

Electron tubes

Part 8 October 1975

TV picture tubes

ELECTRON TUBES

Part 8

October 1975

| General section | | |
|----------------------------------|---------------------------------------|---|
| Colour TV picture tubes | · · · · · · · · · · · · · · · · · · · | - |
| Black and white TV picture tubes | 3 | : |
| Index; Maintenance type list | | |

Argentina Fapesa I.y.C. Av. Crovara 2550 Tel. 652-7438/7478 BUENOS AIRES

Australia Philips Industries Ltd. Elcoma Division 67-71 Mars Road Tel. 42 1261 LANE COVE, 2066, N.S.W.

Austria
Osterreichische Philips
Bauelemente Industrie G.m.b.H.
Zieglergasse 6
Tel. 93 26 11
A-1072 VIENNA

Belgium M.B.L.E. 80, rue des Deux Gares Tel. 523 0000 B-1070 BRUSSELS

Brazil IBRAPE S.A. Av. Paulista 2073-S/Loja Tel. 278-1111 SAO PAULO, Sp.

Canada Philips Electron Devices 116 Vanderhoof Ave. Tel. 425-5161 TORONTO 17, Ontario

Chile Philips Chilena S.A. Av. Santa Maria 0760 Tel. 39-40 01 SANTIAGO

Colombia SADAPE S.A. Calle 19, No. 5-51 Tel. 422-175 BOGOTA D.E. 1

Denmark Miniwatt A/S Emdrupvej 115A Tel. (01) 69 16 22 DK-2400 ΚΦΒΕΝΗΑVN NV

Finland
Oy Philips Ab
Elcoma Division
Kaivokatu 8
Tel. 1 72 71
SF-00100 HELSINKI 10

France R.T.C. La Radiotechnique-Compelec 130 Avenue Ledru Rollin Tel. 355-44-99 F-75540 PARIS 11

Germany Valvo G.m.b.H. Valvo Haus Burchardstrasse 19 Tel. (040) 3296-1 D-2 HAMBURG 1

Greece Philips S.A. Hellénique Elcoma Division 52, Av. Syngrou Tel. 915 311 ATHENS Hong Kong Philips Hong Kong Ltd. Components Dept. 11th Fl., Din Wai Ind. Bldg. 49 Hoi Yuen Rd. Tel. K-42 72 32 KWUNTONG

India INBELEC Div. of Philips India Ltd. Band Box House 254-D, Dr. Annie Besant Rd Tel. 457 311-5 Prabhadevi, BOMBAY-25-DD

Indonesia P.T. Philips-Ralin Electronics Eleoma Division Djalan Gadjah Mada 18 Tel. 44 163 DJAKARTA

Ireland Philips Electrical (Ireland) Ltd. Newstead, Clonskeagh Tel. 69 33 55 DUBLIN 14

Italy Philips S.p.A. Sezione Elcoma Piazza IV Novembre 3 Tel. 2-6994 I-20124 MILANO

Japan NIHON PHILIPS 32nd Fl., World Trade Center Bldg. 5, 3-chome, Shiba Hamamatsu-cho Minato-ku Tel. 03-435-5268 TOKYO

Korea Philips Electronics (Korea) Ltd. Room 2501, Samilro Building 10, Kwanchul-Dong, Chongro-ku Tel. 73-7222 C.P.O. Box 3680 SEOUL

Mexico Electrónica S.A. de C.V. Varsovia No.36 Tel. 5-33-11-80 MEXICO 6, D.F.

Netherlands Philips Nederland B.V. Afd. Elonco Boschdijk 525 Tel. (040) 79 33 33 NL-4510 EINDHOVEN

New Zealand EDAC Ltd. 70-72 Kingsford Smith Street Tel. 873 159 WELLINGTON

Norway Electronica A.S. Vitaminveien 11 P.O. Box 29, Grefsen OSLO 4

Peru CADESA Jr. Ilo, No. 216 Apartado 10132 Tel. 27 73 17 LIMA Philippines ELDAC Philips Industrial Dev. Inc. 2246 Pasong Tamo Tel. 86-89-51 to 59 MAKATI-RIZAL

Portugal Philips Portuguesa S.A.R.L. Av. Eng. Duharte Pacheco 6 Tel. 68 31 21 LISBOA 1

Singapore Philips Singapore Private Ltd. Elcoma Div. P.O. Box 340, Toa Payoh Central P.O., Lorong 1, Toa Payoh Tel. 53 88 11 SINGAPORE 12

South Africa EDAC (Pty.) Ltd. South Park Lane New Doornfontein Tel. 24/6701-2 JOHANNESBURG

Spain COPRESA S.A. Balmes 22 Tel. 329 63 12 BARCELONA 7

Sweden ELCOMA A.B. Lidingövägen 50 Tel. 573231 S-10 250 STOCKHOLM 27

Switzerland Philips A.G. Edenstrasse 20 Tel. 01/44 22 11 CH-8027 ZUERICH

Taiwan Philips Taiwan Ltd. 3rd. Fl., San Min Building 57-1, Chung Shan N.Rd, Section 2 P.O. Box 22978 Tel. 553101-5 TAIPEI

Turkey Türk Philips Ticaret A.S. EMET Department Gümüssuyu Cad. 78-80 Tel. 45.32.50 Beyoglü, ISTANBUL

United Kingdom Mullard Ltd. Mullard House Torrington Place Tel. 01-580 6633 LONDON WC1E 7HD

United States North American Philips Electronic Component Corp. 230, Duffy Avenue Tel. (516)931-6200 HICKSVILLE, N.Y. 11802

Uruguay Luzilectron S.A. Rondeau 1567, piso 5 Tel. 9 43 21 MONTEVIDEO

Venezuela C.A. Philips Venezolana Elcoma Dept. Av. Principal de los Ruices Edif. Centro Colgate, Apdo 1167 Tel. 36.05.11 CARACAS

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, subassemblies and materials; it is made up of three series of handbooks each comprising several parts.

| ELECTRON TUBES | BLUE |
|--|-------|
| SEMICONDUCTORS AND INTEGRATED CIRCUITS | RED |
| COMPONENTS AND MATERIALS | GREEN |

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

This information is furnished for guidance, and with no guarantee as to its accuracy or completeness; its publication conveys no licence under any patent or other right, nor does the publisher assume liability for any consequence of its use: specifications and availability of goods mentioned in it are subject to change without notice; it is not to be reproduced in any way, in whole or in part without the written consent of the publisher.

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part la Transmitting tubes for communications

April 1973

and Tubes for r.f. heating Types PB2/500 + TBW15/125

Part 1b Transmitting tubes for communication

August 1974

Tubes for r.f. heating

Amplifier circuit assemblies

Part 2 Microwave products

October 1974

Communication magnetrons
Magnetrons for microwave heating
Klystrons
Travelling-wave tubes

Triodes T-R Switches

Neutron tubes

Diodes

Microwave Semiconductor devices Isolators Circulators

Part 3 Special Quality tubes;
Miscellaneous devices

January 1975

Part 4 Receiving tubes

March 1975

Part 5a Cathode-ray tubes

April 1975

Part 5b Camera tubes; Image intensifier tubes

May 1975

Part 6 Products for nuclear technology
Photodiodes

July 1975

Channel electron multipliers

Geiger-Mueller tubes

N.B. Photomultiplier tubes and Photo diodes will be issued in Part 9

Part 7 Gas-filled tubes

August 1975

Voltage stabilizing and reference tube Counter, selector, and indicator tubes Trigger tubes Switching diodes

Thyratrons Ignitrons Industrial rectifying tubes High-voltage rectifying tubes

Part 8 TV Picture tubes

October 1975

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

| Part 1a | Rectifier | diodes | and | thy | yristors |
|---------|-----------|--------|-----|-----|----------|
|---------|-----------|--------|-----|-----|----------|

June 1974

October 1975

Rectifier diodes Voltage regulator diodes (> 1,5 W) Transient suppressor diodes Thyristors, diacs, triacs Rectifier stacks

Part 1b Diodes

Small signal germanium diodes Small signal silicon diodes Special diodes Voltage regulator diodes (< 1,5 W) Voltage reference diodes Tuner diodes

Part 2 Low frequency transistors

July 1974

Part 3 High frequency and switching transistors

October 1974

Part 4a Special semiconductors

November 1974

Dual transistors

Microministure devices for

Transmitting transistors Microwave devices Field-effect transistors

Microminiature devices for thick- and thin-film circuits

Part 4b Devices for opto-electronics

December 1974

Photosensitive diodes and transistors Light emitting diodes Photocouplers Infra-red sensitive devices Photoconductive devices

Part 5 Linear integrated circuits

March 1975

Part 6 Digital integrated circuits

April 1974

DTL (FC family)
CML (GX family)

MOS (FD family) MOS (FE family)

COMPONENTS AND MATERIALS (GREEN SERIES)

These series consists of the following parts, issued on the dates indicated.

Part 1 Functional units, Input/output devices, Electro-mechanical components, Peripheral devices June 1974

High noise immunity logic FZ/30-Series Circuit blocks 40-Series and CSA70 Counter modules 50-Series Norbits 60-Series, 61-Series

Circuit blocks 90-Series Input/output devices Electro-mechanical components Peripheral devices

Part 2a Resistors

Fixed resistors Variable resistors Voltage dependent resistors (VDR) Light dependent resistors (LDR)

September 1974

Negative temperature coefficient thermistors (NTC) Positive temperature coefficient thermistors (PTC) Test switches

Part 2b Capacitors

Electrolytic and solid capacitors Paper capacitors and film capacitors

November 1974

Ceramic capacitors Variable capacitors

Part 3 Radio, Audio, Television

FM tuners Loudspeakers Television tuners, aerial input assemblies

February 1975

Components for black and white television
Components for colour television
*)

Part 4a Soft ferrites

Ferrites for radio, audio and television Beads and chokes

April 1975

Ferroxcube potcores and square cores Ferroxcube transformer cores

Part 4b Piezoelectric ceramics, Permanent magnet materials May 1975 Part 5 Ferrite core memory products July 1975

Ferroxcube memory cores Matrix planes and stacks

Core memory systems

Part 6 Electric motors and accessories

Small synchronous motors Stepper motors

September 1975

Miniature direct current motors

Part 7 Circuit blocks

Circuit blocks 100 kHz-Series Circuit blocks 1-Series Circuit blocks 10-Series

September 1971

Circuit blocks for ferrite core memory drive

Part 8 Variable mains transformers

July 1975

^{*)} Deflection assemblies for camera tubes are now included in handbook series "Electron tubes", Part 5b.



General section



LIST OF SYMBOLS

| Symbols deno | oting electrodes/elements and electrode/element connections | |
|---------------------------|---|----------|
| Heater or fila Cathode | nment | f k |
| | istinguished by means of an additional numeral; the earest to the cathode having the lowest number. | g |
| External con- | ductive coating, rim-band | m |
| Fluorescent | | 1 |
| • | ch must not be connected externally | i.c. |
| Tube pin whi | ch may be connected externally | n.c. |
| Symbols deno | oting voltages | |
| Symbol for v | oltage, followed by an index | V |
| | e relevant electrode/element | |
| Heater or file | ament voltage | v_f |
| Peak value of | | V_p |
| Peak to peak | value of a voltage | v_{pp} |
| | ltage for visual extinction raster (grid drive service) | v_{GR} |
| Cathode volt | age for visual extinction | |
| of focused | raster (cathode drive service) | v_{KR} |
| Symbols dend | oting currents | |
| | The positive electrical current is directed opposite to the direction of the electron current. | |
| | The symbols quoted represent the average values of | |
| | the concerning current unless otherwise stated. | |
| Symbol for c | urrent followed by an index | I |
| | e revelant electrode | • |
| Heater or fil | | I_f |
| | | 1 |
| Symbols deno | oting powers | |
| Dissipation o | f the fluorescent screen | Wρ |
| Grid dissipat | | Wg |
| · | | ''g |
| Symbols deno | oting capacitances | |

See I.E.C. Publication 100

Symbols denoting resistances

| Symbol for resistance followed by an index for the revelant electrode pair. When only one index is given | R |
|--|--------------|
| the second electrode is the cathode. | |
| Ditto impedance | \mathbf{Z} |
| Symbols denoting various quantities | |
| Brightness | В |
| Frequency | f |
| Magnetic field strength | Н |



Ξ

GENERAL OPERATIONAL RECOMMENDATIONS T.V. PICTURE TUBES

CONTENTS

| 1 | Today 1 may |
|-------|--|
| 1 | Introduction |
| 2 | Spread in tube characteristics |
| 3 | Spread and variation in operating conditions |
| 3.1 | Spread |
| 3.2 | Variation |
| 4 | Limiting values |
| 4.1 | Rating systems |
| 4.1.1 | Absolute max. rating system |
| 4.1.2 | Design max. rating system |
| 4.1.3 | Design centre rating system |
| 4.2 | More than one rating system |
| 5 | Heater circuit |
| 5.1. | Parallel connection |
| 5.2 | Series connection |
| 5.3 | Stand-by (instant-on circuits) |
| 6 | Cathode to heater voltage |
| 7 | Intermediate electrodes |
| 8 | Electrode voltages |
| 9 | Luminescent screen |
| 10 | External conductive coating |
| 11 | Metal rimband |
| 12 | Flash-over |
| 13 | Handling |
| 14 | Mounting |
| 15 | Dimensions |
| 16 | Reference line |
| 17 | Corner cutting or neck shadowing |
| 18 | Raster centring |
| | |



GENERAL OPERATIONAL RECOMMENDATIONS T.V. PICTURE TUBES

1. INTRODUCTION

Equipment design should be based on the characteristics as stated in the data sheets.

Where deviations from these general recommendations are permissible or necessary, statements to that effect will be made.

If applications are considered not referred to in the data sheets of the relevant tube type extra care should be taken with circuit design to avoid that the tube is overloaded due to unfavourable operating conditions.

2. SPREAD IN TUBE CHARACTERISTICS

The spread in tube characteristics is the difference between maximum and minimum values. Values not qualified as maximum or minimum are nominal ones. It is evident that average or nominal values, as well as spread figures, may differ according to the number of tubes of a certain type that are being checked. No guarantee is given for values of characteristics in settings substantially differing from those specified in the data sheets.

3. SPREAD AND VARIATION IN OPERATING CONDITIONS

The operating conditions of a tube are subject to spread and/or variation.

- 3.1 <u>Spread</u>. Spread in an operating condition is a <u>permanent</u> deviation from an average condition due to, e.g., component value deviations. The average condition is found from such a number individual cases taken at random that an increase of the number will have a negligible influence.
- 3.2 <u>Variation.</u> Variation in an operating condition is <u>non-permanent</u> (occurs as a function of time), e.g., due to supply voltage fluctuations. The average value is calculated over a period such that a prolongation of that period will have negligible influence.

4. LIMITING VALUES

4.1 Limiting values are in accordance with the applicable rating system as defined by I.E.C. publication 134.

Reference may be made to one of the following 3 rating systems.

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

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

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

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

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

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

4.1.3 <u>Design-centre rating system.</u> Design-centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device* of a specified type as defined by its published data, and should not be exceeded under average conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply-voltage variation, equipment component spread and variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations or spread in the characteristics of all electronic devices.

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

Note*. A bogey tube is a tube whose characteristics have the published nominal values for the type. A bogey tube for any particular application can be obtained by considering only those characteristics which are directly related to the application.



- 4.2 If the tube data specify limiting values according to more than one rating system the circuit has to be designed so that none of these limiting values is exceeded under the relevant conditions.
- 4.3 In addition to the limiting values given in the individual data sheets the directives in the following paragraphs should be observed.

5. HEATER CIRCUIT

Any deviation from the nominal heater voltage (in case of parallel connection) or from the nominal heater current (in case of series connection) has a detrimental effect on tube performance and life, and should therefore be kept at a minimum. Such deviations may be caused by:

- a) Mains voltage fluctuations.
- b) Spread in the characteristics of components such as transformers, resistors capacitors etc.

Designers of heater circuits are strongly recommended to bear this in mind when dealing with equipment to be used in areas where the actual mains voltage is likely to differ from the nominal value.

5.1 Parallel connection

The maximum deviation of the heater voltage should not exceed \pm 15% (design maximum value).

This condition will be fulfilled when the mains voltage fluctuates by \pm 10% and a ordinary transformer (see below) is used.

5.2 Series connection

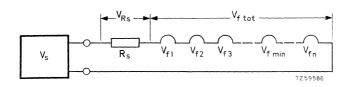
The maximum deviation of the heater current should not exceed $\pm\,8\%$ (design maximum value).

When a small number of tubes with large differences in the heater voltage is used in series connection combined with a series resistor or a series capacitor, the maximum permitted deviation of the heater current may be exceeded.

To avoid this, certain restrictions must be imposed on the composition of the heater chain; the maximum part of the supply voltage that can be eliminated, and the tolerances of the voltage dropper in series with the heaters.

A number of circuits for If = 300 mA will be described in detail below.

T.V. PICTURE TUBES



V_S = source voltage (mains voltage or mains voltage stepped down via a transformer)

V_{Rs} = voltage drop over series resistor

 $V_{\text{ftot.}} = V_{f1} + V_{f2} + V_{f3} + \cdots + V_{fmin.} + \cdots + V_{fmin.}$

V_{fmin} = lowest individual heater voltage of all tubes in the chain

 R_s = series resistor

Voltage source

The following spreads have been taken into account for the source voltage:

- Mains voltage spread \pm 10% either or not combined with the voltage spread caused by a transformer with a permanent deviation from the nominal value of \pm 1% and with a spread of \pm 2% (ordinary, well made transformer).

The following circuits are allowed:

- 5.2.1 Supply directly from a voltage source ($V_s = V_{ftot.}$)
 - No restrictions.
- 5.2.2 Supply from a voltage source via a 5% series resistor (V_S = V_{Rs} + V_{ftot} .)
 - a. One single tube: permitted if $\frac{VRs}{Vftot}$ ≤ 2
 - b. Heater chain consisting of 2 or more tubes:

the maximum permitted ratio $\frac{V \, R \, s}{V_{ftot}}$ can be read from diagram number 1 as follows:

Determine $\frac{V_{fmin.}}{V_{ftot.}}$ of the heater chain. Draw a vertical line through the corresponding point in the diagram. Draw a horizontal line through the point of intersection of this vertical line with the line which indicates the total number of tubes in the chain. The point of intersection of this horizontal line with the vertical axis gives the maximum permitted ratio between the series resistor and the sum of the heater voltages of all tubes in the chain.

5.2.3 Supply from a voltage source via a series diode
$$(\frac{V_S}{\sqrt{2}} = V_{ftot.})$$

- No restrictions.
- 5.2.4 Supply from a voltage source via a series diode and a series resistor

$$(\frac{V_{S}}{\sqrt{2}} = V_{ftot} + V_{Rs})$$

In the above formula $V_{ftot.}$ and V_{Rs} are RMS values and the maximum permitted ratio $\frac{V_{Rs}}{V_{ftot.}}$ can be read from diagram number 1 (see 5.2.2).

For calculation of R_S divide the required VR_S (RMS) by the nominal heater current: $R_S = \frac{VR_S}{0.3}$

Remark to 5.2.3 and 5.2.4:

When series diodes are applied, the D.C. component of the resulting heater voltage should preferably be negative with respect to the cathodes of the tubes.

5.2.5 Supply from a voltage source via a series capacitor

a. One single 300 mA tube; permitted if

 $\frac{V_{ftot.}}{V_{s}}$ \geq 0.50 when 5% paper capacitors are applied.

b. $\frac{V_{ftot.}}{V_{s}} \geq$ 0.70 when 10% metallized polycarbonate capacitors are applied.

c. Heater chain consisting of 2 tubes or more; permitted if $\frac{V_{\text{ftot.}}}{V_{\text{S}}}$

 $\frac{V f tot.}{V_S}$ \geq 0.6 when 5% paper capacitors are applied.

 $\frac{V f tot.}{V_S} \ge 0.8$ when 10% metallized polycarbonate capacitors are applied.

5.3 Stand-by (instant -on circuits)

In order to maintain reliability during life, it is recommended to reduce the heater voltage of the tubes during stand-by operation to $\!\leq\!75\%$ of the nominal value.

Note

If other designs for the heater supply circuit are wanted than the configurations described above it is strongly recommended to contact the tube manufacturer.



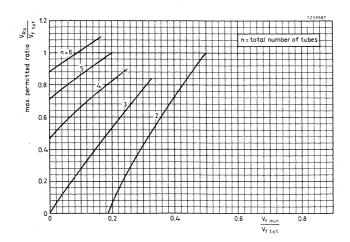


Diagram No.1

6. CATHODE TO HEATER VOLTAGE

The voltage between cathode and heater should be as low as possible and never exceed the limiting value given on the data sheets of the individual tubes. The values given under "Limiting values" relate to that side of the heater where the voltage between cathode and heater is greatest. The voltage between cathode and heater may be D.C., A.C., or a combination of both voltages. Unless otherwise stated, the maximum values quoted for the voltage between cathode and heater indicate the maximum permissible value (D.C. component). If an A.C. voltage, or an combination of D.C. and A.C. voltages, is applied the peak value may be twice the rated $V_{\mathbf{kf}}$; however, unless otherwise stated, the peak value shall never exceed 315 V. The D.C. component is not allowed to exceed the published value.

Unless otherwise stated, the $V_{\mbox{\scriptsize kf}}$ max. holds for both polarities of the voltage; however, a positive cathode is usually the most favourable in view of insulation during life.

In order to avoid excessive hum the A.C. component of the heater to cathode voltage should be as low as possible and never exceed $20\,V_{rms}$ (mains frequency).

7. INTERMEDIATE ELECTRODES (between cathode and final accelerator)

In no circumstances should the tube be operated without a D.C. connection between each electrode and the cathode. The total effective impedance between each electrode and the cathode should never exceed the published maximum value. However, no electrode should be connected directly to a high energy source such as the hot line. When such a connection is required, it should be made via a series resistor of not less then $1 \text{ k}\Omega$.

7

8. ELECTRODE VOLTAGES

All electrode voltages are given with respect to cathode.

For cathode drive service the reference point is grid No.1

8.1 Grid No.1 cut-off voltage

Generally curves showing the limits of grid No.1 cut-off voltage for specific values of the first accelerator voltage are included in the data. The brightness control should be so dimensioned that it can handle any tube within the limits shown, at the appropriate first accelerator voltage.

The published limits are determined at an ambient illumination level of 10 lux with the aid of a focused raster. Because the brightness of a focused spot is in general greater than that of a raster, the visual cut-off voltage determined with the aid of a spot will be more negative by about 5 V.

8.2 Grid No.2 voltage

For each individual tube the grid No.2 voltage can be adjusted so that the beam current is cut off at a fixed value within the published range of the grid No.1 voltage.

In the data, graphs are included giving the relationship between the grid No.2 voltage and the grid No.1 cut-off voltage.

8.3 Focusing electrode voltage

Individual tubes will have satisfactory focus over the entire screen at some value within the published range of the focusing voltage.

If centre-focusing is desired this range will shift in the negative direction.

9. LUMINESCENT SCREEN

To prevent permanent damage to the screen material care should be taken

- a. not to operate the tube with a stationary picture at high beam currents for extended periods
- b. not to operate the tube with a stationary or slowly moving spot except at extremely low beam currents
- c. to choose the time constants of the grid No.1 the grid No.2 and the time bases supply line circuits such that sufficient beam current is maintained to discharge the e.h.t. capacitance before deflection has ceased after equipment has been switched off.

10. EXTERNAL CONDUCTIVE COATING

The external conductive coating must be connected to the chassis. The capacitance of this coating to the final accelerating electrode may be used to provide smoothing for the e.h.t. supply.

The coating is not a perfect conductor and in order to reduce radiation caused by the line time base it may be necessary to make multiple connections to the coating. See also 12.

May 1971

11. METAL RIMBAND

An appreciable capacitance exist between the metal rimband and the internal conductive coating of the tube; its value is quoted in the individual data sheets. To avoid electric shocks, a D.C. connection should be provided between the metal band and the rest of the receiver. In receivers where the chassis can be connected directly to the mains there is a risk of electric shock if acces is made to the metal band. To reduce the shock to the safe limit, it is suggested that a $2~\mathrm{M}\Omega$ resistor capable of handling the peak voltages be inserted between the metal band and the point of contact with the external conductive coating. This safety arrangement will provide the necessary insulation from the mains but in the event of flash-over high voltages will be induced on the metal band. It is therefore recommended that the $2~\mathrm{M}\Omega$ resistor be bypassed by a 4.7 nF capacitor capable of withstanding the peak voltage determined by the voltage divider formed by this capacitor and the capacitance of the metal rimband to the internal conductive coating.

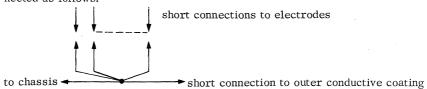
The 4.7 nF capacitor also serves to reduce the radiation from the band.

12. FLASH-OVER

Picture tubes, in common with other high voltage devices, are prone to internal flash-over. During a breakdown arcing occurs between an electrode connected to the e.h.t. capacitor and an electrode terminated in a pin on the base of the tube. The resulting transient currents and voltages may be of sufficient magnitude to cause damage to the tube itself and to various components on the chassis. Arcing terminates when the e.h.t. capacitor is discharged.

During the subsequent recharging period an additional load is imposed on the e.h.t. generator.

It is of vital importance to provide protective circuits with spark gaps, particularly when semiconductor devices are employed. The spark gaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible.

Additional information available on request.

13. HANDLING

The precautions taken in manufacture reduce the possibility of spontaneous implosion to a minimum but any additional stress due to mishandling considerably increases the risk of implosion: such an implosion may occur immediately or may be delayed. Care should be taken not to scratch or bump any part of the bulb, particularly the screen to cone area, as this will appreciably reduce the strength of the bulb and may lead to implosion.

When a tube is not in its equipment or original packing and is placed screen downwards, it should be placed on a soft pad of suitable material free from abrasive substances. Stresses on the neck should be avoided.

If the transportation method uses the lugs it is necessary to employ at least two lugs in the lifting of the tube. The lift should be made in such a way that the applied forces are equally distributed between the lugs.

The maximum force that may be applied to one lug, at any angle, shall not exceed twice the weight of the tube.

The tube should not be subjected to accelerations higher than 30 g.

Before removing the tube from the equipment the capacitance C_{am} should be discharged via a resistor of approx. 50 k Ω .

The manufacturers notify all concerned that they do not accept any responsibility for any damage on injury sustained in any manner in connection with the picture tube, neither is any condition or warranty given or to be implied.

14. MOUNTING

Unless otherwise specified on the data sheets for individual tubes there are no restrictions on the position of mounting.

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely.

The weight of the socket and possible additional circuitry should not be more than $80~\rm g$. With tubes with a 7-pin miniature base the socket may not be used for mounting components.

Tubes having all-glass bases must not be soldered direct into the wiring. It is very desirable that tubes should not be exposed to strong electrostatic and magnetic fields.

In front of the face of a mono-panel T.V. picture tube a protecting screen of transparent material should be placed. The screen should be of adequate strength to withstand the effects of an implosion of the tube.

Tubes having integral protection do not require a protective screen.

15. DIMENSIONS

In designing the equipment the tolerances given on the dimensional drawings should be considered. Under no circumstances should the equipment be designed a round dimensions taken from individual tubes.

16. REFERENCE LINE

The reference line indicated on the tube outline drawing is determined by means of a gauge.

Drawings of these gauges are given in this book.

December 1973

GENERAL

T.V. PICTURE TUBES

17. CORNER CUTTING OR NECK SHADOWING

Corner cutting is caused by a direct interception of the deflected electron beam before it is reaching the screen and results in a non-scanned corner of the raster. It may be avoided by applying an appropriate deflection unit.

18. RASTER CENTRING

To centre the raster on the screen it is recommended that either a magnetic field just behind the deflection coils (viewed from the screen) be used or a direct current be passed through the deflection coils.

The centring device should provide a shift to allow for non-centrality of the spot with respect to the geometric centre of the screen, in addition the centring device should provide the shift needed to allow for non-centrality of the visible raster (i.e. to compensate for line blanking and also time base non-linearity, if any) and the earth magnetic field.

The use of a too strong centring magnetic field should be avoided; this may result in raster distortion and even corner cutting.



1

RATING SYSTEMS

(in accordance with I.E.C. publication 134)

Absolute maximum rating system

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

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

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

Design-maximum rating system

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

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

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

Design-centre rating system

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

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

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

TYPE DESIGNATION

PRO-ELECTRON TYPE DESIGNATION CODE

Single letter, group of figures, hyphen, group of figures, letter or letter group.

The first letter indicates the prime application of the tube:

A - Television display tube for domestic application.

M - Television display tube for professional application-direct view.

First group of figures: Diameter or diagonal of the face in cm.

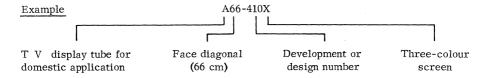
Second group of figures: Development or design number.

Final letter or letter group: Properties of the phosphor screen.

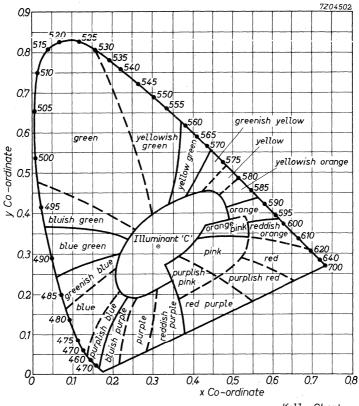
The first letter denotes the colour of the fluorescence, the second letter, if any, other specific differences in screen properties.

W - White screen for T V display tubes.

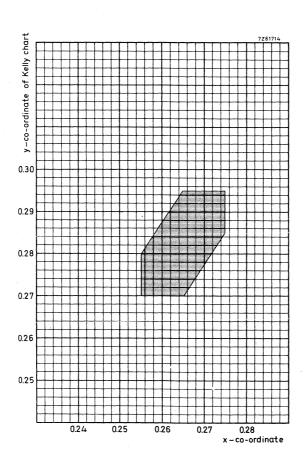
X - Three-colour screen for T.V. display tubes.



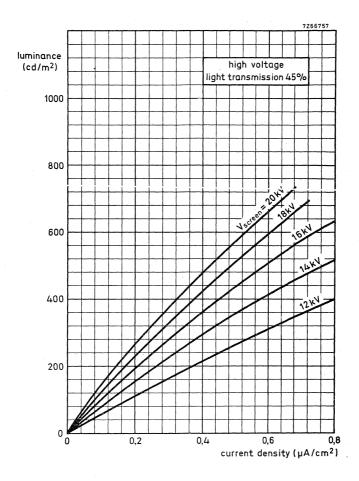
SCREEN PHOSPHORS

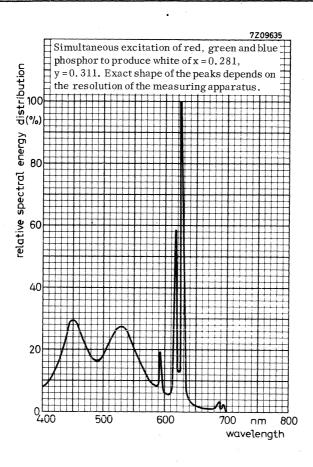


Kelly Chart



Colour point tolerance area for \boldsymbol{W} phosphor



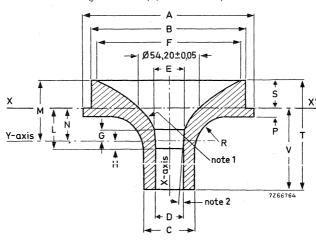


Colour coordinates

| | x | У |
|-------|--------|-------|
| red | 0,630 | 0,340 |
| green | 0,315 | 0,600 |
| blue | 0, 150 | 0,065 |

REFERENCE LINE GAUGES

REFERENCE LINE GAUGE C (JEDEC 126) (IEC 67-IV-3)



The millimetre dimensions are derived from the original inch dimensions.

| | inches | | | millimetres | | | notes |
|-----|--------|--------|--------|-------------|---------|---------|-------|
| ref | min | nom | max | min | nom | max | |
| A | - | 5,000 | - | - | 127,00 | _ | - |
| В | - | 4,500 | - | - | 114,30 | - | - |
| C | - | 2,000 | - | - | 50, 80 | - | - |
| D | 1, 168 | 1,168 | 1,171 | 29,668 | 29,668 | 29, 743 | - |
| Е | 1, 241 | 1,242 | 1,243 | 31,522 | 31,547 | 31,572 | _ |
| F | 4, 248 | 4,250 | 4, 252 | 107,900 | 107,950 | 108,000 | - |
| G | - , | 0,279 | - | - | 7,09 | - | 2 |
| Н | - | 0,250 | - | - | 6,35 | - ' | - |
| L | 1,165 | 1,170 | 1,175 | 29,60 | 29,72 | 29, 84 | 2 |
| М | - | 1,634 | - | - | 41,50 | - 1 | - |
| N | - | 0,920 | | - | 23, 37 | - | 1 |
| P | - | 0, 250 | - | - | 6, 35 | - | - |
| R | - | 1,000r | - | - | 25, 40r | ~ | - |
| S | 0,712 | 0,714 | 0,716 | 18,085 | 18, 136 | 18, 186 | - |
| Т | - | 3,214 | | - | 81,64 | - 1 | - |
| V | 2, 490 | 2,500 | 2,510 | 63, 25 | 63,50 | 63, 75 | - |

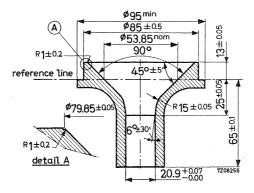
- 1. $y = 0.58 \text{ m}^2 + 0.576$ inches $(0.0228 \text{ m}^2 + 14.630 \text{ mm})$ 'y' values must be held to ± 0.002 " (0.05 mm). The Y-axis is 0.920" (23.368 mm) below the X-X' reference plane.
- 2. $4^{\circ} \pm 30'$ taper between planes G and L.

Reference line gauge for 110^{0} deflection angle.

Tune 1972

REFERENCE LINE GAUGE D

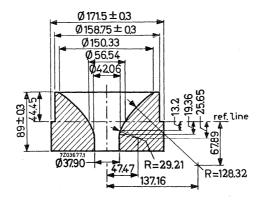
Dimensions in mm



Reference line gauge for 90° deflection angle

REFERENCE LINE GAUGE E

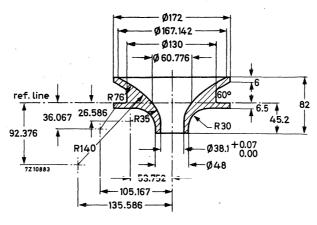
Dimensions in mm



Reference line gauge for $90^{\rm O}$ deflection angle colour tubes

REFERENCE LINE GAUGE F

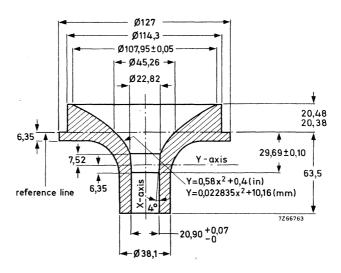
Dimensions in mm



Reference line gauge for $110^{\rm o}$ deflection angle colour tubes

REFERENCE LINE GAUGE G $(JEDEC\ G148)$

Dimensions in mm

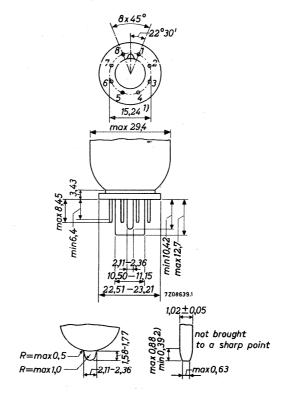


Reference line gauge for $110^{\rm O}$ deflection angle

BASES

SMALL-BUTTON NEO EIGHTAR BASE

IEC67-I-31 JEDEC B7-208 Dimensions in mm



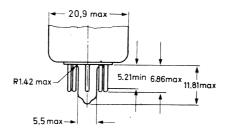
 $^{^1)}$ Base-pin positions are held to tolerances such that the base will $\,$ fit a flat-plate gauge having a thickness of 9,53 and eight equally spaced holes of 1,40 $\pm 0,01$ diameter located on a 15,24 $\pm 0,01$ diameter circle. The gauge is also provided with a centre hole to provide 0,25 diametric clearance for the lug and key. Pin fit in the gauge shall be such that the entire length of pins will, without undue force, pass into and disengage from the gauge.

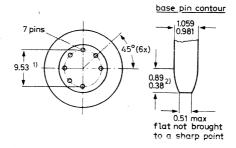


²) This dimension may vary within the limits shown around the periphery of any individual pin.

7 PIN MINIATURE BASE WITH PUMPING STEM

Dimensions of this base are within the JEDEC E7-91 dimensions



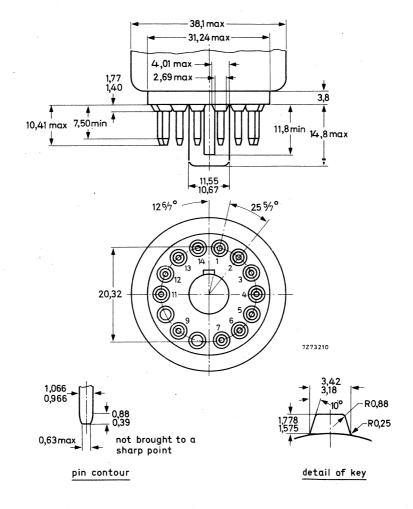




¹⁾ Base-pin and pumping stem positions are held to tolerances such that entire length of pins and stem will without undue forcepassinto and disengage from a flat-plate gauge having a thickness of 6, 35 mm and eight holes with diameters of 1, 27 ± 0 , 013 mm so located on a 9, 525 ± 0 , 013 mm diameter circle that the distance along the chord between any two adjacent hole centres is 3, 645 ± 0 , 013 mm and a centre hole of 5, 97 ± 0 ,025 mm being chamfered at the top over 1,52 mm with an angle of 45 degrees.

²⁾ This dimension around the periphery of any individual pin may vary within the limits shown.

12 PIN BASE JEDEC B12-246, IEC-67-I-47a





Colour TV picture tubes





90° COLOUR TELEVISION PICTURE TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed three-colour phosphor dot screen. A high white luminance is obtained at near unity current ratio. Being temperature compensated the shadow-mask makes for optimum field purity and good uniformity during warm-up. Minimum occurrence of the moiré effect is ensured by optimizing the mask for the reproduction of 625-line pictures. The tube has a reinforced envelope and therefore no separate safety screen is necessary.

OUICK REFERENCE DATA

| TEMPERATURE-COMPENSATED SHADOW-MASK | |
|---|---|
| SHADOW-MASK OPTIMIZED FOR 625-LINE SYSTEM | |
| HIGH WHITE LUMINANCE AT UNITY CURRENT RATIO | |
| Face diagonal | 56 cm |
| Deflection angle | 92 0 |
| Neck length | 164.2 mm |
| Envelope | reinforced suitable for push through |
| Focusing | electrostatic |
| Deflection | magnetic |

magnetic

54.5 %

6.3 V, 900 mA

SCREEN

Convergence

Heating

Metal-backed tricolour phosphor dots

Light transmission of face glass

| Discount of the second | Red: Europium activated rare earth |
|------------------------|------------------------------------|
| Phosphor type | Green and blue: sulphide type |

| Dot arrangement | Triangular |
|-----------------|------------|

Spacing between centres of adjacent dot trios $0.68\,$ mm Light transmission at centre of face glass $54.5\,$ %

HEATING

Indirect by A.C. or D.C.; parallel or series supply

Heater voltage

V_f 6.3 V

Heater current

I_f 900 mA

For maximum cathode life it is recommended that the heater supply be regulated at $6.3~\rm V$. If the tube is connected in a series heater chain the r.m.s. surge heater voltage must not exceed $9.5~\rm V$ when the supply is switched on.

CAPACITANCES

| Final accelerator to external conductive coating | C _{ag5g4/m} | max. min. | 2300 1700 | pF pF |
|--|---|--------------|--------------|----------------|
| Final accelerator to metal rimband | Cag5g4/m' | | 400 | pF |
| Grid No. 1 of any gun to all other electrodes | C_{g_1} | | 7 | pF |
| Cathodes of all guns (connected in parallel) to all other electrodes | C_k | | 15 | pF |
| Cathode of any gun to all other electrodes | C _{kR} C _{kG} C _{kB} | | | pF pF pF |
| Grid No. 3 (focusing electrode) to all other electrodes | C_{g_3} | | 7 | pF |

FOCUSING

electrostatic

DEFLECTION

magnetic

Diagonal deflection angle

92⁰

Horizontal deflection angle

79⁰

Vertical deflection angle

61⁰

CONVERGENCE

magnetic

MECHANICAL DATA

| Overall length | 472. | 2 ± 9.5 | mm. |
|---|----------------------|-------------------|----------------|
| Neck length | max. | 168.7 | mm |
| Diagonal | max. | 566.2 | mm |
| Horizontal axis | of bulb max. | 486.3 | mm |
| Vertical axis | max. | 381.8 | mm |
| Useful screen diagonal horizontal axis vertical axis | min. min. min. | 533 447 337 | mm mm mm |

MECHANICAL DATA (continued)

Mounting position: any

Net weight: approx. 150 N (15 kg)

Base: 12 pin base JEDEC B12-244 but with a 5 mm shorter spigot.

Anode contact: Small cavity contact J1-21, IEC 67-III 2.

Magnetic shielding:

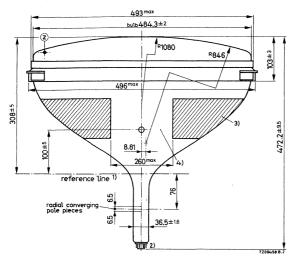
Magnetic shielding should be provided by means of a metal shield extending 24 cm over the cone of the tube measured from the centre of the face plate. The metal shell is preferably constructed of min. 0.5 mm cold rolled steel properly annealed. The air gap between the shield and the metal rimband should be as small as possible and not exceed 10 mm. The magnetic shield should be connected to the outer conductive coating.

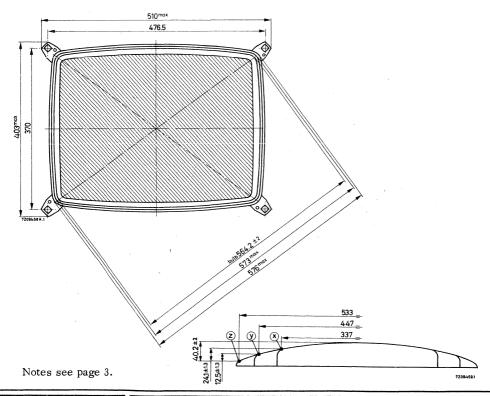
NOTES TO OUTLINE DRAWING (See pages 4 and 5)

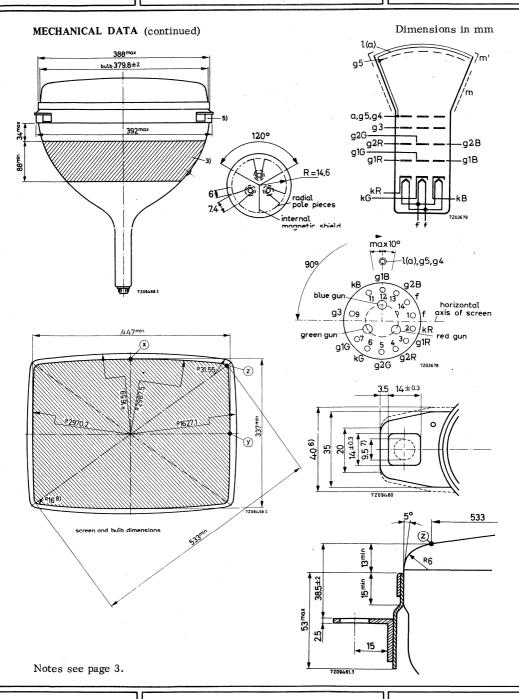
- 1. Reference line, determined by the plane of the upper edge of the flange of the reference line gauge E, when the gauge is resting on the cone.
- 2. The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with bulb axis and having a diameter of 55 mm.
- Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4. To clean this area, whipe only with a solft dry lintless cloth.
- 5. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 6. Minimum space to be reserved for mounting lug.
- 7. The position of the mounting screw in the cabinet must be within a circle of 9.5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 476.5 mm x 370 mm.
- 8. Co-ordinates for radius R = 16 mm: x = 203.92 mm, y = 145.50 mm.



