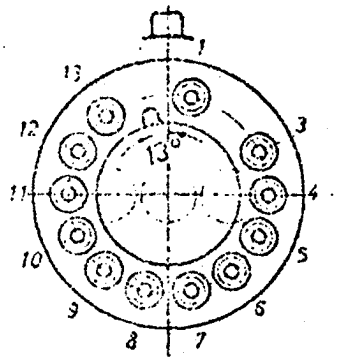
COLOUR PICTURE TUBE
HELIOCHROM

with integrated neck components
semitoroid

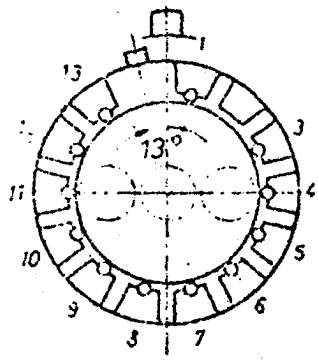
A51-210X
A51-211X
20"
preliminary

A51-210X



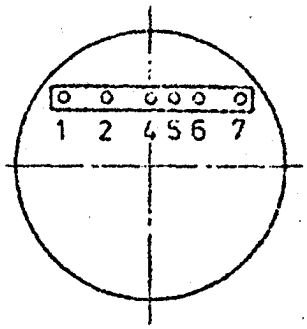
Tube base
JEDEC B 12-262

A51-211X



Tube base
JEDEC B 12-260

Deflection yoke



1 Grid No. 3
3 Blue cathode
6 Heater
7 Heater
8 Red cathode
9 Grid No. 1
10 Grid No. 2
12 Green cathode
Grid No. 4, Grid No. 5
Anode and slotted mask

Unused pegs must not be connected

1 N.C.
2 Horiz. coil
4 Horiz. coil
5 Vert. coil
6 Vert. coil
7 N.C.

Tube

51 cm (20") screen diagonal
90° deflection angle
Extremely rectangular
Sides approx. 30 x 40 cm
Screen area approx. 1190 cm^2
Neck diameter 29 mm
Quick heating cathode
No convergence correction necessary
Neck components optimally adjusted - solidly mounted
Slotted mask; striped screen
Inline gun
Internal magnetic shielding (supplemented by external degaussing)
Faceplate filter glass, light transmission approx. 70 %
Heliochrom offers a higher brightness at same contrast ratio.
Implosion protected (tension band)
Push-through presentation
Weight approx. 12,3 kg

Deflection yoke

Toroidal winding vertical and saddle winding horizontal
The deflection yoke is adjusted and set during manufacture for optimum dynamic convergence, colour and white purity.

Multi-pole unit

A permanently magnetised ring pair for colour purity.
Two permanently magnetised ring pairs for static convergence.

The multi-pole unit is adjusted during manufacture for optimum colour and white purity and for static convergence.

Maximum Ratings

Heater voltage	U_f	Optimum cathode life time is achieved by stabilization of the heater voltage at 6.3 V. Continued over or under heating by 0.2 V is harmless. The absolute maximum rating is ± 10 %, but may only be applied for short periods whereby the long-term average value should be ± 0.2 V.	
Anode voltage	$U_{a\ max.}$		27.5 kV (abs. value)
	$U_{a\ min.}$		20 kV
Anode current	$I_{a\ max.}$		1.0 mA
Focusing voltage	$U_{g3\ max}$		6 kV
Screen grid voltage	$U_{g2\ p\ max}$		1 kV
Peak voltage between cathode and grid No. 1	$(-U_k)_{p\ max}$		2 V
	$U_{k\ p\ max}$		400 V
Voltage between cathode and grid No. 1	$(-U_k)_{max}$		0 V
	$U_{k\ max}$		200 V
Peak voltage between cathode and heater	$U_{-fk\ p\ max}$		200 V
	$U_{+fk\ p\ max}$		200 V
Voltage between cathode and heater	$U_{-fk\ max}$		450 V*
	$U_{-fk\ max}$		200 V
	$U_{+fk\ max}$		0 V
		* During warm-up period of max. 15 sec. the voltage between cathode and heater may increase to max. 450 V. Between 15 and 45 seconds after switch-on the voltage must decrease proportionally with time to max. 200 V	
Shock acceleration during transport and handling	max.		350 m/s^2

