder of the lug immediately above the connecting hole.
5. The valve should be mounted and ventilated in such a manner that adequate cooling by free convection is ensured.
   The valve should be supported from the anode connector only. In order to avoid damage to the glass seals, the filament lugs must on no account be bent.
   A cylindrical volume of radius 140mm about the axis must be kept free of appreciable obstructions or heat producing components. When two or more valves are mounted in close proximity the distance between centres should not be less than 155mm.

XR1-12A

THYRATRON



B1055 All dimensions in mm

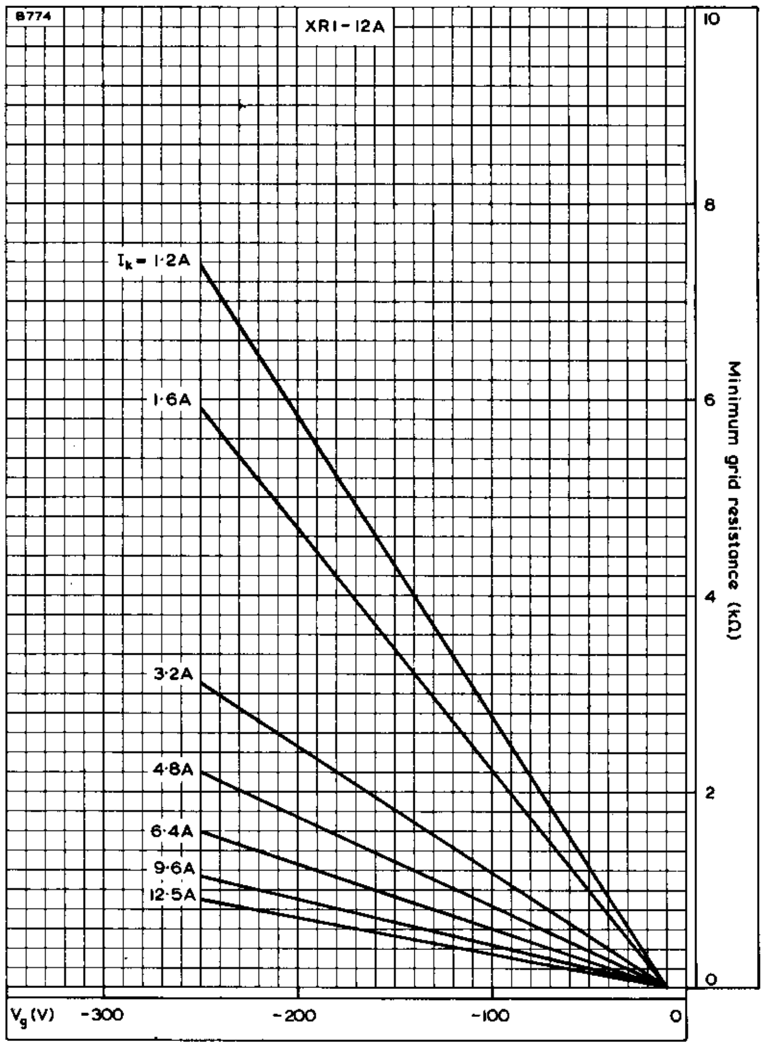


CONTROL CHARACTERISTIC

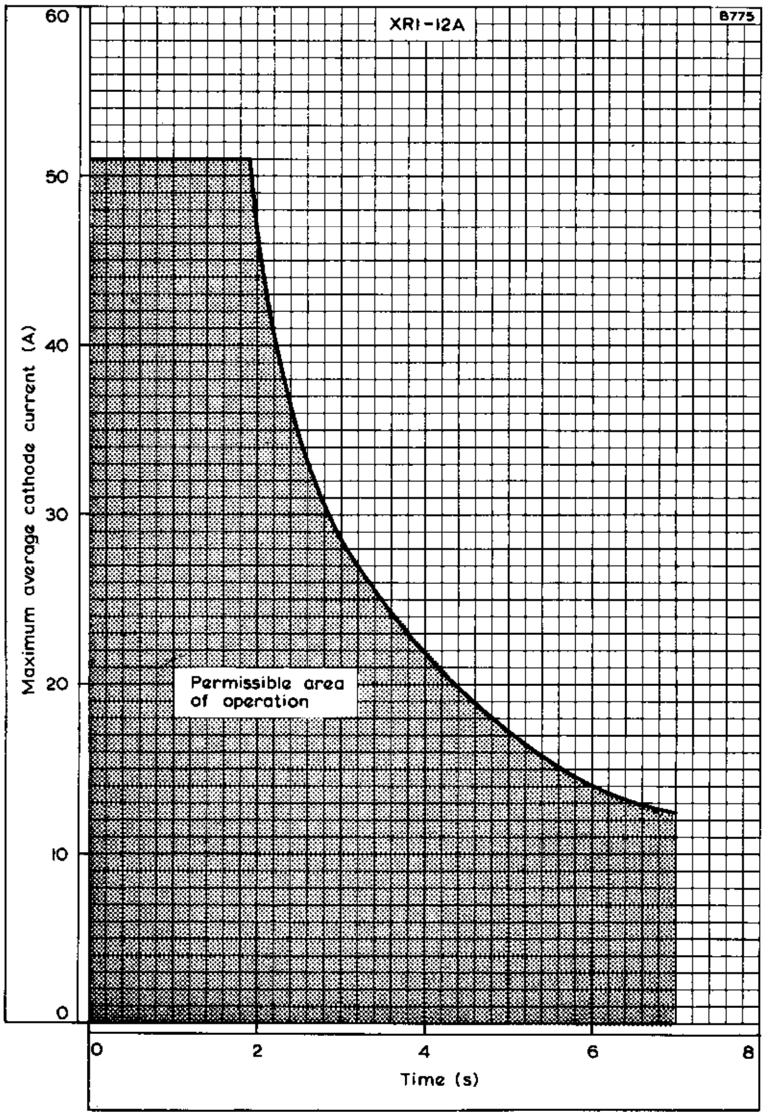
NOMINAL VARIATION BETWEEN ANODE AND GRID VOLTAGES FOR DIFFERENT IGNITION DELAY TIMES

XR1-12A

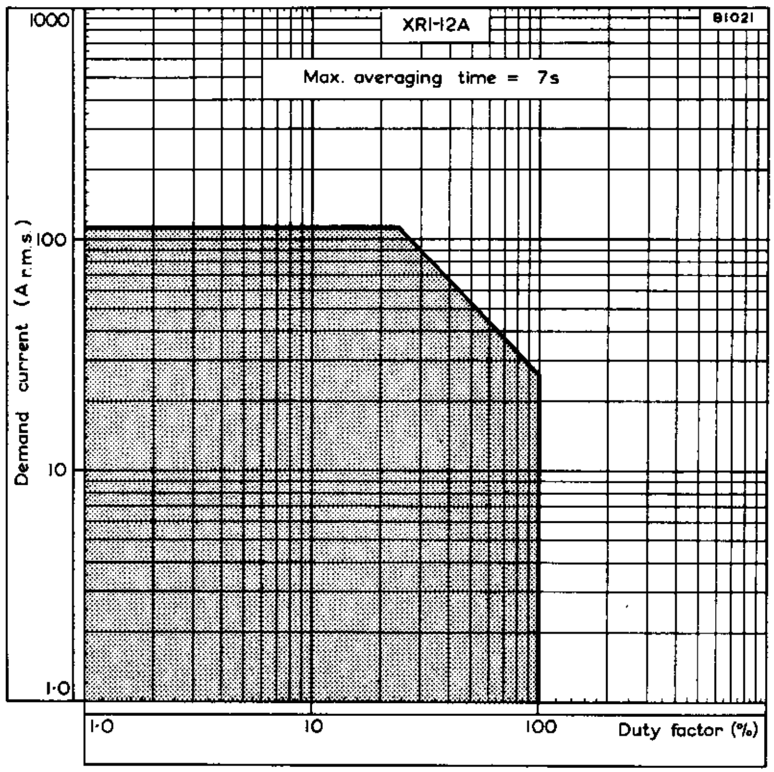
THYRATRON



MINIMUM GRID RESISTANCE PLOTTED AGAINST NEGATIVE SUPPLY VOLTAGE WITH CATHODE CURRENT AS PARAMETER



This curve shows the maximum number of seconds in any seven second period for which a given average current may be drawn from a sinusoidal supply.



WELDER CURRENT RATING FOR TWO VALVES CONNECTED IN INVERSE PARALLEL ('Back to Back')

$$\text{Duty factor} = \frac{\text{Weld time}}{\text{Weld} + \text{'off' time}}$$

The maximum weld + 'off' time which may be considered in the calculation of the duty factor is 7s.

The current ratings in the above chart are absolute maximum ratings and must never be exceeded.

TRIODE THYRATRON

XR1-3200

(5544)

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.

This data sheet should be read in conjunction with "DEFINITIONS AND OPERATIONAL RECOMMENDATIONS—THYRATRONS" preceding this section of the Handbook.

LIMITING VALUES (absolute ratings, not design centre)

It is important that these limits are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at actual valve operating conditions.

Max. peak anode voltage		
Inverse	1.5	kV
Forward	1.5	kV
Max. cathode current		
Peak	40	A
Average (Max. averaging time 15 secs)	3.2	A
Surge (Fault protection max. duration 0.1 secs)	560	A
Max. negative control-grid voltage		
Before conduction	250	V
During conduction	10	V
Max. average positive control-grid current for anode voltage more positive than −10V (averaging time 1 cycle)	200	mA
Max. peak positive control-grid current during the time that the anode voltage is more positive than −10V	2.5	A
Max. peak positive control-grid current during the time that the anode voltage is more negative than −10V	25	mA
Max. control-grid resistor (Recommended min. control-grid resistor 500 Ω)	100	kΩ
Filament voltage limits	2.37 to 2.63	V
Min. valve heating time	60	s
Max. commutation factor	130	
Ambient temperature limits	−55 to +70	°C

CHARACTERISTICS

Electrical

Filament voltage	2.5	V
Filament current at 2.5V		
Average	12	A
Maximum	13.5	A
Anode to control-grid capacitance	0.8	μμF
Control-grid to cathode capacitance	45	μμF
Deionisation time (approx.)		
(a) V_g = −250V	40	μs
(b) V_g = −12V	400	μs
Ionisation time (approx.)	10	μs
Anode voltage drop (approx.)	16	V
Critical grid current at V_a=1.5kV	<20	μA

XR1-3200

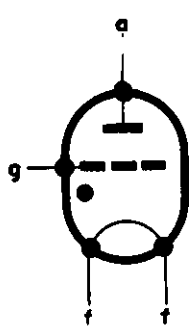
(5544)

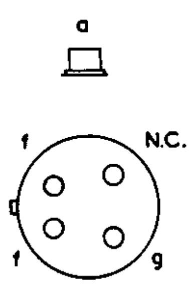
TRIODE THYRATRON

Triode, inert gas-filled thyratron with negative control characteristic. Primarily designed for motor control applications.

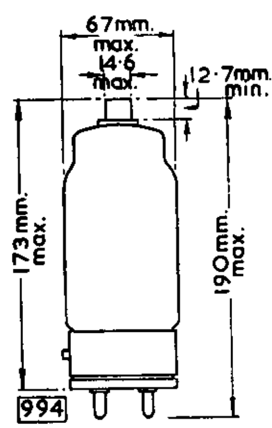
Mechanical

Type of cooling	Convection
Mounting position	Any position between horizontal and vertical with base downwards
Max. net weight	11 oz. / 300 g





B4D BASE



THYRATRON XR1-3200A

QUICK REFERENCE DATA (maximum values)		
Inert gas-filled triode for power control applications		
Peak anode voltage	1.5	kV
Cathode current		
peak	40	A
average	3.2	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS - THYRATRONS which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variations.

Anode		
Peak anode operating voltage (forward and inverse)	1.5	kV
Anode voltage drop (approx. instantaneous value)		
$i_k = 3.2A$	12	V
$i_k = 40A$	18	V
Maximum commutation factor (see note 1)	130	$VA/\mu s^2$
Ignition delay time	see page C1	
Anode Recovery time	see page C2	
Grid		
Control characteristic	see page C1	
Maximum negative grid voltage		
before conduction	250	V
during conduction	10	V
Maximum positive grid current for anode voltage more positive than -10V		
peak	2.5	A
average (maximum averaging time = 20ms)	200	mA
Maximum peak positive grid current for anode voltage more negative than -10V	25	mA
Grid resistance		
maximum	100	kΩ
minimum (see page C2)		
Maximum critical grid current	20	μA

Cathode (see note 2)

Maximum cathode current		
peak	40	A
average (maximum averaging time = 15s) see page C3	3.2	A
surge (fault protection only, maximum duration = 100ms)	560	A
Minimum cathode heating time	60	s
Filament voltage	2.5	V
Filament current at 2.5V (I_k = 0A)	13.5	A

Capacitances

Grid-to-cathode capacitance	15	pF
Grid-to-anode capacitance (see note 3)	0.7	pF

Mechanical

Type of cooling	Convection
Mounting position	Any position between vertical with base downwards and horizontal
Net weight (approx.)	9.2 oz 260 g
Weight of valve in carton	1lb 10oz 725 g
Nominal dimensions of packing	5.5 x 5.5 x 12.25 in 140 x 140 x 310 mm

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode

Maximum peak anode voltage (forward and inverse)	1.5	kV

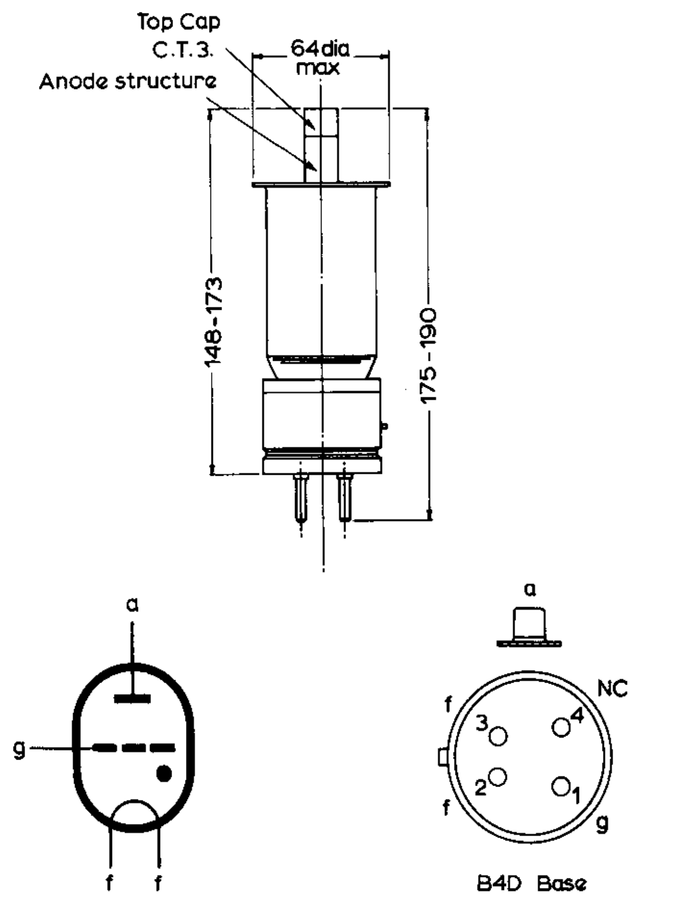
Grid

Maximum negative grid voltage		
before conduction	250	V
during conduction	10	V
Maximum positive grid current for anode voltage more positive than -10V		
peak	2.5	A
average (maximum averaging time = 20ms)	200	mA
Maximum peak positive grid current for anode voltage more negative than -10V	25	mA

Cathode		
Maximum cathode current		
peak	40	A
average (maximum averaging time = 15s) see page C3	3.2	A
surge (fault protection only, maximum duration = 100ms)	560	A
Minimum cathode heating time	60	s
Filament voltage		
minimum	2.3	V
maximum	2.7	V
Ambient temperature		
minimum	-55	°C
maximum	+70	°C

OPERATING NOTES

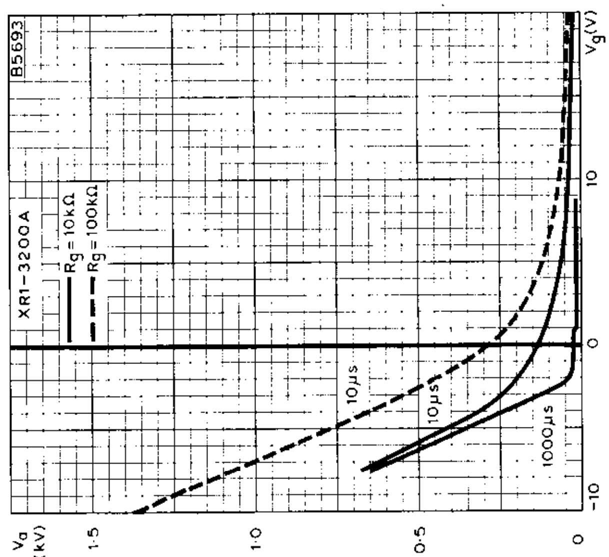
1. In order to minimise gas clean-up, the inverse voltage applied across the valve should be kept to a minimum during the immediate post conduction period. Therefore, the inverse voltage should not exceed 250V during the first 500μs after the cessation of anode current.
2. The anode and grid circuit returns should be made to the centre tap of the filament transformer.
3. In order to prevent spurious ignition due to capacitive anode-to-grid coupling, a capacitor should be connected between grid and cathode.



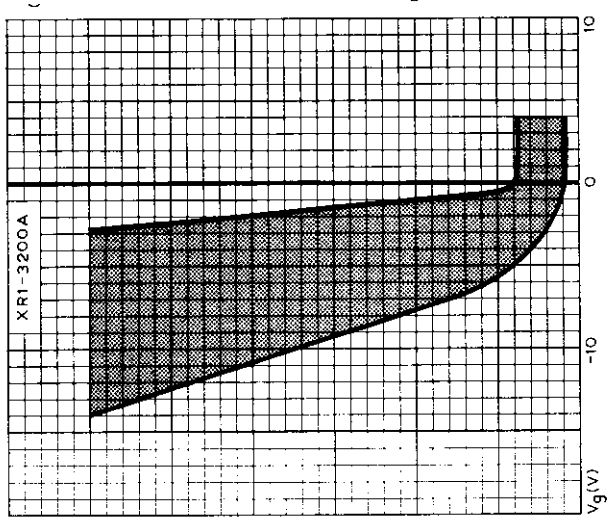
All dimensions in mm.

The anode structure must be left free to ensure adequate cooling by free convection

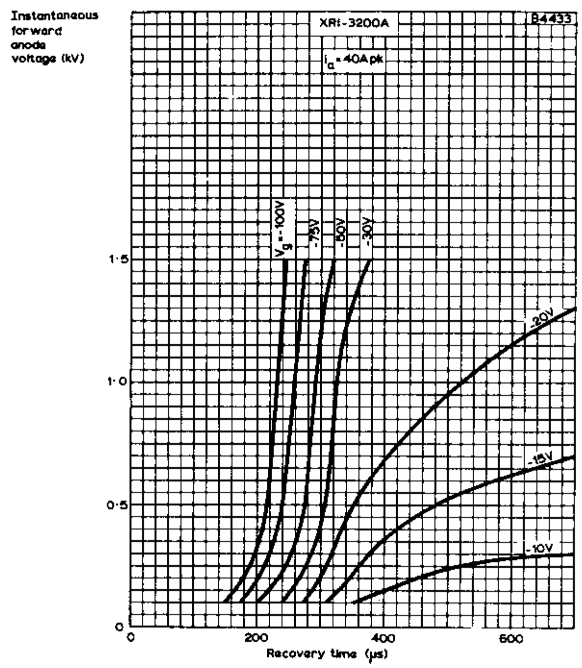
B4677



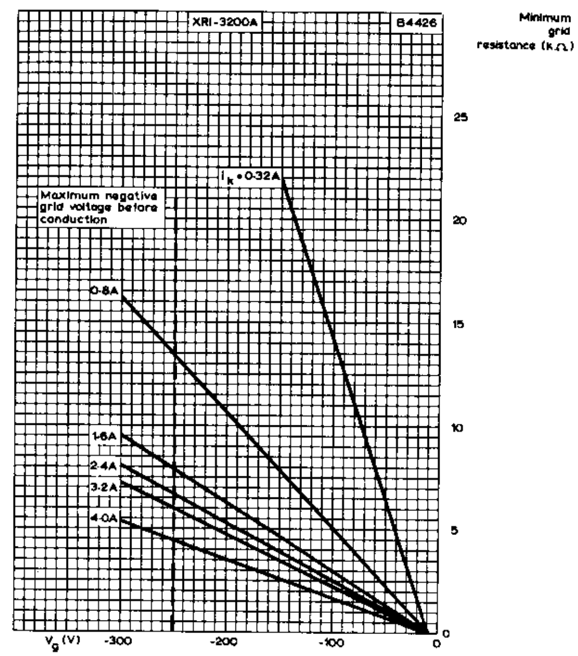
NOMINAL VARIATION BETWEEN ANODE AND GRID VOLTAGES FOR DIFFERENT IGNITION DELAY TIMES



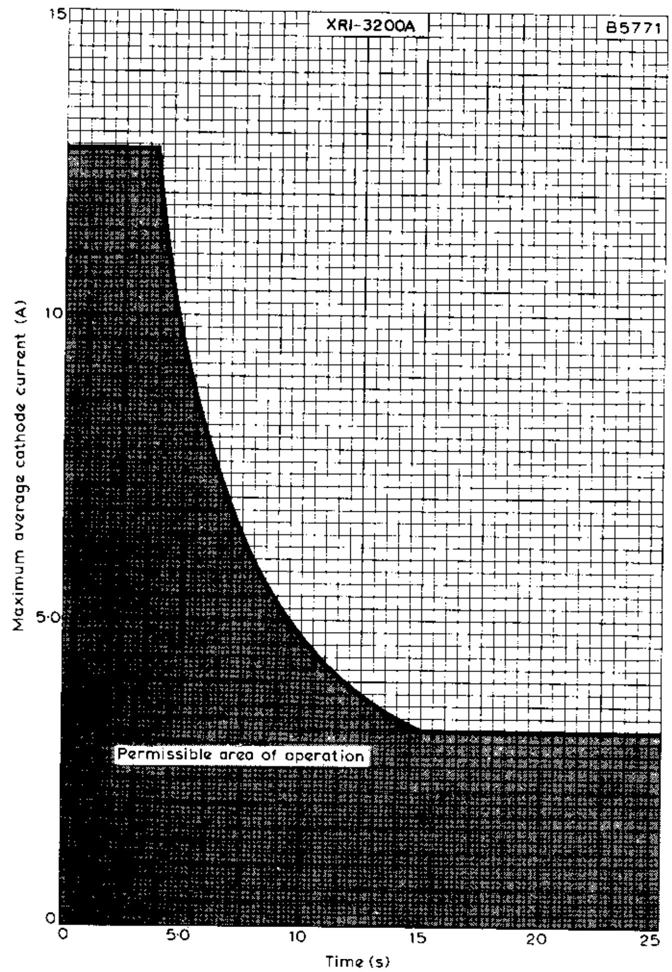
CONTROL CHARACTERISTIC



NORMAL RELATIONSHIP BETWEEN FORWARD ANODE VOLTAGE WHICH WILL NOT CAUSE RE-IGNITION AND TIME FROM CESSATION OF CONDUCTION



MINIMUM GRID RESISTANCE PLOTTED AGAINST NEGATIVE SUPPLY VOLTAGE WITH INSTANTANEOUS CATHODE CURRENT AS PARAMETER



This curve shows the maximum number of seconds in any fifteen second period for which a given average current may be drawn from a sinusoidal supply.

THYRATRON XR1-6400A

QUICK REFERENCE DATA (maximum values)

Inert gas-filled triode for power control applications.

Peak anode voltage	1.5	kV
Cathode current		
Peak	80	A
Average	6.4	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS – THYRATRONS which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variation.

Anode

Peak anode operating voltage (forward and inverse)	1.5	kV
Anode voltage drop (approx. instantaneous value)		←
i_k = 6.4A	12	V
i_k = 80A	18	V
Maximum commutation factor (*note 1*)	130	VA/μs² ←
Anode-to-grid capacitance (*note 2*)	7	pF
Anode-to-cathode capacitance	0.2	pF
Ignition delay time	See page C1	←
Recovery (deionisation) time (approx.)	800	μs ←

Grid

Control characteristic	See page C1	
Maximum negative grid voltage		
Before conduction	–250	V
During conduction	–10	V
Maximum positive grid current for anode voltage more positive than –10V		
Peak	2.5	A ←
Average (maximum averaging time = 20ms)	200	mA
Maximum peak positive grid current for anode voltage more negative than –10V	25	mA
Grid resistance		
Maximum	100	kΩ
Minimum	See page C2	←
Maximum critical grid current	20	μA ←
Grid-to-cathode capacitance	5	pF

XR1-6400A

THYRATRON

Cathode (*note 3*)

Maximum cathode current		
Peak (*note 4*)	80	A
Average (maximum averaging time = 15s) See page C3	6.4	A
Surge (fault protection only, maximum duration = 0.1s)	1120	A
Minimum cathode heating time	60	s
Filament voltage (*note 5*)	2.5	V
Filament current range at 2.5V (I_k = 0mA)	19 to 23	A

Mechanical

Type of cooling	Convection	
Mounting position	Any position between vertical with base downwards and horizontal	
Net weight (approx.)	13	oz
	370	g
Weight of valve in carton (approx.)	18	oz
	510	g
Nominal dimensions of packing	5.5 × 5.5 × 12.25	in
	140 × 140 × 310	mm.

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode

Maximum peak anode voltage (forward and inverse)	1.5	kV

Grid

Maximum negative grid voltage		
Before conduction	−250	V
During conduction	−10	V
Maximum positive grid current for anode voltage more positive than −10V		
Peak	2.5	A←
Average (maximum averaging time = 20ms)	200	mA
Maximum peak positive grid current for anode voltage more negative than −10V	25	mA

Cathode

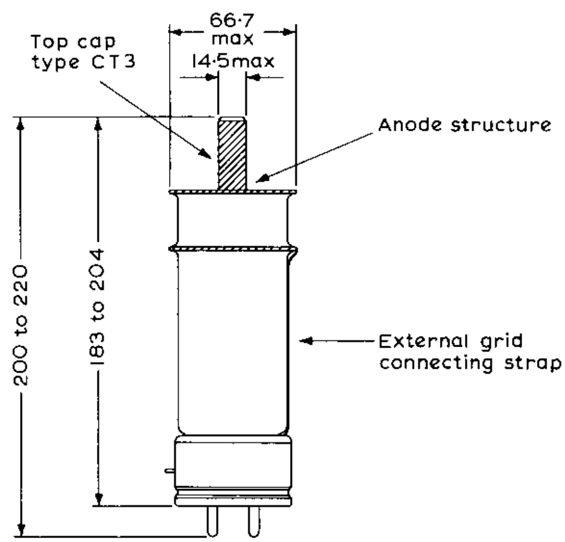
Maximum cathode current		
Peak (*note 4*)	80	A
Average (maximum averaging time = 15s) See page C3	6.4	A
Surge (fault protection only, maximum duration = 0.1s)	1120	A
Minimum cathode heating time	60	s
Filament voltage		
Minimum	2.3	V
Maximum	2.7	V
Ambient temperature		
Minimum	−55	°C
Maximum	+70	°C

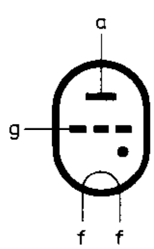
OPERATING NOTES

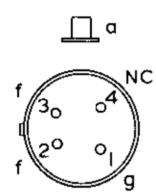
1. In order to minimise gas clean up, the inverse voltage applied across the valve should be kept to a minimum during the immediate post conduction period. Therefore, the inverse voltage should not exceed 250V during the first 500µs after the cessation of anode current.
2. In order to prevent spurious ignition due to capacitive anode-to-grid coupling, a capacitor of approximately 1000pF should be connected between grid and cathode.
3. The anode and grid circuit returns should be made to the centre tap of the filament transformer.
4. In welding applications, a single pulse cathode current of up to 120A may be passed provided the average cathode current does not exceed 1A averaged over 1s.
5. Quadrature operation of the filament is recommended.
   When quadrature operation is used, the voltage of filament pin 2 should be crossing zero from positive towards negative when the anode voltage is at the peak of the positive half cycle.
   In three phase systems, each valve should be connected so that its anode and filament voltages approximate to quadrature phasing, i.e. filament voltage 90±30° out of phase with the anode voltage.
   When quadrature operation is not practicable, filament pin 2 should be negative when the anode is positive.

XR1-6400A

THYRATRON







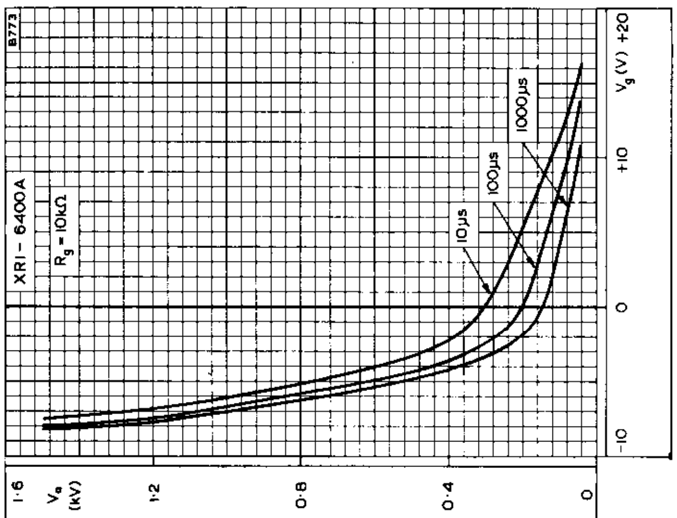
B4D Base

All dimensions in mm

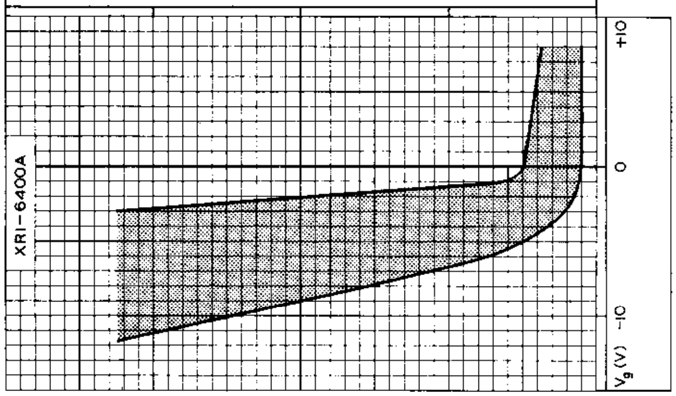
The anode structure must be left free to ensure adequate cooling by free convection

Care should be taken to avoid damage to or contact with the external grid connecting strap

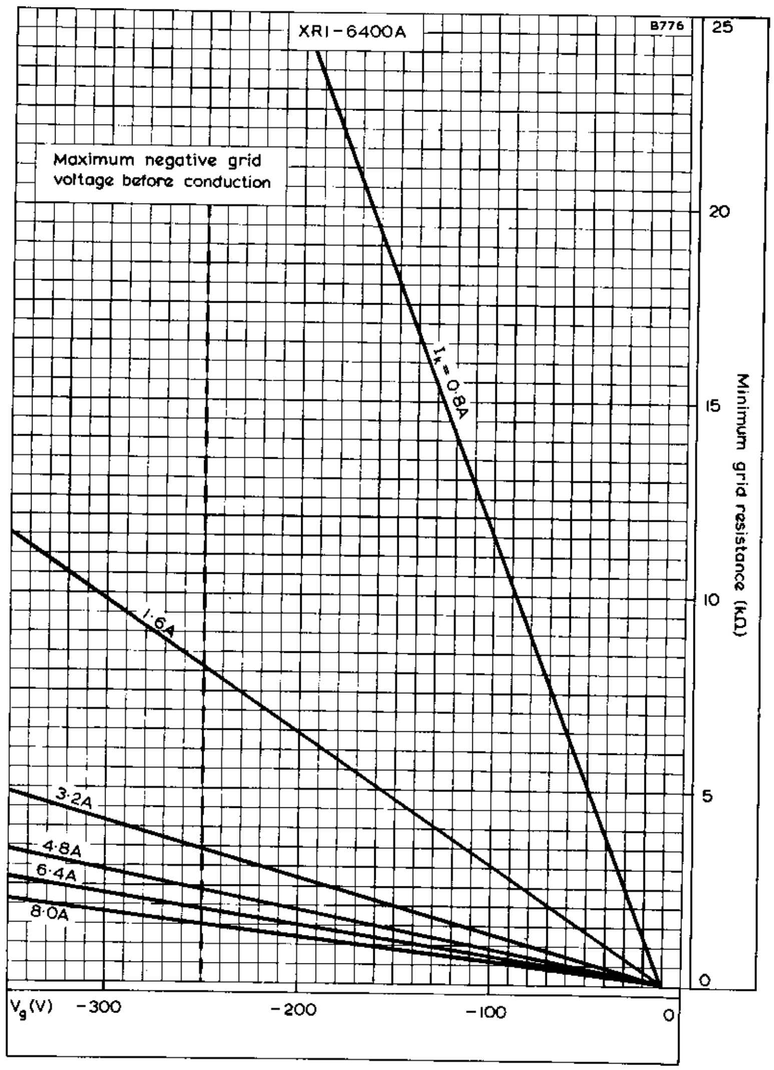
B1013



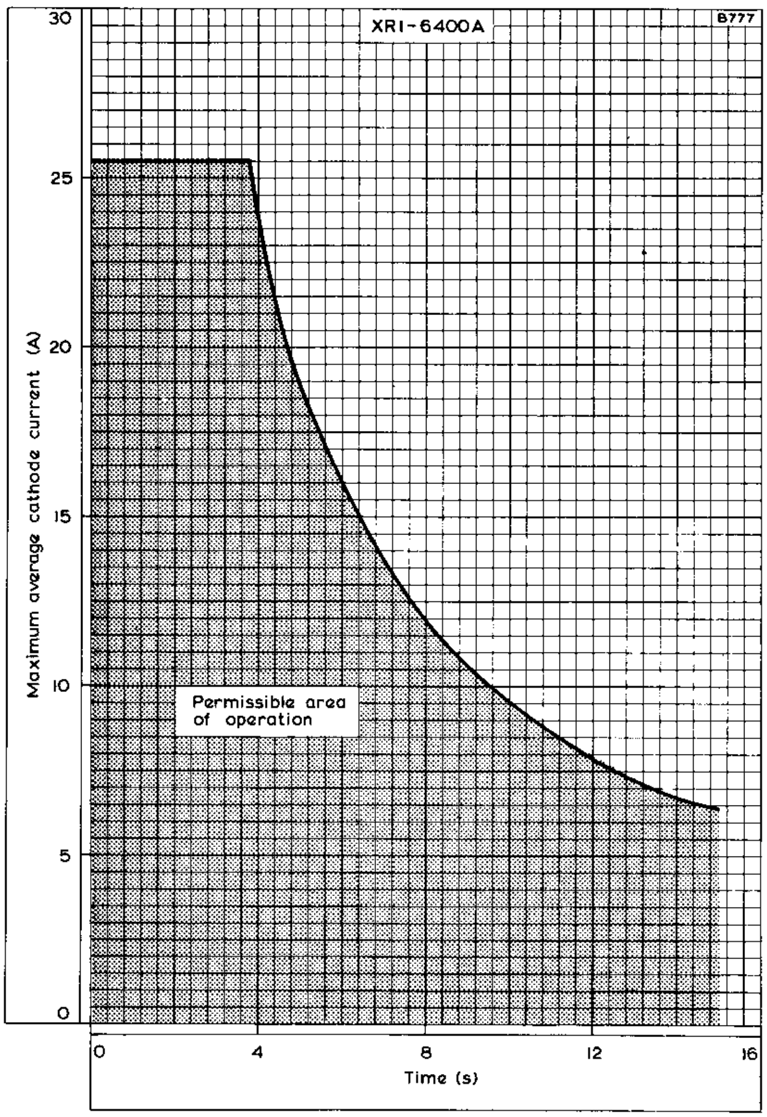
NOMINAL VARIATION BETWEEN ANODE AND GRID VOLTAGES FOR DIFFERENT IGNITION DELAY TIMES



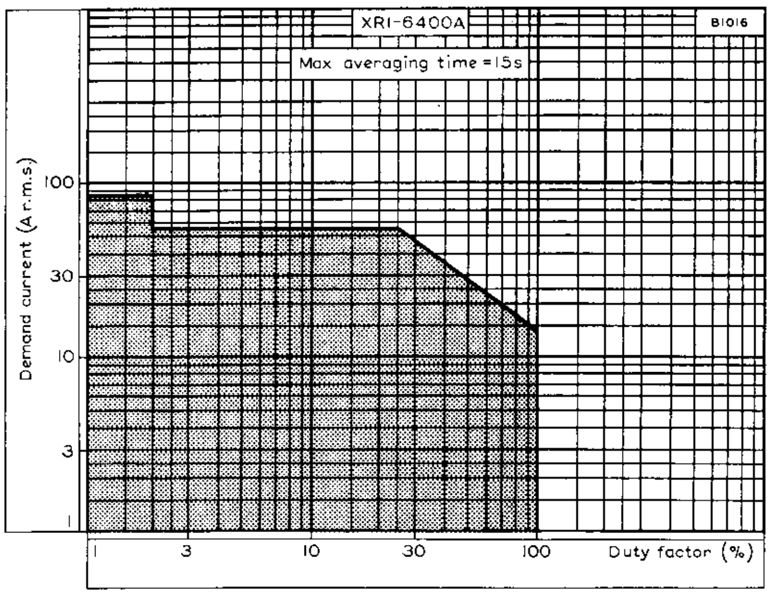
CONTROL CHARACTERISTIC



MINIMUM GRID RESISTANCE PLOTTED AGAINST NEGATIVE SUPPLY VOLTAGE WITH CATHODE CURRENT AS PARAMETER



This curve shows the maximum number of seconds in any fifteen second period for which a given average current may be drawn from a sinusoidal supply.



