CANADIAN **Marconi** COMPANY

TUBE DATA SHEET

Tentative Data

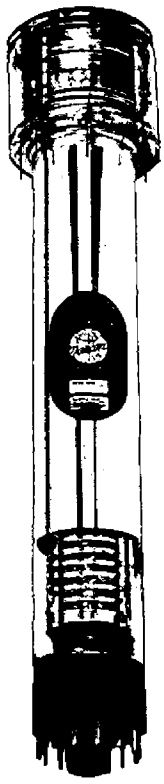
7294

IMAGE ORTHICON

For Outdoor and Studio Pickup
Exceptional Sensitivity

Magnetic Focus
Magnetic Deflection

3" - Diameter Bulb
15-1/4" Length



The 7294 is a television camera tube recommended for colour applications and high quality monochrome transmission. It has exceptionally high sensitivity combined with a spectral response approaching that of the eye. The 7294 is very stable in performance at all incident light levels on the object ranging from bright sunlight (several thousand foot-candles) to a deep shadow (one foot-candle or less). Commercially acceptable pictures can be obtained at incident light levels greater than 10 foot-candles.

The photocathode utilised in the 7294 is characterized by a spectral response having high blue sensitivity, high green sensitivity, very good yellow sensitivity, good red sensitivity, and practically no infrared sensitivity. This latter characteristic of the response prevents any colour masking by infrared, and thus permits portrayal of colours in nearly their true tonal gradation.

The relatively small size of the 7294 lends itself to use in comparatively light-weight, portable television cameras, and facilitates the use of a telephoto lens with such cameras.

The 7294 tube supersedes and is interchangeable with the 6474 although differing in construction and slightly in operation.

For satisfactory operation the beam focus voltage should be approximately 150 volts.

PRINCIPLES OF OPERATION

The 7294 may be divided into three sections — an image section, scanning section and a multiplier section as shown in Fig. 1.

Image Section

The image section contains a semi-transparent photocathode on the inside of the face plate, and electrodes to provide an accelerating electrostatic field to the target. This consists of a thin glass disc with a fine mesh screen mounted very closely to it on the photocathode side.

Light from the scene to be televised is focussed by an optical lens system on to the photocathode from which the photo-electrons are emitted proportionally to the intensity of the optical image at any particular point. These photoelectrons are focussed on to the target by the combined action of the electrostatic and longitudinal magnetic-fields, the latter being produced by an external coil. Secondary electrons produced by the incident photoelectrons are collected by a suitably positioned fine mesh screen, held at a definite small positive potential with respect to the target. The potential excursion of the target is thus limited, ensuring complete stability at all light levels. The secondary emission at the target produces a pattern of positive charges corresponding point by point with the light distribution of the original scene. The thinness of the target allows this charge pattern to be reproduced on its reverse side, i.e. the scanned side.

Please send inquiries to:

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APPROXIMATE DATA FOR THE TUBE TYPE 7294 IMAGE ORTHICON

GENERAL DATA

Electrical

Cathode	Indirectly Heated, Oxide Coated	
Heater Voltage	6.3	V
Heater Current	0.6	A
Inter-electrode Capacitance:		
Anode to all other electrodes	12	pF Max
Spectral Response	(See Spectral Sensitivity Curve)	
Focusing Method	Magnetic	
Deflection Method	Magnetic	
Magnetic Fields:		
Focusing Field (See Note 1)	75	Gauss
Alignment Field	0 to 3	Gauss

Mechanical

Overall Length	15.44 in. (393 mm) Max
Diameter of Image Section	3.07 in. (78.0 mm) Max
Diameter of Scanning Section	2.07 in. (52.6 mm) Max
Deflecting Coil Length	5.0 in. (127 mm)
Focusing Coil Length	10.0 in. (254 mm)
Photocathode Distance Inside End of Focusing Coil	0.5 in (12.7 mm)
Useful Size of Rectangular Image for standard operation:	
Diagonal	1.6 inches (40.7 mm) Max, centrally situated

Orientation of Rectangular Image:
Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the centre of the face plate and Pin No. 7 of the shoulder base.

Net Weight .... 14 ounces (410 gm) Approx

Mounting Position: Any except with diheptal base up and with tube axis at an angle less than 20° from vertical

End Base ....
Small Shell Diheptal 14-pin (JETEC No. B15-45)

Shoulder Base .... Keyed Jumbo Annular 7-pin

MAXIMUM AND MINIMUM RATINGS
(Absolute Values)

No Individual rating should be exceeded

	Min	Max	
Heater Voltage	5.7	6.9	V
Photocathode Voltage (Image Focus): Negative value	—	700	V
Grid No. 6 Voltage (Image Accelerator): Negative value	—	700	V
Target Voltage	—	±10	V
Grid No. 5 Voltage (Decelerator)	—	150	V
Grid No. 4 Voltage (Beam Focus)	—	350	V
Grid No. 3 Voltage (Multiplier Focus)	—	400	V
Grid No. 2 and Dynode No. 1 Voltage	—	350	V
Grid No. 1 Voltage (negative value, never positive)	0	125	V
Anode Supply Voltage	—	1350	V
Voltage per Multiplier Stage	—	350	V
Peak Heater to Cathode Voltage:			
Heater negative with respect to cathode	—	125	V
Heater positive with respect to cathode	—	10	V
Anode Current	—	50	uA
Operating Temperature of Any Part of Bulb	—	65	°C
Operating Temperature of Bulb of Image Section	35	60	°C
Temperature Difference between Target Section and Any Part of Bulb Hotter than Target Section	—	5	°C