Dimensions in mm

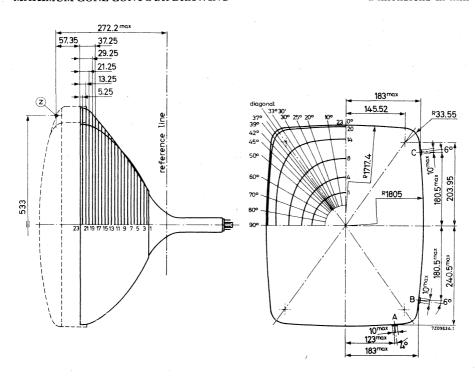






MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| | | | Distance from centre (max. values) | | | | | | | | | | | | | | |
|------|----------------|--------|------------------------------------|--------|--------|--------|---------|---------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Sec- | Nom . distance | go | 102 | 200 | 250 | 300 | 330 30' | 35° 30' 29.4" | 37 ⁰ | 390 | 42° | 45° | 50° | 600 | 700 | 800 | 900 |
| tion | from point "Z" | Long | | | | | | Diagonal | | | | | | | | | Short |
| 1 | 227.20 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 | 79.87 |
| 2 | 222.60 | 87.66 | 87.64 | | | | | 87.41 | 87.39 | 87.37 | | 87.31 | 87.26 | 87.18 | | 87.09 | 87.09 |
| 3 | 214.60 | | | | 101.53 | | | 100.32 | 100.15 | | | 99.29 | 98.82 | | 97.58 | 97.35 | 97.3 |
| 4 | 206.60 | | | | 115.05 | | | 112.87 | | | | 100.91 | | | 107.1 | 106.4 | 106.18 |
| 5 | 198.60 | | | | 127.85 | | 125.65 | 125.08 | | | | 122.33 | | | | | |
| 6 | 190.60 | 142.65 | 142.33 | 141.09 | 140.04 | 138.72 | 137.64 | 136.97 | | | | 133.49 | | | | | |
| 7 | 182.60 | 153.27 | 153.25 | 152.55 | 151.7 | 150.43 | 149.3 | 148.56 | | | | 144.39 | 141.92 | 137.01 | 132.86 | 130.1 | 129.12 |
| 8 | 174.60 | 163 | | | 162.85 | | | 159.85 | | 158.27 | | | | | | 136.96 | |
| 9 | 166.60 | | | | 173.55 | | | 170.88 | | | | 165.31 | | | | | |
| 10 | 158.60 | 180.58 | | | 183.83 | | | 181.64 | | 179.75 | | | 170.86 | | | 149.32 | |
| 11 | 150.60 | | 189.94 | | 193.7 | | | 192.15 | 191.37 | | | 184.95 | | | | | |
| 12 | 142.60 | 196.14 | | | 203.14 | | | 202.42 | | | | 194.21 | | | | 160.06 | |
| 13 | 134.60 | | | | 212.17 | | | 212.46 | | | | 203.08 | | | | | |
| 14 | 126.60 | | | | 220.78 | | | 222.29 | | | | 211,53 | | | | | |
| 15 | 118.60 | | | | 228.98 | | | 231.9 | | | | 219.53 | | | | | |
| 16 | | | | | 236.75 | | | 241.31 | | | | 227.06 | | | | | |
| 17 | 102.60 | | | | 244.11 | | | 250.52 | | | | 234.08 | | | | | |
| 18 | 94.60 | 233.31 | | | 250.88 | | | 259.54 | 258.35 | 255.57 | 248.48 | 240.57 | | | | | 181.64 |
| 19 | 86.60 | | | | 256.43 | | 268.3 | 268.38 | | | | 246.51 | | 209.86 | | 187.2 | 184.6 |
| 20 | 78.60 | | | | 260.67 | | 276.08 | 276.83 | | | | 251.68 | | | 198.05 | | 187.29 |
| 21 | 70.60 | | | | 263.22 | | | 281.74 | | | | 254.86 | | | | 191.89 | |
| 22 | 62.60 | | | | 264.5 | | | 283.65 | | | | 256.4 | | | | | |
| 23 | 57.35 | 243.81 | 247.03 | 257.06 | 264.98 | 275,16 | 282.78 | 284.11 | 283.38 | 279.97 | 268.68 | 256.95 | 240.49 | 216.63 | 201.71 | 193.49 | 190.86 |



TYPICAL OPERATING CONDITIONS

| Final accelerator voltage | V_{a,g_5,g_4} | 25 | kV |
|--|------------------|-------------|------|
| Grid No.3 (focusing electrode) voltage | ${ m v_{g_3}}$ | 4.2 to 5 | kV |
| Grid No.2 voltage for a spot cut-off voltage V _{g1} = -105 V | ${ m v_{g}}_{2}$ | 210 to 495 | v 1) |
| Grid No.1 voltage for spot cut-off at V_{g_2} = 300 V | v_{g_1} | -70 to -140 | V 2) |
| Luminance at the centre of the screen | | See page 21 | |

EQUIPMENT DESIGN VALUES (each gun if applicable)

Valid for final accelerator voltages between 20 kV and 27.5 kV.

| Grid No.3 (focusing electrode) voltage | v_{g_3} | fir | 16.8 mal accel | to 20 % o lerator v | |
|---|-------------------------------|----------------------|-----------------------|-------------------------|-------------|
| Grid No.2 voltage 1) | v_{g_2} | Se | ee cut-ofi pa | f design ige 22 | chart |
| Grid No.1 voltage for visual extinction of focused spot (cut-off voltage) 2) | v_{g_1} | Se | ee cut-off pa | f design ige 22 | chart |
| Difference in cut-off voltages between guns in any tube | ΔV_{g1} | lo | west valu of high | ie is min iest value | , 0 |
| Grid No.3 (focusing electrode) current | I_{g_3} | | -15 | to +15 | μ A |
| Grid No.2 current | I_{g_2} | | -5 | 5 to +5 | μ A |
| Grid No.1 current at $V_{g_1} = -150 \text{ V}$ | $^{\mathrm{I}}\mathrm{g}_{1}$ | | -5 | to +5 | μ A |
| To produce white of the following CIE coordinates | x y | 3) 0.310 0.316 | 4) 0.265 0.290 | 5) 0.281 0.311 | |
| Percentage of total anode current supplied by each gun (typical) red gun green gun blue gun | | 43.5 30.0 26.5 | 27.9 34.9 37.2 | 32.2 35.6 32.2 | % % % |
| Ratio of anode currents red gun to green gun | min. av. max. | 1.05 1.45 2.00 | 0.60 0.80 1.10 | 0.65 0.90 1.25 | |
| Ratio of anode current red gun to blue gun | min. av. max. | 1.20 1.65 2.25 | 0.55 0.75 .1.05 | 0.75 1.00 1.35 | |

Notes see page 8.

ELECTRICAL STATEMENT STATE

EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction

max. 13 mm

Correction which must be supplied by purifying magnet to compensate for mis-register (including caused by earth's magnetic field) when using recommended components. Measured at the centre of the screen in any direction.

max. 115 μ m

Lateral distance between the blue spot and the converged red and green spots

max. 6 mm (in both directions)

Radial convergence displacement excluding effects of dynamic convergence (each beam)

max. 9 mm 6) (in both directions)

 $^{^{\}rm l})\, {\rm This}\ {\rm range}\ {\rm of}\ {\rm Vg}_2$ has to be used when in circuit design fixed values for cut-off of the three guns are used.

 $^{^2)}$ This range of ${\rm V_{g}}_1$ has to be used when in circuit design fixed values for ${\rm V_{g}}_2$ of the three guns are used.

³⁾ To produce colour pictures with the best possible quality, this white point should be used as the transmission systems are based on this point. (Point C)

⁴⁾ To produce black/white pictures a more bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

⁵⁾ This point is a compromise between the white point C and the white point x = 0.265 and y = 0.290, given in order to enable good rendition of colour and black-and-white pictures with one white point.

⁶⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape synchronized with scanning.

LIMITING VALUES (Each gun if applicable) (Design centre rating system unless otherwise specified)

| Final accelerator voltage | v_{a,g_5,g_4} | max. min. | 27.5 20 | kV ¹) ²) ³) kV ¹) ⁴) |
|--|--|----------------------|--------------------------|---|
| Average current for 3 guns | \cdot I _a | max. | 1000 | μ A 5.) |
| Grid No.3 (focusing electrode) voltage | v_{g_3} | max. | 6000 | V |
| Grid No. 2 voltage, peak, including video signal voltage | v_{g_2p} | max. | 1000 | V |
| Grid No.1 voltage, negative negative, operating cut-off positive positive péak | -V _{g1} -V _{g1} V _{g1} V _{g1} | max. max. max. | 400 200 0 2 | V V V |
| Cathode to heater voltage, positive positive peak negative negative peak | V kf V kfp -V kf -V kfp | max. max. max. | 250 300 135 180 | V 6)7) V V V |

¹⁾ Absolute max. rating system.

²⁾ The X-ray dose rate remains below the acceptable value of 0.5 mr/h, measured with ionization chambre when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

⁴) Operation of the tube at lower voltages impairs the brightness and resolution and may have a detrimental effect on colour purity.

^{5) 1500} μA permitted provided a current limiting circuit is used.

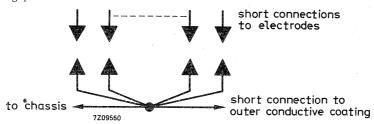
⁶⁾ In order to avoid excessive hum the a.c. component of the heater to chassis voltage should be as low as possible and must not exceed 20 $\rm V_{rms}$.

⁷⁾ During an equipment warm-up period not exceeding 15 s V_{kf} is allowed to rise to 410 V_{\bullet} . Between 15 s and 45 s after switching on a decrease in V_{kf} proportional with time from 410 V to 250 V is permissible.

REMARK

With the high voltage used with this tube (max. 27.5 kV) internal flash overs may occur, which may destroy the cathode(s). Therefore it is necessary to provide protective circuits, using spark gaps.

The sparkgaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible.

Additional information available on request.

REFERENCE LINE GAUGE

Gauge E. See chapter "Reference line gauges" in front of this book.

DESCRIPTION OF THE TUBE

The A56-120X is a rectangular temperature compensated shadow-mask colour picture tube for use in colour television receivers. The tube can display a picture, either in full colour or in black and white, on an almost rectangular, almost flat screen, with rounded-off corners of small curvature. Mounting the tube with the screen protruding through the cabinet front is possible since the rimband is clamped some distance from the screen edge. The minimum useful screen area measures 447 mm x 337 mm and has a projected area of 1471 cm²

The A56-120X has

- a deflection angle of 920
- a neck diameter of 36.5 mm
- a three-colour phosphor dot screen, composed of closely spaced dots in a regular pattern of tri-angular groups, each containing a red, a green and a blue light emitting dot.
- Three electron guns with axes tilted towards the screen centre, with electrostatic focusing systems and mounted side by side in the neck of the tube $120^{\rm o}$ apart.

Colour selection is effected by a metal graded-hole shadow mask positioned in front of the tricolour phosphor-dot screen. This mask is aligned with the dot pattern so that the electron beam from each gun lands only on phosphor dots of the associated colour.

The shadow mask has graded holes that increase gradually in diameter from the edge of the mask towards the centre. Grading enables correct purity to be achieved over the whole screen with minimum adjustment.

Although the three guns are tilted towards the screen centre so that their axes intersect at the shadow mask, lateral and radial convergence are necessary to ensure correct convergence over the entire screen. Each of the three guns is therefore provided with a pair of radial converging pole pieces.

Radial convergence can be achieved by means of magnets and coils mounted externally on the neck of the tube. The magnetic flux provided is coupled through the glass neck of the tube to associated internal pole pieces. The shape of the pole pieces, together with the internal magnetic shielding, is shown in Fig. 1. Internal shielding prevents interaction of the various magnetic fields.

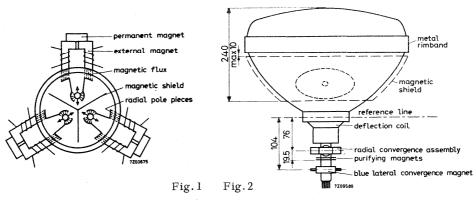


Fig. 2 shows the position of the components on the neck of the tube.

Lateral convergence is achieved by a separate assembly mounted on the neck of the tube. This assembly causes horizontal movement of the blue beam, and simultaneously, movements of the red and green beams in the opposite direction.

Facilities for dynamic blue lateral convergence are also provided in this convergence assembly.

APPLICATION NOTES

1. Magnetic shielding

The tube should be fitted with a magnetic shield around the cone, to minimize the effects of external magnetic fields, including the horizontal, vertical and axial components of the earth's magnetic field. The latter so influences the colour purity that compensation by means of the purifying magnets is not possible.

The metal shield should preferably be constructed of coldrolled steel, at least 0.5 mm thick and properly annealed at 850 °C. Since the tube re-inforcing band is an essential part of the magnetic circuit used for degaussing, the air gap between the band and the shield should be as small as possible and certainly not more than 10 mm. To be effective, the shield must be degaussed as described under "Adjustment procedures". Building-in of an automatic degaussing system is advised.

2. Centring of raster on the screen.

Raster centring in a shadow-mask colour picture tube is achieved by passing direct current of the required value through each pair of deflection coils. The values for raster displacement given in the data apply when all components are properly adjusted.

3. Component considerations.

The necessary components are the deflection coil, the radial convergence assembly, the purifying magnets and the blue lateral convergence magnet. Basically the functions of the components are:

- deflection of the three beams over the entire screen: deflection coil.
- good convergence of the three beams over the screen: radial convergence assembly and blue lateral convergence magnet.
- landing adjustment: purifying magnets and deflection coil

The mounting positions of the components are as follows:

The deflection coil: in such a way that its deflection centre coincides with the one used in the screen-laying process during manufacturing. The coil must therefore be designed so that sufficient movement in the axial direction is possible.

The <u>radial convergence assembly:</u> with its pole pieces centred above the convergence pole pieces inside the tube. Initially, the assembly should be mounted upright. Small rotations of the whole assembly influence the convergence and can be used during adjustment of the blue lateral correction to obtain optimum lateral convergence.

The <u>purifying magnets</u>: over the gap between the electrode g3 and g4 of the gun, or still closer to the deflection coil. Placing the purifying magnets closer to the base results in poorer performance as the spot quality is adversely affected.

The <u>blue lateral convergence magnet</u>: as near as possible to the rear side of the purifying magnets but not shifted backwards more than halfway along electrode g3 of the gun.

3.1 Convergence

Static convergence, i.e. convergence of the three beams onto the centre of the screen, is usually accomplished with permanent magnets which are part of the radial convergence assembly, or with D.C. currents through the convergence coils in combinations with the lateral converging magnet.

The strength of the magnetic field that is adjustably coupled to the radial convergence pole pieces of the gun should be such that each beam can be moved 9 mm in both directions towards the centre of the screen excluding effects of dynamic convergence. The static blue lateral convergence magnet should provide a magnetic field adjustable in magnitude and polarity.

This field exerts a directive force on the blue beam and simultaneously a force in the opposite direction on the green and the red beams.

The displacement of the blue beam opposite to the movement of the red and green beams should be 6 mm in both directions.

With these four adjustable magnetic fields static convergence of the three beams can be attained.

For good convergence over the entire screen dynamic radial convergence is required together with a small amount of dynamic lateral convergence in line direction.

The radial convergence assembly consists fundamentally of three cores with associated windings. Through the windings are passed the necessary currents for maintaining convergence when the beams are deflected over the screen.

The required form of the currents can be obtained by adding a current with a sawtooth wave form to one with a parabolic wave form. Two separate windings are required for correction in the horizontal and the vertical direction. The parabolic and sawtooth currents should be adjustable in amplitude and the sawtooth currents and the vertical blue parabola should, in addition be adjustable in polarity.

The blue lateral convergence magnet consists of a core and associated windings to obtain dynamic lateral convergence in line direction.

3.2 Landing

Landing is defined as the relative position of each beam with respect to its associated phosphor dot.

 $Good\ landing$ is achieved when each beam excites only its associated colour phosphor dot.

Optimum landing is achieved by adjusting both the purifying magnets and the deflection coil .

August 1968

3.2.1 Purifying magnets

Purifying magnets are required to compensate for the effects of outside magnetic fields, (including the earth's magnetic field), and manufacturing variations, which could cause mislanding.

Such purifying magnets, designed to provide a magnetic field adjustable in magnitude and direction, effect good landing over the entire screen when the deflection coil position is properly adjusted.

3.2.2 Deflection coil

The position of the deflection centre must be adjustable to make sure that proper landing can be attained in any set. To achieve this the deflection coil should be free to move along the neck over a minimum distance of 12 mm from its most forward position when the purity adjustment is made with the aid of a microscope, or about 20 mm if purity is adjusted by means of the so-called "red ball" method. (See 6.1.2.1.)

4. Drive requirements

To calculate the drive voltages which should be supplied to the tube the following points should be taken into account. \cdot

4.1 In presently known systems the luminance signal is composed as follows:

Y = 0.30R + 0.59G + 0.11B.

The colour information is carried by two chrominance signals which in the receiver after subcarrier detection, deliver the so-call colour difference signals R-Y, G-Y and B-Y.

These have to be combined with the Y-signal in a matrix circuit to recover the original red, green and blue signals. With the aid of the luminance signal equation it is possible to calculate the maximum voltage ranges for the colour difference signals. The maximum values are reached when the primary colours and their complementaries are produced at maximum brightness.

These values are tabulated below. All values are referred to the maximum value Y=R=G=B=1 for peak white and are considered positive if they cause an increase in beam current.

| Colour | R | G | B | Y | R-Y | G-Y | B-Y |
|---------|---|---|---|------|-------|-------|-------|
| Red | 1 | 0 | 0 | 0.3 | 0.7 | -0.3 | -0.3 |
| Green | 0 | 1 | 0 | 0.59 | -0.59 | 0.41 | -0.59 |
| Blue | 0 | 0 | 1 | 0.11 | -0.11 | -0.11 | 0.89 |
| Cyan | 0 | 1 | 1 | 0.7 | -0.7 | 0.3 | 0.3 |
| Magenta | 1 | 0 | 1 | 0.41 | 0.59 | -0.41 | 0.59 |
| Yellow | 1 | 1 | 0 | 0.89 | 0.11 | 0.11 | -0.89 |

| Signal | Minimum | Maximum | Total range |
|--------|---------|---------|-------------|
| R-Y | -0.7 | 0.7 | 1.4 |
| G-Ÿ | -0.41 | 0.41 | 0.82 |
| B-Y | -0.89 | 0.89 | 1.78 |

In practice the saturation of the colours is lower than that of the primary colours as considered above, so that the demands on the colour difference signals can be lower than those indicated.

- 4.2 The combining of the Y-signal with the R-Y, G-Y and B-Y signals can be performed by two methods:
- Method 1. Letting the picture tube perform the matrix function by driving the cathodes with the luminance signal while putting the colour difference signals onto the three first grids of the picture tube. (colour difference drive)
- Method 2. By means of a separate matrix circuit that delivers red, green and blue signals to the picture tube. (R.G.B. drive). If fed to the three cathodes these signals attain the same maximum amplitudes as the Y-signal in the first method, and it should be remembered that each channel requires full video bandwidth.

In both methods it should be recognized that with cathode drive a higher slope is obtained than with grid drive and to compensate for this higher drive voltages are required for grid drive in each case. For grid drive the relation between grid drive voltage ($V_{\mbox{drg}}$) and beam current (I_a) is approximately:

$$I_a = k \frac{V_{drg}^3}{V_{cog}^{3/2}}$$
 ($I_a \text{ in } \mu A$)
($V_{cog} \text{ is cut-off voltage for grid drive})$
($V_{cog} \text{ is cut-off voltage for grid drive})$

For cathode drive this function reads:

$$I_{a} = \frac{k (1+D)^{3}}{\left(1+D\frac{V drk}{V_{cok}}\right)^{3/2}} \cdot \frac{V drk^{3}}{(V_{cok})^{3/2}} \quad (V_{cok} = \text{cathode drive voltage}) \\ (V_{cok} = \text{cut-off voltage for cathode drive}) \\ (D = \text{penetration factor})$$

This shows that there is a difference in sensivity between the two drive techniques, and that the relationship between them is not strictly linear. In practice the best result is obtained if the gridsignal amplitudes are made 20% larger than the corresponding cathode signal amplitudes.

- 4.3 Unequal currents are required for the red, green and blue signals to produce white as the efficiencies of the red, green and blue phosphors are different. (See Equipment Design Values)
- 4.4 Spread occuring in picture tube properties:
 - (1) k factor, (2) penetration of g2 (D) and (3) phosphor efficiencies.

- (1) The k factor, having a nominal value of 3.0, spreads between 2.6 and 3.1 but it can be derived from the I_a = f(V_{dr}) graph for cathode drive that compensation for this spread is attainable when the luminance drive stage is capable of producing approx. 6 volts more than the nominal peak drive needed for the red gun.
- (2) The penetration D may spread from 0.18 to 0.40 with a nominal value of 0.29 and is experienced as a spread in V_{CO} . It can be offset if required by adjustment of V_{g_2} (See page 22).
- (3) Phosphor efficiencies: the ratios of cathode currents for white having, for example, CIE x and y coordinates:

x = 0.281 and y = 0.311, may spread as follows:

$$\frac{I_R}{I_G}$$
 = 0.90 with a min. value of 0.65 and a max. value of 1.25

$$\frac{I_R}{I_B}$$
 = 1.00 with a min. value of 0.75 and a max. value of 1.35

In calculations, for the worst case the values I_R/I_G = 1.25 and I_R/I_B = 1.35 should be used if the compromise white point is chosen (x = 0.281 y = 0.311). If the white point C is chosen for reproduction of colours then for the worst case the current ratio values, I_R/I_G = 2.00 and I_R/I_B = 2.25 should be used.

5. Raster shape correction

It appears that for 90° deflection the combination of picture tube and deflection coil can give good convergence and landing, but it is not practical to design the combination such that a perfectly rectangular raster is obtained. To avoid the pin cushion raster which results it is necessary to provide raster correction electrically by modulating the deflecting current.

Adjustment procedures

The following procedures are suggested to ensure good landing, optimum convergence of the three beams over the entire area of the screen and good grey scale tracking.

Exact focusing is the final operation in the sequence of adjustments, see 6.3. When starting the sequence it is sufficient to adjust the convergence test pattern for optimum sharpness.

Prior to the adjustment procedure the picture tube has to be degaussed. This treatment will correct for localized areas of colour impurity resulting from any magnetization of the shield and internal tube parts and minimize the effect of the earth's magnetic field. Degaussing can be obtained by a coil that consists of 800 turns of 0.7 mm dia. enamelled copper wire (for 220 $\rm V_{\rm rms}$) and has an outer diameter of approx. 300 mm.

The coil should be moved such that the entire screen is subjected to its field. After about 10 seconds, the coil is moved away from the face plate to a distance of at least 2 m and disconnected from the A.C. power supply.

During manufacture the receiver chassis should be degaussed in a similar manner, with the receiver switched on and care should be taken that the assembly line is properly degaussed. An automatic degaussing system built into the receiver serves for degaussing during normal operation.

It is recommended that the receiver has some adjustments made before the picture tube is built in. These adjustments should include EHT and deflection, and the dynamic convergence in order to facilitate the adjustment of purity and static convergence. Before deflection power and high voltage are applied to the tube, the bias control should be adjusted for maximum bias. After deflection power and high voltage are applied, the beam currents should be increased gradually to minimize the possibility of tube damage in the event of circuit faults. With the application of a test signal, initial adjustment of focus, raster size, linearity and centring should be made.

6.1 Colour purity and convergence procedures

The normal sequence involves, first, static convergence adjustment next the purifying magnet and adjustment of the axial position of the deflection coil, and lastly final adjustment of dynamic convergence.

6.1.1 Static convergence adjustment

A crosshatch pattern is the most suitable signal for convergence adjustments. The pattern should be displayed at moderate brightness to improve the accuracy. It is advisable to converge red and green first, with the blue gun cut off, and then to converge blue into the yellow pattern formed by the coinciding of red and green lines.

The red and green beams are made to converge statically by adjusting the permanent magnets of the radial convergence assembly, or the corresponding D.C. currents. Correct convergence is obtained when the lines in the centre converge to give yellow.

Before the blue lateral convergence magnet is used, the blue lines are brought horizontally adjacent to the yellow lines by means of the radial blue static convergence adjustment (permanent magnet or D.C. current).

Hereafter the blue lines are made to converge with the yellow lines in the centre with the aid of the blue lateral convergence magnet, resulting in white lines in the centre. If necessary this procedure is repeated.

6.1.2 Adjustment for colour purity

Adjustment for colour purity involves two steps:

Adjustment of the purifying magnets. (6.1.2.1)

Adjustment of the position of the deflection coil. (6.1.2.2)

To obtain optimum adjustment, the static and dynamic convergence should be adjusted previously and the picture tube degaussed and well warmed up to normal operating temperature (approx. 30 min, total beam current 600 μ A). Purity assessments are best made on a plain raster.

August 1968 | 17

Adjustment of the purifying magnets influences purity all over the screen. The deflection coil adjustment influences purity mainly at the screen edges. Therefore, the magnets have to be adjusted before the coil.

6.1.2.1 The purifying magnets are adjusted, judging by the landing in the screen centre. There are two ways of doing this.

The <u>first method</u> makes use of a microscope (magnification about 50x). With this method, the deflection coil need not possess more axial adjustment margin than that needed to cope with the spreads of the deflection centres. (12 mm total).

With the microscope, the position of the spot trio's is compared with the position of the phosphor dot trio's at the screen centre. To do this, the three colour rasters are displayed simultaneously, and the phosphor dots are illuminated by means of a light source, shining onto the screen at a small angle. The spot trio's should be made to land on the phosphor dot trio's as shown in Fig.1, with their centre points coinciding.

Due to the beam grouping used in this tube (which improves the overall landing) the spots will then be approx. 25 μm eccentric with respect to their corresponding phosphor dots.

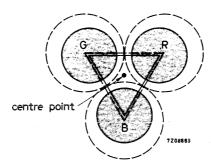
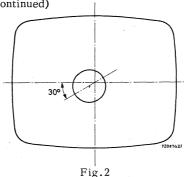


Fig.1. Correct landing in the screen centre.

The <u>second method</u> ("Red ball" method) is applicable if the mounting of the deflection coil is such that it can be drawn away approx. 20 mm backwards from its foremost position when it touches the funnel.

The coil is moved backwards as far as possible, and only the red raster is turned on. (The red gun needs relatively the highest current, thus mislanding on blue and green phosphor dots is seen more clearly so that a sharp indication is obtained).

Now a red area of approx. 10 cm diameter is visible on the screen, surrounded by discoloured and blue and green areas. With the aid of the purifying magnets, the red area is positioned near the screen centre. In order that the above mentioned beam grouping shows to full adventage, the red area should be positioned 20 mm down to the left of the screen centre, see Fig.2.



- 6.1.2.2 After adjustment of the purifying magnets, the deflection coil is adjusted by shifting it axially until optimum landing over the entire screen is reached. This can be done in two stages:
 - 1. Only the red raster turned on, and the coil position giving an overall pure red raster sought.
 - 2. For the final adjustment, a white raster is displayed and, if necessary, very slight adjustment of the deflection coil position made to obtain the best white uniformity.

After having completed 1 and 2, the red, green and blue rasters are checked separately for their purity, and if necessary the procedure repeated.

6.1.3 Adjustment of dynamic convergence

Just as for the static convergence a crosshatch pattern is recommended, displayed at low luminance.

It is advisable to adjust first the convergence in the vertical direction (with frame frequency) and then the horizontal convergence (with currents of line frequency). During the dynamic convergence adjustments, the static convergence (6.1.1) may need readjustment depending on the efficiency of any clamping circuits used.

A favourable sequence is to adjust the red and green convergence controls first so that both rasters coincide to display yellow lines while the blue gun is kept cut-off. Thereafter the blue pattern is added and adjusted to coincide with the yellow to give a white pattern. However, as the blue horizontal convergence system usually has a significant power consumption which influences the line time base to some degree, it is often advisable to start the whole convergence procedure by adjusting the blue horizontal convergence controls coarsely to give a straight blue horizontal centre line.

During the vertical dynamic convergence adjustment, the vertical axis of the screen should be taken as reference, while the horizontal adjustments should be referred to the horizontal axis. During the latter sequence the lateral blue dynamic convergence is also adjusted.

The currents for dynamic convergence (except blue lateral) consist of two components, viz. one of parabolic and one of sawtooth wave form. Usually both have their own controls which have to be adjusted in combination to obtain convergence. The parabolic ("amplitude") controls are used to make the configurations at the extremities of the picture axis equal to that at the centre. With the sawtooth ("phase" or "tilt") control the two extremities of the picture axis are made equal to each other as far as possible.

In addition, the blue horizontal convergence needs an extra waveform correction to correct for the tilting of the outer edges.

The blue lateral waveform needed is basically a sawtooth. Left-to-right asymmetry can be adjusted by slight rotation of the radial convergence assembly.

By repeated adjustments of the controls the line patterns in the various colours ultimately coincide and become parallel to each other. Thereafter these are made to coincide with the aid of the static convergence magnets to white lines.

After convergence onto the axes is obtained, usually some errors in the corners of the picture remain. Slight readjustment may be needed to minimize these errors.

At the end of the procedure purity is checked, and readjusted if needed, with the aid of the purifying magnets.

6.2 Adjustment of grey scale

This adjustment is carried out last of all and the sequence of the manipulations depends on receiver circuitry.

To obtain a constant hue of white over the whole grey scale when displaying a monochrome signal, the three guns must track accurately. This can be achieved by adjusting two points of each gun characteristic, one near cut-off and one near the highlights. To this end the following variables are available, and in a receiver two of them must be made adjustable for each gun:

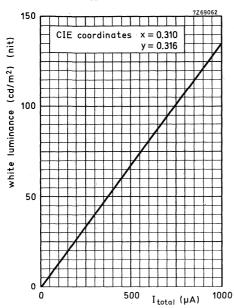
- 1. cut-off point (V_{g_1})
- 2. slope (V_{g_2})
- 3. drive

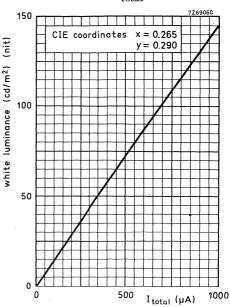
The proper adjustment procedure depends on receiver circuitry. After adjustment, the luminance and contrast controls should not cause any change in hue, and the chosen white point should be displayed.

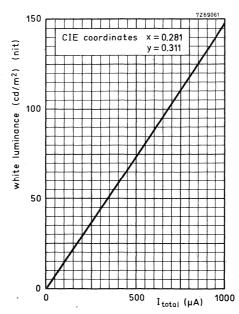
6.3 Focusing

The focusing voltage for all three guns can be adjusted via the common focus base pin No.9. In order to obtain optimum focus it is recommended to use a black-and-white picture with a low peak to mean luminance ratio, such as the RMA test picture, running at a total mean current of about 1 mA (peak currents in the three guns in the order of 2.5 mA), and to focus at the highlights. This procedure will give best overall focus.

Luminance at the centre of the screen as a function of $I_{\mbox{total}}$

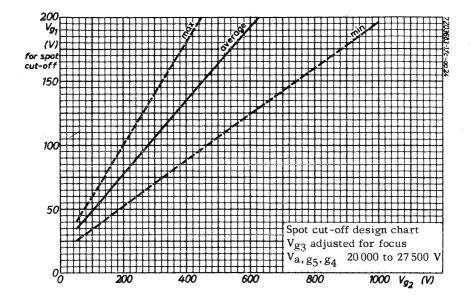


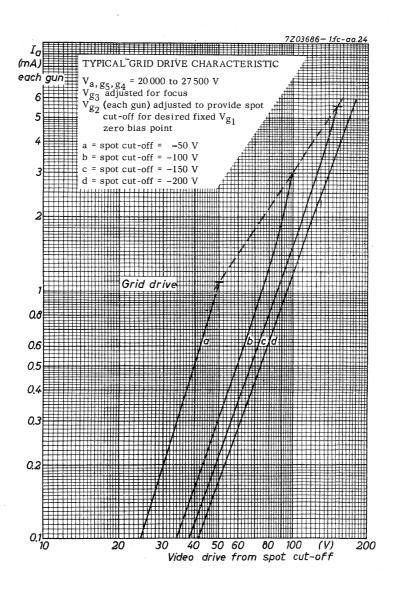


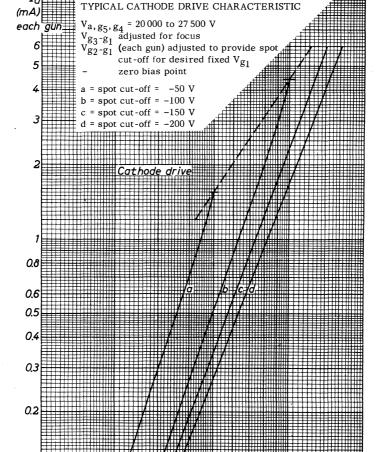


Scanned area 447 mm x 337 mm









) 40 50 60 80 100 (V) Video drive from spot cut-off

7Z03684-1,fc-aa.24



200

110° COLOUR TELEVISION TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed three-colour phosphor dot screen and internal magnetic shield. A high white luminance is obtained at near unity current ratio. Being temperature compensated, the shadow-mask makes for optimum field purity and good uniformity during warm-up. The design is such that minimum occurence of the moiré effect is ensured. The tube has a reinforced envelope and therefore no separate safety screen is necessary.

| QUICK REFERENCE DATA | |
|---|---|
| TEMPERATURE-COMPENSATED SHADOW-MASK | |
| DESIGNED FOR MINIMUM MOIRE EFFECT | |
| HIGH WHITE LUMINANCE AT UNITY CURRENT RATIO | |
| Face diagonal | 56 cm |
| Deflection angle | .110 ° |
| Neck diameter | 36.5 mm |
| Envelope | reinforced suitable for push through |
| Magnetic shield | internal |
| Focusing | bipotential |
| Convergence | magnetic |
| Heating | 6.3 V, 900 mA |
| Light transmission of face glass | 54.5 % |

A56-140X

SCREEN

Metal-backed phosphor dots

Red: Europium activated rare earth

Phosphor type Green: Sulphide type

Blue: Sulphide type

Dot arrangement Triangular

Spacing between centres of adjacent dot trios 0.81 mm

Light transmission at centre of face glass

54.5 % **⋖**

HEATING: indirect by A.C. or D.C.; parallel or series supply

For maximum cathode life it is recommended that the heater supply be regulated at 6.3 V.If the tube is connected in a series heater chain the surge heater voltage must not exceed 9.5 $V_{\rm rms}$ when the supply is switched on.

CAPACITANCES

| conductive coating | Ca, g5, g4/m | max. min. | 1800 1300 | pF pF |
|--|---|--------------|--------------|----------------|
| Final accelerator to metal rimband | C_a , g_5 , g_4/m | max. | 400 | pF |
| Grid No. 1 of any gun to all other electrodes | c_{g1} | | 7 | pF |
| Cathodes of all guns (connected in parallel) to all other electrodes | C_k | | 15 | pF |
| Cathode of any gun to all other electrodes | $egin{array}{l} { m C}_{ m k_R} \\ { m C}_{ m k_B} \end{array}$ | | 5 5 5 | pF pF pF |
| Grid No.3 (focusing electrode) to all other electrodes | $C_{ m g3}$ | | 7 | pF |

FOCUSING bipotential

DEFLECTION magnetic

Diagonal deflection angle
Horizontal deflection angle
Vertical deflection angle
77

CONVERGENCE magnetic

MECHANICAL DATA

| Overall length | | | 387.3 to | 400.3 | mm |
|-----------------|---------|---|----------|-------|----|
| Neck diameter | | | | 36.5 | mm |
| Diagonal | | | max. | 566.2 | mm |
| Horizontal axis | of bulb | | max. | 486.3 | mm |
| Vertical axis | | | max. | 381.8 | mm |
| Useful screen | | | | | |
| diagonal | | | min. | 533 | mm |
| horizontal axis | | | min. | 447 | mm |
| vertical axis | | ė | min. | 337 | mm |

Mounting position: any

Net weight : approx. 14.5 kg

Base : 12 pin base JEDEC B12-246

Anode contact : Small cavity contact J1-21, IEC 67-III-2

Magnetic shielding, degaussing: The tube is provided with an internal magnetic shield. The internal magnetic shield and the shadow-mask with its suspension system may be provided with an automatic degaussing system, consisting of two coils covering left and right cone parts. For proper degaussing an initial m.m.f. of 450 ampereturns is required in each of the coils. This m.m.f. has to be gradually decreased by appropriate circuitry. After decreasing to $10\,\mathrm{A.t.}$ or less, sudden switch off is permissible. In the steady state, no significant m.m.f. should remain in the coils ($\leq 0.5\,\mathrm{A.t.}$).

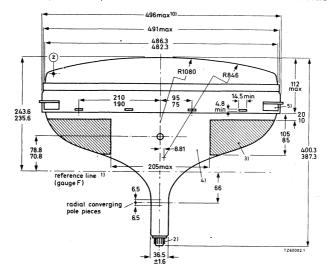
To ease the mounting of the coils, the rimband is provided with rectangular holes.

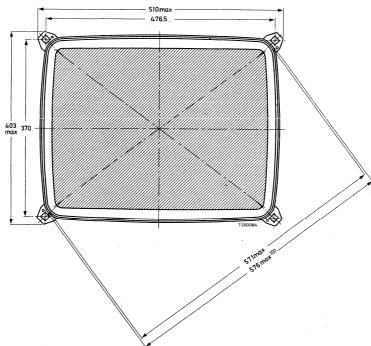
NOTES TO OUTLINE DRAWING (See pages 4, 5, and 6)

- 1) Reference line, determined by the plane of the upper edge of the flange of the reference line gauge, when the gauge is resting on the cone.
- 2) The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a concentric circle with the tube axis and having a diameter of 55 mm.
- 3) Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4) To clean this area, whipe only with a soft lintless cloth.
- 5) The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 6) Minimum space to be reserved for mounting lug.
- 7) The position of the mounting screw in the cabinet must be within a circle of 9.5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 476.5 mm x 370 mm.
- 8) Coördinates for radius R = 15.95 mm: x = 203.95 mm, y = 145.52 mm.
- 9) Distance from point Z to any hardware.
- 10) Maximum dimensions in plane of lugs.

MECHANICAL DATA (continued)

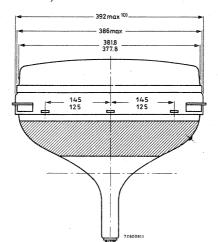
Dimensions in mm



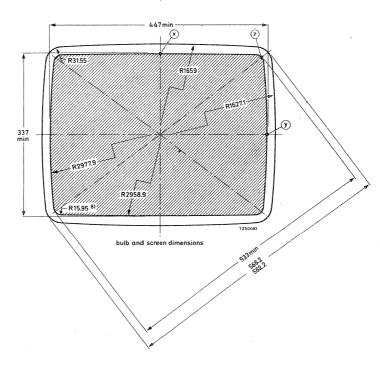


Notes see page 3

MECHANICAL DATA (continued)



Dimensions in mm



Notes see page 3

MECHANICAL DATA (continued) Dimensions in mm 533 ----13 ⁹⁾ min ₹R6 41 | 36 25 max 14 min 40 6) max 57 max 7260078.2 4-15 → 120° a,g5,g4 g2G g1G = g2B g1R g1B magnetic shield → max10° l(a),g5,g4 909

horizontal axis of screen

Notes see page 3

TYPICAL OPERATING CONDITIONS

| Final accelerator voltage | Va, g5, g4 | | 25 | kV | |
|---|--------------|----------------|--------------|----|----|
| Grid No. 3 (focusing electrode) voltage | V_{g3} | 4.2 to | 5 | kV | |
| Grid No. 2 voltage for a spot cut-off | 80 | | | | |
| voltage $V_{g_1} = -105 \text{ V}$ | v_{g2} | 212 to | 495 | V | 1) |
| Grid No. 1 voltage for spot cut-off | 04 | | | | |
| at $V_{g2} = 300 \text{ V}$ | v_{g_1} | - 70 to | -14 0 | V | 2) |
| Luminance at the centre of the screen | , U - | see pag | e 11 | | |

EQUIPMENT DESIGN VALUES (each gun if applicable)

| Valid for final accelerator voltages between Grid No.3 (focusing electrode) voltage | 20 kV and 2° V_{g3} | 16.8 | to 20% | | | |
|---|--|----------------------------------|--|------------------------------|--|--|
| Grid No. 2 voltage | v_{g2} | See cut | final accelerator voltage See cut-off design chart page 12 | | | |
| Grid No. 1 voltage for visual extinction of focused spot (cut-off voltage) ²) | v_{g1} | | See cut-off design chart page 12 | | | |
| Difference in cut-off voltages between guns in any tube | ΔV_{g1} | | lowest value is min. 65% of highest value | | | |
| Grid No. 3 (focusing electrode) current Grid No. 2 current Grid No. 1 current at V _{g1} = -150 V | $egin{array}{l}_{\mathrm{g}3}\ \mathrm{I}_{\mathrm{g}2}\ \mathrm{I}_{\mathrm{g}1} \end{array}$ | -5 -5 -5 | to +5 to +5 to +5 | μA | | |
| To produce white of the following CIE coordinates | x y | 3 ₎ 0.265 0.290 | 4) 0.281 0.311 | 6) 0.313 0.329 | | |
| Percentage of total anode current supplied by each gun (typical) red gun green gun | , | 25.8 33.5 | 30.2 34.5 | 41.0 31.3 | | |
| blue gun Ratio of anode currents red gun to green gun | min. | 40.7 0.55 0.75 1.10 | 35.3 0.65 0.90 1.25 | 0.95 1.30 | | |
| Ratio of anode currents red gun to blue gun | max. min. av. max. | 0.50 0.65 0.85 | 0.65 0.85 1.15 | 1.80 1.15 1.50 2.00 | | |

EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction max. 11

Correction that must be supplied by purifying magnet to compensate for mis-register in any direction max. 100

Lateral distance between blue spot and the converged red and green spots max. 4.5

Radial convergence displacement excluding effects of dynamic convergence (each gun) ⁵)

max. 7 mm (in both directions)

(in both directions)

mm

 μm

mm



 $^{^{1}}$) This range of V_{g2} has to be used when in circuit design fixed values for cut-off of the three guns are used.

²⁾ This range of V_{g1} has to be used when in circuit design fixed values for V_{g2} of the three guns are used.