WELDER CURRENT RATING FOR TWO VALVES CONNECTED IN INVERSE PARALLEL ('Back to Back')

$$\text{Duty factor} = \frac{\text{Weld time}}{\text{Weld} + \text{'off' time}}$$

The maximum weld + 'off' time which may be considered in the calculation of the duty factor is 15s.

The current ratings in the above chart are absolute maximum ratings and must never be exceeded.

XR1-12A

QUICK REFERENCE DATA (maximum values)		
Inert gasfilled triode for power control applications		
Peak anode voltage	1.5	kV
Cathode current		
Peak	160	A
Average	12.5	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variations.

Anode

Peak anode operating voltage (forward and inverse)	1.5	kV
Anode voltage drop (approx. instantaneous value)		
i_k = 12.5A	16	V
i_k = 160A	20	V
Maximum commutation factor (*note 1*)	50	VA/μs^2
Anode-to-grid capacitance (*note 2*)	50	pF
Ignition delay time	see page C1	
Recovery (deionisation) time (approx.)	1.3	ms

Grid

Control characteristic	see page C1	
Maximum negative grid voltage		
Before conduction	−250	V
During conduction	−10	V
Maximum positive grid current for anode voltage more positive than −10V		
Peak	5	A
Average (maximum averaging time = 20ms)	500	mA
Maximum peak positive grid current for anode voltage more negative than −10V	25	mA
Grid resistance		
Maximum	20	kΩ
Minimum	see page C2	
Maximum critical grid current	40	µA
Grid-to-cathode capacitance	25	pF

Cathode (*note 3*)

Maximum cathode current		
Peak	160	A
Average (maximum averaging time = 7s) See page C3	12.5	A
Surge (fault protection only, maximum duration = 0.1s)	1400	A
Minimum cathode heating time	60	s
Filament voltage (*note 4*)	2.5	V
Filament current range at 2.5V (I_k = 0A)	36 to 43	A

Mechanical

Type of cooling	Convection
Mounting position (*note 5*)	Vertical with the filament lugs downwards
Net weight (approx.)	2 lb 10 oz 1.2 kg

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode

Maximum peak anode voltage (forward and inverse)	1.5	kV

Grid

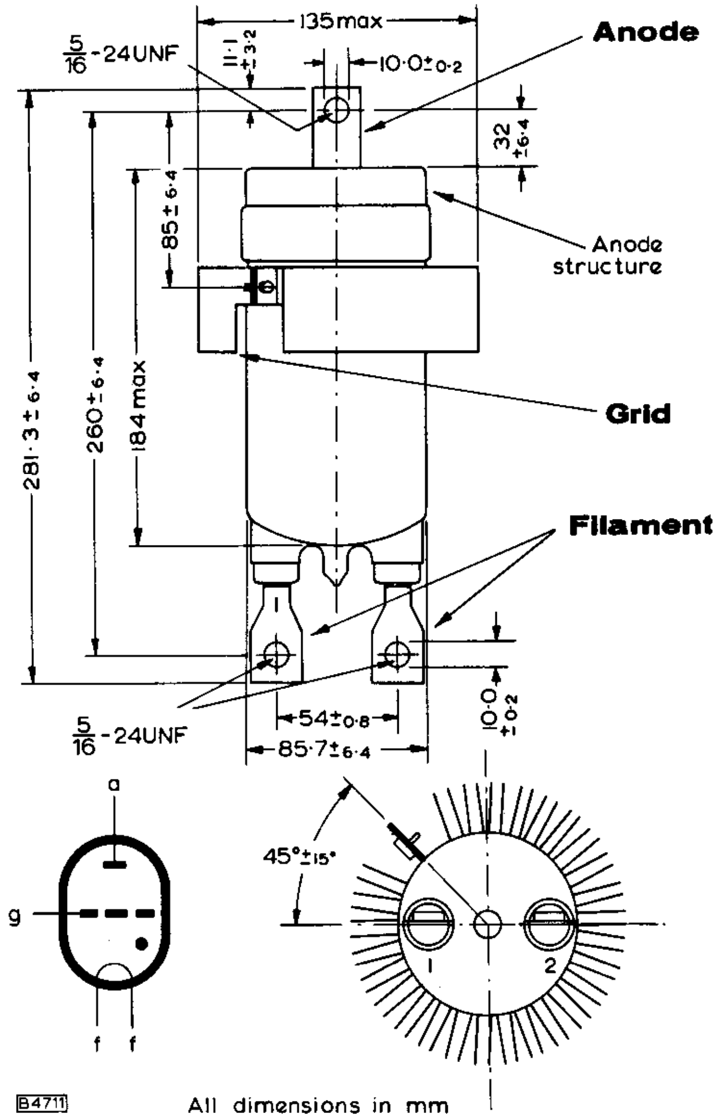
Maximum negative grid voltage		
Before conduction	−250	V
During conduction	−10	V
Maximum positive grid current for voltage more positive than −10V		
Peak	5	A
Average (maximum averaging time = 20ms)	500	mA
Maximum peak positive grid current for anode voltage more negative than −10V	25	mA

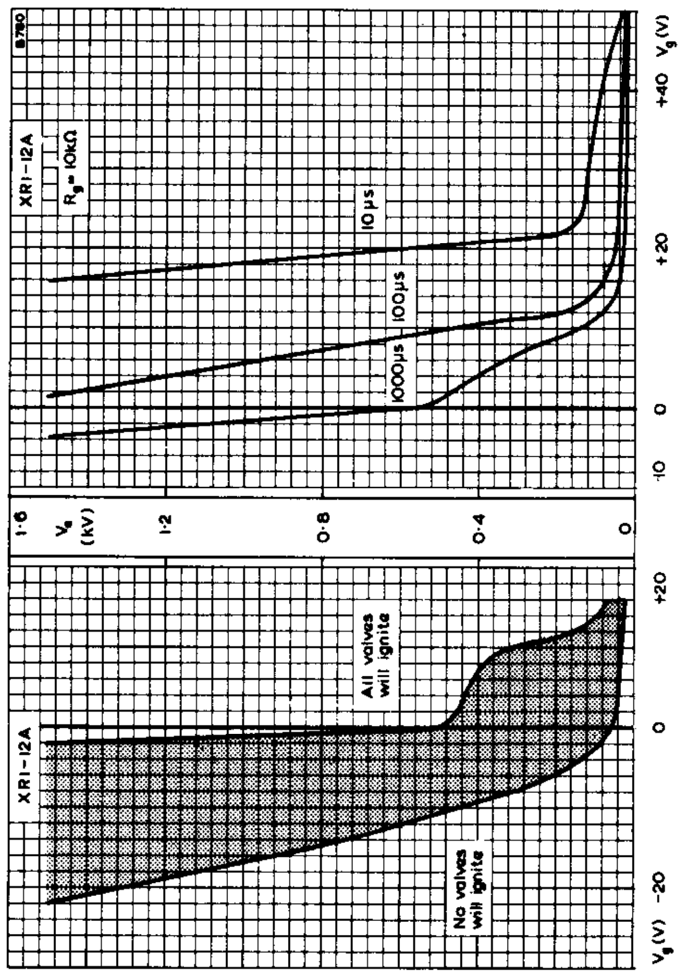
Cathode

Maximum cathode current		
Peak	160	A
Average (maximum averaging time = 7s) See page C3	12.5	A
Surge (fault protection only, maximum duration = 0.1s)	1400	A
Minimum cathode heating time	60	s
Filament voltage		
Minimum	2.3	V
Maximum	2.7	V
Ambient temperature		
Minimum	−55	°C
Maximum	+70	°C

OPERATING NOTES

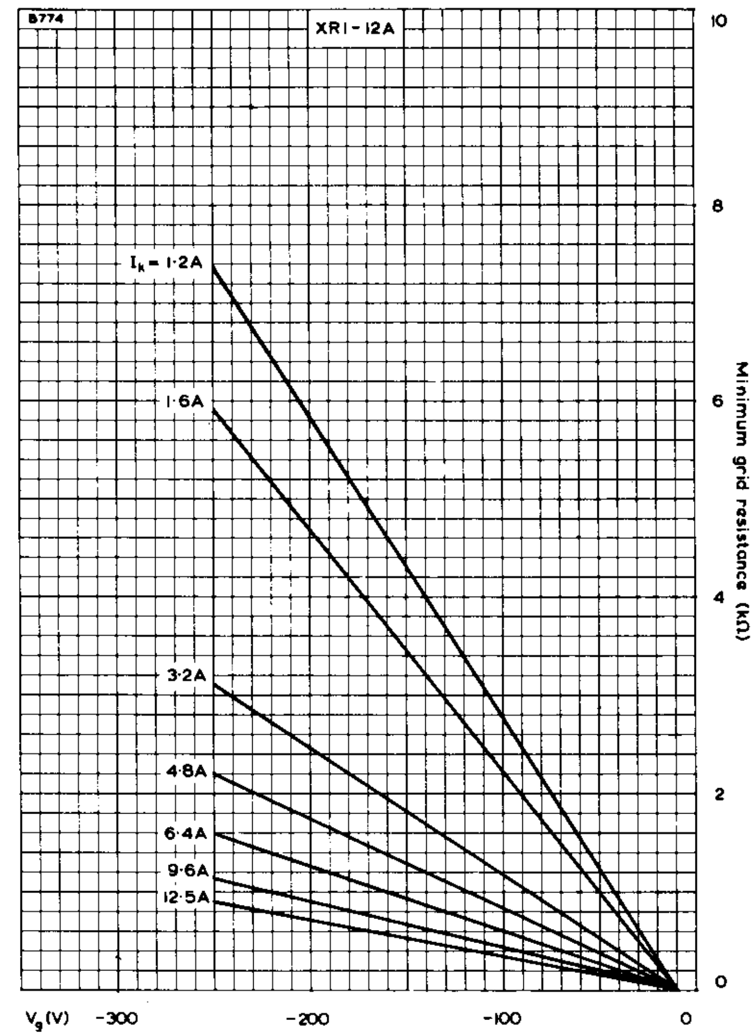
1. In order to minimise gas clean-up, the inverse voltage applied across the valve should be kept to a minimum during the immediate post conduction period. Therefore, the inverse voltage should not exceed 250V during the first 500μs after the cessation of anode current.
2. In order to prevent spurious ignition due to anode-to-grid coupling, a capacitor of approximately 5000pF should be connected between grid and cathode.
3. The anode and grid circuit returns should be made to the centre tap of the filament transformer. If the valve is to replace an XR1-12 and the filament transformer does not have a centre tap, the circuit returns should be connected to the filament lug marked 1.
4. Quadrature operation of the filament is recommended.
   When quadrature operation is used, the voltage of filament lug 1 should be crossing zero from positive towards negative when the anode voltage is at the peak of the positive half cycle.
   In three phase systems, each valve should be connected so that its anode and filament voltages approximate to quadrature phasing, i.e. filament voltage 90±30° out of phase with the anode voltage.
   When quadrature operation is not practicable, filament lug 1 should be negative when the anode is positive.
   Measurement of the filament voltage should be made at the shoulder of the lug immediately above the connecting hole.
5. The valve should be mounted and ventilated in such a manner that adequate cooling by free convection is ensured.
   The valve should be supported from the anode connector only. In order to avoid damage to the glass seals, the filament lugs must on no account be bent.
   A cylindrical volume of radius 140mm about the axis must be kept free of appreciable obstructions or heat producing components. When two or more valves are mounted in close proximity the distance between centres should not be less than 155mm.


Anode
Anode structure
Grid
Filament
5/16-24UNF
5/16-24UNF
135max
10·0±0·2
11·1 ±3·2
32 ±6·4
85±6·4
281·3±6·4
260±6·4
184max
54±0·8
85·7±6·4
10·0 ±0·2
a
g
f
f
45°±15°
1
2
B4711
All dimensions in mm

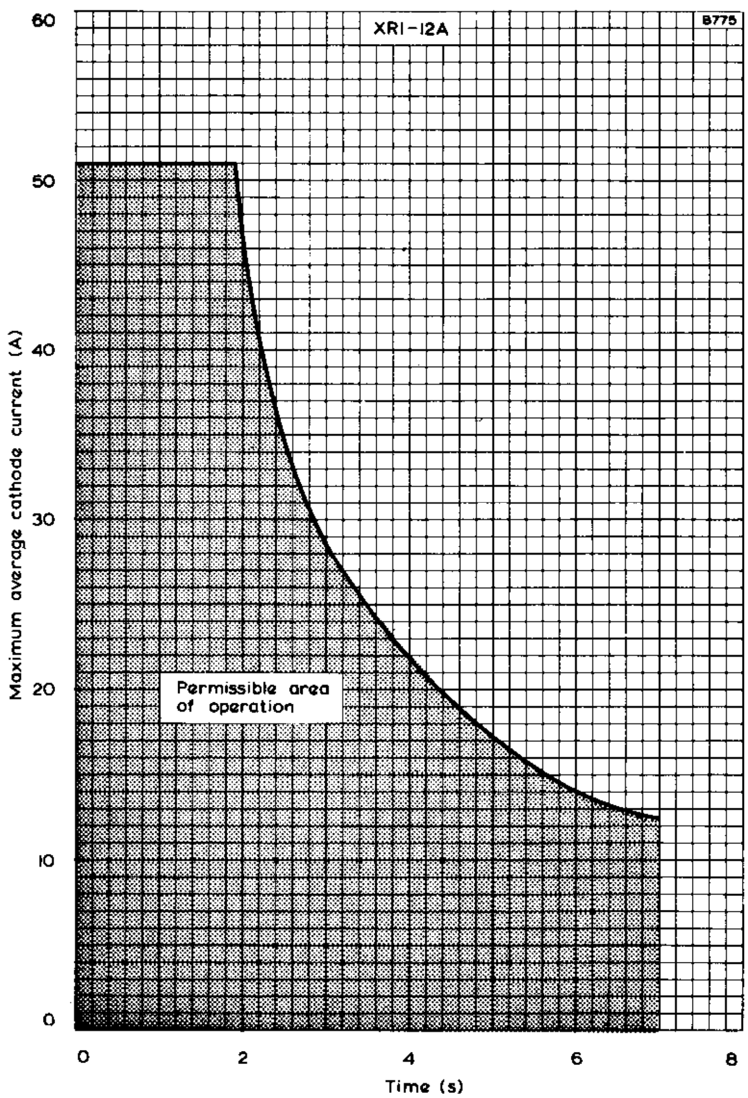


CONTROL CHARACTERISTIC

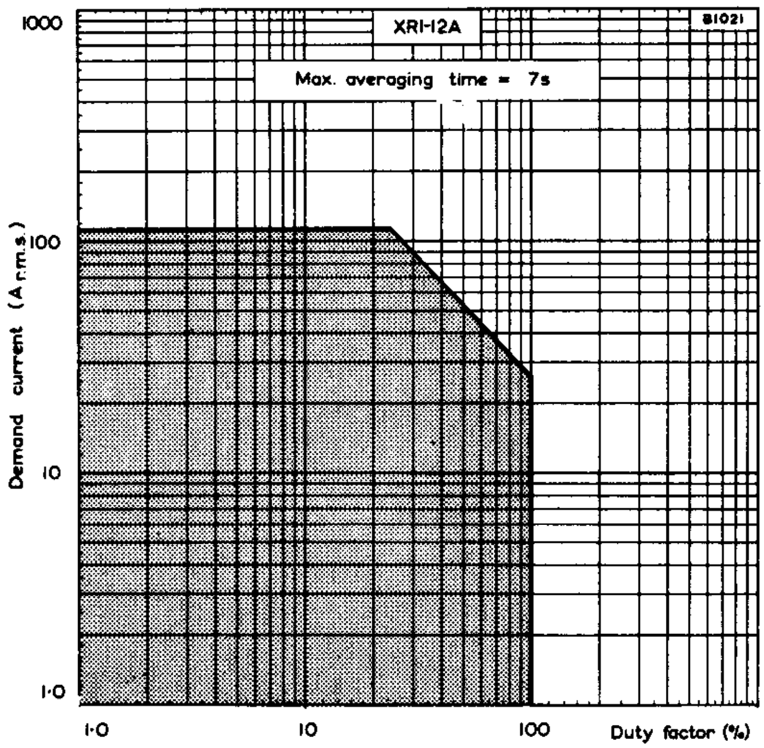
NOMINAL VARIATION BETWEEN ANODE AND GRID VOLTAGES FOR DIFFERENT IGNITION DELAY TIMES



MINIMUM GRID RESISTANCE PLOTTED AGAINST NEGATIVE SUPPLY VOLTAGE WITH CATHODE CURRENT AS PARAMETER



This curve shows the maximum number of seconds in any seven second period for which a given average current may be drawn from a sinusoidal supply.



WELDER CURRENT RATING FOR TWO VALVES CONNECTED IN INVERSE PARALLEL ('Back to Back')

$$\text{Duty factor} = \frac{\text{Weld time}}{\text{Weld} + \text{'off' time}}$$

The maximum weld + 'off.' time which may be considered in the calculation of the duty factor is 7s.

The current ratings in the above chart are absolute maximum ratings and must never be exceeded.

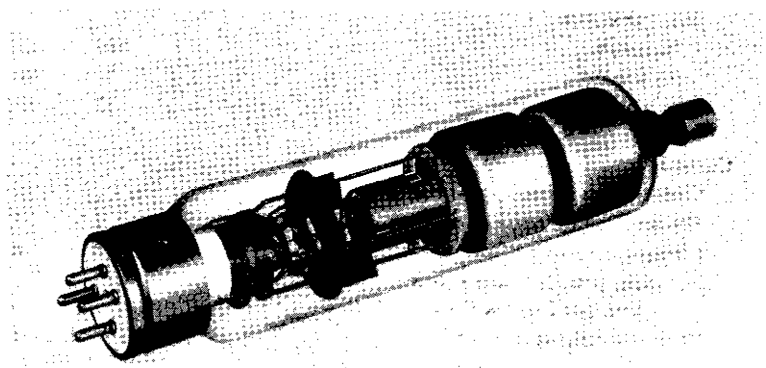
THYRATRON # ZT1000

PRELIMINARY DATA

QUICK REFERENCE DATA (maximum values)

Mercury-vapour triode for high voltage power control applications.

Peak anode voltage	21	kV
Cathode current		
Peak	10	A
Average	2.5	A



This data should be read in conjunction with DEFINITIONS and GENERAL OPERATIONAL RECOMMENDATIONS - THYRATRONS which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations.

Anode

Maximum peak anode voltage		
Forward	21	kV
Inverse	21	kV
Anode voltage drop (approx.)	12	V

ZT1000

THYRATRON

Grid		
Maximum negative grid voltage before conduction	−300	V
Recommended grid voltage for hold-off		
P.I.V. = 21kV	−100	V
P.I.V. = 10kV	−50	V
Maximum grid current		
Average	25	mA
Peak	125	mA
Grid resistance		
Maximum	100	kΩ
Minimum	10	kΩ
Recommended	33	kΩ
Cathode		
Directly heated, oxide-coated cathode		
Filament voltage (*see note 1*)	5	V
Filament current	13	A
Minimum cathode heating time (*see note 2 and page C2*)	90	s
Maximum cathode current	see table in absolute maximum ratings	
Capacitances		
Anode-to-grid	4	pF
Grid-to-cathode	13	pF
Ionisation and recovery time		
Nominal ionisation time	10	µs
Nominal recovery time	500	µs
Mechanical		
Net weight (approx.)	750 1 lb 10	g oz
Weight of valve in carton (approx.)	2.3 5 lb 1	kg oz
Nominal dimensions of carton	20 × 20 × 57 8 × 8 × 22.5	cm in
Mounting position	vertical, base down	
Accessories		
Anode hood (*see note 3*) supplied with valve	40616	

FULL LOAD OPERATING CONDITIONS AS RECTIFIER

These figures are based upon the absolute maximum ratings of the valve and no account has been taken of mains variations or transformer, valve and choke losses. In practice, due consideration must be given to these factors.

For a P.I.V. of 21kV

Circuit	No. of valves	Full load d.c. output (kV)	Full load d.c. output (A)	Applied a.c. voltage ($kV_{r.m.s.}$)
Single phase full wave	2	6.7	5	7.4 (per valve)
Single phase bridge	4	13.4	5	14.8
Three phase half wave	3	10	7.5	8.5 (per phase)
Three phase full wave	6	20	7.5	14.8 (per phase)

For a P.I.V. of 15kV

Circuit	No. of valves	Full load d.c. output (kV)	Full load d.c. output (A)	Applied a.c. voltage ($kV_{r.m.s.}$)
Single phase full wave	2	4.8	6	5.3 (per valve)
Single phase bridge	4	9.6	6	10.6
Three phase half wave	3	7.2	9	6.1 (per phase)
Three phase full wave	6	14.4	9	10.6 (per phase)

ZT1000 THYRATRON

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

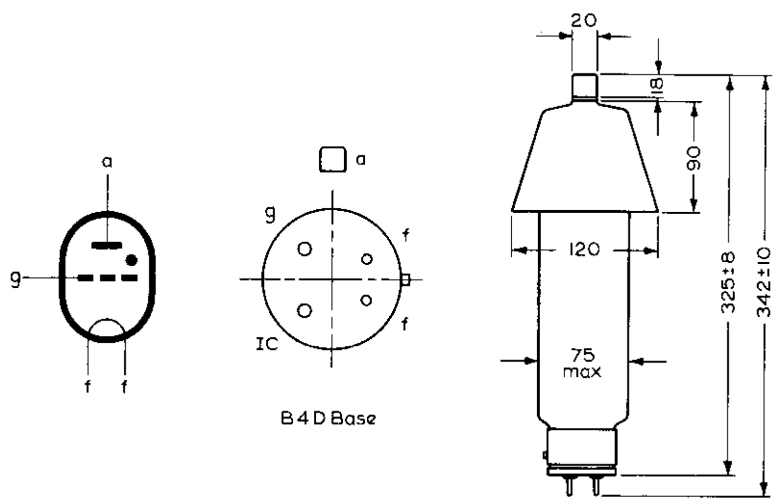
Maximum operating frequency				150	c/s
Maximum peak anode voltage					
Forward	2.5	10	15	21	kV
Inverse	2.5	10	15	21	kV
Maximum cathode current					
Average (max. averaging time = 30s)	5	3	3	2.5	A
Peak	20	12	12	10	A
Surge (max. duration = 0.1s)	200	120	120	100	A
Condensed-mercury temperature (*see note 4*)	25 to 75	25 to 60	25 to 55	25 to 45	°C
Ambient temperature (*see note 5*)	15 to 55	15 to 40	15 to 35	15 to 30	°C
Maximum negative grid voltage before conduction				−300	V
Maximum grid current					
Average				25	mA
Peak				125	mA

OPERATING NOTES

1. A phase shift of 90° ± 30° between anode and filament voltages and/or use of a centre-tapped filament transformer are recommended.
2. The preferred minimum value of the total valve heating-up time can be obtained from the heating curve on page C2. This shows how the condensed-mercury temperature rises above the ambient temperature from the instant of switching on the filament supply. Under normal conditions, however, cathode current may be drawn when the condensed-mercury temperature is within 5°C of the minimum quoted value. (See appropriate section of 'General Operational Recommendation – Thyratrons.')

   After a storage period, a long interruption of operation or transportation, a longer valve heating time is required before the anode voltage may be applied. In general a time of 60 minutes will be sufficient to ensure proper distribution of the mercury.
3. The cap must always be mounted on the tube, even during pre-heating.
4. If the equipment is not started more than twice daily, it is permitted to apply a h.t. voltage at a condensed-mercury temperature which is 5°C lower than the values given.

5. The ambient temperature figures are approximate values with natural cooling and define the temperature of the surrounding air.
   They should be measured in the following conditions.
   a. Normal atmospheric pressure.
   b. The valve should be adjusted to the worst possible operating condition.
   c. The temperature should be measured when thermal equilibrium is reached.
   d. The distance from the thermometer to the outside of the envelope should be 75mm (measured in a plane perpendicular to the main axis of the valve at the height of condensed-mercury boundary).
   e. The thermometer should be screened against direct heat radiation.



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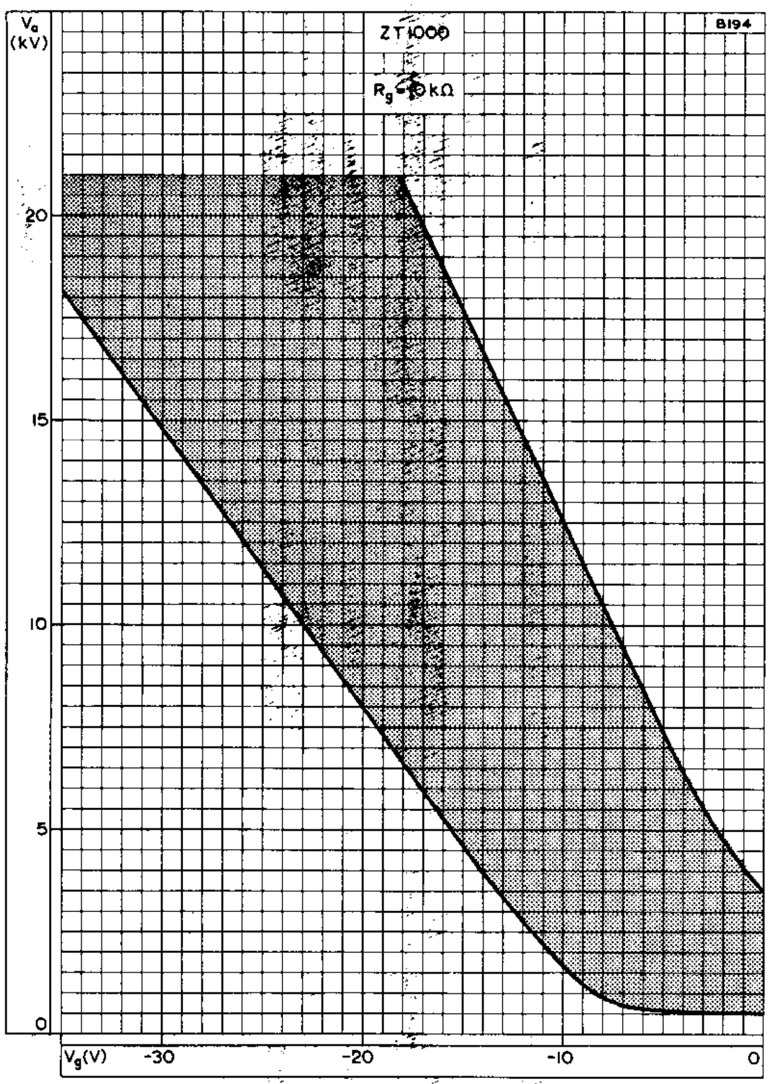
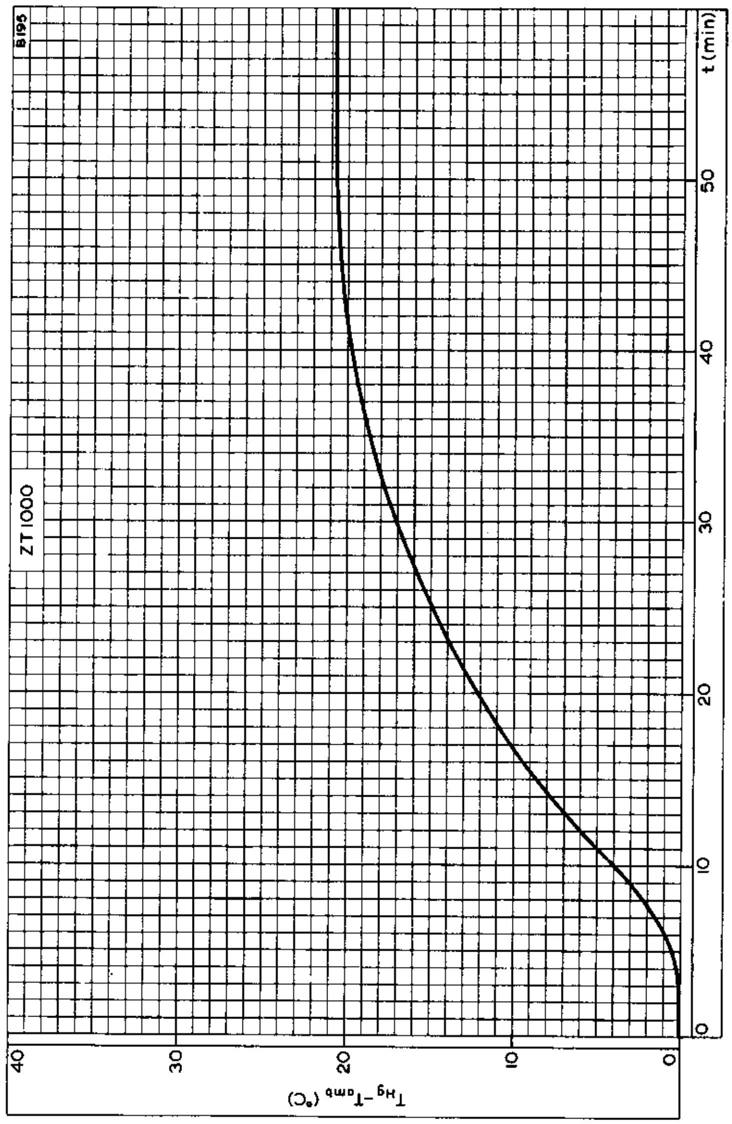
All dimensions in mm



CONTROL CHARACTERISTIC



RATE OF RISE OF CONDENSED-MERCURY TEMPERATURE

THYRATRON

ZT1011

(Formerly XR1-1600A)

QUICK REFERENCE DATA (maximum values)

Inert gas-filled triode for power control and ignitor firing.

Peak anode voltage	1.5	kV
Cathode current		
Peak	30	A
Average	2.5	A

This data should be read in conjunction with DEFINITIONS AND GENERAL OPERATIONAL RECOMMENDATIONS—THYRATRONS, which precede this section of the handbook.

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the valve will operate. No allowance has been made in the data for supply voltage and component variations.

Anode

Peak anode operating voltage (forward and inverse)		
$I_{k(av)} \leqslant 1.6A$, $i_{k(pk)} \leqslant 20A$	1.5	kV
$I_{k(av)} > 1.6A$	1.25	kV
Anode voltage drop (approx.)	10	V
Anode-to-grid capacitance	350	mpF
Commutation factor	10	VA/μs^2
Ignition delay time	*see page C2*	

Grid

Maximum negative grid voltage		
Before conduction	−300	V
During conduction	−10	V
Maximum positive grid current during the time that the anode voltage is more positive than −10V		
Peak	1.25	A
Average (maximum averaging time = 20ms)	100	mA
Maximum peak positive grid current during the time that the anode voltage is more negative than −10V	5.0	mA ←
Grid-to-cathode capacitance	10	pF
Grid resistance		
Maximum	100	kΩ
Minimum	*See page C3*	
Recovery (deionisation) time (approx.)		
$V_g = -250V$	200	µs
$V_g = -100V$	300	µs
Critical grid current at $V_a = 1.5kV$	<20	µA

ZT1011

THYRATRON

(Formerly XR1-1600A)

Cathode		
Maximum cathode current (*see note 1*)		
Peak (25c/s and above) *see note 5*		
$V_a \leq 1.25kV$	30	A
$V_a = 1.5kV$	20	A
Average (*see page C4*)		
Maximum averaging time = 15s, $V_a = 1.5kV$	1.6	A
Maximum averaging time = 10s, $V_a \leq 1.25kV$	2.5	A
Surge (fault protection, maximum duration, = 0.1s) *see note 3*	300	A
Minimum cathode heating time (*see note 2*)		
$i_{k(pk)} \leq 20A$	10	s
$i_{k(pk)} > 20A$	30	s
Filament voltage (*see note 5*)	2.5	V
Filament current range at 2.5V and $I_k = 0A$	7.5 to 9.5	A

Mechanical		
Type of cooling	Convection	
Mounting position	Any between horizontal and vertical with base down	
Net weight (approx.)	115	g
	4.1	oz
Weight of valve in carton (approx.)	275	g
	9.7	oz
Nominal dimensions of carton	3.5×3.5×8.5	in
	90×90×125	mm

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual valve operating conditions.