RANGE OF CHARACTERISTICS FOR EQUIPMENT DESIGN

	Min	Max	
Heater Current at heater voltage 6.3V)	540	660	mA
Capacitance Anode to all other electrodes	—	12	pF
Sensitivity of Photocathode	20	—	uA/lumen
Signal to Noise Ratio* (See Note 2 (Bandwidth 5.1M/cs)	31	—	db
Drop in Amplitude Response at 400 lines per picture height, without aperture correction, with respect to black/white signal* (See Note 3)	—	11	db
Limiting Horizontal Resolution* (See Note 4)	525	—	TV lines

*When tested under Typical Operation Conditions with Heater Voltage 6.3V, Pattern No. 1 unless otherwise specified and Lens Stop (See Note 5).

TYPICAL OPERATION

Operational Conditions

Photocathode Voltage (Image Focus) (See Note 6)	—300 to —500	V
Grid No. 6 Voltage (Image Accelerator 50% to 70% of photocathode voltage (See Note 7)	—150 to —350	V
Target Cut-off Voltage	—3 to +1	V
Target Voltage (See Note 8)	2 to 3V	above cut-off
Target Blanking Voltage (peak to peak)	5	V Min
Grid No. 5 Voltage (Decelerator) (See Note 15)	0 to 125	V
Grid No. 4 Voltage (Beam Focus) See Note 9)	140 to 220	V
Grid No. 3 Voltage (Multiplier Focus) (See Note 10)	225 to 330	V
Grid No. 2 & Dynode No. 1 Voltage	300	V
Grid No. 1 Voltage:		
Normal (See Note 11)	—25 to —115	V
For picture cut-off	—45 to —115	V
Dynode No. 2 Voltage	600	V
Dynode No. 3 Voltage	800	V
Dynode No. 4 Voltage	1000	V
Dynode No. 5 Voltage	1200	V
Anode Supply Voltage	1250	V
Anode Current	50	uA
Signal Current (See Note 12)	3 to 24	uA
Recommended Operating Temperature (See Note 13)	40 to 50	°C
Magnetic Fields:		
Focusing Field (See Note 1)	75	Gauss
Alignment Field	0 to 3	Gauss

Typical Performance

Sensitivity of Photocathode	20	uA/lumen Min
Approximate Scene Brightness required for Acceptable Picture (assuming standard lens aperture of f/5.6)	25	ft-Lamberts
Signal to Noise Ratio, average (See Note 2) (Bandwidth 5.1 Mc/s)	34	db
Drop in Amplitude Response at 400 lines per picture height, without aperture correction, with respect to black/white signal (See Note 3)	11	db Max
Colour Response		(See Note 14)

WARNING

When testing a tube the following precautions should be observed:

1. Ensure that the temperature of the tube is within its recommended range.
2. Avoid over exposure of the test patterns, or severe after-image will result.

NOTES

1. The direction of the focusing current should be such that a north seeking pole is attracted to the image end of the focusing coil, which is therefore a north pole.
2. Pattern No. 4 is used for this test. The signal to noise ratio is measured through a filter flat within ±0.25db up to 5.1Mc/s. Using a line strobe waveform monitor, select a line containing peak white information and measure the amplitude of the peak white signal with respect to the black level, the latter as determined with the lens capped.

   The peak to peak noise amplitude is then measured with the lens capped.

   The signal to noise (r.m.s.) ratio is expressed in decibels as given by

   $$20 \log_{10} 6 \left(\frac{\text{Signal amplitude}}{\text{Noise amplitude}} \right)$$

   If a flat amplifier of restricted bandwidth is not available, the measurement should be made on a standard channel and the result corrected for:
   (a) Aperture correction present in the amplifier.
   (b) Increased bandwidth.
3. Pattern No. 2 is used for this test. Amplitude response is measured with the same filter as for the noise measurements (Note 2). Using Pattern 2 on page 8, and considering the wide vertical bars as 100% modulated, the loss in modulation depth for the 400 line block is obtained in decibels.
4. Limiting horizontal resolution is observed in the centre of the pattern when the picture is adjusted for the best overall resolution.
5. Lens Stop

   Adjust the light level until the knee of the signal output versus the highlight illumination curve is reached by gradually opening the lens from its minimum aperture and observing the increase of the signal amplitude on the oscilloscope. The knee is defined as the point at which the rapid increase in signal amplitude ceases and a shading redistribution is the only change observed on the oscilloscope. Then increase the light level to twice that at which the knee occurs (i.e. open lens one calibration stop, e.g., as from f/16 to f/11).
6. Adjusted for best focus.
7. Adjusted for minimum "S" distortion with the photocathode at its correct value.
8. Adjustable from —3 to +5V with the blanking voltage off.
9. Adjusted for picture focus. Approx. 150V.
10. Adjust to give the most uniformly shaded picture near maximum signal. This adjustment should be made with the photocathode capped.
11. Adjusted for the best picture.
12. Pattern No. 3 is used for this test. The signal current is measured under standard test conditions viewing a plain white sheet, the resulting anode current being designated Iwu**A**. Then the lens is capped and the anode current measured under these conditions, this being designated Ibu**A**. The signal current is given by (Ib—Iw)u**A**.
13. No part of the bulb may be more than 5°C hotter than the target section.
14. Use Ilford Colour Chart (Pattern No. 5) under Standard Reference White Light. The response from No. 1 Red should be intermediate between the responses from monochrome scales 1 and 4.
15. Adjusted for minimum corner shading.