³⁾ To produce black/white pictures a bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

⁴) This point is a compromise between white point D and the white point x = 0.265 y = 0.290, given in order to enable good rendition of colour and black and white pictures with one white point.

⁵⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape through the convergence coils synchronized with scanning.

⁶⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point (Point D).

LIMITING VALUES (Each gun if applicable)

(Design centre rating system unless otherwise specified)

| Final accelerator voltage | V _a , g ₅ , g ₄ | max. min. | 27.5 20 | kV1)2)3) kV1)4) |
|--|--|--------------|------------|--------------------|
| Average current for three guns | I_a | max. | 1000 | μA^5) |
| Grid No.3 (focusing electrode) voltage | v_{g3} | max. | 6000 | V |
| Grid No. 2 voltage, peak, including video signal voltage | $ m V_{g2p}$ | max. | 1000 | V |
| Grid No. 1 voltage, | | | | |
| negative | -Vg1 | max. | 400 | V |
| negative, operating cut-off | -V _{g1} | max. | 200 | V |
| positive | v_{g_1} | max. | 0 | V |
| positive peak | V_{g1p}^{g1} | max. | 2 | V |
| Cathode to heater voltage, | | | | |
| positive | v_{kf} | max. | 250 | v6)7) |
| positive peak | V_{kf_D} | max. | 300 | V |
| negative | -V _{kf} | max. | 135 | V |
| negative peak | $-v_{kfp}$ | max. | 180 | V |

¹⁾ Absolute max. rating system.

²⁾ The X-ray dose rate remains below the acceptable value of 0.5 mr/h, measured with ionization chamber when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

⁴⁾ Operation of the tube at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

 $^{^5)~1500~\}mu\text{A}$ permitted provided a current limiting circuit is used.

 $^{^{6}}$) In order to avoid excessive hum the a.c. component of the heater to chassis voltage should be as low as possible and must not exceed 20 V_{rms} .

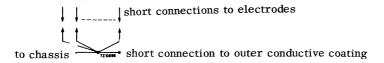
 $^{^{7})}$ During an equipment warm-up period not exceeding 15 s $\rm V_{kf}$ is allowed to rise to 410 V. Between 15 s and 45 s after switching on a decrease in $\rm V_{kf}$ proportional with time from 410 V to 250 V is permissible.

A56-140X

REMARKS

With the high voltage used with this tube (max. 27.5 kV) internal flash-overs may occur. These may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible.

Additional information is given in Application Information 258, available on request.

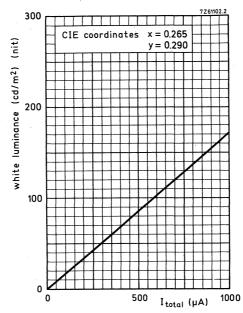
During shipment and handling the tube should not be subjected to accelerations greater than 35 g in any direction.

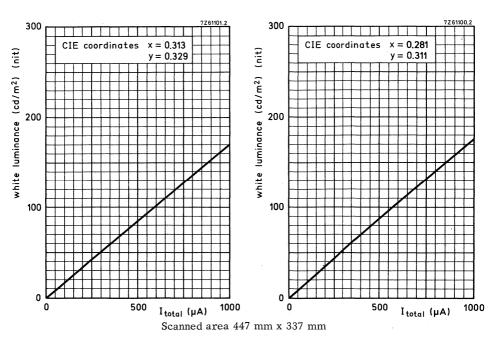
REFERENCE LINE GAUGE (Gauge F)

Gauge F. See chapter "Reference line gauges" in front of this book.

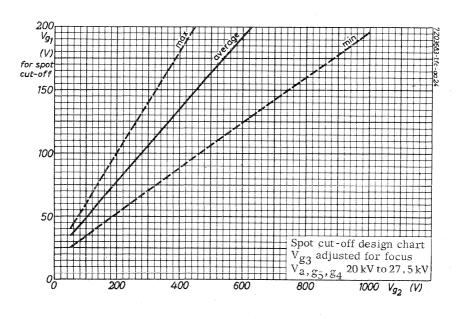


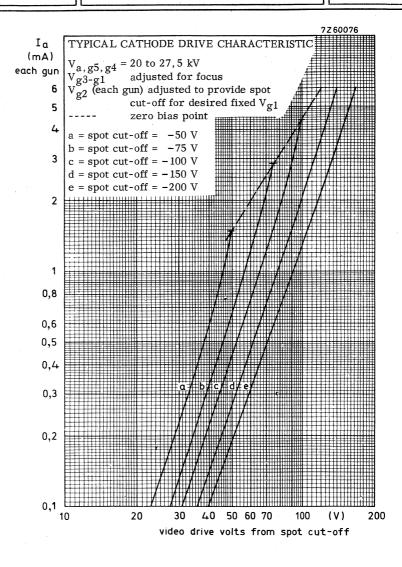
Luminance at the centre of the screen as a function of $I_{\mbox{total}}$

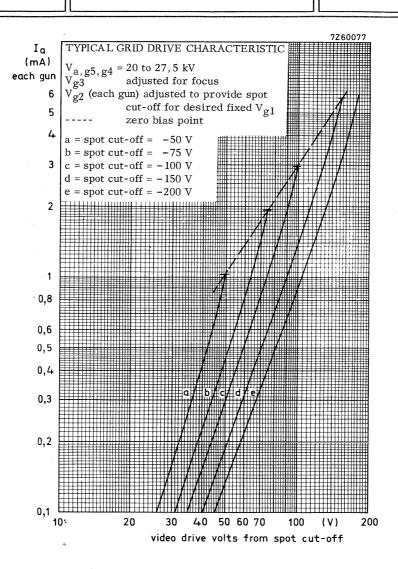


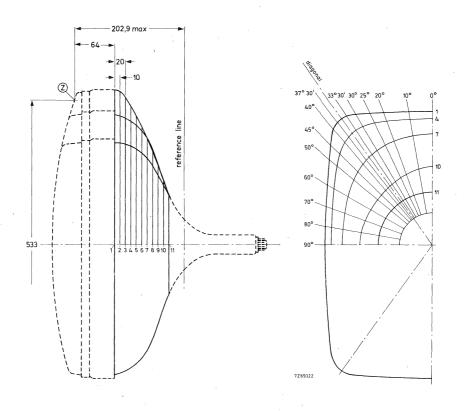












A56-140X

| Sec- | Nom. distance | | Distance from centre (max. values) | | | | | | | | | | | | | |
|------|-------------------|-------|------------------------------------|-------|-------|--------|--------|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| tion | from section 1 | 0° | 10° | 20" | 25° | 30° | 33°30' | diag. | 37°30° | 40° | 45° | 50° | 60° | 70° | 80° | 90° |
| 1 | 0 | 248,0 | 251,2 | 261,3 | 269,3 | 279,5 | 286,8 | 288,0 | 286,8 | 281,7 | 262,3 | 245,9 | 222,0 | 207,0 | 198,7 | 196,0 |
| 2 | 10 | 244,4 | 247.6 | 257,5 | 265.4 | 275,3 | 282,3 | 283,3 | 282,0 | 276,8 | 257,8 | 241,6 | 218,0 | 203,2 | 195,0 | 192,4 |
| 3 | 20 | 240,5 | 243.6 | 252,9 | 259.6 | 267,0 | 271,2 | 271.3 | 269,7 | 265,3 | 250,6 | 236,6 | 214,2 | 199,6 | 191,4 | 188,8 |
| 4 | 30 | 235,0 | 237.8 | 245,5 | 250,2 | ,254,4 | 255,7 | 255,0 | 253,3 | 249,9 | 239,5 | 228,3 | 208,6 | 194,8 | 186,9 | 184,3 |
| 5 | 40 | 227,7 | 229,9 | 235.2 | 237,8 | 239,1 | 238,7 | 237,6 | 236,0 | 233,3 | 225,8 | 217,3 | 201,0 | 188,8 | 181,6 | 179,2 |
| 6 | 50 | 218,2 | 219.6 | 222.2 | 222,9 | 222,3 | 220.8 | 219,6 | 218,1 | 215,8 | 210,1 | 203,6 | 191,0 | 180,9 | 174,7 | 172,6 |
| 7 | 60 | 206,4 | 206.8 | 206,8 | 205,9 | 204,0 | 202,2 | 200,9 | 199,5 | 197.5 | 193,1 | 188,4 | 179,2 | 171,6 | 166,8 | 165,2 |
| - 8 | 70 | 191.6 | 190,9 | 188,5 | 186,6 | 184,1 | 182,2 | 181,0 | 179,8 | 178.2 | 175,0 | 171,7 | 165,7 | 160,8 | 157,7 | 156,6 |
| 9 | 80 | 172,5 | 170,9 | 166,8 | 164.4 | 161,9 | 160.1 | 159,1 | 158,2 | 157,0 | 154,8 | 152,9 | 149,7 | 145,6 | 146.5 | 146,2 |
| 10 | 90 | 147,0 | 144,8 | 140,5 | 138,3 | 136,3 | 135,0 | 134,3 | 133,6 | 132,9 | 131,7 | 130,8 | 130,0 | 130,3 | 131,3 | 132,0 |
| 11 | 1021 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 | 99,4 |



110° COLOUR TELEVISION PICTURE TUBE

Three-gun temperature compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed threecolour phosphor dot screen and internal magnetic shield. A high white luminance is obtained at near unity current ratio. Being temperature compensated, the shadow-mask makes for optimum field purity and good uniformity during warm-up. The design is such that minimum occurrence of the moire effect is ensured. The tube has a reinforced envelope and therefore no separate safety screen is necessary. The tube features a quick heating cathode; typically, a legible picture will appear within approx. 5 s.

| QUICK REFERE | NCE DATA | |
|------------------------------------|---|------|
| TEMPERATURE COMPENSATED SHADOW M | IASK | |
| DESIGNED FOR MINIMUM MOIRE EFFECT | | |
| HIGH WHITE LUMINANCE AT UNITY CURR | ENT RATIO | |
| Face diagonal | 56 c | m |
| Deflection angle | 110 d | eg |
| Neck diameter | 36,5 m | nm |
| Envelope | reinforced suitable for push thro | ough |
| Magnetic shield | internal | |
| Focusing | . bi-potential | |
| Deflection | magnetic | |
| Convergence | magnetic | |
| Heating | 6,3 V, 730 r | nA |
| Light transmission of face glass | 54,5 |) |
| Quick heating cathode | with a typical tube a legible pictur will appear within approx. 5 s | e |

SCREEN

Metal-backed phosphor dots

Europium activated rare earth Red:

Sulphide type Phosphor type Green: Blue : Sulphide type

Triangular Dot arrangement

Spacing between centres of adjacent dot trios 0.81 mm

Light transmission of face glass 54,5 %

1 October 1974

HEATING: indirect by a.c. or d.c.; parallel supply

Heater voltage $V_f \hspace{1cm} \text{6,3} \hspace{1cm} \text{V} \\ \text{Heater current} \hspace{1cm} \text{I}_f \hspace{1cm} \text{730} \hspace{1cm} \text{mA} \hspace{1cm} \text{^1} \text{)}$

For maximum cathode life it is recommended that the heater supply be regulated at $6,3~\mathrm{V}$.

For heating time as a function of source impedance see graph page 12 below.

CAPACITANCES

| Final accelerator conductive coati | | C _{a, g3, g4/m} | max. min. | 1800 1300 | pF pF |
|--|-------------------------------------|--------------------------------|--------------|--------------|----------|
| Final accelerator | to rimband | Ca,g3,g4/m' | | 400 | pF |
| Grid no.1 of any g | run to all other electrode | $_{ m cg_1}$ | | 7 | pF |
| Cathodes of all gur to all other elec | ns (connected in parallel trodes |) C _k | * | 15 | pF |
| Cathode of any gur | n to all other electrodes | C_{kR} , C_{kG} , C_{kl} | В | 5 | pF |
| Grid no.3 (focusing all other electrons) | | $\mathrm{C_{g3}}$ | | 7 | pF |
| FOCUSING | electrostatic (bi-pote | ntial) | | | |
| DEFLECTION | magnetic | | | | |
| Diagonal deflection | n angle | | | 110 | deg |
| Horizontal deflect | ion angle | | | 97 | deg |
| Vertical deflection | angle | | | 77 | deg |

CONVERGENCE magnetic



¹⁾ If the heater is supplied from a mains transformer designed for tube type A56-140X, the source impedance should not exceed 0, 6 Ω to ensure that the heater voltage of the A56-410X is not exceeded.

If the **heater** is supplied from a line time base designed for tube type A56-140X, the series impedance, if any, should match the lower heater current of the quick-heating tube.

3

MECHANICAL DATA

| Overall length Neck diameter | | | 387,3 to | 400, 3 36, 5 | mm mm |
|---------------------------------|---------|--|----------|-----------------|----------|
| Diagonal | , | | max. | 566, 2 | mm |
| Horizontal axis | of bulb | | max. | 486,3 | mm |
| Vertical axis | J | | max. | 381,8 | mm |
| Useful screen | | | | | |
| diagonal | | | min. | 533 | mm |
| horizontal axis | | | min. | 447 | mm |
| vertical axis | | | min. | 337 | mm |

Mounting position: any

Net weight : approx. 14,5 kg

Base: 12 pin base IEC 67-I-47a, type 2

Anode contact : Small cavity contact J1-21, IEC 67-III-2

Magnetic shielding, degaussing: The tube is provided with an internal magnetic shield. The internal magnetic shield and the shadow-mask with its suspension system may be provided with an automatic degaussing system, consisting of two coils covering left and right cone parts. For proper degaussing an initial m.m.f. of 450 ampere-turns is required in each of the coils. This m.m.f. has to be gradually decreased by appropriate circuitry. After decreasing to 10 A.t. or less, sudden switch off is permirable. In the steady state, no significant m.m.f. should remain in the coils (< 0,5 A.t.).

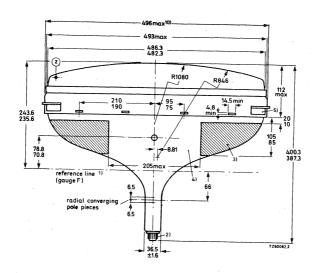
To ease the mounting of the coils, the rimband is provided with rectangular holes.

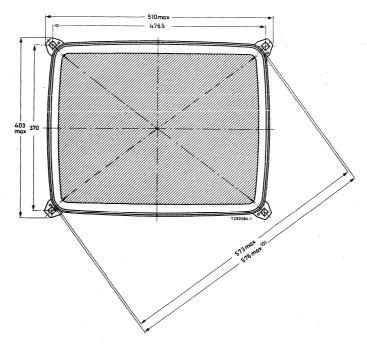
NOTES TO OUTLINE DRAWING (see pages 4, 5, and 6)

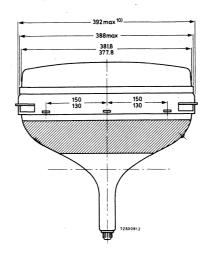
- 1) Reference line, determined by the plane of the upper edge of the flange of the reference line gauge, when the gauge is resting on the cone.
- 2) The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with the tube axis and having a diameter of 55 mm.
- 3) Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4) To clean this area, wipe only with a soft lintless cloth.
- 5) The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 6) Minimum space to be reserved for mounting lug.
- 7) The position of the mounting screw in the cabinet must be within a circle of 9,5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 476,5 mm x 370 mm.
- 8) Cobrdinates for radius R = 15,95 mm: x = 203,95 mm, y = 145,52 mm.
- 9) Distance from point z to any hardware.
- 10) Maximum dimensions in plane of lugs.

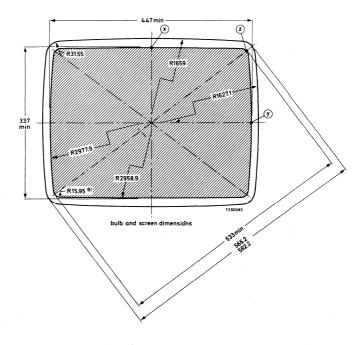
MECHANICAL DATA (continued)

Dimensions in mm



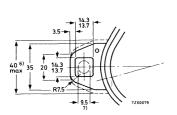


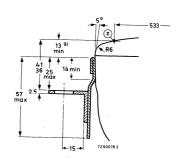




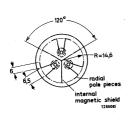
MECHANICAL DATA

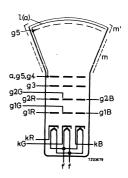
Dimensions in mm

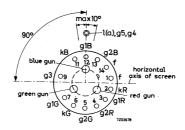












| TVDICAL | UDED | ATING | CONDITIONS | |
|---------|------|-------|------------|--|

| Final accelerator voltage | $V_{a,g5,g}$ | 4 | | 25 | kV |
|--|--------------|-------------|------|------|------------------|
| Grid no.3(focusing electrode voltage) | v_{g3} | 4,2 | to | 5 | kV |
| Grid no.2 voltage for a spot cut-off voltage V _{g1} = -105 V | v_{g2} | 212 | to | 495 | V ¹) |
| Grid no.1 voltage for spot cut-off at V_{g2} = 300 V | v_{g1} | - 70 | to | -140 | v ²) |
| Luminance at the centre of the screen | L | See 1 | page | 11 | • |

EQUIPMENT DESIGN VALUES (each gun if applicable) Valid for final accelerator voltages between 20 kV and 27,5 kV.

| e | V_{g3} | 3 16,8 to 20 % of final accelerator voltage | | | |
|----------------------------------|---------------------------|---|--|--|--|
| | v_{g2} | See | cut-off d | esign cha | rt page 12 |
| 1 | v_{g1} | See | cut-off de | esign cha | rt page 12 |
| ı | ΔV_{g1} | | | | |
| nt | I_{g3} | - 5 | to | +5 | μ A |
| | I_{g2} | - 5 | to | +5 | μ A |
| | I_{g1} | - 5 | to | +5 | μ A |
| | | J - 3 ₃ | 1 4 | 6) | |
| | x y | 0, 265 0, 290 | 0,281 0,311 | 0,313 0,329 | |
| red gun green gun blue gun | | 25,8 33,5 40,7 | 30, 2 34, 5 35, 3 | 41, 0 31, 3 27, 7 | - % % % |
| | | - | | | |
| | min. av. max. | 0,55 0,75 1,10 | 0,65 0,90 1,25 | 0,95 1,30 1,80 | |
| | min. av. max. | 0,50 0,65 0,85 | 0,65 0,85 1,15 | 1,15 1,50 2,00 | |
| | n red gun green gun | $\begin{array}{c} V_{g2} \\ \\ V_{g1} \\ \\ \Delta V_{g1} \\ \\ \\ \\ \Delta V_{g1} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ |

EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction

max. 11 mm

Correction that must be supplied by purifying magnet to compensate for mis-register in any direction

max. $100 \mu m$

Lateral distance between blue spot and the converged red and green spots

max. 4,5 mm (in both directions)

Radial convergence displacement excluding effects of dynamic convergence (each gun) 5)

max. 7 mm (in both directions)

 $^{^{1}}$) This range of V_{g2} has to be used when in circuit design fixed values for cut-off of the three guns are used.

²) This range of V_{g1} has to be used when in circuit design fixed values for V_{g2} of the three guns are used.

³⁾ To produce black/white pictures a bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

 $^{^4}$) This point is a compromise between white point D and the white point x = 0, 265, y = 0,290 given in order to enable good rendition of colour and black and white pictures with one white point.

⁵⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape through the convergence coils synchronized with scanning.

⁶⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point. (Point D).

2

max.

V

6)

LIMITING VALUES (Each gun if applicable)

27.5 $kV^{1})^{2})^{3}$ max. Final accelerator voltage $V_{a,g5,g4}$ $kV^{1})^{4}$ 20 min. μΑ ⁵) Average current for three guns 1000 max. Grid no.3 (focusing electrode) voltage 6000 max. Grid no. 2 voltage, peak, including video signal voltage v_{g2_p} 1000 V max. Grid no.1 voltage. negative max. 400 $\begin{array}{c} v_{g1}^{g1} \\ v_{g1} \\ v_{g1}_{p} \end{array}$ negative, operating cut-off max. 200 positive V max. 0

(Design centre rating system unless otherwise specified)

| Cathode to heater voltage, | | | | |
|----------------------------|------------------------------|------|-----|---|
| positive | $v_{ m kf}$ | max. | 250 | v |
| positive peak | $v_{kf_{D}}^{N}$ | max. | 300 | V |
| negative | -V _{kf} | max. | 135 | V |
| negative peak | -V _{kf_D} | max. | 180 | V |

positive peak

¹⁾ Absolute max. rating system.

²⁾ The X-ray dose rate remains below the acceptable value of 0,5 mr/h, measured with ionization chamber when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value, During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

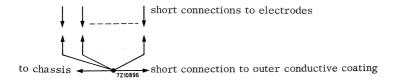
⁴⁾ Operation of the tube at lower voltages impairs luminance and resolution and may have a detrimental effect on colour purity.

^{5) 1500} μA permitted provided a current limiting circuit is used.

⁶⁾ During an equipment warm-up period not exceeding 15 s $\,\mathrm{V}_{\mathrm{kf}}$ is allowed to rise to 385V. Between 15 s and 45 s after switching on a decrease in Vkf propotional with time from 385 V to 250 V is permissible.

With the high voltage used with this tube (max. 27,5~kV) internal flash-overs may occur. These may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible. Additional information is given in Application Information 258, available on request.

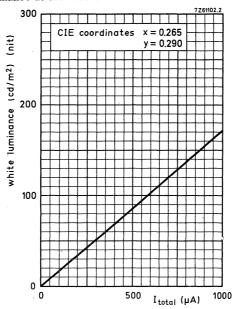
During shipment and handling the tube should not be subjected to accelerations greater than $35\ \mathrm{g}$ in any direction.

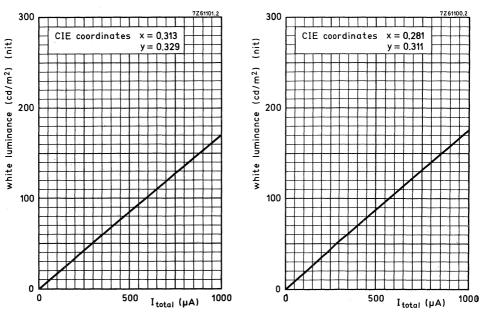
REFERENCE LINE GAUGE

Gauge F. See chapter "Reference line gauges" in front of this book.

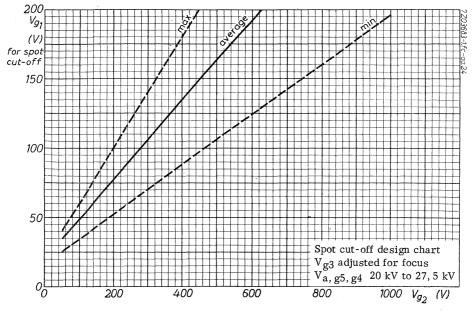


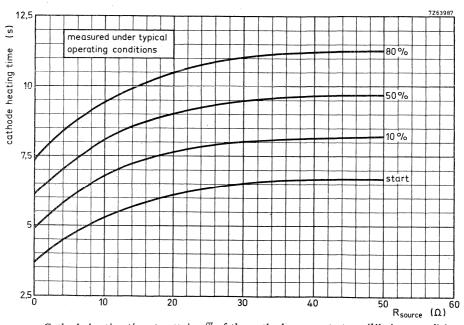
Luminance at the centre of the screen as a function of $I_{\mbox{total}}$.



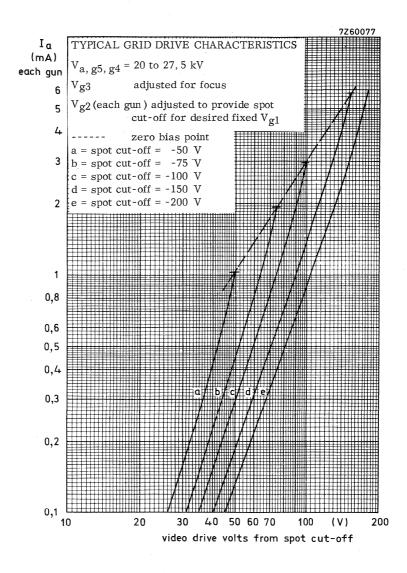


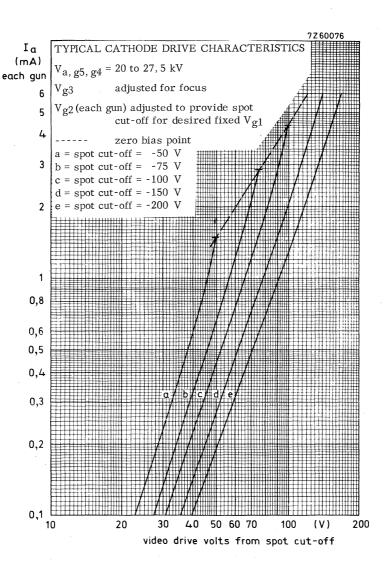
Scanned area 447 mm x 337 mm





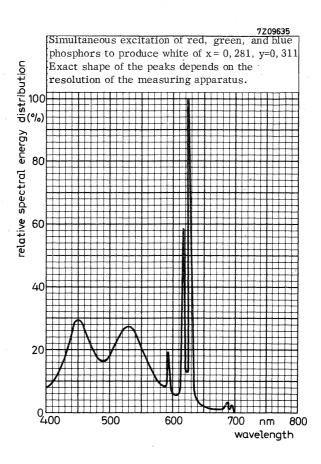
Cathode heating time to attain x% of the cathode current at equilibrium condition











Colour co-ordinates

| | X | У |
|-------|-------|-------|
| red | 0,630 | 0,340 |
| green | 0,315 | 0,600 |
| blue | 0,150 | 0,065 |

90° COLOUR TELEVISION PICTURE TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed three-colour phosphor dot screen. A high white luminance is obtained at near unity current ratio. Temperature compensating the shadow-mask has led to optimum field purity and good uniformity during warm-up. Minimum occurrence of the moiré effect is ensured by optimizing the mask for the reproduction of 625-line pictures. The tube has a reinforced envelope and therefore no separate safety screen is necessary.

| OUICK | REFERENCE | DATA |
|-------|-----------|------|
|-------|-----------|------|

TEMPERATURE-COMPENSATED SHADOW-MASK

SHADOW-MASK OPTIMIZED FOR 625-LINE SYSTEM

HIGH WHITE LUMINANCE AT UNITY CURRENT RATIO

Face diagonal

63 cm

Deflection angle

90 °

Neck length

164.2 mm

Envelope

reinforced

suitable for push through

Focusing

Service Too Feedings

Deflection

electrostatic magnetic

Convergence

magnetic

Heating

6.3 V. 900 mA

Light transmission of face glass

52.5 %



SCREEN

| Metal-backed tricolour phosphor dots | | |
|---|------|-------|
| Phosphor type | rare | earth |
| Dot arrangement Triangular | | |
| Spacing between centres of adjacent dot trios | 0.81 | mm |
| Light transmission at centre of face glass | 52.5 | % |

HEATING

Indirect by A.C. or D.C.; parallel or series supply

| Heater voltage | $V_{\mathbf{f}}$ | 6.3 | V |
|----------------|------------------|-----|----|
| Heater current | I_f | 900 | mΑ |

For maximum cathode life it is recommended that the heater supply be regulated at 6.3 V. If the tube is connected in a series heater chain the surge heater voltage must not exceed 9.5 $V_{\mbox{rms}}$ when the supply is switched on.

CAPACITANCES

| Final accelerator to external conductive coating | $C_{ag_5g_4/m}$ | max. min. | 2500 2000 | pF pF |
|--|---|--------------|--------------|----------|
| Final accelerator to metal rimband | $C_{ag_5g_4/m}$ ' | | 500 | pF |
| Grid No.1 of any gum to all other electrodes | C_{g_1} | | 7 | pF |
| Cathodes of all guns (connected in parallel) to all other electrodes | C_k | | 15 | pF |
| Cathode of any gun to all other electrodes | C _{kR} C _{kG} C _{kB} | | | pF pF |
| Grid No.3 (focusing electrode) to all other electrodes | C_{g_3} | | 7 | pF pF |

FOCUSING electrostatic

| DEFLECTION | magnetic | |
|---------------------|-----------|-----------------|
| Diagonal deflection | n angle | 90° |
| Horizontal deflect | ion angle | 79 ⁰ |
| Vertical deflectio | n angle | 62 ⁰ |

CONVERGENCE magnetic

MECHANICAL DATA

| Overall length | | | | | 521 ± 9.5 | mm |
|-----------------|---------|---|---|------|-----------------|----|
| Neck length | | | | | 164.2 ± 4.5 | mm |
| Diagonal | | | | max. | 626 | mm |
| Horizontal axis | of bulb | | | max. | 548.1 | mm |
| Vertical axis | | | | max. | 440.5 | mm |
| Useful screen | | | | | | • |
| diagonal | | | | min. | 584 | mm |
| horizontal axis | | ٠ | | min. | 504 | mm |
| vertical axis | | | • | min. | 396 | mm |

Mounting position: any

Net weight: approx. 188N (18.8 kg) Base: 12 pin base JEDEC B12-246

Anode contact: Small cavity contact J1-21, IEC67-III-2.

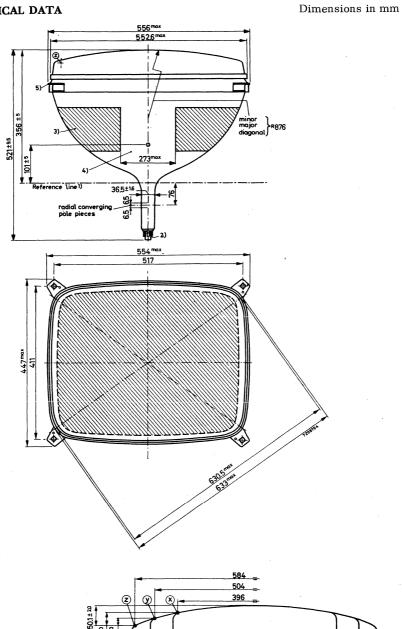
Magnetic shielding

Magnetic shielding should be provided by means of a metal shield extending 28 cm over the cone of the tube measured from the centre of the face plate. The metal shell is preferably constructed of min.0.5 mm cold rolled steel properly annealed. The air gap between the shield and the metal rimband should be as small as possible and not exceed 10 mm. The magnetic shield should be connected to the outer conductive coating.

NOTES TO OUTLINE DRAWING (See pages 4 and 5)

- 1. Reference line, determined by the plane of the upper edge of the flange of the reference line gauge E, when the gauge is resting on the cone.
- 2. The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with bulb axis and having a diameter of 55 mm.
- 3. Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4. To clean this area, whipe only with a soft dry lintless cloth.
- 5. The displacement of any lug with respect to the plane through the three other lugs is \max . 2 mm.
- 6. Minimum space to be reserved for mounting lug.
- 7. The position of the mounting screw in the cabinet must be within a circle of $9.5~\mathrm{mm}$ diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of $517~\mathrm{mm} \times 411~\mathrm{mm}$.
- 8. Co-ordinates for radius R = 30 mm: x = 213.66 mm, y = 151.63 mm.

MECHANICAL DATA

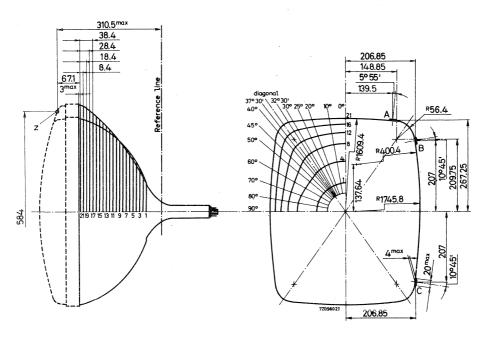






MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| | distance point Z | | | | | | | Distance f | rom cen | tre (ma | c. values | s) | | | | |
|--------|---------------------|--------------|--------|--------|--------|-------|-----------------|------------|---------|---------|-----------|--------|--------|--------|--------|----------------------|
| ection | Nom. di from po | Long axis | 100 | 200 | 250 | 300 | 32 0 30' | 35°21'38" | 37030* | 400 | 450 | 500 | 600 | 700 | 800 | Short axis 900 |
| S | ZG | 00 | 100 | 200 | 250 | 300 | 32°30 | Diag. | 37030 | 400 | | | | | | |
| 1 | 265.5 | 82.5 | 82.6 | 83.0 | 83.0 | 83.0 | 83.0 | 83.0 | 83.0 | 83.0 | 83.3 | 83.5 | 83.5 | 83.0 | 82.8 | 82.8 |
| 2 | 255.5 | | | 106.7 | 106.1 | 105.7 | 105.5 | 105.2 | 105.1 | 105.0 | 104.7 | 104.5 | 106.3 | 111.0 | 115.0 | 115.5 |
| 3 | 245.5 | | | 128.0 | 127.3 | 126.6 | 125.8 | 124.8 | 124.0 | 123.2 | 122.2 | 121.4 | 122.5 | 126.9 | 129.9 | 130.2 |
| 4 | 235.5 | 147.4 | 147.2 | 146.0 | 145.0 | 144.8 | 144.2 | 142.6 | 141.2 | 139.6 | 137.2 | 135.4 | 134.7 | 138.0 | 140.0 | 140.0 |
| 5 | 225.5 | 162.8 | | 161.6 | 160.7 | 160.3 | 159.4 | 157.7 | 156.2 | 154.3 | 150.4 | 147.7 | 145.0 | 146.4 | 148.2 | 148.0 |
| ó | 215.5 | 176.3 | | 175.4 | 175.0 | 174.3 | 173.5 | 171.6 | 169.9 | 167.9 | 163.1 | 159.0 | 154.4 | 154.0 | 155.4 | 155.3 |
| 7 | 205.5 | 188.2 | | 187.8 | 187.6 | 187.2 | 186.6 | 185.2 | 183.4 | 181.1 | 175.4 | 169.9 | 163.5 | 161.2 | 161.6 | 161.5 |
| 8 | 195.5 | 198.8 | | 199.2 | 199.4 | 199.6 | 199.1 | 197.8 | 196.1 | 193.4 | 186.9 | 180.3 | 171.9 | 170.0 | 167.4 | 167.2 |
| 9 | 185.5 | | | 209.6 | 210.3 | 211.1 | 210.9 | 209.7 | 207.8 | 205.3 | 197.9 | 190.3 | 179.7 | 174.4 | 172.9 | 172.7 |
| 10 | | 216.9 | | 219.2 | 220.5 | 222.2 | 222.2 | 221.3 | 218.9 | 216.1 | 208.0 | 199.4 | 187.2 | 180.8 | 178.2 | 178.1 |
| 11 | | | | 227.7 | 229.7 | 231.9 | 232.2 | 231.6 | 229.6 | 226.4 | 217.5 | 208.0 | 194.4 | 186.9 | 183.5 | 182.9 |
| 12 | | 231.9 | | 235.9 | 238.5 | 241.4 | 242.1 | 241.9 | 240.1 | 237.0 | 226.9 | 216.4 | 201.5 | 191.5 | 188.6 | 187.7 |
| 13 | | 238.2 | | 243.6 | 246.8 | 250.5 | 251.7 | 251.9 | 250.4 | 247.0 | 236.0 | 224.5 | 208.3 | 198.0 | 193.4 | 192.3 |
| 14 | | | | 251.0 | 254.9 | 259.5 | 261.3 | 261.8 | 260.5 | 257.1 | 245.3 | 232.6 | 214.8 | 203.4 | 198.2 | 196.8 |
| 15 | 125.5 | 250.3 | | 258.0 | 262.3 | 268.1 | 270.5 | 271.3 | 270.1 | 266.3 | 254.0 | 240.4 | 220.9 | 208.5 | 202.4 | 200.3 |
| 16 | 115.5 | 256.1 | | 264.9 | 270.0 | 276.6 | 279.6 | 280.7 | 279.3 | 275.4 | 262.4 | 247.8 | 226.8 | 213.7 | 206.6 | 204.1 |
| 17 | | 260.0 | | 270.8 | 276.8 | 284.7 | 287.9 | 289.3 | 287.9 | 283.9 | 270.0 | 254.7 | 232.3 | 218.5 | 210.5 | 207.7 |
| 18 | | 265.6 | | 276.4 | 283.3 | 292.4 | 295.7 | 297.6 | 296.3 | 292.1 | 277.0 | 261.0 | 237.6 | 223.1 | 214.3 | 211.2 |
| 19 | | 269.4 | | 281.5 | 289.4 | 299.4 | 302.9 | 305.2 | 304.2 | 299.6 | 283.8 | 267.1 | 242.6 | 227.2 | 217.9 | 214.7 |
| 20 | | 272.3 | | 286.0 | 294.0 | 304.6 | 309.4 | 311.1 | 310.5 | 305.9 | 289.8 | 272.5 | 247.0 | 230.6 | 221.2 | 218.0 |
| 21 | 67.1 | 273.3 | 276.79 | 287.64 | 296.17 | 307.1 | 311.8 | 313.6 | 312.6 | 308.79 | 292.55 | 275.38 | 248.85 | 232.15 | 222.91 | 219.95 |



| TYPICAL OPERA | TING | CONDITIONS |
|---------------|------|------------|

| Final accelerator voltage | Va, g5, g4 | 25 | kV |
|--|----------------|-------------|------------------|
| Grid No. 3 (focusing electrode) voltage | ${ m v_{g_3}}$ | 4.2 to 5 | kV |
| Grid No. 2 voltage for a spot cut-off voltage V_{g_1} = -105 V | v_{g_2} | 210 to 495 | v ¹) |
| Grid No. 1 voltage for spot cut-off at V _{g2} = 300 V | v_{g_1} | -70 to -140 | v ²) |
| Luminance at the centre of the screen | | See page 2 | 1 |

EQUIPMENT DESIGN VALUES (each gun if applicable)

Valid for final accelerator voltages between 20 kV and 27.5 kV.

| Grid No. 3 (focusing electrode) voltage | v_{g_3} | 16.8 to $20%$ of final accelerator voltage | | | | |
|---|-------------------------------|--|----------------------|----------------------|-------------|--|
| Grid No. 2 voltage ¹) | v_{g_2} | See cut-off design chart page 22 | | | | |
| Grid No. 1 voltage for visual extinction of focused spot (cut-off voltage) ²) | v_{g_1} | See cut-off design chart page 22 | | | | |
| Difference in cut-off voltages between guns in any tube | ΔV_{g_1} | lowest value is min. 65 % of highest value | | | | |
| Grid No. 3 (focusing electrode) current | I_{g_3} | -15 to $+15$ μA | | | | |
| Grid No. 2 current | $^{\mathrm{I}\mathrm{g}_{2}}$ | -5 to $+5$ μA | | | | |
| Grid No.1 current at $V_{g_1} = -150 \text{ V}$ | I_{g_1} | | -5 to | +5 μ. | A | |
| To produce white of the following | | 3) | 4) | 5) | | |
| CIE co-ordinates | х У | 0.310 0.316 | 0.265 0.290 | 0.281 | | |
| Percentage of total anode current supplied by each gun (typical) red gun green gun blue gun | | 43.5 30.0 26.5 | 27.9 34.9 37.2 | 32.2 35.6 32.2 | % % % | |
| Ratio anode currents red gun to green gun | min. av. max. | 1.05 1.45 2.00 | 0.60 0.80 1.10 | 0.65 0.90 1.25 | | |
| Ratio of anode currents red gun to blue gun | min. av. max. | 1.20 1.65 2.25 | 0.55 0.75 1.05 | 0.75 1.00 1.35 | | |

EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction

max. 15 mm

Correction which must be supplied by purifying magnet to compensate for misregister (including that caused by earth's magnetic field) when using recommended components. Measured at the centre of the screen in any direction

max. 130 μm

Lateral distance between the blue spot and the converged red and green spots

max. 6.5 mm (in both directions)

Radial convergence displacement excluding effects of dynamic convergence (each beam)

max. 9.5 mm 6) (in both directions)



 $[\]overline{\mbox{-1)}}$ This range of \mbox{V}_{g_2} has to be used when in circuit design fixed values for cut-off—of the three guns are used.

 $^{^2)}$ This range of ${\rm Vg}_1$ has to be used when in circuit design fixed values for ${\rm Vg}_2$ of the three guns are used.

³⁾ To produce colour pictures with the best possible quality, this white point should be used as the transmission systems are based on this point. (Point C).

⁴⁾ To produce black/white pictures a more bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

⁵⁾ This point is a compromise between the white point C and the white point x = 0.265 and y = 0.290, given in order to enable good rendition of colour and black-andwhite pictures with one white point.

⁶⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape synchronized with scanning.

| Final accelerator voltage | V _{a,g5} ,g ₄ | max. min. | 27.5 20 | kV 1)2)3) kV 1)4) |
|---|-----------------------------------|--------------|------------|---------------------------------|
| Average current for 3 guns | I_a | max. | 1000 | μ A 5) |
| Grid No.3 (focusing electrode) voltage | v_{g_3} | max. | .6000 | V |
| Grid No.2 voltage, peak, including video signal voltage | $v_{g_{2p}}$ | max. | 1000 | V |
| Grid No.1 voltage, | | | | |
| negative | $-v_{g_1}$ | max. | 400 | V |
| negative, operating cut-off | $-v_{g_1}$ | max. | 200 | V |
| positive | v_{g_1} | max. | 0 | V |
| positive peak | $v_{g_{1p}}$ | max. | 2 | V |
| Cathode to heater voltage, | • | | | |
| positive | v_{kf} | max. | 250 | v ⁶) ⁷) |
| positive peak | $V_{\mathbf{kf_p}}$ | max. | 300 | V |
| negative | $-v_{kf}$ | max. | 135 | V |
| negative peak | $-v_{kfp}$ | max. | 180 | V |

¹⁾ Absolute maximum rating system.



²⁾ The X-ray dose rate remains below the acceptable value of 0.5 mr/h, measured with ionisation chambre when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

⁴) Operation of the tube at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

 $^{^{5}}$) 1500 μ A permitted provided a current limiting circuit is used.

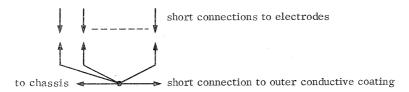
 $^{^6)}$ In order to avoid excessive hum the a.c. component of the heater to chassis voltage should be as low as possible and must not exceed 20 $V_{\hbox{RMS}}$.

 $^{^7)}$ During an equipment warm-up period not exceeding 15 s V_{k/f} is allowed to rise $_$ to 410 V. Between 15 s and 45 s after switching on a decrease in V_{k/f} proportional with time from 410 V to 250 V is permissible.

REMARK

With the high voltage used with this tube (max. 27.5~kV) internal flash-overs may occur. These may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



No outer connections between the outer conductive coating and the chassis are permissible.

Additional information available on request.

REFERENCE LINE GAUGE

Dimensions in mm

Reference line E. See chapter "Reference line gauges" in front of this book.



DESCRIPTION OF THE TUBE

The A63-120X is a rectangular temperature compensated shadow-mask colour picture tube for use in colour television receivers. The tube can display a picture, either in full colour or in black and white measuring $504 \text{ mm} \times 396 \text{ mm}$ minimum (projected area of 1905 cm^2).

The A63-120X has

- a deflection angle of 900
- a neck diameter of 36.5 mm
- a three-colour phosphor dot screen, composed of closely spaced dots in a regular pattern of tri-angular groups, each containing a red, a green and a blue light emitting dot.
- Three electron guns with axes tilted towards the screen centre, with electrostatic focusing systems and mounted side by side in the neck of the tube 120° apart.