Anode		
Maximum peak anode voltage (forward and inverse)		
$I_{k(av)} \leq 1.6A$, $i_{k(pk)} \leq 20A$	1.5	kV
$I_{k(av)} > 1.6A$	1.25	kV
Grid		
Maximum negative grid voltage		
Before conduction	−300	V
During conduction	−10	V
Maximum positive grid current during the time that the anode voltage is more positive than −10V		
Peak	1.25	A
Average (maximum averaging time = 20ms)	100	mA
Maximum peak positive grid current during the time that the anode voltage is more negative than −10V	5.0	mA

Cathode

Maximum cathode current (*see note 1*)		
Peak (25c/s and above) *see note 5*		
$V_a \leqslant 1.25kV$	30	A
$V_a = 1.5kV$	20	A
Average (*see page C4*)		
Maximum averaging time = 15s, $V_a = 1.5kV$	1.6	A
Maximum averaging time = 10s, $V_a \leqslant 1.25kV$	2.5	A
Surge (fault protection, maximum duration = 0.1s) *see note 3*	300	A
Minimum cathode heating time (*see note 2*)		
$i_{k(pk)} \leqslant 20A$	10	s
$i_{k(pk)} > 20A$	30	s
Heater voltage		
Minimum	2.25	V
Maximum		
($I_k > 0.5A$)	2.75	V
($I_k \leqslant 0.5A$)	3.0	V
Ambient temperature (*see note 4*)		
Minimum	−55	°C
Maximum	+70	°C

OPERATING NOTES

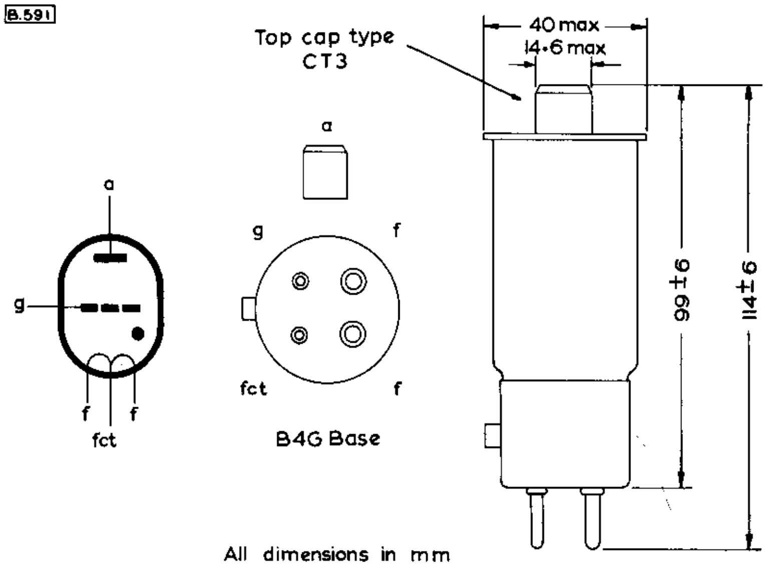
1. The centre tap of the filament should be connected to the centre tap of the filament transformer. This connection is essential when the average current exceeds 6.4A averaged over any 1 second period. When two or more valves are used with one filament transformer, the filament centre taps must never be connected together without the further connection to the centre tap of the filament transformer.
2. Peak currents greater than 20A should not be drawn until 1 minute after the application of the filament voltage.
3. The rating applies when the filament and filament transformer centre taps are connected together. The maximum surge current must not exceed 140A, if the cathode current return is to only one of these points.
4. The anode structure must be left free to ensure cooling by free convection.
5. For operation with peak currents in excess of 20A and a mean current of less than 0.5A, such as occurs under ignitron firing service, a nominal heater voltage of 2.75V may be used. Under these conditions a maximum peak anode voltage of 1.5kV is permissible.

ZT1011

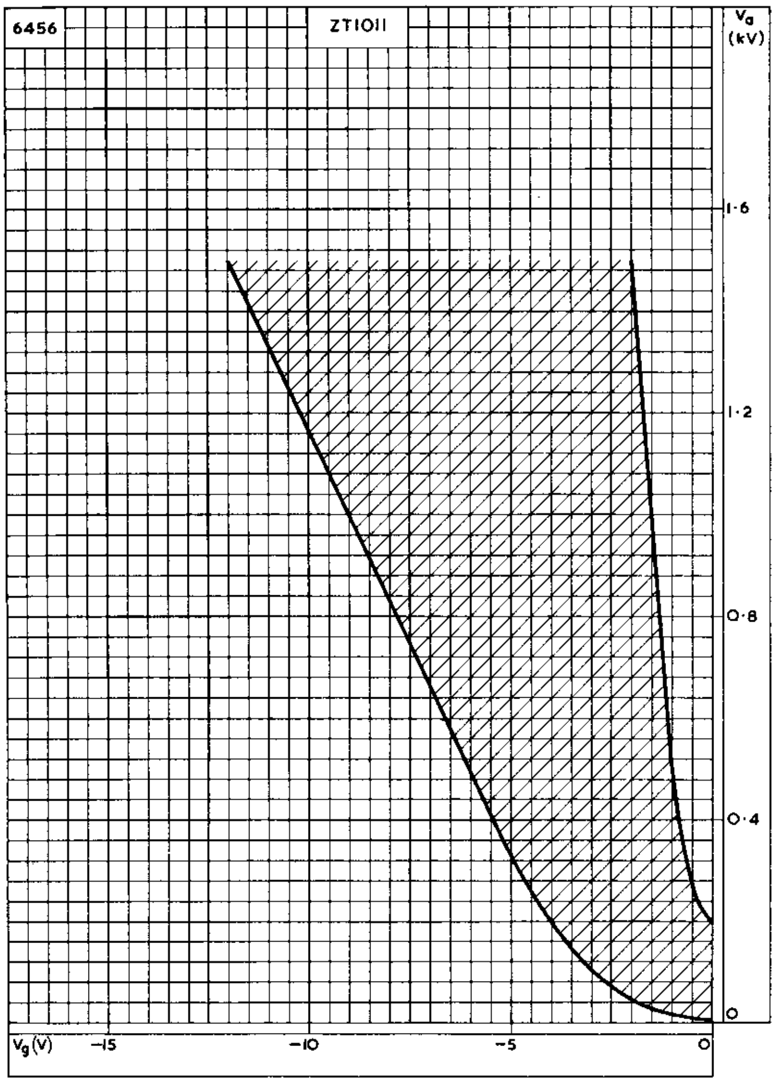
(Formerly XR1-1600A)

THYRATRON

B.591



All dimensions in mm

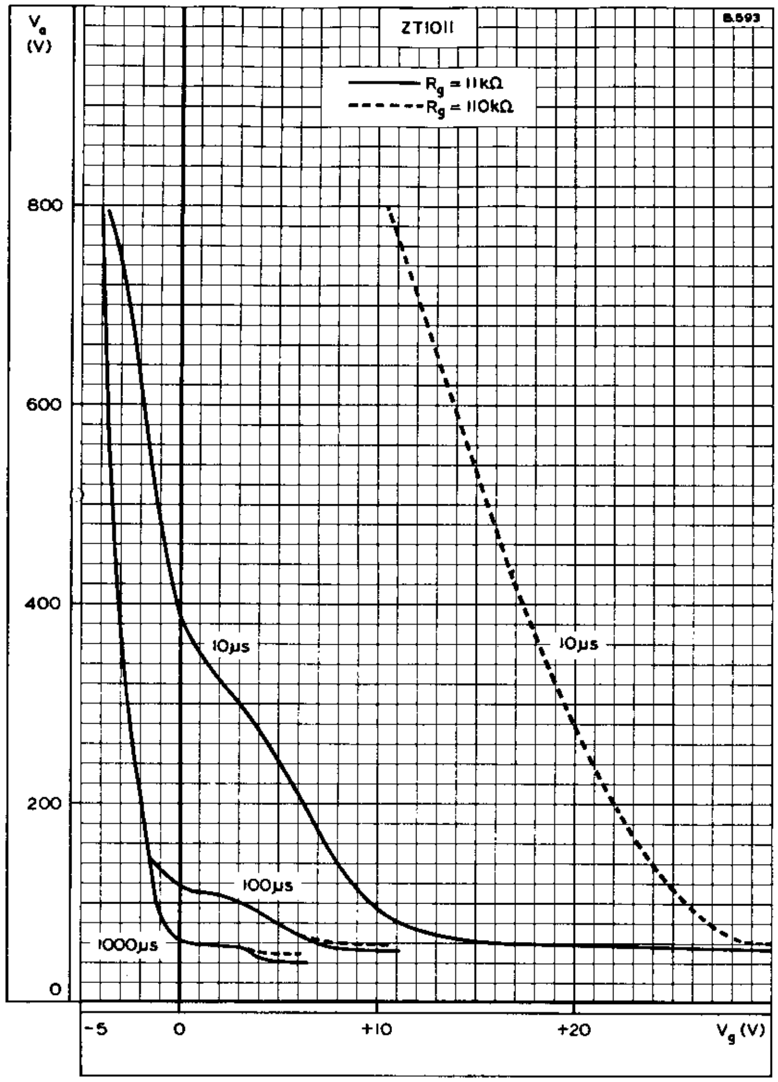


CONTROL CHARACTERISTIC

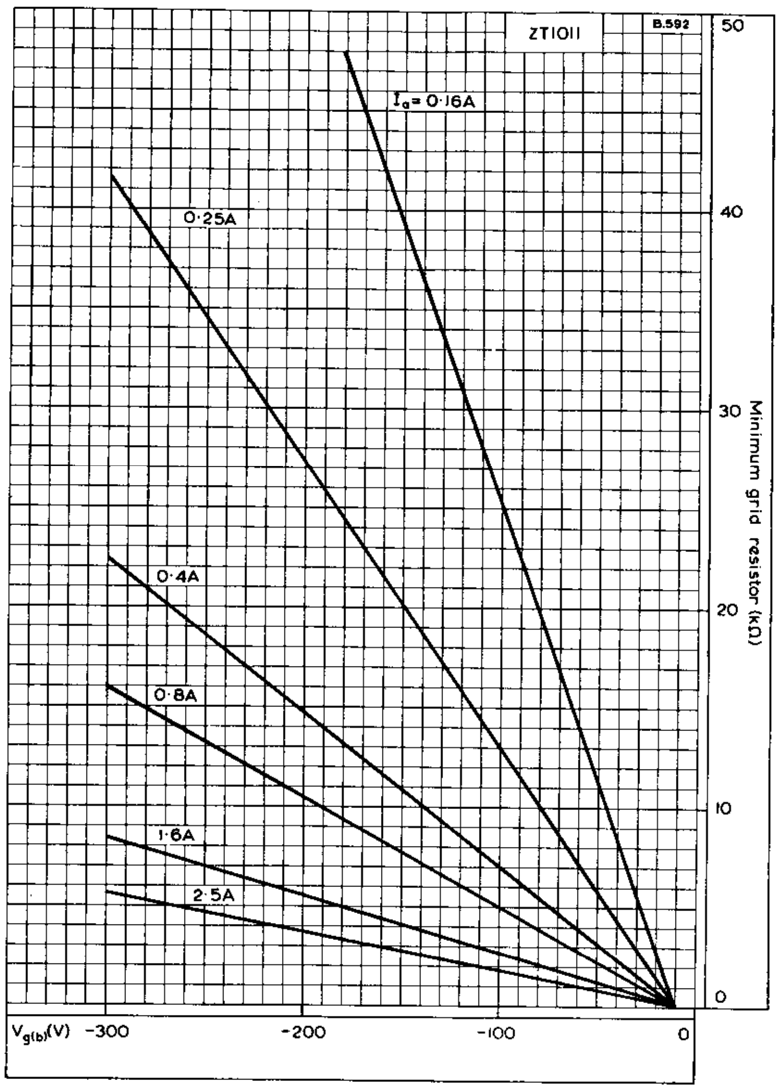
ZT1011

THYRATRON

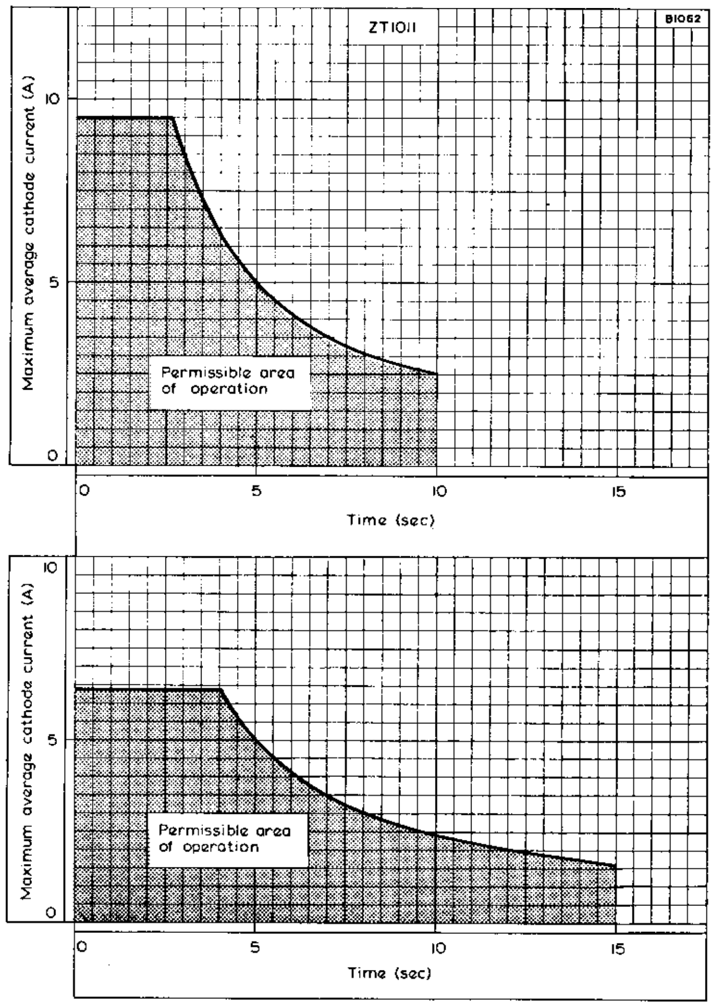
(Formerly XR1-1600A)



NOMINAL VARIATION BETWEEN ANODE AND GRID VOLTAGES FOR DIFFERENT IGNITION DELAY TIMES



MINIMUM GRID RESISTANCE PLOTTED AGAINST NEGATIVE SUPPLY VOLTAGE WITH ANODE CURRENT AS PARAMETER



The top curve shows the maximum number of seconds in any 10 second period for which a given average current may be drawn from a sinusoidal supply if the peak voltage applied to the valve is less than 1.25kV. The bottom curve shows the maximum number of seconds in any 15 second period for which a given average current may be drawn from a sinusoidal supply if the applied peak voltage lies between 1.25 and 1.5kV.

IGNITRON ZX1000

QUICK REFERENCE DATA

Coaxial ignitron primarily intended for resistance welding and a.c. control applications. Special features include air or water cooling, fast ignition, low ignitor energy requirements.

Peak anode voltage	800	V
Cathode current		
Peak	1.14	kA
Average	13	A
Demand kVA (two tubes in inverse parallel)	200	kVA
Nominal ignition time	9	μs

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life.

Anode

Maximum anode supply voltage	See table in 'Full Load Operating Conditions'.	
Minimum instantaneous positive anode voltage for ignitor to anode transfer	25	V
Arc voltage drop	See curve on page C1	
*Minimum instantaneous anode current to maintain conduction	5	A

*Note this current must be established within 200μs of application of ignitor pulse.

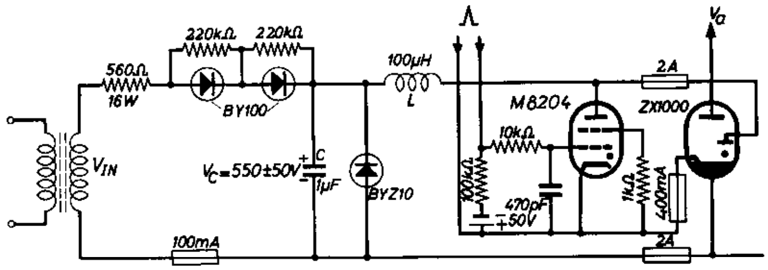
Cathode

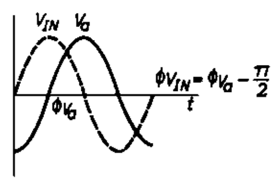
See table in Full Load Operating Conditions and pages C3-C6.

Ignitor and auxiliary electrode

The tube is designed for a separate ignition system using a miniature thyratron. The ignition must be started by a short pulse through the ignitor, after which the discharge is taken over by the auxiliary electrode, and finally by the main anode, provided that there is a minimum voltage of 25 volts between main anode and cathode.

The firing circuit is shown below





Tolerance of passive components = 10% max.

Circuit resistance = 0.5Ω max.

For satisfactory operation the a.c. supply should lag the ignitron anode supply by 90°. This may be obtained from a three-phase 4 wire supply, or by using a passive component network for single phase operation.

Mechanical

Type of cooling	Air or water		
Water cooling	Min.	Max.	
Continuous water flow at maximum load	0.04	0.22	gal/min
Pressure drop at minimum flow		0.71	lb/in^2
Water temperature at inlet of cooling system		See curve on page C9	

Forced air cooling		
Continuous air flow through each air cooler at maximum load	21	cu.ft/min
Cooling air temperature at minimum flow	See curve on page C10	
Net weight (approx)	17.6	oz
	500	g
Weight of valve in carton (approx)	26.5	oz
	750	g
Minimum distance between centres for mounting	120	mm
Mounting position	Vertical with anode connection up	

Accessories

	Type number	Net weight	Weight in carton
Water cooler	40700	250g	500g
Air cooler	40701	300g	500g
Connector for ignitor and auxiliary electrode	40702 (Supplied with tube)		

FULL LOAD OPERATING CONDITIONS

The figures given in this data are based on full cycle conduction, regardless of whether or not phase delayed firing is used. No allowance has been made for supply voltage or component variations.

Single phase a.c. control, supply frequency 25 to 60c/s (see pages C2-C6)

R.M.S. supply voltage (Vb)	220	250	380	440	500	V

For use at maximum kVA demand

Maximum demand	176	200	200	200	200	kVA
Maximum average cathode current per tube	7.0	7.0	7.0	7.0	7.0	A
Maximum r.m.s. demand current, two tubes in inverse parallel	800	800	526	454	400	A
Duty factor	1.9	1.9	3.0	3.5	3.9	%

For use at maximum average current

Maximum average cathode current per tube	13.0	13.0	13.0	13.0	13.0	A
Maximum demand	58	67	67	67	67	kVA
Maximum r.m.s. demand current, two tubes in inverse parallel	267	267	175	151	133	A
Duty factor	10.7	10.7	16.4	19.2	21.6	%

Maximum surge current for fault protection (maximum duration 150ms)	2260	2260	1490	1270	1130	A
Maximum averaging time						
*When using water cooling with maximum inlet temperature = 32°C	25.6	25.6	16.8	14.5	12.8	s
*When using forced air cooling with maximum inlet temperature = 25°C	12	12	10	9	8	s

*For use at higher inlet temperatures see curves on pages C8 and C9.

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual tube operating conditions.

The values given in this section are based on full cycle conduction without phase delay regardless of whether or not phase control is used.

Anode and cathode

Maximum peak voltage (forward and inverse)	800	V
Maximum anode current		
Peak (at 250V r.m.s.)	1.14	kA
Average (continuous) See pages C3, C4, C5 and C6	13	A
Surge (fault protection only, maximum duration = 150ms)	2.8 x max. demand current	
Maximum demand (two tubes connected in inverse parallel) See page C2	200	kVA

See pages C3, C4, C5, and C6 for curves showing r.m.s. demand current and duty factor.

COOLING (Air or water cooling may be used)

	Min.	Max.	
Water cooling			
Continuous water flow at maximum load	0.04	0.22	gal/min
Pressure drop at minimum flow		0.71	lb/in^2
Water temperature at inlet of cooling system		See curve on page C8	
Forced air cooling			
Minimum continuous air flow through each air cooler at maximum load		21	cu.ft/min
Cooling air temperature at minimum flow		See curve on page C9	

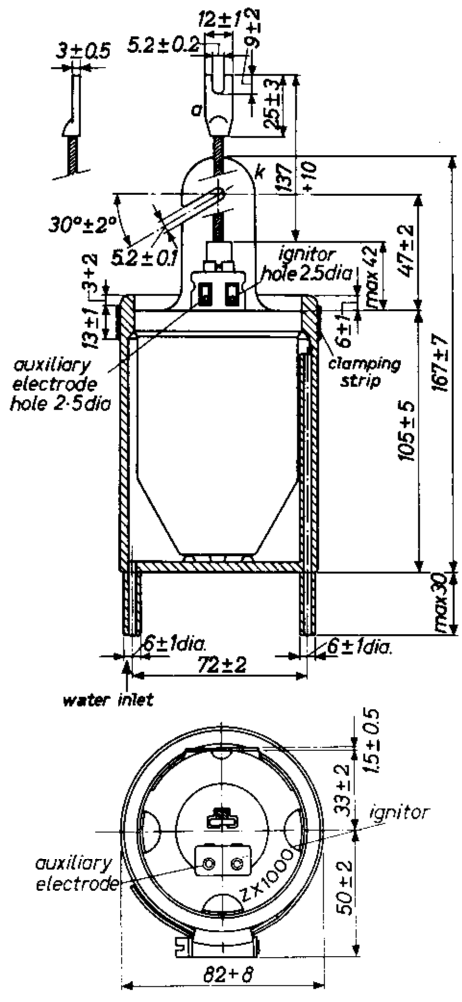
OPERATING NOTES

1. To prevent condensation of mercury on the anode or on the anode insulator, the temperature of the anode lead-in and insulator should always be higher than the cathode temperature.

2. The ignitron should be mounted vertically, anode uppermost. It should not be subject to vibration, or the influence of magnetic or radio frequency fields.

OUTLINE DRAWING AND DIMENSIONS

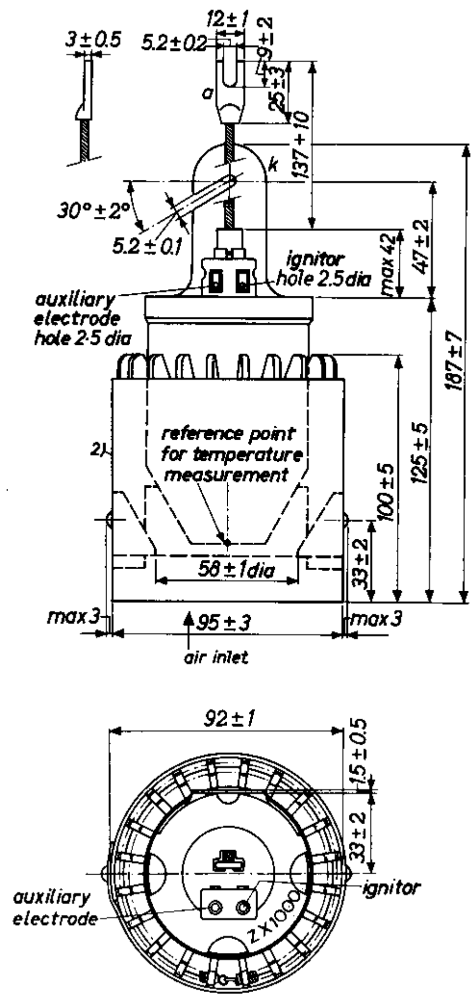
Water cooling



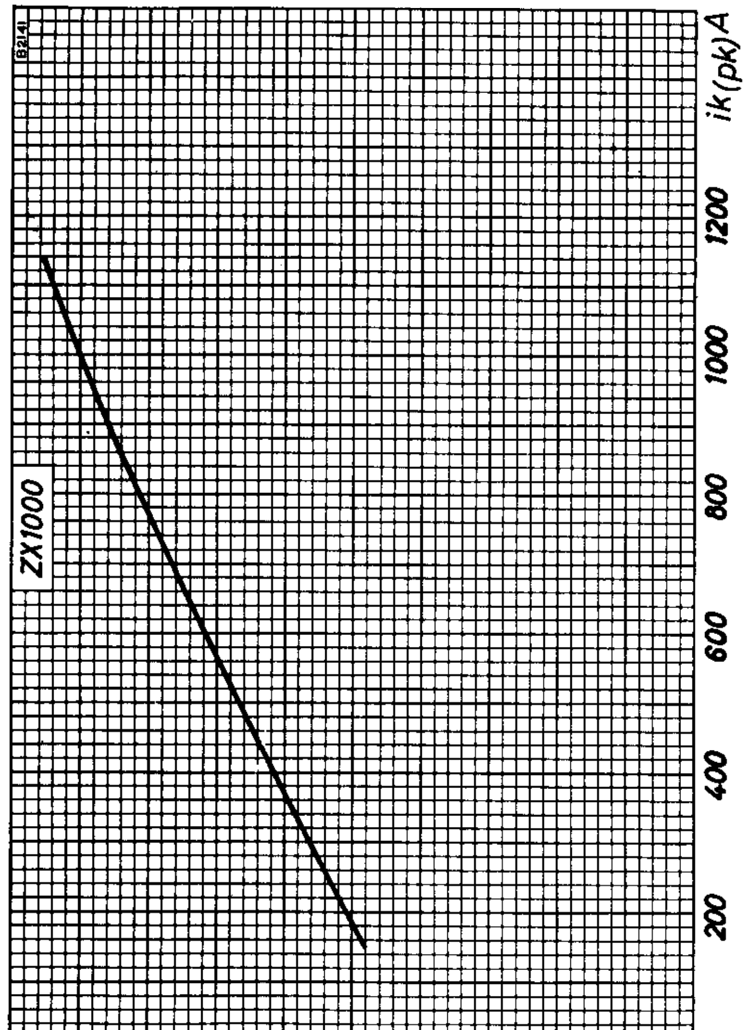
Dimensions in mm.

OUTLINE DRAWING AND DIMENSIONS

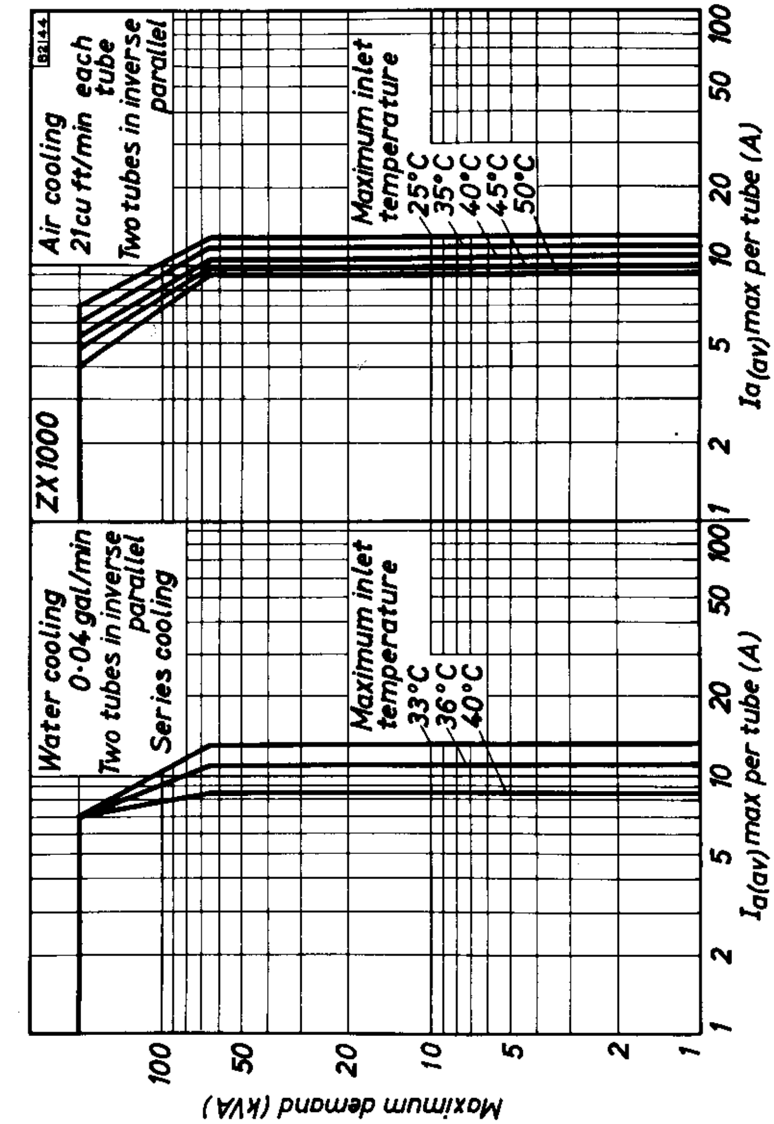
Air cooling



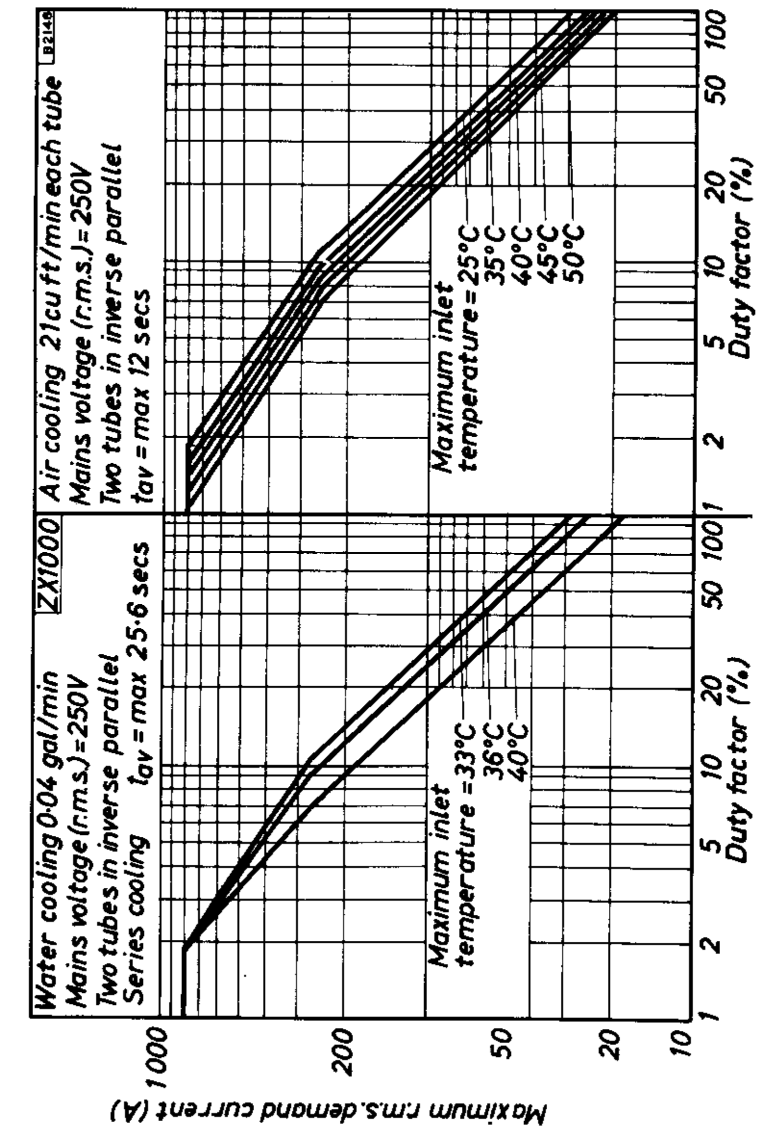
Dimensions in mm.



