DATA SHEET

M41EHN30WB20/02

17" high resolution triple gun monochrome monitor tube assembly

Product specification

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Professional Display Systems B.V.

17" high resolution triple gun monochrome monitor tube assembly

M41EHN30WB20/02

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17" high resolution triple gun monochrome monitor tube assembly

M41EHN30WB20/02

1 HIGHLIGHTS

1.1 Features

1.1.1 HIGH PERFORMANCE DESIGN

- High resolution; higher pixel density possible up to 1280 × 1024 pixels (non-interlaced) displayable conform ISO 9241 by:
  - high resolution DAF gun
- High brightness and contrast
- Excellent white uniformity
- Accurate convergence and raster geometry:
  - double mussel coil technology
  - internal magnetostatic beam alignment
- Application friendly design:
  - worldwide useable design
  - East-West correction max. 10.0%
  - deflection units designed for minimal ringing
  - static convergence adjustment on monitor level: multipole for 4 and 6 pole correction
  - dynamic convergence adjustment on monitor level: horizontal balance coil; vertical balance potentiometer
  - rotation coil for adjustment of axial magnetic fields

1.1.2 ERGONOMIC DESIGN

- Less ambient reflection:
  - 'flat' and 'square' design
  - AGAS (Anti Glare Anti Static) coating
- Less eye strain:
  - P45 medium/short persistence phosphor
  - high frequency yokes
- Green design:
  - CFC-free production process
  - Cd-free phosphor
  - 0.65 W power saving cathode
- Fulfilling electric/magnetic radiation standards
- Safety approved:
  - VDE; CSA; UL.

1.1.3 OPTIMUM DISPLAY SOLUTION

- High-end PC applications
- Workstation applications
- Resolution standards up to 1280 × 1024 pixels non-interlaced application.

1.2 Quick reference data

PARAMETER	TYP.	UNIT
Deflection angle	90	deg
Face diagonal	444	mm
Overall length	<388	mm
Neck diameter	29.4	mm
Glass transmission	43	%
Colour coordinates		
x	244	
y	309	
Heater voltage	6.1	V
Anode voltage	26	kV
Focus voltage	27.5% of anode voltage	

1.3 Deflection coil data

Deflection coil is mounted with dynamic convergence correction coils (PECOMA).

PARAMETER	VALUE	UNIT
Horizontal coil inductance	0.101	mH
Vertical coil inductance	6.27	mH
Maximum advised frequency	95	kHz

1.4 Ordering information

TYPE NUMBER	SCREEN FINISH
M41EHN30WB20/02	AGAS

2 PERFORMANCE SPECIFICATION

2.1 Colour coordinates

PHOSPHOR DATA	COLOUR COORDINATES	
	x	y
Phosphor type: P45 (N 1045) $I_{a(av)}$ = 300 μA (per gun) V_a = 26 kV Scanned duty cycle = 75% Scanned area = 312 × 234 mm Screen finish AGAS Spot size 5%	244±10	309±15

2.2 Brightness uniformity

Brightness uniformity between centre and corners: > 85%; < 110%.

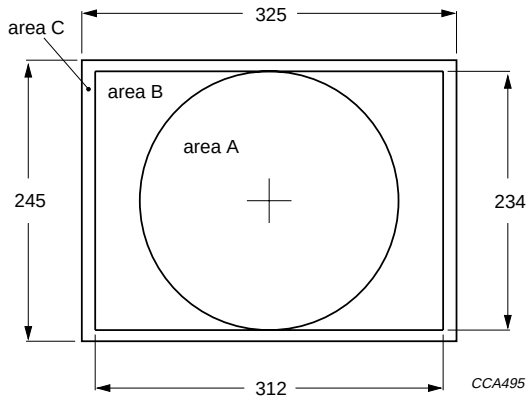
2.3 Convergence specification

2.3.1 TEST CONDITIONS

1. Set-up in accordance with Section 4.1.
2. Measure maximum misconvergence after 30 minutes operation.
3. To be adjusted for focus at $^2/_3$ centre-corner using crosshatch pattern at anode current is 300 μA (peak value) per gun.
4. Misconvergence is the distance between the centres of the red, green and blue guns at the screen using a crosshatch pattern.
5. Anode and/or focusing voltage and terrestrial magnetism may slightly affect the static convergence. Therefore, small re-adjustments to static convergence may be necessary.
6. Avoid stray magnetic fields etc. due to chassis influences which may affect convergence.

2.3.2 CONVERGENCE LIMITS

LOCATION (see Fig.1)	TYPE OF ERROR	MAXIMUM ERROR BETWEEN GUN SPOTS	
		STANDARD	WITH PECOMA
Centre	red-green-blue gun line separation in either the horizontal or vertical direction	0.30 mm	0.2 mm
Area A/corner		0.50 mm	0.2 mm



Dimensions in mm.

Fig.1 Maximum misconvergence.

2.4 Resolution specification

With the settings given in Section 4.1, the displayed characters will be recognisable as individual $ characters on a data raster measuring 325 mm × 234 mm.

ANODE CURRENT	SPOT SIZE CENTRE (NOMINAL)		SPOT SIZE CORNER (NOMINAL)		UNIT
	X	Y	X	Y	
100 µA	0.5	0.5	0.8	0.4	mm
200 µA	0.5	0.5	0.8	0.4	mm
400 µA	0.6	0.6	1.0	0.5	mm

2.5 Raster geometry

2.5.1 RASTER CENTRING

CENTRING	MAX.	UNIT
Horizontal	±5.0	mm
Vertical	±5.0	mm

2.5.2 RASTER ORTHOGONALITY

Orthogonality of the horizontal/vertical scan axis is ±0.5°.

2.5.3 RASTER ROTATION

Measure the angle of the horizontal green scanning line with reference to a horizontal centre line that is drawn parallel to the tube reference points A1 and A2, see Fig.2. Chassis influences may affect raster rotation.

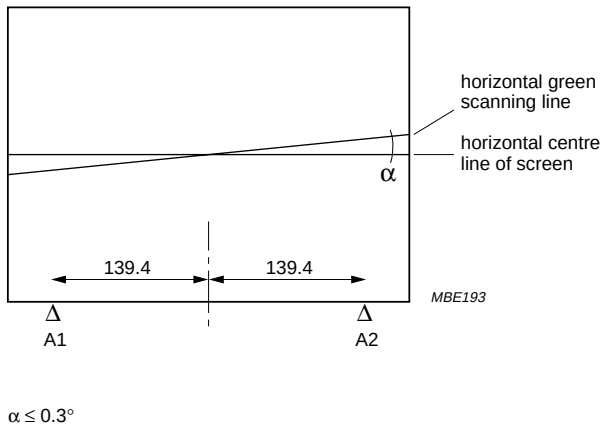
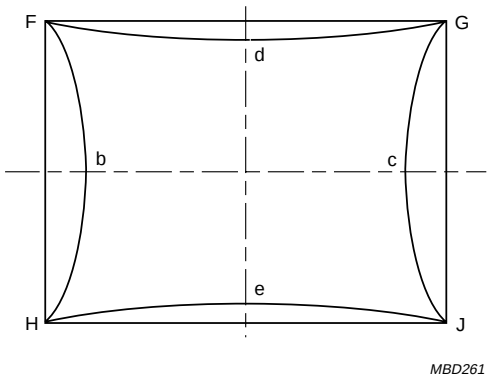


Fig.2 Rotation measurement.

2.5.4 PIN¬CUSHION DISTORTION



FG = HJ = 312 mm.
FH = GJ = 234 mm.
Measured with no pin-cushion correction applied, with ‘b’, ‘c’, ‘d’ and ‘e’ measured along the main axis.

Fig.3 Pin-cushion distortion.

2.5.5 DISTORTION NORTH - SOUTH

The following formulae define the pin¬cushion distortion in the north and south directions.

$$\text{North} = \frac{4d}{FH + GJ} \times 100\% = 0\% \text{ to } +0.8\%$$

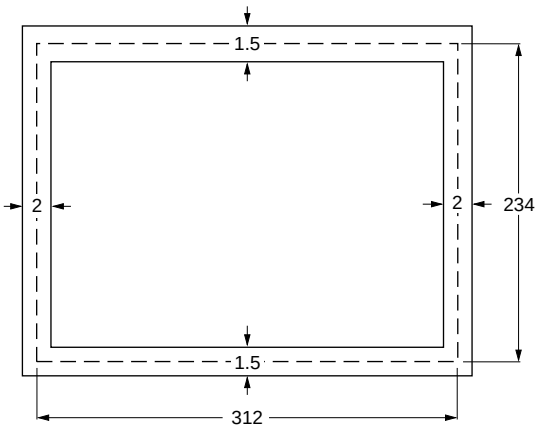
$$\text{South} = \frac{4e}{FH + GJ} \times 100\% = 0\% \text{ to } +0.8\%$$

2.5.6 DISTORTION EAST - WEST

The following formulae define the pin-cushion distortion in the east and west directions.

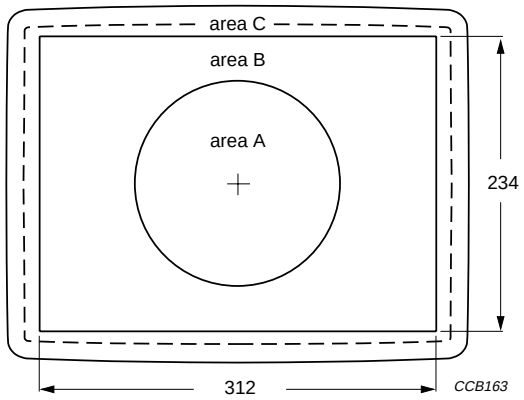
$$\text{East} = \frac{4b}{FG + HJ} \times 100\% \leq 8\%$$

$$\text{West} = \frac{4c}{FG + HJ} \times 100\% \leq 8\%$$



Dimensions in mm.