Colour selection is effected by a metal graded-hole shadow mask positioned in front of the tricolour phosphor-dot screen. This mask is aligned with the dot pattern so that the electron beam from each gun lands only on phosphor dots of the associated colour.

The shadow mask has graded holes that increase gradually in diameter from the edge of the mask towards the centre. Grading enables correct purity to be achieved over the whole screen with minimum adjustment.

Although the three guns are tilted towards the screen centre so that their axes intersect at the shadow mask, lateral and radial convergence are necessary to ensure correct convergence over the entire screen. Each of the three guns is therefore provided with a pair of radial converging pole pieces.

Radial convergence can be achieved by means of magnets and coils mounted externally on the neck of the tube. The magnetic flux provided is coupled through the glass neck of the tube to associated internal pole pieces. The shape of the pole pieces, together with the internal magnetic shielding, is shown in Fig. 1. Internal shielding prevents interaction of the various magnetic fields.

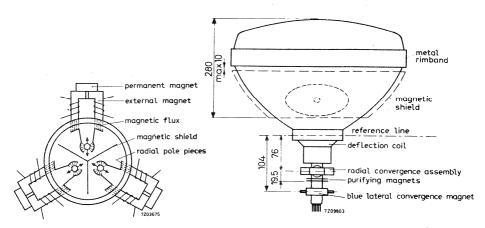


Fig.1

Fig.2

Fig. 2 shows the position of the components on the neck of the tube.

Lateral convergence is achieved by a separate assembly mounted on the neck of the tube. This assembly causes horizontal movement of the blue beam, and simultaneously, movements of the red and green beams in the opposite direction.

Facilities for dynamic blue lateral convergence are also provided in this convergence assembly.

APPLICATION NOTES

1. Magnetic shielding

The tube should be fitted with a magnetic shield around the cone, to minimize the effects of external magnetic fields, including the horizontal, vertical and axial components of the earth's magnetic field. The latter so influences the colour purity that compensation by means of the purifying magnets is not possible.

The metal shield should preferably be constructed of coldrolled steel, at least 0.5 mm thick and properly annealed at 850 °C. Since the tube re-inforcing band is an essential part of the magnetic circuit used for degaussing, the air gap between the band and the shield should be as small as possible and certainly not more than 10 mm. To be effective, the shield must be degaussed as described under "Adjustment procedures". Building-in of an automatic degaussing system is advised.

2. Centring of raster on the screen.

Raster centring in a shadow-mask colour picture tube is achieved by passing direct current of the required value through each pair of deflection coils. The values for raster displacement given in the data apply when all components are properly adjusted.

3. Component considerations.

The necessary components are the deflection coil, the radial convergence assembly, the purifying magnets and the blue lateral convergence magnet.

- Basically the functions of the components are:
 deflection of the three beams over the entire screen:
- deflection coil.
- good convergence of the three beams over the screen: radial convergence assembly and blue lateral convergence magnet.
- landing adjustment: purifying magnets and deflection coil

The mounting positions of the components are as follows:

The deflection coil: in such a way that its deflection centre coincides with the one used in the screen-laying process during manufacturing. The coil must therefore be designed so that sufficient movement in the axial direction is possible.

The <u>radial convergence assembly</u>: with its pole pieces centred above the convergence pole pieces inside the tube. Initially, the assembly should be mounted upright. Small rotations of the whole assembly influence the convergence and can be used during adjustment of the blue lateral correction to obtain optimum lateral convergence.



The <u>purifying magnets</u>: over the gap between the electrode g3 and g4 of the gun, or still closer to the deflection coil. Placing the purifying magnets closer to the base results in poorer performance as the spot quality is adversely affected.

The <u>blue lateral convergence magnet</u>: as near as possible to the rear side of the purifying magnets but not shifted backwards more than halfway along electrode g3 of the gun.

3.1 Convergence

Static convergence, i.e. convergence of the three beams onto the centre of the screen, is usually accomplished with permanent magnets which are part of the radial convergence assembly, or with D.C. currents through the convergence coils in combinations with the lateral converging magnet.

The strength of the magnetic field that is adjustably coupled to the radial convergence pole pieces of the gun should be such that each beam can be moved 9.5 mm in both directions towards the centre of the screen excluding effects of dynamic convergence. The static blue lateral convergence magnet should provide a magnetic field adjustable in magnitude and polarity.

This field exerts a directive force on the blue beam and simultaneously a force in the opposite direction on the green and the red beams.

The displacement of the blue beam opposite to the movement of the red and green beams should be $6.5~\mathrm{mm}$ in both directions.

With these four adjustable magnetic fields static convergence of the three beams can be attained.

For good convergence over the entire screen dynamic radial convergence is required together with a small amount of dynamic lateral convergence in line direction.

The radial convergence assembly consists fundamentally of three cores with associated windings. Through the windings are passed the necessary currents for maintaining convergence when the beams are deflected over the screen.

The required form of the currents can be obtained by adding a current with a sawtooth wave form to one with a parabolic wave form. Two separate windings are required for correction in the horizontal and the vertical direction. The parabolic and sawtooth currents should be adjustable in amplitude and the sawtooth currents and the vertical blue parabola should, in addition be adjustable in polarity.

The blue lateral convergence magnet consists of a core and associated windings to obtain dynamic lateral convergence in line direction.

3.2 Landing

Landing is defined as the relative position of each beam with respect to its associated phosphor dot.

Good landing is achieved when each beam excites only its associated colour phosphor dot .

Optimum landing is achieved by adjusting both the purifying magnets and the deflection coil.

October 1968

3.2.1 Purifying magnets

Purifying magnets are required to compensate for the effects of outside magnetic fields, (including the earth's magnetic field), and manufacturing variations, which could cause mislanding.

Such purifying magnets, designed to provide a magnetic field adjustable in magnitude and direction, effect good landing over the entire screen when the deflection coil position is properly adjusted.

3.2.2 Deflection coil

The position of the deflection centre must be adjustable to make sure that proper landing can be attained in any set. To achieve this the deflection coil should be free to move along the neck over a minimum distance of 12 mm from its most forward position when the purity adjustment is made with the aid of a microscope, or about 20 mm if purity is adjusted by means of the so-called "red ball" method. (See 6.1.2.1.)

4. Drive requirements

To calculate the drive voltages which should be supplied to the tube the following points should be taken into account.

 $4.1\ \mbox{In presently known systems}$ the luminance signal is composed as follows:

Y = 0.30R + 0.59G + 0.11B.

The colour information is carried by two chrominance signals which in the receiver after subcarrier detection, deliver the so-call colour difference signals R-Y, G-Y and B-Y.

These have to be combined with the Y-signal in a matrix circuit to recover the original red, green and blue signals. With the aid of the luminance signal equation it is possible to calculate the maximum voltage ranges for the colour difference signals. The maximum values are reached when the primary colours and their complementaries are produced at maximum brightness.

These values are tabulated below. All values are referred to the maximum value Y=R=G=B=1 for peak white and are considered positive if they cause an increase in beam current.

| Colour | R | G | В | Y | R-Y | G-Y | B-Y |
|---------|-----|---|---|------|-------|-------|-------|
| Red | 1 | 0 | 0 | 0.3 | 0.7 | -0.3 | -0.3 |
| Green | 0 | 1 | 0 | 0.59 | -0.59 | 0.41 | -0.59 |
| Blue | . 0 | 0 | 1 | 0.11 | -0.11 | -0.11 | 0.89 |
| Cyan. | 0 | 1 | 1 | 0.7 | -0.7 | 0.3 | 0.3 |
| Magenta | 1 | 0 | 1 | 0.41 | 0.59 | -0.41 | 0.59 |
| Yellow | 1 | 1 | 0 | 0.89 | 0.11 | 0.11 | -0.89 |

| Signal | Minimum | Maximum | Total range |
|--------|---------|---------|-------------|
| R-Y | -0.7 | 0.7 | 1.4 |
| G-Y | -0.41 | 0.41 | 0.82 |
| B-Y | -0.89 | 0.89 | 1.78 |

In practice the saturation of the colours is lower than that of the primary colours as considered above, so that the demands on the colour difference signals can be lower than those indicated.

- 4.2 The combining of the Y-signal with the R-Y, G-Y and B-Y signals can be performed by two methods:
- Method 1. Letting the picture tube perform. putting the colour difference signals odes with the luminance signal while the colour difference drive) onto the three first grids of the picture in
- Method 2. By means of a separate matrix circuit that decorate to the three cathodes signals to the picture tube. (R.G.B. drive). If fewers the Y-signal in the these signals attain the same maximum amplitudes a cohannel requires first method, and it should be remembered that each confidence of the three cathodes are channel requires full video bandwidth.

In both methods it should be recognized that with cathode drive a higher slope is obtained than with grid drive and to compensate for this large drive voltages are required for grid drive in each case. For grid drive, the relation between grid drive voltage ($V_{\mbox{drg}}$) and beam current ($I_{\mbox{a}}$) is approximately:

$$I_a = k \frac{V_{drg}^3}{V_{cog}^{3/2}}$$
 ($I_a \text{ in } \mu A$)
($V_{cog} \text{ is cut-off voltage for grid drive}$)
($V_{cog} \text{ is cut-off voltage for grid drive}$)

For cathode drive this function reads:

$$I_{a} = \frac{k (1 + D)^{3}}{\left(1 + D \frac{V drk}{V_{cok}}\right)^{3/2}} \cdot \frac{V_{drk}^{3}}{(V_{cok})^{3/2}}$$
 (V_{drk} = cathode drive voltage) (V_{cok} = cut-off voltage for cathode drive) (D = penetration factor)

This shows that there is a difference in sensivity between the two drive techniques, and that the relationship between them is not strictly linear. In practice the best result is obtained if the gridsignal amplitudes are made 20% larger than the corresponding cathode signal amplitudes.

- 4.3 Unequal currents are required for the red, green and blue signals to produce white as the efficiencies of the red, green and blue phosphors are different. (See Equipment Design Values)
- 4.4 Spread occurring in picture tube properties:(1) k factor, (2) penetration of g2 (D) and (3) phosphor efficiencies.

October 1968 15

- (1) The k factor, having a nominal value of 3.0, spreads between 2.6 and 3.1 but it can be derived from the I_a = $f(V_{dr})$ graph for cathode drive that compensation for this spread is attainable when the luminance drive stage is capable of producing approx. 6 volts more than the nominal peak drive needed for the red gun.
- (2) The penetration D may spread from 0.18 to 0.40 with a nominal value of 0.29 and is experienced as a spread in V_{CO} . It can be offset if required by adjustment of V_{g_2} (See page 22).
- (3) Phosphor efficiencies: the ratios of cathode currents for white having, for example, CIE x and y coordinates:

x = 0.281 and y = 0.311, may spread as follows:

 $\frac{I_R}{I_G}$ = 0.90 with a min. value of 0.65 ar and a max. value of 1.25

 $\frac{I_R}{I_B}$ = 1.00 with a min. value of 0.75 and a max. value of 1.35

In calculations, for the worst case the values I_R/I_G = 1.25 and I_R/I_B = 1.35 the white point if the compromise white point is chosen (x = 0.281 y = 0.311). If the current C is chosen for reproduction of colours then for the worst case the tratio values, I_R/I_G = 2.00 and I_R/I_B = 2.25 should be used.

5. Raste shape correction

It appears that for 90° deflection the combination of picture tube and deflection coil can give good convergence and landing, but it is not practical to design the combination such that a perfectly rectangular raster is obtained. To avoid the pin cushion raster which results it is necessary to provide raster correction electrically by modulating the deflecting current.

6. Adjustment procedures

The following procedures are suggested to ensure good landing, optimum convergence of the three beams over the entire area of the screen and good grey scale tracking.

Exact focusing is the final operation in the sequence of adjustments, see 6.3. When starting the sequence it is sufficient to adjust the convergence test pattern for optimum sharpness.

Prior to the adjustment procedure the picture tube has to be degaussed. This treatment will correct for localized areas of colour impurity resulting from any magnetization of the shield and internal tube parts and minimize the effect of the earth's magnetic field. Degaussing can be obtained by a coil that consists of 800 turns of 0.7 mm dia. enamelled copper wire (for 220 $V_{\rm rms}$) and has an outer diameter of approx. 300 mm.

The coil should be moved such that the entire screen is subjected to its field. After about 10 seconds, the coil is moved away from the face plate to a distance of at least 2 m and disconnected from the A.C. power supply.

During manufacture the receiver chassis should be degaussed in a similar manner, with the receiver switched on and care should be taken that the assembly line is properly degaussed. An automatic degaussing system built into the receiver serves for degaussing during normal operation.

It is recommended that the receiver has some adjustments made before the picture tube is built in. These adjustments should include EHT and deflection, and the dynamic convergence in order to facilitate the adjustment of purity and static convergence. Before deflection power and high voltage are applied to the tube, the bias control should be adjusted for maximum bias. After deflection power and high voltage are applied, the beam currents should be increased gradually to minimize the possibility of tube damage in the event of circuit faults. With the application of a test signal, initial adjustment of focus, raster size, linearity and centring should be made.

6.1 Colour purity and convergence procedures

The normal sequence involves, first, static convergence adjustment next the purifying magnet and adjustment of the axial position of the deflection coil, and lastly final adjustment of dynamic convergence.

6.1.1 Static convergence adjustment

A crosshatch pattern is the most suitable signal for convergence adjustments. The pattern should be displayed at moderate brightness to improve the accuracy. It is advisable to converge red and green first, with the blue gun cut off, and then to converge blue into the yellow pattern formed by the coinciding of red and green lines.

The red and green beams are made to converge statically by adjusting the permanent magnets of the radial convergence assembly, or the corresponding D.C. currents. Correct convergence is obtained when the lines in the centre converge to give yellow.

Before the blue lateral convergence magnet is used, the blue lines are brought horizontally adjacent to the yellow lines by means of the radial blue static convergence adjustment (permanent magnet or D.C. current).

Hereafter the blue lines are made to converge with the yellow lines in the centre with the aid of the blue lateral convergence magnet, resulting in white lines in the centre. If necessary this procedure is repeated.

6.1.2 Adjustment for colour purity

Adjustment for colour purity involves two steps:

Adjustment of the purifying magnets. (6.1.2.1)

Adjustment of the position of the deflection coil. (6.1.2.2)

To obtain optimum adjustment, the static and dynamic convergence should be adjusted previously and the picture tube degaussed and well warmed up to normal operating temperature (approx. 30 min, total beam current 600 μ A). Purity assessments are best made on a plain raster.

October 1968 | 17

Adjustment of the purifying magnets influences purity all over the screen. The deflection coil adjustment influences purity mainly at the screen edges. Therefore, the magnets have to be adjusted before the coil.

6.1.2.1 The purifying magnets are adjusted, judging by the landing in the screen centre. There are two ways of doing this.

The <u>first method</u> makes use of a microscope (magnification about 50x). With this method, the deflection coil need not possess more axial adjustment margin than that needed to cope with the spreads of the deflection centres. (12 mm total).

With the microscope, the position of the spot trio's is compared with the position of the phosphor dot trio's at the screen centre. To do this, the three colour rasters are displayed simultaneously, and the phosphor dots are illuminated by means of a light source, shining onto the screen at a small angle. The spot trio's should be made to land on the phosphor dot trio's as shown in Fig.1, with their centre points coinciding.

Due to the beam grouping used in this tube (which improves the overall landing) the spots will then be approx. 25 μm eccentric with respect to their corresponding phosphor dots.

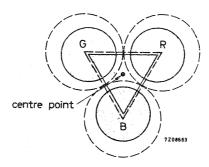


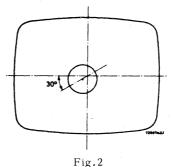
Fig.1. Correct landing in the screen centre.

The <u>second method</u> ("Red ball" method) is applicable if the mounting of the deflection coil is such that it can be drawn away approx. 20 mm backwards from its foremost position when it touches the funnel.

The coil is moved backwards as far as possible, and only the red raster is turned on. (The red gun needs relatively the highest current, thus mislanding on blue and green phosphor dots is seen more clearly so that a sharp indication is obtained).

Now a red area of approx. 10 cm diameter is visible on the screen, surrounded by discoloured and blue and green areas. With the aid of the purifying magnets, the red area is positioned near the screen centre. In order that the above mentioned beam grouping shows to full adventage, the red area should be positioned 20 mm down to the left of the screen centre, see Fig. 2.





- 6.1.2.2 After adjustment of the purifying magnets, the deflection coil is adjusted by shifting it axially until optimum landing over the entire screen is reached. This can be done in two stages:
 - 1. Only the red raster turned on, and the coil position giving an overall pure red raster sought.
 - 2. For the final adjustment, a white raster is displayed and, if necessary, very slight adjustment of the deflection coil position made to obtain the best white uniformity.

After having completed 1 and 2, the red, green and blue rasters are checked separately for their purity, and if necessary the procedure repeated.

6.1.3 Adjustment of dynamic convergence

Just as for the static convergence a crosshatch pattern is recommended, displayed at low brightness.

It is advisable to adjust first the convergence in the vertical direction (with frame frequency) and then the horizontal convergence (with currents of line frequency). During the dynamic convergence adjustments, the static convergence (6.1.1) may need readjustment depending on the efficiency of any clamping circuits used.

A favourable sequence is to adjust the red and green convergence controls first so that both rasters coincide to display yellow lines while the blue gun is kept cut-off. Thereafter the blue pattern is added and adjusted to coincide with the yellow to give a white pattern. However, as the blue horizontal convergence system usually has a significant power consumption which influences the line time base to some degree, it is often advisable to start the whole convergence procedure by adjusting the blue horizontal convergence controls coarsely to give a straight blue horizontal centre line.

During the vertical dynamic convergence adjustment, the vertical axis of the screen should be taken as reference, while the horizontal adjustments should be referred to the horizontal axis. During the latter sequence the lateral blue dynamic convergence is also adjusted.

October 1968 19

The currents for dynamic convergence (except blue lateral) consist of two components, viz. one of parabolic and one of sawtooth wave form Usually both have their own controls which have to be adjusted in combination to obtain convergence. The parabolic ("amplitude") controls are used to make the configurations at the extremities of the picture axis equal to that at the centre. With the sawtooth ("phase" or "tilt") control the two extremities of the picture axis are made equal to each other as far as possible.

In addition, the blue horizontal convergence needs an extra waveform correction to correct for the tilting of the outer edges.

The blue lateral waveform needed is basically a sawtooth. Left-to-right asymmetry can be adjusted by slight rotation of the radial convergence assembly.

By repeated adjustments of the controls the line patterns in the various colours ultimately coincide and become parallel to each other. Thereafter these are made to coincide with the aid of the static convergence magnets to white lines.

After convergence onto the axes is obtained, usually some errors in the corners of the picture remain. Slight readjustment may be needed to minimize these errors.

At the end of the procedure purity is checked, and readjusted if needed, with the aid of the purifying magnets.

6.2 Adjustment of grey scale

This adjustment is carried out last of all and the sequence of the manipulations depends on receiver circuitry.

To obtain a constant hue of white over the whole grey scale when displaying a monochrome signal, the three guns must track accurately. This can be achieved by adjusting two points of each gun characteristic, one near cut-off and one near the highlights. To this end the following variables are available, and in a receiver two of them must be made adjustable for each gun:

- 1. cut-off point (V_{g_1})
- 2. slope (V₂₂)
- 3. drive

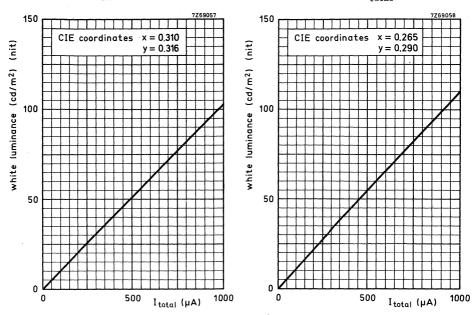
The proper adjustment procedure depends on receiver circuitry. After adjustment, the brightness and contrast controls should not cause any change in hue, and the chosen white point should be displayed.

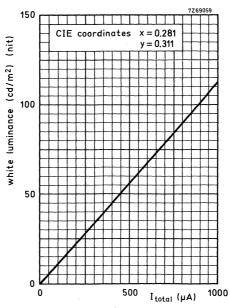
6.3 Focusing

The focusing voltage for all three guns can be adjusted via the common focus base pin No.9. In order to obtain optimum focus it is recommended to use a black-and-white picture with a low peak to mean brightness ratio, such as the RMA test picture, running at a total mean current of about 1 mA (peak currents in the three guns in the order of 2.5 mA), and to focus at the highlights. This procedure will give best overall focus.



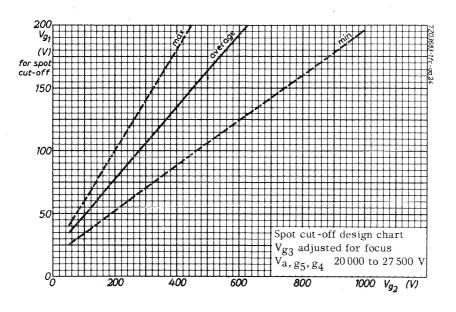
Luminance at the centre of the screen as a function of $I_{\mbox{total}}$

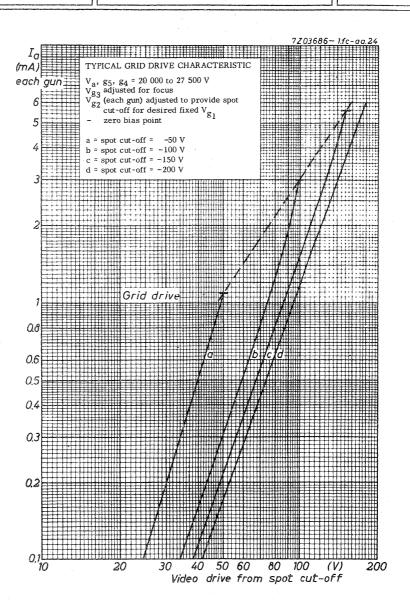


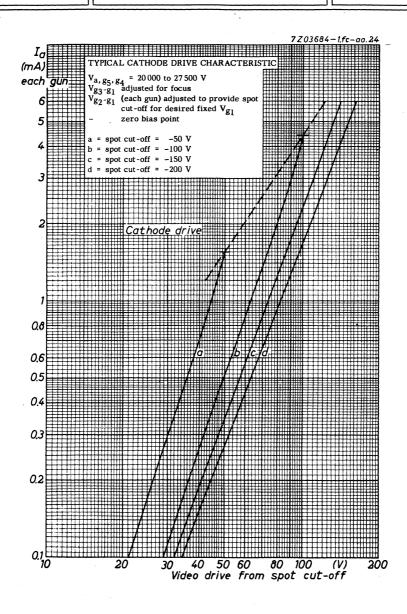


Scanned area 504 mm x 396 mm









90° COLOUR TELEVISION TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus magnetic deflection and convergence, metal-backed three-colour phosphor dot screen. A high white luminance is obtained at near unity current ratio. Being temperature compensated, the shadow-mask makes for optimum field purity and good uniformity during warm-up. Minimum occurrence of the moiré effect is ensured by optimizing the shadow-mask for reproduction of 625-line pictures. The tube has a reinforced envelope and therefore no separate safety screen is necessary. The rimband leaves the edge of the faceplate free.

| OHICK | REFERENCE I | ATA |
|--------|-------------|------|
| CHILL. | REFERENCE | JAIA |

TEMPERATURE COMPENSATED SHADOW-MASK

SHADOW-MASK OPTIMIZED FOR 625-LINE SYSTEM

HIGH WHITE LUMINANCE AT UNITY CURRENT RATIO

Face diagonal

Deflection angle 90 °

Neck diameter 36.5 mm

Envelope reinforced

suitable for push through

66 cm

Focusing electrostatic

Deflection magnetic

Convergence magnetic

Heating 6.3 V, 900 mA

Light transmission 52.5 %

SCREEN

Metal-backed tricolour phosphor dots

Phosphor type

Red: Europium activated rare earth

Green and blue: sulphide type

Dot arrangement

Spacing between centres of adjacent dot trios

0.81 mm

Light transmission at centre of face glass

52.5 %

HEATING

Indirect by A.C. or D.C.; parallel or series supply

Heater voltage Heater current

Triangular

6.3 V

 I_f

900 mA

For maximum cathode life it is recommended that the heater supply be regulated at $6.3\,\mathrm{V.}$ If the tube is connected in a series heater chain the surge heater voltage must not exceed 9.5 $\mathrm{V}_{\mathrm{rms}}$ when the supply is switched on.

CAPACITANCES

| Final accelerator to external conductive coating | C _{ag5g4} /m | max. min. | 2500 2000 | pF pF |
|--|---|--------------|--------------|----------------|
| Final accelerator to metal rimband | $C_{ag5g4/m}$ | | 500 | pF |
| Grid No. 1 of any gun to all other electrodes | C_{g1} | | 7 | pF |
| Cathodes of all guns (connected in parallel) to all other electrodes | C_k | | 15 | рF |
| Cathode of any gun to all other electrodes | C _{kR} C _{kG} C _{kB} | | 5 5 5 | pF pF pF |
| Grid No. 3 (focusing electrode) to all other electrodes | C_{g3} | | 7 | pF |
| FOCUSING electrostatic | | | | |

DEFLECTION

magnetic

Diagonal deflection angle

Horizontal deflection angle

Vertical deflection angle

61°

CONVERGENCE

magnetic

MECHANICAL DATA

| Overall length | | | 521. | 8 <u>±</u> 6.5 | mm |
|-----------------|---------|--|------|----------------|----|
| Neck length | | | 164. | 2 <u>+</u> 4.5 | mm |
| Diagonal | | | max. | 657.6 | mm |
| Horizontal axis | of bulb | | max. | 556.4 | mm |
| Vertical axis | | | max. | 435.3 | mm |
| Useful screen | | | | | |
| diagonal | | | min. | 617.8 | mm |
| horizontal axis | | | min. | 518 | mm |
| vertical axis | | | min. | 390 | mm |

Mounting position: any

Net weight: approx.21.5 kg

Base: 12 pin base JEDEC B12-246

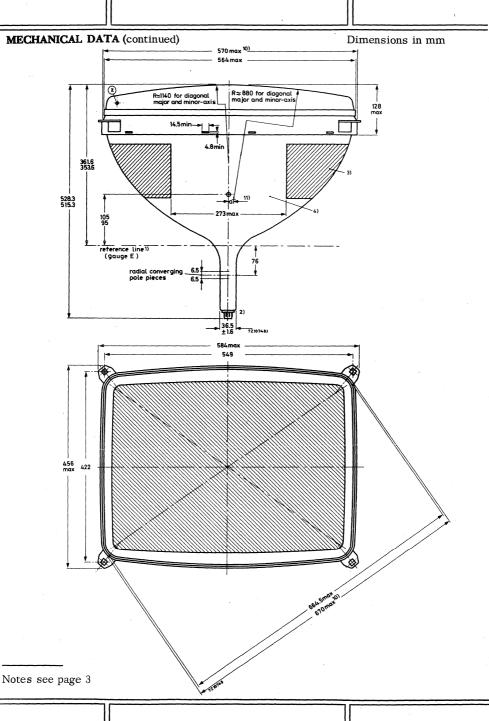
Anode contact: Small cavity contact [1-21, IEC67-III-2

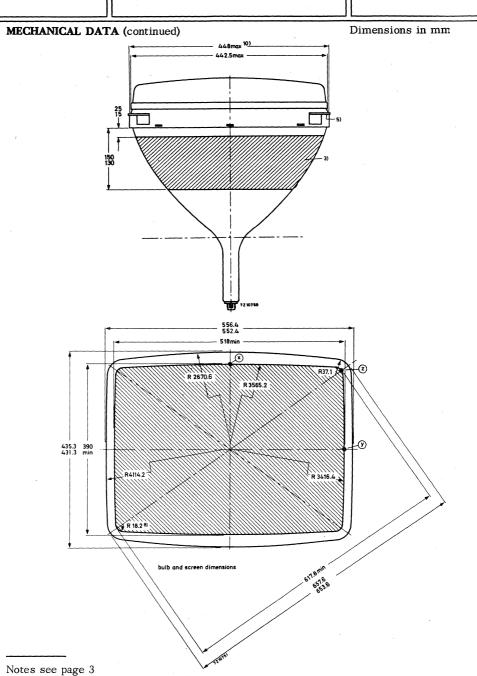
Magnetic shielding

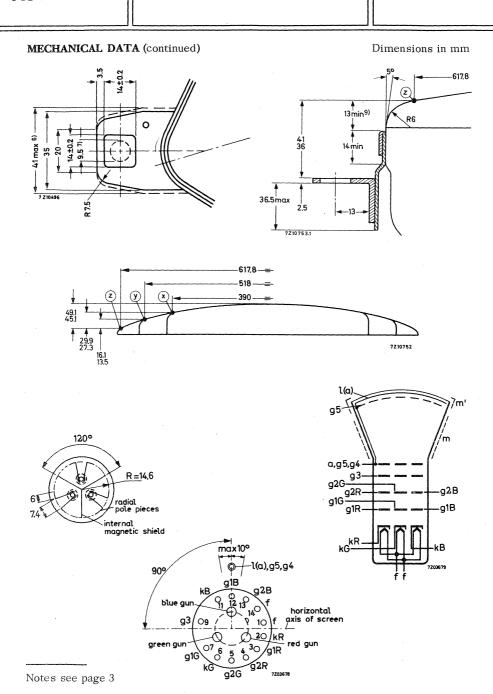
Magnetic shielding should be provided by means of a metal shield extending 285 mm over the cone of the tube measured from the centre of the face plate. The metal shield is preferably constructed of min. 0.5 mm cold rolled steel properly annealed. The air gap between the shield and the metal rimband should be as small as possible and not exceed 10 mm. The magnetic shield should be connected to the outer conductive coating.

NOTES TO OUTLINE DRAWING (See pages 4, 5 and 6)

- 1. Reference line determined by the plane of the upper edge of the flange of the reference line gauge, when the gauge is resting on the cone. Gauge see page 10.
- 2. The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with bulb axis and having a diameter of 55 mm.
- 3. Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4. To clean this area, whipe only with a soft lintless cloth.
- 5. The displacement of any lug with respect to the plane through the three other lugs is max. 2 \mbox{mm}
- 6. Minimum space to be reserved for mounting lug.
- 7. The position of the mounting screw in the cabinet must be within a circle of 9.5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 549 mm x 422 mm.
- 8. Coördinates for radius R = 18.2 mm: x = 236.6 mm, y = 168.9 mm
- 9. Distance from point Z to any hardware.
- 10. Maximum dimension in plane of lugs.
- 11. a = 30.0 mm on diagonal, 28.4 mm on major axis, 18.8 mm on minor axis.







see page 11

| TYPICAL OPERATING CONDITIONS | | | | |
|---|-----------------|--------|------|------------------|
| Final accelerator voltage | V_{a,g_5,g_4} | | 25 | kV |
| Grid No.3 (focusing electrode) voltage | v_{g_3} | 4.2 to | 5 | kV |
| Grid No.2 voltage for a spot cut-off voltage $V_{g_{\bar{1}}} = -105 \text{ V}$ | v_{g_2} | 210 to | 495 | V ¹) |
| Grid No.1 voltage for spot cut-off at V_{g_2} = 300 V | v_{g_1} | -70 to | -140 | v ²) |

EQUIPMENT DESIGN VALUES (each gun if applicable)

Luminance at centre of screen

Valid for final accelerator voltages between 20 kV and 27.5 kV

| Grid No.3 (focusing electrode) voltage | | v_{g_3} | 16.8 to 20% of | | | |
|--|---------------------------------------|----------------------|--|----------------------|--|--------|
| Grid No.2 voltage ¹) | | v_{g_2} | final accelerator volta See cut-off design cha page 12 | | | |
| Grid No.1 voltage for visual extinction of focused spot (cut-off voltage) ²) | V _{g1} See cut-off design cl | | | | nart | |
| Difference in cut-off voltages between guns in any tube | ΔV_{g_1} lowest value is min. | | | | 65 <u>%</u> | |
| Grid No.3 (focusing electrode) current | | I_{g_3} | | -15 to | | uΑ |
| Grid No. 2 current | | I_{g_2} | | -5 to | +5 / | иΑ |
| Grid No.1 current at Vg ₁ = -150 V | | Ig ₁ | | -5 to | +5 | ıΑ |
| To produce white of the following CIE coordinates | | 3) | 4) 0,265 | 5) | 6) | |
| Percentage of total anode current | х · У | 0.310 | 0.290 | 0.281 | $\begin{bmatrix} 0.313 \\ 0.329 \end{bmatrix}$ | |
| supplied by each gun (typical) red gun green gun blue gun | · | 43.5 30.0 26.5 | 27.9 34.9 37.2 | 32.3 35.6 32.2 | 43.1 32.0 24.9 | % % |
| Ratio of anode currents | | | | | | |
| red gun to green gun | min. av. max. | 1.05 1.45 2.00 | 0.55 0.80 1.10 | 0.65 0.90 1.25 | 0.95 1.35 1.85 | |
| Ratio of anode currents | | | | | | |
| red gun to blue gun | min. | 1.25 | 0.55 | 0.75 | 1.30 | |
| | av. | 1.65 | 0.75 | 1.00 | 1.75 | |
| | max. | 2.25 | 1.00 | 1.35 | 2.35 | l |

Notes see page 8

EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction

max. 15 mm

Correction that must be supplied by purifying magnet to compensate for mis-register in any direction

max. $100 \mu m$

Lateral distance between blue spot and the converged red and green spots

max. 6.4 mm (in both directions)

Radial convergence displacement excluding effects of dymanic convergence (each beam)

max. 9.4 mm⁷) (in both directions)

 $^{^{}m l}$) This range of ${\rm Vg_2}$ has to be used when in circuit design fixed values for cut-off of the three guns are used.

²⁾ This range of Vg_1 has to be used when in circuit design fixed values for Vg_2 of the three guns are used.

³⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point. (Point C).

⁴⁾ To produce black/white pictures a more bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

⁵⁾ This point is a compromise between the white point C and the white point x = 0.265 and y = 0.290, given in order to enable good rendition of colour and black and white pictures with one white point.

⁶⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point. (Point D).

⁷⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape synchronized with scanning.

LIMITING VALUES (Each gun if applicable)

(Design centre rating system unless otherwise specified)

| Final acce | elerator voltage | Va, g5, g4 | max. min. | 27.5 20 | kV ¹) ²) ³) kV ¹) ⁴) |
|------------|------------------------------|-------------------|--------------|------------|---|
| Average c | urrent for three guns | Ia | max. | 1000 | μ A ⁵) |
| Grid No.3 | (focusing electrode) voltage | Vg3 | max. | 6000 | V |
| Grid No.2 | voltage, peak, including | . • | | | |
| video sig | nal voltage | Vg _{2p} | max. | 1000 | V |
| Grid No.1 | voltage, | | | | |
| | negative | -Vg1 | max. | 400 | V |
| | negative, operating cut-off | -Vg1 | max. | 200 | \mathbf{V} |
| | positive | Vgl | max. | . 0 | V |
| | positive peak | Vg1p | max. | 2 | V |
| Cathode to | heater voltage, | | | | |
| | positive | v_{kf} | max. | 250 | $v^{(6)7}$ |
| | positive peak | V_{kf_D} | max. | 300 | V |
| | negative | -V _{kf} | max. | 135 | V |
| | negative peak | -V _{kfp} | max. | 180 | V |

¹⁾ Absolute max. rating system.

²) The X-ray dose rate remains below the acceptable value of 0.5 mr/h, measured with ionization chambre when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustment for normal operation without picture tube.

⁴) Operation of the tube at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

 $^{^5)}$ 1500 $\mu\mathrm{A}$ permitted provided a current limiting circuit is used.

⁶⁾ In order to avoid excessive hum the a.c. component of the heater to chassis voltage should be as low as possible and must not exceed 20 V_{rms}.

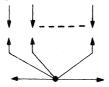
 $^{^{7})}$ During an equipment warm-up period not exceeding 15 s V_{kf} is allowed to rise to 410 V. Between 15 s and 45 s after switching on a decrease in V_{kf} proportional with time from 410 V to 250 V is permissible.

A66-120X

REMARKS

With the high voltage used with this tube (max. 27.5 kV) internal flash-overs may occur, these may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible.

Additional information available on request.

During shipment and handling the tube should not be subjected to accelerations greater than $35\ \mathrm{g}$ in any directions.

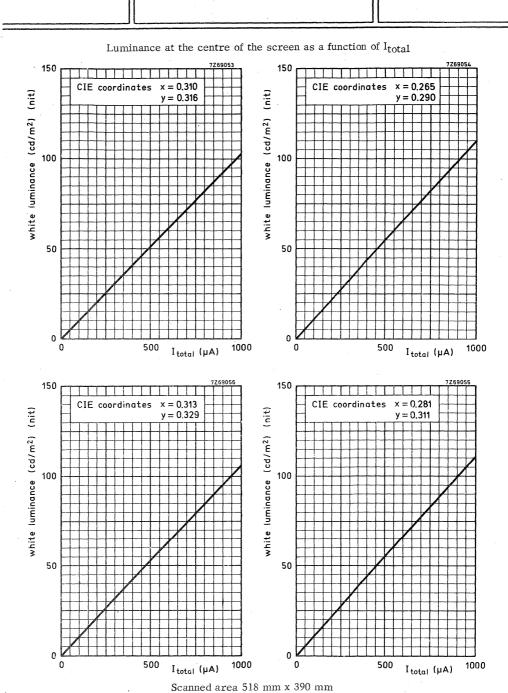
REFERENCE LINE GAUGE (gauge E)

Gauge E. See chapter "Reference line gauges" in front of this book

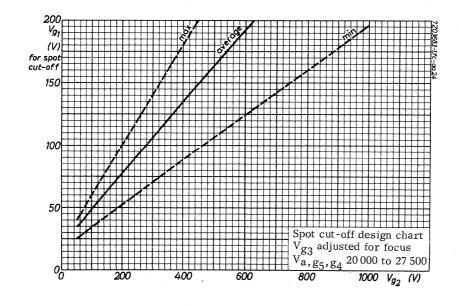


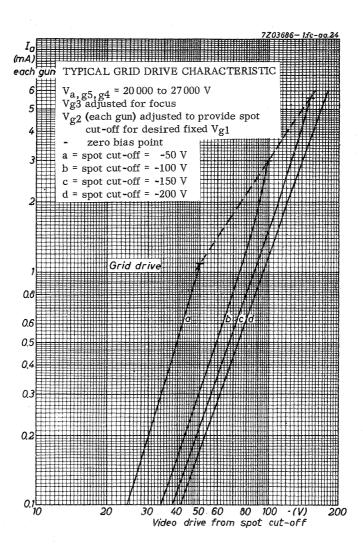
11



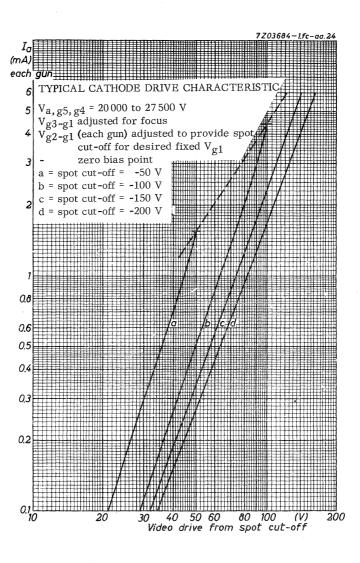














.

110° COLOUR TELEVISION TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed three-colour phosphor dot screen and internal magnetic shield. A high white luminance is obtained at near unity current ratio. Being temperature compensated, the shadow-mask makes for optimum field purity and good uniformity during warm-up. The design is such that minimum occurence of the moiré effect is ensured. The tube has a reinforced envelope and therefore no separate safety screen is necessary.

| OUICK | REFER | ENCE | DATA |
|---------|-------|---------|------|
| CHILLIA | KEFEF | CHINCIP | DALA |

TEMPERATURE-COMPENSATED SHADOW-MASK

DESIGNED FOR MINIMUM MOIRE EFFECT

HIGH WHITE LUMINANCE AT UNITY CURRENT RATIO

Face diagonal 66 cm

Deflection angle 110^{-0}

Neck diameter 36.5 mm

Envelope reinforced

suitable for push through

1

Magnetic shield internal

Focusing bi-potential

Deflection magnetic
Convergence magnetic

Heating 6.3 V, 900 mA

Light transmission of face glass 52.5 %

Tamuary 1974

A66-140X

SCREEN

Metal-backed phosphor dots

Red: Europium activated rare earth

Phosphor type Green: Sulphide type

Blue: Sulphide type

Dot arrangement Triangular

Spacing between centres of adjacent dot trios 0.81 mm

Light transmission at centre of face glass

HEATING: indirect by A.C. or D.C.; parallel or series supply

For maximum cathode life it is recommended that the heater supply be regulated at 6.3 V. If the tube is connected in a series heater chain the surge heater voltage must not exceed 9.5 $V_{\rm rms}$ when the supply is switched on.

CAPACITANCES

| Final accelerator to external conductive coating | Ca, g5, g4/m | max. min. | 2100 1600 | pF pF |
|--|--|--------------|--------------|----------|
| Final accelerator to metal rimband | C _a , g ₅ , g ₄ /m' | | 500 | pF |
| Grid No.1 of any gun to all other electrodes | C_{g1} | | 7 | pF |
| Cathodes of all guns (connected in parallel) to all other electrodes | C_k | | 15 | pF |
| Cathode of any gun to all other electrodes | C _{kR} C _{kG} | | 5 5 | pF pF |

CkB 5 pF Grid No.3 (focusing electrode) to all

Cg3

FOCUSING electrostatic (bi-potential)

•

DEFLECTION magnetic

other electrodes

| Diagonal deflection angle | | | 110 | 0 |
|-----------------------------|--|--|-----|---|
| Horizontal deflection angle | | | 97 | 0 |
| Vertical deflection angle | | | 77 | 0 |

CONVERGENCE magnetic



7 pF

52.5 %

MECHANICAL DATA

| Overall length Neck diameter | | 425.1 | to 438.1 36.5 | mm mm |
|---------------------------------|---------|-------|------------------|----------|
| Diagonal) | | max. | 657.6 | mm |
| Horizontal axis | of bulb | max. | 556.4 | mm |
| Vertical axis | | max. | 435.3 | mm |
| Useful screen | | | | |
| diagonal | | min. | 617.8 | mm |
| horizontal axis | | min. | 518 | mm |
| vertical axis | | min. | 390 | mm |

Mounting position: any

Net weight : approx. 20 kg

Base : 12 pin base JEDEC B12-246

Anode contact : Small cavity contact [1-21, IEC 67-III-2

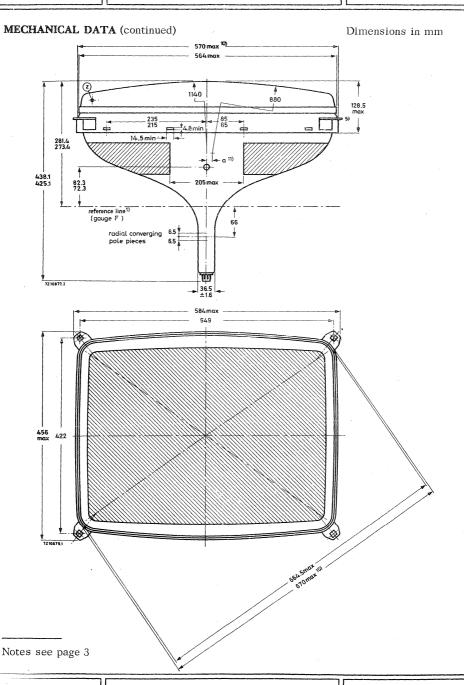
Magnetic shielding, degaussing: The tube is provided with an internal magnetic shield. The internal magnetic shield and the shadow-mask with its suspension system may be provided with an automatic degaussing system, consisting of two coils covering left and right cone parts. For proper degaussing an initial m.m.f. of 500 ampere-turns is required in each of the coils. This m.m.f. has to be gradually decreased by appropriate circuitry. After decreasing to 10 A.t. or less, sudden switch off is permissible. In the steady state, no significant m.m.f. should remain in the coils (≤ 0.5 A.t).