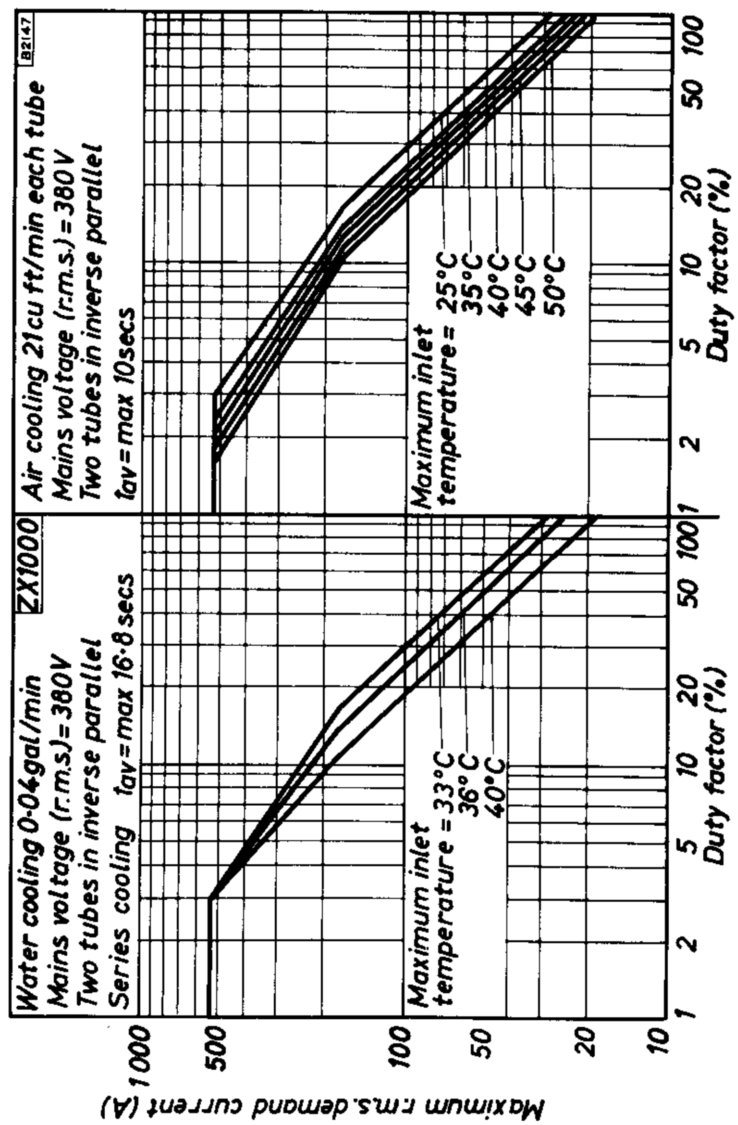
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



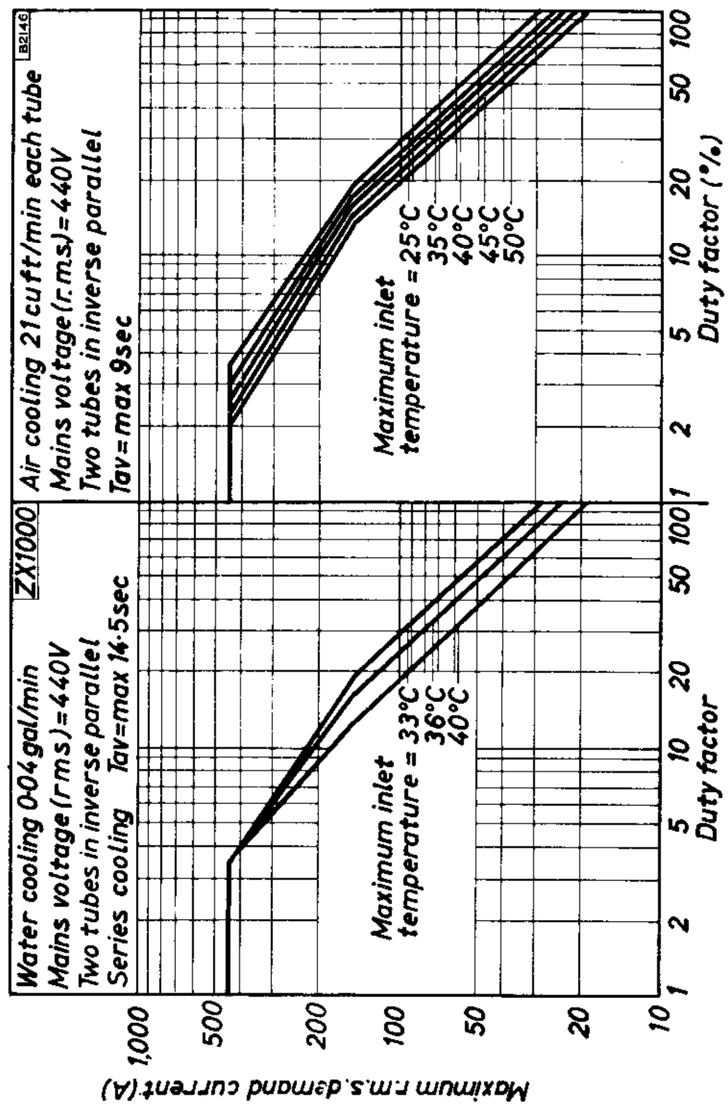
MAXIMUM r.m.s. DEMAND PLOTTED AGAINST ANODE CURRENT



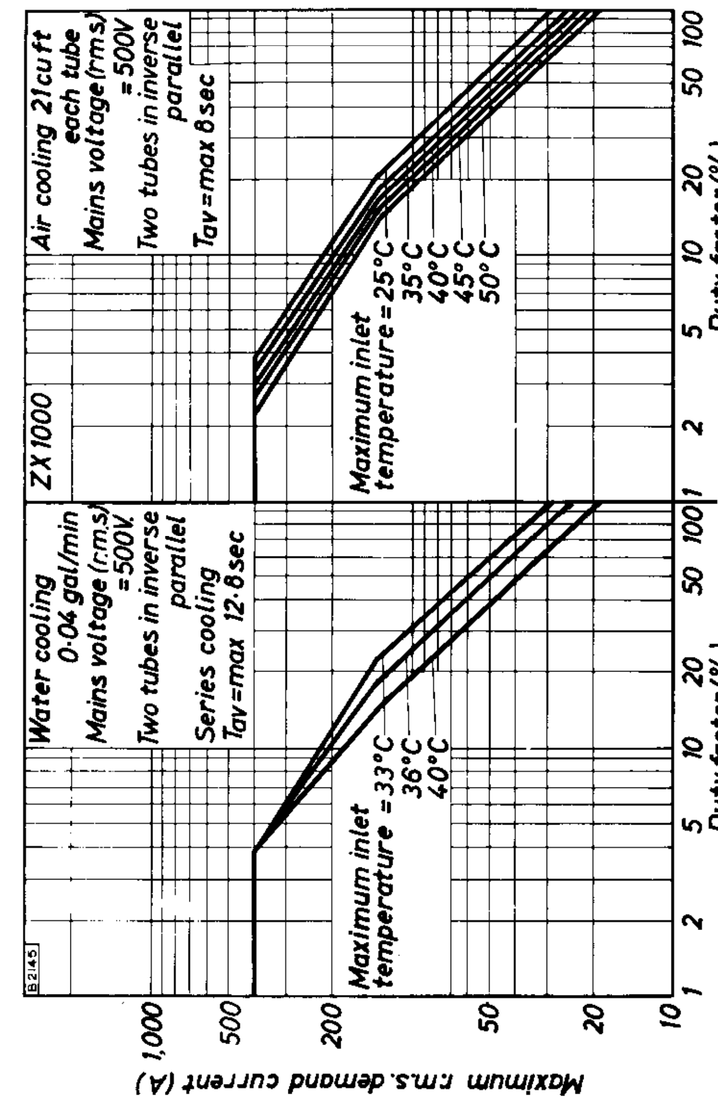
MAXIMUM r.m.s. DEMAND CURRENT PLOTTED AGAINST DUTY FACTOR FOR A MAINS VOLTAGE ≤ 250V (r.m.s.)



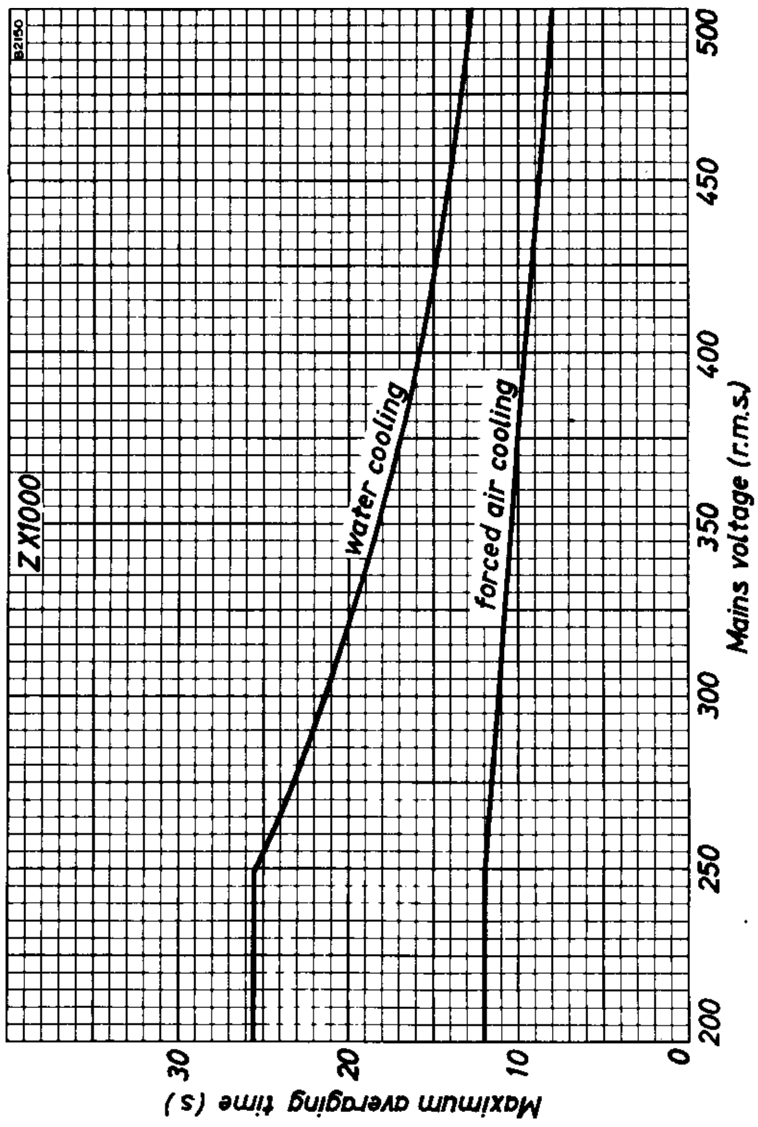
MAXIMUM r.m.s. DEMAND CURRENT PLOTTED AGAINST DUTY FACTOR FOR A MAINS VOLTAGE=380V(r.m.s.)



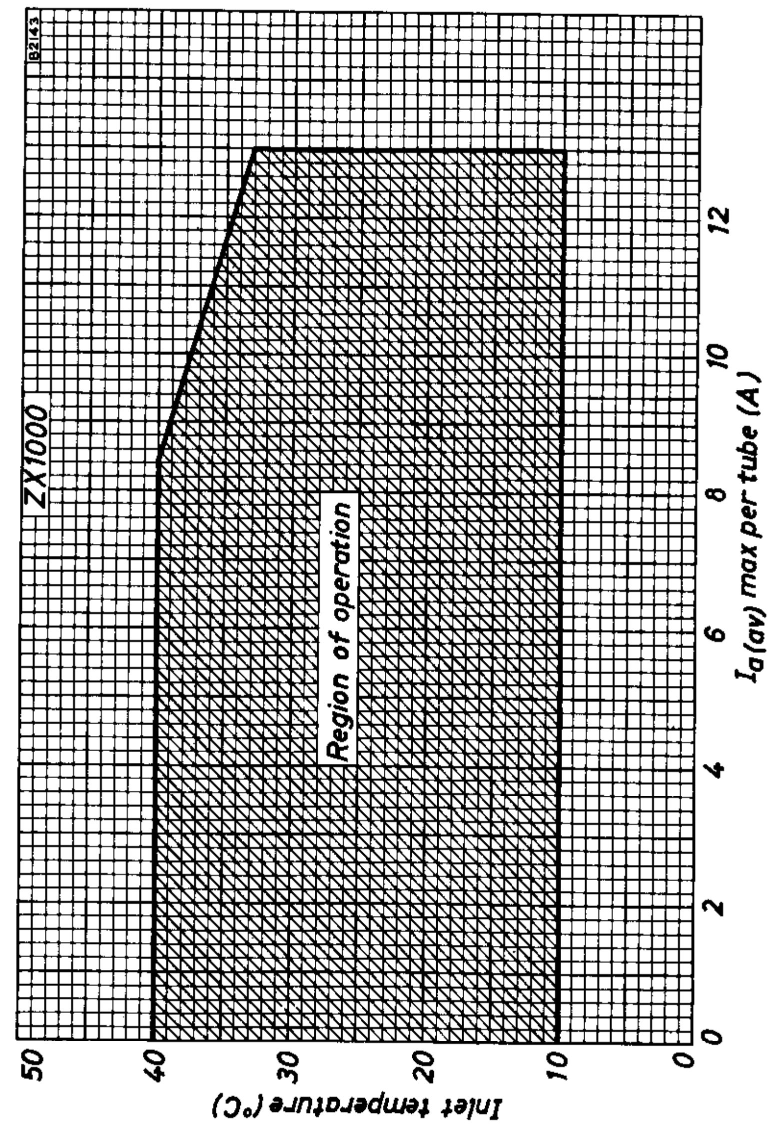
MAXIMUM r.m.s. DEMAND CURRENT PLOTTED AGAINST DUTY FACTOR FOR A MAINS VOLTAGE = 440V (r.m.s.)



MAXIMUM r.m.s. DEMAND CURRENT PLOTTED AGAINST DUTY FACTOR
FOR A MAINS VOLTAGE = 500V (r.m.s.)

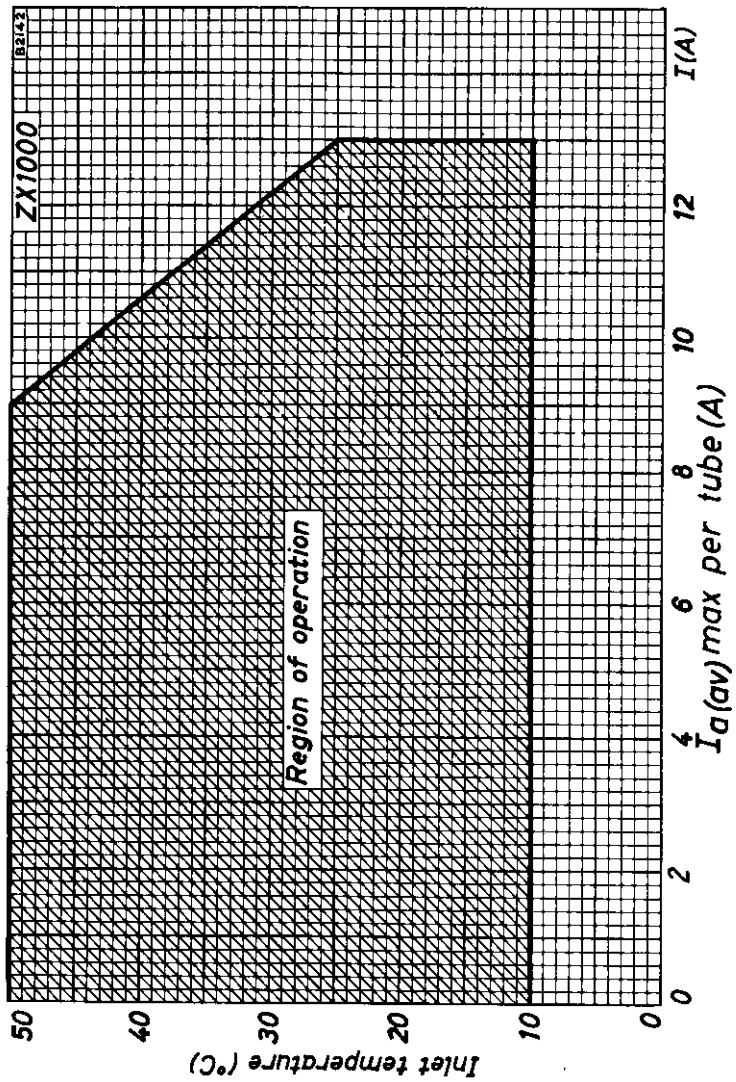


MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE

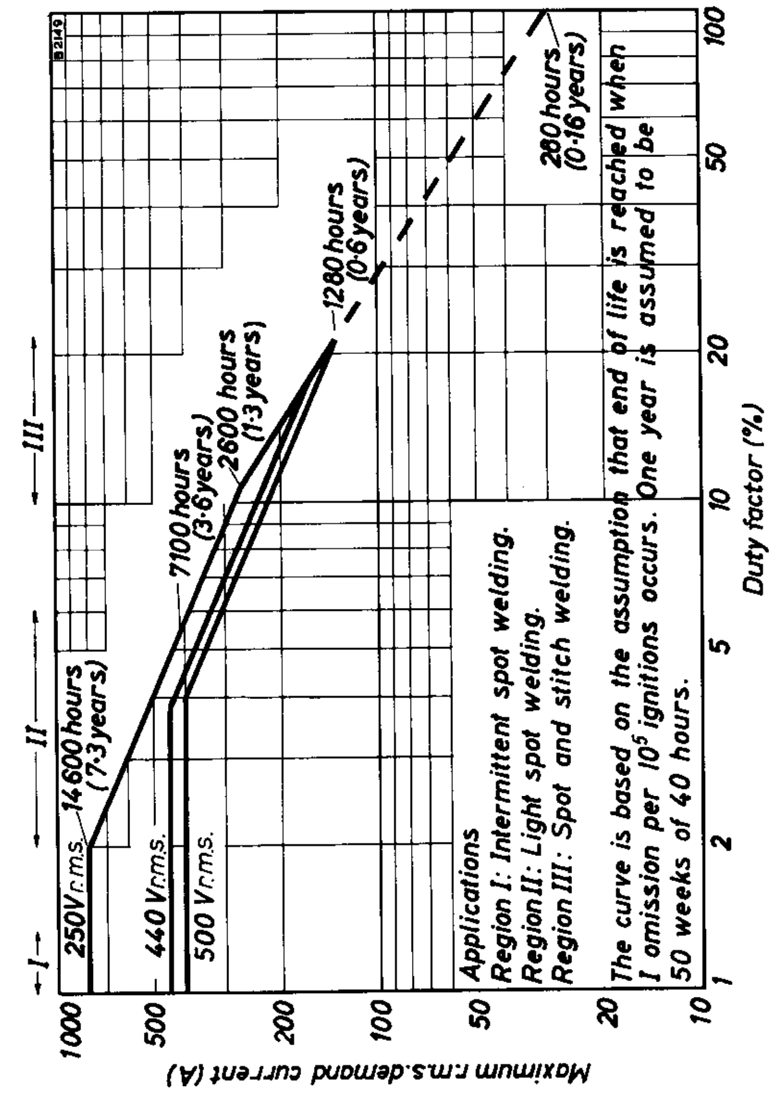


INLET TEMPERATURE PLOTTED AGAINST AVERAGE ANODE CURRENT

FOR WATER COOLING



INLET TEMPERATURE PLOTTED AGAINST AVERAGE ANODE CURRENT
FOR AIR COOLING



LIFE EXPECTANCY AS A FUNCTION OF R.M.S. DEMAND CURRENT AND DUTY FACTOR FOR TWO TUBES IN INVERSE PARALLEL

IGNITRON ZX1051

QUICK REFERENCE DATA		
Water-cooled ignitron primarily intended for resistance welding and a.c. control applications. The tube has a plastic coated stainless steel water jacket.		
International size	B	
Maximum demand power (two tubes in inverse parallel)	600	kVA
Maximum average current	56	A
Minimum ignitor requirements to fire all tubes		
Peak voltage	150	V
Peak current	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values in each section state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life, with the specified cooling conditions.

Anode and Cathode

See under sections listed in "Full Load Operating Conditions":-

1. Single phase welding service and A.C. control
   a. Maximum demand power
   b. Maximum average current
2. Intermittent rectifier or three phase frequency changer resistance welding service.

Arc voltage drop — See graph, page C1

Ignitor

See section "Ignitor characteristics, etc."

FULL LOAD OPERATING CONDITIONS

The figures given in the data are based on full cycle conduction, with equally distributed load on all ignitrons, regardless of whether or not phase delayed firing is used. The load must be limited so that at zero phase delay no overload will result. No allowance has been made for supply voltage or component variations.

SINGLE PHASE WELDING SERVICE AND A.C. CONTROL. Supply frequency 50Hz, two tubes in inverse parallel connection (see graph on page C2)

A. Maximum demand power

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. demand power	530	600	600	600	600	600	kVA
Max. average current per tube	30.2	30.2	30.2	30.2	30.2	30.2	A
Max. r.m.s. demand current	2.4	2.4	1.6	1.4	1.2	1.0	kA
Max. averaging time	18	18	11.8	10.4	9.0	7.5	s
Duty factor	2.8	2.8	4.2	4.8	5.6	6.7	%
Max. number of cycles in max. averaging time	25	25	25	25	25	25	
Integrated r.m.s. load current	400	400	320	310	280	260	A

B. Maximum average current

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. average current per tube	56	56	56	56	56	56	A
Max. demand power	180	200	200	200	200	200	kVA
Max. r.m.s. demand current	800	800	530	450	400	330	A
Max. averaging time	18	18	11.8	10.4	9.0	7.5	s
Duty factor	15.6	15.6	23.5	26	31.1	37.7	%
Max. number of cycles in max. averaging time	140	140	140	140	140	140	
Integrated r.m.s. load current	320	320	260	230	220	200	A
Max. surge current for max. 0.15s	6.7	6.7	4.5	3.8	3.4	2.8	kA

Notes

1. For supply voltages less than 250V r.m.s., the values of maximum demand current and maximum averaging time at 250V r.m.s. must not be exceeded.
2. The "maximum number of cycles in the maximum averaging time" is the maximum integrated number of cycles that a pair of tubes may conduct, with or without interruption, during the maximum averaging time.

   Max. no. of cycles = Duty factor × Max. averaging time × Supply frequency

INTERMITTENT RECTIFIER OR THREE PHASE FREQUENCY CHANGER RESISTANCE WELDING SERVICE. Supply frequency 50Hz (see graph page C3)

Max. peak voltage (forward and inverse)	1.2	1.5	kV
For use at max. peak current			
Max. peak current	600	480	A
Max. average current	5.0	4.0	A
For use at max. average current			
Max. peak current	135	108	A
Max. average current	22.5	18	A
Max. averaging time	10	10	s
Max. value of the ratio of average current to peak current (averaging time = 0.5s)	0.17	0.17	
Max. value of the ratio of surge current to peak current (averaging time = 150ms)	12.5	12.5	

IGNITOR CHARACTERISTICS, RATINGS AND IGNITION CIRCUITS

Ignitor characteristics

Minimum voltage required for ignition (all tubes)	150	V
Minimum current required for ignition (all tubes)	12	A
Typical current required for ignition	6 to 8	A
Minimum period of application of voltage or current	50	μs

Ignitor ratings (Absolute maximum system)

Maximum peak positive voltage	2.0	kV
Maximum peak negative voltage (including any transients)	5.0	V
Maximum peak forward current	100	A
Maximum peak inverse current	zero	A
Maximum r.m.s. forward current	10	A
Maximum average forward current for maximum averaging time of 5 seconds	1.0	A

Anode excitation circuit requirements

For recommended circuit using two thyristors see figure 1, or for one common thyristor see figure 2.

Minimum peak ignitor voltage for ignition	200	V
Minimum peak ignitor current for igniton	12	A
Minimum rate of rise of ignitor current	0.1	A/μs

$V_{r.m.s.}$	220	250	380	440	500	600	V
R	2	2	4	4.7	5	6	Ω

F_1 — 2A fast response time fuse

F_2 — 10A fast response time fuse

Z — Silicon voltage regulator diode. Zener voltage ≥18V

Separate excitation circuit requirements

For recommended circuit see figure 3.

Capacitor (C)	2.0	8.0	μF
Capacitor voltage (±10%)	650	400	V
Peak value of closed circuit current	80 to 100		A
Maximum ohmic resistance of series inductance (L)	0.2		Ω

NOTE

In each circuit the thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

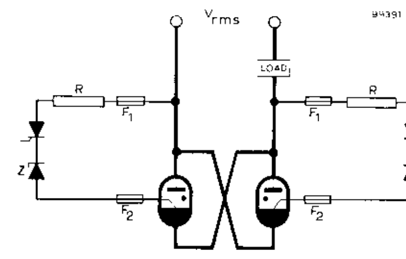


Figure 1:- Anode excitation (two thyristors)

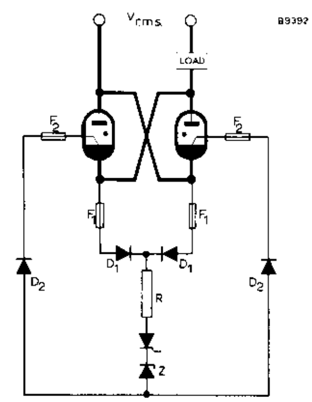


Figure 2:- Anode excitation (Common thyristor)

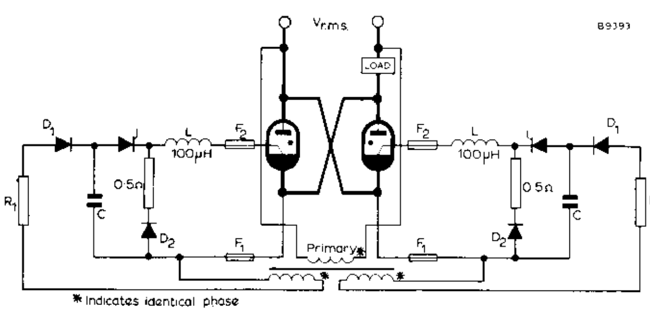


Figure 3:- Separate excitation

MOUNTING POSITION

The ignitron should be mounted within 3° of vertical, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

When connecting the anode lead, care should be taken not to stress the anode insulator.

COOLING

Characteristics at flow of 3 litres/min

Typical maximum pressure drop	0.1 1.4	kg/cm^2 lb/in^2
Typical maximum temperature rise at maximum average current	5.0	°C

A.C. control service ratings (Absolute maximum system)

Minimum water flow at maximum average current (see graph on page C1)	3.0	l/min
Minimum inlet temperature (see note 1)	10	°C
Maximum inlet temperature (see note 1)	40	°C
Maximum temperature at the thermostat plate (see note 2)	50	°C

Intermittent rectifier or three-phase welding service ratings
(Absolute maximum system)

Minimum water flow at maximum average current (see graph page C1)	3.0	l/min
Minimum inlet temperature (see note 1)	10	°C
Maximum inlet temperature (see note 1)	35	°C
Maximum temperature at the thermostat plate (see note 2)	45	°C

NOTES

1. When the cooling systems of two or three tubes are connected in series, the minimum inlet temperature applies to the coldest tube and the maximum inlet temperature applies to the hottest tube.

   The protective thermostat should be mounted on the hottest tube and the water economy thermostat on the tube immediately preceeding the hottest tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.
   Hoses should be of insulating material and the minimum length between tube and tube, or between tube and earth, should be 50cm.

2. The thermostat plate is at the supply voltage.

3. The main casing of the ignitron is made from stainless steel, but care should be taken not to use water with a high mineral content.

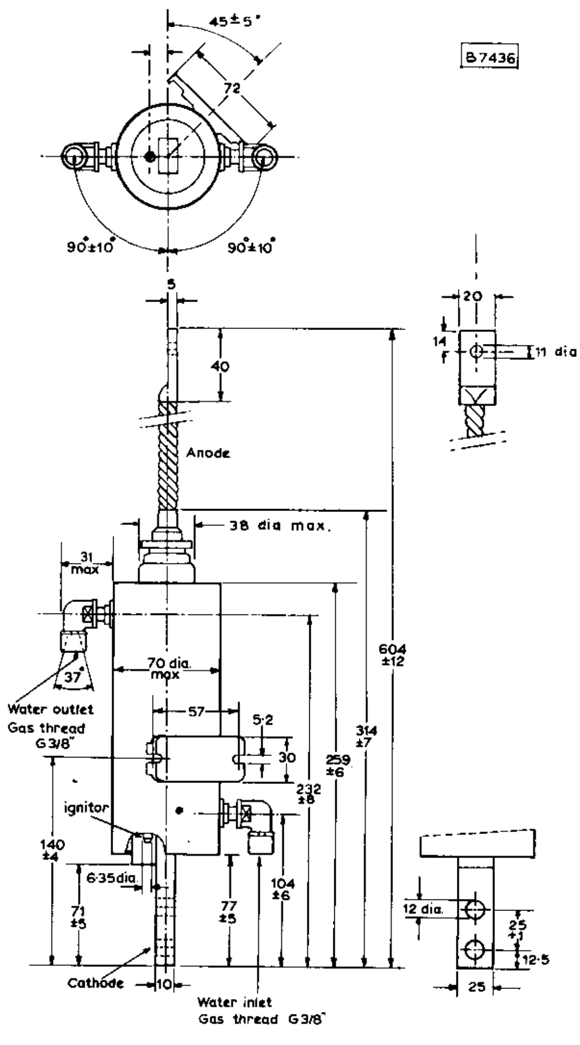
WEIGHT

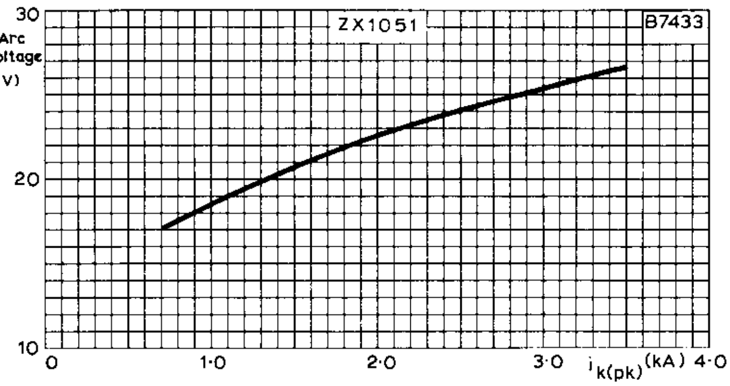
Net weight (approx.)	1.42	kg
Weight of tube in carton (approx.)	2.04	kg

ACCESSORIES

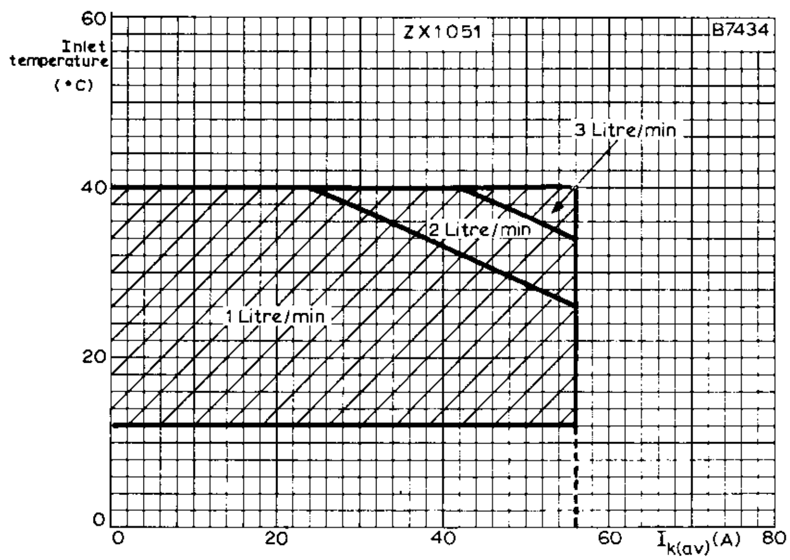
Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

OUTLINE DRAWING
OF ZX1051

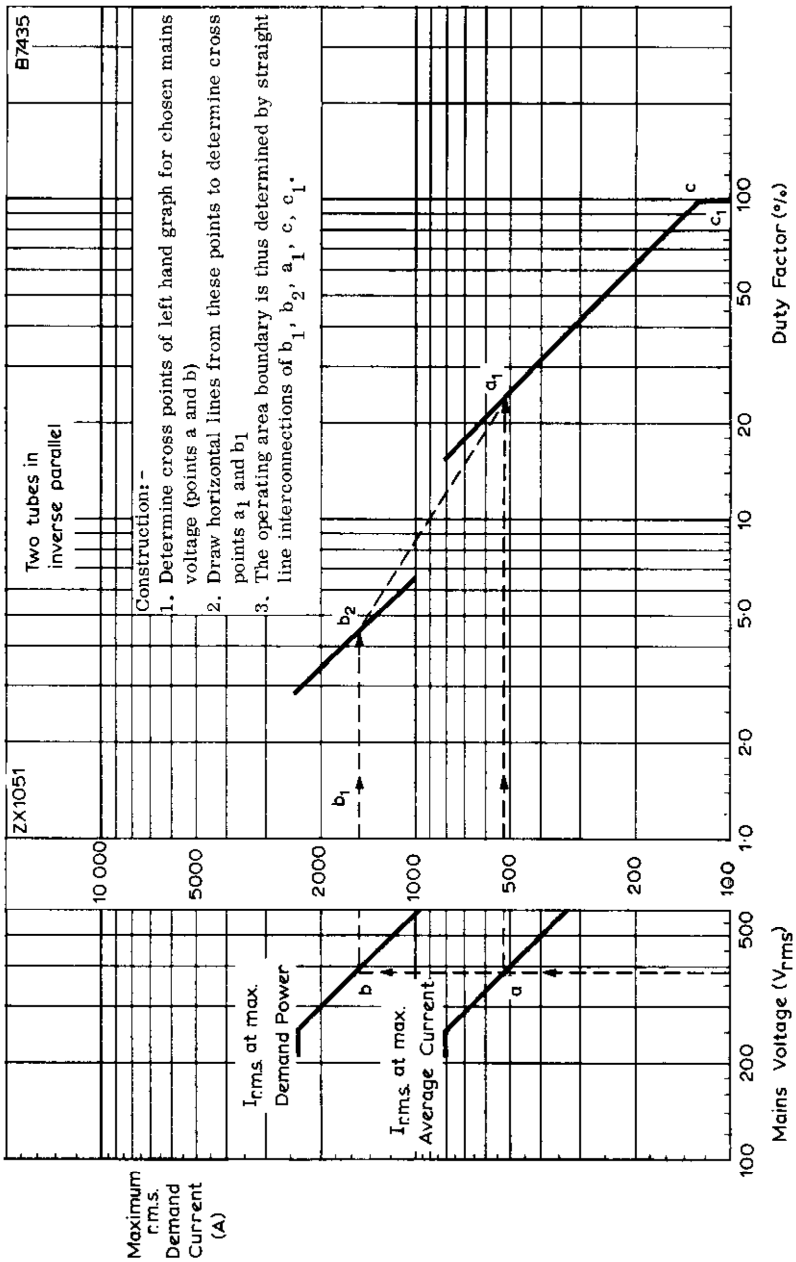




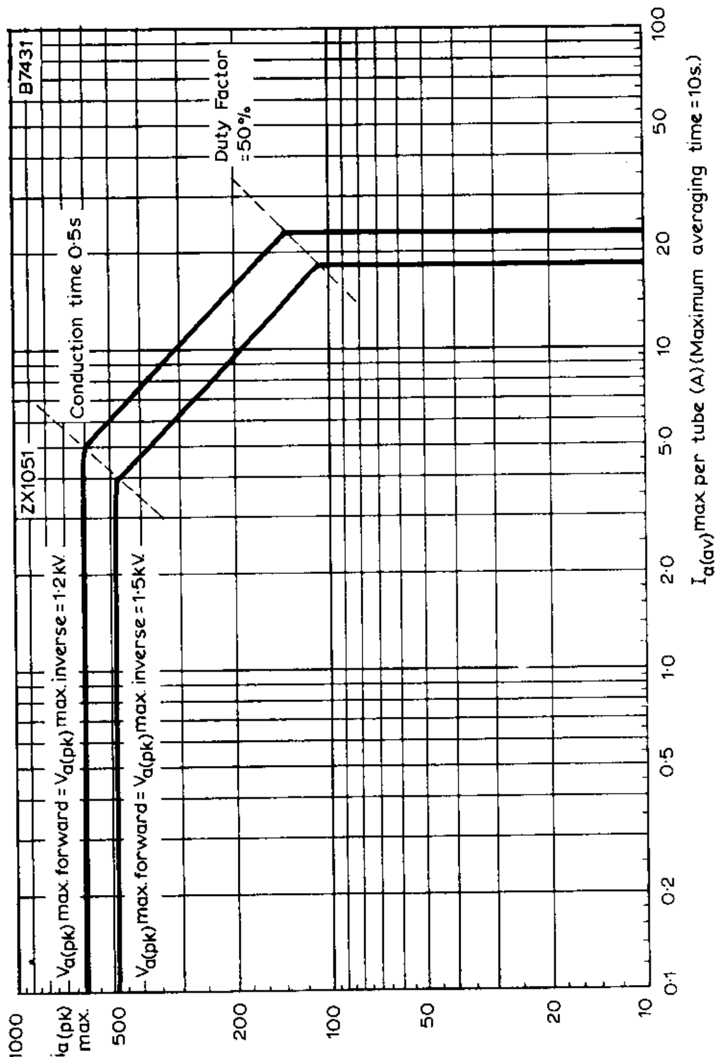
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



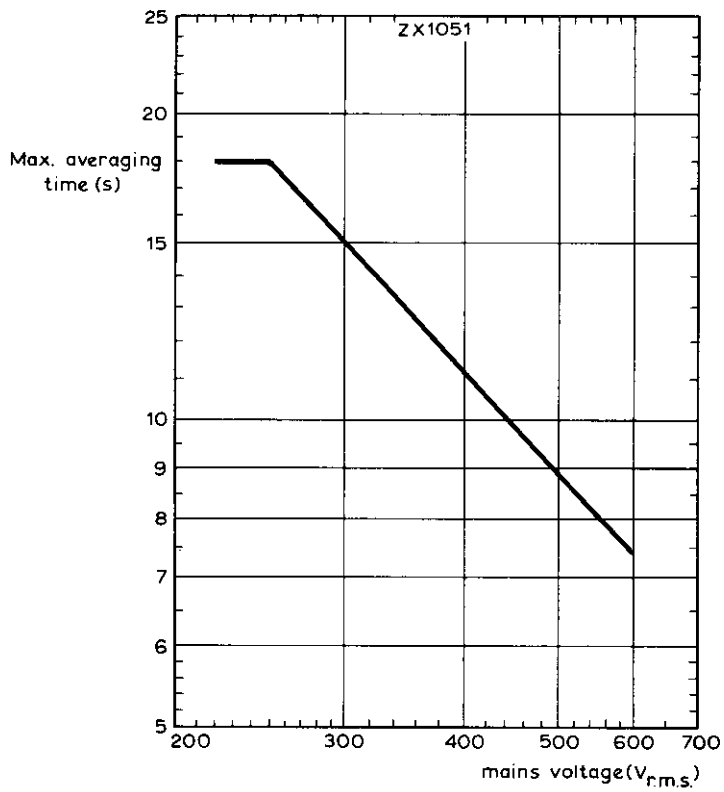
MINIMUM REQUIRED CONTINUOUS WATERFLOW
(TWO TUBES COOLED IN SERIES)



GRAPH RELATING DEMAND CURRENT WITH DUTY FACTOR AS A FUNCTION OF THE MAINS VOLTAGE. WELDING SERVICE ONLY



MAXIMUM PEAK ANODE CURRENT PLOTTED AGAINST
AVERAGE ANODE CURRENT. INTERMITTENT RECTIFIER SERVICE



MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE

IGNITRON ZX1052

QUICK REFERENCE DATA		
Water-cooled ignitron primarily intended for resistance welding and a.c. control applications. The tube has a plastic coated stainless steel water jacket.		
International size	C	
Maximum demand power (two tubes in inverse parallel)	1200	kVA
Maximum average current	140	A
Minimum ignitor requirements to fire all tubes		
Peak voltage	150	V
Peak current	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values in each section state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life, with the specified cooling conditions.