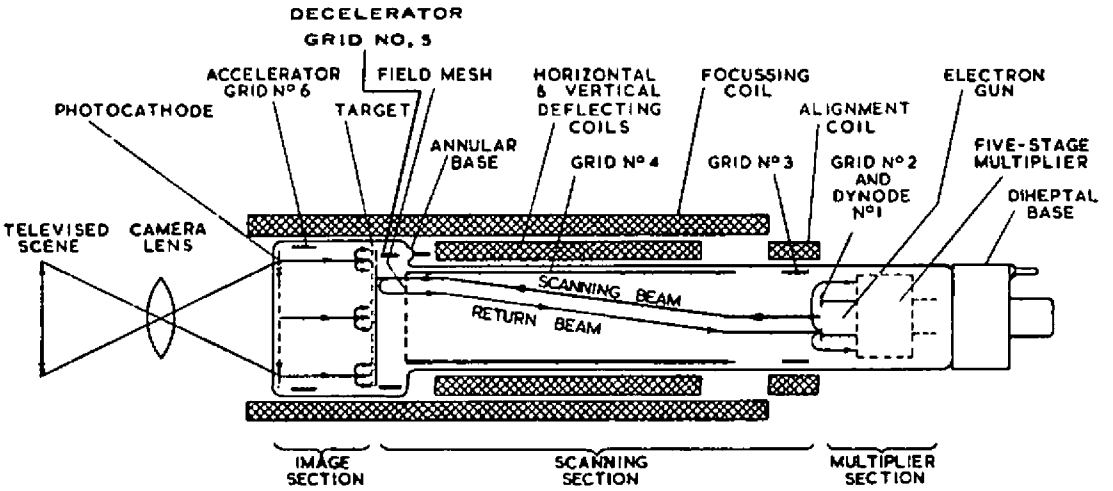


Fig. 1—Schematic Arrangement of Type 7294

Scanning Section

The reverse side of the glass target is scanned by an electron beam emanating from the electron gun in the scanning section. This gun comprises a thermionic cathode, a control grid (grid No. 1), and an accelerating grid (grid No. 2). The beam is focussed at the target by the magnetic field of the external focussing coil and the electrostatic field of grid No. 4 and the field mesh.

The beam is aligned with the focussing magnetic field by means of a small transverse magnetic field produced by an external coil located at the gun end of the focussing coil.

Deflection of the beam is accomplished by transverse magnetic fields produced by external deflection coils.

The relative potentials of the gun and associated electrodes are such that the beam approaches the target with substantially zero velocity.

In areas of the target corresponding to the dark areas of the image, the beam is unable to land and the beam is reflected towards the gun. In areas corresponding to the illuminated regions of the image, the target will be positively charged and electrons will be deposited until the target potential is restored to its original value. That fraction of the beam not required for neutralisation of the target charge pattern will return towards the gun. The return beam is thus amplitude modulated, its intensity being inversely proportional to the brightness of the original image.

All the beam electrons will fail to land, irrespective of the picture content, if the target mesh is more negative than a fixed potential termed the "target cut-off potential." For normal operation the target mesh is approximately 2 volts positive with respect to this potential.

The target end of the wall cylinder is closed by a fine mesh screen of high transmission. This increases the strength of the decelerating field immediately in front of the target, thus reducing errors due to distortion of the beam by the potential field due to the charge pattern on the target. In addition it facilitates the defocussing of the first dynode.

The decelerator G5 is located between the wall cylinder and the target, and by varying its potential, the electrostatic field at the edges of the target can be corrected.

Multiplier Section

The electrons which fail to land on the target constitute the return beam and are directed to the first dynode of a five stage electrostatically focussed multiplier. By virtue of secondary emission the modulated beam is amplified, the overall multiplication over the five stages being between 500 and 2000. The gain of the multiplier is sufficiently high so that the random noise of the electron beam is brought above that of the input stage of the video amplifier. It thus becomes the limiting noise in the use of the tube. The presence of the mutiplier also permits the use of an amplifier of fewer stages.

It can be seen that when the beam moves from a less positive portion on the target to a more positive portion, the signal output voltage across the load resistor (R30 Fig.2) changes in the positive direction. Hence for highlights in the scene, the grid of the first video amplifier stage swings in the positive direction.