Typical operating conditions

Unless otherwise stated, the following conditions apply:

1. Heater voltage U_f = 6.3 V
2. All voltages are referenced to grid No. 1
3. Voltage of grid No. 2 is equal to that of the measured grid No. 2 cutoff voltage.
4. Voltage of grid No. 3 is set for optimum sharpness of definition.
5. The colour coordinates for white are: x = 0,313; y = 0,329

Criterion	Value	Maximum rating
Heating current	U_f = 6.3 V	appr. 0.680 A
Heater-cathode leakage current	Grid Nos. 1, 2 and 3 connected to the cathode measured, and set at + 300 V above heater voltage U_a = 0 V	max. 90 µA
Heating time	U_f = 6.3 V. Internal resistance of power source <0,1Ω (constant power soucre with current limitation >6 A). The time measured is that between switch-on of heater and appearance of a clean recognizable picture (cross-hatch or colour bars), which does not need to be focused. All other settings of the picture tube meet the application in the TV-set at central position of regulators for contrast and brightness.	max. 6 s
Anode leakage current	$(-U_{g1})$ = 150 V; U_a = 27.5 kV	max. 45 µA
Grid No. 3 leakage current	$(-U_{g1})$ = 150 V; U_a = 27.5 kV	± 15 µA
Grid No. 2 leakage current	$(-U_{g1})$ = 450 V; U_a = 27.5 kV U_{g2} = 1000 V	± 5 µA
Grid No. 1 leakage	$(-U_{g1})$ = 150 V; U_a = 27.5 kV	± 5 µA

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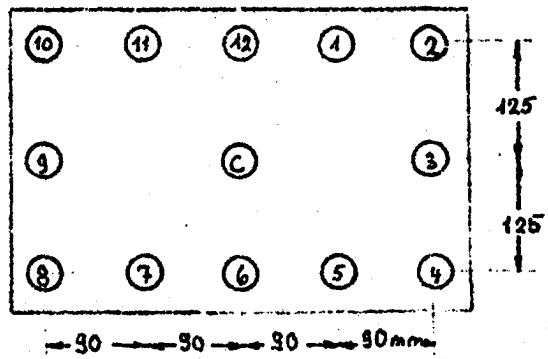
Flashovers	$(-U_{g1}) = 150$ V; $U_{g2} = 0$ V $U_{g3} = 6$ kV; $U_k = 0$ V $U_a = 27.5$ kV	max. 2 in 1 min max. 5 in 15 min with no pile up
Stray emission	Horizontal and vertical deflection switched on or horizontal deflection only switched on. $(-U_{g1}) = 150$ V; $U_{g2} = 0$ V $U_{g3} = 6$ kV; $U_a = 27.5$ kV	no visible brightening
Focusing voltage	$(-U_{g1}) = 100$ V; $U_a = 25$ kV $I_{a\,p} = 1000$ µA Test picture = grid pattern	4.2...5.0 kV or 16.8...20 % of final accelerator voltage
Focusing voltage difference RGB	Setting as for focusing voltage white, however, U_{g3} is adjusted for the best overall sharpness for each colour, and the diffence between the max. and min. voltages for the three colours must be determined.	max. 300 V
Grid No. 2 cutoff voltage	$(-U_{g1}) = 100$ V; $U_a = 25$ kV With only horizontal deflection connected (U_k of the system under test at 0 V, the other two cathodes at 200 V). U_{g2} should be adjusted so that the horizontal line is still just visible.	153...380 V
Cathode cutoff quotient	$U_a = 25$ kV; with only horizontal deflection connected, the three cathodes set at a higher voltage (max 200 V) than grid No. 1; then U_{g2} is adjusted so that the horizontal line of one colour (red, green or blue) is still just visible; then reduce the voltage of the other two cathodes until the corresponding lines just become visible. Finally, the quotient between the max. and min. cathode voltages (all three colours) must be determined.	max. 1.50