Anode and Cathode

See under sections listed in "Full Load Operating Conditions":-

Single phase welding service and A.C. control
a. Maximum demand power
b. Maximum average current

Arc voltage drop — See graph, page C1

Ignitor

See section "Ignitor characteristics, etc."

FULL LOAD OPERATING CONDITIONS

The figures given in the data are based on full cycle conduction, with equally distributed load on all ignitrons, regardless of whether or not phase delayed firing is used. The load must be limited so that at zero phase delay no overload will result. No allowance has been made for supply voltage or component variations.

SINGLE PHASE WELDING SERVICE AND A.C. CONTROL. Supply frequency 50Hz, two tubes in inverse parallel connection (see graph on page C2)

A. Maximum demand power

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. demand power	1060	1200	1200	1200	1200	1200	kVA
Max. average current per tube	75.6	75.6	75.6	75.6	75.6	75.6	A
Max. r.m.s. demand current	4.8	4.8	3.15	2.92	2.4	2.0	kA
Max. averaging time	14	14	9.4	8.0	7.0	5.8	s
Duty factor	3.5	3.5	5.3	6.2	7.0	8.4	%
Max. number of cycles in max. averaging time	25	25	25	25	25	25	
Integrated r.m.s. load current	900	900	720	670	630	580	A

B. Maximum average current

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. average current per tube	140	140	140	140	140	140	A
Max. demand power	350	400	400	400	400	400	kVA
Max. r.m.s. demand current	1600	1600	1050	910	800	660	A
Max. averaging time	14	14	9.4	8.0	7.0	5.8	s
Duty factor	19.4	19.4	29.5	34.0	39.0	47.0	%
Max. number of cycles in max. averaging time	140	140	140	140	140	140	
Integrated r.m.s. load current	700	700	570	530	500	450	A
Max. surge current for max. 0.15s	13.5	13.5	9.0	7.7	6.7	5.7	kA

Notes

1. For supply voltages less than 250V r.m.s., the values of maximum demand current and maximum averaging time at 250V r.m.s. must not be exceeded.
2. The "maximum number of cycles in the maximum averaging time" is the maximum integrated number of cycles that a pair of tubes may conduct, with or without interruption, during the maximum averaging time.

   Max. no. of cycles = Duty factor × Max. averaging time × Supply frequency

IGNITOR CHARACTERISTICS, RATINGS AND IGNITION CIRCUITS

Ignitor characteristics

Minimum voltage required for ignition (all tubes)	150	V
Minimum current required for ignition (all tubes)	12	A
Typical current required for ignition	6 to 8	A
Minimum period of application of voltage or current	50	μs

Ignitor ratings (Absolute maximum system)

Maximum peak positive voltage	2.0	kV
Maximum peak negative voltage (including any transients)	5.0	V
Maximum peak forward current	100	A
Maximum peak inverse current	zero	A
Maximum r.m.s. forward current	10	A
Maximum average forward current for maximum averaging time of 5 seconds	1.0	A

Anode excitation circuit requirements

For recommended circuit using two thyristors see figure 1, or for one common thyristor see figure 2.

Minimum peak ignitor voltage for ignition	150	V
Minimum peak ignitor current for ignition	12	A
Minimum rate of rise of ignitor current	0.1	A/μs

$V_{r.m.s.}$	220	250	380	440	500	600	V
R	2	2	4	4.7	5	6	Ω

F_1 2A fast response time fuse

F_2 10A fast response time fuse

Z Silicon voltage regulator diode. Zener voltage ≥ 18V

Separate excitation circuit requirements

For recommended circuit see figure 3.

Capacitor (C)	2.0	8.0	μF
Capacitor voltage (±10%)	650	400	V
Peak value of closed circuit current	80 to 100		A
Maximum ohmic resistance of series inductance (L)	0.2		Ω

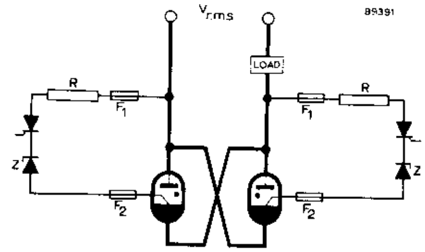


Fig.1: Anode excitation (Two thyristors)

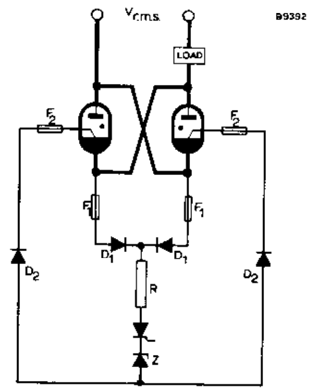


Fig.2. Anode excitation (Common thyristor)

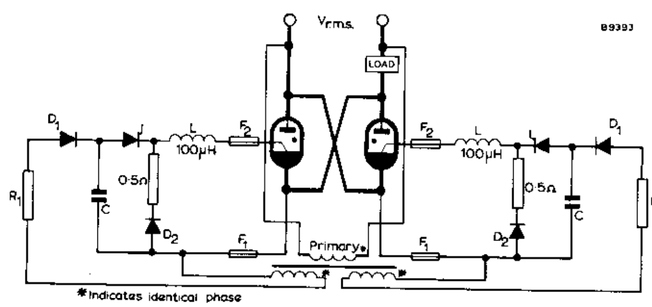


Fig.3: Separate excitation

NOTE

In each circuit the thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

MOUNTING POSITION

The ignitron should be mounted within 3^{o} of vertical, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

When connecting the anode lead, care should be taken not to stress the anode insulator.

COOLING

Characteristics at flow of 5 litres/min ←

Typical maximum pressure drop	0.16	kg/cm^2
	2.2	lb/in^2
Typical maximum temperature rise at maximum average current	6.0	^{o}C

A.C. control service ratings (Absolute maximum system)

Minimum water flow at maximum average current (see graph on page C1)	5.0	l/min
Minimum inlet temperature (see note 1)	10	^{o}C
Maximum inlet temperature (see note 1)	40	^{o}C
Maximum temperature at the thermostat plate (see note 2)	50	^{o}C

NOTES

1. When the cooling systems of two or three tubes are connected in series, the minimum inlet temperature applies to the coldest tube and the maximum inlet temperature applies to the hottest tube.

   The protective thermostat should be mounted on the hottest tube and the water economy thermostat on the tube immediately preceeding the hottest tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.
   Hoses should be of insulating material and the minimum length between tube and tube, or between tube and earth, should be 50cm.

2. The thermostat plate is at the supply voltage.

3. The main casing of the ignitron is made from stainless steel, but care should be taken not to use water with a high mineral content.

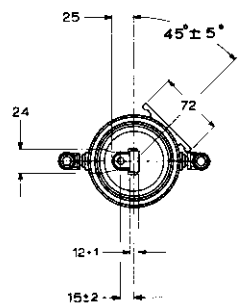
WEIGHT

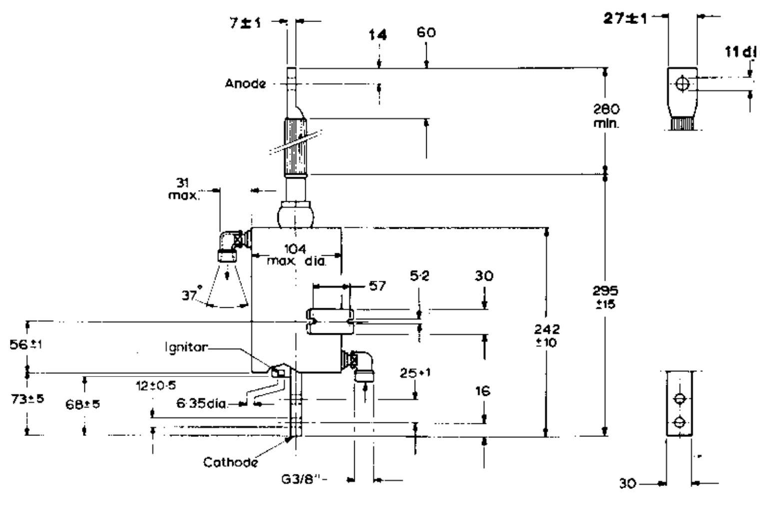
Net weight (approx.)	2.82	kg
Weight of tube in carton (approx.)	4.08	kg

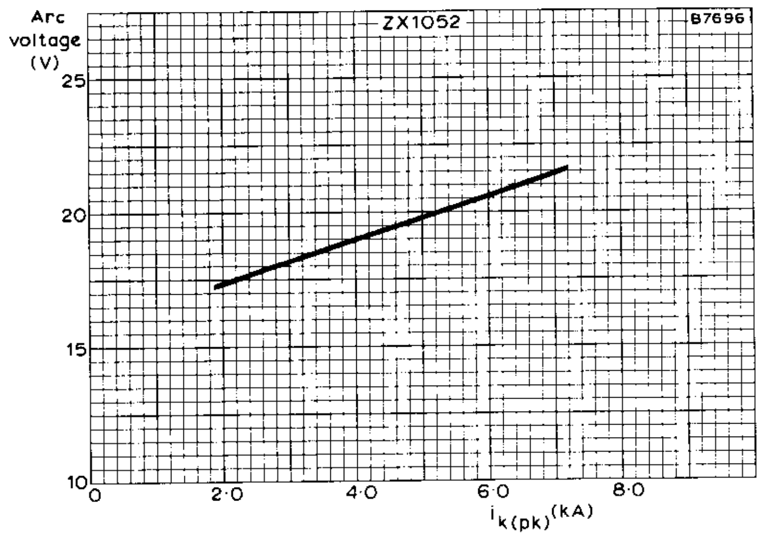
ACCESSORIES

Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

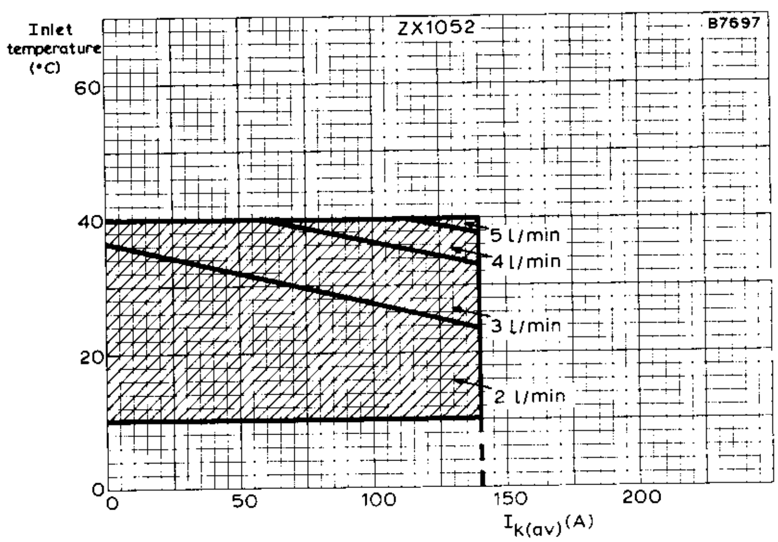
OUTLINE DRAWING OF ZX1052



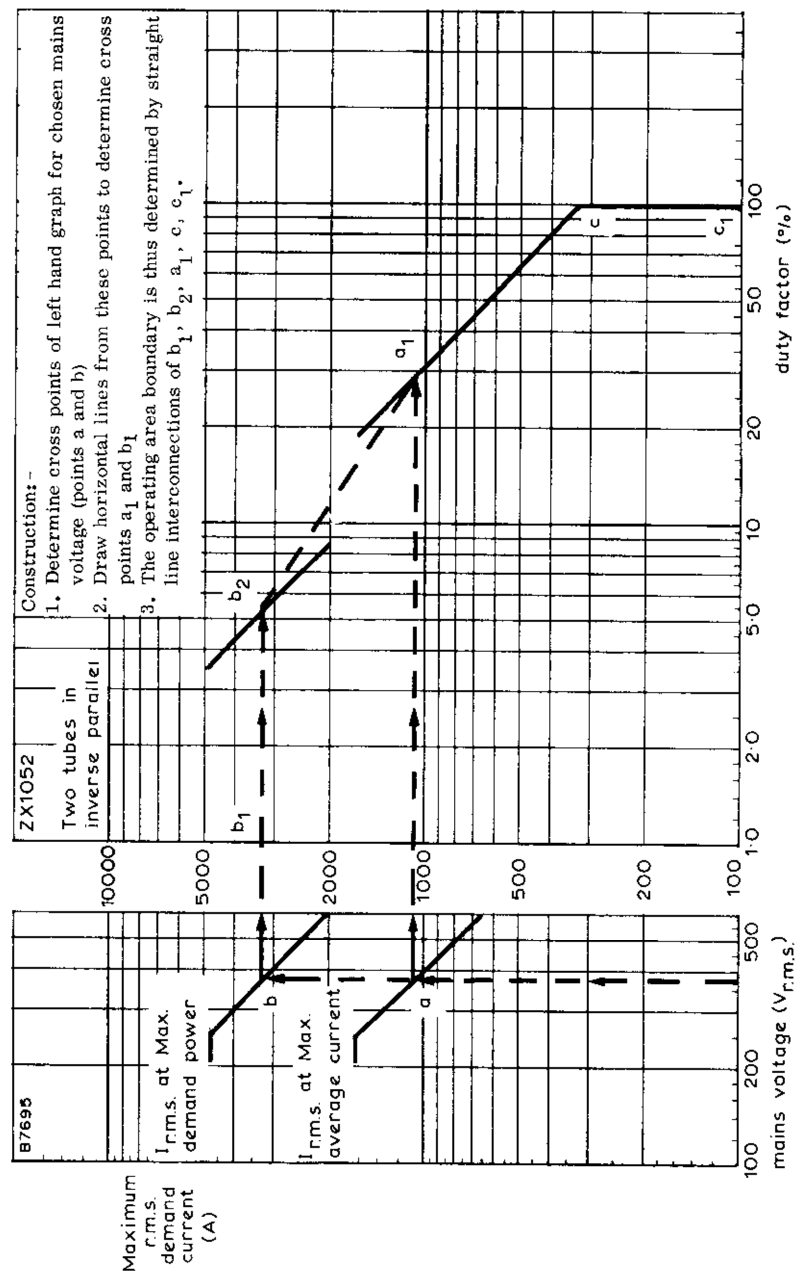




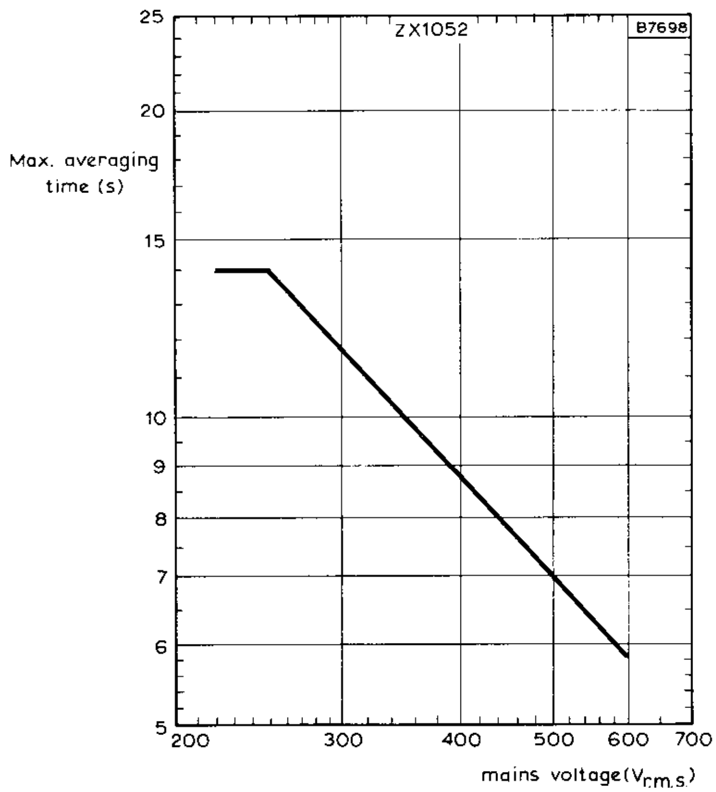
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



MINIMUM REQUIRED CONTINUOUS WATERFLOW
(TWO TUBES COOLED IN SERIES)



GRAPH RELATING DEMAND CURRENT WITH DUTY FACTOR AS A FUNCTION OF THE MAINS VOLTAGE. WELDING SERVICE ONLY



MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE

TENTATIVE DATA

QUICK REFERENCE DATA

Water-cooled ignitron primarily intended for resistance welding and a.c. control applications. The tube has a plastic coated stainless steel water jacket.

International size	D	
Maximum demand power (two tubes in inverse parallel)	2400	kVA
Maximum average current	355	A
Minimum ignitor requirements to fire all tubes		
Peak voltage	200	V
Peak current	15 to 30	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values in each section state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life, with the specified cooling conditions.

Anode and Cathode

See under sections listed in "Full Load Operating Conditions":-

1. Single phase welding service and A.C. control
    a. Maximum demand power
    b. Maximum average current
2. Intermittent rectifier or three phase frequency changer resistance welding service.

Arc voltage drop See graph, page 9

Ignitor

See section "Ignitor characteristics, etc."

FULL LOAD OPERATING CONDITIONS

The figures given in the data are based on full cycle conduction, with equally distributed load on all ignitrons, regardless of whether or not phase delayed firing is used. The load must be limited so that at zero phase delay no overload will result. No allowance has been made for supply voltage or component variations.

SINGLE PHASE WELDING SERVICE AND A.C. CONTROL. Supply frequency 50Hz, two tubes in inverse parallel connection (see graph on page 10).

A. Maximum demand power

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. demand power	2120	2400	2400	2400	2400	2400	kVA
Max. average current per tube	192	192	192	192	192	192	A
Max. r.m.s. demand current	9.6	9.6	6.3	5.5	4.8	4.0	kA
Max. averaging time	11	11	7.3	6.4	5.6	4.6	s
Duty factor	4.4	4.4	6.8	7.8	8.8	10.6	%
Max. number of cycles in max. averaging time	25	25	25	25	25	25	
Integrated r.m.s. load current	2.0	2.0	1.64	1.52	1.42	1.3	kA

B. Maximum average current

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. average current per tube	355	355	355	355	355	355	A
Max. demand power	700	800	800	800	800	800	kVA
Max. r.m.s. demand current	3.2	3.2	2.1	1.85	1.6	1.32	kA
Max. averaging time	11	11	7.3	6.4	5.6	4.6	s
Duty factor	24.6	24.6	37.5	43.0	49.3	60.0	%
Max. number of cycles in max. averaging time	140	140	140	140	140	140	
Integrated r.m.s. load current	1.6	1.6	1.3	1.21	1.13	1.02	kA
Max. surge current for max. 0.15s	27	27	17.8	15.5	13.5	11.2	kA

Notes

1. For supply voltages less than 250Vr.m.s., the values of maximum demand current and maximum averaging time at 250Vr.m.s. must not be exceeded.

2. The "maximum number of cycles in the maximum averaging time" is the maximum integrated number of cycles that a pair of tubes may conduct, with or without interruption, during the maximum averaging time.

   Max. no. of cycles = Duty factor × Max. averaging time × Supply frequency

INTERMITTENT RECTIFIER OR THREE PHASE FREQUENCY CHANGER RESISTANCE WELDING SERVICE. Supply frequency 50Hz (see graph page 11)

Max. peak voltage (forward and inverse)	600	1200	1500	V
For use at max. peak current				
Max. peak current	4.0	3.0	2.4	kA
Max. average current	54	40	32	A
For use at max. average current				
Max. peak current	1140	840	672	A
Max. average current	190	140	112	A
Max. averaging time	6.25	6.25	6.25	s
Max. value of the ratio of average current to peak current (averaging time = 0.5s)	0.17	0.17	0.17	
Max. value of the ratio of surge current to peak current (averaging time = 150ms)	12.5	12.5	12.5	

IGNITOR CHARACTERISTICS, RATINGS AND IGNITION CIRCUITS

Ignitor characteristics

Minimum voltage required for ignition (all tubes)	200	V
Minimum current required for ignition (all tubes)	12	A
Typical current required for ignition	6 to 8	A
Minimum period of application of voltage or current	100	μs

Ignitor ratings (Absolute maximum system)

Maximum peak positive voltage	2.0	kV
Maximum peak negative voltage (including any transients)	5.0	V
Maximum peak forward current	100	A
Maximum peak inverse current	zero	A
Maximum r.m.s. forward current	10	A
Maximum average forward current for maximum averaging time of 5 seconds	1.0	A

*Anode excitation circuit requirements

For recommended circuit using two thyristors see figure 1, or for one common thyristor see figure 2.

Minimum peak ignitor voltage for ignition	200	V
**Minimum peak ignitor current for ignition	15 to 30	A
Minimum rate of rise of ignitor current	0.1	A/μs

$V_{r.m.s.}$	220	250	380	440	500	600	V
R	2	2	4	4.7	5	6	Ω

F_1	2A fast response time fuse
F_2	10A fast response time fuse
Z	Silicon voltage regulator diode. Zener voltage ≥18V

*Separate excitation circuit requirements

For recommended circuit see figure 3

Capacitor (C)	2.0	μF
Capacitor voltage (±10%)	650	V
Peak value of closed circuit current	80 to 100	A
Maximum ohmic resistance of series inductance (L)	0.2	Ω

*In each circuit, the thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

**Higher peak ignitor currents are required at lower anode voltages and lower water inlet temperatures; lower peak ignitor currents are required at higher anode voltages and higher water inlet temperatures.

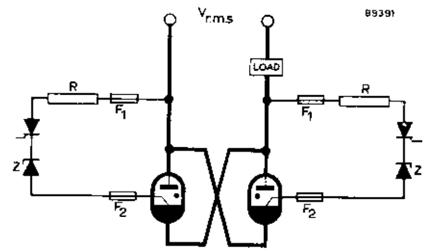


Figure 1:- Anode excitation (two thyristors)

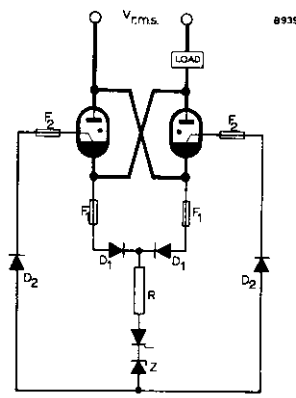


Figure 2:- Anode excitation (common thyristor)

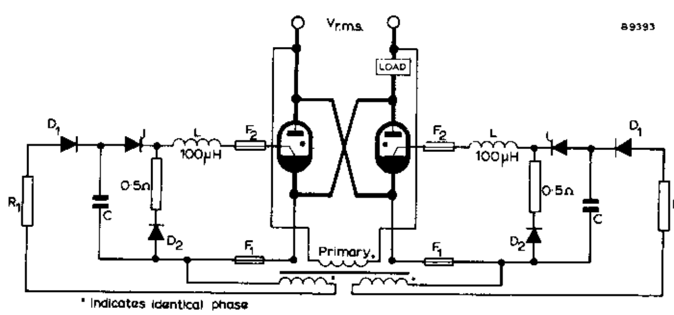


Figure 3:- Separate excitation

MOUNTING POSITION

The ignitron should be mounted within 3^{o} of vertical, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

When connecting the anode lead, care should be taken not to stress the anode insulator.

COOLING

Characteristics at flow of 9 litres/min

Typical maximum pressure drop	0.35 5.0	kg/cm^2 lb/in^2
Typical maximum temperature rise at maximum average current	9.0	^{o}C

A.C. control service ratings (Absolute maximum system)

Minimum water flow at maximum average current	9.0	l/min
Minimum inlet temperature (see note 1)	10	^{o}C
Maximum inlet temperature (see note 1)	40	^{o}C
Maximum temperature at the thermostat plate (see note 2)	50	^{o}C

Intermittent rectifier or three-phase welding service ratings (Absolute maximum system)

Minimum water flow at maximum average current	9.0	l/min
Minimum inlet temperature (see note 1)	10	^{o}C
Maximum inlet temperature (see note 1)	35	^{o}C
Maximum temperature at the thermostat plate (see note 2)	45	^{o}C

NOTES

1. When the cooling systems of two or three tubes are connected in series, the minimum inlet temperature applies to the coldest tube and the maximum inlet temperature applies to the hottest tube.

   The protective thermostat should be mounted on the hottest tube and the water economy thermostat on the tube immediately preceeding the hottest tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.

   Hoses should be of insulating material and the minimum length between tube and tube, or between tube and earth, should be 50cm.

2. The thermostat plate is at the supply voltage.

3. The main casing of the ignitron is made from stainless steel, but care should be taken not to use water with a high mineral content.

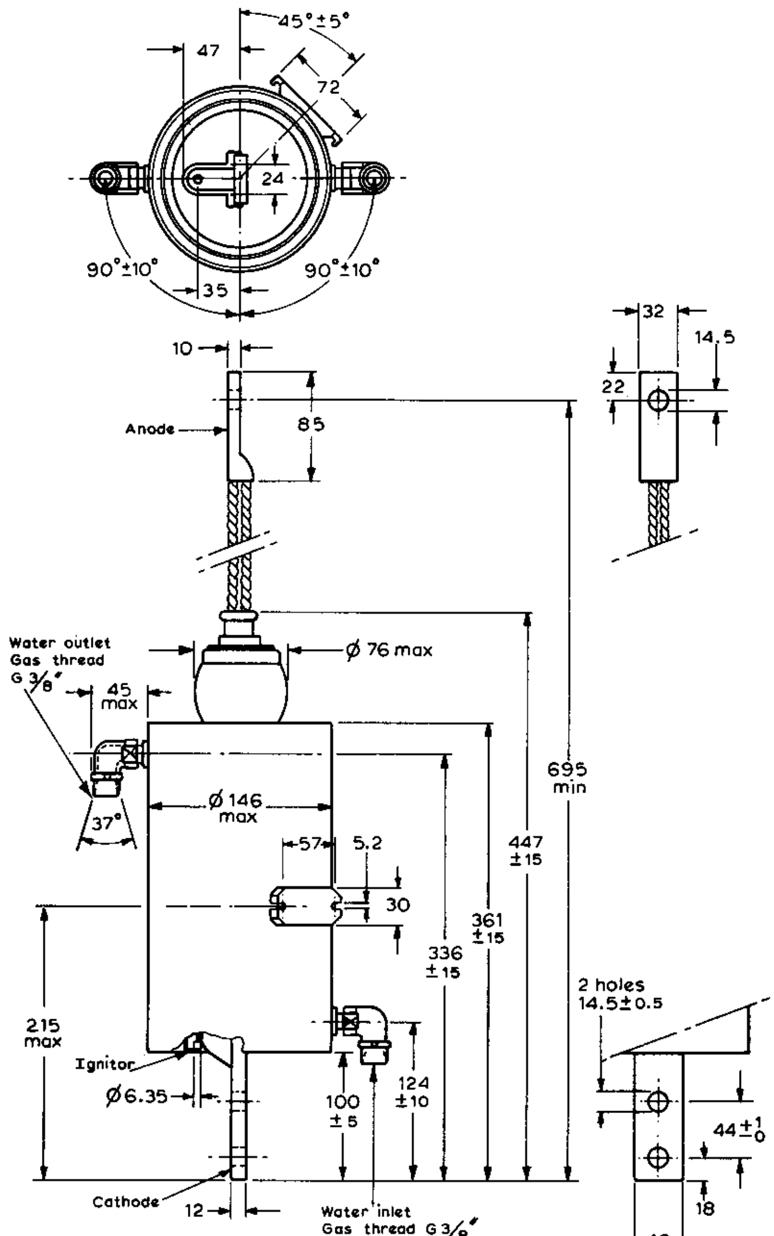
WEIGHT

Net weight (approx.)	8.7	kg
Weight of tube in carton (approx.)	11	kg

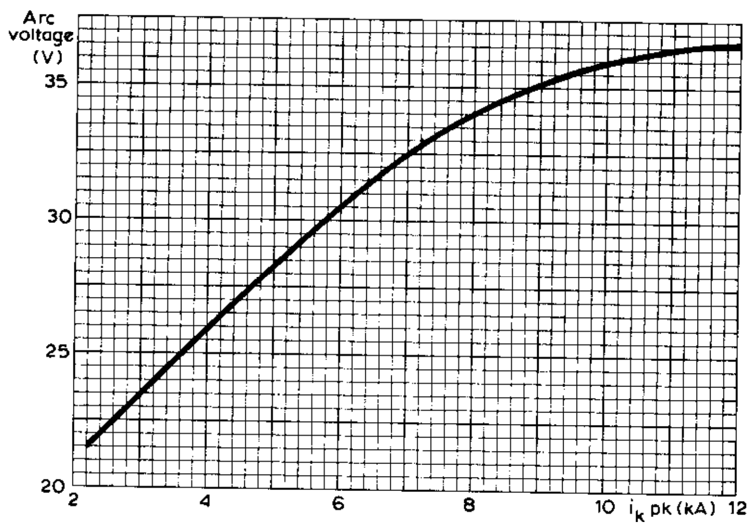
ACCESSORIES

Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
Nipple	TE1051c
Nut	TE1051b

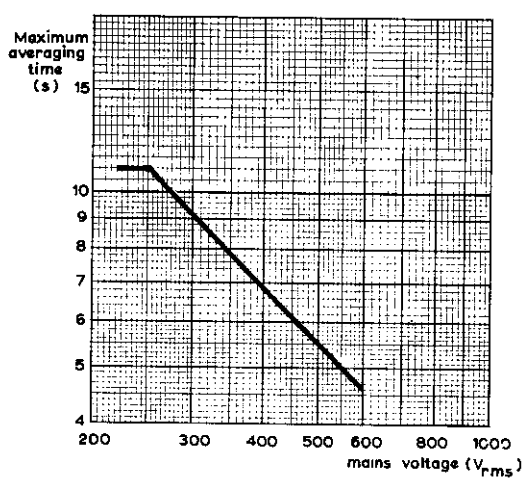
OUTLINE DRAWING
OF ZX1053



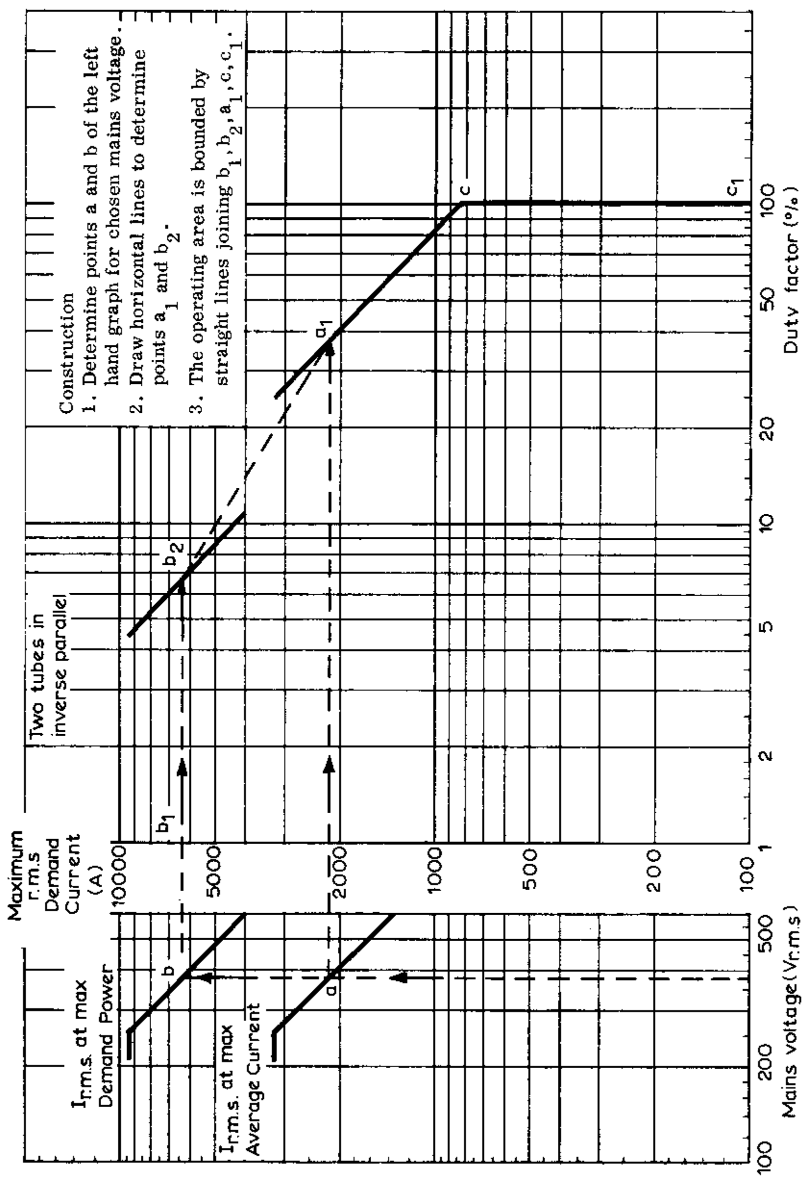
All dimensions in mm



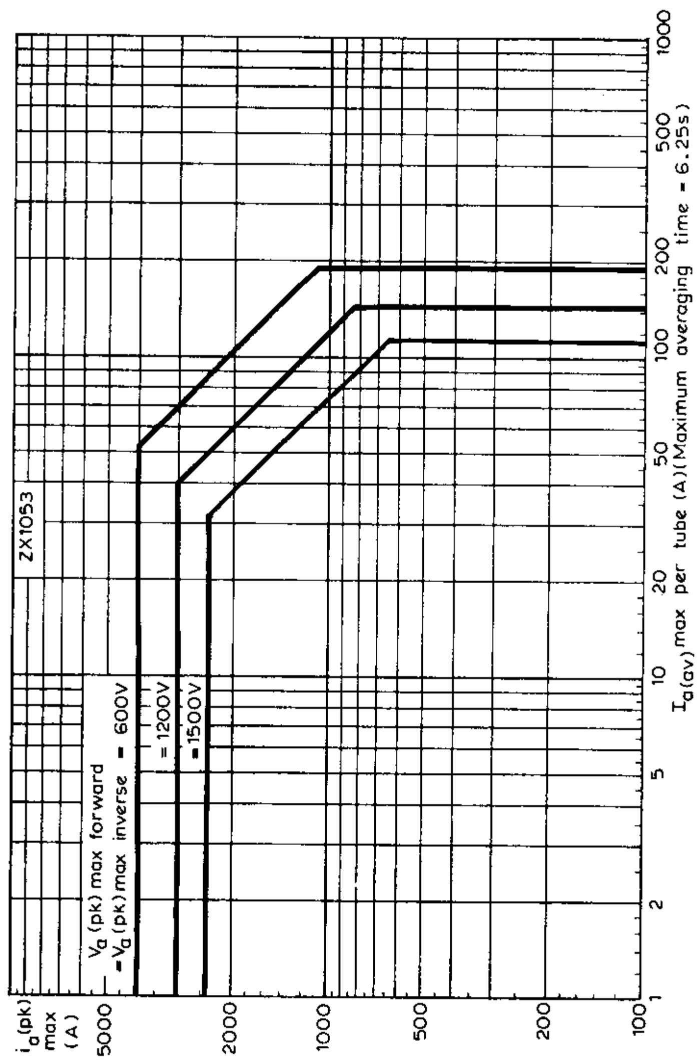
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE



GRAPH RELATING DEMAND CURRENT WITH DUTY FACTOR AS A FUNCTION OF THE MAINS VOLTAGE. WELDING SERVICE ONLY



MAXIMUM PEAK ANODE CURRENT PLOTTED AGAINST AVERAGE ANOLE CURRENT. INTERMITTENT RECTIFIER SERVICE

IGNITRON ZX1061

QUICK REFERENCE DATA		
Water-cooled ignitron primarily intended for resistance welding and a.c. control applications. The tube has a plastic coated stainless steel water jacket.		
International size	B	
Maximum demand power (two tubes in inverse parallel)	1200	kVA
Maximum average current	70	A
Minimum ignitor requirements to fire all tubes		
Peak voltage	150	V
Peak current	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values in each section state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life, with the specified cooling conditions.