Fig.4 General distortion.



Dimensions in mm.

Fig.5 Screen areas.

2.6 Screen quality

2.6.1 GENERAL TEST PROCEDURE

Tests are to be done under the following general conditions:

- Viewing distance should be 50 cm minimum.
- For an activated screen the diffuse ambient light level at the centre of the screen should be between 2 and 5 lux.
- For an unactivated screen the diffuse ambient light level at the centre of the screen should be between 700 and 1000 lux.
- The viewing angle relative to the tube axis should not exceed 45°.
- Faults not visible under these general conditions are permitted.
- The following quality areas are specified (see Fig.5):
  - Area A: a circular area with a diameter of 165 mm, of which the centre coincides with the mechanical centre of the screen.
  - Area B: the area between the edge of area A and the rectangular area measuring 312 mm × 234 mm, of which the centre coincides with the mechanical centre of the screen.
  - Area C: the area between the edge of area B and the rimband.

2.6.2 ASSESSMENT OF THE GLASS AND THE UNACTIVATED SCREEN QUALITY

2.6.2.1 Definition of blemishes

Unless otherwise specified, the shape of a blemish is defined as round and elliptical.

The size of a blemish is given by:

- $\frac{L + W}{2}$; if L > 3W the size is given by $\frac{L}{20} + 2W$,

  where L = length and W = width.

2.6.2.2 Limits

Table 1 Limits of measurable glass blemishes

SIZE (mm)	MAX. NUMBER OF BLEMISHES IN AREAS		MIN. PERMISSIBLE DIST ANCE BETWEEN ANY 2 BLEMISHES (mm)	AREA C
	A	A + B		
>0.6	0	0	not applicable	only limits as regards tube safety
>0.4 to ≤0.6	1	2	50	
>0.2 to ≤0.4	2	5	50	
Total number	2	5	50	–
≤0.2	limited only by cloud			–

Table 2 Limits of measurable coating blemishes for AGAS coating

SIZE (mm)	MAX. NUMBER OF BLEMISHES IN AREA A+B	MIN. PERMISSIBLE DISTANCE BETWEEN ANY 2 BLEMISHES (mm)	AREA C
High contrast			
>1.5	0	not applicable	acceptable
>1.0 to ≤1.5	3	50	
>0.5 to ≤1.0	5	30	
≤0.50	no limits	no limits	
Low contrast			
>3.0	0	not applicable	acceptable
>1.0 to ≤3.0	5	30	
≤1.0	no limits	no limits	

Table 3 Limits of scratches

AREA	WIDTH (mm)	MAX. ALLOWABLE TOTAL LENGTH (mm)	MIN. SEPARATION (mm)
A+B	>0.15	0	not permitted
	>0.10 to ≤0.15	13	50
	>0.05 to ≤0.10	25	20
	≤0.05	no limits	not applicable
C	only as regards tube safety		

2.6.3 ASSESSMENT OF THE QUALITY OF THE ACTIVATED PHOSPHOR SCREEN

The assessment of the quality of the phosphor and matrix layer at area A should take place at typical operating conditions and a blanked raster. The current for each gun must be adjusted to a brightness of 200 cd/m^2.

2.6.3.1 Definition of blemishes

- A blemish is a fault which is clearly visible within 5 seconds.
- A defect, which looks visually as one blemish should be regarded as a single blemish.
- Unless otherwise specified, the shape of a blemish is defined as round and elliptical.

The size of a blemish is given by:

- $\frac{L+W}{2}$; if L > 3W the size is given by $\frac{L}{20} + 2W$,

  where L = length and W = width.

2.6.3.2 Limits

1. The distance between any two blemishes >0.2 mm should be >50 mm.
2. Maximum number of blemishes >0.2mm per screen is 9.
3. Blemishes ≤0.2 mm can be ignored, except for a concentration of such blemishes that have a diameter of more than 8 mm.

Table 4 Limits of blemishes

BLEMISH SIZE (mm)	MAXIMUM NUMBER OF BLEMISHES IN		
	AREA A	AREA B	AREA A + B
>0.6	0	0	0
>0.4 to ≤0.6	1	5	5
>0.2 to ≤0.4	4	6	9
≤0.2	limited only by cloud		

2.7 Coating performance

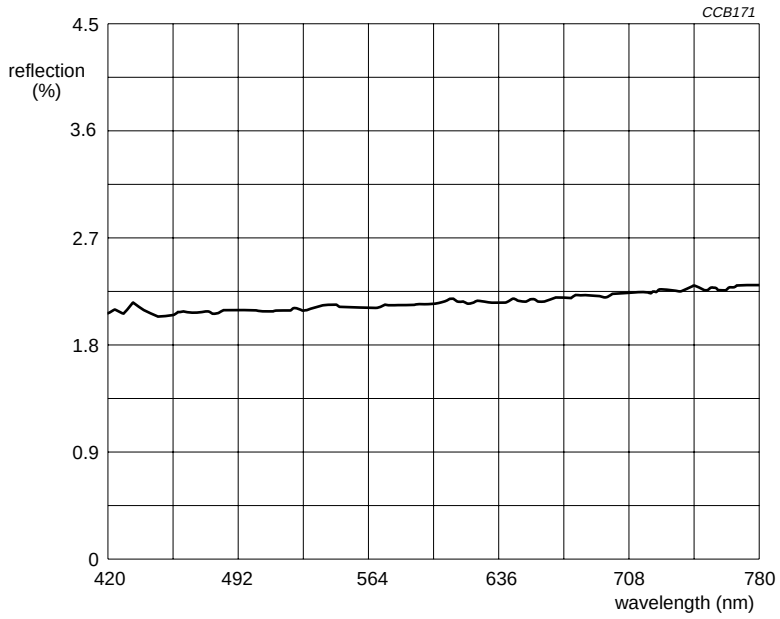


Fig.6 Relative reflection for AGAS.

3 PRODUCT CHARACTERISTICS

3.1 Electrical data

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
Capacitances					
$C_{a(m+m')}$	anode to external conductive cone coating, including rimband (with and without screen coating)	1000	1300	1600	pF
C_k	cathodes of all guns, connected in parallel, to all other electrodes	–	10	15	pF
C_{kR}, C_{kG}, C_{kB}	cathode of any gun to all other electrodes	–	4	–	pF
C_{g1}	grid 1 of any gun to all other electrodes	–	22	–	pF
C_{g2}	grid 2 to all other electrodes	–	17	–	pF
C_{g3a}	grid 3a (focus electrode) to all other electrodes	–	12	–	pF
C_{g3b}	grid 3b (dynamic focus electrode) to all other electrodes	–	10	–	pF
$C_{(g3a-g3b)}$	grid 3a to grid 3b	–	9	–	pF
Heater					
V_f	heater voltage	–	6.1	–	V
I_f	heater current	289	309	329	mA
t_{kwu}	cathode warm up time at 0-hour from 10% to 80% of end emission	–	–	8	s
Deflection unit					
V_{max}	maximum permissible DC voltage				
	between horizontal and vertical coils	–	–	2000	V
	between vertical coils and core	–	–	300	V
R_{ins}	insulation resistance at 1 kV (DC)				
	between horizontal and vertical coils	500	–	–	MΩ
	between horizontal coil and core clamping ring	500	–	–	MΩ
	between vertical coil and core clamping ring	10	–	–	MΩ
	crosstalk (1 V applied to the horizontal coils)	–	–	30	mV

3.2 Deflection unit data

All values are valid at T_{amb} = 25 °C and V_a = 26.0 kV; deflection units fulfil the MPRII and TCO magnetic requirements (see Section 5.1); the deflection coil is designed for a positive pulse on the horizontal coil.

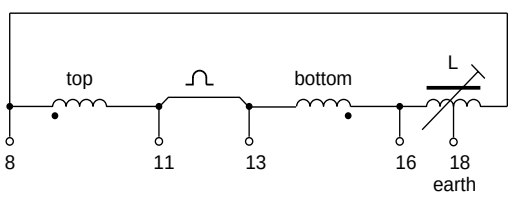
PARAMETER	VALUE	TOLERANCE	UNIT
Advised frequency; notes 1 and 2	95	–	kHz
Horizontal deflection coil			
Inductance	0.101	±4%	mH
Resistance	0.19	±10%	Ω
Current (peak-to-peak value)	13.5	±4%	A
Used wire	litz	–	
Vertical deflection coil			
Inductance	6.27	±4%	mH
Resistance	6.06	±7%	Ω
Current (peak-to-peak value)	1.81	±5%	A
Used wire	litz	–	

Notes

1. Advised maximum frequency depends on the internal maximum set temperature and used deflection-overscan.
2. No annoying ringing with 0% overscan.

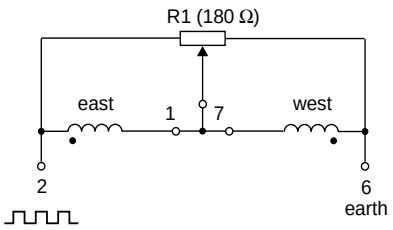
Rotation coil data

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Resistance	T_{amb} = 20 °C	50.9	56.6	62.3	Ω
Sensitivity	I = 75 mA; V_a = 26.0 kV	–	0.95	–	deg



The beginning of the windings is indicated with •

Fig.7 Horizontal coils.



The beginning of the windings is indicated with •

Fig.8 Vertical coils.

