PHOTOMULTIPLIER TUBES

Spectral Response	Diameter (nominal) in	No. of Stages	Secondary Emitting Surface	RCA Tube Types
S-1	1-1/2	10	Mg-O[a]	7102
S-4	1/2	9	Cs-Sb	8571
	1-1/8	9	Cs-Sb	IP21, 931A, 4471, 4472, 4473, 6328, 6472, 7117
S-5	1-1/8	9	Cs-Sb	IP28, IP28A
S-8	1-1/8	9	Cs-Sb	IP22
S-10	2	10	Cs-Sb	6217
S-11	3/4	6	Be-O	7764
		10	Be-O	4460, 7767
	1-1/2	10	Be-O	4461
		10	Cs-Sb	2060, 2067, 4438, 4439, 4440, 4441, 4441A, 6199
	2	10	Be-O	2020, 2061, 2063, 6342A, 7746, 8053
		10	Cs-Sb	2062, 5819, 6655A
		12	Be-O	7850
		14	Be-O	6810A, 7264
	3	10	Be-O	2064, 2064B, 8054
	5	10	Be-O	2065, 8055
S-11[b]	5	14	Be-O	7046
S-13	2	10	Cs-Sb	6903
S-19	1-1/2	9	Cs-Sb	7200
S-20	3/4	10	Be-O	8644, 8645
	2	10	Be-O	4463, 7326
		12	Be-O	4459
		14	Be-O	7265
	3	10	Be-O	4464
	5	10	Be-O	4465
(c)	2	10	Be-O	4523
	3	10	Be-O	4524
	5	10	Be-O	4525
	2	12	Be-O	8575

VACUUM AND GAS PHOTODIODES

Spectral Response	Single-Unit		Twin Unit	Anode-Cathode
	Vacuum	Gas	Gas	Vacuum
S-1	917 919 922 925 6570	1P40 1P41 868 918 921 923 927 930 6405/1640 6953	920	
S-3	926	1P29		
S-4	1P39 929 934 5653 7043	1P37 4409 5581 5582 5583		5652
S-5	935			
S-9	1P42			

IMAGE-CONVERTER TUBES[d]

Spectral Response	Recommended Service	
	Infrared	Photographic Shutter
S-1	6032A 6914 6914A 6929	
S-11		4449A

CAMERA TUBES

	VIDICONS[e]		
	Recommended Service		
Tube Diameter inches	Television Film Pickup	Live Television and Industrial	Space Military and Industrial
1/2			4427
1	7038 8134/V1 8572	4478 4488 4493 4494 4495 7262A 7697 7735B 8134 8507 8573	2048[b] 4482[b] 4500 4503[b] 7263A[b] 8567[b]

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

CAMERA TUBES

VIDICONS[e] (Cont'd)

Tube Diameter inches	Recommended Service		
	Television Film Pickup	Live Television and Industrial	Space Military, and Industrial
1-1/2	8051 8480 8480/V1		8480 8521

IMAGE ORTHICONS

Tube Diameter inches	Recommended Service		
	Live Television Pickup		Military and Industrial
	Color	Black and White	
3	4415, 4416 4415/S, 4416/S[g] 7513[h] 7513/S, 4513/S[g] 7513/L 8092A/S	4401V1 4401V1/L 5820A 5820A/L 7293A 7293A/L 7513 7513/L 8092A 8093A 8093A/L	4401V1 4401V1/L 7198A[b] 7629A 7967 8092A
4-1/2	4492[j]	7295B 7295C 7389B 7389C	

IMAGE-INTENSIFIER ORTHICON

Tube Diameter inches	Combined Image-Converter and Image Orthicon Sections
	Recommended Service
	Extremely Low-Light Level Television Cameras
5	4470

[a] This surface is being replaced gradually by Be-O.

[b] Has extended spectral response in the near-ultraviolet. Maximum response occurs at about 4200 angstroms. The approximate spectral range, at the 10 per cent points, is from 2500 to 6500 angstroms.

[c] A spectral-response S- designation has not been assigned for these bialkali photocathode types. Maximum response occurs at about 3850 angstroms for approximate spectral range, at the 10 per cent points, is from 2600 to 6000 angstroms for type 8575 and from 3100 to 6100 for types 4523, 4524, and 4525.

[d] These types utilize a P20 phosphor screen except type 4449A which has a P11 phosphor screen.

[e] Variants of each vidicon type having fiber-optics faceplates, reticles, and/or radiation-resistant faceplates can often be supplied to meet the needs of specific applications.

[f] Ruggedized type.