Maximum cathode current (emission)	Adjustment as with grid No.2 cutoff voltage, but with $(-U_{g1}) = 100$ V. Connect vertical deflection, then connect grid No.1 to the test cathode for a maximum of 10 sec. and measure the cathode current.	min. 2.1 mA
Grid No. 1 capacitance	Between grid No. 1 and all other electrodes	appr. 15 pF
Cathode capacitance	From each cathode to all other electrodes	appr. 5 pF
Grid No. 3 capacitance	Between grid No. 3 and all other electrodes	appr. 6 pF
Anode capacitance	Between anode and external conductive coating	1500...2300 pF
Tension band capacitance	Between anode and tension band	appr. 250 pF
Resistance of external conductive coating	Resistance between two points 50 mm apart; measured with curved surface contacts (r=5mm)	max. 2 KΩ
Resistance of tension band-external conductive coating		min. 50 MΩ
Voltage stability tension band-external conductive coating		min. 5 kV
X-rays	$U_a = 27.5$ kV; $I_k = 1$ mA dosage measured at a distance of 50 mm from the glass surface	max. 36 pA/kg (0.5 mR/h)
Diagonal deflection angle		appr. 90°
Horizontal deflection angle		appr. 78°
Vertical deflection angle		appr. 60°
Convergence error	$U_a = 25$ kV; $I_{k\,p} = 700$ µA white Test picture = grid pattern	

Measuring points:



Measured: The horizontal and vertical distance between the centres of two related different coloured grid lines. Centre determined as the brigtest point within the line width.

Measuring point: screen centre	Red - green - blue	max. 0.4 mm
Measuring points: 3; 6; 9; 12	Red - green Blue - red or green	max. 1.0 mm max. 1.3 mm
Measuring points: 2; 4; 8; 10	Red - green Blue - red or green	max. 1.5 mm max. 1.8 mm
Measuring points: 1; 5; 7; 11	Red - green Blue - red or green	max. 1.4 mm max. 1.5 mm
Raster twisting	Angle between electronically traced horizontal axis and mechanical axis	max. 1° (corresp. 3.5 mm at screen edge)
Raster shift	U_a = 25 kV, horizontal and vertical deflection disconnected; I_k is adjusted to give a light spot that is still just visible, and the horizontal and vertical deflection of the spot measured from the mechanical screen centre	horizontal max. 6.35 mm vertical max. 6.35 mm
White uniformity	U_a = 25 kV, test picture = white raster with appr. 5 cd; viewing distance 2 m	no conspicuous discolouring of white visible
Colour purity	Connection as for white uniformity, but in each case only one colour switched on; viewing distance 2 m	no extraneous colour visible with the naked eye

Screen

Light transmission		appr. 70 %
Colour		neutral
Surface		polished
Mutual distance between stripe centres at centre of screen		appr. 0.82 mm
Colour coordinates	Red x = 0.63 y = 0.34 Green x = 0.30 y = 0.60 Blue x = 0.15 y = 0.06	
Ratio of cathode currents for white (x = 0.318; y = 0.329)	Red to blue Red to green	1.15...2.05 0.95...1.70
Typical total cathode current to produce white (x = 0.313; y = 0.329)		Red 41 % Green 33 % Blue 26 %
Phosphorescent persistence		medium-short

Dot-shaped screen and glass faults

Zone A refers to the central field of 213 x 165 mm.

Zone B refers to the remain screen area.

Observation of the fault through grey filters with densities of 0.7 and 1.3 from a distance of min. 60 cm.

High contrast:

The visibility of the fault is maintained between change from 0.7 to 1.3 filter.

Medium contrast:

The fault disappears between change from o.7 to 1.3 filter.

For non-circular faults, the equivalent fault size is: Length plus width divided by two

Missing or non-illuminating phosphor dots are evaluated as for dot-shaped faults.