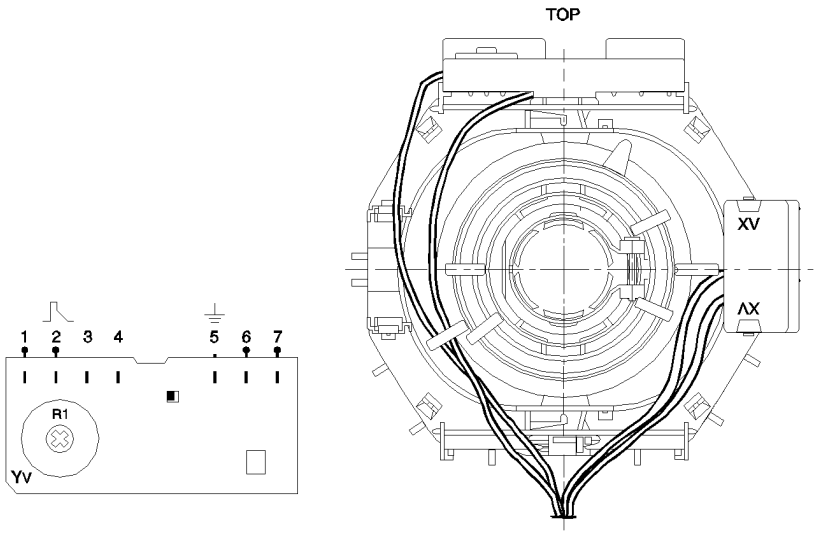
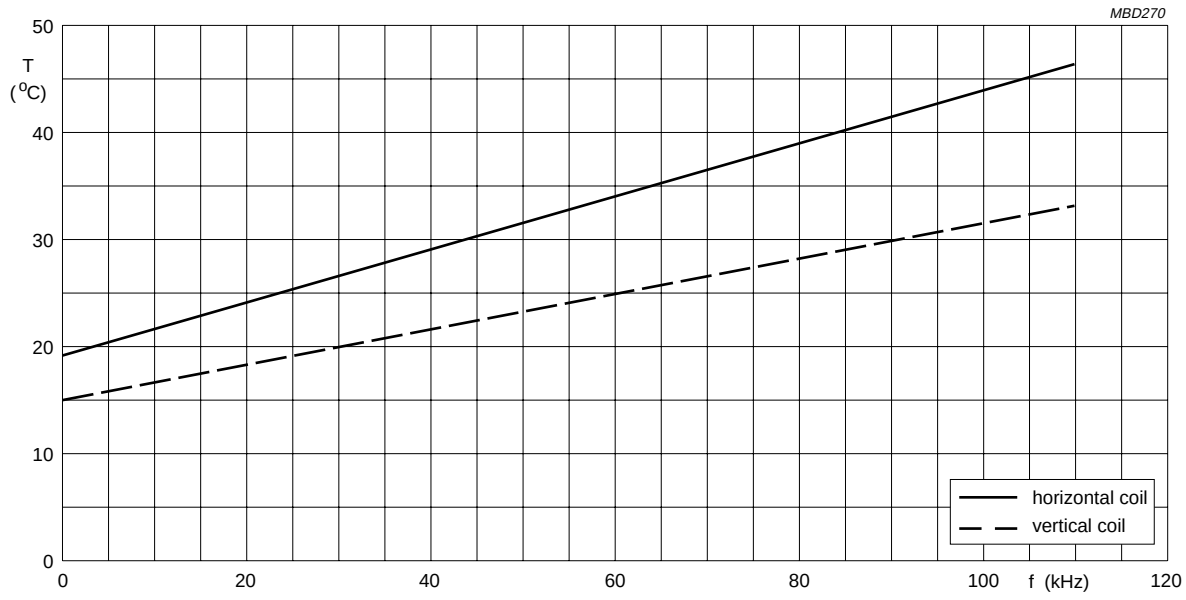


Fig.9 Deflection coil connections.

3.2.1 DEFLECTION UNIT TEMPERATURE

SYMBOL	PARAMETER	MAX.	UNIT
T_{copper}	average copper temperature of horizontal coil	110	°C
ΔT	maximum temperature rise of used wire	50	°C



Maximum operating copper temperature (resistance measurement) is 110 °C.

Fig.10 Temperature rise as a function of frequency.

3.3 Electro optical data

PARAMETER	VALUE
Electron gun system	three in-line integrated guns
Focus method	electrostatic
Focus lens	polygon and DAF
Convergence method	magnetic
Deflection method	self converging
Deflection angle	
diagonal	≈90°
horizontal	≈78°
vertical	≈60°

3.4 Screen properties

PARAMETER	VALUE
Screen finish	AGAS
Light transmission at screen centre	43%
Recommended active screen area	
horizontal axis	312 mm
vertical axis	234 mm

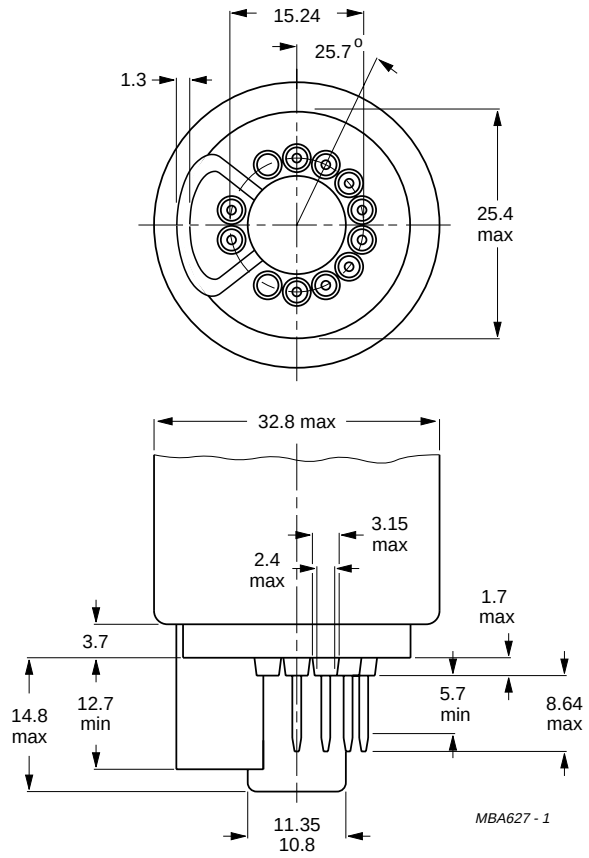
3.5 Coating properties

TYPE NUMBER	SCREEN FINISH	GLOSS
M41EHN30WB20/02	Anti Glare Anti Static (AGAS), tested in the centre	60 ±12%

3.6 Mechanical tube data

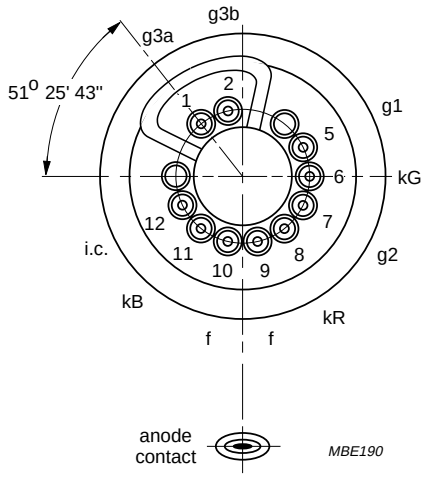
PARAMETER	VALUE
Overall length	383.5 ±4.5 mm
Neck diameter	29.4 +0.6/–0.4 mm
Maximum dimensions, excluding mounting lugs but including rimband	
diagonal	446.2 mm
width	387.9 mm
height	297.6 mm
Implosion protection	pre-stressed banded Mini-P shrunk-on rimband; CSA, UL and VDE approved
Anode contact	JEDEC J1-21; IEC 60067-III-2
Base designation	JEDEC B10-301
Base pin configuration	see Fig.12
Mass	≈10 kg
Mounting position	anode contact on top

3.7 Mechanical tube drawings



Dimensions in mm.

Fig.11 Base JEDEC B10-301.



i.c. = internally connected and not to be used.

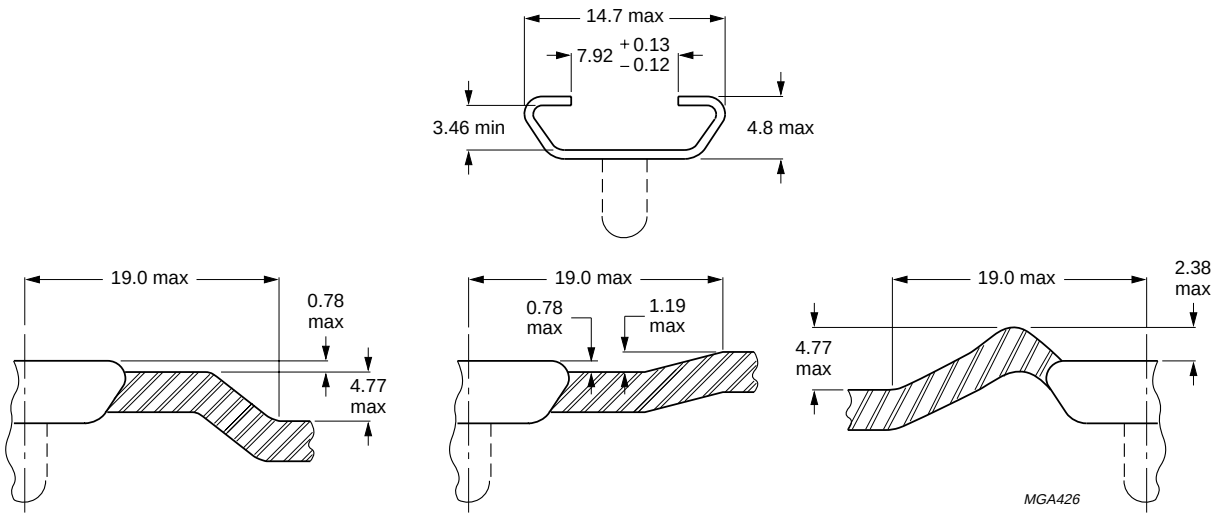
Fig.12 Pin arrangement.

