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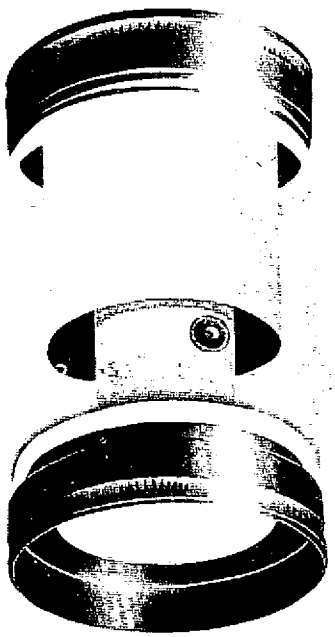
Image Converter Tube Type 7177/IC-6

ELECTRONIC CAMERA TUBES FEATURING LOW LIGHT LEVEL INTEGRATION AND CONTRAST ENHANCEMENT FOR USE IN HIGH-SPEED PHOTOGRAPHY, PULSED LIGHT SYSTEMS, AND HIGH-SPEED SINGLE-EVENT STUDIES.



The 7177/IC-6 Image Converter Tube is of the unipotential or fixed focus type. Consequently no focusing voltage is required. The cathode has a sensitivity range covering the visible near-infrared portion of the spectrum. Utilizing its ability to make visual an infrared image, its many uses include the inspection of photographic film, criminal investigation, and various military applications. It has also been effectively used as a light shutter for high speed photography.

COMPONENTS and INSTRUMENTATION Laboratory
Fort Wayne, Indiana

7177/IC-6 ELECTRICAL CHARACTERISTICS

	LOWER ALLOWABLE LIMIT	TYPICAL	UPPER ALLOWABLE LIMIT	
Photocathode to anode potential (1)	—	6	6.5	kv
Photocathode current density (2)	—	—	0.4	$\mu a/cm^2$
Dark current (3)	—	—	0.1	μa

GENERAL CHARACTERISTICS

Photocathode luminous sensitivity (4) (5) (6)	10	20	—	μa/lumen
Photocathode peak radiant sensitivity (4) (6) (7)	—	0.0018	—	amperes/watt
Phosphor screen luminous efficiency at 6 kv (6)	0.12	0.19	—	lumens/μa
Phosphor screen radiant efficiency at 6 kv (6)	—	0.066	—	watts/watt
Infrared conversion index at 6 kv (6)	2	3.8	—	—
Peak radiant power gain at 6 kv (6)	—	0.7	—	watts/watt
Image magnification (paraxial)	—	0.68	—	—
Radial image distortion at 7.35 mm from center of photocathode (6)	—	10	—	percent
Resolving power (paraxial) (6)	20	25	—	line pairs/mm
Resolving power at 7.35 mm from center of photocathode (6)	—	10	—	line pairs/mm
Mean background screen brightness at 6 kv (3)	—	—	1	μlambert
Ambient temperature	—	—	75	degrees C
Useful photocathode diameter	—	0.658	—	inch
Useful phosphor screen diameter	—	0.517	—	inch

Photocathode type.....S-1

Phosphor screen type.....P-20 (aluminized)

NOTES

(1) The upper allowable working voltage is specified on the basis of a suitable margin of safety regarding internal glow or flashover. Such glow or flashover invariably causes loss in stability or photocathode sensitivity.

(2) Averaged over an interval of not greater than 30 seconds.

(3) Photocathode not illuminated; temperature 25 degrees Centigrade.

(4) At 100 volts dc between photocathode and anode.

(5) With standard tungsten lamp source (2870 degrees Kelvin color temperature, coiled or coiled-coil filament, lead or lime glass envelope).

(6) See "definitions pertaining to image converter tubes".