Permissible are:	Faults with high contrast			Faults with high and medium contrast		
Fault size in mm	Max. in zone A	Max. in zones A + B	Min.dist. between 2 faults	Max. in zone A	Max. in zones A + B	Min. dist. between 2 faults
> 3.2	0	0		0	0	
1.8...3.2	0	0		1	2	50 mm
1.3...1.8	0	1		2	3	25 mm
0.5...1.3	2	2	50 mm	4	6	5 faults in periphery of 50 mm
0.3...0.5	4	8	6 faults in periphery of 50 mm	as for faults < 0.3		

< 0.3 Any quantity of faults permissible so long as no conspicuous clouding or discolouring is visible from a distance of 1 m.

Glass scratches

Permissible are	Width mm	Length mm	Min. distance between 2 scratches mm
	< 0.05	unlimited	
	0.05...0.10	50	19
	0.10...0.15	13	45

The sum of the lengths of all scratches with widths from 0.05 to 0.15 mm is max. 180 mm.

General

For stand-by heating, a heater voltage of 4,5 to 5 V is recommended .

To reduce the possibility of damage to the tube or circuit by internal high voltage flashovers, spark gaps should be used and the connection with the external conductive coating should be made using the shortest possible leads.

The connection to the external conductive coating should be made over a large surface area.

In order to conserve the optimal factory adjustments of the colour purity and convergence, it is necessary to degauss the tube completly.*

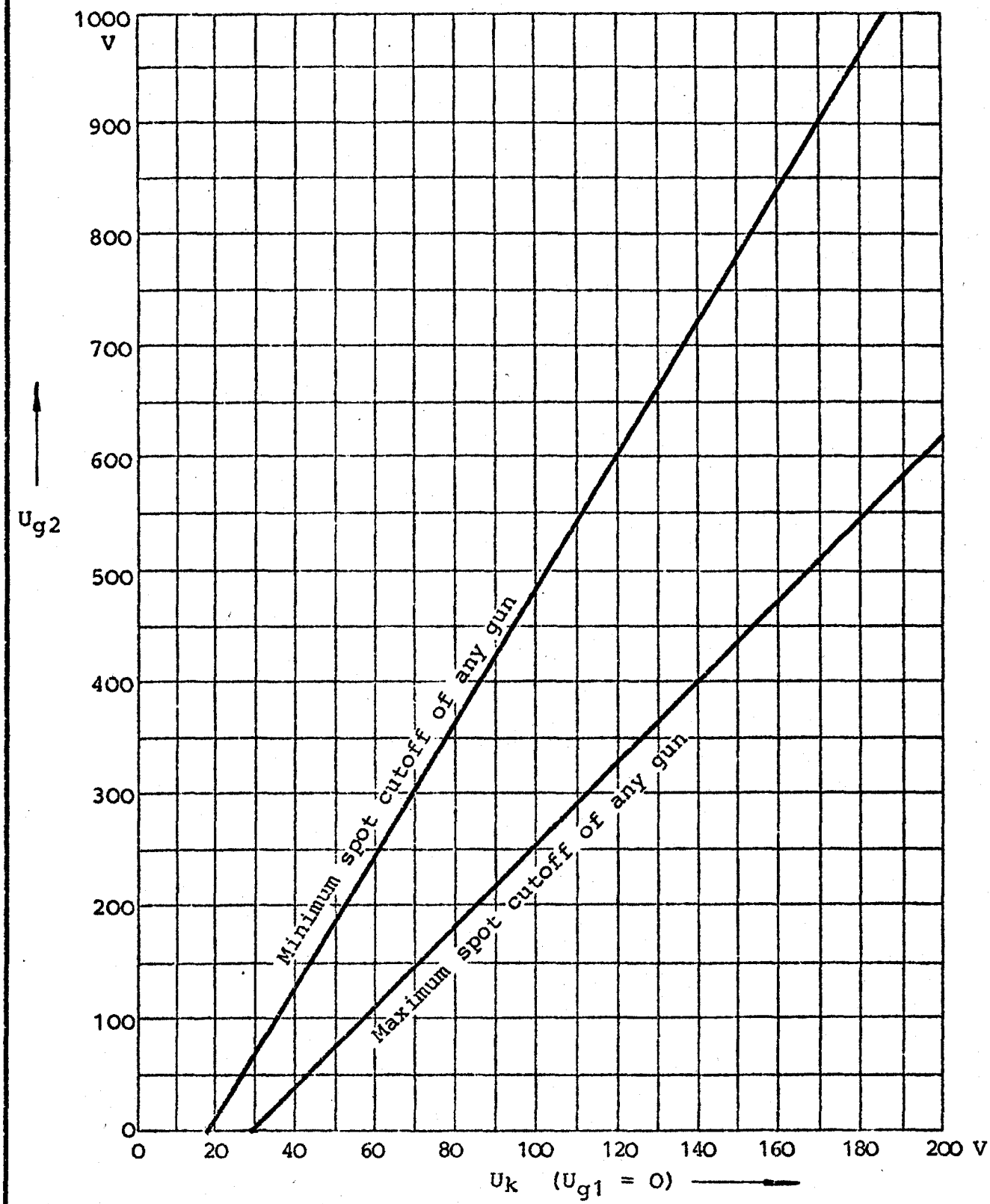
During transport and handling of the tube, the neck components must not be mechanically strained. Even slight changes of positioning or adjustments, also deformation of the coils, can have a large effect on colour purity and convergence.