CAMERA EQUIPMENT

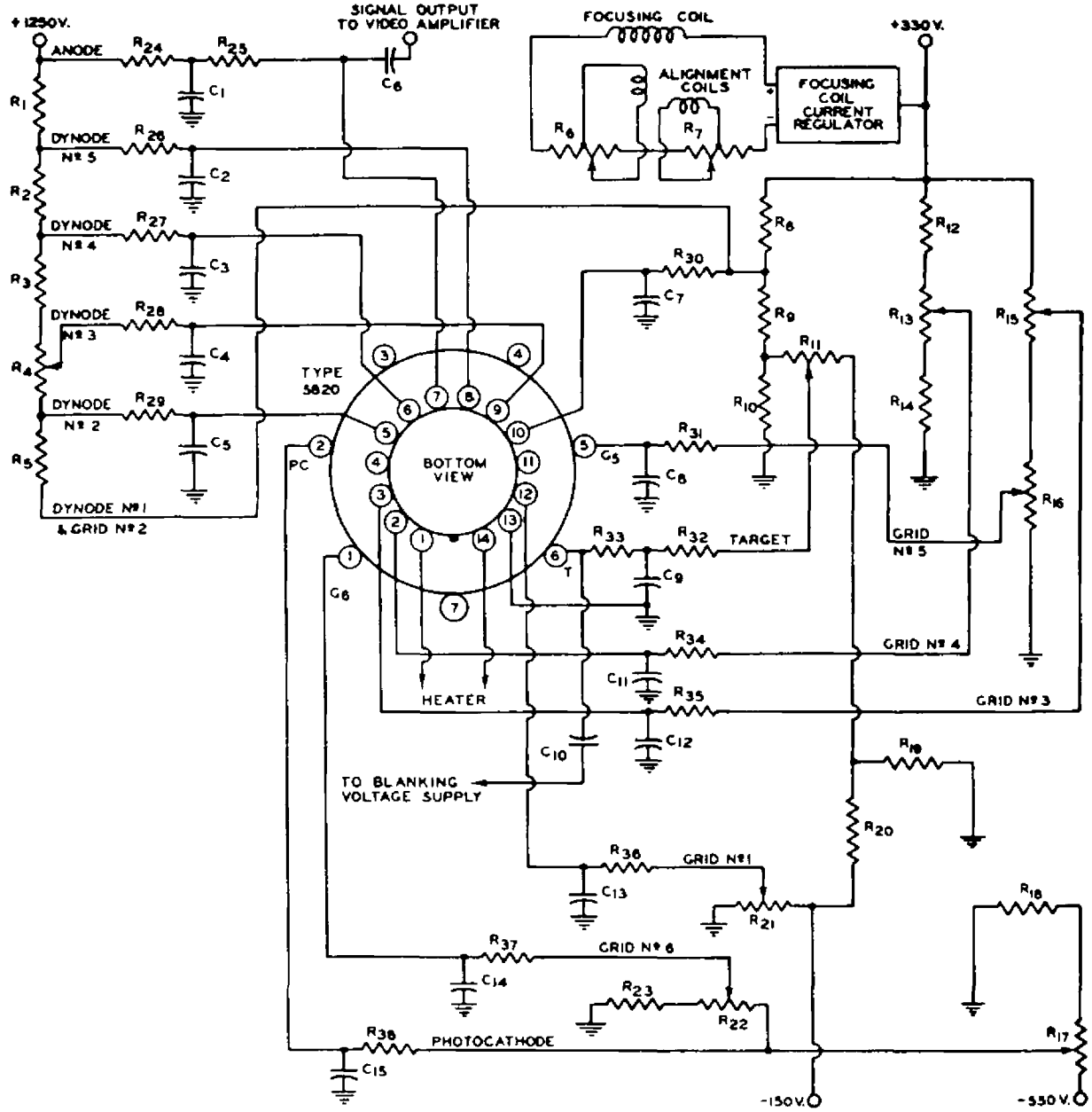
Focussing and Scanning Coils

The focus coil should be designed in accordance with the dimensions and field strengths given above.

The annular socket should be positioned so that the slot for the index pin No. 7 of the shoulder base is located at the bottom of the coil. The orientation of the scanning coils should be such that vertical scan is essentially parallel to the plane passing through this index socket and the centre of the face plate.

Provision should be made to allow a slight rotation of the shoulder socket and scanning coils to permit correction of any image rotation introduced between the photocathode and target.

The operating position of the coil and 7294 should preferably be such that any loose particles in the neck of the tube will not fall down and strike or become lodged on the target. It is therefore recommended that the tube never be operated in a vertical position with the diheptal base end up or in any other direction where the axis of the tube with base up makes an angle of less than 20° with the vertical through the centre of the base.



C1 C2: 0.05 μf, 1600 v working voltage
C3: 0.01 μf mica, 1600 v working voltage
C4: 0.001 μf mica, 1000 v working voltage
C5: 0.001 μf mica, 600 v working voltage
C6: 0.03 μf mineral-oil impregnated, 1600 v working voltage
C7 C8 C9 C11 C12 C13 C14 C15: 0.001 μf mica, 400 v working voltage
C10: 1 μf, 400 v working voltage
R1: 47000 ohms, 1/2 watt
R2 R3: 220000 ohms, 1/2 watt
R4: 250000-ohm potentiometer, 1 watt
R5: 270000 ohms, 1/2 watt
R6 R7: 200-ohm potentiometer, center-tapped, 2 watts
R8: 5100 ohms, 1/2 watt
R9: 51000 ohms, 2 watts
R10: 510 ohms, 1/2 watt
R11: 150000-ohm potentiometer, 1/2 watt
R12: 125000 ohms, 1/2 watt
R13: 75000-ohm potentiometer, 1 watt
R14: 125000 ohms, 1/2 watt
R15: 250000-ohm potentiometer, 1 watt
R16: 150000-ohm potentiometer, 1 watt
R17: 250000-ohm potentiometer, 1 watt
R18: 510000 ohms, 1 watt
R19: 11000 ohms, 1/2 watt
R20: 330000 ohms, 1/2 watt
R21: 500000-ohm potentiometer, 1 watt
R22: 250000 ohms, 1 watt
R23: 560000 ohms, 1/2 watt
R24: 47000 ohms, 1/2 watt
R25: 20000 ohms, 1/2 watt
R26 R27: 100000 ohms, 1/2 watt
R28 R29 R31 R32 R34 R35 R36 R37 R38: 200000 ohms, 1/2 watt
R30: 50000 ohms, 1/2 watt
R33: 100000 ohms, 1/2 watt

Fig. 2 - Voltage-Divider Circuit for Type 7293 with Recommended Arrangement for Connecting the Focusing Coil and Alignment Coils.