To ease the mounting of the coils, the rimband is provided with rectangular holes.

NOTES TO OUTLINE DRAWINGS (See pages 4, 5, and 6)

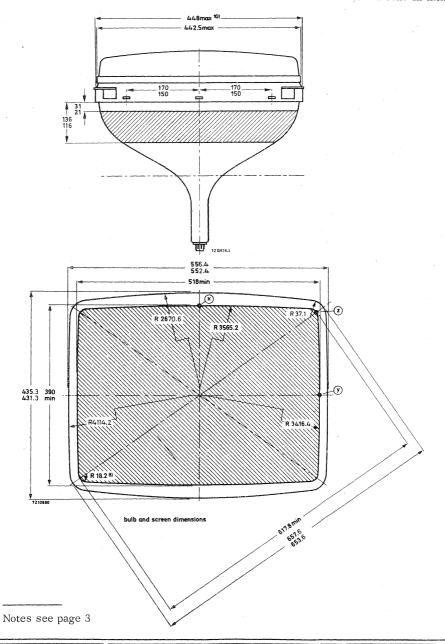
- 1) Reference line, determined by the plane of the upper edge of the flange of the reference line gauge, when the gauge is resting on the cone.
- 2) The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with the tube axis and having a diameter of 55 mm.
- 3) Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.
- 4) To clean this area, wipe only with a soft lintless cloth.
- 5) The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 6) Minimum space to be reserved for mounting lug.
- 7) The position of the mounting screw in the cabinet must be within a circle of 9.5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 549 mm x 422 mm.
- 8) Coordinates for radius R = 18.2 mm: x = 236.6 mm, y = 168.9 mm.
- 9) Distance from point z to any hardware.
- 10) Maximum dimensions in plane of lugs.
- 11) Dimension a = 30.0 mm on diagonal, 28.4 mm on major axis, 18.8 mm on minor axis.

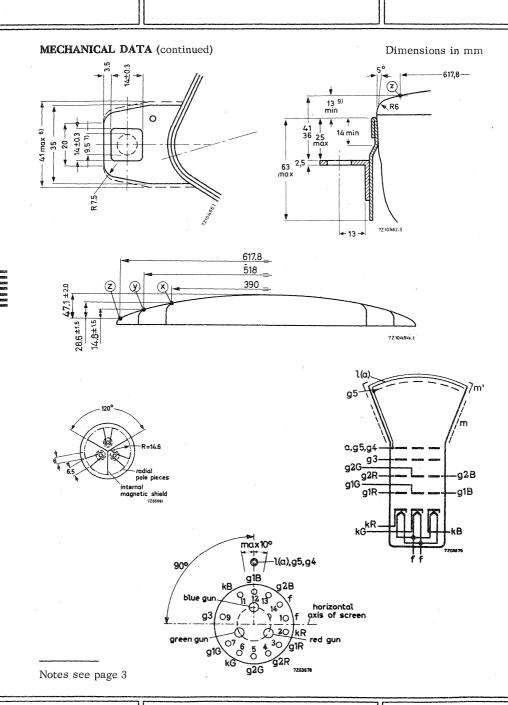




MECHANICAL DATA

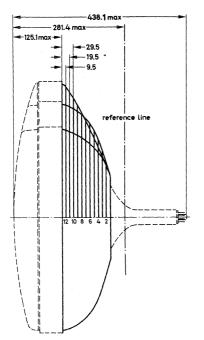
Dimensions in mm

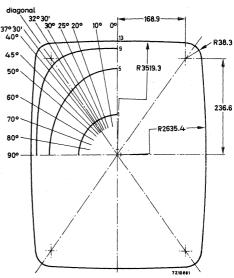




MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm





| | | Distance from centre | | | | | | | | | | | | | | |
|------|---------------|----------------------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|
| Sec- | Distance from | 00 | 10° | 20 ° | 25 ° | 30° | 32° 304 | 35° 31° | 37° 30° | 40° | 45° | 50° | 60° | 70° | 80 ° | 900 |
| tion | section 13 | Long | | | | ĺ | | Diagon. | | | | - | | | - | Short |
| 1 | 119.5 nom. | 99.41 | 99.18 | 98.70 | 98.46 | 98.26 | 98.18 | 98.11 | 98.07 | 98.05 | 98.05 | 98.13 | 98.51 | 99.08 | 99.65 | 99.93 |
| 2 | 109.5 " | 142.11 | 139.07 | 133.90 | 131.47 | 129.35 | 128.43 | 127.45 | 126.89 | 126.28 | 125.38 | 124.90 | 125.49 | 126.92 | 129.46 | 131.09 |
| 3 | 99.5 " | 171.81 | 168.10 | 161.35 | 157.99 | 154.92 | 153.52 | 151.98 | 151.06 | 149.99 | 148.22 | 146.91 | 145.65 | 145.96 | 147.25 | 148,22 |
| 4 | 89.5 " | 193.96 | 191.36 | 185.57 | 182.25 | 178.92 | 177.30 | 175.41 | 174.22 | 172.78 | 170.12 | 167.81 | 164.25 | 162.10 | 161.14 | 160.96 |
| 5 | 79.5 " | 213.30 | 211.91 | 207.82 | 204.94 | 201.66 | 199.92 | 197.75 | 196.31 | 194.48 | 190.86 | 187.37 | 181.15 | 176.39 | 173.40 | 172.38 |
| 6 | 69.5 " | 230.11 | 229.83 | 227.80 | 225.69 | 222.75 | 220.99 | 218.64 | 216.97 | 214.76 | 210.09 | 205.28 | 196.20 | 188.93 | 184.26 | 182.64 |
| 7 | 59.5 " | 243.54 | 244.45 | 245.30 | 244.63 | 242.68 | 241.15 | 238.79 | 236.97 | 234.39 | 228.50 | 222.08 | 209.60 | 199.67 | 193.44 | 191.31 |
| 8 | 49.5 " | 253.95 | 255.93 | 260.00 | 261.38 | 261.16 | 260.19 | 258.10 | 256.19 | 253.23 | 245.82 | 237,40 | 221.05 | 208.54 | 200.97 | 198,44 |
| 9 | 39.5 " | 262.25 | 265.05 | 272.04 | 275.72 | 277.94 | 277.99 | 276.37 | 274.36 | 270.89 | 261.35 | 250,54 | 230.35 | 215.70 | 207.15 | 204.34 |
| 10 | 29.5 " | 268.76 | 272.13 | 281.47 | 287.43 | 292.66 | 294.27 | 293.44 | 291.30 | 287.13 | 274.58 | 261.11 | 237.50 | 221.30 | 212.11 | 209.13 |
| 11 | 19.5 " | 273.39 | 277.11 | 288.19 | 296.17 | 304.82 | 308.65 | 309.17 | 307.00 | 301.85 | 285.09 | 268,75 | 242.46 | 225.33 | 215.81 | 212.75 |
| 12 | 9,5 " | 276.43 | 280.34 | 292.47 | 301.96 | 313.84 | 320.37 | 323.09 | 321.27 | 314.80 | 292.49 | 273.50 | 245.58 | 228.11 | 218.52 | 215.46 |
| 13 | 0 | 279.00 | 282.96 | 295.36 | 305,23 | 318.01 | 325.40 | 329.00 | 327.49 | 320.66 | 296.49 | 276.73 | 248.34 | 230.73 | 221.08 | 218.00 |



TYPICAL OPERATING CONDITIONS

| Final accelerator voltage Grid No.3 (focusing electrode) voltage | Va, g5, g4 V _{g3} | 4.2 to | 25 5 | kV kV | |
|--|-------------------------------|------------------|----------------|----------|----------------|
| Grid No.2 voltage for a spot cut-off voltage V _{g1} = -105 V Grid No.1 voltage for spot cut-off | v_{g2} | 212 to | 495 | V | ¹) |
| at V_{g2} = 300 V Luminance at the centre of the screen | v_{g1} | -70 to -See page | | V | ²) |

EQUIPMENT DESIGN VALUES (each gun if applicable)

| Valid for final accelerator voltages between | een 20 kV and 2 | 27.5 k | V. | | | |
|---|--|-------------|--|----------------------|-------|--|
| Grid No.3 (focusing electrode) voltage | Vg3 16.8 to 20% of final accelerator voltage | | | | | |
| Grid No.2 voltage | v_{g2} | See | cut-off | design | tago | |
| Grid No.1 voltage for visual extinction | | | P-8- | | | |
| of focused spot (cut-off voltage) 2) | v_{g1} | See | cut-off | design | | |
| Difference in out off college between | | char | t page | 13 | | |
| Difference in cut-off voltages between guns in any tube | A37 | 1 | | | | |
| guils in any tube | ΔV_{g1} | | | e is min est valu | | |
| Grid No.3 (focusing electrode) current | $I^{\alpha\beta}$ | - 5 | | $+5 \mu$ | | |
| Grid No.2 current | I_{g2}^{g3} | - -5 | to | +5 μ. | A | |
| Grid No.1 current at $V_{g1} = -150 \text{ V}$ | $\begin{smallmatrix} \mathrm{I}_{\mathrm{g}3} \\ \mathrm{I}_{\mathrm{g}2} \\ \mathrm{I}_{\mathrm{g}1} \end{smallmatrix}$ | - 5 | to | | | |
| To produce white of the following | | | 3) | ⁴) | 6) | |
| CIE coordinates | | X | $\begin{vmatrix} 0.265 \\ 0.290 \end{vmatrix}$ | 1 | 0.313 | |
| | | У | 0.290 | 0.311 | 0.329 | |
| Percentage of total anode current | | | | | | |
| supplied by each gun (typical) | | | | | | |
| red gun | | | 25.8 | 30.2 | 41.0 | |
| green gun | | | 33.5 | 34.5 | 31.3 | |
| blue gun | | | 40.7 | 35.3 | 27.7 | |
| Ratio of anode currents | , | | | | | |
| red gun to green gun | | min. | 0.55 | 0.65 | 0.95 | |
| 9 | | av. | 0.75 | 0.90 | 1.30 | |
| | | max. | 1.10 | 1.25 | 1.80 | |
| | • | | | | | |
| Ratio of anode currents | | | | | | |
| red gun to blue gun | | min. | 0.50 | 0.65 | 1.15 | |
| • | | av. | 0.65 | 0.85 | 1.50 | |
| | | max. | 0.85 | 1.15 | 2.00 | |

Notes see page 9.



EQUIPMENT DESIGN VALUES (continued)

Required centring, measured at the centre of the screen in any direction max. 12 mm Correction that must be supplied by purifying magnet to compensate for mis-register in any direction max. 100 μm Lateral distance between blue spot and the converged red and green spots max. mm (in both directions) Radial convergence displacement excluding effects of dynamic convergence (each gun) 5) max. mm (in both directions)

 $^{^{1})}$ This range of V_{g2} has to be used when in circuit design fixed values for cut-off of the three guns are used.

 $^{^2)}$ This range of $\rm V_{g1}$ has to be used when in circuit design fixed values for $\rm V_{g2}$ of the three guns are used.

³⁾ To produce black/white pictures a bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

⁴⁾ This point is a compromise between white point D and the white point x = 0.265 y = 0.290, given in order to enable good rendition of colour and black and white pictures with one white point.

⁵⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape through the convergence coils synchronized with scanning.

⁶⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point. (Point D).

LIMITING VALUES (Each gun if applicable)

(Design centre rating system unless otherwise specified)

| Final acc | elerator values | Va, g5, g4 | max. min. | 27.5 20 | kV ¹) ²) ³) kV ¹) ⁴) |
|------------|--|-------------------|--------------|------------|---|
| Average o | current for three guns | I_a | max. | 1000 | μA 5) |
| Grid No.3 | (focusing electrode) voltage | v_{g3} | max. | 6000 | V |
| | 2 voltage, peak, including gnal voltage | v_{g2p} | max. | 1000 | V |
| Grid No.1 | voltage, | | | | |
| | negative | $-v_{g_1}$ | max. | 400 | V |
| | negative, operating cut-off | $-v_{g_1}$ | max. | 200 | V |
| | positive | v_{g_1} | max. | 0 | V |
| | positive peak | v_{g1p} | max. | 2 | V |
| Cathode to | oheater voltage, | | | | |
| | positive | $V_{\mathbf{kf}}$ | max. | 250 | v 6) 7) |
| | positive peak | v_{kf_D} | max. | 300 | V |
| | negative | $-v_{kf}$ | max. | 135 | V |
| | negative peak | $-v_{kf_p}$ | max. | 180 | V |
| | | | | | |

¹⁾ Absolute max. rating system.

²⁾ The X-ray dose rate remains below the acceptable value of 0.5 mr/h, measured with ionization chamber when the tube is used within its limiting values.

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

⁴⁾ Operation of the tube at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

 $^{^5)}$ 1500 $\mu\mathrm{A}$ permitted provided a current limiting circuit is used.

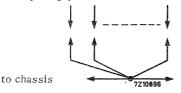
 $^{^6}$) In order to avoid excessive hum the a.c. component of the heater to chassis voltage should be as low as possible and must not exceed 20 $V_{\rm rms}$.

⁷⁾ During an equipment warm-up period not exceeding 15 s V_{kf} is allowed to rise to 410 V. Between 15 s and 45 s after switching on a decrease in V_{kf} proportional with time 410 V to 250 V is permissible.

REMARK.

With the high voltage used with this tube (max. 27.5 kV) internal flash-overs may occur. These may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



short connections to electrodes

short connection to outer conductive coating

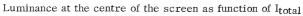
No other connections between the outer conductive coating and the chassis are permissible.

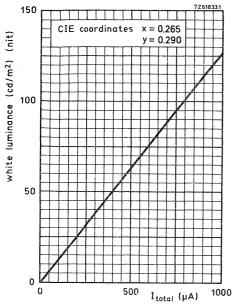
Additional information is given in Application Information 258, available on request.

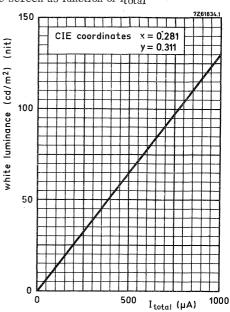
During shipment and handling the tube should not be subjected to accelerations greater than 35 g in any direction.

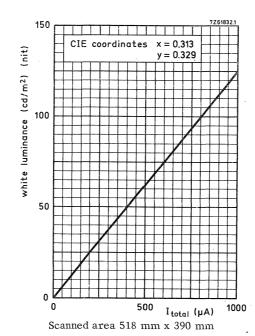
REFERENCE LINE GAUGE (Gauge F)

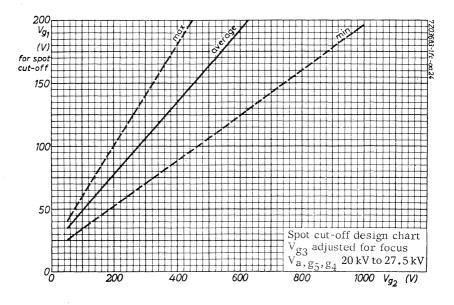
Gauge F. See chapter "Reference line gauges" in front of this book.

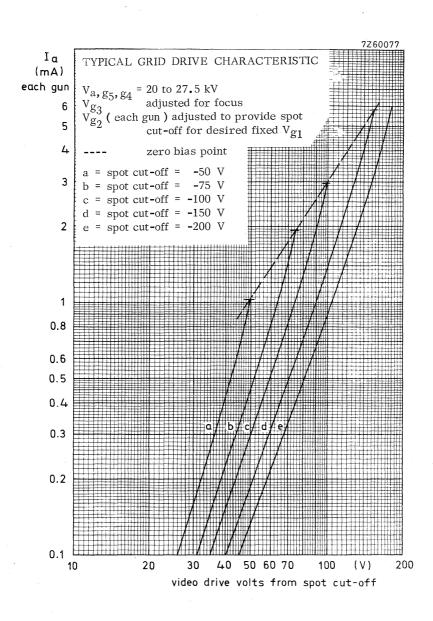


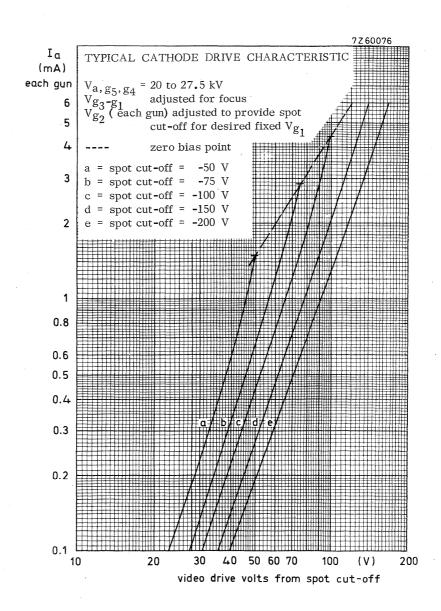














110° COLOUR TELEVISION PICTURE TUBE

Three-gun temperature-compensated shadow-mask rectangular colour television tube with electrostatic focus, magnetic deflection and convergence, metal-backed three-colour phosphor dot screen and internal magnetic shield. A high white luminance is obtained at near unity current ratio. Being temperature compensated, the shadow-mask makes for optimum field purity and good uniformity during warm-up. The design is such that minimum occurence of the moire effect is ensured. The tube has a reinforced envelope and therefore no separate safety screen is necessary. Typically, a legible picture will appear within 5 s.

| QUICK REFERENCE DAT | ГА | |
|--|--|--------|
| TEMPERATURE-COMPENSATED SHADOW-MASK | | |
| DESIGNED FOR MINIMUM MOIRE EFFECT | | |
| HIGH WHITE LUMINANCE AT UNITY CURRENT RA | TIO | |
| Face diagonal | 66 | cm |
| Deflection angle | 110 | deg |
| Neck diameter | 36,5 | mm |
| Envelope | reinforc | ed |
| Magnetic shield | internal | |
| Focusing | bi-poten | tial |
| Deflection | magneti | c |
| Convergence | magneti | c |
| Heating | 6,3 V, 7 | 730 mA |
| Light transmission of face glass | 52,5 | % |
| | th a typical tube a l l appear after with | |

SCREEN

Metal-backed phosphor dots

Red: Europium activated rare earth

Phosphor type Green: Sulphide type
Blue: Sulphide type

Dot arrangement Triangular

Spacing between centres of adjacent dot trios 0,81 mm

Light transmission at centre of face glass \$ 52,5 $\,\%$

HEATING: indirect by a.c. or d.c.; parallel supply

| Heater voltage | ${ m v_f}$ | 6,3 | V |
|----------------|------------------|-----|-------------------|
| Heater current | . $\mathbf{I_f}$ | 730 | mA ¹) |

For maximum cathode life it is recommended that the heater supply be regulated at 6,3 V. For heating time as a function of source impedance see graph page 13 below.

CAPACITANCES

| Final accelerator to conductive coating | external | $C_a, g_3, g_4/m$ | max. min. | 2100 1600 | | pF pF |
|---|--------------------------------|--------------------------------|--------------|--------------|---|----------|
| Final accelerator to | metal rimband | $C_{a,g3,g4}/m$ ' | | 500 | | pF |
| Grid no.1 of any gun | to all other electrodes | C_{g1} | | 7 | | pF |
| Cathodes of all guns to all other electro | (connected in parallel) des | C_k | | 15 | | pГ |
| Cathode of any gun to | all other electrodes | C_{kR} , C_{kG} , C_{kI} | 3 | 5 | | pF |
| Grid no.3 (focusing eall other electrode | • | C_{g3} | | 7 | | pF |
| FOCUSING | electrostatic (bi-potential) | | | | | |
| DEFLECTION | magnetic | | | | | |
| Diagonal deflection as | ngle | | | 110 | 0 | |
| Horizontal deflection | angle | | | 97 | 0 | |
| Vertical deflection ar | ngle | | | 77 | 0 | |
| | | | | | | |

CONVERGENCE magnetic

 $^{^1)}$ If the heater is fed from a mains transformer designed for tube type A66-140X, the source impedance should not exceed 0, 6 Ω to ensure that the heater voltage of the A66-410X is not exceeded.

If the heater is fed from $\,$ a line time base designed for tube type A66-140X, the series impedance, if any, should match the lower heater current of the quick-heating tube.

MECHANICAL DATA

| Overall length Neck diameter | | | 425, 1 to | 36, 5 | |
|---------------------------------|---------|-----|-----------|-------|----|
| Diagonal | | • , | max. | 657,6 | mm |
| Horizontal axis | of bulb | | max. | 556,4 | mm |
| Vertical axis | | | max. | 435,3 | mm |
| Useful screen | | | | | |
| diagonal | | | min. | 617,8 | mm |
| horizontal axis | | | min. | 518 | mm |
| vertical axis | | | min. | 390 | mm |

Mounting position: any

Net weight : approx. 20 kg

Base : 12 pin base JEDEC B12-246

Anode contact : Small cavity contact J1-21, IEC 67-III-2

Magnetic shielding, degaussing: The tube is provided with an internal magnetic shield. The internal magnetic shield and the shadow-mask with its suspension system may be provided with an automatic degaussing system, consisting of two coils covering left and right cone parts. For proper degaussing an initial m.m.f. of 500 ampere-turns is required in each of the coils. This m.m.f. has to be gradually decreased by appropriate circuitry. After decreasing to 10 A.t. or less, sudden switch off is permissible. In the steady state, no significant m.m.f. should remain in the coils (< 0,5 A.t.).

To ease the mounting of the coils, the rimband is provided with rectangular holes.

NOTES TO OUTLINE DRAWING (see pages 4, 5, and 6)

1) Reference line, determined by the plane of the upper edge of the flange of the reference line gauge, when the gauge is resting on the cone.

2) The socket for this base should not be rigidly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base will fall within a circle concentric with the tube axis and having a diameter of 55 mm.

3) Configuration of outer conductive coating may be different, but will contain the contact area as shown in the drawing.

4) To clean this area, wipe only with a soft lintless clotch.

5) The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.

6) Minimum space to be reserved for mounting lug.

7) The position of the mounting screw in the cabinet must be within a circle of 9,5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 549 mm x 422 mm.

8) Coordinates for radius R = 18, 2 mm: x = 236, 6 mm, y = 168, 9 mm.

9) Distance from point z to any hardware.

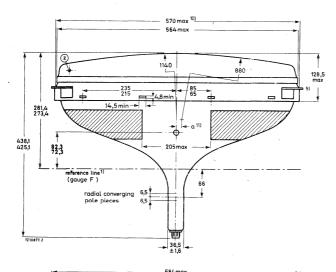
10) Maximum dimensions in plane of lugs.

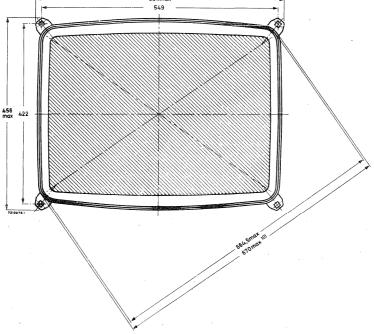
11) Dimension a = 30,0 mm on diagonal, 28,4 mm on major axis, 18,8 mm on minor axis.

March 1973 3

MECHANICAL DATA (continued)

Dimensions in mm

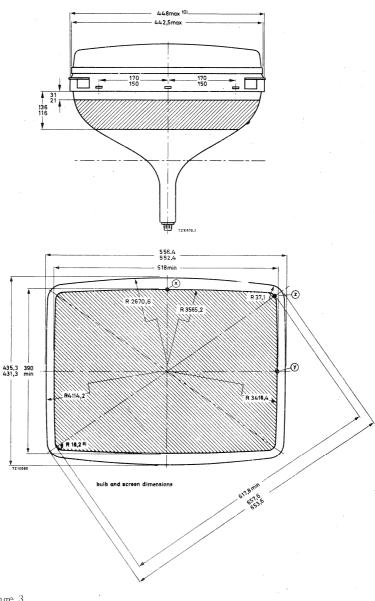




Notes see page 3

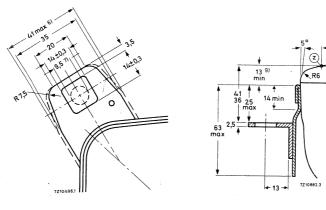
MECHANICAL DATA

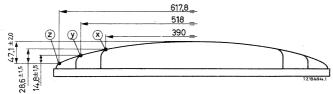
Dimensions in mm

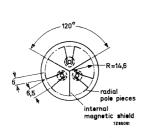


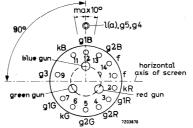
MECHANICAL DATA (continued)

Dimensions in mm









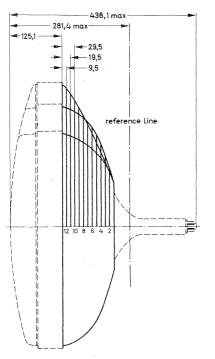
a,g5,g4 g2G-g3g1G-

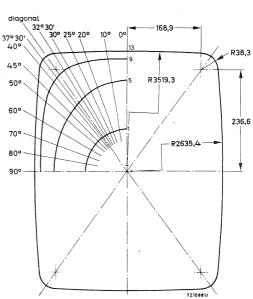
Notes see page 3

.g2B .g1B

MAXIMUM CONE CONTOUR DRAWING

dimensions in mm





| | | | | | | | Ε | istance f | rom cent | re | | | | | | |
|-------|---------------|----------|---------|---------|---------|---------|---------|-----------|----------|---------|---------|---------|---------|---------|---------|---------|
| Sec - | Distance from | 00 | 100 | 200 | 25° | 30° | 32° 30' | 35° 31' | 37º 30' | 40° | 45° | 50° | 60° | 70° | 80° | 90° |
| tion | section 13 | Long | - | | | | | Diagon. | | | | | | | | Short |
| 1 | 119, 5 nom. | 99, 41 | 99, 18 | 98, 70 | 98, 46 | 98, 26 | 98, 18 | 98, 11 | 98,07 | 98, 05 | 98,05 | 98, 13 | 98, 51 | 99, 08 | 99, 65 | 99, 93 |
| 2 | 109,5 " | 142, 11 | 139,07 | 133, 90 | 131, 47 | 129, 35 | 128, 43 | 127, 45 | 126, 89 | 126, 28 | 125,38 | 124, 90 | 125, 19 | 126, 92 | 129, 46 | 131, 09 |
| 3 | 99,5 " | 171, 81 | 168, 10 | 161, 35 | 157, 99 | 154, 92 | 153, 52 | 151,98 | 151,06 | 149, 99 | 148, 22 | 146, 91 | 145, 65 | 145, 96 | 147, 25 | 148, 22 |
| 4 | 89,5 " | 193, 96 | 191, 36 | 185, 57 | 182, 25 | 178, 92 | 177, 30 | 175, 41 | 174, 22 | 172, 78 | 170,12 | 167, 81 | 164, 25 | 162, 10 | 161, 14 | 160, 96 |
| 5 | 79,5 " | 213,30 | 211,91 | 207, 82 | 204, 94 | 201,66 | 199,92 | 197, 75 | 196, 31 | 194, 48 | 190,86 | 187, 37 | 181, 15 | 176, 39 | 173,40 | 172, 38 |
| 6 | 69, 5 " | 230, 11 | 229, 83 | 227, 80 | 225, 69 | 222, 75 | 220, 99 | 218,64 | 216, 97 | 214, 76 | 210,09 | 205, 28 | 196, 20 | 188, 93 | 184, 26 | 182, 64 |
| 7 | 59,5 " | 243,54 | 244, 45 | 245, 30 | 244, 63 | 242,68 | 241, 15 | 238, 79 | 236, 97 | 234, 39 | 228,50 | 222,08 | 209, 60 | 199, 67 | 193, 44 | 191, 31 |
| 8 | 49,5 " | 253, 95 | 255, 93 | 260,00 | 261,38 | 261, 16 | 260, 19 | 258, 10 | 256, 19 | 253, 23 | 245,82 | 237, 40 | 221,05 | 208,54 | 200, 97 | 198, 44 |
| 9 | 39,5 " | 262, 25 | 265,05 | 272, 04 | 275, 72 | 277, 94 | 277, 99 | 276, 37 | 274, 36 | 270, 89 | 261, 35 | 250,54 | 230, 35 | 215, 70 | 207, 15 | 204, 34 |
| 10 | 29,5 | 268, 76. | 272, 13 | 281, 47 | 287, 43 | 292, 66 | 294, 27 | 293, 44 | 291, 30 | 287, 13 | 274,58 | 261, 11 | 237, 50 | 221, 30 | 212, 11 | 209, 13 |
| 11 | 19,5 " | 273, 39 | 277, 11 | 288, 19 | 296, 17 | 304, 82 | 308, 65 | 309, 17 | 307,00 | 301, 85 | 285,09 | 268, 75 | 242, 46 | 225, 33 | 215, 81 | 212, 75 |
| 12 | 9,5 | 276, 43 | 280,34 | 292, 47 | 301,96 | 313,84 | 320, 37 | 323,09 | 321, 27 | 314,80 | 292, 49 | 273,50 | 245,58 | 228, 11 | 218,52 | 215. 46 |
| 13 | 0 | 279,00 | 282, 96 | 295, 36 | 305, 23 | 318,01 | 325, 40 | 329,00 | 327, 49 | 320,66 | 296, 49 | 276, 73 | 248, 34 | 230, 73 | 221,08 | 218,00 |
| | | L | | | | | L | | L | | | | | | | |

TYPICAL OPERATING CONDITIONS

| TYPICAL OPERATING CONDITIONS | | | | |
|--|-------------------------------|----------------|--------------------------|----------------------|
| Final accelerator voltage Grid No. 3 (Focusing electrode) voltage | Va, g5, V _{g3} | - | | 5 kV 5 kV |
| Grid No. 2 voltage for a spot cut-off voltage V _{g1} = -105 V Grid No. 1 voltage for spot cut-off | v_{g2} | 2 | 12 to 49 | 5 V ¹) |
| at $V_{g2} = 300 \text{ V}$ Luminance at the centre of the screen | v_{g1} | | 70 to -14 ee page 12 | , |
| EQUIPMENT DESIGN VALUES (each gun if a | applicable) | | | |
| Valid for final accelerator voltages between | 20 kV and 27, 5 I | κV. | | 5 |
| Grid No. 3 (focusing electrode) voltage | v_{g3} | 16 | , 8 to 20% celerator | |
| Grid No.2 voltage | v_{g2} | Se | e cut-off art page | design |
| Grid No. 1 voltage for visual extinction | | | F8- | |
| of focused spot (cut-off voltage) 2) | v_{g1} | | e cut-off art page] | |
| Difference in cut-off voltages between | | | | |
| guns in any tube | ΔV_{g1} | | vest value % of highe | |
| Grid No.3 (focusing electrode) current Grid No.2 current | I_{g3} | -5 -5 | | |
| Grid No. 1 current at V _{ol} = -150 V | $^{\mathrm{l}}_{\mathrm{g}2}$ | -5 | to +5 | • |
| Grid No. 1 current at $V_{g1} = -150 \text{ V}$ To produce white of the following | g ı | 1 3) | (⁴) | (6) |
| CIE coordinates | · x | 0,265 | 0,281 | 0,313 |
| | У | 0,290 | 0,311 | 0,329 |
| Percentage of total anode current supplied by each gun (typical) | | | | |
| red gun | | 25,8 | 30,2 | 41,0 |
| green gun | | 33,5 | 34,5 | 31,3 |
| blue gun | | 40,7 | 35, 3 | 27,7 |
| Ratio of anode currents | | 10, / | 00,0 | 27,7 |
| red gun to green gun | min. | 0,55 | 0,65 | 0,95 |
| | av. | 0,75 | 0,90 | 1,30 |
| | max. | 1, 10 | 1,25 | 1,80 |
| Ratio of anode currents | | | | |
| red gun to blue gun | | 0.50 | 0.65 | 1 15 |
| | mir | | | |
| | min. | 0,50 | 0,65 | 1, 15 |
| | min. av. max. | 0, 65 0, 85 | 0,65 0,85 1,15 | 1,15 1,50 2,00 |

Notes see page 9.

2,00

mm

max.

(in both directions)

EQUIPMENT DESIGN VALUES (continued)

dynamic convergence (each gun) ⁵)

Required centring, measured at the centre of the screen in any direction max. 12 mm Correction that must be supplied by purifying magnet to compensate for mis-register in any direction . 100 μm max. Lateral distance between blue spot and the converged red and green spots max. 5 mm (in both directions) Radial convergence diaplacement excluding effects of

 $^{^{\}rm I})$ This range of ${\rm V}_{\rm g2}$ has to be used when in circuit design fixed values for cut-off of the three guns are used.

 $^{^2)}$ This range of $\rm V_{g1}$ has to be used when in circuit design fixed values for $\rm V_{g2}$ of the three guns are used.

³⁾ To produce black/white pictures a bluish white point would be preferable. This white point corresponds virtually with the white point of current black/white picture tubes.

 $^{^4}$) This point is a compromise between white point D and the white point x = 0.265 y = 0.290, given in order to enable good rendition of colour and black and white pictures with one white point.

⁵⁾ Dynamic convergence to be effected by currents of approximately parabolic waveshape through the convergence coils synchronized with scanning.

⁶⁾ To produce colour pictures with the best possible quality, this white point should be used when the transmission system is based on this point. (Point D).

LIMITING VALUES (Each gun if applicable)

(Design centre rating system unless otherwise specified)

| Final accelerator values | $ m V_a,~g5,~g4$ | max. min. | | kV 1) 2) 3 kV 1) 4) |) |
|--|--|--------------|------|------------------------|---|
| Average current for three guns | I_a | max. | 1000 | μA ⁵) | |
| Grid No.3 (focusing electrode) | voltage V _{g3} | max. | 6000 | V | |
| Grid No.2 voltage, peak, incluvideo signal voltage | $ m V_{g2p}$ | max. | 1000 | V | |
| Grid No. 1 voltage, | | | | | |
| negative, | $-v_{g1}$ | max. | 400 | V | |
| negative, operating | cut-off -Vg1 | max. | 200 | V | |
| positive | $V_{\sigma 1}^{\sigma}$ | max. | 0 | V | |
| positive peak | $egin{vmatrix} { m V}_{{ m g1}}^{{ m g1}} \\ { m V}_{{ m g1p}} \end{matrix}$ | max. | 2 | V | |
| Cathode to heater voltage, | | | | | |
| positive | ${ m v}_{ m kf}^{\cdot}$ | max. | 250 | V ⁶) | |
| positive peak | Vkfp | max. | 300 | V | |
| negative | $-V_{\mathbf{kf}}^{\mathbf{kp}}$ | max. | 135 | V | |
| negative peak | $-V_{\mathrm{kfp}}^{\mathrm{Kr}}$ | max. | 180 | V | |
| | | | | | |



¹⁾ Absolute max. rating system.

²⁾ The X-ray dose rate remains below the acceptable value of 0,5mr/h, measured with ionization chamber when the tube is used within its limiting values;

³⁾ For optimal operating conditions the final accelerator voltage has to be stabilized. Therefore its absolute maximum value can be approached in actual operation and for this reason this value is given instead of the design centre value. During adjustment on the production line this value is likely to be surpassed considerably. It is therefore strongly recommended to first make the necessary adjustments for normal operation without picture tube.

⁴⁾ Operation of the tube at lower voltages impairs brightness and resolution and may have a detrimental effect on colour purity.

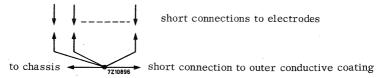
 $^{^{5}}$) $1500~\mu\mathrm{A}$ permitted provided a current limiting circuit is used.

⁶⁾ During an equipment warm-up period not exceeding 15 s $\rm V_{kf}$ is allowed to rise to 385 V. Between 15 s and 45 s after switching on a decrease in $\rm V_{kf}$ proportional with time from 385 V to 250 V is permissible.

REMARKS

With the high voltage used with this tube (max. 27,5~kV) internal flash-overs may occur. These may destroy the cathode(s) of the tube. Therefore it is necessary to provide protective circuits, using spark gaps.

The spark gaps must be connected as follows:



No other connections between the outer conductive coating and the chassis are permissible.

Additional information is given in Application Information 258, available on request.

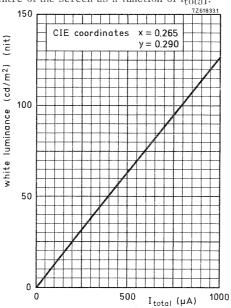
During shipment and handling the tube should not be subjected to accelerations greater than $35\ g$ in any direction.

REFERENCE LINE GAUGE (gauge F)

Gauge F. See chapter "Reference line gauges" in front of this book.

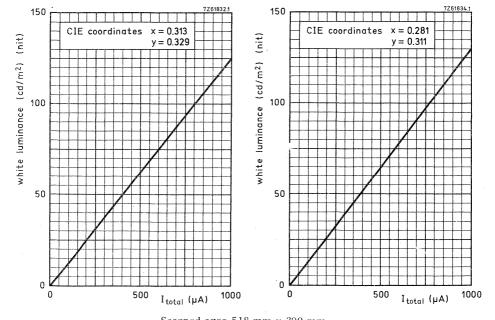


Luminance at the centre of the screen as a function of $I_{\mbox{total}}$.

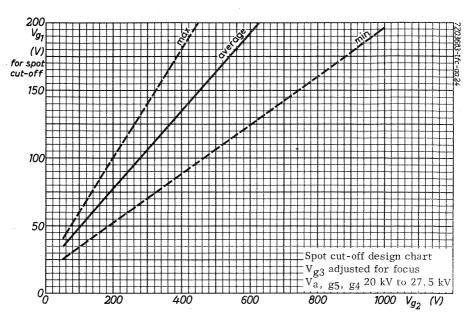


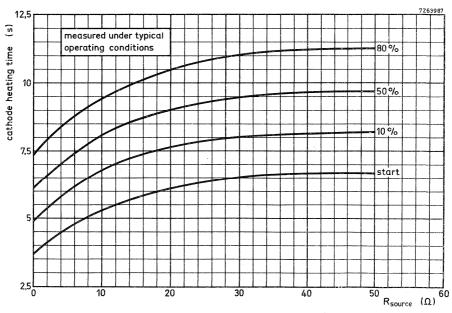
CONCRETEDINGS

CONCRE

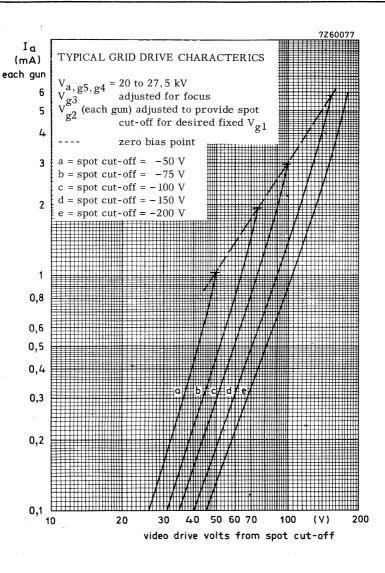


Scanned area $518 \text{ mm} \times 390 \text{ mm}$

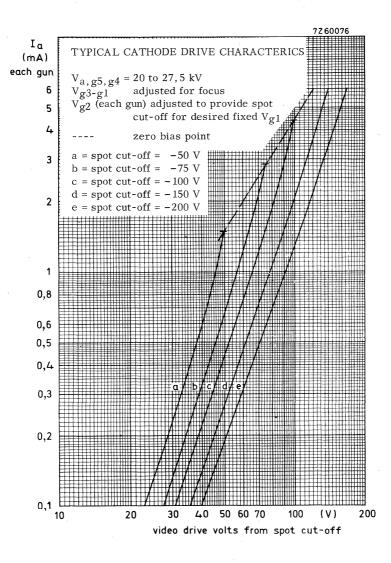




Cathode heating time to attain x% of the cathode current at equilibrium condition









March 1973

15

Black and white TV picture tubes





TV PICTURE TUBE

 $31~\mathrm{cm}$ (12), 110^{0} , rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

| QUICK | REFERENCE DATA. | | | | | | |
|---------------------------|-----------------|--|----|-------|------------|--|--|
| Face diagonal | | | | 31 | cm (12 in) | | |
| Deflection angle | | | | 110° | | | |
| Overall length | | max. | | 233 | mm | | |
| Neck diameter | | | | 20 | mm | | |
| Heating | | 11 V | , | 140 | mA | | |
| Grid no. 2 voltage | | | | 250 | V | | |
| Final accelerator voltage | | | 12 | to 15 | kV | | |
| Quick heating cathode | | with a typical tube a legible picture will appear within 5 s | | | | | |

SCREEN

Metal-backed phosphor

| Luminescence | white | | |
|----------------------------------|-------|-----|-----|
| Light transmission of face glass | | 50 | % |
| Useful diagonal | min. | 295 | mm. |
| Useful width | min. | 257 | mm |
| Useful height | min. | 195 | mm |

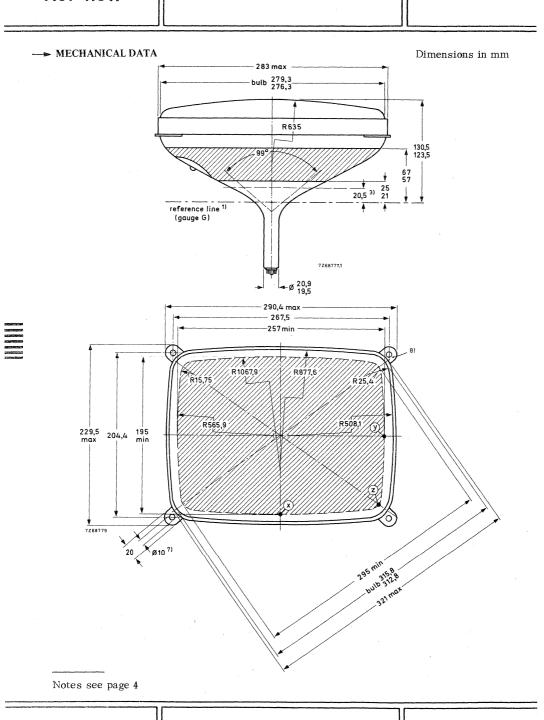
HEATING

Indirect by a.c. or d.c.; parallel supply

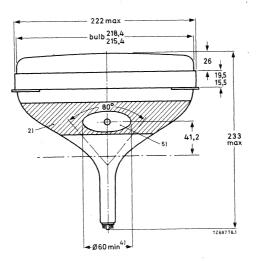
| Heater voltage | $v_{ m f}$ | | 11 | V | |
|---|------------------|--------------|----------------|--------|----|
| Heater current | $I_{\mathbf{f}}$ | | 140 | mA | |
| Limits (Absolute max. rating system) of r.m.s. heater voltage, measured in any 20 ms. | ${ m v_f}$ | max. min. | 12, 7 9, 13 | V V | 1) |

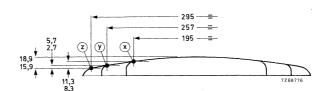
For heating time as a function of source impedance see page 11.

