CAMERA TUBE

Plumbicon, pick-up tube with photoconductive target and low velocity stabilisation exclusively intended for use with X-ray image intensifier in medical equipment.

QUICK REFERENCE DATA	
Focusing	magnetic
Deflection	magnetic
Diameter	30 mm

OPTICAL

Image dimensions on photoconductive layer		circle of 17.0 mm diameter	[1][2]	
Sensitivity, measured with a fluorescent light source having P20 distribution	min.	175	μA/lumen	
Gamma of transfer characteristic		0.9 ± 0.1		[3]
Spectral response, region of max. response		4300 to 5200	A	

HEATING

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

Heater voltage	V_f	6.3	V ±10%
Heater current	I_f	90	mA

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1) All underscanning of the specified useful target-area of 17.0 mm diameter or failure of scanning, for even the shortest duration, should be carefully avoided, since this may cause permanent damage to the photoconductive layer.

2) The area beyond the 17.0 mm circular optical image preferably to be covered by a mask.

3) The near unity gamma of the 55876 ensures good contrast when televising low contrast X-ray image-intensifier pictures as encountered in radiology. Further contrast improvement may be obtained when an adjustable gamma expansion circuitry is incorporated in the video amplifier system.

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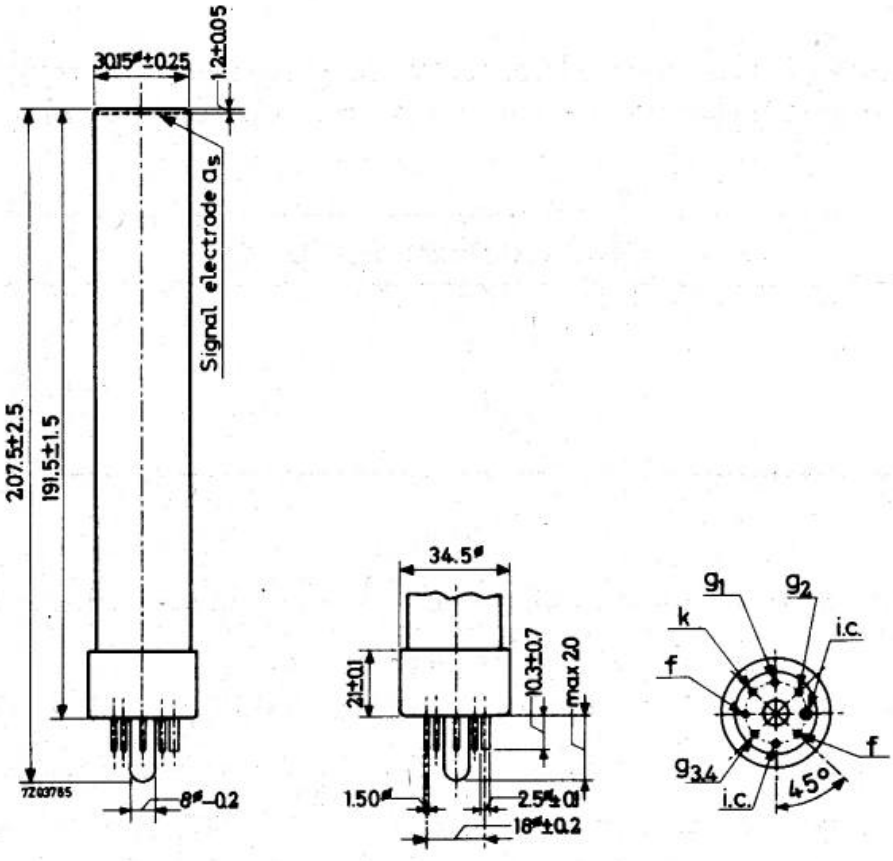
CAPACITANCES

Signal electrode to all	C_{a_s}	4 to 6	pF [1]

MECHANICAL DATA

Dimensions in mm



When Indium seal technique is used, face plate thickness will be increased to 2.3 mm

FOCUSING	magnetic
DEFLECTION	magnetic
MOUNTING POSITION	any

ACCESSORIES

Socket	type	56020
Focusing and deflection coil assembly	type	AT1122
NET WEIGHT	approx.	100 g

[1] Cap. a_s-rest, which effectively is the output impedance, increases by approx. 5 pF when the tube is inserted into the deflection/focusing coil assembly.