[g] Types 4415/S, 4416/S are available as a trio having matched characteristics. The 4415/S's are for use in the red and green channels and the 4416/S is for use in the blue channel. Types 7513/S, 4513/S are also available as a set of three tubes having matched characteristics. Types 7513/S are for the red and green channels and type 4513/S for the blue.

[h] A trio of these tubes having matched characteristics is available as three type 7513/S.

[j] For the luminance channel in 4-tube color cameras.

DEFINITIONS

of Photosensitive-Device Terms

Radiant Sensitivity. The quotient of output current by incident radiant power of a given wavelength, at constant electrode voltages.

Radiant Intensity Sensitivity. The quotient of output current by incident radiant power per unit area, at constant electrode voltages.

Cathode Radiant Sensitivity. The quotient of current leaving the photocathode by incident radiant power of a given wavelength.

Luminous Sensitivity. The quotient of output current by incident luminous flux, at constant electrode voltages.

Luminous Intensity Sensitivity. The quotient of the output current by the incident luminous intensity, at constant electrode voltages.

Cathode Luminous Sensitivity. The quotient of current leaving the photocathode by the incident luminous flux.

Illumination Sensitivity. The quotient of output current by the incident illumination, at constant electrode voltages.

Dynamic Sensitivity. The quotient of the modulated component of the electrical output by the modulated component of the incident radiation.

Current Amplification. Ratio of the output current to the photocathode current, at constant electrode voltages.

Equivalent Anode-Dark-Current Input. The quotient of the anode dark current by the luminous sensitivity.

Equivalent Noise Input. That value of incident luminous flux which when modulated in a stated manner produces an rms output current equal to the rms noise current within a specified bandwidth.

Electrode Dark Current. The electrode current which flows when there is no radiant flux incident on the photocathode.

Transit-Time Spread. The increase in width of the output pulse over that of the input pulse. Pulse width is measured at 50 per cent of the pulse height.

Pulse Rise Time. The time required for the instantaneous amplitude of the pulse to go from 10 per cent to 90 per cent of the peak value.

Median. That value in a series such that half of the devices in the series are on one side of it, and half on the other.

PHOTOTUBE SENSITIVITY AND SENSITIVITY MEASUREMENTS

GENERAL CONSIDERATIONS

The range of luminous-sensitivity limits given for a phototube on the data sheets of this Section is that which the tube will display when operated under low-current conditions.

If the tube is to be operated under conditions approaching its maximum-current rating, the equipment design should provide for a wider sensitivity range having a minimum value equal to one-half of that shown for low-current operation. The sensitivity of a phototube under such high-current conditions is dependent upon the tube type, as follows:

1. Single-Unit and Twin Phototubes

a. Gas Types: For high-current operation, and particularly in applications in which the type is subjected to these higher values continuously, a drop in sensitivity below the values for low-current operation may be expected, the extent of the drop being affected by the severity of the operating conditions. After a period of idleness, a gas phototube usually recovers most of its initial sensitivity.

b. Vacuum Types: Unlike gas phototubes, this class of phototubes shows negligible drop in sensitivity values for different degrees of illumination and over long periods of use. The output current of a vacuum phototube is a linear function of the exciting illumination under normal operating conditions. The frequency response is flat up to frequencies at which transit-time effects become the limiting factor.

2. Multiplier Phototubes

Although RCA Multiplier Phototubes are vacuum types, a drop in sensitivity is to be expected from this class of phototubes when operated at high anode-current values. The extent of the drop is affected by the nature and severity of the operating conditions to which the tube is subjected. After a period of idleness, the multiplier phototube usually recovers a substantial percentage of this loss of sensitivity.

Multiplier-phototube-sensitivity values are dependent on the respective amplification of each dynode stage. Hence, large variations in sensitivity can be expected between individual tubes of a given type. The overall amplification of a multiplier phototube is equal to the average amplification per stage raised to the nth power, where n is the number of stages. Thus, very small variations in amplification per stage produce very large changes in overall tube amplification.

Because these overall changes are very large, it is advisable for designers to provide adequate adjustment of the supply voltage per stage so as to be able to adjust the amplification of individual tubes to the desired design value. It is suggested that an overall voltage-adjustment

(continued on next page)

range of at least 2 to 1 be provided. When the output current can be controlled by change in the illumination of the photocathode of the multiplier phototube, the required range of adjustment in the voltage per stage can be reduced.

SENSITIVITY MEASUREMENTS

The luminous-sensitivity values shown on the data pages of this Section are measured according to the following procedures:

1. Single-Unit and Twin Phototubes

a. Gas Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. For the 0-cycle measurements, a light input of 0.1 lumen is used, unless otherwise specified. For the 5000- and 10000 cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean. For all measurements, a dc anode-supply voltage of 90 volts and a 1.0-megohm load resistor are employed. Under these conditions, the effect of tube capacitance is negligible.