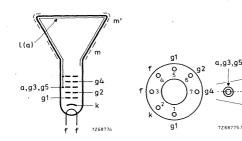
^{1,} This limit also applies during equipment warming up. Use of the tube in a series heater chain is not allowed.

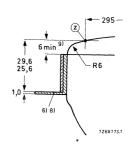












Mounting position: any

Net mass

: approx. 2, 8 kg.

Base

: JEDEC E7-91

The socket for the base should not be rigidly mounted, it should have flexible leads and be allowed to move freely.

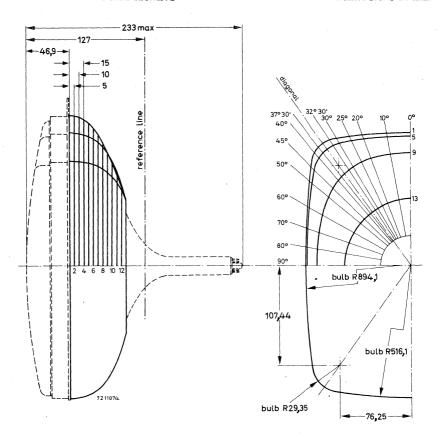
NOTES TO OUTLINE DRAWINGS

- 1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone. (Gauge G).
- The configuration of the external conductive coating may be different but contains the contact area shown in the drawing.
 The external conductive coating must be earthed.
- 3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.
- 4. This area must be kept clean.
- 5. Recessed cavity contact IEC 67-III-2.
- 6. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 7. The mounting screws in the cabinet must be situated inside a circle of 7 mm diameter drawn around the true geometrical positions, i.e. at the corners of a rectangle of 267,5 mm x 204,4 mm.
- 8. The metal band must be earthed. Electrical contact between the metal band and the mounting lugs is guaranteed.
- 9. Distance from reference point Z to any hardware.



MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Sec- | Nom. distance | Distance from centre (max. values) | | | | | | | | | | | | | | |
|------|-------------------|------------------------------------|--------|--------|--------|--------|---------------------|--------|---------------------|---------|--------|--------|--------|-----------------|--------|--------|
| tion | from section 1 | 00 | 10° | 20° | 25° | 38' | 32 ⁰ 30' | diag | 37 ⁰ 30' | 40° | 45° | 50° | 60° | 70 ⁰ | 80° | 90° |
| | | | | | | | | | | | | | | | | |
| 13 | 59.6 | 72, 2 | 72,0 | 71,7 | 71,4 | 71,2 | 71,1 | 71,0 | 71,0 | 70, 9 | 70,8 | 70,7 | 70,6 | 70, 7 | 70, 8 | 70, 8 |
| 12 | 55 | 85, 9 | 85, 6 | 84,9 | 84, 4 | 84,0 | 83, 8 | 83,5 | 83,3 | 83, 1 | 82,7 | 82, 4 | 81,9 | 81,6 | 81.5 | 81,5 |
| 1.1 | 50 | 99,5 | 99, 4 | 98,9 | 98,5 | 97, 9 | 97,5 | 97,1 | 96, 8 | 96,3 | 95,4 | 94,4 | 92.4 | 90.7 | 89.5 | 89.1 |
| 10 | 45 | 112, 3 | 112,4 | 112,2 | 111,7 | 110,9 | 110,4 | 109,7 | 109, 1 | 108,3 | 106,6 | 104,7 | 100.9 | 97.7 | 95.5 | 94.7 |
| 9 | 40 | 121, 3 | 121,3 | 122,8 | 122, 9 | 122,4 | 121,9 | 121,2 | 120, 5 | 119,5 | 117,1 | 114,3 | 108,6 | 103.8 | 100.8 | 99.7 |
| 8 | 35 | 127, 9 | 128,9 | 131, 2 | 132, 1 | 140,8 | 132, 3 | 131,7 | 130, 9 | 129, 7. | 126,5 | 122,7 | 114,9 | 108.8 | 105.0 | 103.7 |
| 7 | 30 | 132,6 | 134,0 | 137,4 | 139, 3 | 147, 2 | 141,2 | 140, 9 | 140, 2 | 138, 8 | 134,6 | 129, 5 | 119,7 | 112.5 | 108.2 | 106.8 |
| 6 | 25 | 136, 0 | 137,5 | 141,7 | 144, 4 | 151,6 | 148,3 | 148,5 | 147,9 | 146,5 | 140,9 | 134, 3 | 122.9 | 115.0 | 110.5 | 109, 0 |
| 5 | 20 | 138, 4 | 140,0 | 144,5 | 147,8 | 154,6 | 153,2 | 153, 7 | 153, 2 | 151,7 | 144,8 | 137, 1 | 124,7 | 116.5 | 111,8 | 110, 3 |
| 4 | 15 | 140, 3 | 141,9 | 146,6 | 150, 2 | 156,5 | 156, 6 | 157,4 | 156, 9 | 155, 1 | 147,1 | 138, 5 | 125, 4 | 117,0 | 112, 3 | 110.8 |
| 3 | 10 | 141,6 | 143, 2 | 148,0 | 151, 8 | 154, 6 | 158, 7 | 159, 5 | 159, 0 | 157, 1 | 148,5 | 139.4 | 126,0 | 117,6 | 112, 9 | |
| 2 | 5 | 142,4 | 143, 9 | 148,8 | 152, 6 | 157, 4 | 159, 5 | 160, 7 | 160, 2 | 158, 2 | 149, 4 | 140, 1 | 126,6 | 118, 1 | 113.4 | 111.9 |
| 1 | 0 | 142,8 | 144, 4 | 149, 3 | 153, 1 | 157,9 | 160, 2 | 161,1 | 160, 6 | 158, 7 | 149, 9 | 140.6 | 127, 1 | 118,5 | 113, 8 | 112.3 |

CAPACITANCES

Final accelerator to external conductive coating $C_{a,\,g3,\,g5/m}$ < 900 pF > 450 pFFinal accelerator to metal band $C_{a,\,g3,\,g5/m}$ ' 150 pF

Cathode to all $$C_k$$ 3 pF $$G_{rid}$ no.1 to all $C_{gl}$$ 7 pF

990

FOCUSING

electrostatic

DEFLECTION magnetic

Diagonal deflection angle 110°

Vertical deflection angle 80°

PICTURE CENTRING MAGNET

Horizontal deflection angle

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 47 mm.

→ TYPICAL OPERATING CONDITIONS

Grid drive service

| Final accelerator voltage | V _{a, g3, g5} | 12 to 15 | kV |
|--|------------------------|-----------|-----------|
| Focusing electrode voltage | ${ m v_{g4}}$ | 0 to 350 | V^{1}) |
| Grid no. 2 voltage | v_{g2} | 250 | V |
| Grid no. 1 voltage for visual extinction | | | |
| of focused raster | V_{GR} -3 | 35 to -69 | V |

Cathode drive service

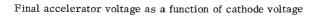
Voltages are specified with respect to grid no. 1

| Final accelerator voltage | $V_{a, g3, g5}$ | 12 to 15 | kV |
|---|--------------------|----------|------------------|
| Focusing electrode voltage | $V_{\mathbf{g4}}$ | 0 to 350 | V ¹) |
| Grid no. 2 voltage | v_{g2} | 250 | V |
| Cathode voltage for visual extinction of focused raster | V _{KR} 32 | to 58 | v |

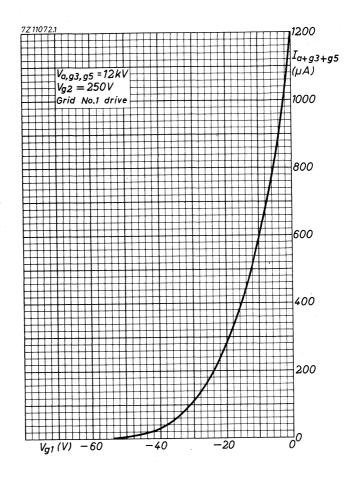
Individual tubes will have optimum focus within this range. In general an acceptable picture will be obtained with a fixed focus voltage.

| LIMITING VALUES (Design max. rating system) | | | | 46 |
|---|----------------------------|--------------|------------|------------|
| Final accelerator voltage | $V_{a,g3,g5}$ | max. min. | 17 9 | kV kV |
| Grid No. 4 voltage positive | $ m V_{g4}$ | max. | 500 | V. |
| negative | $-v_{g4}$ | max. | 50 | V |
| Grid No. 2 voltage | v_{g2} | max. min. | 350 200 | V V |
| Grid No. 2 to grid No. 1 voltage | $v_{g2}/_{g1}$ | max. | 450 | V |
| Cathode to grid No. 1 voltage positive | $v_{k/g1}$ | max. | 200 | V |
| positive peak | $V_{k/g1p}$ | max. | 400 | V^{-1}) |
| negative | $-v_{k/g1}$ | max. | 0 | V |
| negative peak | $-V_{k/g1p}$ | max. | 2 | V |
| Cathode-to-heater voltage positive | $v_{k/f}$ | max. | 200 | V |
| CIRCUIT DESIGN VALUES | | | | |
| Grid No. 4 current positive | $^{	ext{-I}}	ext{g4}$ | max. | 25 | μA |
| negative | $-I_{g4}$ | max. | 25 | μΑ |
| Grid No.2 current positive | $^{ m I}{ m g2}$ | max. | 5 | μA |
| negative | $-I_{g2}$ | max. | 5 | μА |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | $R_{k/f}$ | max. | 1 | $M\Omega$ |
| Impedance between cathode and heater | $\mathrm{Z_{k/f}}$ (50 Hz) | max. | 0,1 | $M\Omega$ |
| Grid No. 1 circuit resistance | $R_{\mathbf{g}1}$ | max. | 1,5 | $M\Omega$ |
| Grid No.1 circuit impedance | z_{g1} (50 Hz) | max. | 0,5 | MΩ |

 $[\]overline{\mbox{\ }}$) Maximum pulse duration 22% of a cycle but max. 1,5 ms.

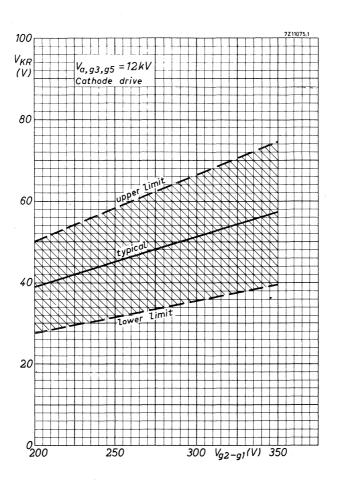






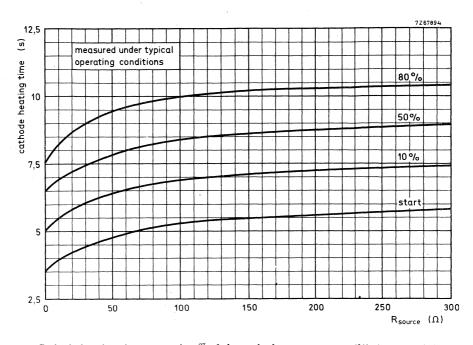
Final accelerator voltage as a function of grid no. 1 voltage





$$\frac{\Delta V_{KR}}{\Delta V_{a, g3, g5}} = 0.3 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage



Cathode heating time to attain x% of the cathode current at equilibrium $\,$ condition



TV PICTURE TUBE

31 cm (12 in), 110° , rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

| | QUICK REFE | RENCE DATA | | |
|-------|---------------------|---------------------------------|------------------|----------------------|
| Face | diagonal | | 31 | cm (12 in) |
| Defle | ction angle | | 110 ^o | |
| Over | all length | max. | 233 | mm |
| Neck | diameter | | 20 | mm |
| Heati | ng | 11 V | , 140 | mA . |
| Grid | no.2 voltage | | 130 | V |
| Final | accelerator voltage | 12 | to 15 | kV |
| Quic | c heating cathode | with a t legible within 5 | picture | ibe a will appear |

SCREEN

| Metal-backed phosphor | | | |
|----------------------------------|-------|-----|----|
| Luminescence | white | | |
| Light transmission of face glass | | 50 | % |
| Useful diagonal | min. | 295 | mm |
| Useful width | min. | 257 | mm |
| Useful height | min, | 195 | mm |

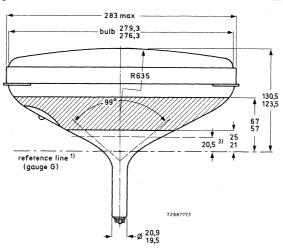
HEATING

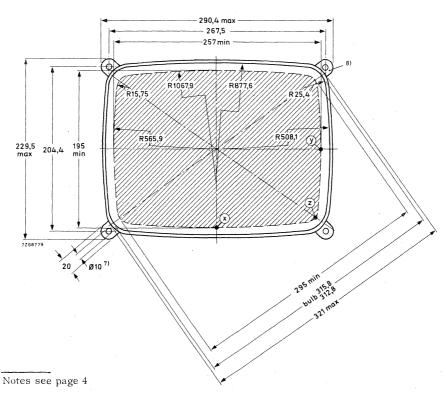
For heating time as a function of source impedance see page 10.

¹⁾ This limit also applies during equipment warming-up. Use of the tube in a series heaterchain is not allowed.

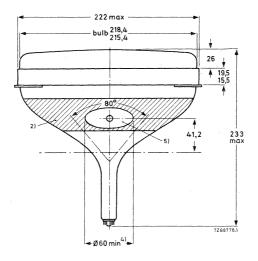
→ MECHANICAL DATA

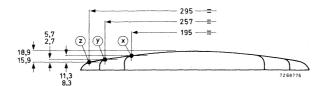
Dimensions in mm



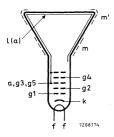


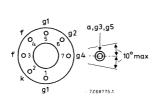


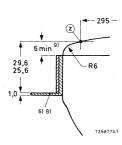












Mounting position: any

Net mass

: approx. 2,8 kg

Base

: JEDEC E7-91

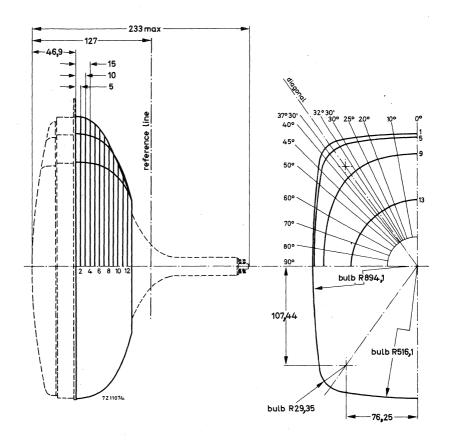
The socket for this base should not be mounted rigidly, it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWINGS

- 1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (Gauge G).
- The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing.The external conductive coating must be earthed.
- 3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.
- 4. This area must be kept clean.
- 5. Recessed cavity contact IEC 67-III-2.
- The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 7. The mounting screws in the cabinet must be situated inside a circle of 7 mm diameter drawn around the true geometrical positions, i.e. at the corners of a rectangle of 267,5 mm x 204.4 mm.
- 8. Electrical contact between the metal band and the mounting lugs is guaranteed.
- 9. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Sec- | Nom. distance | | | | ` _ | Distan | ce from | centre | (max. | values) | | | | | | |
|------|-------------------|--------|--------|--------|--------|--------|---------------------|--------|---------------------|---------|-----------------|--------|--------|-----------------|--------|--------|
| tion | from section 1 | 00 | 10° | 20° | 25° | 38' | 32 ⁰ 30' | diag | 37 ⁰ 30' | 40° | 45 ⁰ | 50° | 60° | 70 ⁰ | 80° | 90° |
| | | | | | | | | | | | | | | | | |
| 13 | 59.6 | 72, 2 | 72,0 | 71,7 | 71,4 | 71,2 | 71, 1 | 71,0 | 71,0 | 70,9 | 70,8 | 70,7 | 70,6 | 70,7 | 70,8 | 70, 8 |
| 12 | 55 | 85,9 | 85,6 | 84,9 | 84, 4 | 84,0 | 83,8 | 83, 5 | 83,3 | 83, 1 | 82,7 | 82, 4 | 81,9 | 81,6 | 81,5 | 81,5 |
| 11 | 50 | 99, 5 | 99,4 | 98, 9 | 98,5 | 97,9 | 97,5 | 97, 1 | 96, 8 | 96, 3 | 95, 4 | 94, 4 | 92,4 | 90,7 | 89,5 | 89, 1 |
| 10 | 45 | 112, 3 | 112, 4 | 112, 2 | 111,7 | 110,9 | 110,4 | 109, 7 | 109, 1 | 108, 3 | 106, 6 | 104, 7 | 100, 9 | 97,7 | 95, 5 | 94, 7 |
| 9 | 40 | 121, 3 | 121, 3 | 122,8 | 122, 9 | 122,4 | 121,9 | 121, 2 | 120,5 | 119,5 | 117, 1 | 114, 3 | 108,6 | 103,8 | 100, 8 | 99, 7 |
| 8 | 35 | 127,9 | 128,9 | 131, 2 | 132, 1 | 140,8 | 132, 3 | 131,7 | 130, 9 | 129,7 | 126, 5 | 122,7 | 114,9 | 108,8 | 105,0 | 103, 7 |
| 7 | 30 | 132, 6 | 134,0 | 137,4 | 139, 3 | 147, 2 | 141,2 | 140, 9 | 140, 2 | 138, 8 | 134,6 | 129, 5 | 119,7 | 112,5 | 108, 2 | 106, 8 |
| 6 | 25 | 136,0 | 137,5 | 141,7 | 144, 4 | 151,6 | 148,3 | 148, 5 | 147,9 | 146, 5 | 140,9 | 134, 3 | 122,9 | 115,0 | 110,5 | 109.0 |
| 5 | 20 | 138, 4 | 140,0 | 144,5 | 147,8 | 154,6 | 153,2 | 153, 7 | 153, 2 | 151,7 | 144,8 | 137, 1 | 124,7 | 116,5 | 111,8 | 110, 3 |
| 4 | 15 | 140, 3 | 141,9 | 146,6 | 150, 2 | 156,5 | 156, 6 | 157,4 | 156, 9 | 155, 1 | 147,1 | 138,5 | 125,4 | 117,0 | 112, 3 | 110.8 |
| 3 | 10 | 141,6 | 143, 2 | 148,0 | 151,8 | 154,6 | 158, 7 | 159, 5 | 159,0 | 157, 1 | 148,5 | 139, 4 | 126,0 | 117,6 | 112,9 | 111.4 |
| 2 | 5 | 142, 4 | 143,9 | 148,8 | 152, 6 | 157, 4 | 159,5 | 160,7 | 160, 2 | 158, 2 | 149, 4 | 140, 1 | 126, 6 | 118, 1 | 113, 4 | 111.9 |
| 1 | 0 | 142,8 | 144, 4 | 149, 3 | 153, 1 | 157,9 | 160, 2 | 161, 1 | 160,6 | 158,7 | 149, 9 | 140,6 | 127, 1 | 118,5 | 113,8 | 112, 3 |

CAPACITANCES

Grid no. 1 to all

 C_{g1}

7

рF

FOCUSING electrostatic

DEFLECTION magnetic

Diagonal deflection angle 110° Horizontal deflection angle 99° Vertical deflection angle 80°

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 47 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no.1

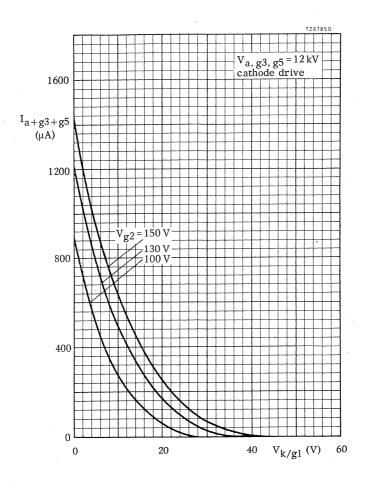
Final accelerator voltage $V_{a,\,g3,\,g5} = 12 \text{ to } 15 \text{ kV}$ Focusing electrode voltage $V_{g4} = 0 \text{ to } 130 \text{ V} \stackrel{1}{\text{y}}$ Grid no. 2 voltage $V_{g2} = 130 \text{ V}$ Cathode voltage for visual extinction of focused raster $V_{KR} = 30 \text{ to } 50 \text{ V}$

Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps; 0 V and 130 V).

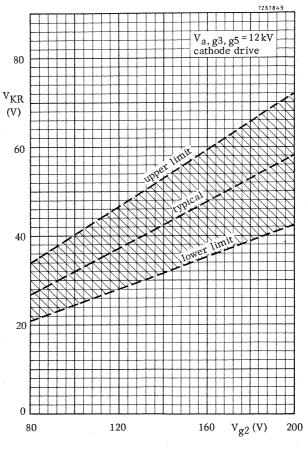
The optimum focusing voltage of individual tubes may be between -100 V and +200 V.

| LIMITING VALUES (Design max. rating system) | | | | | • |
|---|------------------------|--------------|---------|-----------|---|
| Final accelerator voltage | $V_{a,g3,g5}$ | max. min. | 17 9 | kV kV | |
| Grid no. 4 voltage | ,,,,,, | | | K V | |
| positive | v_{g4} | max. | 500 | V | |
| • | e e | max. | 200 | V | |
| negative | -V _{g4} | | 200 | V | |
| Grid no. 2 voltage | V_{g2} | max. | 200 | ٧ , | |
| Cathode to grid no. 1 voltage | | | 200 | | |
| positive | $V_{k/g1}$ | max. | 200 | V | |
| positive peak | $v_{k/g1_p}$ | max. | 400 | V 1) |) |
| negative | $-V_{k/g1}$ | max. | 0 | V | |
| negative peak | $^{-V}k/g1_{D}$ | max. | 2 | V | |
| Cathode-to-heater voltage | - r | | | | |
| positive | $V_{k/f}$ | max. | 200 | V | |
| | , | | | | |
| CIRCUIT DESIGN VALUES | | | | | |
| Grid no. 4 current | | | | | |
| positive | I_{g4} | max. | 25 | μΑ | |
| negative | -Ig4 | max. | 25 | μA | |
| Grid no. 2 current | | | | | |
| positive | I_{g2} | max. | 5 | μΑ | |
| negative | $-I_{g2}$ | max. | 5 | μΑ | |
| MAXIMUM CIRCUIT VALUES | | | | | |
| Resistance between cathode and heater | $R_{k/f}$ | max. | 1 | $M\Omega$ | |
| Impedance between cathode and heater | Z _{k/f} (50H: | z)max. | 0,1 | $M\Omega$ | |
| Grid no. 1 circuit resistance | R _{g1} | max. | 1,5 | MΩ | |
| Grid no. 1 circuit impedance | Z _{g1} (50Hz |) max. | 0,5 | МΩ | |
| | | | | | |

 $[\]overline{\mbox{1}}$ Maximum pulse duration 22 % of a cycle but max. 1,5 ms.

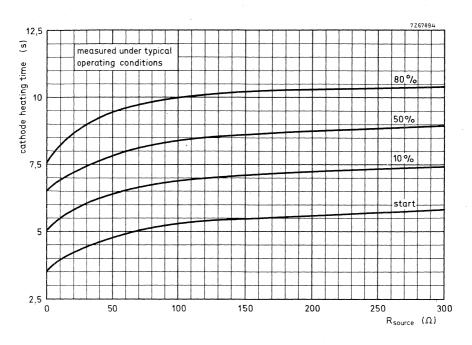


Final accelerator current as a function of cathode voltage



$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no.2 voltage



Cathode heating time to attain $x\,\%$ of the cathode current at equilibrium condition

TV PICTURE TUBE

 $34~\rm cm$ (14 in), $110^{\,0}$, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy.

A special feature of this tube is its short cathode heating time.

The tube is designed for "push through" application and is provided with four metal lugs for mounting into a cabinet.

| QUICK REFERENCE DATA | | | | | | |
|---------------------------|------|------------------------------|------------|--|--|--|
| Face diagonal | , | 34 | cm (14 in) | | | |
| Deflection angle | | 110 ° | | | | |
| Overall length | max. | 247 | mm | | | |
| Neck diameter | | 20 | mm | | | |
| Heating | 1 | 1 V, 140 | m A | | | |
| Grid no. 2 voltage | | 130 | V | | | |
| Final accelerator voltage | | 12 to 15 | kV | | | |
| Quick heating cathode | | cal tube a le I appear wi | 0 | | | |

SCREEN.

| white | | |
|---------|-------------------------|--|
| approx. | 48 | % |
| min. | 322,3 | mm |
| min. | 270,2 | mm |
| min. | 210,7 | mm |
| | approx. min. min. | approx. 48 min. 322, 3 min. 270, 2 |

HEATING

Indirect by a.c. or d.c.

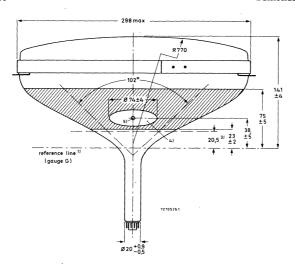
| Heater voltage | Vf | | 11 | V | |
|---|------------------|------|------|----|----|
| Heater current | $I_{\mathbf{f}}$ | | 140 | mA | |
| Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms | $V_{\mathbf{f}}$ | max. | 12,7 | V | 1) |

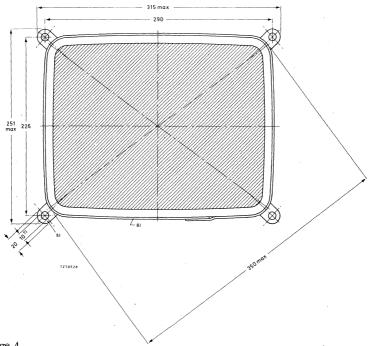
For heating time as a function of source impedance see page 10.

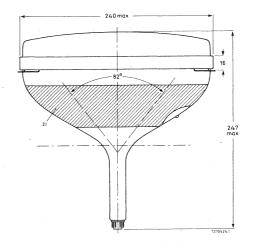
¹⁾ This limit also applies during equipment warming up. Use of the tube in a series heater chain is not allowed.

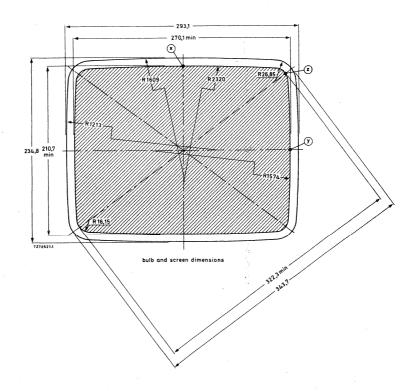
MECHANICAL DATA

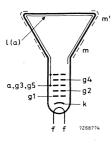
Dimensions in mm

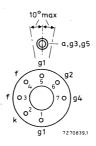


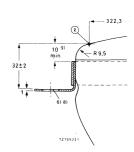


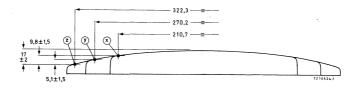












Mounting position: any

: approx. 3,2 kg Netmass

Base

: [EDEC E7-91

The socket for this base should not be mounted rigidly it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWINGS

- 1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (gauge G).
- 2. The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing.

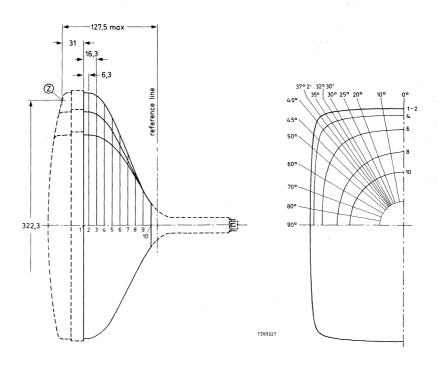
The external conductive coating must be earthed.

- 3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.
- 4. This area must be kept clean.
- 5. Recessed cavity contact IEC67-III-2.
- 6. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- 7. The mounting screws in the cabinet must be situated inside a circle of 7 mm drawn around the true geometrical positions i.e. at the corners of a rectangle of 290 mm x 226 mm.
- 8. Electrical contact between the metal band and mounting lugs is guaranteed.
- 9. Distance from reference point Z to any hardware.



MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Sec- | Nom. | | | | | | Dis | stance fi | om cen | tre (max | c. value: | s) | | | | |
|------|-------------------|-------|--------|--------|--------|--------|--------|-----------|--------------------|----------|-----------------|--------|--------|--------|--------|--------|
| tion | from section 1 | 00 | 10° | 20° | 25° | 30° | 32°30' | 35° | 37 ⁰ 2' | 40° | 45 ⁰ | 50° | 60° | 70° | 80° | 90° |
| 1 | 0 | 150,6 | 152, 7 | 159,3 | 164, 4 | 170,4 | 173,4 | 175,7 | 176,5 | 174.8 | 165,3 | 154.6 | 138, 6 | 128, 6 | 123, 2 | 121.4 |
| 2 | 6,3 | 150,6 | 152, 7 | 159, 3 | 164,4 | 170,4 | 173,4 | 175,7 | 176,5 | 174,8 | 165,3 | 154,6 | | 128.6 | , , | 121.4 |
| 3 | 16, 3 | 148,1 | 150, 2 | 156,6 | 161,6 | 167,6 | 170,6 | 173,0 | 173,9 | 172,6 | 163,7 | 153, 2 | 137,3 | 127,4 | | 120.2 |
| 4 | 26, 3 | 141,6 | 143,5 | 149, 3 | 153,6 | 158, 3 | 160,3 | 161,8 | 162, 2 | 161,3 | 155,5 | 147, 2 | 132,8 | 123,5 | 118,3 | 116.7 |
| 5 | 36, 3 | 133,5 | 135, 2 | 139, 9 | 142,9 | 145,7 | 146,7 | 147,3 | 147,3 | 146,4 | 142,8 | 137,4 | 126,1 | 117,7 | 113.0 | 111.5 |
| 6 | 46, 3 | 124,0 | 125, 3 | 128,5 | 130,1 | 131, 2 | 131,4 | 131,4 | 131,1 | 130, 3 | 127,9 | 124,6 | 116,9 | 110, 3 | 106, 2 | 104.9 |
| 7 | 56, 3 | 112,2 | 113,0 | 114,1 | 114,3 | 114, 2 | 114,0 | 113,6 | 113, 2 | 112,5 | 110,0 | 109,1 | 104,7 | 100,7 | 97, 8 | 96.7 |
| - 8 | 66, 3 | 95,8 | 95, 6 | 95,6 | 94,6 | 93, 9 | 93,6 | 93, 2 | 92, 9 | 92,4 | 91,5 | 90,6 | 88, 9 | 87,4 | 86,3 | 85,9 |
| 9 | 71,3 | 84,5 | 84, 1 | 83, 3 | 82, 8 | 82, 2 | 81,9 | 81,7 | 81,4 | 81,1 | 80,6 | 80,1 | 79,3 | 78,8 | 78,5 | 78,5 |
| 10 | 76, 0 | 69,0 | 69, 0 | 69,0 | 69,0 | 69,0 | 69,0 | 69, 0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69, 0. |

CAPACITANCES

Final accelerator to external conductive coating $C_{a, g3, g5/m} \stackrel{<900}{\underset{>400}{}_{>}} pF$

Final accelerator to metal band $C_{a,\,g3,\,g5/m}$ 200 pF

Cathode to all $$C_{k}$$ 3 $\ pF$

Grid no. 1 to all C_{g1} 7 pF

FOCUSING electrostatic

DEFLECTION magnetic

Diagonal deflection angle 1100

Horizontal deflection angle 1020

Vertical deflection angle 820

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 47 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1.

Final accelerator voltage $V_{a,\,g3,\,g5} \qquad 12 \text{ to } 15 \quad kV$ Focusing electrode voltage $V_{g4} \qquad 0 \text{ to } 130 \quad V^{\ 1})$ Grid no. 2 voltage $V_{g2} \qquad 130 \quad V$

Cathode voltage for visual extinction of focused raster

V_{KR} 30 to 50

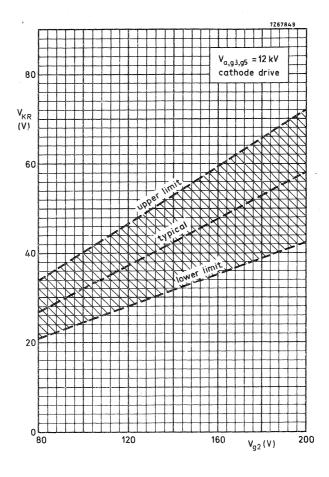
Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 V and +130 V (e.g. two taps, 0 V and 130 V).
 The optimum focus voltage of individual tubes may be between -100 V and +200 V.

| LIMITING VALUES | (Design max. rating system) | *. | | | |
|------------------------|------------------------------|-------------------------------------|---------|---------|-----------|
| Final accelerator vo | Itage at $I_{a, g3, g5} = 0$ | Va, g3, g5 | max. 1 | 17 9 | kV kV |
| Grid no. 4 voltage, | | | | | |
| positive | | V_{g4} | max. 50 | 00 | V |
| negative | | -V _{g4} | max. 20 | 00 | V |
| Grid no. 2 voltage | | v_{g2} | max. 20 | 00 | v |
| Cathode to grid no. 1 | voltage, | | | | |
| positive | | Vk/g1 | max. 20 | 00 | V |
| positive peak | | $V_{k/g1p}$ | max. 40 | 00 | V 1) |
| negative | | $-V_{k/g1}$ | max. | 0 | V |
| negative peak | | -V _{k/g1p} | max. | 2 | V |
| Cathode-to-heater ve | oltage | | | | |
| positive | | $v_{k/f}$ | max. 20 | 00 | V |
| CIRCUIT DESIGN VAI | LUES | | | | |
| Grid no. 4 current | | | | | |
| positive | | I_{g4} | max. 2 | 25 | μA |
| negative | | -I _{g4} | max. 2 | 25 | μA |
| Grid no. 2 current | | | | | |
| positive | | I_{g2} | max. | 5 | μA |
| negative | | $-I_{g2}$ | max. | 5 | μA |
| MAXIMUM CIRCUIT V | VALUES | | | | |
| Resistance between | cathode and heater | R _k /f | max. | 1 | $M\Omega$ |
| Impedance between o | eathode and heater | $\mathrm{Z}_{\mathrm{f/k}}$ (50 Hz) | max. 0, | 1 | $M\Omega$ |
| Grid no. 1 circuit res | sistance | R_{g1} | max. 1, | 5 | $M\Omega$ |
| Grid no.1 circuit im | pedance | Z_{g1} (50 Hz) | max. 0, | 5 | $M\Omega$ |
| | | | | | |

 $[\]overline{\mbox{1}})$ Maximum pulse duration 22% of a cycle but max. 1,5 ms.

Final accelerator current as a function of cathode voltage.

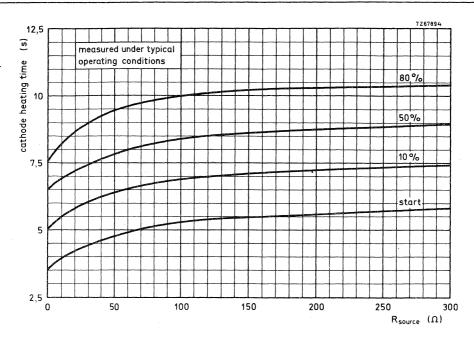




$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no.2 voltage.





Cathode heating time to attain $x\,\%$ of the cathode current at equilibrium condition.

TV PICTURE TUBE

 $44\ \mathrm{cm}\ (17\ \mathrm{in}),\ 110^{\mathrm{o}},$ rectangular direct vision picture tube with integral protection for black-and-white TV.

| QUICK REFERENCE DATA | |
|---------------------------|---------------|
| Face diagonal | 44 cm |
| Deflection angle | 110° |
| Overall length | 284,5 mm |
| Neck diameter | 28,6 mm |
| Heating | 6,3 V, 300 mA |
| Grid no. 2 voltage | 400 V |
| Final accelerator voltage | 20 kV |

SCREEN

Metal-backed phosphor

| Luminescence | white |
|----------------------------------|-------------|
| Light transmission of face glass | 48 % |
| Useful diagonal | min. 413 mm |
| Useful width | min. 346 mm |
| Useful height | min. 270 mm |

HEATING

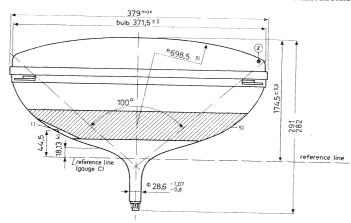
Indirect by a.c. or d.c.; series or parallel supply

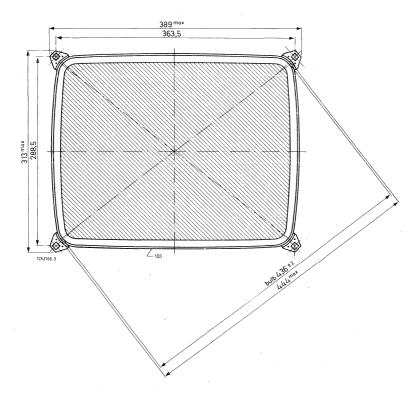
| Heater current | $I_{\mathbf{f}}$ | 300 mA |
|----------------|------------------|--------|
| | | |
| Heater voltage | $V_{\mathbf{f}}$ | 6,3 V |

If the tube is connected in a series heater chain the surge heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

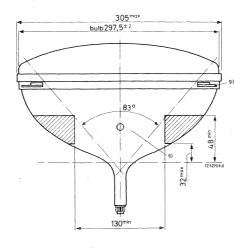
MECHANICAL DATA

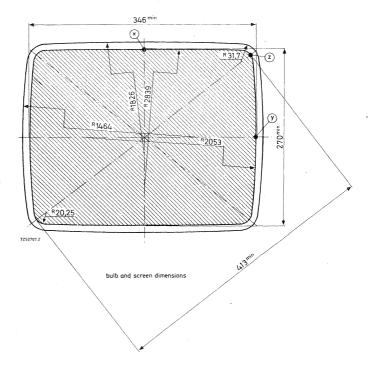
Dimensions in mm

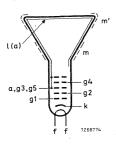


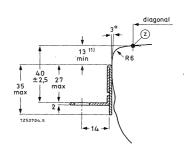


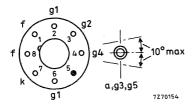
Notes see page 5.

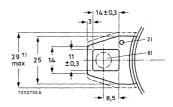


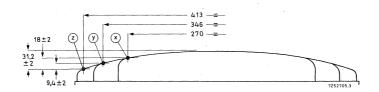












Mounting position: any

Base : neo eightar 7 pin JEDEC B7-208, B8H, IEC-67-I-31a

Net mass : approx. 6 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of 40 mm.

The socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.

Notes see page 5

NOTES TO OUTLINE DRAWINGS

- 1. Small cavity contact IEC-67-III-2.
- 2. The metalrim-bandmust be earthed. The hole of 3 mm dia in each lug is provided for this purpose.
- 3. Spherical face-plate.
- 4. End of guaranteed contour. The maximum contour from reference line towards screen is given by the reference line gauge C (18, 13 mm).
- The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing.The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 7,5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 363,5 mm x 288,5 mm.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. Max. curvatures of the outside rim-band are nominal bulb radius + 4 mm.
- 11. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING Dimensions in mm 146,3 max 57,3 30 20 10 (N) reference line 20° 10° 40° 440 50° 60° 70° 80° 900 8 6 4 2 R1826 7Z09531.1 R31,7

| | Distance from centre (max. values) | | | | | | | | | | | | | |
|--------------------------------------|---|---|--|--|--------------------------------------|----------------|--|--|--|----------------------------|--|--------------------------------------|----------------------------|--------------------------|
| Sec- tion | Nom, distance from point "Z" | 0 ⁰ Long | 10° | 20° | 300 | 33°30' | 36 ⁰ 30' Diagonal | 40° | 44 ⁰ | 50° | 60° | 70° | 80° | 90 ⁰ Short |
| 1 2 3 4 5 6 7 8 | 128, 0 117, 3 107, 3 97, 3 87, 3 77, 3 67, 3 57, 3 | 60,0 95,9 118,1 135,0 149,5 162,5 172,5 | 60, 0 95, 2 117, 8 136, 1 151, 1 164, 0 174, 4 183, 1 | 60, 0 93, 0 118, 3 138, 3 155, 1 168, 8 180, 1 189, 3 | 139, 9 159, 1 176, 0 190, 0 | 161,3 179,0 | 60, 0 92, 1 119, 2 141, 6 162, 0 179, 5 196, 3 210, 9 | 60, 0 92, 3 117, 8 141, 1 161, 5 178, 0 194, 9 206, 1 | 60, 0 92, 6 117, 7 138, 5 157, 5 173, 5 186, 8 196, 0 | 135, 4 151, 0 163, 4 | 60,0 93,8 115,5 130,5 142,0 150,8 159,1 165,5 | 125, 6 135, 8 143, 3 149, 3 | 130, 8 138, 3 143, 9 | 136, 4 141, 7 |



110,76

CAPACITANCES

| Final accelerator to external conductive coating | C _{a,g3,g5/m} < > | 1300 700 | pF pF |
|--|----------------------------|-------------|----------|
| Final accelerator to metal band | C _{a,g3,g5/m} ' | 200 | pF |
| Cathode to all | $C_{\mathbf{k}}$ | 5 | pF |
| Grid no. 1 to all | C_{g1} | 7 | pF |

FOCUSING

electrostatic

DEFLECTION

magnetic

Diagonal deflection angle

110° 100°

Horizontal deflection angle

Vertical deflection angle

830

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe).

Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Grid drive service

| Final accelerator voltage | $V_{a,g3,g5}$ | 20 | kV |
|--|---------------|------------|------------|
| Focusing electrode voltage | v_{g4} | 0 to 400 | V^{-1}) |
| Grid no. 2 voltage | v_{g2} | 400 | V |
| Grid no. 1 voltage for visual extinction of focused raster | v_{GR} | -40 to -77 | V |

Cathode drive service

Voltages are specified with respect to grid no. 1

| Final accelerator voltage | $V_{a,g3,g5}$ | 20 | kV |
|---|------------------|----------|------------------|
| Focusing electrode voltage | ${ m v_{g4}}$ | 0 to 400 | V ¹) |
| Grid no. 2 voltage | ${ m v_{g2}}$ | 400 | V |
| Cathode voltage for visual extinction of focused raster | ${ m v}_{ m KR}$ | 36 to 66 | V |

 $^{^{1}}$) Individual tubes will have optimum focus within this range. In general an acceptable picture will be obtained with a fixed focus voltage.