The image section of the coil should be well shielded to prevent the ingress of cross talk from the scanning coils. If this is not done the electron image will oscillate at scanning frequency with a consequent loss in resolution.

If the heat generated by the focussing and scanning coils is sufficient to elevate the temperature of the tube above the maximum permitted (50°C.), provision must be made for forced air cooling. For this purpose a small air blower is satisfactory, but care must be taken to prevent vibration of the 7294 and its amplifier.

In the event of there being insufficient heat generated to maintain the temperature within the specified range, a heater surrounding the image section should be provided. This should preferably be controlled by means of a thermostat.

The D.C. voltages required for the 7294 are stated in the electrical data above.

Two D.C. high voltage supplies are required:- 1500 volts, 1 mA for the anode section, and—500 volts 1 mA for the image section. A typical voltage dividing network for obtaining the intermediate voltages is shown in figure 2.

In designing the voltage divider for the multiplier stages of the 7294, engineers should recognize that the D.C. output of individual 7294's may have a range of 10 to 1. This range, therefore, must be considered in the choice of bleeder-resistor values. If the values are too high, the distribution of voltages applied to the dynodes will be upset by a 7294 with a D.C. output at the upper end of this range. As a result, there will be an abrupt drop in the A.C. output of the tube as the beam current is increased. When this drop occurs before the beam is at its optimum value, the ratio of signal to noise will be lessened.

Even with satisfactory bleeder-resistor values, it is possible to over-load the tube itself. For 7294's having high D.C. outputs, a current reversal can occur at the 5th dynode stage of the multiplier as the beam current is increased. This current reversal will also produce a sharp drop in the A.C. output of the tube. To prevent such current reversal, it is recommended that provision be made to reduce the overall multiplier voltage for tubes with D.C. outputs at the upper end of the range. A reduction to 1000 volts should be adequate for either out-door pickup or studio-pickup tubes.

Video Amplifier

The video amplifier should be designed to cover a range of A.C. signal voltages corresponding to signal output currents of 2 to 15 microamperes in the load resistor.

To utilize the resolution capability of the 7294 in the horizontal direction, it is necessary to use a video amplifier with an adequate bandwidth. For 405 lines a bandwidth of at least 4 megacycles is necessary, 525 and 625 lines require 6 megacycles.

Shading Correction

The provision of shading correction signals is recommended. A sawtooth signal with a frequency equal to the line frequency and an amplitude approximately twice that of the video signal should be provided. Provision should be made for varying the amplitude and polarity of the signal. Field shading correction should also be provided, the frequency in this case being equal to that of the field.

Target Blanking

A blanking signal should be applied to the target to prevent the electron beam from striking the target during the return portions of the horizontal and vertical deflecting cycles. Unless this is done the camera tube return lines will appear in the received picture.

The blanking signal is a series of negative voltage pulses. The voltage between pulses must be constant to prevent fluctuation of the target voltage. During the blanking periods, the full beam current without video signal modulation is returned to the multiplier and its multiplied output flows through the load resistance.

Scan Failure Protection Circuits

To avoid damage to the target of the 7294 provision should be made to bias off the electron beam in the event of failure of one or other of the deflection circuits.

Optical Lens

The lens system used with the 7294 should be designed in accordance with standard optical practice. An iris must be incorporated to control the amount of light falling on the photocathode. To prevent the entrance of stray light all the internal surfaces of the lens holder should be finished in matte black, and a lens hood employed whenever possible.

INSTALLATION OF 7294

The 7294 has two complementary guides for inserting the tubes correctly in the annular socket, i.e. the large pin (No. 7) on the annular base and the white radial line in the corresponding position on the face plate.

Usually it is installed by inserting the diheptal base end of the tube through the coil assembly, the position being such that No. 7 pin and the radial index mark are on the underside of the tube. The annular base pins are then pushed into their socket and the diheptal socket is put on the 14 pin base.

Sequence of Adjustments

1. Insert tube in camera, verify that the tube and camera are functional by noting reaction to G1 control. Bias off the target, cap lens and adjust Grid No. 1 voltage to give small amount of beam current.
2. Set scan amplitude controls at maximum.
3. Leave to warm up.
4. Uncap camera lens.
5. Increase target voltage until information appears.
6. Adjust beam focus, image focus and optical focus until detail can be discerned.
7. Adjust alignment current controls until picture response is a maximum. If the picture appears in negative contrast increase the beam current. The tube is correctly aligned when the centre of the picture does not rotate but merely goes through focus, when "beam focus" (G4) is varied.
8. Set voltage of target approx. 2 volts above cut off and adjust beam current to lowest value consistent with a satisfactory picture.
9. Decrease the scanning amplitude until the edge of the target ring just disappears at the corners of the picture. The adjustment of the scanning raster to the correct size and aspect ratio is facilitated by use of a ring mask consisting of a perspex disc on which

is inscribed two concentric circles of diameter .96" and 1.28", placed in contact and concentric with the photocathode of the tube.* Light is allowed to fall on the photocathode and an image of the rings is obtained on the monitor. No lens is necessary. The scan amplitude and centering controls on the camera are adjusted until the diameter of the large circle is equal to the width of the raster and the diameter of the smaller circle is equal to the height. Verify that scanned area is centrally located with respect to the target ring.