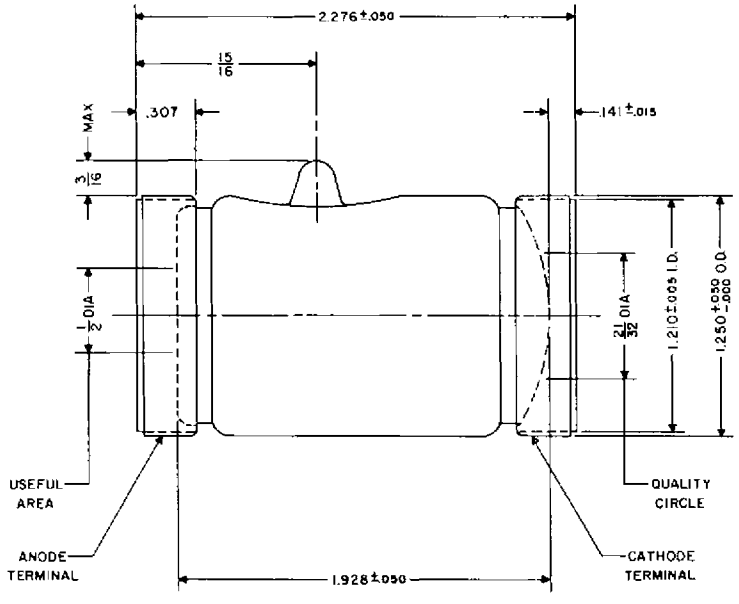
(7) Calculated from the approximate relationship: peak radiant sensitivity in amperes per watt equals 9×10^{-3} times the luminous sensitivity in microamperes per lumen; this relationship being derived for a photocathode having a typical S-1 spectral response peaking at 8000 Angstroms.

GENERAL INFORMATION

1. The 7177/IC-6 normally is used in conjunction with an objective lens and magnifying eyepiece. The inverted image on the cathode is reinverted by the electron optics of the tube so that the image as it appears on the screen or is seen through the eyepiece is erect. The objective may be either refractive or reflective (Schmidt), and should be designed with proper consideration given to the spherical cathode surface. The eyepiece should be a good quality achromat with a field slightly in excess of the useful phosphor screen area (0.517 inch diameter). A 7-power Hastings triplet will be found reasonably satisfactory for most applications.

2. For the majority of viewing applications a filtered tungsten lamp is used for irradiating the subject. The visible component is suitably suppressed with one of the readily available filters or with several in combination. (Wratten 87C, 88A, Corning 2540, and others.)

3. It is recommended that the precise internal dimensions of the photocathode and anode terminals indicated in the outline drawing be used in the tube mounting. This will aid in maintaining alignment of the tube with respect to the optical system when servicing.



OUTLINE DRAWING

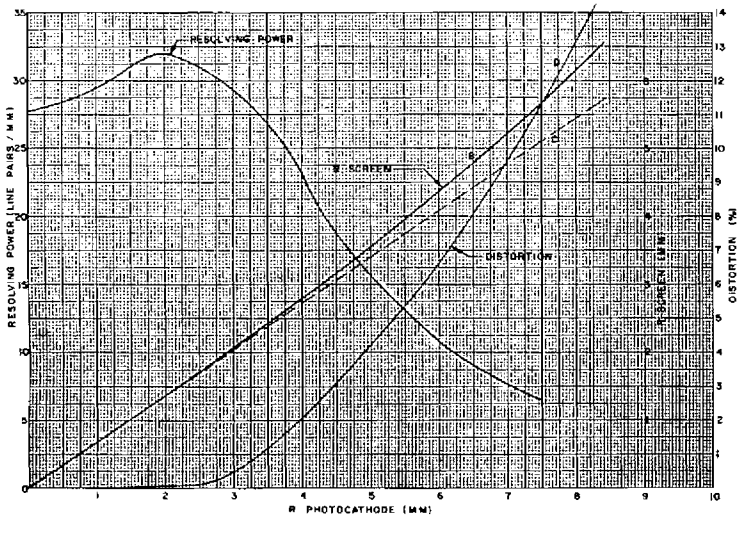
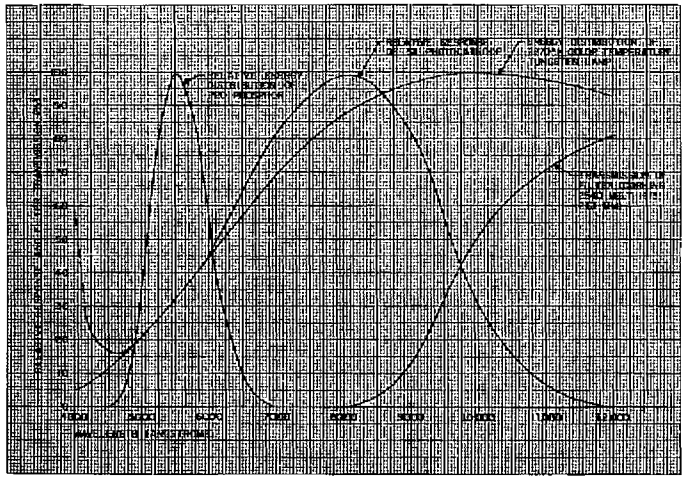


IMAGE CHARACTERISTICS



SPECTRAL CHARACTERISTICS

DEFINITIONS PERTAINING TO IMAGE CONVERTER TUBES

PHOTOCATHODE LUMINOUS SENSITIVITY

The ratio of the total photocurrent emitted by the photocathode to the total incident luminous flux; the incident flux being emitted by a standard 2870°K tungsten lamp source.