Remarks: to Figs 11 and 12.

The socket for this base should not be rigidly mounted, it should have flexible leads and be allowed to move freely. After mounting the tube in the cabinet, note that the position of the base can fall within a circle, having a diameter of max. 40 mm concentric with an imaginary tube axis.

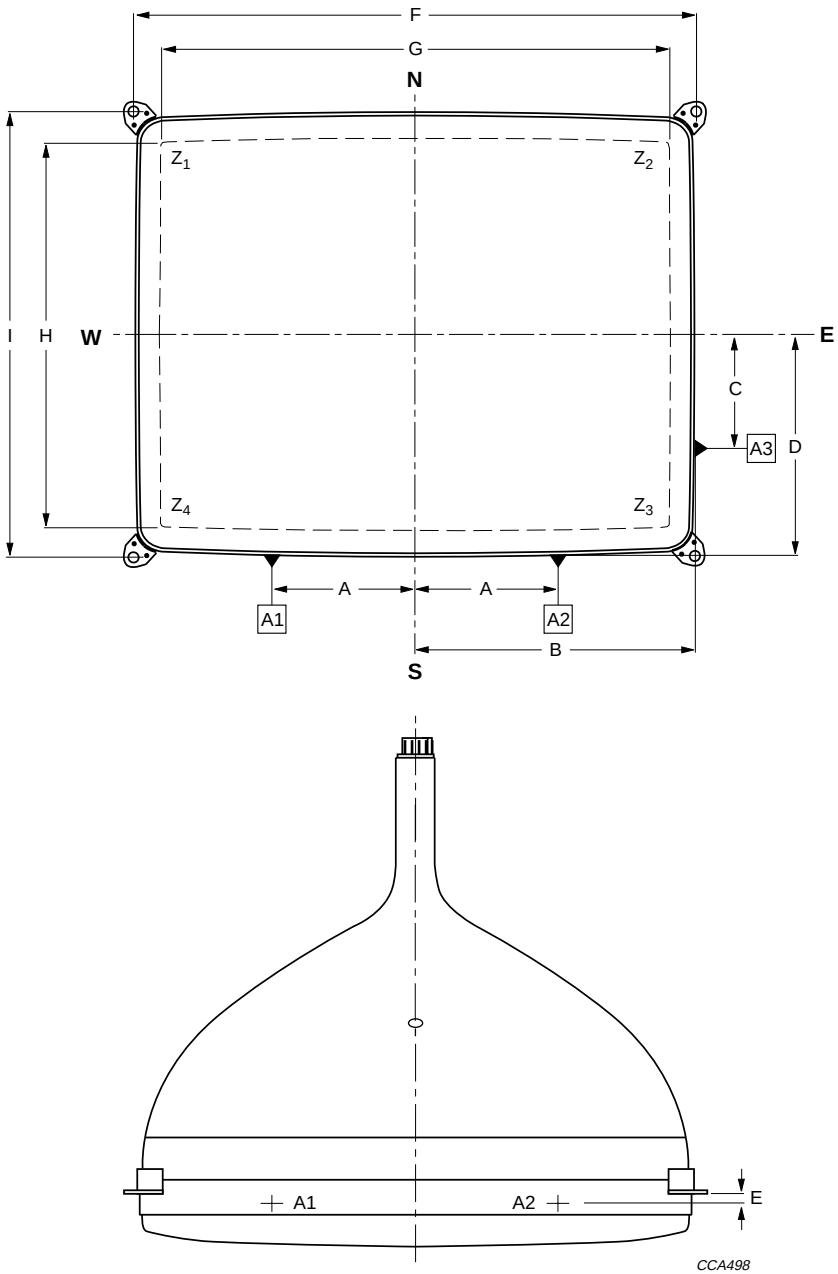
The mass of the mounting socket assembly should not exceed 450 g.

Maximum permissible torque on the tube neck is 0.14 Nm.



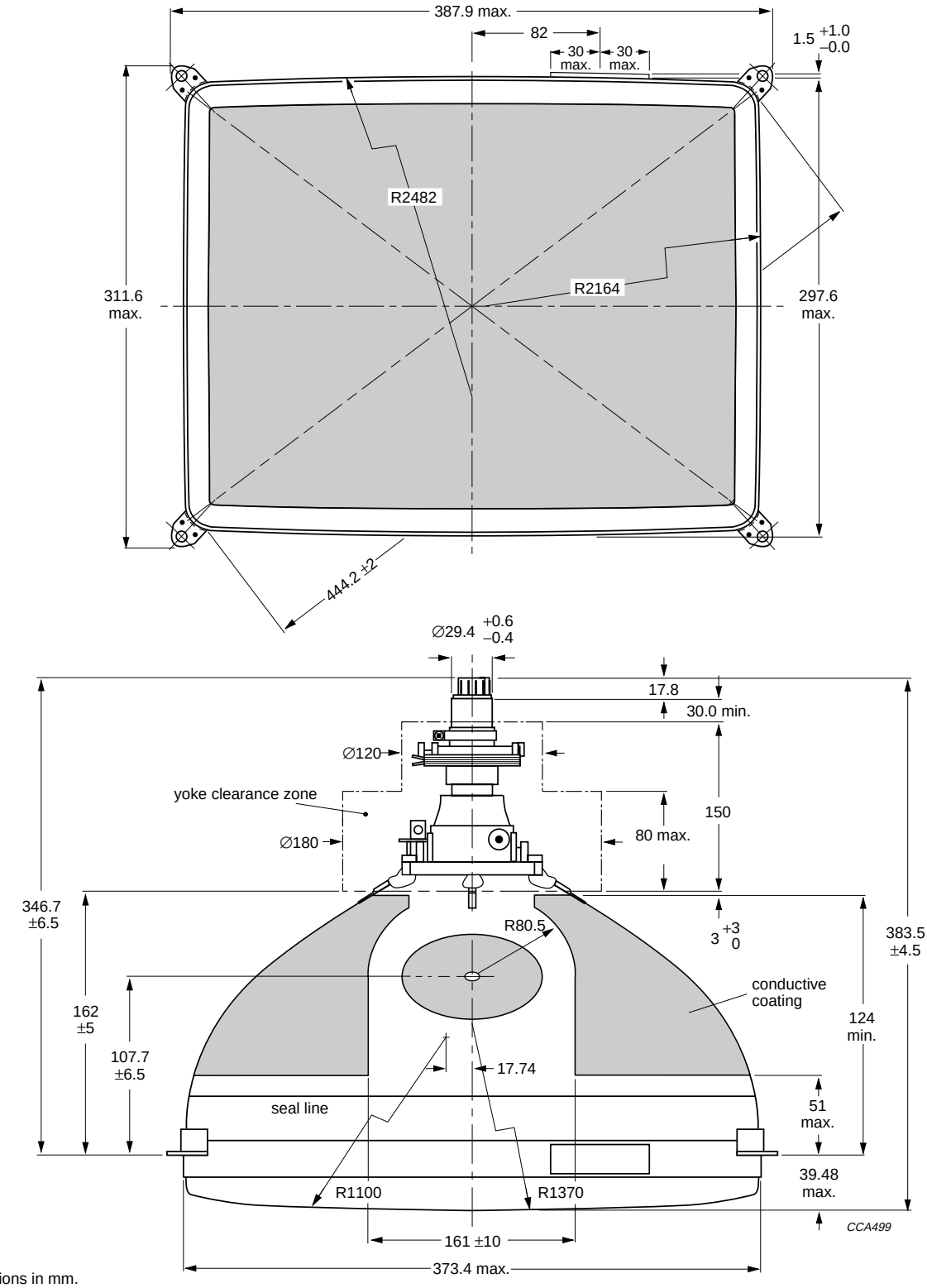
Dimensions in mm.

Fig.13 Cavity cap JEDEC J1-21, IEC60067-III-2.