*Recommendation for degaussing in separate description.

CUTOFF-DESIGN-CHART

U_{g4g5a} = 21...25 kV

U_{g3} adjusted for optimum focus



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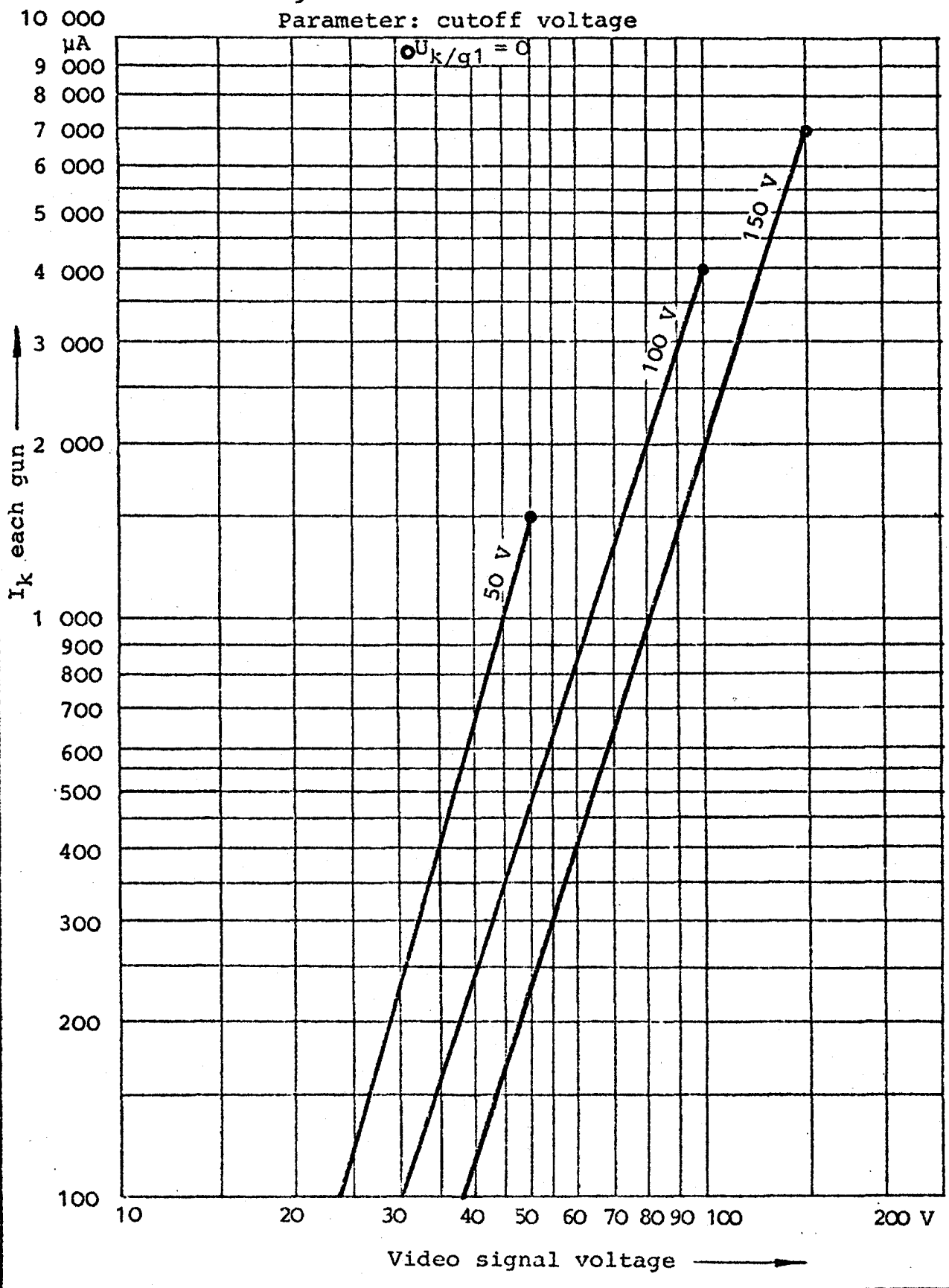
CATHODE-DRIVE-CHARACTERISTICS