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CHARACTERISTICS

Grid No.1 voltage for cut-off at V_{g_2} = 300 V	V_{g_1}	−30 to −100		V [1]
Blanking voltage, peak to peak				
on grid No.1	$V_{g_{1p-p}}$	min.	40	V
on cathode	$V_{k_{p-p}}$	min.	15	V
Grid No.2 current at normally required beam current	I_{g_2}	max.	1	mA
Dark current	I_{a_s}	max.	0.003	μA [2]

LIMITING VALUES (Absolute max. rating system)

Signal electrode voltage	V_{a_s}	max.	50	V [3]
Grid No.4 and grid No.3 voltage	V_{g_4}, V_{g_3}	max.	750	V [3]
Grid No.2 voltage	V_{g_2}	max.	450	V [3]
Grid No.1 voltage				
positive	V_{g_1}	max.	0	V [3]
negative	$-V_{g_1}$	max.	125	V [3]
Cathode current	I_k	max.	3	mA
Cathode to heater voltage				
positive peak	V_{kf_p}	max.	125	V
negative peak	V_{kf_p}	max.	10	V
Ambient temperature (storage and operation)	t_{amb}	max.	50	°C
		min.	−30	°C
Face-plate illumination		max.	100	lux
Face-plate temperature (storage and operation)	t	max.	50	°C
		min.	−30	°C

[1]) With no blanking voltage on g_1

[2]) The target voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each individual tube.

[3]) At V_k = 0 V

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OPERATING CONDITIONS AND PERFORMANCE

Cathode voltage	V_k	0	V
Grid No.2 voltage	V_{g_2}	300	V
Grid No.4 and grid No.3 voltage	V_{g_4}, V_{g_3}	250 to 300	V [1]
Signal electrode voltage	V_{a_s}	15 to 45	V [2]
Beam current	I_{beam}	See note 3	
Focusing coil current		17 mA (AT1122)	
Highlight signal electrode current	I_{a_s}	0.1 to 0.6	μA [4]
Average signal output		approx. 0.06	μA [4]
Face-plate temperature	t	25 to 40	°C
Face-plate illumination		approx. 2	lux [5]

1) Grid No.4 and No.3 voltage adjusted for optimum picture focus. Preferred focus-coil current approx. 17 mA.

2) The target voltage should be adjusted to the value indicated by the tube manufacturer on the test sheet as delivered with each individual tube.

3) Operation of the tube with beam currents I_b not sufficient to stabilize the brightest highlight picture elements must be carefully avoided in order to prevent loss of highlight-detail and/or "sticking" effects.
Operation at excessively high beam currents will result in loss of resolution.

4) Substraction of dark current is unnecessary because of the extremely small value.

5) Illumination on the photoconductive layer, B_{ph}, is related to scene-illumination, B_{sc}, by the formula:

$$B_{ph} = B_{sc} \frac{R.T.}{4.F^2.(m+1)^2}$$

in which R represents the scene-reflexivity (average or of the object under consideration, whichever is relevant), T the lens transmissionfactor, F the lens aperture and m the linear magnification from scene to target.

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OPERATING CONDITIONS AND PERFORMANCE (continued)

Resolution

Modulation depth, i.e. uncompensated horizontal amplitude response (see note 1) at 5 Mc/s in picture centre (625 lines, 50 fields system) > 30 % [2])

Signal to noise ratio

at a signal current of 0.15 μA approx. 200 : 1

Persistence (or lag)

Low persistence renders tube very suitable for medical X-ray applications in combination with X-ray image intensifier

Persistence is basically independent of illumination level

Decay

Measured with 100% video signal current of 0.1 μA to zero signal after 5 s peak video signal. Fluorescent light source having P20 distribution.

Residual signal after dark pulse of 100 ms	max.	10 %
Residual signal after dark pulse of 500 ms	max.	1 %

1) With a signal current of 0.10 μA and a beam current of 0.20 μA.

2) Horizontal amplitude response can be raised by the application of suitable phase-and-aperture correction circuits. Such compensation, however, does not affect vertical resolution, nor does it influence the limiting resolution.