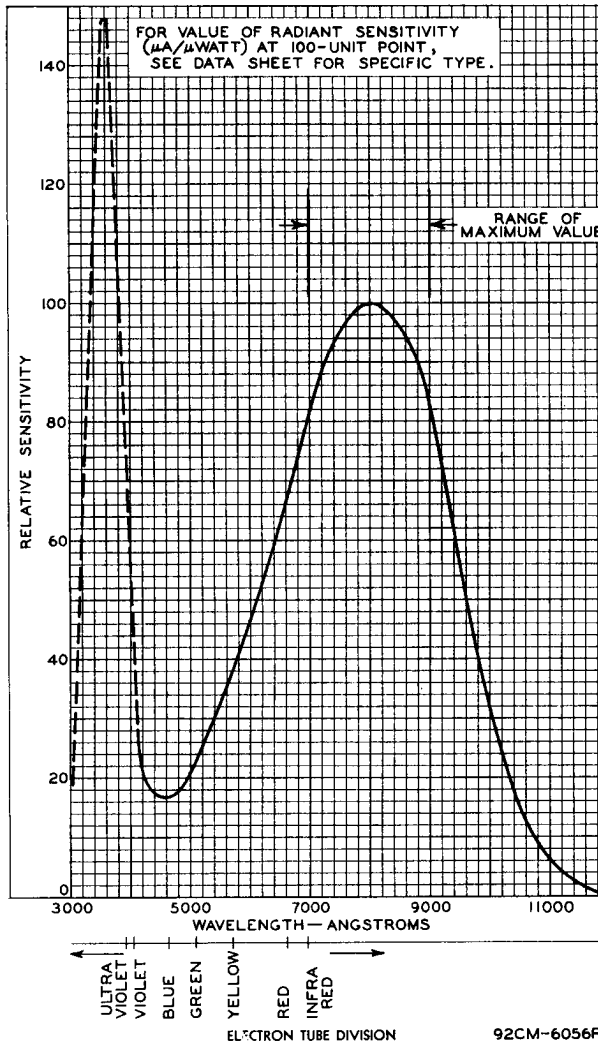
b. Vacuum Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A steady light input of 0.1 lumen is used, unless otherwise specified, together with a dc anode-supply voltage of 250 volts and a 1-megohm load resistor.

2. Multiplier Phototubes

The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A light flux of 10 microlumens from a rectangular aperture approximately 0.8" long and 0.2" wide is projected normal to the cathode in the direction noted on the basing diagram and outline. The load resistor has a value of 0.01 megohm. The applied voltages are specified on the individual data sheets.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-1 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



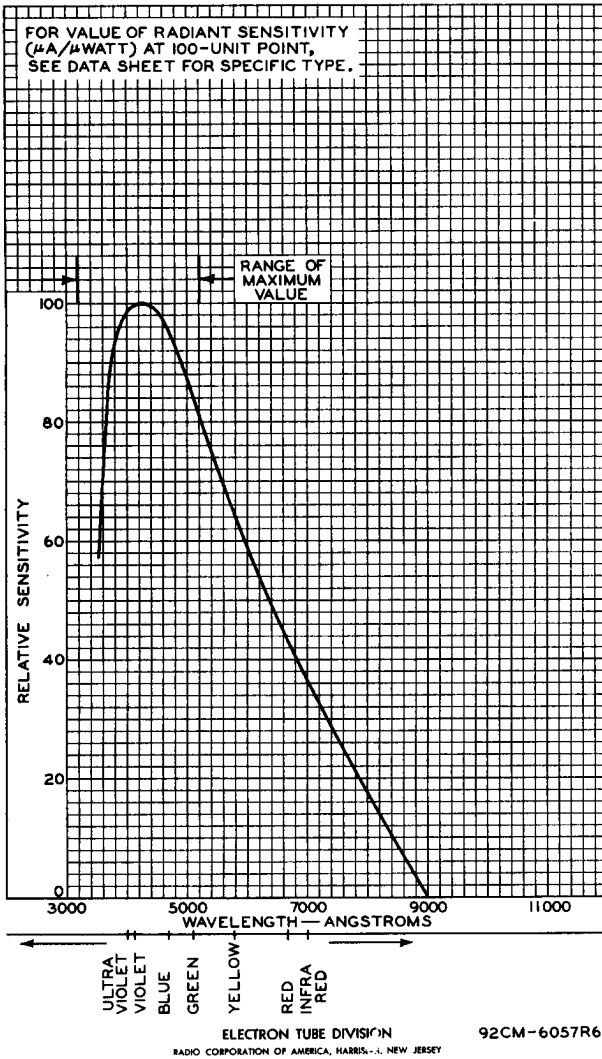
ELECTRON TUBE DIVISION

92CM-6056R6

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-3 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