10. Adjust lens stop for correct exposure.
11. Adjust decelerator G5 for minimum shading consistent with best geometry.
12. Adjust image accelerator G6 for minimum S distortion when camera is panned horizontally.
13. Cap lens and adjust multiplier focus G3 for most uniform black signal near maximum output. Residual frame and line tilt is corrected by insertion of shading correction.
14. Adjust gain for signal of correct amplitude.
15. Readjust beam focus and image focus for sharpest picture.

* Alternatively the Marconi diascope and mask as designed for the Marconi Mark III camera may be used.

Standby Procedure

During programme and rehearsal breaks of short durations, the camera should be capped up. It is unnecessary and undesirable to bias off the beam, which should be left at the picture setting. This ensures that the potential of the target glass remains stable and that high potential differences between the target glass and mesh, which may cause contact of the two elements, do not develop.

In addition it improves the stability of the beam and multiplier, with an accompanying improvement in the signal to noise ratio.

If an "electronic cap" is required, this should be done by switching photocathode potential to +10V. approx. during standby periods. Although no signal is transmitted by the tube under these conditions, damage to the photocathode can occur if the camera is left pointing at bright lights.

Under no conditions should the filament voltage be switched off without removing the high tension supplies to the tube.

Target Voltage

The target voltage should be set at 2V.

Operation at a higher target voltage is undesirable for the following reasons:—

(i) Tube life is reduced.

(ii) Inter field flicker effects are more pronounced.

(iii) Onset of microphony is encouraged.

Conversely operation at target voltages lower than 2 volts should be avoided, as under these conditions the signal to noise ratio is poor due to the deterioration in beam modulation, and the contrast range of the tube is limited.

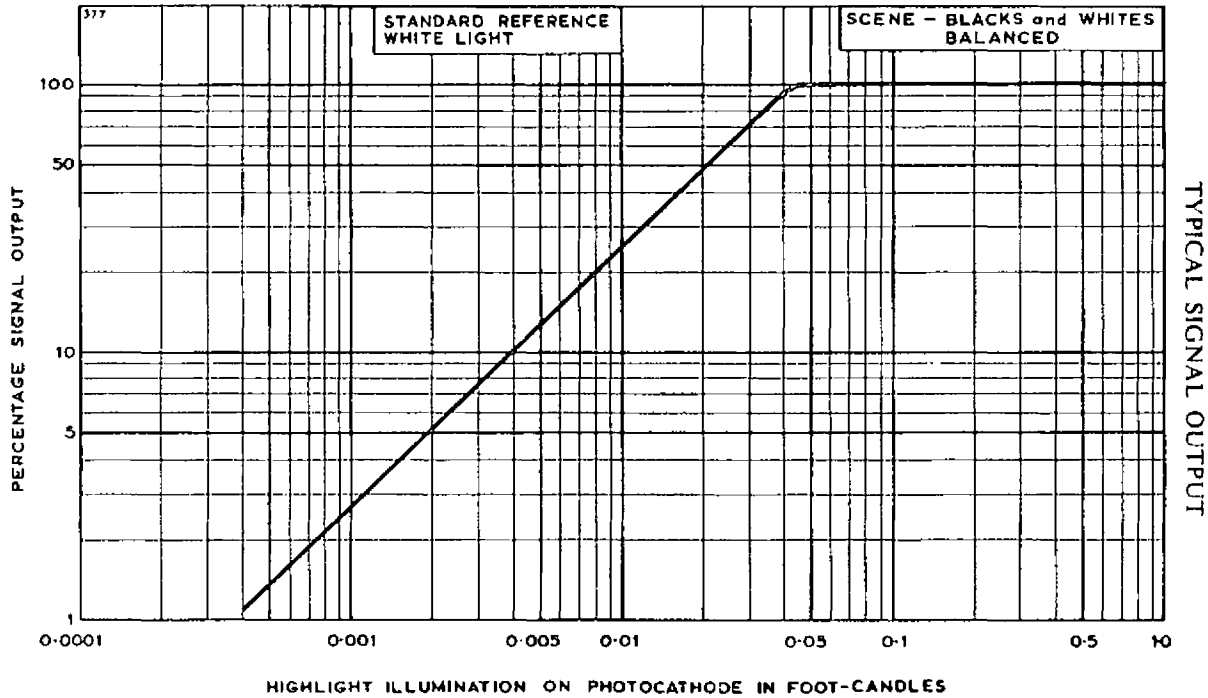
Shading Correction

The line and field shading correction signals should only be used, if after setting up the tube in accordance with the above instructions, there remains shading on the picture. As the correcting waveforms are sawtooth in shape it is only possible to correct linear shading faults. If the shading has a parabolic form it is usually corrected by adjusting the multiplier focus.

Adjustment of Exposure

As a general instruction the lens aperture should be opened until the highlights are between ½ and 1 stop above the knee. However, the quality of the pictures obtained under this condition is very dependent upon the contrast of the scene being reproduced.

The position of the "knee" can be determined by observing the wave form monitor whilst the lens aperture is opened. The highlight signal will increase steadily to a certain value and then saturate. At this point the high-



lights are at the knee of the transfer characteristic. The preferred operating point can then be determined by opening the lens aperture one stop number, or adjusting the filter wheel by the equivalent amount.

Ideally the lens aperture required for each shot should be determined and noted during the lighting rehearsal. However, this is often not possible, the adjustment being made immediately before the camera is taken on a new shot. In this case the lens or filter wheel should be adjusted until the highlight saturation occurs and expansion of the grey tones takes place. Correct operation is facilitated if the highlight levels in the various sets are adjusted so that, with a given acceptable aperture setting, differences from set to set may be accommodated on the filter wheel.