Anode and Cathode

See under sections listed in "Full Load Operating Conditions":-

1. Single phase welding service and A.C. control
   a. Maximum demand power
   b. Maximum average current
2. Intermittent rectifier or three phase frequency changer resistance welding service.

Arc voltage drop — See graph, page C1

Ignitor

See section "Ignitor characteristics, etc."

FULL LOAD OPERATING CONDITIONS

The figures given in the data are based on full cycle conduction, with equally distributed load on all ignitrons, regardless of whether or not phase delayed firing is used. The load must be limited so that at zero phase delay no overload will result. No allowance has been made for supply voltage or component variations.

SINGLE PHASE WELDING SERVICE AND A.C. CONTROL. Supply frequency 50Hz, two tubes in inverse parallel connection (see graph on page C2)

A. **Maximum demand power**

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. demand power	550	630	850	950	1050	1200	kVA
Max. average current per tube	38	38	38	38	38	38	A
Max. r.m.s. demand current	2.5	2.5	2.25	2.2	2.1	2.0	kA
Max. averaging time	24	24	15.8	13.6	12	10	s
Duty factor	3.3	3.3	3.8	3.9	4.0	4.2	%
Max. number of cycles in max. averaging time	40	40	30	27	24	21	
Integrated r.m.s. load current	460	460	440	430	420	410	A

B. **Maximum average current**

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. average current per tube	70	70	70	70	70	70	A
Max. demand power	180	210	280	310	350	400	kVA
Max. r.m.s. demand current	850	850	750	720	700	660	A
Max. averaging time	24	24	15.8	13.6	12	10	s
Duty factor	18.3	18.3	20.8	21.5	22.2	23.5	%
Max. number of cycles in max. averaging time	220	220	164	148	134	118	
Integrated r.m.s. load current	360	360	340	334	330	320	A
Max. surge current for max. 0.15s	7.0	7.0	6.3	6.0	5.9	5.6	kA

Notes

1. For supply voltages less than 250Vr.m.s., the values of maximum demand current and maximum averaging time at 250Vr.m.s. must not be exceeded.

2. The "maximum number of cycles in the maximum averaging time" is the maximum integrated number of cycles that a pair of tubes may conduct, with or without interruption, during the maximum averaging time.

   Max. no. of cycles = Duty factor × Max. averaging time × Supply frequency

INTERMITTENT RECTIFIER OR THREE PHASE FREQUENCY CHANGER RESISTANCE WELDING SERVICE. Supply frequency 50Hz (see graph page C3)

Max. peak voltage (forward and inverse)	1.2	1.5	kV
For use at max. peak current			
Max. peak current	1.5	1.2	kA
Max. average current	20	16	A
For use at max. average current			
Max. peak current	420	336	A
Max. average current	70	56	A
Max. averaging time	6.25	6.25	s
Max. value of the ratio of average current to peak current (averaging time = 0.5s)	0.17	0.17	
Max. value of the ratio of surge current to peak current (averaging time = 150ms)	12.5	12.5	

IGNITOR CHARACTERISTICS, RATINGS AND IGNITION CIRCUITS

Ignitor characteristics

Minimum voltage required for ignition (all tubes)	150	V
Minimum current required for ignition (all tubes)	12	A
Typical current required for ignition	6 to 8	A
Minimum period of application of voltage or current	50	μs

Ignitor ratings (Absolute maximum system)

Maximum peak positive voltage	2.0	kV
Maximum peak negative voltage (including any transients)	5.0	V
Maximum peak forward current	100	A
Maximum peak inverse current	zero	A
Maximum r.m.s. forward current	10	A
Maximum average forward current for maximum averaging time of 5 seconds	1.0	A

Anode excitation circuit requirements

For recommended circuit using two thyristors see figure 1, or for one common thyristor see figure 2.

Minimum peak ignitor voltage for ignition	200	V
Minimum peak ignitor current for ignition	12	A
Minimum rate of rise of ignitor current	0.1	A/μs

$V_{r.m.s.}$	220	250	380	440	500	600	V
R	2	2	4	4.7	5	6	Ω

F_1	2A fast response time fuse
F_2	10A fast response time fuse
Z	Silicon voltage regulator diode. Zener voltage≥18V

Separate excitation circuit requirements

For recommended circuit see figure 3

Capacitor (C)	2.0	8.0	μF
Capacitor voltage (±10%)	650	400	V
Peak value of closed circuit current	80 to 100		A
Maximum ohmic resistance of series inductance(L)	0.2		Ω

NOTE

In each circuit, the thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

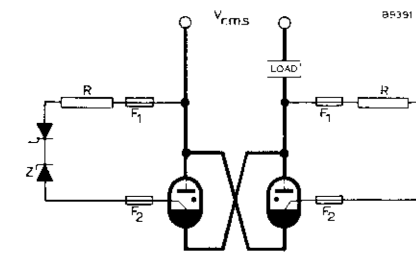


Figure 1:- Anode excitation (two thyristors)

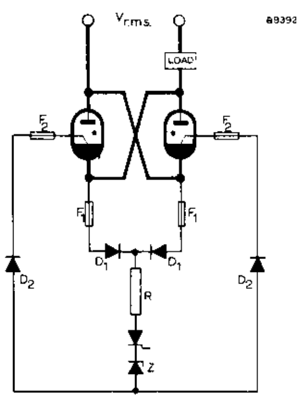


Figure 2:- Anode excitation (common thyristor)

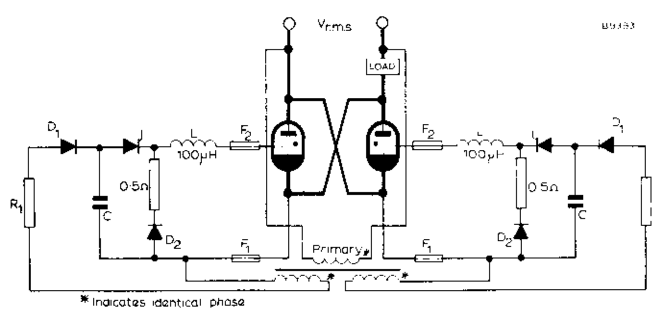


Figure 3:- Separate excitation

MOUNTING POSITION

The ignitron should be mounted within 3° of vertical, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

When connecting the anode lead, care should be taken not to stress the anode insulator.

COOLING

Characteristics at flow of 3 litres/min

Typical maximum pressure drop	0.1 1.4	kg/cm^2 lb/in^2
Typical maximum temperature rise at maximum average current	5.5	°C

A.C. control service ratings (Absolute maximum system)

Minimum water flow at maximum average current (see graph on page C1)	3.0	l/min
Minimum inlet temperature (see note 1)	10	°C
Maximum inlet temperature (see note 1)	40	°C
Maximum temperature at the thermostat plate (see note 2)	50	°C

Intermittent rectifier or three-phase welding service ratings (Absolute maximum system)

Minimum water flow at maximum average current (see graph page C1)	4.0	l/min
Minimum inlet temperature (see note 1)	10	°C
Maximum inlet temperature (see note 1)	35	°C
Maximum temperature at the thermostat plate (see note 2)	45	°C

NOTES

1. When the cooling systems of two or three tubes are connected in series, the minimum inlet temperature applies to the coldest tube and the maximum inlet temperature applies to the hottest tube.

   The protective thermostat should be mounted on the hottest tube and the water economy thermostat on the tube immediately preceeding the hottest tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.

   Hoses should be of insulating material and the minimum length between tube and tube, or between tube and earth, should be 50cm.

2. The thermostat plate is at the supply voltage.

3. The main casing of the ignitron is made from stainless steel, but care should be taken not to use water with a high mineral content.

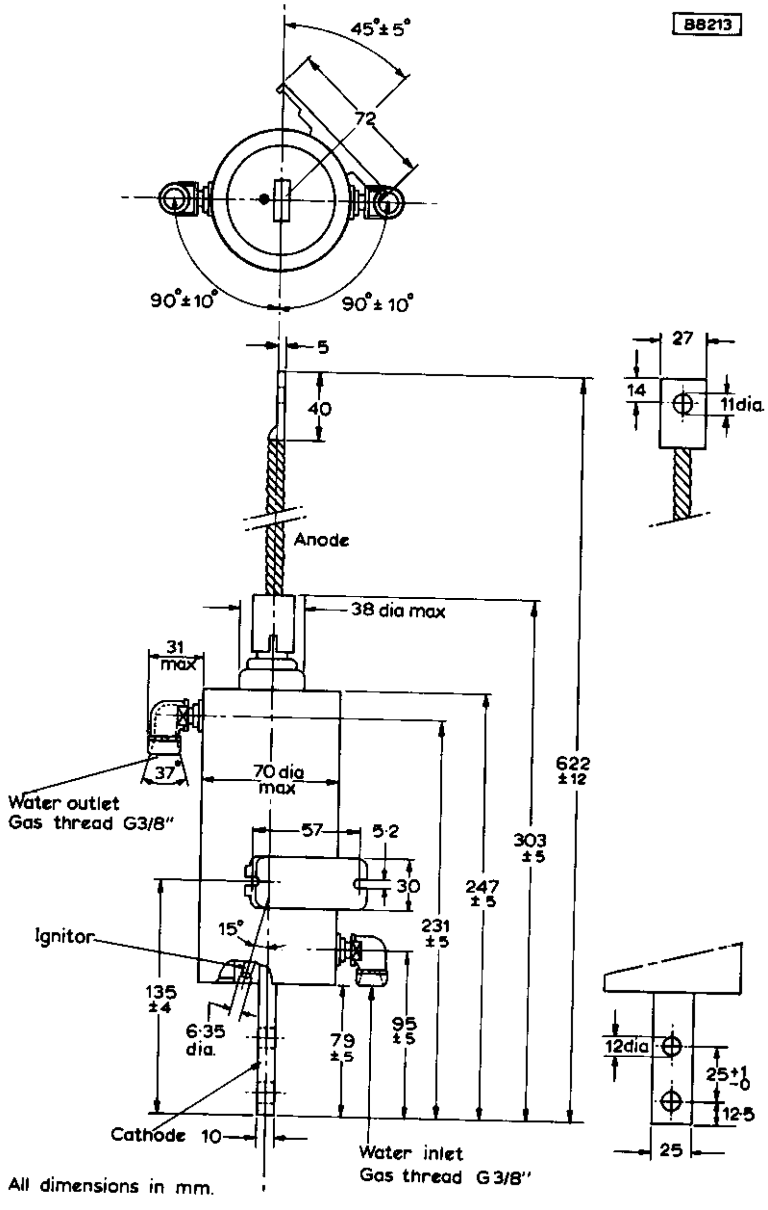
WEIGHT

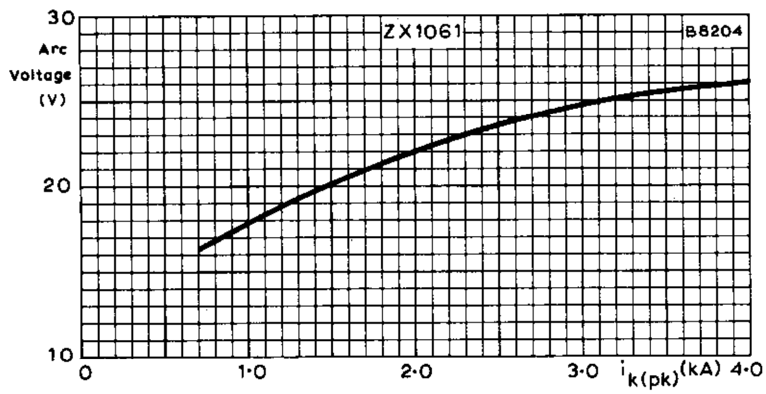
Net weight (approx.)	1.66	kg
Weight of tube in carton (approx.)	2.28	kg

ACCESSORIES

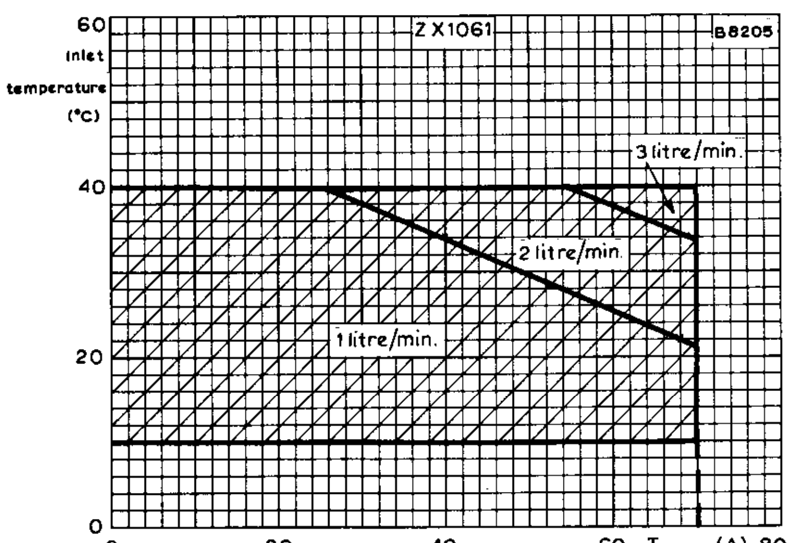
Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
Nipple	TE1051C
Nut	TE1051B

OUTLINE DRAWING
OF ZX1061

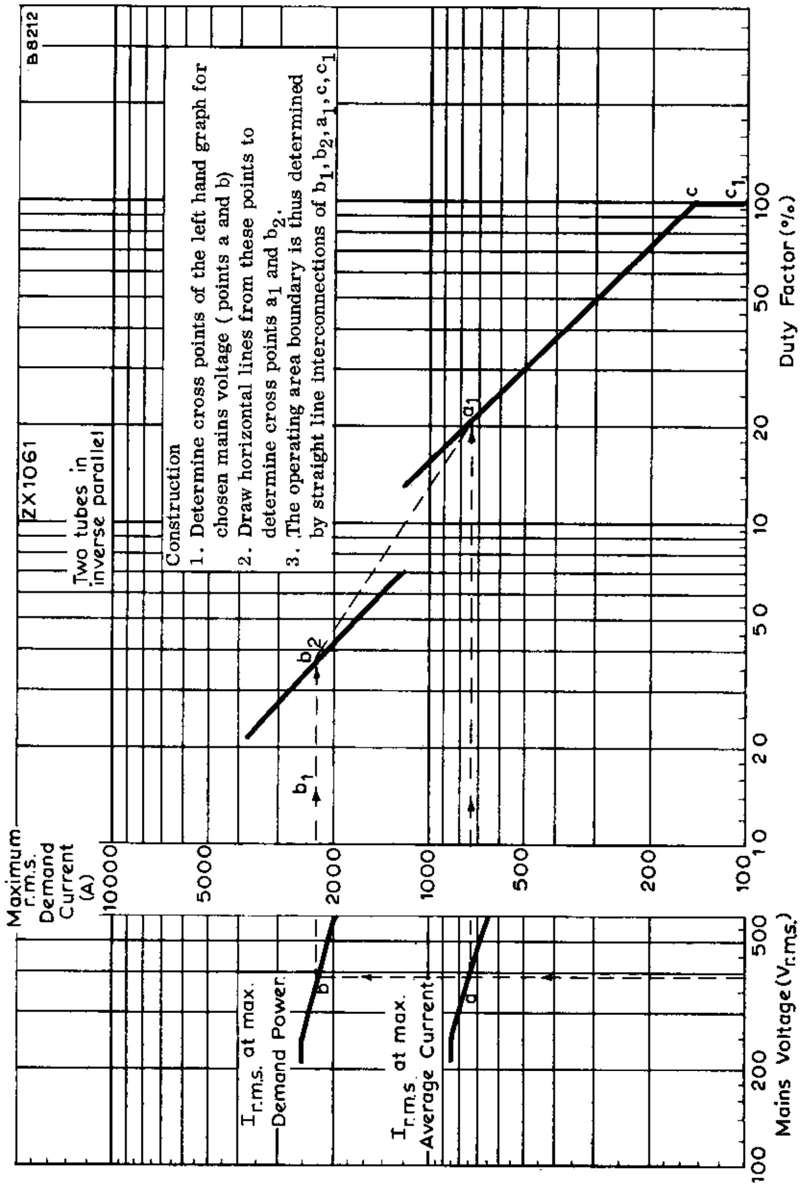




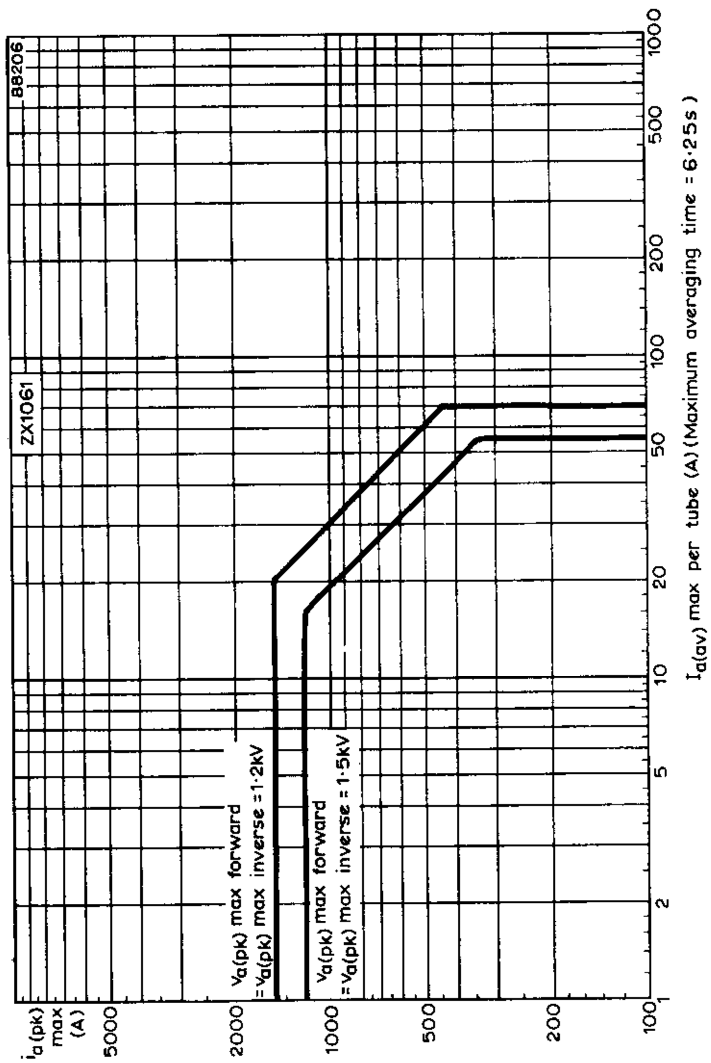
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



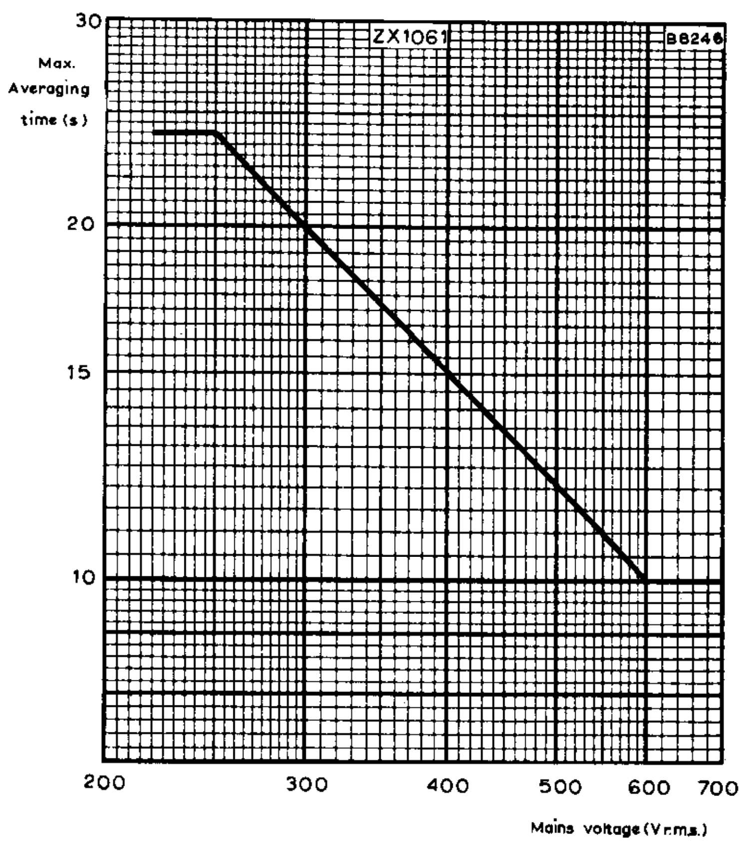
MINIMUM REQUIRED CONTINUOUS WATERFLOW
(TWO TUBES COOLED IN SERIES)



GRAPH RELATING DEMAND CURRENT WITH DUTY FACTOR AS A FUNCTION OF THE MAINS VOLTAGE. WELDING SERVICE ONLY



MAXIMUM PEAK ANODE CURRENT PLOTTED AGAINST AVERAGE ANODE CURRENT. INTERMITTENT RECTIFIER SERVICE



MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE

IGNITRON ZX1062

QUICK REFERENCE DATA		
Water-cooled ignitron primarily intended for resistance welding and a.c. control applications. The tube has a plastic coated stainless steel water jacket.		
International size	Uprated C	
Maximum demand power (two tubes in inverse parallel)	2300	kVA
Maximum average current	180	A
Minimum ignitor requirements to fire all tubes		
Peak voltage	150	V
Peak current	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values in each section state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life, with the specified cooling conditions.

Anode and Cathode

See under sections listed in "Full Load Operating Conditions":-

Single phase welding service and A.C. control
a. Maximum demand power
b. Maximum average current

Arc voltage drop — See graph, page C1

Ignitor

See section "Ignitor characteristics, etc."

FULL LOAD OPERATING CONDITIONS

The figures given in the data are based on full cycle conduction, with equally distributed load on all ignitrons, regardless of whether or not phase delayed firing is used. The load must be limited so that at zero phase delay no overload will result. No allowance has been made for supply voltage or component variations.

SINGLE PHASE WELDING SERVICE AND A.C. CONTROL. Supply frequency 50Hz, two tubes in inverse parallel connection (see graph on page C2)

A. Maximum demand power

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. demand power	1000	1250	1650	1820	2000	2300	kVA
Max. average current per tube	110	110	110	110	110	110	A
Max. r.m.s. demand current	5.0	5.0	4.35	4.2	4.0	3.8	kA
Max. averaging time	21	21	13.8	11.8	10.5	8.7	s
Duty factor	4.9	4.9	5.6	5.8	6.1	6.4	%
Max. number of cycles in max. averaging time	51	51	38	35	32	27	
Integrated r.m.s. load current	1100	1100	1030	1010	990	970	A

B. Maximum average current

Supply voltage (r.m.s.)	220	250	380	440	500	600	V
Max. average current per tube	180	180	180	180	180	180	A
Max. demand power	340	415	550	610	670	760	kVA
Max. r.m.s. demand current	1.65	1.65	1.45	1.40	1.33	1.27	kA
Max. averaging time	21	21	13.8	11.8	10.5	8.7	s
Duty factor	24.2	24.2	27.2	28.5	30.0	31.4	%
Max. number of cycles in max. averaging time	254	254	190	171	157	136	
Integrated r.m.s. load current	810	810	760	745	730	710	A
Max. surge current for max. 0.15s	14.0	14.0	12.2	11.8	11.2	10.6	kA

Notes

1. For supply voltages less than 250V r.m.s., the values of maximum demand current and maximum averaging time at 250V r.m.s. must not be exceeded.
2. The "maximum number of cycles in the maximum averaging time" is the maximum integrated number of cycles that a pair of tubes may conduct, with or without interruption, during the maximum averaging time.

   Max. no. of cycles = Duty factor × Max. averaging time × Supply frequency

IGNITOR CHARACTERISTICS, RATINGS AND IGNITION CIRCUITS

Ignitor characteristics

Minimum voltage required for ignition (all tubes)	150	V
Minimum current required for ignition (all tubes)	12	A
Typical current required for ignition	6 to 8	A
Minimum period of application of voltage or current	50	µs

Ignitor ratings (Absolute maximum system)

Maximum peak positive voltage	2.0	kV
Maximum peak negative voltage (including any transients)	5.0	V
Maximum peak forward current	100	A
Maximum peak inverse current	zero	A
Maximum r.m.s. forward current	10	A
Maximum average forward current for maximum averaging time of 5 seconds	1.0	A

Anode excitation circuit requirements

For recommended circuit using two thyristors see figure 1, or for one common thyristor see figure 2.

Minimum peak ignitor voltage for ignition	150	V
Minimum peak ignitor current for ignition	12	A
Minimum rate of rise of ignitor current	0.1	A/µs

$V_{r.m.s.}$	220	250	380	440	500	600	V
R	2	2	4	4.7	5	6	Ω

F_1 — 2A fast response time fuse

F_2 — 10A fast response time fuse

Z — Silicon voltage regulator diode. Zener voltage ≥ 18V

Separate excitation circuit requirements

For recommended circuit see figure 3.

Capacitor (C)	2.0	8.0	µF
Capacitor voltage (± 10%)	650	400	V
Peak value of closed circuit current	80 to 100		A
Maximum ohmic resistance of series inductance (L)	0.2		Ω

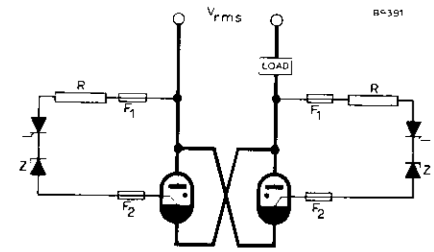


Fig.1: Anode excitation (Two thyristors)

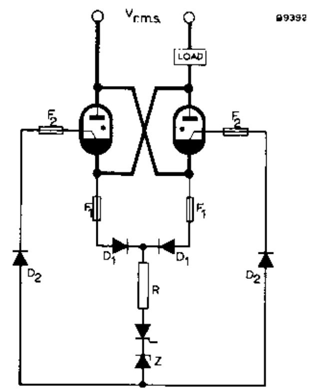


Fig.2: Anode excitation (Common thyristor)

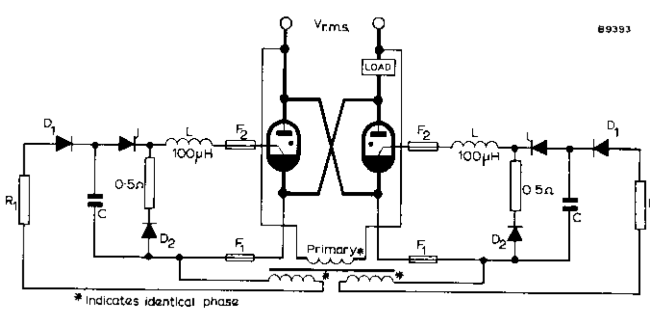


Fig.3: Separate excitation

NOTE

In each circuit the thyristor or combination of thyristor and voltage regulator diode may be replaced by a thyratron.

MOUNTING POSITION

The ignitron should be mounted within 3° of vertical, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

When connecting the anode lead, care should be taken not to stress the anode insulator.

COOLING

Characteristics at flow of 6 litres/min

Typical maximum pressure drop	0.2 2.8	kg/cm^2 lb/in^2
Typical maximum temperature rise at maximum average current	6.0	°C

A.C. control service ratings (Absolute maximum system)

Minimum water flow at maximum average current (see graph on page C1)	6.0	l/min
Minimum inlet temperature (see note 1)	10	°C
Maximum inlet temperature (see note 1)	40	°C
Maximum temperature at the thermostat plate (see note 2)	50	°C

NOTES

1. When the cooling systems of two or three tubes are connected in series, the minimum inlet temperature applies to the coldest tube and the maximum inlet temperature applies to the hottest tube.

   The protective thermostat should be mounted on the hottest tube and the water economy thermostat on the tube immediately preceeding the hottest tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.
   Hoses should be of insulating material and the minimum length between tube and tube, or between tube and earth, should be 50cm.

2. The thermostat plate is at the supply voltage.

3. The main casing of the ignitron is made from stainless steel, but care should be taken not to use water with a high mineral content.