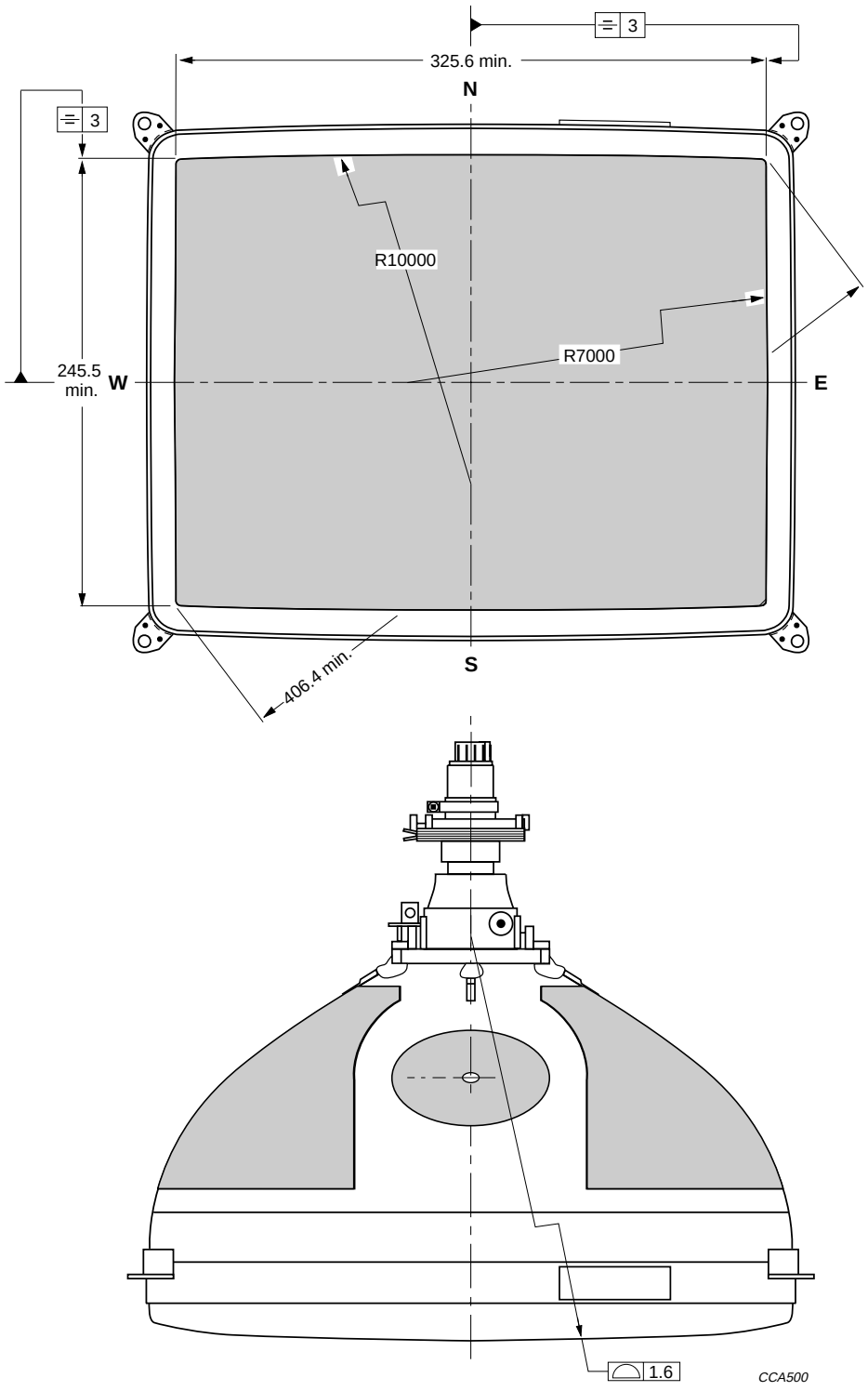
A = 139.4 mm.
B = 183.60 mm.
C = 100.00 mm.
D = 143.80 mm.
E = 0.58 mm.
F = 366.90 mm.
G = 330.24 mm.
H = 247.68 mm.
I = 290.60 mm.

Fig.14 Mechanical reference points.



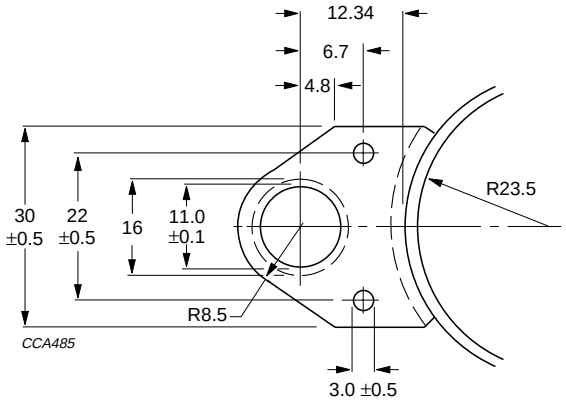
Dimensions in mm.

Fig.15 Top view.



Dimensions in mm.

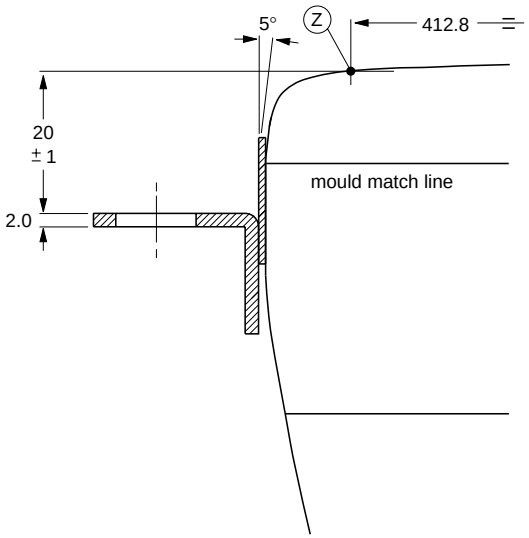
Fig.16 Dimensions of phosphor area on screen.



Dimensions in mm.

The mounting screw in the cabinet must be within a circle of 6.5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 366.9 mm × 290.6 mm.

Fig.17 Lug dimensions.



Dimensions in mm.

Fig.18 Lug position.

3.8 Sagittal heights of screen

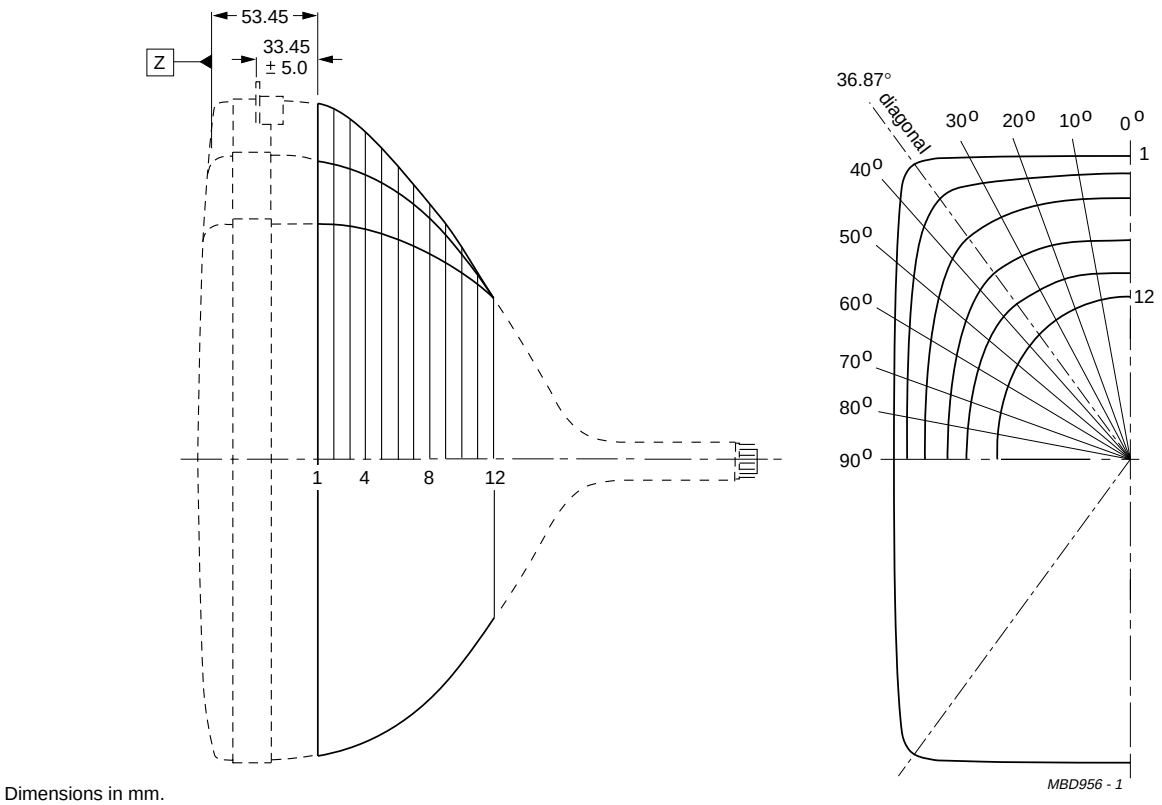
Sagittal heights of the nominal useful screen measured with respect to the end of the diagonal axis.

COORDINATES		SAGITTAL HEIGHT
X (mm)	Y (mm)	(mm)
0.0	0.0	16.3
0.0[1]	123.0	10.6
10.0	123.0	10.6
20.0	123.0	10.5
30.0	123.0	10.3
40.0	122.9	10.0
50.0	122.9	9.7
60.0	122.8	9.2
70.0	122.8	8.7
80.0	122.7	8.1
90.0	122.6	7.4
100.0	122.5	6.7
110.0	122.4	5.8
120.0	122.3	4.9
130.0	122.2	3.9
140.0	122.0	2.8
150.0	121.9	1.6
160.0	121.7	0.3
162.2[2]	121.7	0.0
162.3	120.0	0.2
162.4	110.0	1.1
162.5	100.0	2.0
162.7	90.0	2.8
162.8	80.0	3.4
162.9	70.0	4.1
162.9	60.0	4.6
163.0	50.0	5.0
163.1	40.0	5.4
163.1	30.0	5.7
163.1	20.0	5.9
163.1	10.0	6.0
163.2[3]	0.0	6.0

Notes

1. End of short axis.
2. End of diagonal axis.
3. End of long axis.

3.9 Cone contour



Dimensions in mm.

Fig.19 Maximum cone contour.