The stop number, and hence the incident illumination on the photocathode required to reach the knee will vary from tube to tube. It is a function of the sensitivity of the image section of the tube.

The illumination on the photocathode can be estimated from a knowledge of the scene illumination by means of the following expression,

$$Ipc = \frac{BT}{4f^2(m+1)^2}$$

B = Brightness of subject in foot lamberts.
Ipc = Photocathode illumination in foot candles.
T = Total transmission of lens.
f = number of lens stop.
m = Linear magnification from scene to photocathode.

Except for close-ups the linear magnification m may be ignored.

For an average tube the knee will occur at a value of the photocathode highlight illumination of approximately .01 ft. candles.

On very bright days it may not be possible to stop the lens down far enough to reduce the highlight illumination on the photocathode to a value near the knee of the output curve. When such a condition is encountered the use of a neutral filter selected to give the required reduction in illumination is recommended. Generally, two filters, one having 1% transmission and the other 10%, will give sufficient choice.

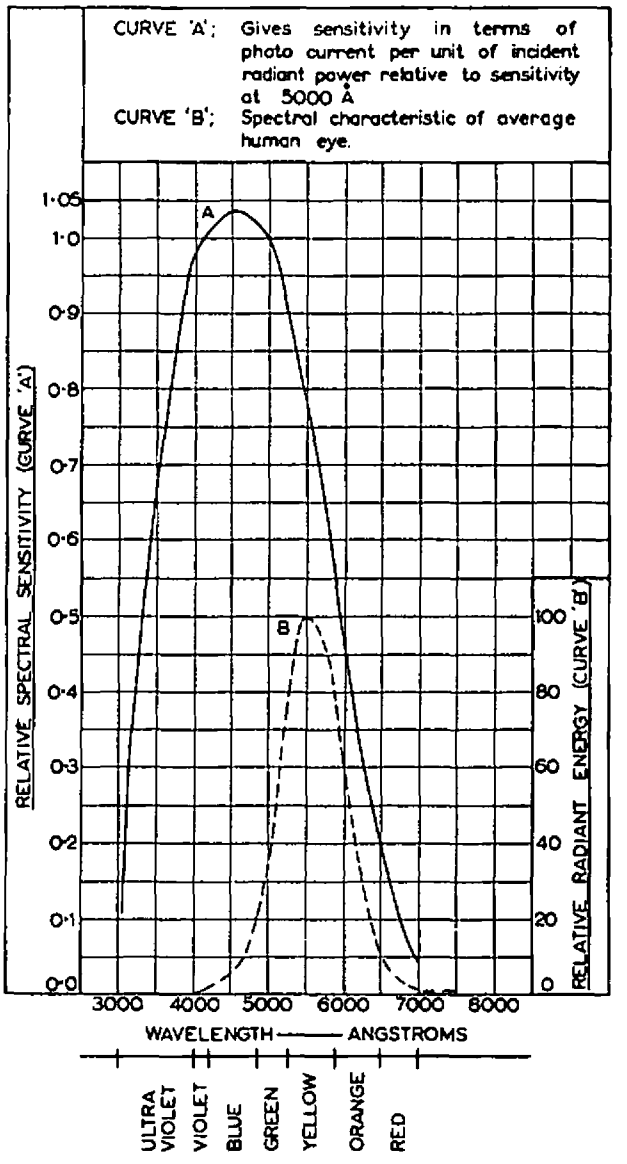
For normal operation the iris should be adjusted so that the highlights on the photocathode bring the signal output slightly over the knee of the signal output curve.

If sufficient light is available, it is sometimes advantageous to operate the tube two stops above the knee. Under these conditions the knee occurs at approximately one quarter the peak highlight brightness, and the low gamma part of the characteristic can be utilised.

OPERATIONAL NOTES

1. Scanning of Target

It is essential that the correct area of the target should be scanned. The continual transferance of charge through the target causes a gradual change in the contact potential of the target with respect to the thermionic cathode of the gun. As a result the scanned area slowly darkens giving rise to what is termed "raster burn." This is not apparent if the same area of the target is always employed, but, if at some time the target has been under scanned, this effect will be apparent, when correct scanning is re-introduced. Under-scanning the target produces a picture of larger magnification on the monitor.



In a similar manner failure of either of the scanning circuits during operation will cause permanent damage to the target. This will appear as a dark line or spot when normal scanning is resumed.

To avoid damage to the target, provision should be made for automatically biassing the beam off in the event of failure of either of the deflection circuits.

Overscanning the target is permissible during rehearsal, but the scanning amplitudes should be reduced to their correct values before transmission.

Overscanning the target produces a picture of lower magnification at the monitor, and limits the resolution of the system.

2. Sticking Picture

If the 7294 tube is operated before it has reached the correct temperature, i.e. between 35°C and 50°C, a "sticking picture" will be observed. Images are retained for several seconds, gradually fading away. The magnitude of the effect depends upon the age of the tube, and in the case of an old tube, the image will be retained for a considerable period. The erasing of the sticking picture

can be accelerated by directing the 7294 towards a clear white screen and allowing the tube to operate with an illumination consistent with a satisfactory picture and

A "sticking picture" will also be observed if the 7294 is left stationary on a bright scene for more than a few minutes. The risk may be reduced by using the lowest illumination of about 1 foot candle on the photo-cathode. limiting the time of exposure.