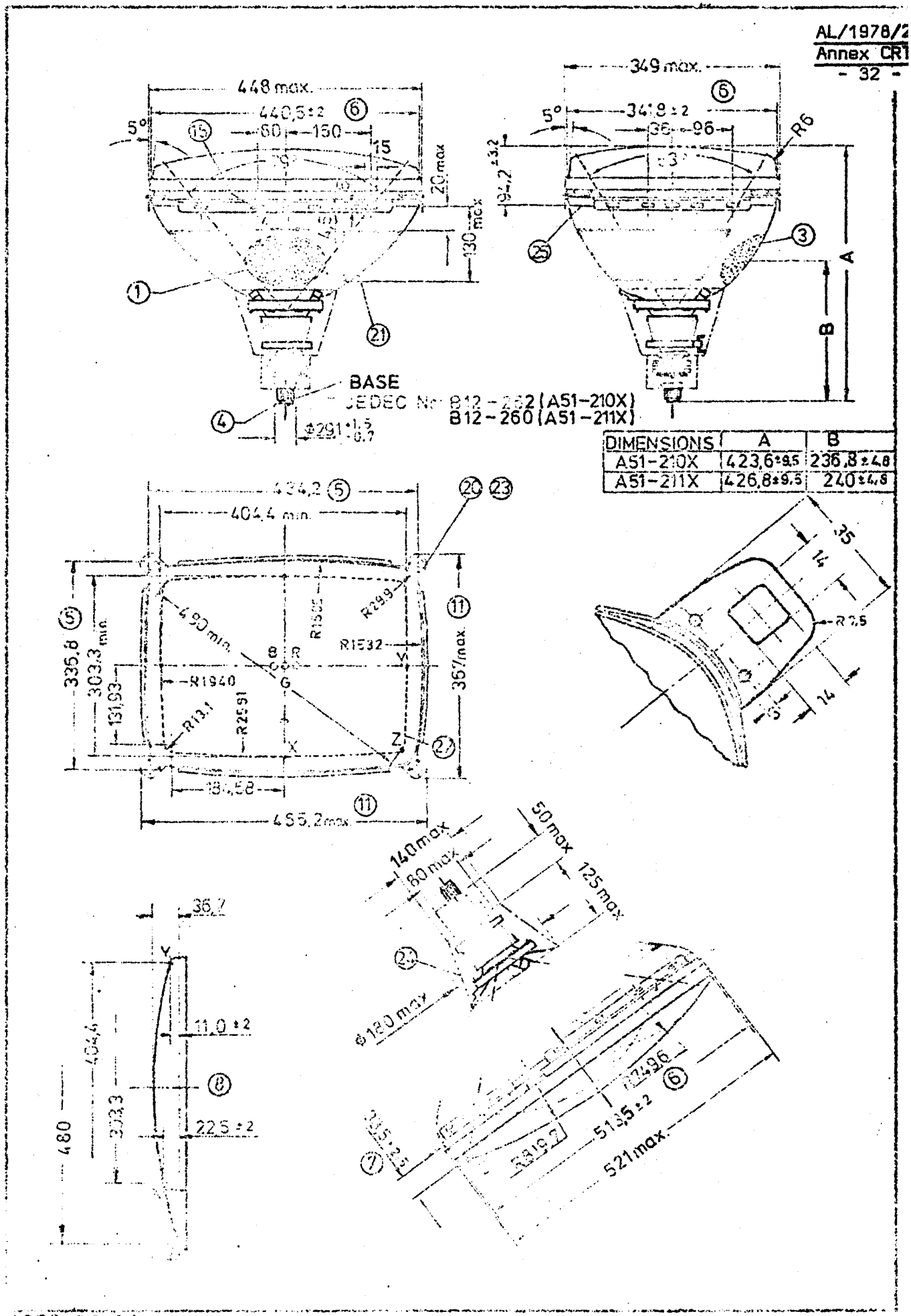
U_f = 6.3 V

U_{g4g5a} = 25 kV

U_{g3} adjusted for optimum focus

Parameter: cutoff voltage





DIMENSIONS	A	B
A51-210X	423,6±9,5	236,8±4,8
A51-211X	426,8±9,5	240±4,8

Notes (dimensional drawing)

1. Anode cavity 7.92 according to the German Industrial Standard DIN 41543 (JEDEC No. J 1 - 21)

3. This area is free of external conductive coating and must be kept clean.

4. The tube base will fall within a tolerance circle of max. 55 mm diameter, with respect to the tube axis. The socket should not be rigidly mounted but must be connected by flexible leads.

5. Nominal dimensions of the mounting bolts. For the bolts a free passage of at least 8.5 mm diameter is guaranteed in normal mounting position.

6. Dimensions of the bulb, measured at the front edge of the implosion protection.