Cone contour data

SECTION	NOMINAL DISTANCE FROM SECTION 1 (mm)	MAXIMUM DISTANCE FROM TUBE AXIS (mm)										
		0°	10°	20°	30°	36.87°	40°	50°	60°	70°	80°	90°
1	0.0	184.3	186.9	195.1	210.1	221.0	217.9	187.3	167.2	154.9	148.2	146.1
2	10.0	182.9	185.4	193.5	208.2	218.6	215.8	185.8	165.8	153.5	146.9	144.7
3	20.0	179.5	181.7	188.6	201.0	209.2	207.1	181.0	162.2	150.6	144.3	142.2
4	30.0	175.0	176.8	182.2	191.6	197.6	196.1	174.9	157.8	147.1	141.2	139.4
5	40.0	169.3	170.6	174.5	181.2	185.5	184.4	167.8	152.8	143.2	137.9	136.2
6	50.0	162.0	162.9	165.6	170.0	172.9	172.2	159.8	147.1	138.9	134.2	132.7
7	60.0	152.6	153.2	155.0	158.0	160.0	159.4	150.6	140.6	133.9	130.1	128.8
8	70.0	141.7	142.1	143.3	145.2	146.4	146.1	140.1	132.8	127.8	124.8	123.9
9	80.0	129.8	130.0	130.6	131.7	132.4	132.1	128.6	123.7	120.3	118.3	117.6
10	90.0	116.7	116.8	117.0	117.4	117.7	117.6	115.7	113.1	111.2	110.1	109.7
11	100.0	102.3	102.3	102.4	102.4	102.5	102.4	101.5	100.7	100.2	99.8	99.7
12	103.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4

4 APPLICATION CONDITIONS

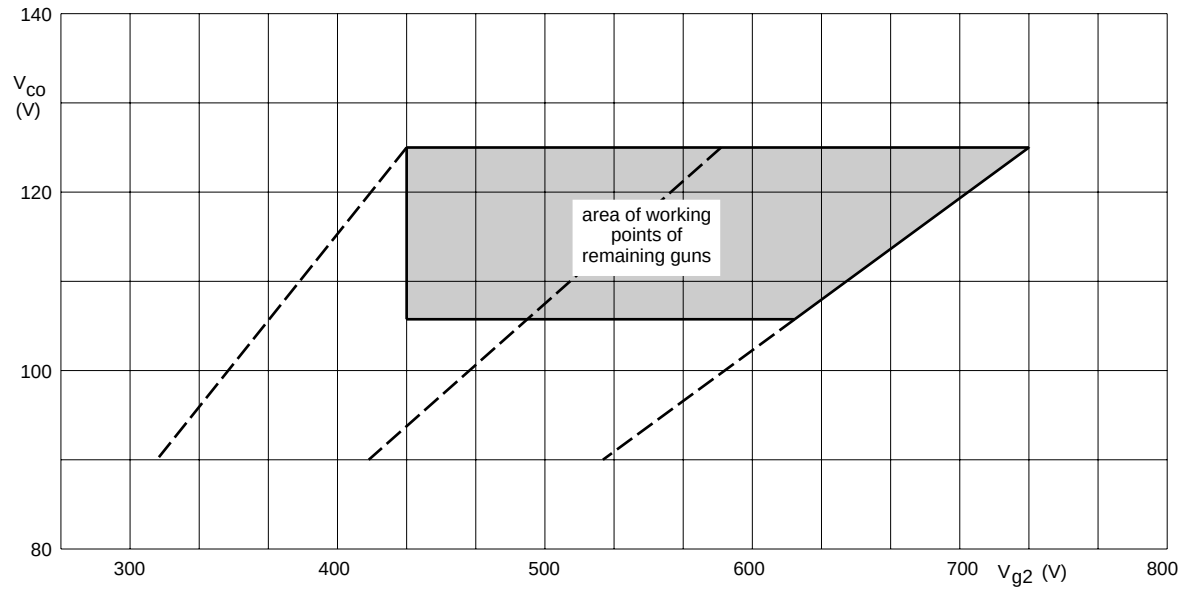
4.1 Recommended adjustment and operating conditions

The voltages are applied to each gun and are measured with respect to grid 1; RH = 40% to 60%; tube facing east; local magnetic field: 0.03 mT vertical, 0.00 mT lateral, 0.00 mT axial. Pre-heat the tube for 15 minutes minimum before tests. Avoid misconvergence, distortion etc. due to stray magnetic fields and chassis influences.

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{a,g4}$	anode voltage	–	26	–	kV
V_{g3a}	grid 3a (static focus electrode) voltage as a percentage of the anode voltage; note 1	25.5	–	29.5	%
V_{g3b}	grid 3b (dynamic focus electrode) voltage				
	DC voltage as a percentage of the anode voltage	25.5	–	29.5	%
	horizontal parabola	–	300	–	V
	vertical parabola	–	150	–	V
V_{g2}	grid 2 voltage at a spot cut-off voltage V_{co} = 125 V; note 2	see Fig.20			V
V_f	heater voltage	–	6.1(3)	–	V
f_H	horizontal sweep frequency	–	30 to 110	–	kHz
f_V	vertical sweep frequency	–	60 to 80	–	Hz
T_{amb}	ambient temperature	–	25	–	°C

Notes

1. Focus adjustment procedure:
   a) Adjust anode current for 750 cd/m^2.
   b) Adjust for optimum focus at $^2/_3$ centre-corner.
2. Grid 2 adjustment procedure:
   a) Grid 2 voltage (V_{g2}) adjusted for highest gun spot cut-off voltage: V_{co} = 125 V.
   b) Remaining guns adjusted for spot cut-off by means of cathode voltage.
   c) V_{g2} range: 425 V to 700 V at V_{co} = 125 V.
   d) Set the cathode voltage (V_k) for each gun at 125 V; increase the grid 2 voltage (V_{g2}) from ≈400 V to the value at which the spot of the gun with the lowest (V_{g2}) cut-off voltage becomes just visible, then decrease the cathode voltage of the remaining guns until the other gun beams become just visible.
3. For maximum cathode life it is recommended that the heater voltage is regulated at 6.1 V.



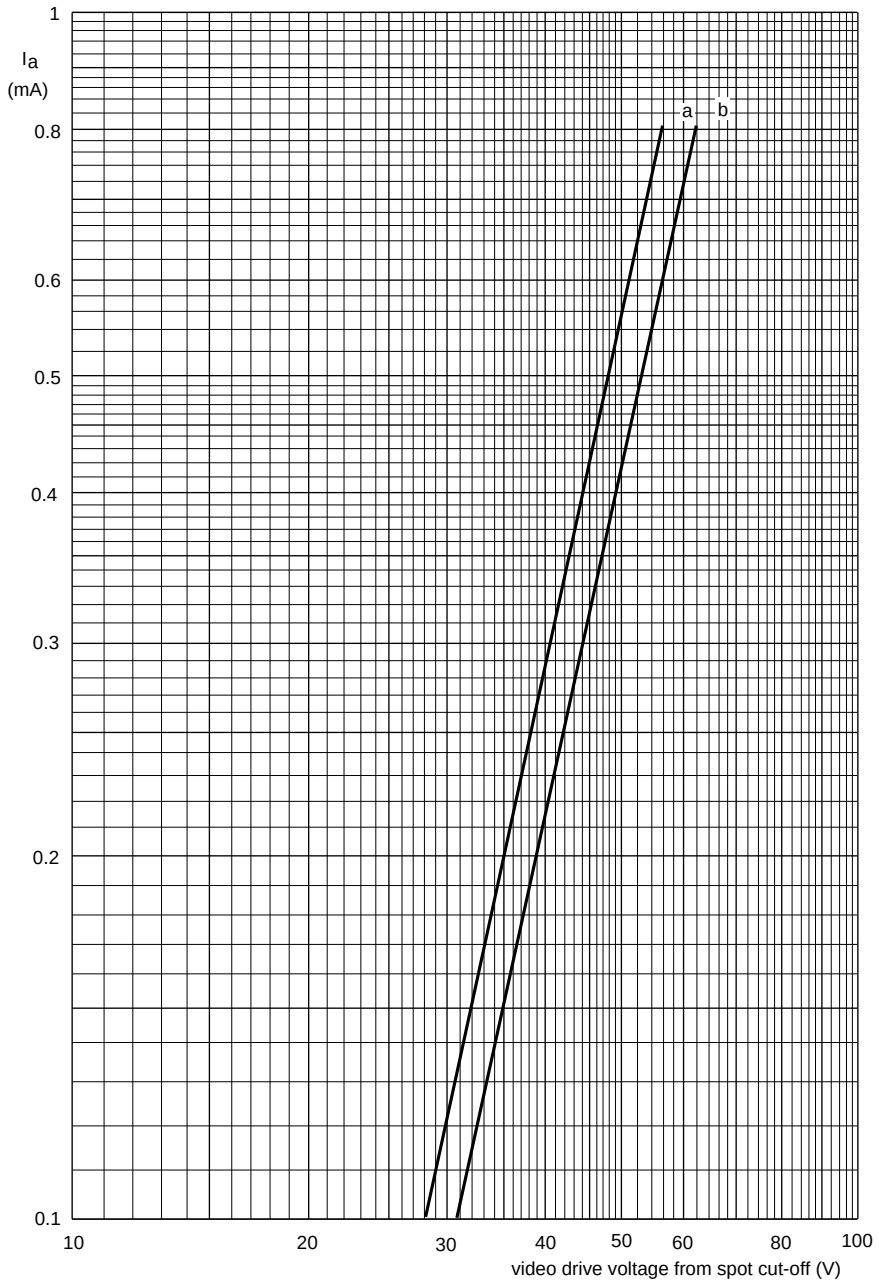
The voltages are specified with respect to grid 1.

Fig.20 Spot cut-off design chart.

4.2 Chassis design values

The values are valid for anode voltages between 20 and 29.9 kV. The voltages are specified with respect to grid 1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{g3a}	grid 3a (static focus voltage) as a percentage of anode voltage		25.5	–	29.5	%
V_{g3b}	grid 3b (dynamic focus voltage) as a percentage of anode voltage	raster size = 312 × 234 mm				
	DC voltage as a percentage of anode voltage		25.5	–	29.5	%
	horizontal parabola		–	300	–	V
	vertical parabola		–	150	–	V
ΔV_{g3a}	difference in focus voltage between red, green and blue guns when separately focused		–	–	300	V
ΔV_{g3a-b}	difference between the static focus voltage and dynamic focus voltage		–	–	200	V
V_{g2}	grid 2 voltage	for visual extinction of focused spot	see Fig.20			
V_k	cathode voltage		see Figs 20 and 21			
ΔV_k	difference in cut-off voltage between guns in any tube (cathodes cut-off ratio)		highest value <1.18 × lowest value			
V_f	heater voltage	at zero beam current	–	6.1	–	V
I_{g3a}	focus current	under cut-off conditions	–3	–	+3	μA
I_{g3b}	focus current	under cut-off conditions	–3	–	+3	μA
I_{g2}	grid 2 current	under cut-off conditions	–2	–	+2	μA
I_{g1}	grid 1 current	under cut-off conditions	–5	–	+5	μA
I_{kf}	cathode/heater current	V_{co} = 125 V	–3	–	+3	μA
Resistance						
R_{kgf}	insulation resistance between each cathode and all other electrodes and heater		50	–	–	MΩ
R_{g2}	grid 2 circuit impedance		–	–	5	MΩ
R_{g3}	grid 3 circuit impedance		–	–	50	MΩ



V_{co} = 100 V (curve a).
V_{co} = 125 V (curve b).