3. Moire Pattern

A beat pattern, generated by the beating of the scanning lines against the lines of the target mesh is sometimes observed. It appears as a moire pattern which is noticeable on the large highlight areas. The pattern can be reduced by a slight defocussing of the beam without serious loss of resolution. A slight change in the amplitude of the horizontal or vertical scans is sometimes efficacious.

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DO'S and DON'TS on the use of the 7294

Here are the "do's"—

1. Allow the 7294 to warm up prior to operation.
2. Hold temperature of the 7294 within operating range.
3. Make sure beam is correctly aligned.
4. Check scene illumination before televising.
5. Select lens stop for best picture.
6. Use lowest beam current and highest target voltage for best signal to noise ratio.
7. Adjust beam focus control for best usable resolution.
8. Condition spare 7294's by operating them several hours each month.

Here are the "don'ts"—

1. Don't force the 7294 into its shoulder socket.
2. Don't operate the 7294 without scanning.
3. Don't underscan the target.
4. Don't focus the 7294 on a stationary bright scene.
5. Don't carry a 7294 with the Image Section downwards.
6. Don't store or pack a 7294 with the Image Section downwards.

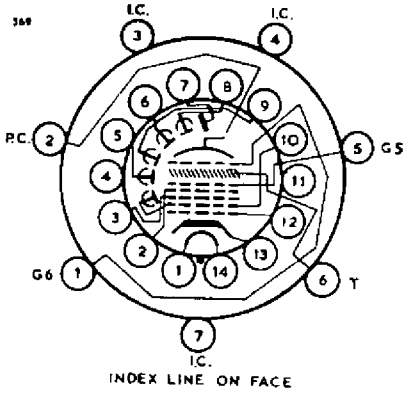
The significance of each of the above "do's" and "don'ts" in obtaining optimum performance from the 7294 is explained in the preceding pages of this bulletin.

SMALL-SHELL DIHEPTAL 14-PIN BASE

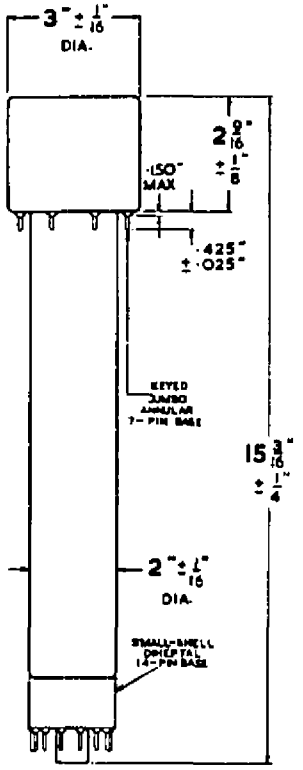
PIN 1: HEATER
PIN 2: GRID No. 4
PIN 3: GRID No. 3
PIN 4: INTERNAL CONNECTION - DO NOT USE
PIN 5: DYNODE No. 2
PIN 6: DYNODE No. 4
PIN 7: ANODE
PIN 8: DYNODE No. 5
PIN 9: DYNODE No. 3
PIN 10: DYNODE No. 1, GRID No. 2
PIN 11: INTERNAL CONNECTION - DO NOT USE
PIN 12: GRID No. 1
PIN 13: CATHODE
PIN 14: HEATER

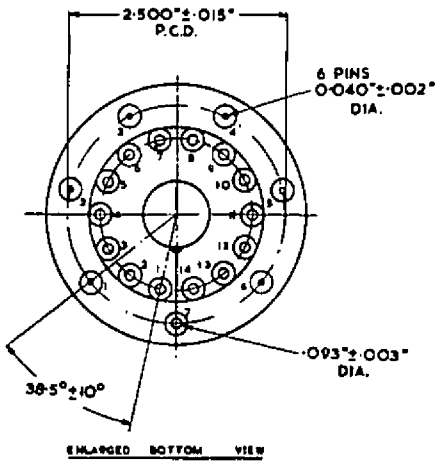
KEYED JUMBO ANNULAR 7-PIN BASE

PIN 1: GRID No. 6
PIN 2: PHOTOCATHODE
PIN 3: INTERNAL CONNECTION - DO NOT USE
PIN 4: INTERNAL CONNECTION - DO NOT USE
PIN 5: GRID No. 5 DECELERATOR
PIN 6: TARGET
PIN 7: INTERNAL CONNECTION - DO NOT USE

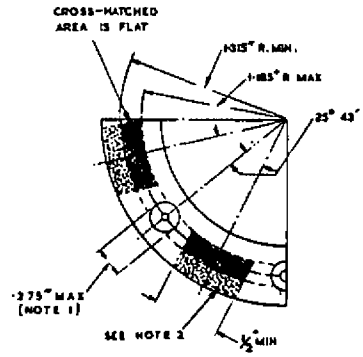


SOCKET CONNECTIONS
BOTTOM VIEW





DETAIL OF BOTTOM VIEW OF KEYED JUMBO ANNULAR BASE



DIMENSIONAL OUTLINE

NOTE 1: Measure at a distance of 1/32" below bottom of annular base.

NOTE 2: Dotted area is flat or extends toward diheptal-base end of tube by 0.060" max.

KEYED ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26' ± 5' on circle diameter of 2.500" ± 0.001".

b. Six stops having height of 0.187" ± 0.001", centred between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 1/8" from 2 13/16" diameter and having height of 0.126" ± 0.001".

d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".

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