3) The specified ratio represents the "visual equivalent signal-to-noise ratio", which is taken as the ratio of highlight video-signal current to R.M.S. noise-current, multiplied by a factor of 3. (Assuming an R.M.S. noise-current of the video pre-amplifier of 2.10^{-9} A, bandwidth 5 Mc/s.)

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GENERAL RECOMMENDATIONS AND INSTRUCTIONS FOR USE

MOUNTING, WORKING POSITION:

1. Any
2. During transport, handling or storage the longitudinal axis must either be in a horizontal position or be kept vertically with the face-plate of the tube up.

GENERAL

1. Signal-electrode connection is made by a suitable spring-contact which is executed as part of the focusing coil.
2. Electrostatic shielding of the signal-electrode is required in order to avoid interference effects in the picture. Effective shielding is provided by grounding shields on the inside of the face-plate end of the focusing coil and on the inside of the deflecting yoke.
3. The Plumbicon as described in these data has been provided with tungsten base pins. It is recommended to avoid mechanical force and shocks to these pins and to insert the tube into its socket with care.
4. In some cases the properties of the photoconductive layer as used in the Plumbicon may be found to have slightly deteriorated during long idle periods, such as encountered between the last test in our works and actual delivery to the user.
   It is therefore recommended to operate the tube directly after receipt under normal voltage settings, in overscanned position with evenly illuminated target and a signal current of 0.15 μA for some hours after which the initial properties will have been fully restored.
5. The Plumbicon not generating own noise to any noticeable extent, the signal to noise ratio will mainly be determined by the entrance noise of the video amplifier system.
   The high sensitivity of the Plumbicon warrants pictures with excellent signal-to-noise ratio, provided its output is fed into a well-designed input stage of the video-amplifier system. In such a system an aperture correction may be incorporated to ensure an attractive gain in resolving power without impairing the visual signal-to-noise ratio.

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INSTRUCTIONS FOR USE

1. Clean face-plate.
2. Insert tube into deflection unit.
3. Place mask with 17.0 mm diameter aperture in front of and in close contact with face-plate.
4. Press socket gently onto the base pins.
5. Set a) grid No.1 bias control at max. neg. bias (beam cut-off)
   b) signal electrode voltage at zero volts
   c) scanning amplitudes to max. scan.
6. Switch on camera equipment and monitor and allow to heat up for a minimum of 30 seconds.
7. Adjust monitor to produce a faint - non overscanned - raster.
8. Remove camerahead from image-intensifier unit.
9. Direct camera to lightbox or place suitable lightbox on objective holder. Switch on light and adjust illumination level to correspond to appr. 0.3 ft.cdl for the whites of the testchart on the face-plate.
10. Adjust signal-electrode voltage to the value as indicated on the tube's test-sheet.
11. Turn grid No.1 control slowly till a picture is produced on the monitor, increase beam-current in order to fully discharge the picture highlights.
12. Adjust grid No.3 and grid No.4 voltage control (beam focus) and optical focus for best picture detail.
13. Align the beam of the plumbicon by either of the two following methods:
    A) Adjust the alignment fields in such a way that the centre of the picture on the monitor does not move when grid No.3 and No.4 voltage (beam focus) is varied.
    B) Reduce signal-electrode potential to a few tenths of a volt only. Adjust alignment field till most uniform picture is obtained as observed on monitor or waveform oscilloscope. Restore signal-electrode voltage to value as indicated on the tube's testsheet.
14. Decrease scanning amplitudes till perfect circular picture is produced on monitor, with diameter equal to height of monitor raster. This procedure may be facilitated by small adjustment of the vertical centring control. Adjust horizontal centring control till circular picture is properly centred at centre of monitor raster.
15. Remove lightbox and attach camera head to image intensifier unit.
16. Place suitable image-intensifier testchart in front of image-intensifier. Switch on image-intensifier and X-ray source.
17. Adjust optical focus and beam focus for max. picture detail.

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ALWAYS:

- keep face-plate capped during transport and shelf-life
- avoid underscanning
- apply sufficient beam current to stabilize picture whites
- make certain that the deflection circuits are operative before applying beam current
- avoid focusing camera head directly to the sun or to reflecting objects
- keep lens capped when transporting camera head

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