Fig.21 Typical cathode drive characteristics.

4.3 Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are specified with respect to grid 1.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{a,g4}$	anode voltage	note 1	20(2)	28.5(3)	kV
I_{ap}	anode current for each gun (peak value)		–	550	μA
I_a	long-term average anode current for each gun		–	400	μA
I_a	long-term average anode current for three guns		–	1100	μA
V_{g3a}	grid 3a (focus) voltage		–	10	kV
V_{g3b}	grid 3b (focus) voltage		–	10	kV
$\Delta V_{g3a-g3b}$	grid 3 (focus) differential voltage		–	1	kV
V_{g2p}	grid 2 voltage, including video signal voltage (peak value)		–	1000	V
V_f	heater voltage	note 4	5.7	6.6(3)	V
Cathode voltage					
V_k	positive	operating	–	200	V
		operating cut-off	–	135	V
V_k	negative		–	0	V
V_{kp}	negative peak		–	–2	V
Cathode to heater voltage					
V_{kf}	positive		–	250	V
V_{kfp}	positive peak		–	300(3)	V
V_{kf}	negative		–	0	V
V_{kfp}	negative peak		–	-50	V

Notes

1. 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 the picture tube.
2. Operation of the tube at lower voltages impairs the luminance and resolution and could impair the convergence.
3. This value is an absolute maximum.
4. For maximum cathode life it is required that the heater supply is designed for 6.1 V at zero beam current. Heater source impedance should have a minimum value of 2 Ω (maximum current during switching on is 600 mA).

4.4 Flashover protection

With the high voltage used with this tube (max. 26 kV) internal flashovers may occur. As a result of Soft-Flash technology these flashover currents are limited to approximately 200 A offering higher reliability, optimum circuit protection and component savings.

Primary protective circuitry using properly grounded spark gaps and series isolation resistors (preferably carbon composition) is still necessary to prevent tube damage.

The spark gaps should be connected to all picture tube electrodes at the socket in accordance with Fig.22; they are not required on the heater pins. No other connections between the outer conductive coating and the chassis are permissible. The spark gaps should be designed for a breakdown voltage at the focus electrode (g3a and g3b) of 11 kV and at the other electrodes of 1.5 to 2 kV, both at an atmospheric pressure of 100 kPa.

The values of the series isolation resistors should be as high as possible (min. 1.5 kΩ) without causing deterioration of the circuit performance. The resistors should be able to withstand an instantaneous surge of 20 kV for the focusing circuit and 12 kV for the remaining circuits without arcing.

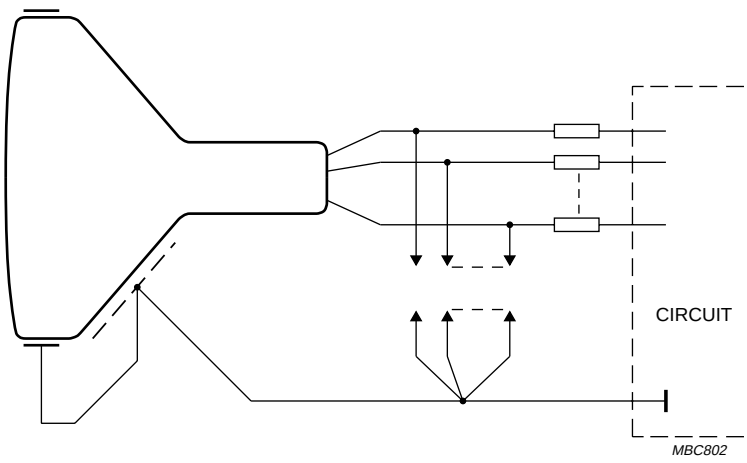


Fig.22 Flashover protection circuit.

5 ERGONOMIC, ENVIRONMENTAL DATA

5.1 X-radiation

Maximum anode voltage at which the X-radiation emitted will not exceed 0.5 mR/h at an anode current of 300 μA.

PARAMETER	TYP.	UNIT
Entire tube; note 1	34	kV

Note

1. This rating applies only if the anode connector used by the set maker provides the necessary attenuation to reduce the X-radiation from the anode contact by a factor equal to the difference between the anode button iso-exposure-rate limit curve and the iso-exposure-rate limit curve for the entire tube.

WARNING
If the value for the tube face only is used as design criterion, adequate shielding must be provided in the monitor for the anode contact and/or certain portions of the tube funnel and panel sidewalls to ensure that the X-radiation from the monitor is attenuated to a value equal to or lower than that specified for the face of the tube.
Maximum voltage difference between anode and focus electrode at which the X-radiation will not exceed 0.5 mR/h is 30 kV.
If this voltage can be exceeded in the monitor, additional attenuation of the X-radiation through the neck may be required.
The X-radiation emitted from this picture tube, as measured in accordance with the procedure of *"JEDEC Publications No.64D"* will not exceed 0.5 mR/h throughout the useful life of the tube when operated within the design-maximum ratings.
The tube should not be operated beyond its design-maximum ratings stated above, but its X-radiation will not exceed 0.5 mR/h for anode voltage and current combinations given by the iso-exposure-rate limit characteristics as shown in Fig.24.
Operation above the values shown by the curve may result in failure of the monitor to comply with the *"Federal Performance Standard of the U.S. for Television Receivers, Section 1020.10 of Part 1020 of Title 21, Code of Federal Regulation (PL90-602)"* as published in *"Federal Register Volume 38, No. 198,b Monday, October 15, 1973"*.
Maximum X-radiation as a function of anode voltage at 300 μA current is shown by Fig.23. X-radiation at a constant anode voltage varies linearly with anode current.

WARNING
The cathode ray tube is intrinsically safe in accordance with *"Appendix III Röntgenverordnung"*.
Eigensichere Kathodenstrahlröhre nach *"Anlage III Röntgenverordnung"*.

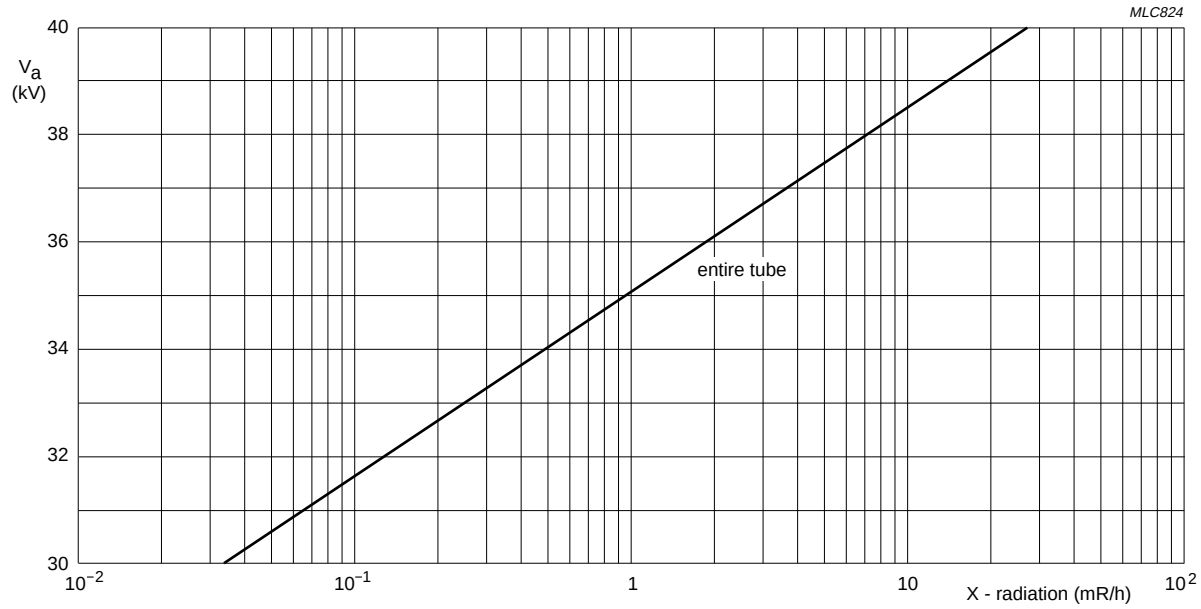


Fig.23 X-radiation limit curve at a constant anode current of 300 μA.