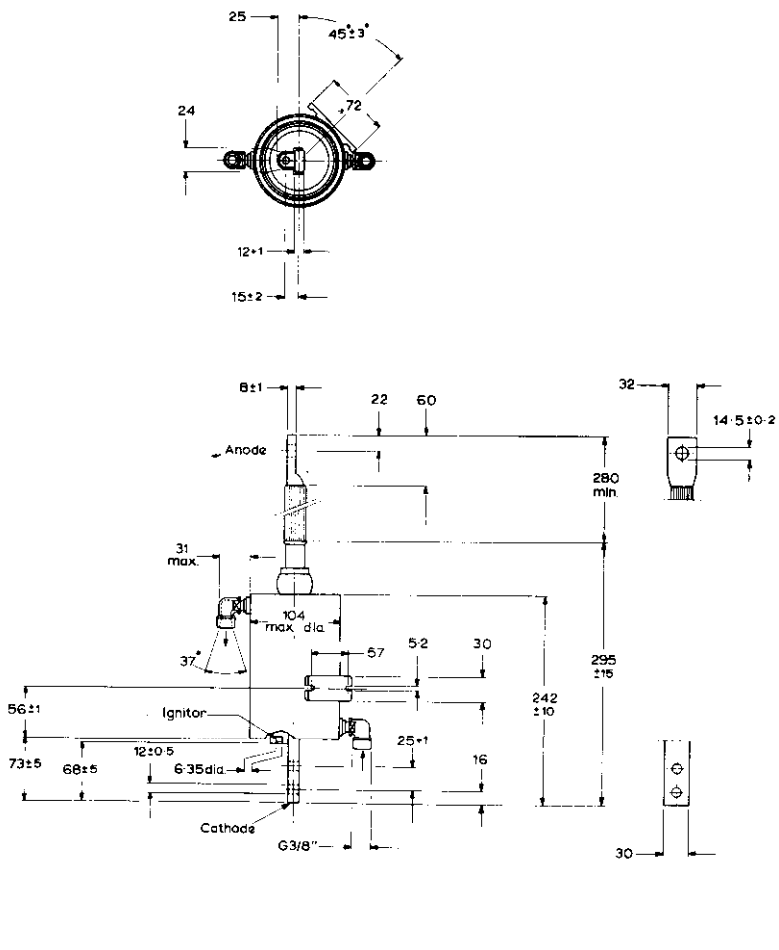
WEIGHT

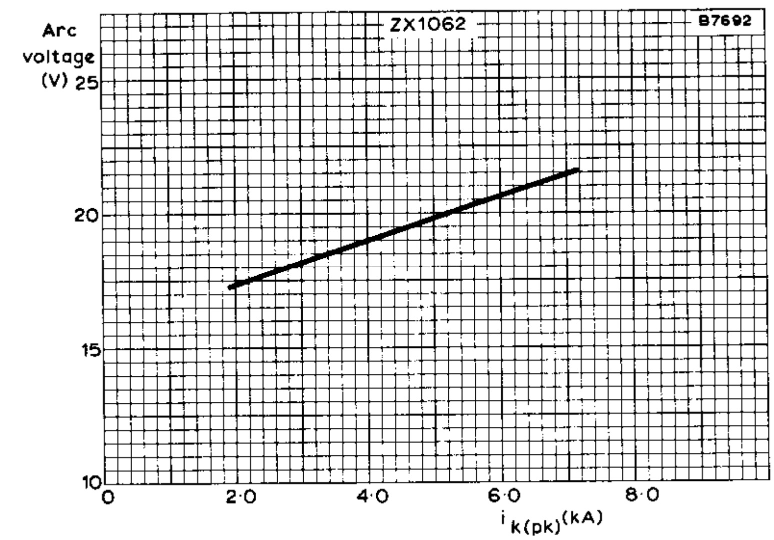
Net weight (approx.)	2.90	kg
Weight of tube in carton (approx.)	4.16	kg

ACCESSORIES

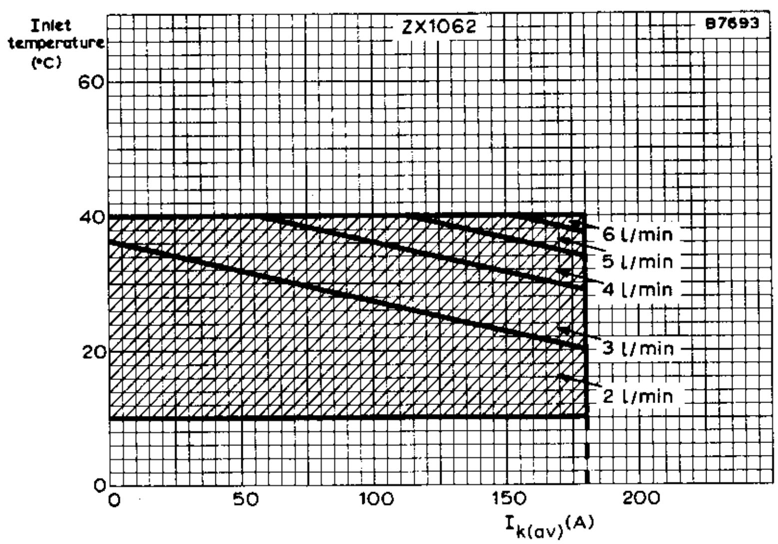
Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

OUTLINE DRAWING OF ZX1062

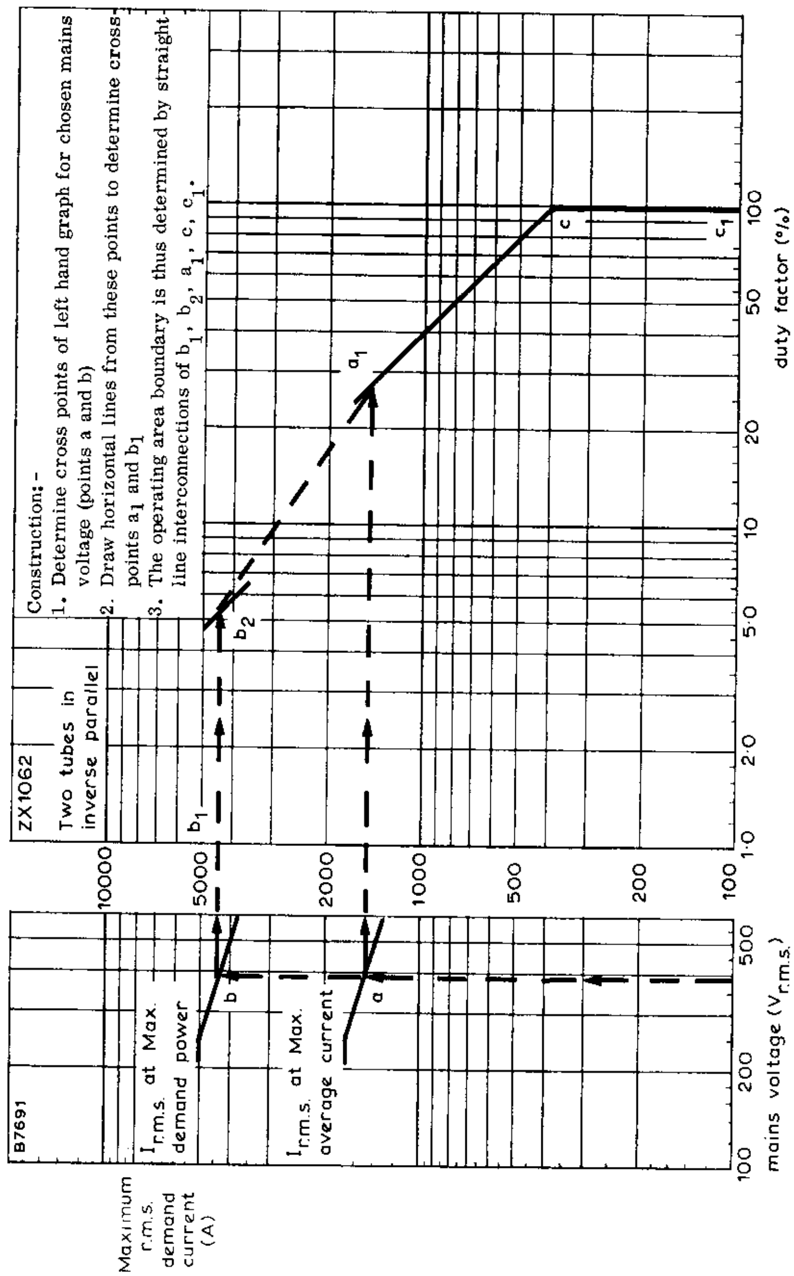




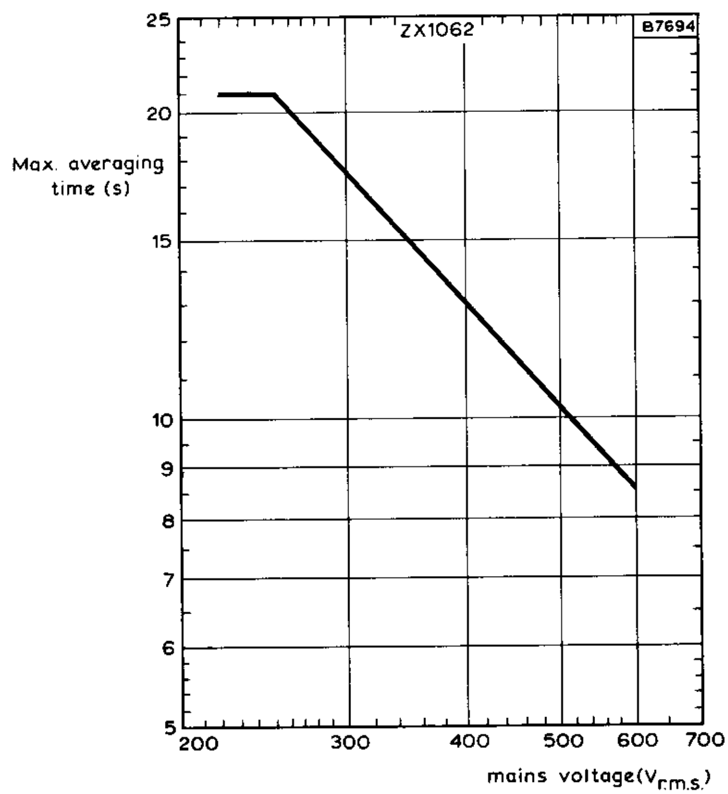
TYPICAL ARC VOLTAGE PLOTTED AGAINST CATHODE CURRENT



MINIMUM REQUIRED CONTINUOUS WATERFLOW
(TWO TUBES COOLED IN SERIES)



GRAPH RELATING DEMAND CURRENT WITH DUTY FACTOR AS A FUNCTION OF THE MAINS VOLTAGE. WELDING SERVICE ONLY



MAXIMUM AVERAGING TIME PLOTTED AGAINST MAINS VOLTAGE

QUICK REFERENCE DATA (Maximum values)			
Water-cooled ignitrons primarily intended for resistance welding and a.c. control applications.			
	5551A	5552A	
International size	B	C	
Peak anode voltage	1.5	0.85	kV
Cathode current			
Peak	3.4	6.75	kA
Average	56	140	A
Demand kVA (two tubes in inverse parallel)	600	1200	kVA
Ignitor requirements			
Peak voltage	200	200	V
Peak current	12	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes, both initially and during life.

Anode

Maximum anode supply voltage	See table in 'Full Load Operating Conditions'	
Minimum instantaneous positive anode voltage for ignitor to anode transfer	40	V
Arc voltage drop (approx.)	12	V
Minimum instantaneous cathode current for initiation of anode conduction	10	A
Minimum instantaneous cathode current to maintain anode conduction	5	A

Cathode

See table in 'Full Load Operating Conditions'.

Ignitor

Minimum voltage required for ignition	200	V
Minimum current required for ignition	12	A
Minimum period of application of voltage or current	100	µs
Recommended circuit for anode excitation	See page D2	
Recommended circuit for separate excitation	See page D3	

Mechanical

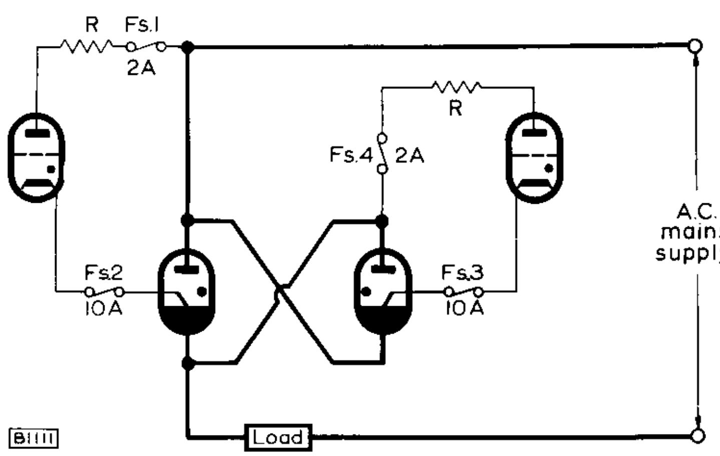
	5551A	5552A	
Type of cooling (see note 1)			water
Maximum quoted pressure drop at minimum flow	1.85	5	lb/in^2
Typical maximum temperature rise	4	4	°C
Minimum inlet temperature	10	10	°C
Recommended mounting position	vertical, with anode up		
Net weight (approx.)	4.5	8	lb
	2	3.6	kg
Weight of tube in carton (approx.)	6	11	lb
	2.7	5	kg

Accessories

Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

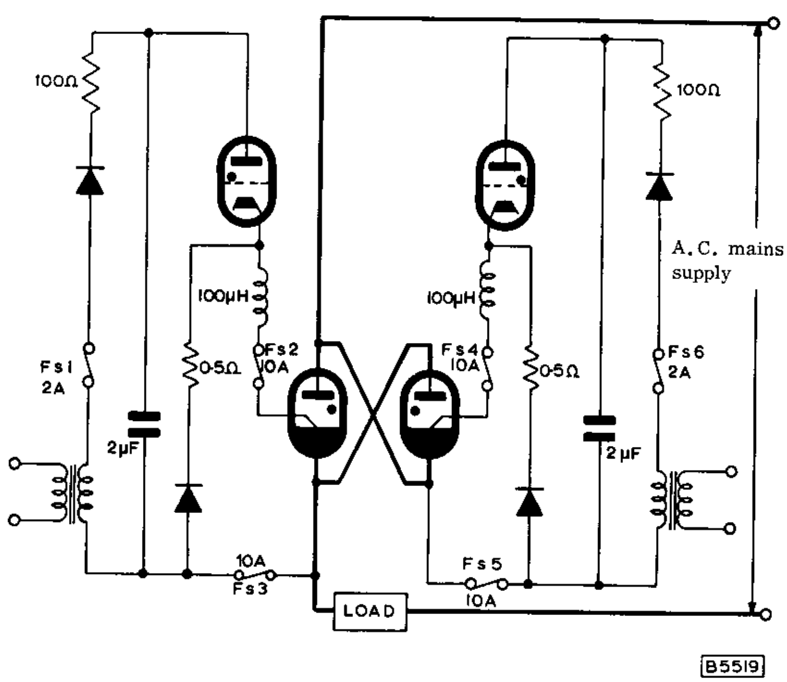
RECOMMENDED CIRCUITS

Anode excitation



Mains voltage (V r.m.s.)	R (Ω)
220 to 250	2
380 to 440	4
500	5
600	6

Separate excitation



Peak closed circuit current	80 to 100	A
Capacitor operating voltage	650 ± 50	V
Maximum ohmic resistance of series inductance	0.2	Ω

FULL LOAD OPERATING CONDITIONS

The figures given in this data are based on full cycle conduction, regardless of whether or not phase delayed firing is used. No allowance has been made for supply voltage or component variations.
Single phase a.c. control, supply frequency 25 to 60c/s (see graphs on pages C1 and C2).

	5551A		5552A	
r.m.s. supply voltage (V_b)	220	to	600	V

FOR USE AT MAXIMUM DEMAND

	5551A	5552A	
Maximum demand			
V_b = 250 to 600V	600	1200	kVA
V_b < 250V	530	1060	kVA
Maximum average current per tube	30.2	75.6	A
Maximum conduction period	0.5	0.5	s

FOR USE AT MAXIMUM AVERAGE CURRENT

	5551A	5552A	
Maximum average current per tube	56	140	A
Maximum demand			
V_b = 250 to 600V	200	400	kVA
V_b < 250V	180	350	kVA

V_b VOLTS	5551A		5552A	
	t_{av} max. in seconds	I_{surge} max. (t max. = 150ms) kA	t_{av} max. in seconds	I_{surge} max. (t max. = 150ms) kA
220	18	6.7	14	13.4
250	18	6.7	14	13.4
380	11.8	4.4	9.4	8.8
440	10.2	3.8	8.0	7.6
550	9.0	3.3	7.0	6.7
600	7.5	2.8	5.8	5.6

INTERMITTENT RECTIFIER OR THREE PHASE FREQUENCY CHANGER RESISTANCE WELDING SERVICE, SUPPLY FREQUENCY 50 to 60c/s (see graphs on page C3).

	5551A		
Maximum peak voltage (forward and inverse)	1.2	1.5	kV
For use at maximum peak current			
Maximum peak current	600	480	A
Maximum average current	5	4	A
For use at maximum average current			
Maximum peak current	135	108	A
Maximum average current	22.5	18.0	A
Maximum averaging time	10	10	s
Maximum value of the ratio of average current to peak current (averaging time = 0.2s)	0.166	0.166	
Maximum value of the ratio of surge current to peak current (averaging time = 150ms)	12.5	12.5	

RECTIFIER SERVICE	5552A	
Maximum peak voltage (forward and inverse)	500	V
Maximum peak anode current	1600	A
Maximum average anode current	100	A
Surge current (averaging time = 150ms)	6.7	kA
Maximum averaging time	6	s

ABSOLUTE MAXIMUM RATINGS

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual tube operating conditions.
The values given in this section are based on full cycle conduction without phase delay, regardless of whether or not phase control is used.

	5551A	5552A	
Anode and cathode			
Maximum peak voltage (forward and inverse)	1.5	0.85	kV
Maximum anode current			
Peak (see page C3)			
Average (continuous) (see pages C1, C2 and C3)	56	140	A
Surge (fault protection only, maximum duration = 150ms)	6	13	kA
Maximum demand (two tubes connected in inverse parallel) (see pages C1 and C2)	600	1200	kVA
Ignitor			
Maximum peak positive voltage = maximum peak anode voltage	1.5	1.5	kV
Maximum peak negative voltage	5	5	V
Maximum peak forward current	100	100	A
Maximum r.m.s. current	10	10	A
Maximum average current (maximum averaging time = 5s)	1	1	A
Minimum rate of rise of ignitor current for ignition within 100μs	0.12	0.12	A/μs

Cooling

	5551A	5552A	
Minimum flow at maximum demand and/or maximum average current	0.9	1.32	gal/min
	4	6	l/min
Maximum pressure within envelope	45	45	lb/in^2
Maximum inlet temperature			
Single phase a.c. control	40	40	^{o}C
Intermittent rectifier or three phase welding service	35	35	^{o}C

	5551A	5552A	
Maximum temperature at thermostat plate (see note 4)			
A.C. control service			
220 to 250V r.m.s. supply	55	55	°C
380 to 500V r.m.s. supply	50	50	°C
500 to 600V r.m.s. supply	45	45	°C
Intermittent rectifier and three phase welding service	45	45	°C

OPERATING NOTES

1. When the cooling systems of two or three tubes are connected in series, the maximum inlet temperature of the hottest tube must not be exceeded and the minimum must be met at the coldest tube. In general, the water economy thermostat should be mounted on the last but one and the protective thermostat on the last tube.

   In three phase welding service using six tubes, not more than three tubes should be cooled in series.

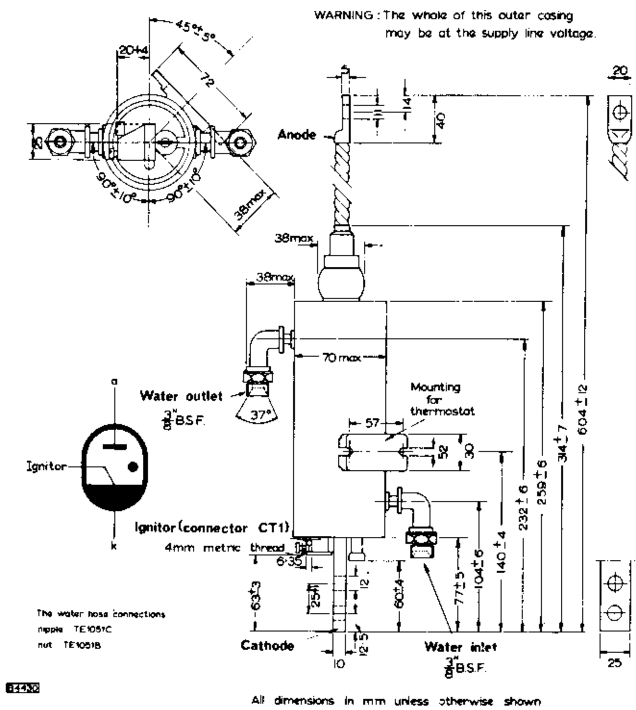
   Hoses should be of insulating material and the minimum length between tube and tube, or tube and earth, should be 18 inches.

2. The ignitron should be mounted vertically, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

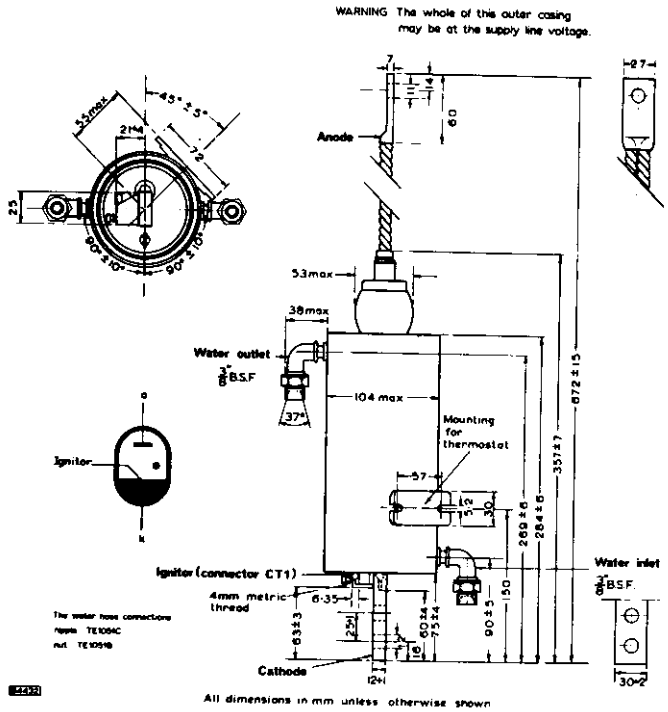
   When connecting the anode lead, care should be taken not to stress the anode insulator.

3. The main casing of the ignitron is made from stainless steel but care should be taken not to use water with a high mineral content.

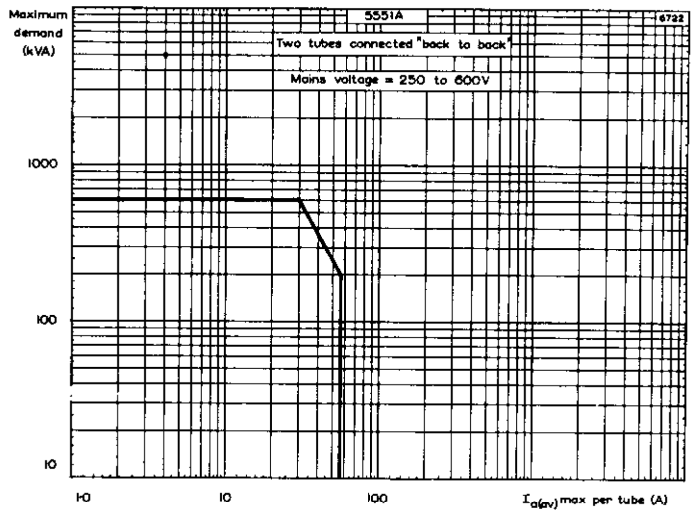
4. The thermostat plate may be at the supply line voltage.

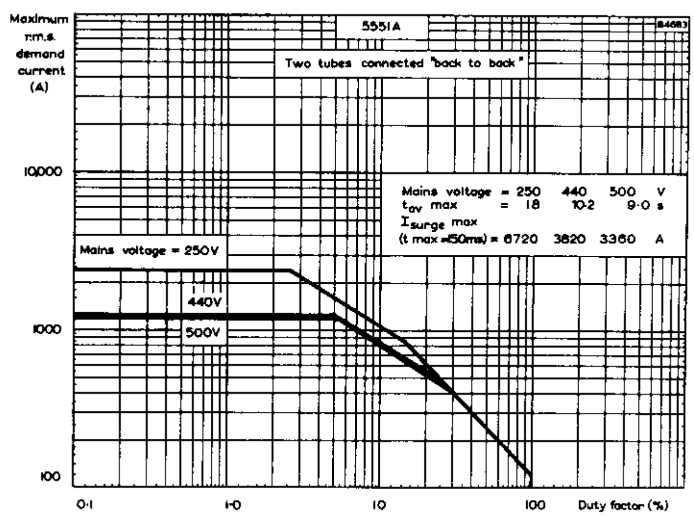


OUTLINE DRAWING FOR 5551A

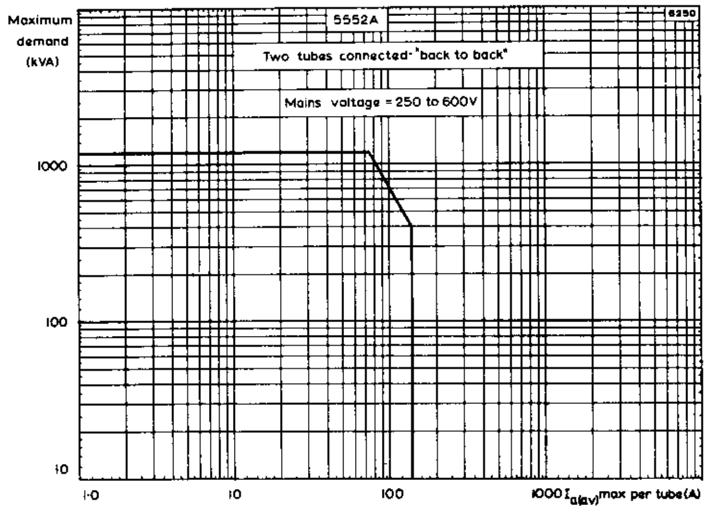


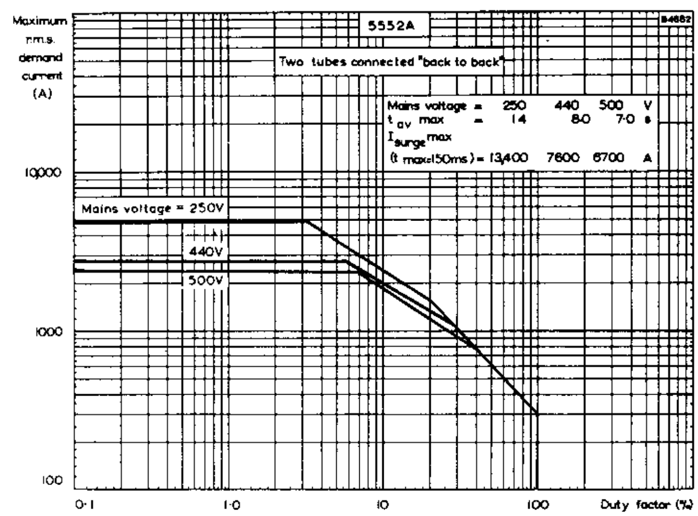
OUTLINE DRAWING FOR 5552A



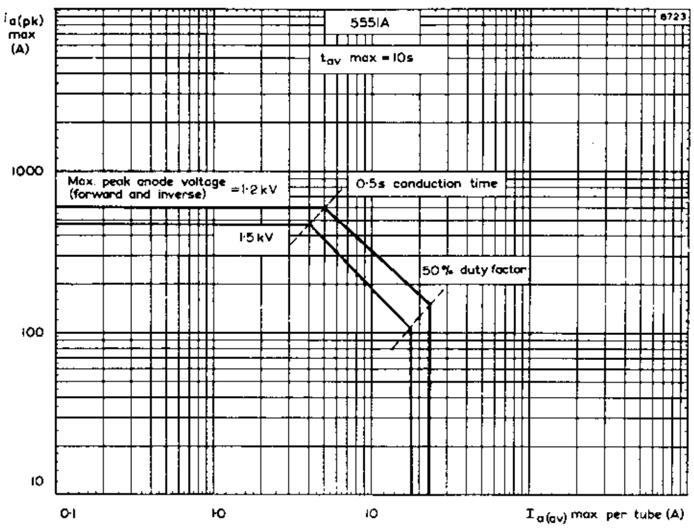


THESE GRAPHS SHOW LIMITING VALUES FOR A.C. CONTROL FOR 5551A.
THEY ARE NOT TO BE USED FOR FREQUENCY CHANGING SERVICE





THESE GRAPHS SHOW LIMITING VALUES FOR A.C. CONTROL FOR 5552A.
THEY ARE NOT TO BE USED FOR FREQUENCY CHANGING SERVICE



THREE PHASE FREQUENCY CHANGING DUTY - 5551A

IGNITRON 5553B

QUICK REFERENCE DATA (Maximum values)		
Water-cooled ignitron primarily intended for resistance welding and a.c. control applications.		
International size	D	
Peak anode voltage	1.5	kV
Cathode current		
Peak	13.5	kA
Average	355	A
Demand kVA (two tubes in inverse parallel)	2400	kVA
Ignitor requirements		
Peak voltage	200	V
Peak current	12	A

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations. The values given apply to all tubes both initially and during life.

Anode

Maximum anode supply voltage	See table in 'Full Load Operating Conditions'	
Minimum instantaneous positive anode voltage for ignitor to anode transfer	40	V
Arc voltage drop (approx.)	12	V
Minimum instantaneous cathode current for initiation of anode conduction	10	A

Cathode

See table in 'Full Load Operating Conditions'.

Ignitor

Minimum voltage required for ignition	200	V
Minimum current required for ignition	30	A
Minimum period of application of voltage or current	100	μs
Recommended circuit for anode excitation	See page D2	
Recommended circuit for separate excitation	See page D3	

Mechanical

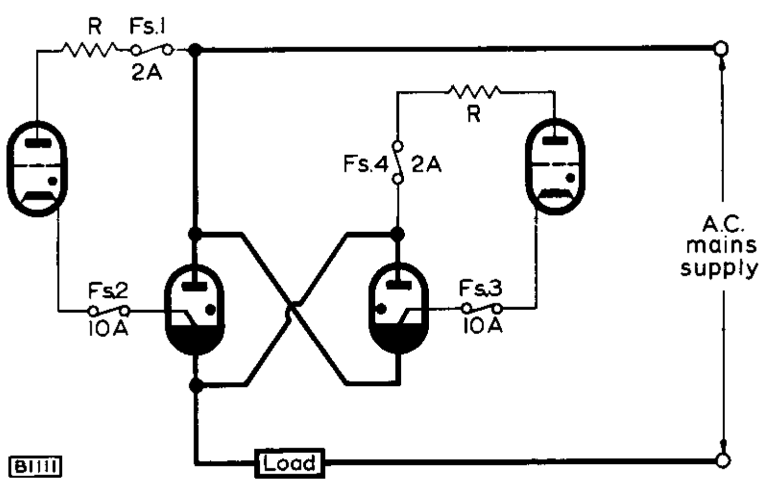
Type of cooling (see note 1)		water
Maximum quoted pressure drop at minimum flow	5	lb/in^2
Typical maximum temperature rise	6	^oC
Minimum inlet temperature	10	^oC
Recommended mounting position	vertical, with anode up	
Net weight (approx.)	21	lb
	9.6	kg
Weight of tube in carton (approx.)	27	lb
	12.6	kg

Accessories

Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

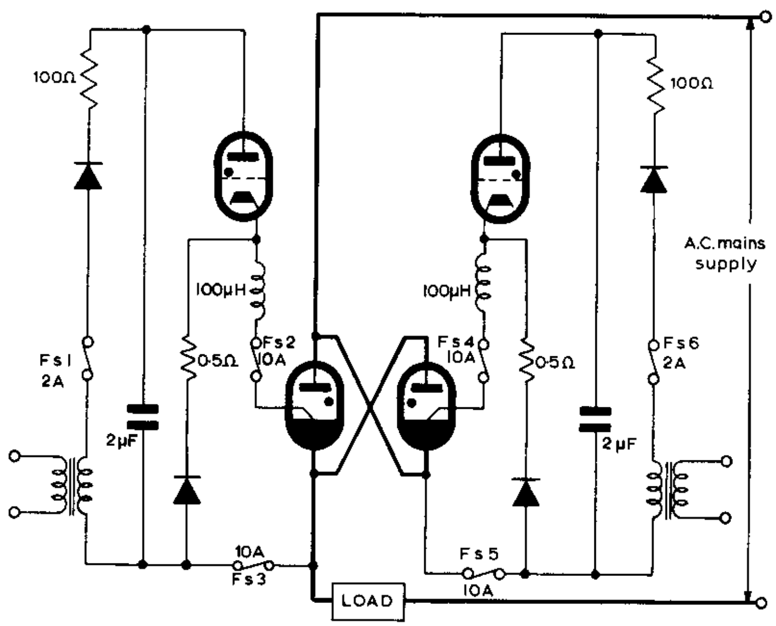
RECOMMENDED CIRCUITS

Anode excitation



Mains voltage (V r.m.s.)	Resistance (Ω)
220 to 250	2
380 to 440	4
500	5
600	6

Separate excitation



Peak closed circuit current	80 to 100	A
Capacitor operating voltage	650 ± 50	V
Maximum ohmic resistance of series inductance	0.2	Ω

FULL LOAD OPERATING CONDITIONS

The figures given in this data are based on full cycle conduction, regardless of whether or not phase delayed firing is used. No allowance has been made for supply voltage or component variations.
Single phase a.c. control, supply frequency 25 to 60c/s (see graphs on pages C1-2)

r.m.s. supply voltage (V_b)	220 to 600	V

FOR USE AT MAXIMUM DEMAND

Maximum demand		
V_b = 250 to 600V	2400	kVA
V_b < 250V	2120	kVA
Maximum average current per tube	192	A
Maximum conduction period	0.5	s

FOR USE AT MAXIMUM AVERAGE CURRENT

Maximum average current per tube	355	A
Maximum demand		
V_b = 250 to 600V	800	kVA
V_b = 220V	705	kVA

V_b VOLTS	t_{av} max. in seconds	I_{surge} max. (t max. = 150ms) kA
220	11	27
250	11	27
380	7.3	17.8
440	6.3	14.2
550	5.6	13.5
600	4.6	11.2

INTERMITTENT RECTIFIER OR THREE PHASE FREQUENCY CHANGER RESISTANCE WELDING SERVICE, SUPPLY FREQUENCY 50 to 60c/s (see graphs on page C3)

Maximum peak voltage (forward and inverse)	0.6	1.2	1.5	kV
For use at maximum peak current				
Maximum peak current	4	3	2.4	kA
Maximum average current	54	40	32	A
For use at maximum average current				
Maximum peak current	1.14	0.84	0.672	kA
Maximum average current	190	140	112	A
Maximum averaging time	6.25	6.25	6.25	s
Maximum value of the ratio of average current to peak current (averaging time = 0.2s)	0.166	0.166	0.166	
Maximum value of the ratio of surge current to peak current (averaging time = 150ms)	12.5	12.5	12.5	

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual tube operating conditions. The values given in this section are based on full cycle conduction without phase delay, regardless of whether or not phase control is used.

Anode and cathode

Maximum peak voltage (forward and inverse)	1.5	kV
Maximum anode current		
Peak (see page C3)		
Average (continuous; see pages C1 and C2)	355	A
Surge (fault protection only, maximum duration 150ms)	27	kA
Maximum demand (two tubes connected in inverse parallel) (see pages C1 and C2)	2400	kVA

Ignitor

Maximum peak positive voltage = maximum peak anode voltage	1.5	kV
Maximum peak negative voltage	5	V
Maximum peak forward current	100	A
Maximum r.m.s. current	10	A
Maximum average current (maximum averaging time = 5s)	1	A
Minimum rate of rise of ignitor current for ignition within 100μs	0.12	A/μs

Cooling

Minimum flow at maximum demand and/or maximum average current	2.0	gal/min
	9.0	l/min
Maximum pressure within envelope	45	lb/in^2
Maximum inlet temperature		
Single phase a.c. control	40	°C
Intermittent rectifier or three phase welding service	35	°C
Maximum temperature at thermostat plate		
A.C. control service		
220 to 250V r.m.s. supply	60	°C
380 to 500V r.m.s. supply	55	°C
500 to 600V r.m.s. supply	50	°C
Intermittent rectifier and three phase welding service	45	°C

OPERATING NOTES

1. When the cooling systems of two or three tubes are connected in series, the maximum inlet temperature of the hottest tube must not be exceeded and the minimum must be met at the coldest tube.