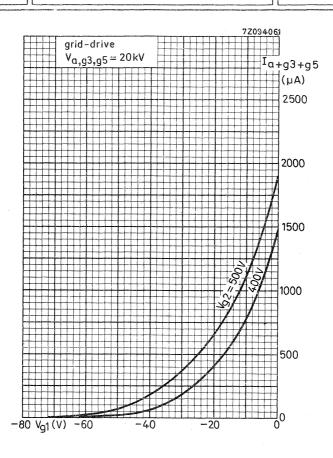
| LIMITING VALUES (Design max. rating system) | | | . • | |
|--|------------------|--------------|------------|------------------|
| Final accelerator voltage at $I_{a,g3,g5} = 0$ | $V_{a,g3,g5}$ | max. min. | 23 12 | kV kV |
| Grid no. 4 voltage, | | | | |
| positive | ${ m v_{g4}}$ | max. | 1000 | \mathbf{v} |
| negative | $-v_{g4}$ | max. | 500 | V |
| Grid no. 2 voltage | V_{g2} | max. min. | 700 350 | V 2) V |
| Grid no. 2 to grid no. 1 voltage | ${ m V_{g2/g1}}$ | max. | 850 | V |
| Grid no. 1 voltage | | | | |
| positive | v_{g1} | max. | 0 | V |
| positive peak | v_{g1_p} | max. | 2 | V |
| negative | $-v_{g1}$ | max. | 200 | V |
| negative peak | $-v_{g1_p}$ | max. | 400 | V ¹) |
| Cathode to heater voltage, | · | | | |
| positive | $V_{k/f}$ | max. | 250 | V |
| positive peak | $v_{k/fp}$ | max. | 300 | V |
| negative | $-V_{k/f}$ | max. | 200 | V |
| positive during equipment warm-up period not exceeding 15 s | $v_{k/f}$ | max. | 450 | v ³) |

¹⁾ Maximum pulse duration 22% of a cycle but maximum 1,5 ms.

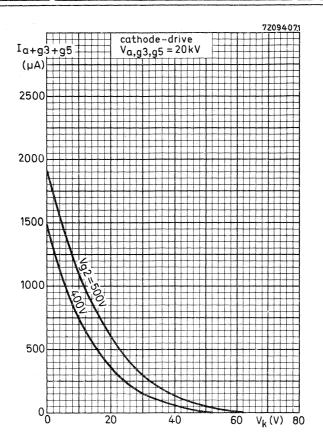
²⁾ At $V_{g1/k} = 0 V$.

 $^{^3}$) Between 15 s and 45 s after switching on a decrease in k/f voltage from 450 V to 250 V, linearly proportional with time, is permissible.

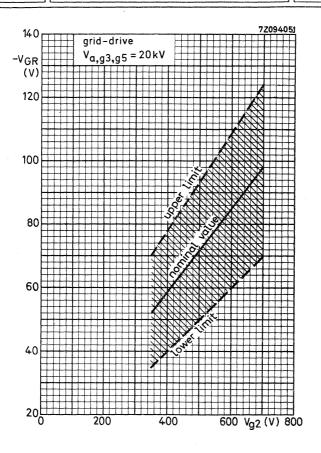
| CIRCUIT DESIGN VALUES | | | | |
|---------------------------------------|-------------------------|------|-----|-----------|
| Grid no. 4 current, | | | | - |
| positive | I_{g4} | < | 25 | μΑ |
| negative | $-I_{g4}$ | < | 25 | μΑ |
| Grid no.2 current, | | | | |
| positive | $I_{\mathbf{g}2}$ | < | 5 | μΑ |
| negative | -I _{g2} | < " | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | R _{k/f} | max. | 1,0 | $M\Omega$ |
| Impedance between cathode and heater | $ m Z_{k/f}$ (50 Hz) | max. | 0,1 | $M\Omega$ |
| Grid no. 1 circuit resistance | R_{g1} | max. | 1,5 | $M\Omega$ |
| Grid no. 1 circuit impedance | $Z_{g1}(50 \text{ Hz})$ | max. | 0,5 | $M\Omega$ |



Final accelerator current as a function of grid no. 1 voltage

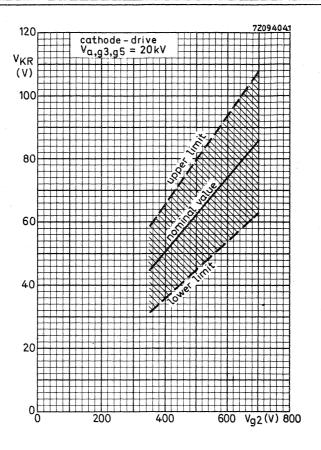


Final accelerator current as a function of cathode voltage



$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \text{ x } 10^{-3}$$

Limits of grid No. 1 cut-off voltage as a function of grid no. 2 voltage



$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage



TV PICTURE TUBE

44 cm (17 in), 110° , rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

The tube is designed for "push through" application and is provided with four metal lugs for mounting into a cabinet.

| QUICK REFERENCE DATA | | | | | | | | | | |
|---------------------------|---|---------------|-----|--|--|--|--|--|--|--|
| Face diagonal | 4 | 44 cm (17 | in) | | | | | | | |
| Deflection angle | 11 | 10º | | | | | | | | |
| Overall length | max. 28 | 88 m m | | | | | | | | |
| Neck diameter | , 2 | 20 mm | | | | | | | | |
| Heating | 11 V, 14 | 40 mA | | | | | | | | |
| Grid no. 2 voltage | . 13 | 30 V | | | | | | | | |
| Final accelerator voltage | 12 to 1 | 15 kV | | | | | | | | |
| Quick heating cathode | with a typical tube a legible picture will appear within 5 s. | | | | | | | | | |

SCREEN

| white | | |
|---------|-------------------------|------------------------------------|
| approx. | 48 | % |
| min. | 413 | $_{\rm mm}$ |
| min. | 346 | mm |
| min. | 270 | mm |
| | approx. min. min. | approx. 48 min. 413 min. 346 |

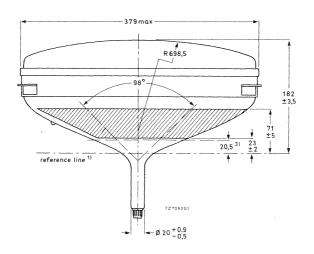
HEATING

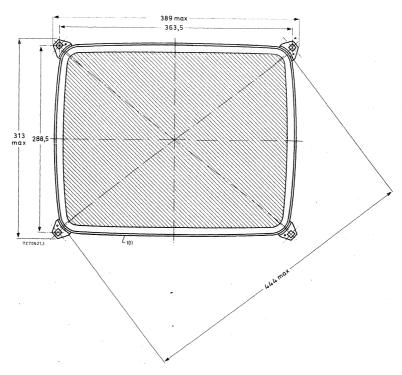
Indirect by a.c. or d.c.

| Heater voltage | $V_{\mathbf{f}}$ | | 11 | $\mathbf{V}_{\mathbf{x}}$ |
|---|------------------|--------------|-------------|---------------------------|
| Heater current | $I_{\mathbf{f}}$ | | 140 | mA |
| Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms | $ m V_{f}$ | max. min. | 12,7 9.3 | V 1) V |

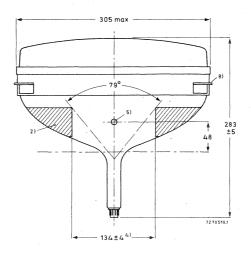
For heating time as a function of source impedance see page 10.

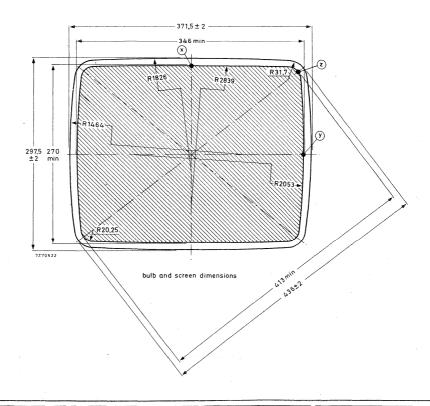
¹⁾ This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.

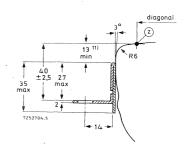


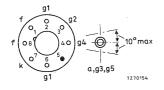


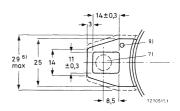
Notes see page 5

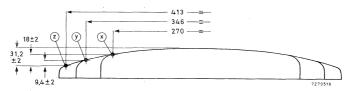












Mounting position: any

Net mass

: approx. 6 kg

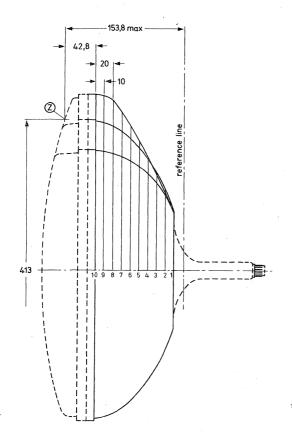
Base

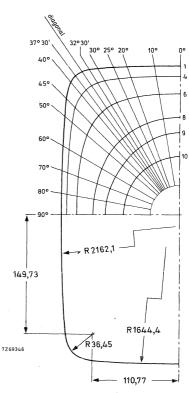
: JEDEC E7-91

The socket for the base should not be mounted rigidly, it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWING

- 1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (gauge G).
- The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing.The external conductive coating must be earthed.
- 3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.
- 4. This area must be kept clean.
- 5. Recessed cavity contact IEC67-III 2.
- 6. Minimum space to be reserved for mounting lug.
- 7. The mounting screws in the cabinet must be situated inside a circle of 7,5 mm drawn around the true geometrical positions i.e. at the corners of a rectangle of 363,5 mm x 288,5 mm.
- 8. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
- The metal rim-band must be earthed. The hole of 3 mm dia in each lug is provided for this purpose. Electrical contact between the metal band and mounting lugs is guaranteed.
- 10. Max, curvatures of the outside rim-band are: nominal bulb radius + 4 mm.
- 11. Distance from reference point Z to any hardware.





| Sec- | Nom. | Distance from centre (max values) | | | | | | | | | | | | | | |
|------|-------------------|-----------------------------------|--------|-----------------|--------|--------|---------------------|--------|---------------------|--------|--------|--------|--------|--------|--------|--------|
| tion | from section 1 | 00 | 10° | 20 ⁰ | 25° | 30° | 32 ⁰ 30' | diag. | 37 ⁰ 30' | 40° | 45° | 50° | 60° | 70° | 80° | 90° |
| 10 | 90 | 73, 8 | 73,6 | 73, 1 | 72,9 | 72.6 | 72.5 | 72, 3 | 72, 2 | 72, 1 | 71.9 | 71,8 | 71,7 | 71.7 | 71.8 | 71,9 |
| 9 | - 80 | 104, 7 | 103, 9 | 102, 1 | 101,0 | 99,9 | 99,4 | 98, 6 | 98, 4 | 98.0 | 1 | 96.5 | 95.6 | 95. 2 | 95, 2 | 95.3 |
| 8 | 70 | 123, 9 | 124,0 | 123,8 | 123,5 | 123,0 | 122, 6 | 122, 0 | 121,8 | 121, 2 | 120, 1 | | 116.0 | 113.5 | 111.7 | 111, 1 |
| 7 | 60 | 140, 4 | 141,3 | 143, 3 | 144, 1 | 144,5 | 144,5 | 144, 0 | 143,8 | 143, 2 | 141, 2 | 138,6 | 132, 7 | 127, 3 | 123.8 | 122.5 |
| 6 | 50 | 154, 8 | 156, 3 | 160, 3 | 162, 5 | 164, 3 | 164, 9 | 164, 7 | 164,5 | 163, 7 | 160,5 | 156.0 | 146, 1 | 138, 1 | 133. 2 | 131.5 |
| 5 | 40 | 166,9 | 168,9 | 174,5 | 178,1 | 181,6 | 183, 1 | 183, 4 | 183, 2 | 182, 1 | 177, 2 | 170, 2 | 156, 6 | 146,6 | 140.8 | 138, 9 |
| 4 | 30 | 176,8 | 179, 1 | 185, 9 | 190, 9 | 196, 3 | 198,9 | 200, 0 | 199,8 | 198, 4 | 191, 2 | 181, 2 | 164, 4 | 153,0 | 146.7 | 144.6 |
| 3 | 20 | 184,1 | 186,6 | 194, 4 | | | 212,0 | | 214, 3 | 212,6 | 202,0 | 189,0 | 169, 6 | 157, 4 | 150,8 | 148.6 |
| 2 | 10 | 188,6 | 191, 2 | 199, 3 | | | | | 221, 2 | 219, 2 | 207, 2 | 193, 1 | 172, 9 | 160, 4 | 153, 6 | 151, 4 |
| 1 | 0 | 190,0 | 192,6 | 200,7 | 207, 1 | 215, 3 | 219,9 | 222, 7 | 222,5 | 220,5 | 208,6 | 194,4 | 174, 1 | 161,5 | 154,7 | 152,5 |



CAPACITANCES

| Final accelerator to external conductive coating | $C_{a,g3,g5/m}$ | <1300 >700 | pF pF |
|--|------------------|---------------|----------|
| Final accelerator to metal rimband | $C_{a,g3,g5/m'}$ | 300 | pF |
| Cathode to all | $C_{\mathbf{k}}$ | 3 | pF |
| Grid no. 1 to all | c_{g1} | 7 | pF |

FOCUSING electrostatic

DEFLECTION magnetic

Diagonal deflection angle 1100 Horizontal deflection angle 980 Vertical deflection angle 790

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of filed of this magnet and reference line: 47 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1

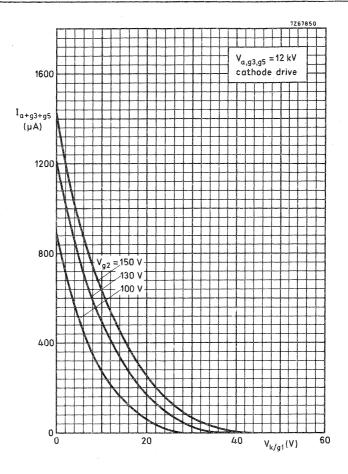
| Final accelerator voltage | $v_{a,g3,g5}$ | 12 to 15 | kV |
|---|------------------|----------|------|
| Focusing electrode voltage | ${ m v_{g4}}$ | 0 to 130 | V 1) |
| Grid no. 2 voltage | v_{g2} | 130 | V |
| Cathode voltage for visual extinction of focused raster | ${ m v}_{ m KR}$ | 30 to 50 | V. |

¹⁾ Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 V and $+\,130$ V (e.g. two taps, 0 V and 130 V). The optimum focus voltage of individual tubes may be between $-\,100$ V and $+\,200$ V.

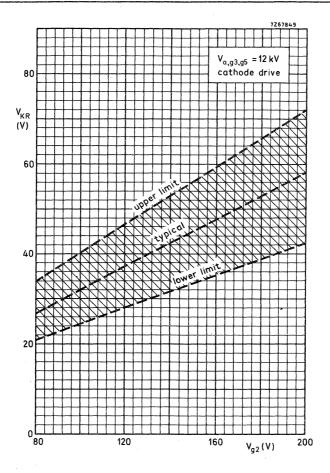
| CANDIDAY. |
|------------------|
| CTG MATERIAL COM |
| Terror other |
| 201202202 |
| Spare Nicolated |
| |

| LIMITING VALUES (Design max. rating system) | | | | |
|--|--------------------------|--------------|---------|---------------------|
| Final accelerator voltage at $I_{a, g3, g5} = 0$ | $v_{a,g3,g5}$ | max. min. | 17 9 | kV kV |
| Grid no. 4 voltage | | | | |
| Positive | v_{g4} | max. | 500 | V |
| Negative | $-V_{g4}$ | max. | 200 | V |
| Grid no. 2 voltage | $V_{\rm g2/k}$ | max. | 200 | V |
| Cathode to grid no. 1 voltage, | _ | | | |
| positive | V _{k/g1} | max. | 200 | V |
| positive peak | V _{k/g1p} | max. | 400 | V 1) |
| negative | $-V_{k/g1}$ | max. | 0 | $V_{\underline{a}}$ |
| negative peak | $-V_{k/g1p}$ | max. | 2 | V |
| Cathode to heater voltage | | | | |
| positive | $V_{k/f}$ | max. | 200 | V |
| CIRCUIT DESIGN VALUES | | | | |
| Grid no. 4 current | | | | |
| positive | $I_{\mathbf{g4}}$ | max. | 25 | μΑ |
| negative | -I _{g4} | max. | 25 | μΑ |
| Grid no. 2 current | | | | |
| positive | $I_{\mathbf{g}2}$ | max. | 5 | μA |
| negative | $-I_{g2}$ | max. | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | $R_{k/f}$ | max. | 1 | $M\Omega$ |
| Impedance between cathode and heater | Z _{f/k} (50 Hz) | max. | 0,1 | $M\Omega$ |
| Grid no. 1 circuit resistance | $R_{\mathbf{g}1}$ | max. | 1,5 | $M\Omega$ |
| Grid no. 1 impedance | Z _{g1} (50 Hz) | max. | 0,5 | МΩ |

¹⁾ Maximum pulse duration 22% of a cycle but max. 1,5 ms.



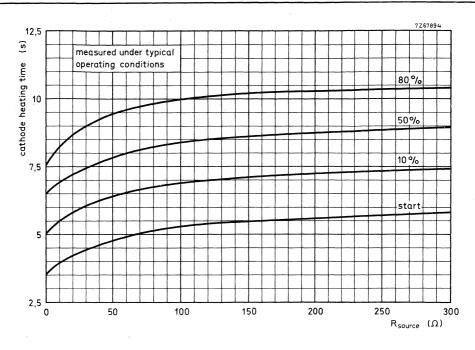
Final accelerator current as a function of cathode voltage.



$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \text{ x } 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage.





Cathode heating time to attain x% of the cathode current at equilibrium condition.

TV PICTURE TUBE

 $44~\rm cm$ (17 in), $110^{\rm o}$, rectangular direct vision picture tube with integral protection for black and white TV. A special feature of this tube is its short cathode heating time.

| QUICK REFERENCE DATA | | | | | | | | | |
|--|------|---------------|---------|--|--|--|--|--|--|
| Face diagonal | is a | | 44 cm | | | | | | |
| Deflection angle | | | 110° | | | | | | |
| Overall length | | max. | 291 mm | | | | | | |
| Neck diameter | | | 28,6 mm | | | | | | |
| Heating | | 6,3 V, 240 mA | | | | | | | |
| Grid no. 2 voltage | | | 130 V | | | | | | |
| Final accelerator voltage | | | 20 kV | | | | | | |
| Quick heating cathode with a typical tube a legible picture will a within 5 s. | | | | | | | | | |

SCREEN

Metal backed phosphor

| Luminescence | white | |
|----------------------------------|-------|--------|
| Light transmission of face glass | | 48 % |
| Useful diagonal | min. | 413 mm |
| Useful width | min. | 346 mm |
| Useful height | min. | 270 mm |

HEATING

Indirect by a.c. or d.c.

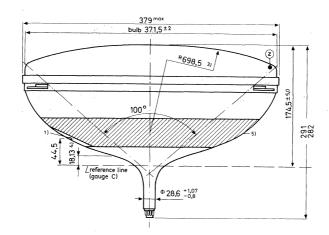
| Heater voltage | $v_{\mathbf{f}}$ | | 6, 3 V |
|---|---------------------------|--------------|---------------------------------|
| Heater current | $\overline{\mathrm{l_f}}$ | | 240 mA |
| Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms | $V_{\mathbf{f}}$ | max. min. | 7, 3 V ¹ ; 5, 3 V |

For heating time as a function of source impedance see page 11.

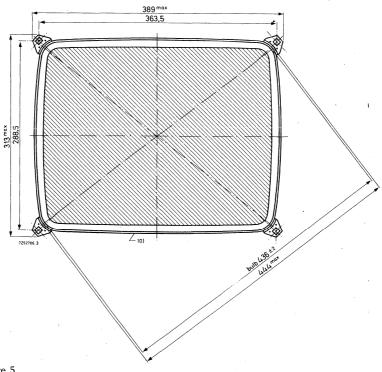
¹⁾ This limit also applies during equipment warming up. Use of the tube in a series heater chain is not allowed.

MECHANICAL DATA

Dimensions in mm

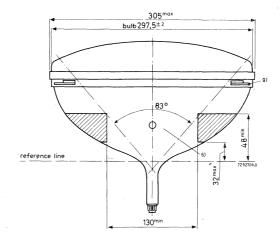


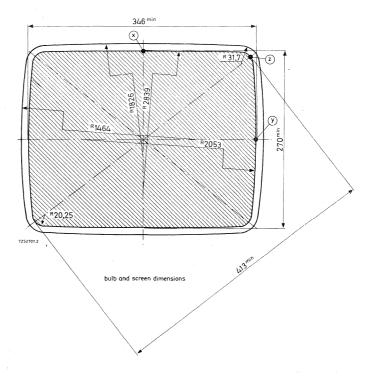


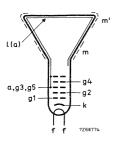


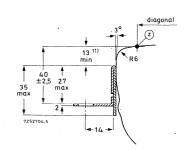
MECHANICAL DATA (continued)

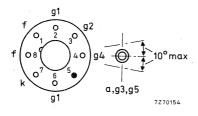
Dimensions in mm

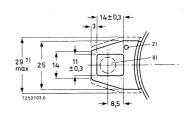


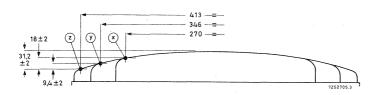












Mounting position: any

Base

: neo eightar 7 pin JEDEC B7-208, B8H, IEC 67-I-31a

Net mass

: approx. 6 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of $40\ \mathrm{mm}$.

The socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.

Emperora Emperora Emperora Emperora Emperora

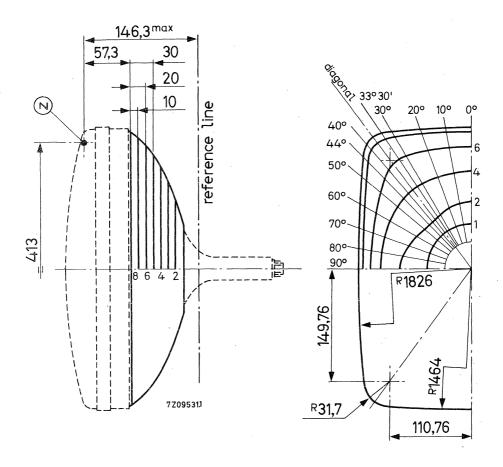
NOTES TO OUTLINE DRAWING

- 1. Small cavity contact IEC 67-III-2.
- 2. The metalrim-band must be earthed. The hole of 3 mm dia in each lug is provided for this purpose.
- 3. Spherical face-plate.
- 4. End of guaranteed contour. The maximum contour from reference line towards screen is given by the reference line gauge C (18, 13 mm).
- 5. The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing.

 The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 7.5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of $363.5 \text{ mm} \times 288.5 \text{ mm}$.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. Max. curvatures of the outside rim-band are nominal bulb radius + 4 mm.
- 11. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Distance from centre (max. values) | | | | | | | | | | | | | | |
|------------------------------------|---|---|--|----------------------------|----------------|--------|--|--|--|--|--|--|--|--|
| Sec- tion | Nom. distance from point "Z" | 0 ⁰ Long | 10° | 20° | 300 | 33°30' | 36 ⁰ 30' Diagonal | 40° | 44 ⁰ | 50° | 60° | 70° | 80° | 90 ⁰ Short |
| 1 2 3 4 5 6 7 | 128, 0 117, 3 107, 3 97, 3 87, 3 77, 3 67, 3 57, 3 | 60,0 95,9 118,1 135,0 149,5 162,5 172,5 | 60, 0 95, 2 117, 8 136, 1 151, 1 164, 0 174, 4 183, 1 | 155, 1 168, 8 180, 1 | 139,9 159,1 | 141,0 | 60, 0 92, 1 119, 2 141, 6 162, 0 179, 5 196, 3 210, 9 | 60,0 92,3 117,8 141,1 161,5 178,0 194,9 206,1 | 60, 0 92, 6 117, 7 138, 5 157, 5 173, 5 186, 8 196, 0 | 60,0 93,1 117,2 135,4 151,0 163,4 174,5 182,8 | 60,0 93,8 115,5 130,5 142,0 150,8 159,1 165,5 | 60,0 94,6 113,3 125,6 135,8 143,3 149,3 154,0 | 60,0 94,9 111,2 121,8 130,8 138,3 143,9 147,9 | 60,0 95,1 109,8 120,8 129,5 136,4 141,7 145,6 |



CAPACITANCES

| Final accelerator to external conductive coating | $C_{a,g3,g5/m}$ $\stackrel{<}{>}$ | 1300 700 | pF pF |
|--|------------------------------------|-------------|----------|
| Final accelerator to metal band | $\mathrm{C}_{\mathrm{a,g3,g5/m'}}$ | 200 | pF |
| Cathode to all | $C_{\mathbf{k}}$ | 3 | pF |
| Grid no. 1 to all | c_{g1} | 7 | pF |

FOCUSING

electrostatic

DEFLECTION

magnetic

Diagonal deflection angle 110° Horizontal deflection angle 100° Vertical deflection angle 83°

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1

| Final accelerator voltage | $V_{a,g3,g5}$ | 20 | kV |
|---|---------------|----------|------------|
| Focusing electrode voltage | ${ m v_{g4}}$ | 0 to 130 | V^{-1}) |
| Grid no. 2 voltage | ${ m v_{g2}}$ | 130 | V |
| Cathode voltage for visual extinction of focused raster | v_{KR} | 42 to 62 | V |

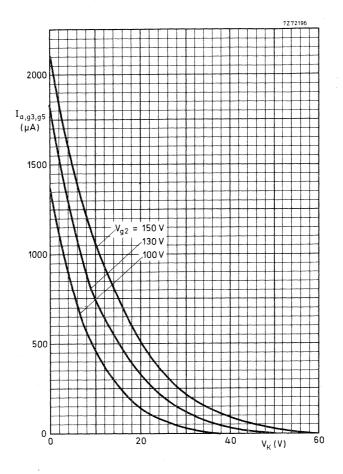
¹⁾ Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and + 130 V (e.g. two taps, 0 V and 130 V). The optimum focus voltage of individual tubes may be between -100 V and +200 V.

| Name and Address of the Owner, where |
|--------------------------------------|
| 2.20 |
| |
| SECRETARIOS SE |
| |
| - |

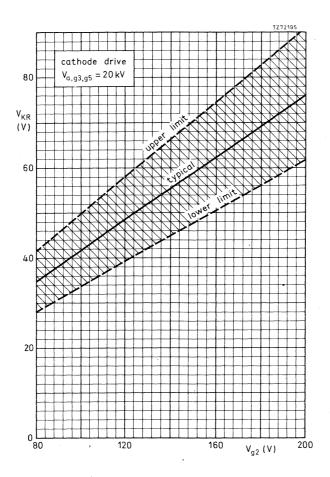
| LIMITING VALUES (Design max. rating system | m) | | | - |
|--|----------------------------|--------------|-----------|-----------------------|
| Final accelerator voltage at $I_{a,g3,g5} = 0$ | $v_{a,g3,g5}$ | max. min. | 23 12 | kV kV |
| Grid no. 4 voltage, | | | | |
| positive | $V_{\mathbf{g4}}$ | max. | 1000 | V |
| negative | $-V_{g4}$ | max. | 500 | V |
| Grid no. 2 voltage | v_{g2} | max. | 200 80 | V ¹) V |
| Cathode to grid no. 1 voltage, | | | | |
| positive | $V_{k/g1}$ | max. | 200 | V |
| positive peak | $V_{k/g1_p}$ | max. | 400 | V 2) |
| negative | $-V_{k/g1}$ | max. | 0 | V |
| negative peak | $^{-V}$ k/g 1_{p} | max. | 2 | V |
| Cathode-to-heater voltage | $v_{ m kf}$ | max. | 200 | V |
| CIRCUIT DESIGN VALUES | | | | |
| Grid no. 4 current, | | | | |
| positive | I_{g4} | max. | 25 | μΑ |
| negative | $-I_{g4}$ | max. | 25 | μA |
| Grid no. 2 current, | | | | |
| positive | I_{g2} | max. | 5 | μΑ |
| negative | $-I_{g2}$ | max. | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | • | | | |
| Resistance between cathode and heater | $R_{k/f}$ | max. | 1,0 | $M\Omega$ |
| Impedance between cathode and heater | $\mathrm{Z_{k/f}}$ (50 Hz) | max. | 0,1 | $M\Omega$ |
| Grid no. 1 circuit resistance | R_{g1} | max. | 1,5 | $M\Omega$ |
| Grid no. 1 circuit impedance | Z _{c1} (50 Hz) | max. | 0,5 | $M\Omega$ |

¹⁾ At $V_{k/g1} = 0$ V.

 $^{^2)}$ Maximum pulse duration 22% of a cycle but maximum 1,5 ms.

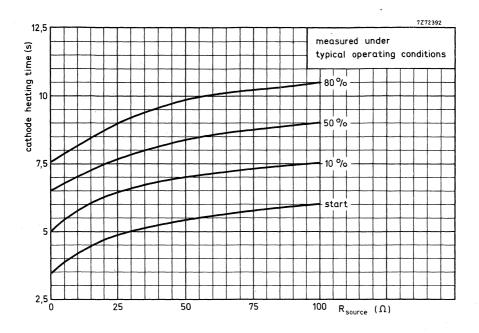


Final accelerator current as a function of cathode voltage $V_a,\,g_3,\,g_5 \, = \, 20 \ kV$



$$\frac{\Delta V_{KR}}{\Delta V_{a, g_3, g_5}} = 0,75 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage



Cathode heating time to attain $x\,\%$ of the cathode current at equilibrium conditions

TV PICTURE TUBE

 $50~\rm{cm}$ (20 in), $110^{\rm{O}},$ rectangular direct vision picture tube with integral protection for black-and-white TV.

| QUICK REFERENCE DATA | | | | | |
|---------------------------|--|---------------|--|--|--|
| Face diagonal | | 50 cm (20 in) | | | |
| Deflection angle | | 110° | | | |
| Overall length | | 312,5 mm | | | |
| Neck diameter | | 28,6 mm | | | |
| Heating | | 6,3 V, 300 mA | | | |
| Grid no. 2 voltage | | 400 V | | | |
| Final accelerator voltage | | 20 kV | | | |

SCREEN

Metal-backed phosphor

| Luminescence | white | | |
|----------------------------------|---------|-----|----|
| Light transmission of face glass | approx. | 45 | % |
| Useful diagonal | min. | 473 | mm |
| Useful width | min. | 394 | mm |
| Useful height | min. | 308 | mm |

HEATING

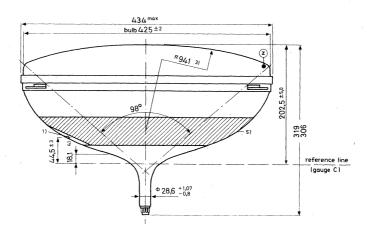
Indirect by a.c. or d.c.; series or parallel supply

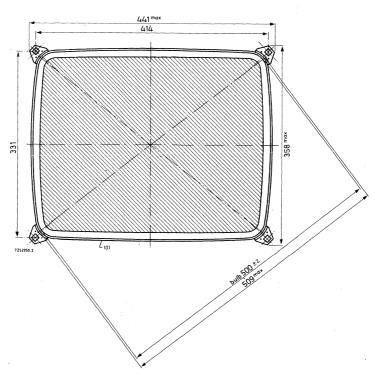
| Heater current | | $I_{\mathbf{f}}$ | 300 | mA |
|----------------|--|--------------------|------|----|
| Heater voltage | | $\overline{v_{f}}$ | 6, 3 | V |

If the tube is connected in a series heater chain the surge heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

MECHANICAL DATA

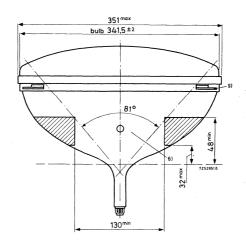
Dimensions in mm

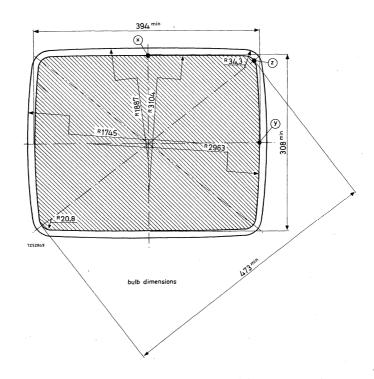


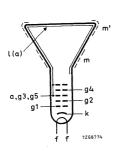


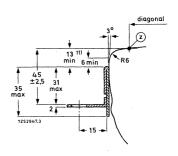
Notes see page 5

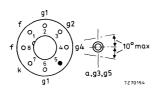
2

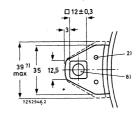


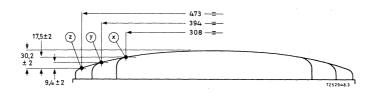












Mounting position: any

Base : neo eightar 7 pin JEDEC B7-208, B8H, IEC67-1-31a

Net mass : approx. 8,5 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of $40\ \mathrm{mm}$.

The socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.

Notes see page 5

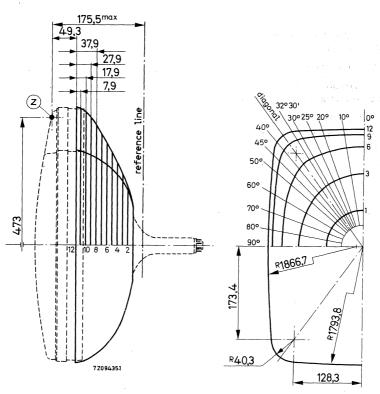
NOTES TO OUTLINE DRAWINGS

- 1. Small cavity contact IEC67-III-2.
- 2. The metal rim-band must be earthed. The holes of 3 mm dia in each lug are provided for this purpose.
- 3. Spherical face-plate.
- 4. End of guaranteed contour. The maximum neck-and-cone contour is given by the reference line gauge C (18,13 mm).
- The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing.The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical position i.e. at the corners of a rectangle of 414 mm x 331 mm.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. Max. curvatures of the outside rim-band are: nominal bulb radius +4 mm.
- 11. Distance from reference point Z to any hardware.

.

MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| A50-120W A50-520W | | | | | | | | | | | | | | | |
|-------------------|------------------------------------|------------|--------|-------|-------|-------|---------|---------------------|--------|-------|-------|-------|-------|-------|--------------|
| | Distance from centre (max. values) | | | | | | | | | | | | | | |
| Sec- tion | Nom distance from point "Z" | 00 Long | 100 | 20º | 250 | 300 | 320 30' | 36º 30' Diagonal | 400 | 450 | 500 | 600 | 700 | 800 | 900 Short |
| 1 | 157,2 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69.0 |
| 2 | 147,2 | 109,2 | 107, 8 | 107,1 | 106,4 | 106,0 | 105,9 | 105,5 | 105,0 | 104,5 | 103,9 | 102,8 | 102,6 | 102.8 | |
| 3 | 137,2 | 136,7 | 134,5 | 133,7 | 133,0 | 132,3 | 131, 8 | 130,7 | 129,3 | 127.5 | 125,3 | 121.9 | 120.7 | 120,2 | |
| 4 | 127,2 | 157,2 | 156,5 | 155,7 | 154,8 | 153,8 | 153,0 | 151,5 | | | | | 134,9 | | |
| 5 | 117,2 | 174,2 | 174,0 | 174,4 | 174,3 | 173,4 | 172,8 | 171,0 | | | 160.8 | | | | 142.3 |
| 6 | 107,2 | 185,8 | 186,3 | 188,4 | 190,0 | 191,2 | 191,2 | 189,5 | 186,7 | 181.7 | 174.7 | 163.2 | 156.0 | 151.7 | 150.4 |
| 7 | 97,2 | 194,5 | 195,7 | 202,2 | 203,8 | 206,9 | 207,3 | 206,4 | | | 187,4 | | | , | 156.9 |
| 8 | 87,2 | 201,7 | 203,8 | 210,2 | 215,4 | 220,6 | 222,1 | 222,2 | | | 198,8 | | | 164,7 | 162.7 |
| 9 | 77,2 | 208,2 | 210,6 | 218,5 | 224,8 | 231,4 | 234,8 | 236.5 | | | 208,5 | | | 169.9 | 167.9 |
| 10 | 67,2 | 213,1 | 215,9 | 225,2 | 231,9 | 239,8 | 244,3 | 248,5 | | | 216,0 | | | 174.5 | |
| 11 | 57,2 | 215,6 | 219,0 | 228,2 | 235,4 | 244.5 | 249,6 | 253,7 | | | 220,5 | | | 177.2 | 174.7 |
| 12 | 49,3 | 217,0 | 219,8 | 229,3 | 236,6 | 246,0 | 251,2 | 254,5 | 251, 7 | | | | | 177,8 | |

CAPACITANCES

| Final accelerator to external conductive coating | $C_{a, g3, g5}/m$ | 1300 pF 850 pF |
|--|--------------------|-------------------|
| Final accelerator to metal band | $C_{a,g_3,g_5/m'}$ | 300 pF |
| Cathode to all | $C_{\mathbf{k}}$ | 5 pF |
| Grid no. 1 to all | C_{g_1} | 7 pF |

FOCUSING

electroststic

DEFLECTION

magnetic

Diagonal

110⁰ le 98⁰

Horizontal deflection angle

Vertical deflection angle 81°

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe).

Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Grid drive service

| Final accelerator voltage | $V_{a, g3, g5}$ | 20 | kV |
|--|--------------------|------------|------------------|
| Focusing electrode voltage | ${ m v}_{{ m g}4}$ | 0 to 400 | V ¹) |
| Grid no.2 voltage | ${ m v_{g2}}$ | 400 | V |
| Grid no. 1 voltage for visual extinction of focused raster | v_{GR} | -40 to -77 | V |

Cathode drive service

Voltages are specifiec with respect to grid no. 1

| Final accelerator voltage | ^v a, g3, g5 | 20 | ΚV |
|---|------------------------|----------|------------------|
| Focusing electrode voltage | ${ m v_{g4}}$ | 0 to 400 | V ¹) |
| Grid no. 2 voltage | v_{g_2} | 400 | V |
| Cathode voltage for visual extinction of focused raster | $v_{ m KR}$ | 36 to 66 | v |

¹⁾ Individual tubes will have optimum focus within this range. In general an acceptable picture will be obtained with a fixed focus voltage.

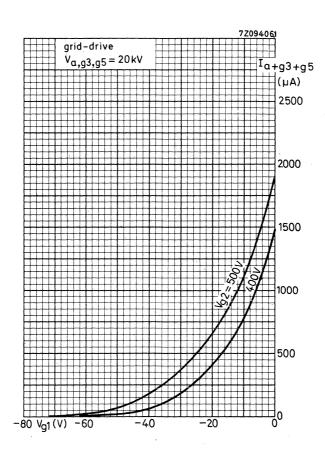
| LIMITING VALUES (Design max. rating system) | | | | |
|--|-------------------|--------------|--------------------|------------------|
| Final accelerator voltage at I _{a, g3, g5} = 0 | v_{a, g_3, g_5} | max. min. | 23 12 | kV kV |
| Grid no. 4 voltage | | 1111111 | 12 | K.V |
| positive | v_{g_4} | max. | 1000 | V |
| negative | $-v_{g_4}$ | max. | 500 | V |
| Grid no. 2 voltage | v_{g_2} | max. min. | 70 0 350 | V V |
| Grid no. 2 to grid no. 1 voltage | $v_{\rm g2/g1}$ | max. | 850 | V |
| Grid no. 1 voltage, | | | | |
| positive | ${ m v_{g_1}}$ | max. | 0 | V |
| positive peak | v_{g1p} | max. | .2 | V |
| negative | $-v_{g_1}$ | max. | 200 | V |
| negative peak | $-v_{g1p}$ | max. | 400 | V ¹) |
| Cathode-to-heater voltage | | | | |
| positive | $v_{k/f}$ | max. | 250 | V |
| positive peak | v_{k/f_p} | max. | 300 | V |
| negative | $-v_{k/f}$ | max. | 200 | V |
| positive during equipment warm-up period not exceeding 15 s | $v_{k/f}$ | max. | 450 | V 3) |

 $^{^{1}\}mbox{)}$ Maximum pulse duration 22% of a cycle but maximum 1,5 ms.

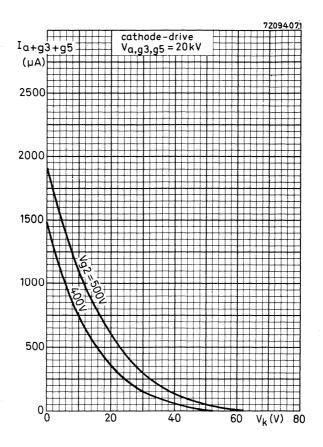
²⁾ At $V_{g_1/k} = 0 \text{ V}$.

³⁾ Between 15 s and 45 s after switching on a decrease in k/f voltage from 450 V to 250 V, linearly proportional with time, is permissible.

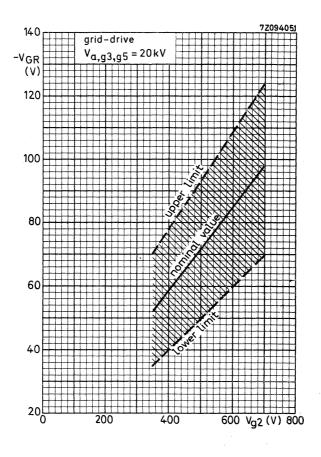
| CIRCUIT DESIGN VALUES | | | | |
|---------------------------------------|--|------|-----|--------------------|
| Grid no. 4 current positive | I_{g4} | max. | 25 | μΑ |
| negative | $-I_{g_4}$ | max. | 25 | μA |
| Grid no.2 current positive | I_{g2} | max. | 5 | μΑ |
| negative | $-I_{g_2}$ | max. | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | $R_{k/f}$ | max. | 1,0 | $M\!\Omega$ |
| Impedance between cathode and heater | $\mathrm{Z}_{\mathrm{k}/\mathrm{f}}$ (50 Hz) | max. | 0,1 | $\mathrm{M}\Omega$ |
| Grid no.1 circuit resistance | R_{g1} | max. | 1,5 | $M\Omega$ |
| Grid no.1 circuit impedance | z_{g1} (50 Hz) | max. | 0,5 | $M\!\Omega$ |



Final accelerator current as a function of grid no.1 voltage

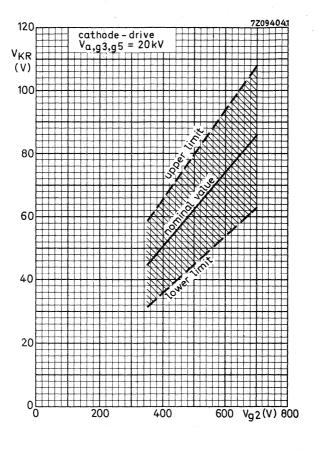


Final accelerator current as a function of cathode voltage



$$\frac{\Delta V_{\rm GR}}{\Delta V_{\rm a, g3, g5}} = 0, 15 \times 10^{-3}$$

Limits of grid no. 1 cut-off voltage as a function of grid no. 2 voltage



$$\frac{\Delta V_{KR}}{\Delta V_{a, g3, g5}} = 0, 15 \times 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage



TV PICTURE TUBE

 $50 \, \mathrm{cm}$ (20 in), 110^{o} , rectangular direct vision picture tube with integral protection for black and white TV. A special feature of this tube is its short cathode heating time.

| QUICK REFERENCE DATA | | | | | | | |
|---------------------------|----|--|--|--|--|--|--|
| Face diagonal | | 50 cm | | | | | |
| Deflection angle | | 1100 | | | | | |
| Overall length | ma | x. 319 mm | | | | | |
| Neck diameter | | 28,6 mm | | | | | |
| Heating | | 6,3 V, 240 mA | | | | | |
| Grid no.2 voltage | | 130 V | | | | | |
| Final accelerator voltage | | 20 kV | | | | | |
| Quick heating cathode | | pical tube a icture will appear s. | | | | | |

SCREEN

Metal backed phosphor

| Luminescence | white | |
|----------------------------------|---------|--------|
| Light transmission of face glass | approx. | 45 % |
| Useful diagonal | min. | 473 mm |
| Useful width | min. | 394 mm |
| Useful height | min. | 308 mm |

HEATING

Indirect by a.c. or d.c.