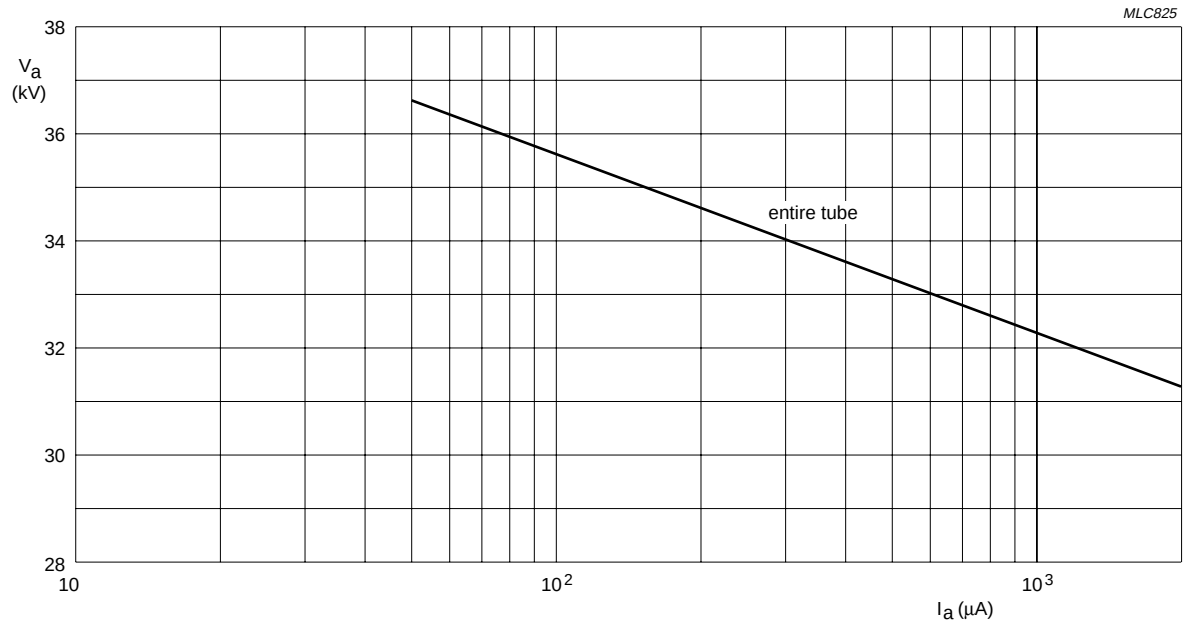
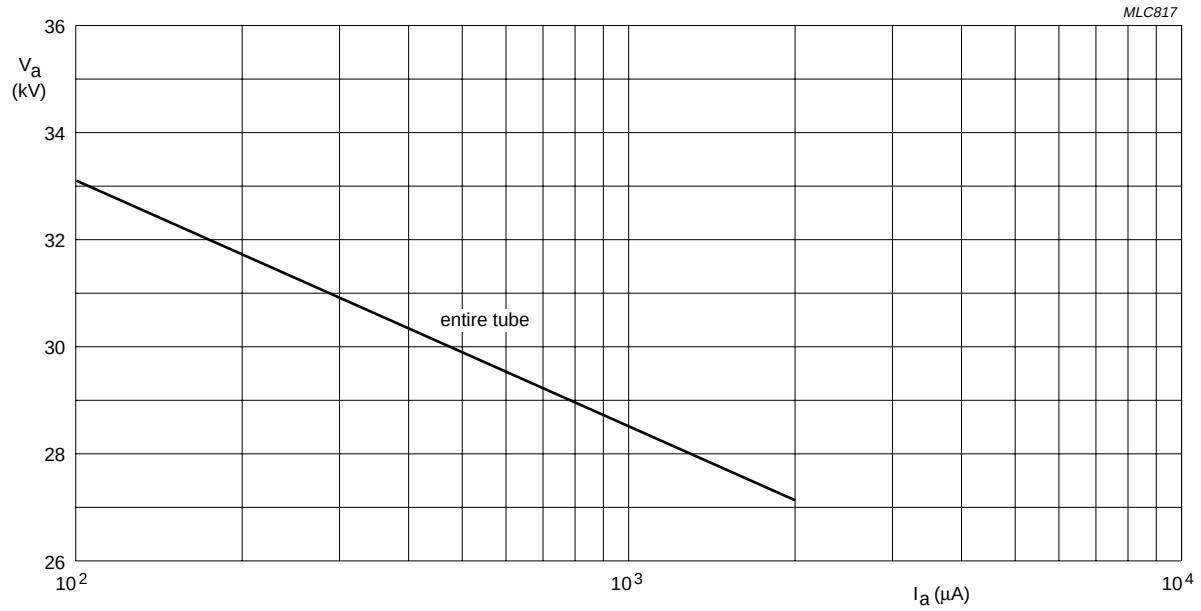


Fig.24 0.5 mR/h iso-exposure-rate limit curve.



The X-radiation emitted will also not exceed 1 μSv/h for anode voltage and current combinations shown in the iso-exposure-rate limit curve according to Eigensichere Kathodenstrahlröhre nach *"Anlage III Röntgenverordnung"*.

Fig.25 1 μSv/h iso-exposure-rate limit curve.

5.2 Warnings

X-radiation
Operation of the colour monitor tube under abnormal conditions that exceed the 0.5 mR/h iso-exposure-rate curve shown in Fig.24 may produce soft X-rays, which may constitute a health hazard on prolonged exposure at close range unless adequate external screening is provided. Precautions must therefore be exercised during servicing of monitors using this tube to ensure that the anode voltage and other tube voltages are adjusted to the recommended values so that the values stated in Section 4.3 are not exceeded.
Tube replacement
This monitor tube incorporates integral X-radiation and implosion protection and must be replaced with a tube of the same type number or recommended replacement to assure continued safety.
Shock hazard
The high voltage at which the tube is operated may be very dangerous. The monitor should include safeguards to prevent the user from coming in contact with the high voltage. Extreme care should be taken in servicing or adjustment of any high-voltage circuit. Caution must be taken during replacement or servicing of the monitor tube since a residual electrical charge may be held by the high-voltage capacitor formed by the external and internal conductive coatings of the monitor tube funnel. To remove any residual charge, short the anode contact button, located in the funnel of the tube, to the external conductive coating before handling the tube. Discharging the high voltage to isolated metal parts such as cabinets and control brackets may produce a shock hazard.

5.3 Handling

The packaging provides protection against tube damage under normal conditions of shipment or handling. Observe any instructions given on the packaging and handle accordingly. Under no circumstances should the tube assembly be subjected to accelerations greater than the values given in Table “Accelerations”.

Accelerations

PARAMETER	PULSE DURATION	MAX.	UNIT
Acceleration in cone direction	≤10 ms	350	m/s^2
	25 ms	300	m/s^2
Acceleration in all other directions	25 ms	350	m/s^2

Monitor tubes should be kept in the shipping box or similar protective container prior to installation.

Although monitor tubes are provided with integral implosion protection which meets the intrinsic safety requirements stipulated in the relevant part of IEC 60065, care should be taken not to scratch or knock any part of the tube. Particularly care should be taken to prevent damage to the seal area.

In all handling procedures prior to insertion in the cabinet, there is a risk of personal injury if severe accidental damage to the tube occurs. It is therefore recommended that in areas containing unpacked and unprotected tubes, protective clothing is worn, particularly, gloves and safety glasses with side-shields to prevent possible injury from flying glass in the event of such an accident.
Handle the tube with extreme care. Do not strike, scratch or subject the tube to more than moderate pressure.

The tube assembly should never be handled by the tube neck, deflection unit or other neck components.

If suspending the tube assembly from the mounting lugs, ensure that a **minimum of two** are used.
Under no circumstances suspend the tube assembly from one lug.

An alternative lifting method is to firmly grasp the assembly by the vertical sides of the rimband. Manually lifting the assembly from the face-down or face-up position is shown in Figs 26 and 27.

To protect the screen when placing the tube face-down, ensure that the tube face rests on a cushion kept free from abrasive substances.

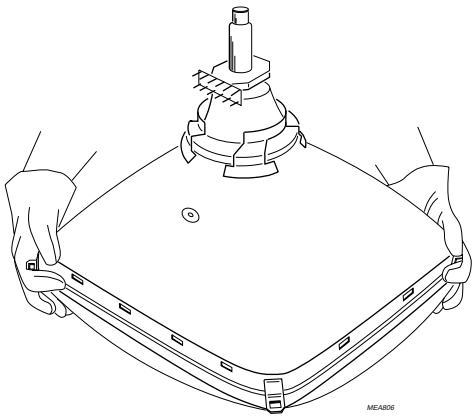


Fig.26 Lifting tube from face-down position.

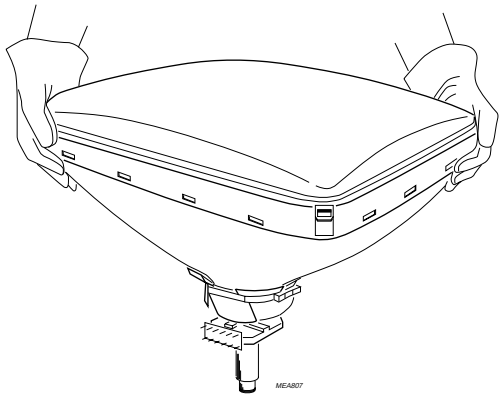


Fig.27 Lifting tube from face-up position.

6 DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	

7 LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. PDS customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify PDS for any damages resulting from such improper use or sale.

5.4 Environmental conditions

The tube assembly must be capable of meeting the requirements of this specification under/after the following environmental conditions.

5.4.1 AMBIENT TEMPERATURE

- Tube operating +10 °C to +53 °C
- Storage and shipment –20 °C to +60 °C with a thermal shock up to 24 °C
- 50% relative humidity at either limit with the tube assembly inside the shipping container.

5.4.2 RELATIVE HUMIDITY

- Operating 8% to 80%
- Storage and shipment 5% to 100% (including condensation, but excluding rain).

5.4.3 BAROMETRIC PRESSURE

- Operating and storage 769 hPa to 1060 hPa
- Shipment 91 hPa to 1060 hPa.

5.4.4 WET BULB TEMPERATURE

- Operating maximum 26.7 °C
- Storage and shipment 29.4 °C.

NOTES

PDS

Professional Display Systems B.V.

PDS

Jan Campertstraat 5

6416 SG Heerlen

The Netherlands

Tel. +31 (0)45 543 9312

Fax. +31 (0)45 542 6458

Printed in The Netherlands