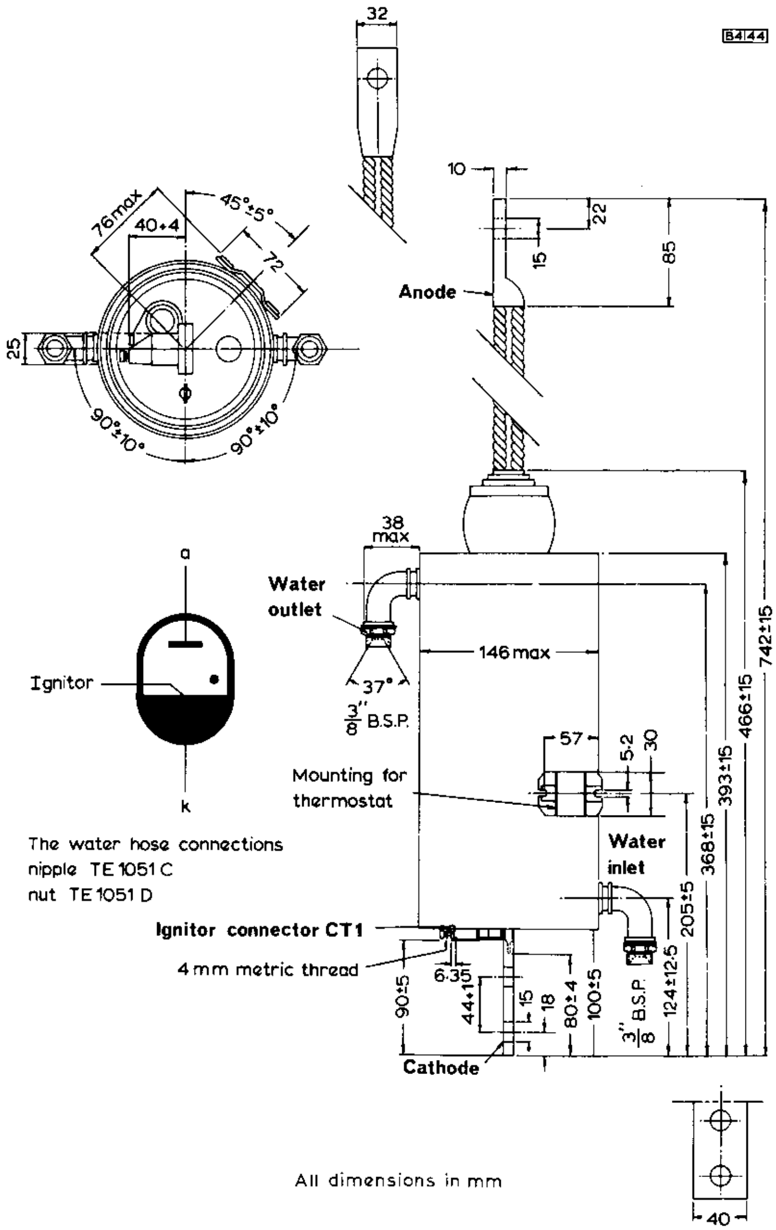
   In three phase welding service using six tubes, not more than three tubes should be cooled in series.

   Hoses should be of insulating material and the minimum length between tube and tube, or tube and earth, should be 18 inches.

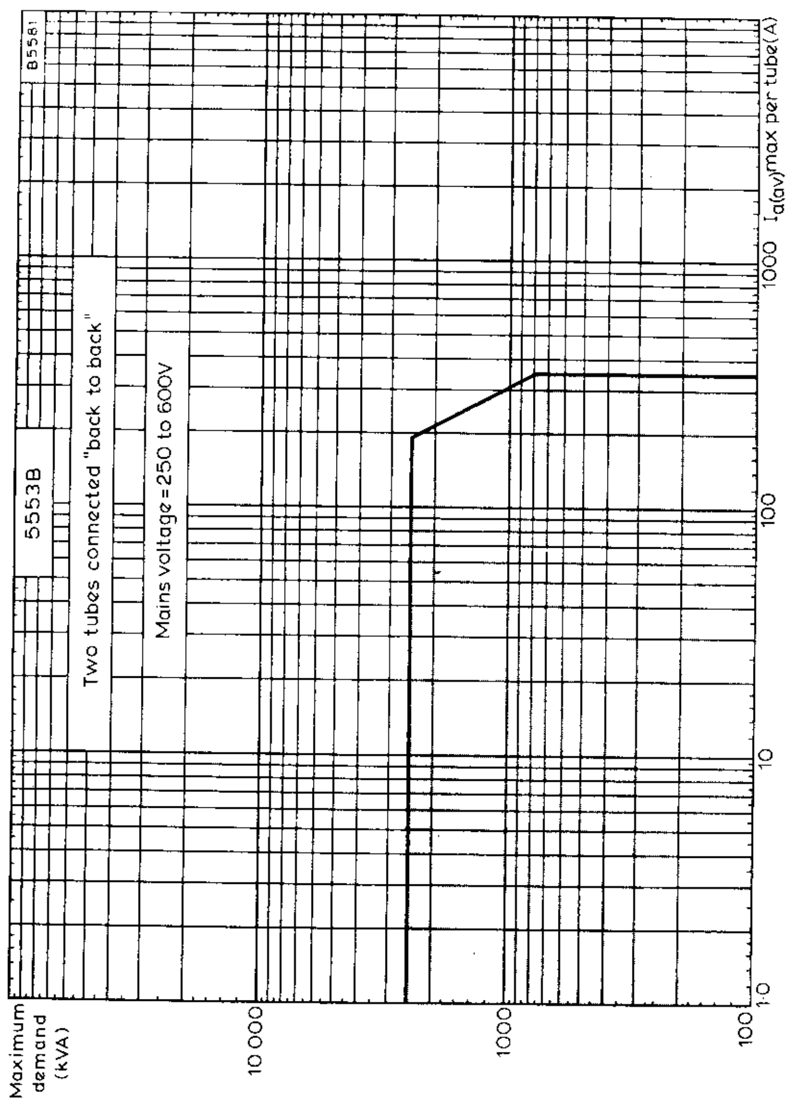
2. The ignitron should be mounted vertically, anode uppermost, and supported by the cathode lug only. It should not be subjected to vibration or the influence of magnetic or radio frequency fields.

   When connecting the anode lead, care should be taken not to stress the anode insulator.

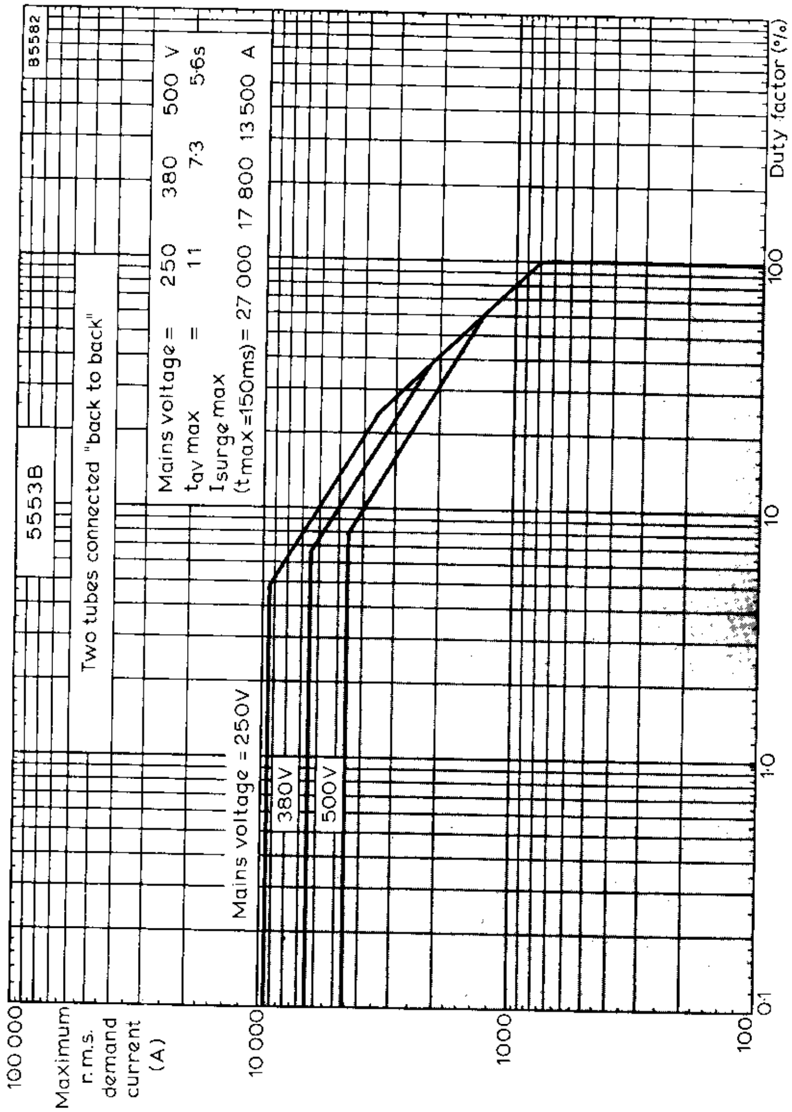
3. The main casing of the ignitron is made from stainless steel but care should be taken not to use water with a high mineral content.



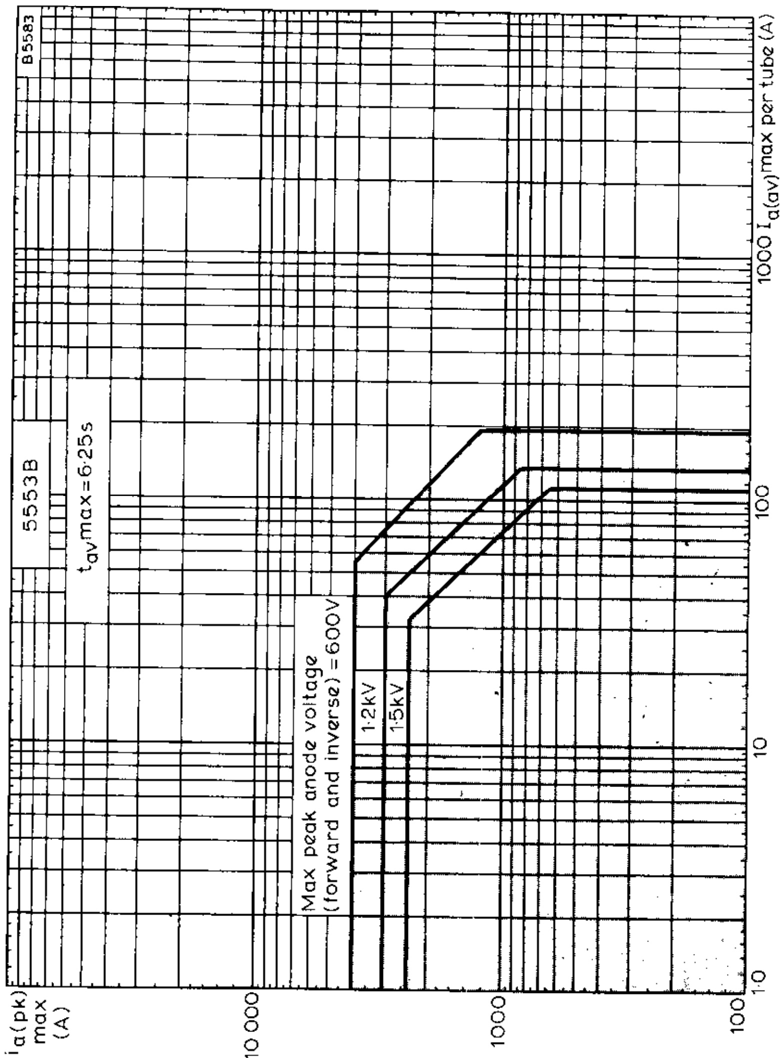
All dimensions in mm



THIS GRAPH SHOWS LIMITING VALUES FOR A.C. CONTROL. IT IS NOT TO BE USED FOR FREQUENCY CHANGING SERVICE



THIS GRAPH SHOWS LIMITING VALUES FOR A.C. CONTROL. IT IS NOT TO BE USED FOR FREQUENCY CHANGING SERVICE



THREE PHASE FREQUENCY CHANGING DUTY

IGNITRON

5555

QUICK REFERENCE DATA (Maximum values)		
Water-cooled ignitron primarily intended for rectifier service. It is provided with an auxiliary anode and two ignitors.		
Peak anode voltage	3.3	kV
Cathode current		
Peak	1.8	kA
Average	207	A
Demand kVA (two tubes in inverse parallel)	2400	kVA

CHARACTERISTICS AND RANGE VALUES FOR EQUIPMENT DESIGN

The values given state the range over which the tube will operate. No allowance has been made in the data for supply voltage and component variations.

The values given apply to all tubes, both initially and during life.

Anode

Maximum anode supply voltage	See table in 'Full Load Operating Conditions'	
Minimum instantaneous positive anode voltage for ignitor to anode transfer	40	V
Arc voltage drop (approx.)	14.5	V
Minimum instantaneous cathode current for initiation of anode conduction	10	A
Minimum instantaneous cathode current to maintain anode conduction	5	A

Cathode

See table in 'Full Load Operating Conditions'

Ignitor

Minimum voltage required for ignition	200	V
Minimum current required for ignition	12	A
Minimum period of application of voltage or current	100	µs
Recommended circuit for separate excitation	See page D4	

Mechanical

Type of cooling	water	
Maximum pressure drop at minimum flow	2.8	lb/in^2
Typical maximum temperature rise	5.5	^oC
Minimum inlet temperature	10	^oC
Recommended mounting position	Vertical with anode up	
Net Weight (approx.)	21	lb
	9.6	kg
Weight of tube in carton (approx.)	27	lb
	12.6	kg

Accessories

Water economy thermostat assembly	55305
Water failure or overload protective thermostat assembly	55306
Ignitor connector lead	55351
Water hose connections	
nipple	TE1051C
nut	TE1051B

FULL LOAD OPERATING CONDITIONS

The figures given in this data are based on full cycle conduction, regardless of whether or not phase delayed firing is used. No allowance has been made for supply voltage or component variations.

Single phase a.c. control, supply frequency 25 to 60c/s (see page C1)

r.m.s. supply voltage (V_b)	2.4	kV

FOR USE AT MAXIMUM DEMAND

Maximum demand	2400	kVA
Maximum average current per tube	135	A
Maximum conduction period	0.5	s

FOR USE AT MAXIMUM AVERAGE CURRENT

Maximum average current per tube	207	A
Maximum demand	1105	kVA
Maximum averaging time	1.66	s
Surge current for fault protection (maximum duration=150ms)	6.0	kA

RECTIFIER SERVICE (see page C2)

Maximum peak voltage (forward and inverse)	900	2100	V
Maximum peak anode current	1.8	1.2	kA
Maximum average anode current continuous	200	150	A
Maximum surge current			
averaging time = two minutes	300	225	A
averaging time = one minute	400	300	A

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

It is important that these ratings are never exceeded and such variations as mains fluctuations, component tolerances and switching surges must be taken into consideration in arriving at the actual tube operating conditions.

The values given in this section are based on full cycle conduction without phase delay, regardless of whether or not phase control is used.

Anode and cathode

Maximum peak voltage (forward and inverse)	3.3	kV
Maximum anode current		
Peak (see page C2)		
Average (continuous) (see page C2)	207	A
Surge (fault protection only, maximum duration = 150ms)	12	kA
Maximum demand (two tubes connected in inverse parallel)	2400	kVA

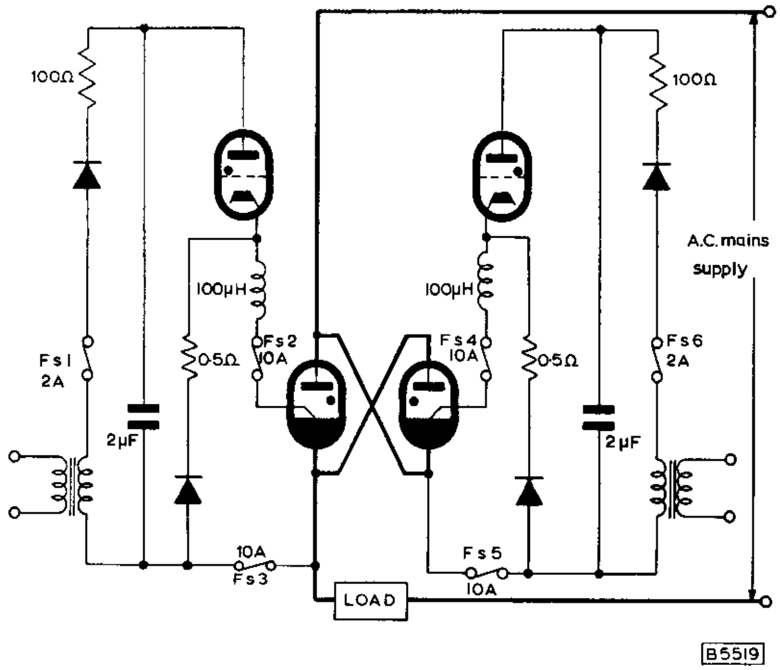
Ignitor

Maximum peak positive voltage = maximum peak anode voltage

Maximum peak negative voltage	5	V
Maximum peak forward current	100	A
Maximum r.m.s. current	10	A
Maximum average current (maximum averaging time = 5s)	1	A

RECOMMENDED CIRCUIT

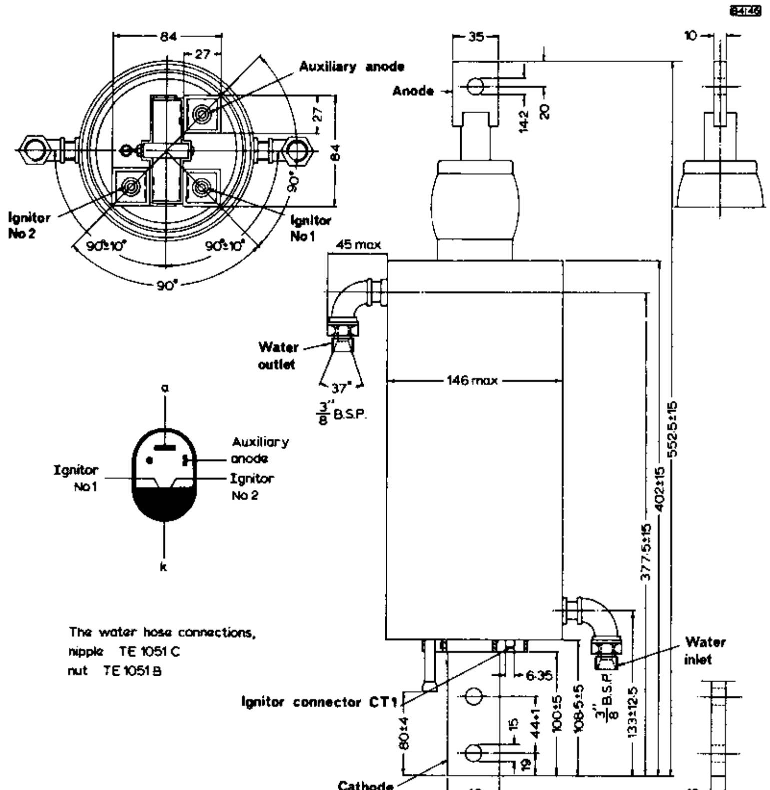
Separate excitation



Peak closed circuit current	80 to 100	A
Capacitor operating voltage	650 ± 50	V
Maximum ohmic resistance of series inductance	0.2	Ω

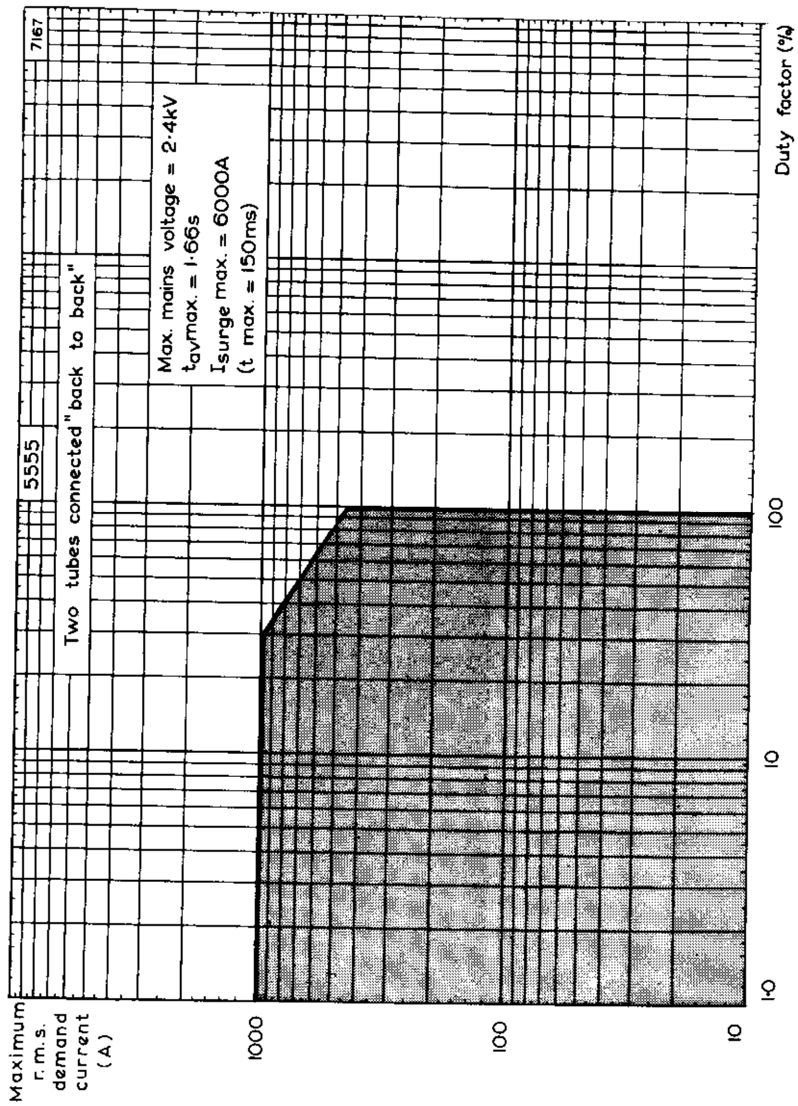
Cooling

Minimum flow at maximum demand and/ or maximum average current	2	gal/min
	9	l/min
Maximum pressure within envelope	45	lb/in^2
Maximum inlet temperature		
For constant loads	10	°C
For widely fluctuating loads	20	°C



The water hose connections,
nipple TE 1051 C
nut TE 1051 B

All dimensions in mm



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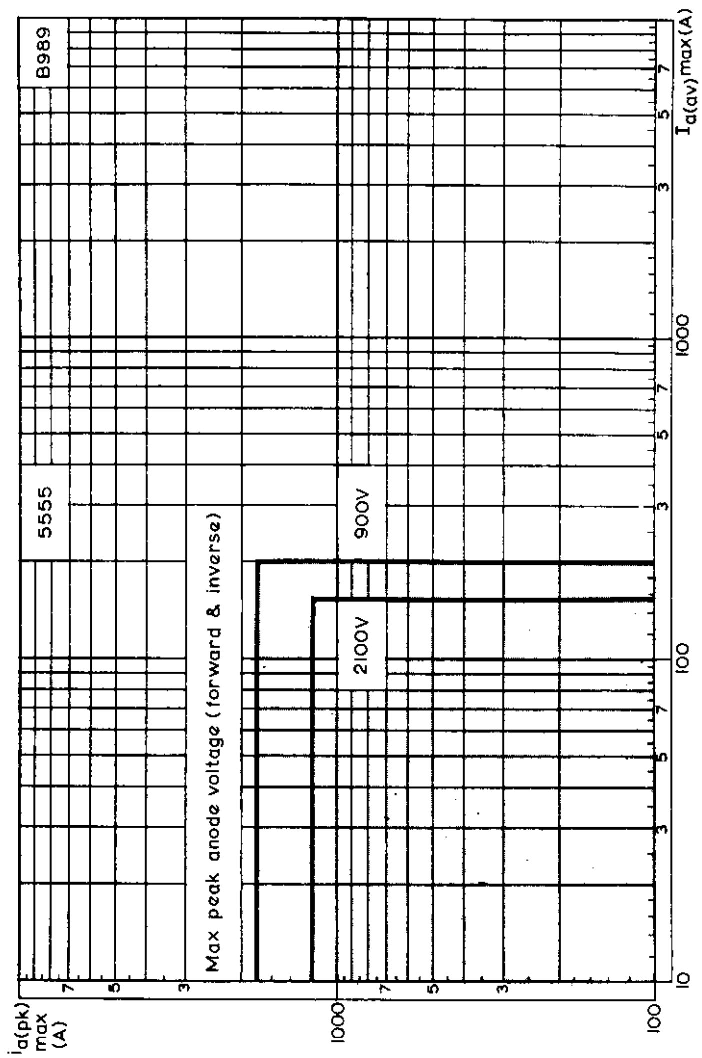


PEAK ANODE CURRENT PLOTTED AGAINST MAXIMUM AVERAGE ANODE CURRENT

IGNITRON

5822A

Water-cooled ignitron primarily intended for resistance welding purposes.

Note: The 5822A may be used for three phase (frequency changing) welding control and similar applications. It has provision for mounting a thermostat which may be used for overload/overheating protection or water economy control.

LIMITING VALUES (absolute ratings)

All the limiting values given in this data are based on full cycle conduction without phase delay, regardless of whether or not phase control is used.

Three phase frequency changing duty

The limiting values for this duty are shown on page C2.

Ignitor ratings

Maximum peak ignitor voltage		
Inverse	5.0	V
Forward	maximum positive anode voltage	
Maximum ignitor current		
Peak	100	A
R.M.S.	10	A
Average (maximum averaging time = 5s)	1.0	A

IGNITOR CHARACTERISTICS

Ignitor voltage required to fire	200	V
Ignitor current required to fire	30	A
Starting time at required voltage and current	≤100	µs

RECOMMENDED CIRCUITS

Anode excitation

7137

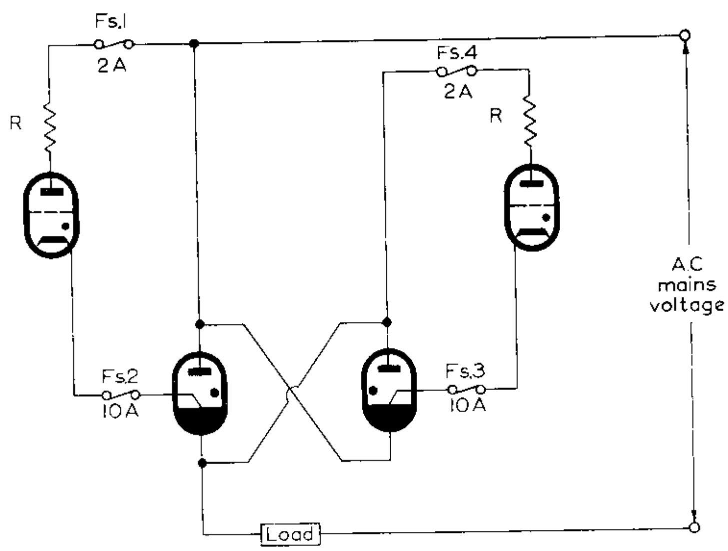


Fig. 1

Mains voltage ($V_{r.m.s.}$)	Resistance (Ω)
220	2
250	2
380	4
500	5
600	6

Separate excitation

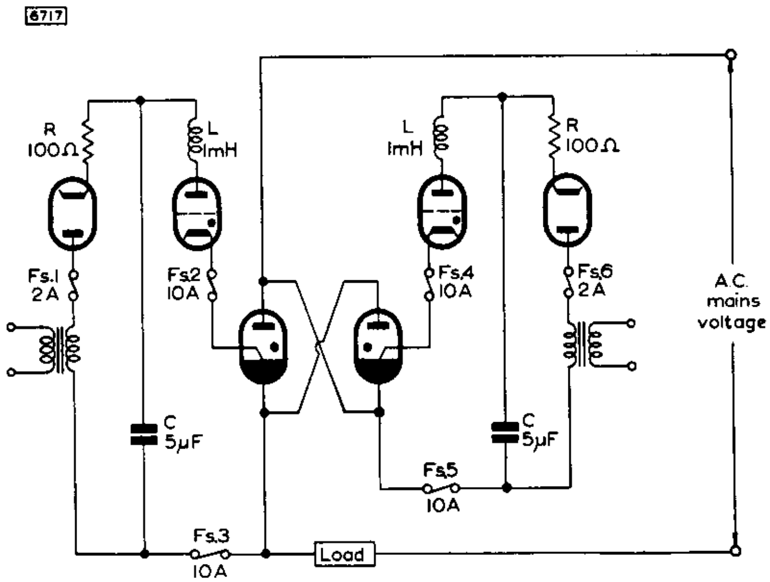


Fig. 2

Peak closed circuit current	40 to 50	A
Capacitor operating voltage	650 ±50	V
Maximum ohmic resistance of series inductance	2	Ω

MOUNTING POSITION vertical with anode up

The ignitron should be mounted and supported by the cathode lug only.

COOLING

Water-cooled		
Minimum flow at maximum load	1.32	gal/min
	6	l/min
Maximum pressure drop at minimum flow	5	lb/in^2
Maximum temperature rise at minimum flow	4.0	°C
Inlet temperature		
Minimum	10	°C
Maximum (3 phase welder service)	35	°C
*Maximum temperature at thermostat mount		
3 phase welder service	45	°C

***WARNING:** The thermostat mount is at the full line voltage.

Note:

In the cooling system when two or more tubes are connected in series, the maximum input temperature must not be exceeded on the hottest tube and the minimum must be met on the coldest tube.

In general the water control thermostat should be mounted on the last but one tube and the protective thermostat on the last tube.

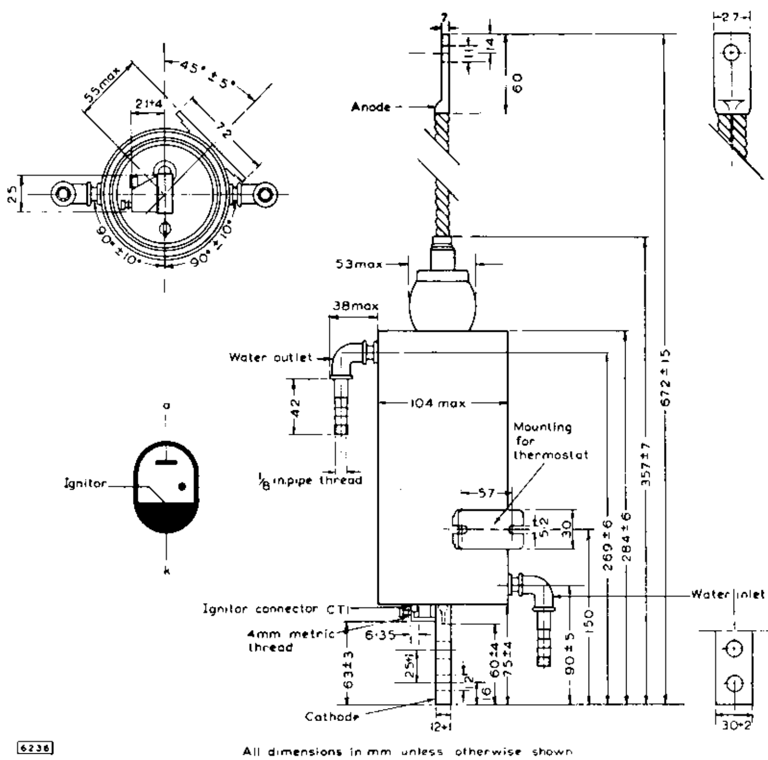
In three phase welder service using six tubes, not more than three tubes should be cooled in series.

ACCESSORIES

Cooling water thermostat	55305
Overload protection thermostat	55306
Ignitor connector lead	55351

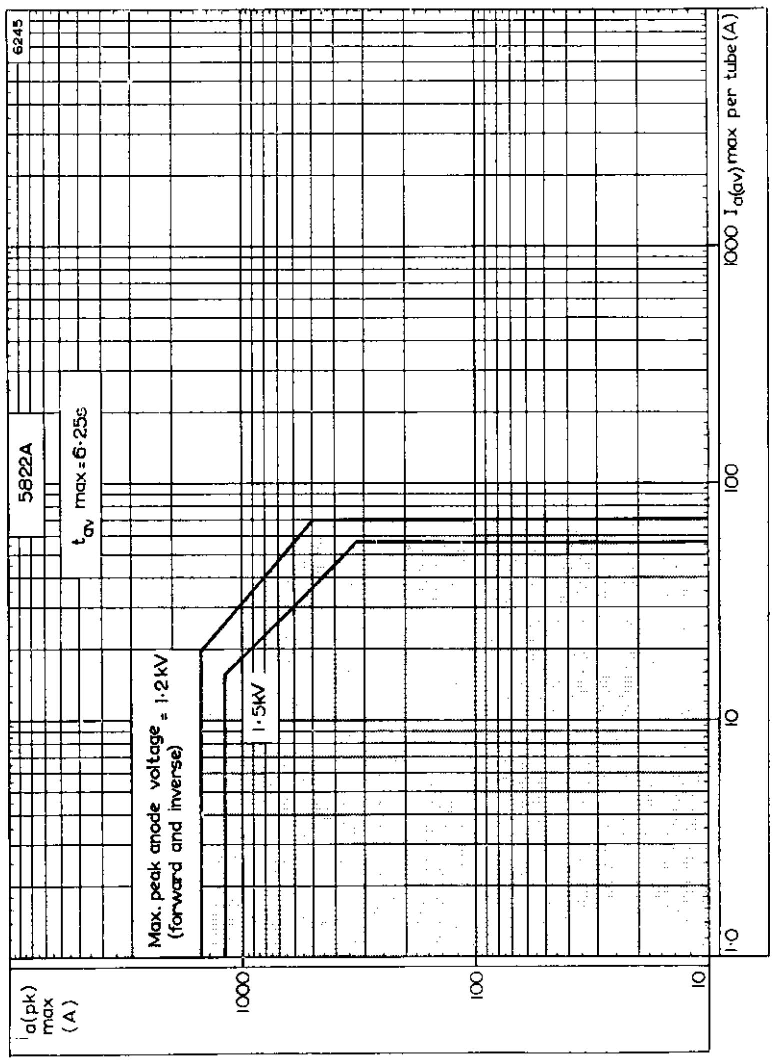
WEIGHT

Net weight	8 lb	3 oz
	3.7	kg
Shipping weight	11	lb
	5	kg



6236

All dimensions in mm unless otherwise shown



THREE PHASE FREQUENCY CHANGING DUTY