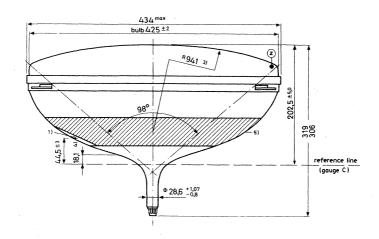
| Heater voltage | $v_{\mathbf{f}}$ | | 6,3 V |
|---|------------------|--------------|---------------------------------|
| Heater current | $I_{\mathbf{f}}$ | | 240 mA |
| Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms | $v_{\mathbf{f}}$ | max. min. | 7, 3 V ¹) 5, 3 V |

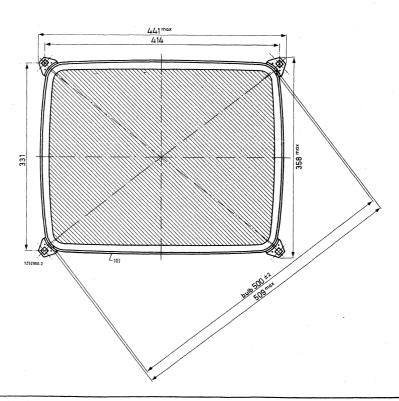
For heating time as a function of source impedance see page 11.

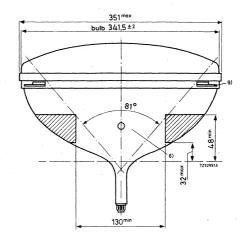
¹⁾ This limit also applies during equipment warming up. Use of the tube in a series heater chain it not allowed.

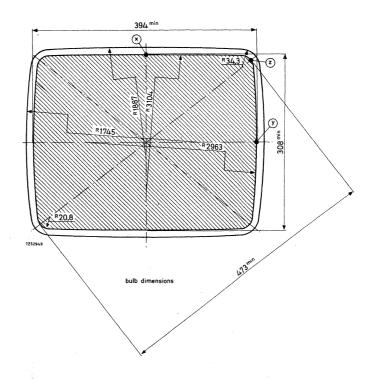
MECHANICAL DATA

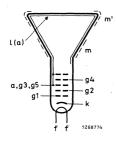
Dimensions in mm

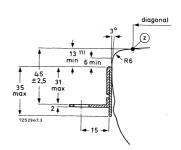


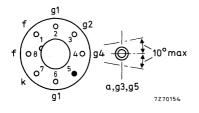


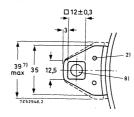


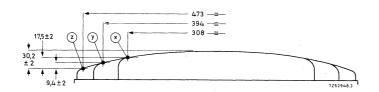












Mounting position: any

Base

: neo eightar 7 pin JEDEC B7-208, B8H, IEC 67-1-31a

Net mass

: approx. 8,5 kg

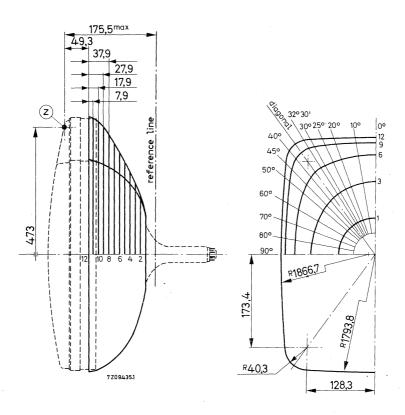
The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of $40\ \mathrm{mm}$.

ENGINEER CONTROL OF THE PROPERTY OF THE PROPER

NOTES TO OUTLINE DRAWINGS

- 1. Small cavity contact IEC 67-III-2.
- 2. The metal rim-band must be earthed. The holes of 3 mm dia in each lugare provided for this purpose.
- 3. Spherical face plate.
- 4. End of guaranteed contour. The maximum neck-and-cone contour is given by the reference line gauge C (18, 13 mm).
- The configuration of the external conductive coating may be different but contains the the contact area as shown in the drawing.
 The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical position i.e. at the corners of a rectangle of 414 mm x 331 mm.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. Max, curvatures of the outside rim-band are; nominal bulb radius + 4 mm.
- 11. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING



| | | | | | | | | | | | A | A50-120 | W A50 | -520W | |
|------|------------------------------------|-------|--------|-------|--------|-------|---------|----------|-------|-------|--------|---------|-------|-------|---------|
| | Distance from centre (max. values) | | | | | | | | | | | | | | |
| Sec- | Nom distance | 00 | 100 | 20° | 250 | 30° | 320 30' | 360 30' | 400 | 450 | 500 | 600 | 70° | 800 | 900 |
| tion | from point "Z" | Long | 1 | | | | | Diagonal | | | | | | | Short |
| 1 | 157,2 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 | 69,0 |
| 2 | 147,2 | 109,2 | 107,8 | 107,1 | 106,4 | 106,0 | 105,9 | 105,5 | 105,0 | 104,5 | 103,9 | 102,8 | 102,6 | 102,8 | 103, 4 |
| 3 | 137,2 | 136,7 | 134,5 | 133,7 | 133,0 | 132,3 | 131,8 | 130,7 | 129,3 | 127,5 | 125, 3 | 121,9 | 120,7 | 120,2 | 120,2 |
| 4 | 127,2 | 157,2 | 156,5 | 155,7 | 154,8 | 153,8 | 153,0 | 151,5 | 150,0 | 147,5 | 144,7 | 138,7 | 134,9 | 133,4 | 132,5 |
| 5 | 117,2 | 174,2 | 174,0 | 174,4 | 174, 3 | 173,4 | 172,8 | 171,0 | 169,3 | 165,7 | 160,8 | 152,0 | 146,5 | 143,7 | 142,3 |
| 6 | 107,2 | 185,8 | 186,3 | 188,4 | 190,0 | 191,2 | 191,2 | 189,5 | 186,7 | 181,7 | 174,7 | 163,2 | 156,0 | 151,7 | 150, 4 |
| 7 | 97,2 | 194,5 | 195,7 | 202,2 | 203,8 | 206,9 | 207,3 | 206,4 | 203,5 | 196,4 | 187,4 | 173,0 | 163,5 | 158,6 | 156,9 |
| 8 | 87,2 | 201,7 | 203, 8 | 210,2 | 215,4 | 220,6 | 222,1 | 222,2 | 218,8 | 210,5 | 198,8 | 181,2 | 170,3 | 164,7 | 162,7 |
| 9 | 77,2 | 208,2 | 210,6 | 218,5 | 224,8 | 231,4 | 234,8 | 236,5 | 233,5 | 222,2 | 208,5 | 188,5 | 176,6 | 169,9 | 167,9 |
| 10 | 67,2 | | | 225,2 | | | 244,3 | 248,5 | 244,8 | 230,3 | 216,0 | 194,7 | 181,6 | 174,5 | 172,0 |
| 11 | 57,2 | | | 228,2 | | | | 253,7 | 250,2 | 235,7 | 220,5 | 198,6 | 184,8 | 177,2 | 174,7 |
| 12 | 49,3 | 217,0 | 219,8 | 229,3 | 236,6 | 246,0 | 251,2 | 254,5 | 251,7 | 237,2 | 222,0 | 199,6 | 185,6 | 177,8 | 175, 7. |



CAPACITANCES

| Final appalantes to outpured conductive cepting | C | < | | pF |
|--|-------------------|---|-----|----|
| Final accelerator to external conductive coating | $C_{a,g3,g5/m}$ | > | 850 | pF |
| Final accelerator to metal band | $C_{a,g3,g5/m'}$ | | 250 | pF |
| Cathode to all | $C_{\mathbf{k}}$ | | 3 | pF |
| Grid no. 1 to all | $C_{\mathbf{g}1}$ | | 7 | pF |

FOCUSING

electrostatic

DEFLECTION

magnetic

Diagonal

 110^{o}

Horizontal deflection angle

980

Vertical deflection angle

810

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to $800 \, \text{A/m}$ (0 to $10 \, \text{Oe}$). Maximum distance between centre of field of this magnet and reference line: $57 \, \text{mm}$.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1

| Final accelerator voltage | $V_{a,g3,g5}$ | - 20 | kV |
|---|---------------|----------|------------------|
| Focusing electrode voltage | v_{g4} | 0 to 130 | V ¹) |
| Grid no. 2 voltage | v_{g2} | 130 | V |
| Cathode voltage for visual extinction of focused raster | v_{KR} | 42 to 62 | V |

¹⁾ Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps, 0 V and 130 V).

The optimum focus voltage of individual tubes may be between $-100\;\mathrm{V}$ and $+200\;\mathrm{V}$.

| LIMITING VALUES (Design max. rating system) | | | | |
|--|-------------------------------------|--------------|-----------|-----------------------|
| Final accelerator voltage at $I_{a,g3,g5} = 0$ | $V_{a,g3,g5}$ | max. min. | 23 12 | kV kV |
| Grid no. 4 voltage | | . • | | |
| positive | v_{g4} | max. | 1000 | V |
| negative | -Vg4 | max. | 500 | V |
| Grid no. 2 voltage | v_{g2} | max. min. | 200 80 | V ¹) V |
| Cathode to grid no. 1 voltage | | | | |
| positive | V _{k/g1} | max. | 200 | V |
| positive peak | $V_{k/g1p}$ | max. | 400 | V^2) |
| negative | $-V_{k/g1}$ | max. | 0 | V |
| negative peak | $-V_{k/g1p}$ | max. | 2 | V |
| Cathode-to-heater voltage | $v_{\mathbf{k}\mathbf{f}}$ | max. | 200 | V |
| CIRCUIT DESIGN VALUES | | | | |
| Grid no. 4 current, | | | | |
| positive | I_{g4} | max. | 25 | μΑ |
| negative | -Ig4 | max. | 25 | μΑ |
| Grid no. 2 current, | | | | |
| positive | I_{g2} | max. | 5 | μA |
| negative | $-I_{g2}$ | max. | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | R _{k/f} | max. | 1,0 | $M\Omega$ |
| Impedance between cathode and heater | $\mathrm{Z}_{k/\mathrm{f}}$ (50 Hz) | max. | 0,1 | $\mathrm{M}\Omega$ |
| Grid no. 1 circuit resistance | R_{g1} | max. | 1,5 | $M\Omega$ |

 Z_{g1} (50 Hz)

Grid no. 1 impedance

0,5

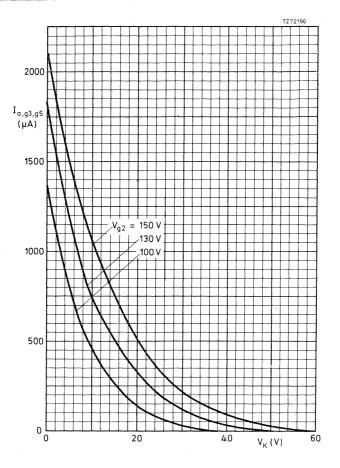
max.

 $\mathsf{M}\Omega$

 $[\]overline{1) \text{ At V}_{g1/k}} = 0 \text{ V}.$

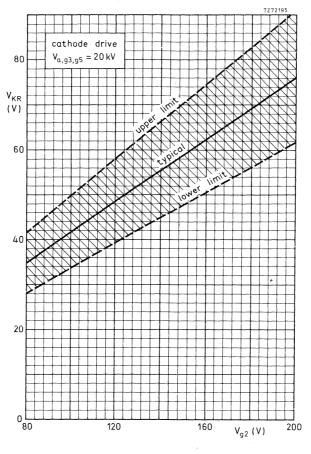
 $^{^2)}$ Maximum pulse duration $22\,\%$ of a cycle but maximum 1,5 ms.





Final accelerator current as a function of cathode voltage $V_{a,\,g\,3,\,g\,5} = 20~kV$

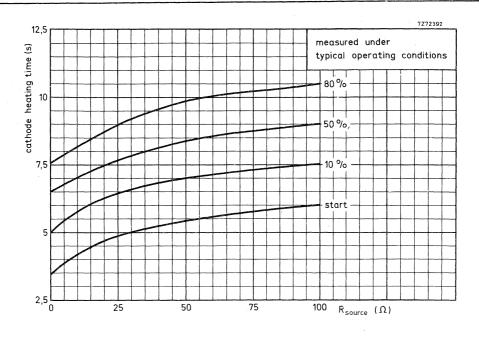
Tune 1975



$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,75 \text{ x } 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage





Cathode heating time to attain $x\,\%$ of the cathode current at equilibrium conditions



TV PICTURE TUBE

 $61~\rm{cm}~(24~\rm{in}),~110^{\rm{O}},~\rm{rectangular}$ direct vision picture tube with integral protection for black and white TV.

| QUICK REFER | ENCE DATA | |
|---------------------------|-------------|------------|
| Face diagonal | 61 | cm (24 in) |
| Deflection angle | 110° | · |
| Overall length | max. 370 | mm |
| Neck diameter | 28,6 | mm |
| Heating | 6, 3 V, 300 | mA |
| Grid no. 2 voltage | 400 | V |
| Final accelerator voltage | 20 | kV |

SCREEN

Metal backed phosphor

| Luminescence | white | | | | |
|----------------------------------|------------|-----|--|--|--|
| Light transmission of face glass | approx. | 42% | | | |
| Useful diagonal | min. 577,5 | mm | | | |
| Useful width | min. 481 | mm | | | |
| Useful height | min. 375 | mm | | | |

HEATING

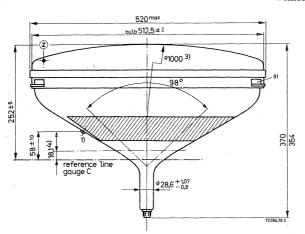
Indirect by a.c. or d.c.; series or parallel supply

| parameter suppry | | | |
|------------------|------------------------|------|----|
| Heater current | $I_{\mathbf{f}}$ | 300 | mA |
| Heater voltage | $\overline{v_{\rm f}}$ | 6, 3 | V |

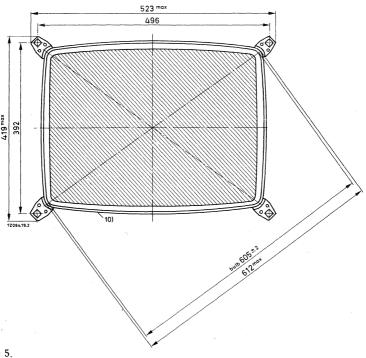
If the tube is connected in a series heater chain the surge heater voltage must not exceed an r.m.s. value of 9,5 V when the supply is switched on.

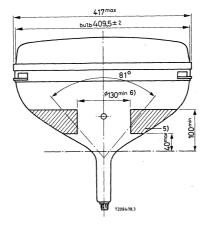
MECHANICAL DATA

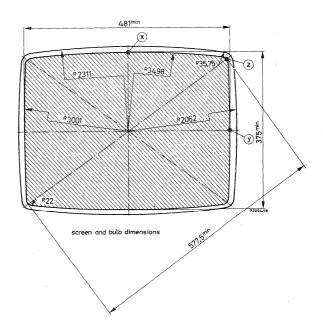
Dimensions in mm

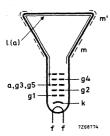


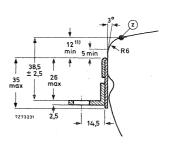


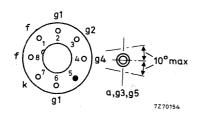


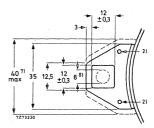


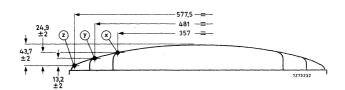












Mounting position: any

Base

: neo eightar 7 pin JEDEC B7-208, B8H, IEC-67-I-31a

Net mass

: approx. 13,5 kg.

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of 40 mm,

The socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.

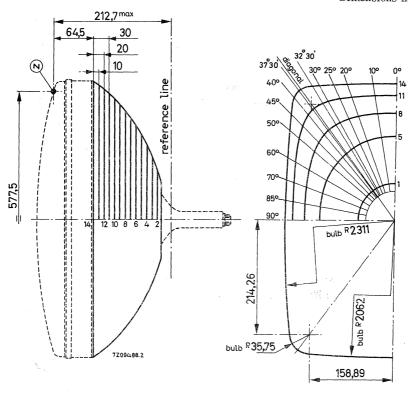


NOTES TO OUTLINE DRAWINGS

- 1. Small cavity contact IEC -67-III-2.
- 2. The metal rim-band must be earthed. The holes of 3 mm dia in each lug are provided for this purpose.
- 3. Spherical face plate.
- 4. End of guaranteed contour. The maximum contour from reference line towards screen is given by the reference line gauge C (18, 13 mm).
- The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing.The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical position; i.e. at the corners of a rectangle of 496 x 392 mm.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. The max, outer contour of the tube with the rim-band is determined by adding 5 mm to the nominal bulb dimensions.
- 11. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Sec- | Nom. distance | | Distance from centre (max. values) | | | | | | | | | | | | | | |
|------|-------------------|--------|------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| tion | from section 1 | 00 | 10° | 20° | 25° | 30° | 32°30' | diag. | 37°30' | 40° | 45° | 50° | 60° | 70° | 80° | 90° | |
| 1 | 130 | 72, 9 | 72, 4 | 71,6 | 71, 1 | 70,7 | 70,5 | 70, 3 | 70, 3 | 70,2 | 70, 1 | 70,0 | 70, 2 | 70.8 | 71.5 | 71.8 | |
| 2 | 120 | 104, 4 | 102,6 | 99,4 | 97, 8 | 96, 5 | 96, 0 | 95, 2 | 95, 1 | 94,7 | 94, 2 | 94,0 | 94,5 | 96,0 | 98,0 | 99, 3 | |
| 3 | 110 | 134, 3 | 131,5 | 126,5 | 124, 2 | 122,1 | 121, 2 | 119,9 | 119,6 | 119,0 | 118,0 | 117,4 | 117, 4 | 118,7 | 120,7 | 122,0 | |
| 4 | 100 | 160, 4 | 157, 1 | 151, 1 | 148, 1 | 145, 3 | 144, 1 | 142,2 | 141,8 | 140,8 | 139, 1 | 137, 9 | 136,7 | 136, 9 | 137, 9 | 138,7 | |
| 5 | 90 | 178,7 | 176, 9 | 172, 9 | 170, 1 | 167,5 | 166, 1 | 164,0 | 163, 5 | 162, 3 | 159, 9 | 157, 8 | 154, 3 | 151,9 | 150, 7 | 150, 3 | |
| 6. | 80 | 193, 3 | 193,0 | 191,4 | 189, 9 | 187,8 | 186, 6 | 184,4 | 183, 4 | 182, 4 | 179, 2 | 175, 9 | 169, 6 | 164, 4 | 161,0 | 159, 8 | |
| 7 | 70 | 205, 7 | 206, 5 | 207, 6 | 207,5 | 206, 4 | 205, 5 | 203,4 | 202,8 | 201,1 | 196, 9 | 192, 2 | 182,7 | 174,8 | 169,7 | 168,0 | |
| 8 | 60 | 216,8 | 212,5 | 222, 1 | 223,5 | 223,8 | 223,4 | 221,5 | 220,9 | 218,9 | 213,6 | 207, 2 | 194, 3 | 183, 9 | 177,6 | 175, 4 | |
| 9 | 50 | 226, 9 | 229, 3 | 235,0 | 238, 1 | 240,0 | 240, 3 | 238, 9 | 238, 2 | 235, 9 | 229, 0 | 220, 7 | 204, 4 | 192, 1 | 184,7 | 182, 3 | |
| 10 | 40 | 236,0 | 238, 7 | 246, 3 | 250, 9 | 254, 9 | 256, 1 | 255,4 | 254, 7 | 252,4 | 243, 2 | 232, 7 | 213, 3 | 199, 3 | 191, 2 | 188, 6 | |
| 11 | 30 | 243,7 | 246,8 | 255, 9 | 262,0 | 268,1 | 270,6 | 271,0 | 270, 3 | 267, 4 | 256,0 | 243, 1 | 220,8 | 205, 7 | 197,1 | 194.3 | |
| 12 | 20 | 250,0 | 253, 4 | 263, 5 | 270, 9 | 279,3 | 283, 5 | 285,5 | 284,8 | 281,6 | 267, 2 | 251,8 | 227,2 | 211, 1 | 202, 2 | 199,4 | |
| 13 | 10 | 255,0 | 258, 5 | 269, 3 | 277, 7 | 288, 1 | 293, 9 | 298,0 | 297,6 | 294, 1 | 276, 2 | 258,5 | 232, 1 | 215.6 | 206.5 | 203.6 | |
| 14 | 0 | 258, 5 | 262, 0 | 273, 1 | 281,9 | 293, 2 | 300,0 | 305, 4 | 305, 1 | 301,5 | 281,6 | 262, 7 | 235, 6 | 218,8 | 209, 6 | 206, 6 | |

CAPACITANCES

Final accelerator to external conductive coating

 $C_{a,g3,g5/m}$ 1500 pF

Final accelerator to metal band

Ca, g3, g5/m' 400 pF

Cathode to all Grid no. 1 to all

5 pF C_{g1} 7 pF

FOCUSING

electrostatic

magnetic

DEFLECTION

Diagonal deflection angle

 110^{0}

Horizontal deflection angle

980

Vertical deflection angle

810

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Grid drive service

| Final accelerator voltage | $V_{a, g3, g5}$ | | 20 | kV |
|---|-----------------|--------|-----|-----------------|
| Focusing electrode voltage | V_{g4} | 0 to | 400 | y ¹⁾ |
| Grid no. 2 voltage | v_{g2} | | 400 | V |
| Grid no. 1 voltage for visual exinction | | | | |
| of focused raster | V_{CP} | -40 to | 77 | v |

Cathode drive service

Voltages are specified with respect to grid no. 1

| Final accelerator voltage | V _{a, g3, g5} | | 20 | kV |
|---------------------------------------|------------------------|------|-----|----------|
| Focusing electrode voltage | | 0 to | 400 | $V^{1)}$ |
| Grid no. 2 voltage | v_{g2} | | 400 | V |
| Cathode voltage for visual extinction | | | | |

of focused raster

 V_{KR} 36 to 66 V

-40 to -77 V

 V_{GR}

¹⁾ Individual tubes will have optimum focus within this range. In general an acceptable picture will be obtained with a fixed focus voltage.

LIMITING VALUES (Design max. rating system)

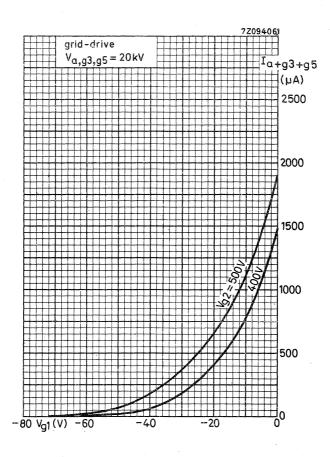
| Final accelerator voltage at Ia, g3, g5 = 0 Grid no.4 voltage, | Va, g3, g5 | max. min. | 23 12 | kV kV |
|--|------------|--------------|------------|-----------------------|
| positive | Vg4 | max. | 1000 | V |
| negative | -Vg4 | max. | 500 | V |
| Grid no. 2 voltage | Vg2 | max. min. | 700 350 | V ²) V |
| Grid no.2 to grid no.1 voltage | Vg2/g1 | max. | 850 | V |
| Grid no. 1 voltage | | | | |
| positive | Vg1 | max. | 0 | V |
| positive peak | Vglp | max. | 2 | V |
| negative | -Vgl | max. | 200 | V |
| negative peak | -Vglp | max. | 400 | V 1) |
| Cathode_to_heater voltage, | | | | |
| positive | Vk/f | max. | 250 | V |
| positive peak | Vk/fp | max. | 300 | V |
| negative | -Vk/f | max. | 200 | V |
| positive during equipment warm-up period not exceeding 15 s | Vk/f | max. | 450 | V 3) |

¹⁾ Maximum pulse duration 22% of a cycle but maximum 1,5 ms.

²⁾ At Vg1/k = 0V,

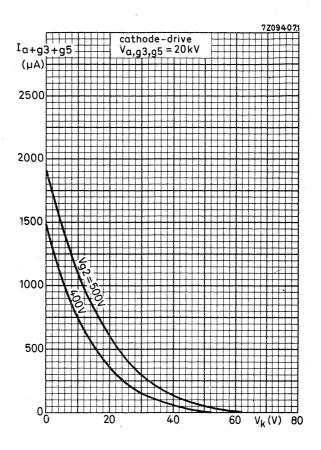
³⁾ Between 15 s and 45 s after switching on a decrease in k/f voltage from 450 V to 250 V, linearly proportional with time, is permissible.

| CIRCUIT DESIGN VALUES | | | | q |
|---------------------------------------|-------------|------|-----|------------------|
| Grid no. 4 current, | | | | |
| positive | Ig4 | max. | 25 | μΑ |
| negative | -Ig4 | max. | 25 | μΑ |
| Grid no. 2 current | | | | |
| positive | Ig2 | max. | 5 | $\mu \textbf{A}$ |
| negative | -Ig2 | max. | 5 | μΑ |
| MAXIMUM CIRCUIT VALUES | | | | |
| Resistance between cathode and heater | Rk/f | max. | 1 | $M\Omega$ |
| Impedance between cathode and heater | Zk/f(50 Hz) | max. | 0,1 | $M\Omega$ |
| Grid no.1 circuit resistance | Rg1 | max. | 1,5 | $M\Omega$ |
| Grid no. 1 circuit impedance | Zg1(50 Hz) | max. | 0,5 | $M\Omega$ |

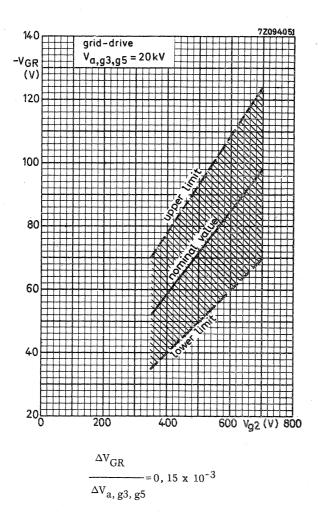


Final accelerator current as a function of grid no.1 voltage.



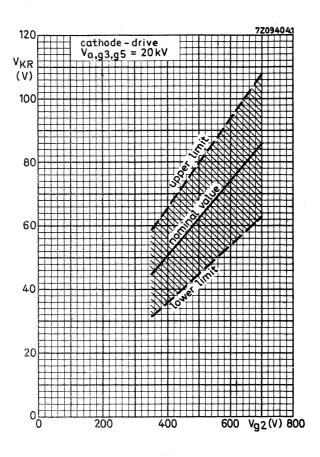


Final accelerator current as a function of cathode voltage.



Limits of grid no.1 cut-off voltage as a function of grid no.2 voltage.





$$\frac{\Delta V_{KR}}{\Delta V_{a, g3, g5}} = 0.15 \text{ X } 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage.

TV PICTURE TUBE

 $61~{\rm cm}$ ($24~{\rm in}$), $110^{\rm o}$, rectangular direct vision picture tube with integral protection for black and white TV. A special feature of this tube is its short cathode heating time.

| QUICK REFERENCE DATA | | | |
|---------------------------|---|--|--|
| Face diagonal | 61 cm | | |
| Deflection angle | 110° | | |
| Overall length | max. 370 mm | | |
| Neck diameter | 28,6 mm | | |
| Heating | 6, 3 V, 240 mA | | |
| Grid no. 2 voltage | 130 V | | |
| Final accelerator voltage | 20 kV | | |
| Quick heating cathode | with a typical tube a legible picture will appear within 5 s. | | |

SCREEN

Metal backed phosphor

| Luminescence | white | |
|----------------------------------|-------|----------|
| Light transmission of face glass | | 42 % |
| Useful diagonal | min. | 577,5 mm |
| Useful width | min. | 481 mm |
| Useful height | min. | 375 mm |

HEATING

Indirect by a.c. or d.c.

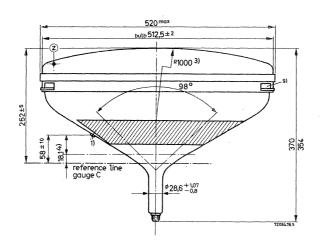
| Heater voltage | $ m V_{f}$ | 6, 3 V |
|---|---------------------------|---------------------------------|
| Heater current | $\mathtt{I}_{\mathbf{f}}$ | 240 mA |
| Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms | ${ m V_f}$ max. | 7, 3 V ¹) 5, 3 V |

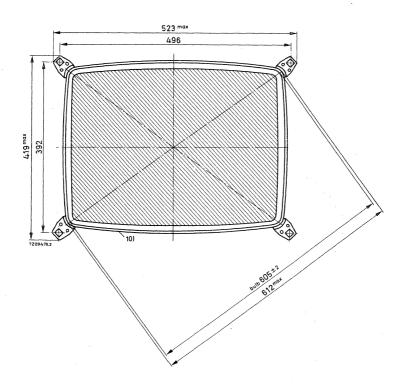
For heating time as a function of source impedance see page 11.

¹⁾ This limit also applies during equipment warming up. Use of the tube in a series heater chain is not allowed.

MECHANICAL DATA

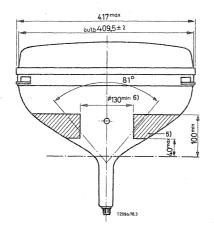
Dimensions in mm

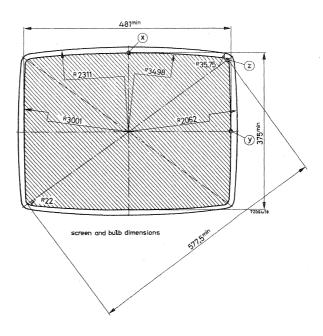




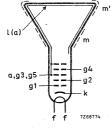
MECHANICAL DATA (continued)

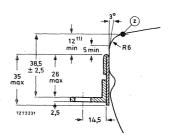
Dimensions in mm

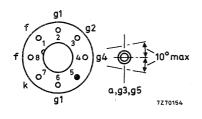


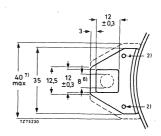


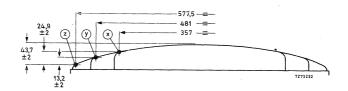
For notes see page 5











Mounting position: any

Base

: neo eightar 7 pin JEDEC B7-208, B8H, IEC-67-I-31a

Net mass

: approx. 13,5 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of 40 mm.

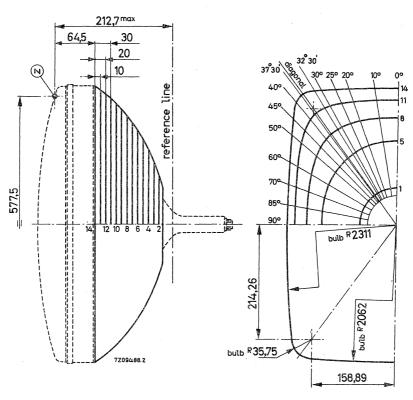
The socket for the base should not be rigidly mounted: it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWINGS

- 1. Small cavity contact IEC 67-III-2.
- 2. The metal rim-band must be earthed. The holes of 3 mm dia in each lug are provided for this purpose.
- 3. Spherical face plate.
- 4. End of guaranteed contour. The maximum contour from reference line towards screen is given by the reference line gauge C (18, 13 mm).
- The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing.The external conductive coating must be earthed.
- 6. This area must be kept clean.
- 7. Minimum space to be reserved for mounting lug.
- 8. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical position; i.e. at the corners of a rectangle of 496 x 392 mm.
- 9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
- 10. The max, outer contour of the tube with the rim-band is determined by adding 5 mm to the nominal bulb dimensions.
- 11. Distance from reference point Z to any hardware.

MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm



| Sec- | Nom. distance | | | | | Ε | Distance | from ce | ntre (m | ax. valu | es) | | | | | |
|------|-------------------|--------|--------|-----------------|-----------------|--------|----------|---------|---------------------|----------|--------|--------|--------|--------|--------|--------|
| tion | from section 1 | 00 | 10° | 20 ⁰ | 25 ⁰ | 30° | 32°30' | diag. | 37 ⁰ 30' | 40° | 45° | 50° | 60° | 70° | 80° | 90° |
| 1 | 130 | 72,9 | 72, 4 | 71,6 | 71, 1 | 70,7 | 70,5 | 70,3 | 70,3 | 70, 2 | 70,1 | 70,0 | 70, 2 | 70,8 | 71,5 | 71,8 |
| 2 | 120 | 104,4 | 102, 6 | 99, 4 | 97, 8 | 96, 5 | 96, 0 | 95, 2 | 95, 1 | 94,7 | 94, 2 | 94,0 | 94,5 | 96,0 | 98,0 | 99, 3 |
| 3 | 110 | 134, 3 | 131,5 | 126, 5 | 124, 2 | 122, 1 | 121, 2 | 119, 9 | 119,6 | 119,0 | 118,0 | 117,4 | 117,4 | 118,7 | 120,7 | 122,0 |
| 4 | 100 | 160,4 | 157,1 | 151, 1 | 148, 1 | 145,3 | 144, 1 | 142,2 | 141,8 | 140,8 | 139, 1 | 137,9 | 136,7 | 136, 9 | 137.9 | 138,7 |
| 5 | 90 | 178,7 | 176, 9 | 172,9 | 170,1 | 167,5 | 166, 1 | 164,0 | 163,5 | 162, 3 | 159, 9 | 157,8 | 154, 3 | 151,9 | 150, 7 | 150, 3 |
| 6 | 80 | 193, 3 | 193, 0 | 191,4 | 189, 9 | 187,8 | 186, 6 | 184,4 | 183, 4 | 182, 4 | 179, 2 | 175, 9 | 169,6 | 164, 4 | 161,0 | 159, 8 |
| 7 | 70 | 205,7 | 206,5 | 207,6 | 207,5 | 206, 4 | 205, 5 | 203, 4 | 202,8 | 201,1 | 196, 9 | 192, 2 | 182,7 | 174,8 | 169.7 | 168.0 |
| 8 | 60 | 216,8 | 212,5 | 222, 1 | 223,5 | 223,8 | 223, 4 | 221,5 | 220,9 | 218,9 | 213,6 | 207, 2 | 194, 3 | 183, 9 | 177.6 | 175.4 |
| 9 | 50 | 226, 9 | 229, 3 | 235, 0 | 238, 1 | 240,0 | 240, 3 | 238, 9 | 238, 2 | 235.9 | 229.0 | 220,7 | 204, 4 | 192.1 | 184,7 | 182.3 |
| 10 | 40 | 236,0 | 238, 7 | 246, 3 | 250, 9 | 254,9 | 256, 1 | 255, 4 | 254,7 | 252.4 | 243.2 | | 213.3 | | 191.2 | 188.6 |
| 11 | 30 | 243,7 | 246, 8 | 255, 9 | 262, 0 | 268, 1 | 270,6 | 271,0 | 270,3 | 267, 4 | 256,0 | 243,1 | 220,8 | 205, 7 | 197, 1 | 194.3 |
| 12 | 20 | 250,0 | 253, 4 | 263, 5 | 270, 9 | 279,3 | 283, 5 | 285,5 | 284, 8 | 281.6 | 267.2 | 251.8 | 227.2 | | 202.2 | |
| 13 | 10 | 255,0 | 258, 5 | 269, 3 | 277,7 | 288, 1 | 293, 9 | 298,0 | 297,6 | 294, 1 | 276, 2 | 258.5 | 232, 1 | 215.6 | 206.5 | 203.6 |
| 14 | 0 | 258, 5 | 262, 0 | 273, 1 | 281, 9 | 293, 2 | 300,0 | 305,4 | 305, 1 | 301,5 | 281,6 | | 235, 6 | , , | 209, 6 | 206, 6 |

CAPACITANCES

| Final accelerator to external conductive coating | C_a , g_3 , g_5/m $>$ | 2500 p | F |
|--|-----------------------------|--------|---|
| Final accelerator to metal band | C_a , g_3 , g_5/m ' | 350 p | F |
| Cathode to all | $C_{\mathbf{k}}$ | 3 p | F |
| Grid no. 1 to all | c_{g_1} | 7 p | F |

FOCUSING

electrostatic

DEFLECTION

magnetic

Diagonal deflection angle

110°

Horizontal deflection angle

98⁰

Vertical deflection angle

810

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 $\mbox{A/m}\,$ (0 to 10 $\mbox{Oe}),$

Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1

| Final accelerator voltage | v_{a} , g_{3} , g_{5} | 20 | kV |
|---|-----------------------------|----------|------------------|
| Focusing electrode voltage | ${ m v_{g_4}}$ | 0 to 130 | V ¹) |
| Grid no. 2 voltage | v_{g_2} | 130 | V |
| Cathode voltage for visual extinction of focused raster | v_{KR} | 42 to 62 | V |

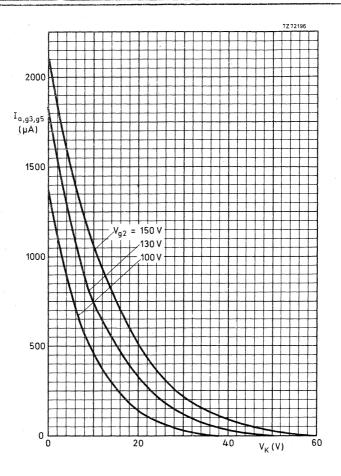
Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and 130 V (e.g. two taps, 0 V and 130 V).
 The optimum focus voltage of individual tubes may between -100 V and +200 V.

| tion on the same |
|---|
| EXPERIENCES. |
| NAMES OF TAXABLE PARTY |
| DECISION NO. |

| LIMITING VALUES (Design max. rating system) | | | | | |
|---|--|--------------|-----------|------------------|--|
| Final accelerator voltage at Ia, g3, g5 = 0 | $V_{a,g3,g5}$ | max. min. | 23 12 | kV kV | |
| Grid no. 4 voltage, | | | | | |
| positive | $V_{\mathbf{g4}}$ | max. | 1000 | V | |
| negative | $-v_{g4}$ | max. | 500 | V | |
| Grid no. 2 voltage | v_{g2} | max. min. | 200 80 | V 1) V | |
| Cathode to grid no. 1 voltage | | | | | |
| positive | $V_{\mathbf{k}/\mathbf{g}1}$ | max. | 200 | V | |
| positive peak | v_{k/gl_p} | max. | 400 | V ²) | |
| negative | $-V_{k/g1}$ | max. | 0 | V | |
| negative peak | $^{-\mathrm{V}}\mathrm{k/g1}_\mathrm{p}$ | max. | 2 | v | |
| Cathode to heater voltage | $v_{\mathbf{k}\mathbf{f}}$ | max. | 200 | V | |
| CIRCUIT DESIGN VALUES | | | | | |
| Grid no. 4 current | | | | | |
| positive | I_{g4} | max. | 25 | μΑ | |
| negative | -I _{g4} | max. | 25 | μA | |
| Grid no. 2 current | | | | | |
| positive | I_{g2} | max. | 5 | μΑ | |
| negative | $-I_{g2}$ | max. | 5 | μA | |
| MAXIMUM CIRCUIT VALUES | | | | | |
| Resistance between cathode and heater | R _{k/f} | max. | 1 | $M\Omega$ | |
| Impedance between cathode and heater | $\mathrm{Z_{k/f}}$ (50 Hz) | max. | 0, 1 | $M\Omega$ | |
| Grid no. 1 circuit resistance | R_{g1} | max. | 1,5 | $M\Omega$ | |
| Grid no. 1 circuit impedance | Z_{gl} (50 Hz) | max. | 0,5 | $M\Omega$ | |
| | | | | | |

 $[\]overline{1)}$ At $V_{k/g1} = 0$ V.

²⁾ Maximum pulse duration 22% of a cycle but maximum 1,5 ms.

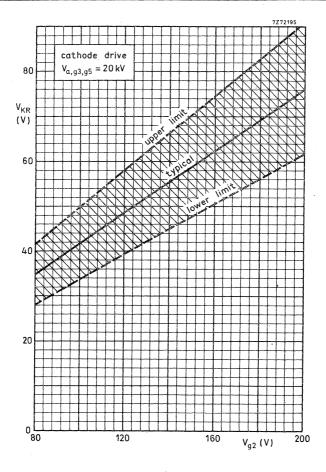


Final accelerator current as a function of cathode voltage.

Cathode drive

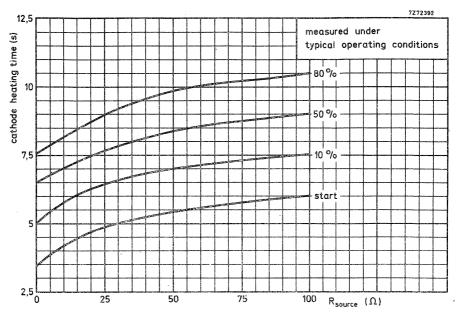
$$V_{a,g3,g5} = 20 \text{ kV}$$





$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,75 \text{ x } 10^{-3}$$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage.



Cathode heating time to attain $x\,\%$ of the cathode current at equilibrium conditions.

Index; Maintenance type list





MAINTENANCE TYPES (Abridged data)

| Type Deflection angle | V_{f} (V) I_{f} (A) | Typical condition | operating | Min. | useful | | Max. | Base connections |
|-----------------------------------|----------------------------|---|---|--------------------|--------|-----|--------|--|
| Transmission | 11 (11) | Conditions | | diag. width height | | | length | connections |
| A28-14 W 90 ⁰ 50 % | 11 0,075 | V _{a, g} 3, g5 V _g 4 Vg2 -V _{GR} V _{KR} | = 11 kV = 0-350 V = 250 V = 35 to 69 V = 32 to 58 V | 263 | 228 | 171 | 250 | 91 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| A31-20 W 90° 54 % | | | | 295 | 257 | 195 | 277 | |
| A31-120 W 110 ^o 50% | | | | 295 | 257 | 195 | 233 | |
| A47-14 W 110° 48% | | | | 446 | 384 | 305 | 309 | |
| A47-26 W 110° 45 % | 6,3 0,3 | $V_{a,g3,g5} \ V_{g4} \ V_{g2} \ -V_{GR}$ | = 20 kV = 0-400 V = 400 V | 446 | 384 | 305 | 309 | @a,93,95 |
| A59-15 W 110 ^o 45 % | | -VGR VKR | = 40 to 77 V = 36 to 66 V | 566 | 489 | 385 | 367 | |
| A59-23 W 110° 45 % | | | | 566 | 489 | 385 | 367 | |
| A63-11 X 90° 52,5% | | Replacen | nent type A6 | 3-120X | | | | |

INDEX OF TYPE NUMBERS

| Type number | Section | Type number | Section |
|-------------|---------|-------------|---------|
| A31-410W | BW | A56-410X | С |
| A31-510W | BW | A61-120W | BW |
| A34-510W | BW | A61-520W | BW |
| A44-120W | BW | A63-120X | С |
| A44-510W | BW | A66-120X | С |
| A44-520W | BW | A66-140X | С |
| A50-120W | BW | A66-410X | C |
| A50-520W | BW | | |
| A56-120X | C | | |
| A56-140X | C | | |

BW = Black and white TV picture tubes
C = Colour TV picture tubes

| PORTOGRAPA PORTOG | General section |
|--|----------------------------------|
| DESCRIPTION OF THE PROPERTY OF | Colour TV picture tubes |
| TOTAL CONTROL OF THE PARTY OF T | Black and white TV picture tubes |
| ESCHOOLS STATE OF THE STATE OF | Index; Maintenance type list |