7. The maximum deviation between one screenside angle-seating and a plane through the other three angle-seatings will not exceed 2 mm.

8. The Z points are reference points for the vertical position of the X and Y points. The dimensions for the position of the X, Y and Z points also apply to the border line of the minimum useful screen area.

11. The outer limitation of the mounting lugs lies within these maximal dimensions.

15. Mounting holes for degaussing coils.

20. Tension band and external coating are galvanically separated from each other. They may be connected mutually if it is allowed by the effective safety rules. The impedance between tension band and the external coating must not exceed 1 MΩ at 50 Hz and 5 kΩ at 15 kHz.

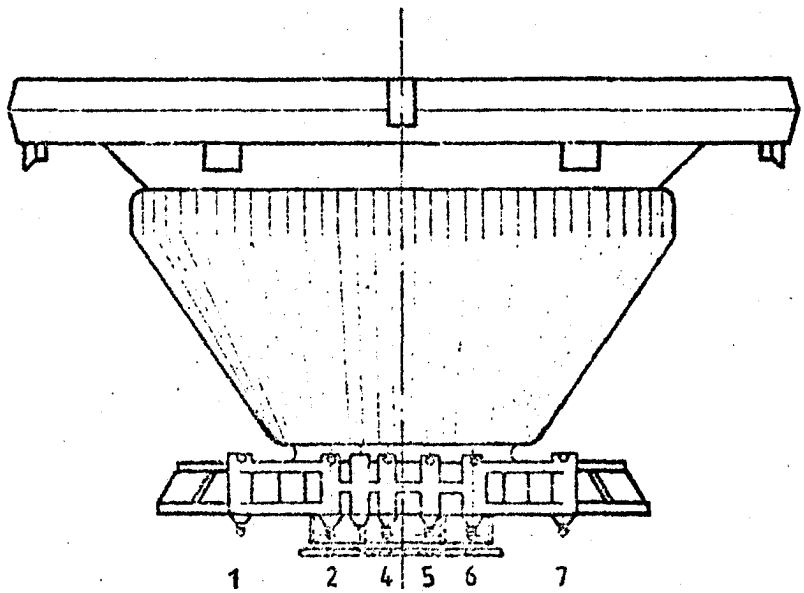
21 The external conductive coating of the tube must be connected with the negative high voltage terminal.