PHOTOCATHODE PEAK RADIANT SENSITIVITY

The ratio of the total photocurrent emitted by the photocathode to the total incident radiant flux; the incident flux being monochromatic radiation at the wavelength yielding maximum radiant sensitivity and being measured in suitable absolute units such as watts.

PHOSPHOR SCREEN LUMINOUS EFFICIENCY

The ratio of the total exit luminous flux to the electrical current input. Since this is a critical function of phosphor screen voltage, this voltage must be specified. (See Figure below).

PHOSPHOR SCREEN RADIANT EFFICIENCY

The ratio of the total exit radiant flux to the electrical power input. Since this is dependent to a certain extent on phosphor screen voltage, this voltage should be specified.

CONVERSION INDEX

The ratio of the total exit luminous flux divided by the luminous equivalent of the incident infrared flux. The incident infrared flux is that originating from a standard 2870°K tungsten lamp source and transmitted by a 2540 Corning filter (melt 1613, thickness 2.61 mm). Non-filtered light on the cathode must not exceed 0.1 lumen. Luminous equivalent is defined as the product of the luminous flux incident on the filter and the transmission factor as determined with a 2870 degree Kelvin tungsten source and a receiver with standard S-1 response.

$$\text{Conversion Index (C. I.)} = \frac{F_e}{F_i T}$$

where F_e = total exit luminous flux from phosphor screen

F_i = luminous flux incident on filter

T = transmission factor of filter

$$T = \frac{\int_0^\infty J_\lambda \, T_\lambda \, R_\lambda \, d\lambda}{\int_0^\infty J_\lambda \, R_\lambda \, d\lambda}$$

$T = 0.116$

J_λ = Power output of the standard lamp at wavelength λ per unit wavelength interval

R_λ = Fractional transmission of filter at wavelength λ

T_λ = Standard S-1 spectral response at wavelength λ

STANDARD LUMINOUS GAIN

The ratio of the total exit luminous flux to the total incident luminous flux, the incident luminous flux being emitted by a standard 2870°K tungsten lamp source, with no filter interposed between source and photocathode. In terms of associated tube parameters:

Luminous gain (lumens/lumen) =
photocathode luminous sensitivity (microamperes/lumen) ×
phosphor screen luminous efficiency (lumens/microampere).

Numerically, the luminous gain and the conversion index of an image converter tube are equal provided the photocathode has a standard S-1 spectral response. If the photocathode does not have this standard spectral response, the conversion index, which will then differ in general from the luminous gain, is a more appropriate measure of the capability of the tube as an infrared image converter.

PEAK RADIANT POWER GAIN

The ratio of the total exit radiant flux, measured in suitable absolute units such as watts, to the total incident radiant flux measured in the same units, the incident flux being monochromatic radiation at the wavelength of peak photocathode radiant sensitivity. In terms of associated tube parameters:

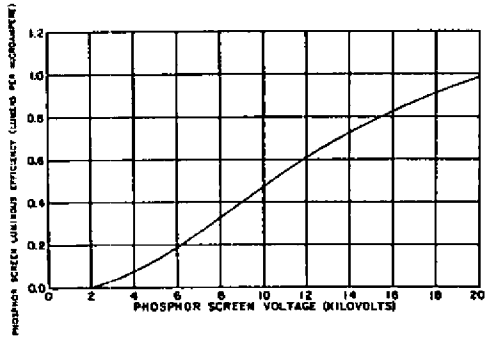
Peak Radiant Power Gain (watts/watt) =
Photocathode peak radiant sensitivity (amperes/watt) ×
accelerating potential (volts) ×
phosphor screen radiant efficiency (watts/watt).

DISTORTION

The percentage departure of the radial distance of an image point on the screen from the product of the radial distance of the corresponding object point on the photocathode and the paraxial magnification. For example, an illuminated point 6 mm from the center of the photocathode would theoretically be reproduced as a point 4.1 mm from the center of the screen (see Curve C), however, because of the 6.6 percent distortion at this distance from the center of the photocathode (see Curve D), the actual point will appear 4.35 mm from the center of the screen (see Curve B). The magnification at any radial position is the slope of curve B at that position.

RESOLVING POWER

The number of equally spaced parallel opaque lines per unit length (with spacing equal to the width of the lines) at the photocathode which may be observed in the resulting screen image.



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