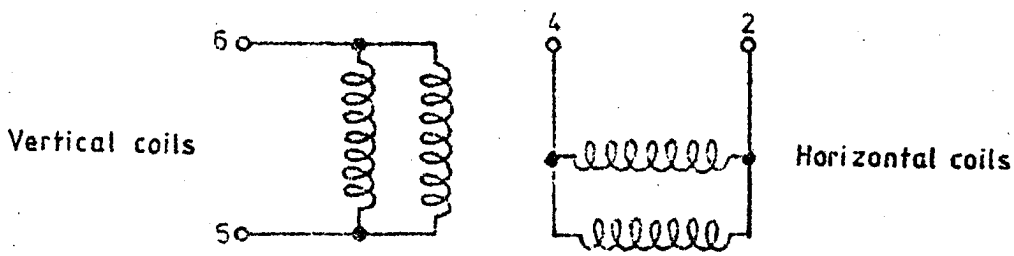
22. Minimum useful screen area.

23. Bare metal on all sides.

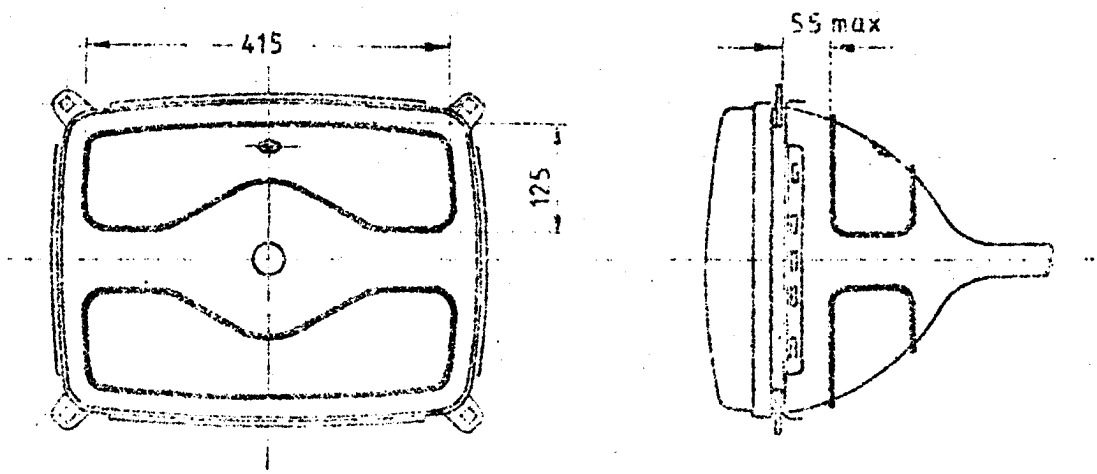
24. This space is to be kept free of other magnetic material in order to reduce negative effects on the tube properties (convergence, incorrect beam landing).

25. Frit seal.





Deflection yoke



Placement of degaussing coils

Colour deflection yoke

Horizontal deflection coils:

Inductance	at 1 V and 1 kHz	1.63 mH ± 4 %
Resistance	at 20°C = 293 K	1.73 Ω ± 10 %
Deflection current peak to peak	at 25 kV and 102 % picture width	3.5 A

Vertical deflection coils:

Inductance	at 1 V and 1 kHz	30.0 mH ± 10 %
Resistance	at 20°C = 293 K	15.0 Ω ± 10 %
Deflection current peak to peak	at 25 kV and 102 % picture width	0.9 A

Limiting Values:

Horizontal deflection coils	Peak pulse voltage across horizontal coils at 15.750 Hz for pulse duration of 12 µsec	max. 1.4 kV
Vertical deflection coils	Peak pulse voltage across vertical coils at 50 Hz for pulse duration of 0.7 msec	max. 200 V
	Peak pulse voltage inclusive DC component between horizontal and vertical coils	max. 1.4 kV