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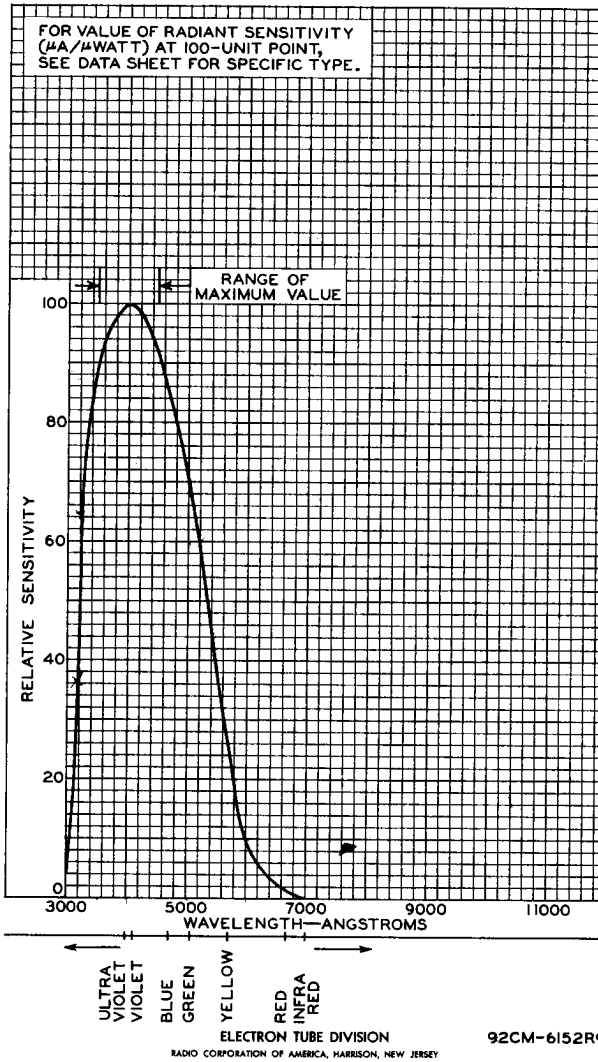
92CM-6057R6

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION

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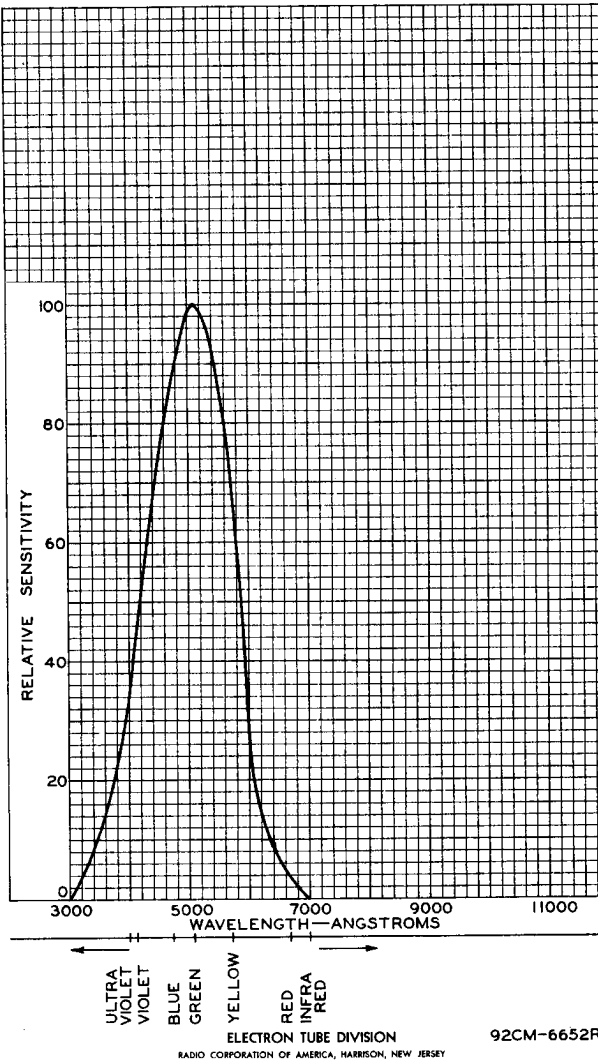
92CM-6152R9

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE

RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K



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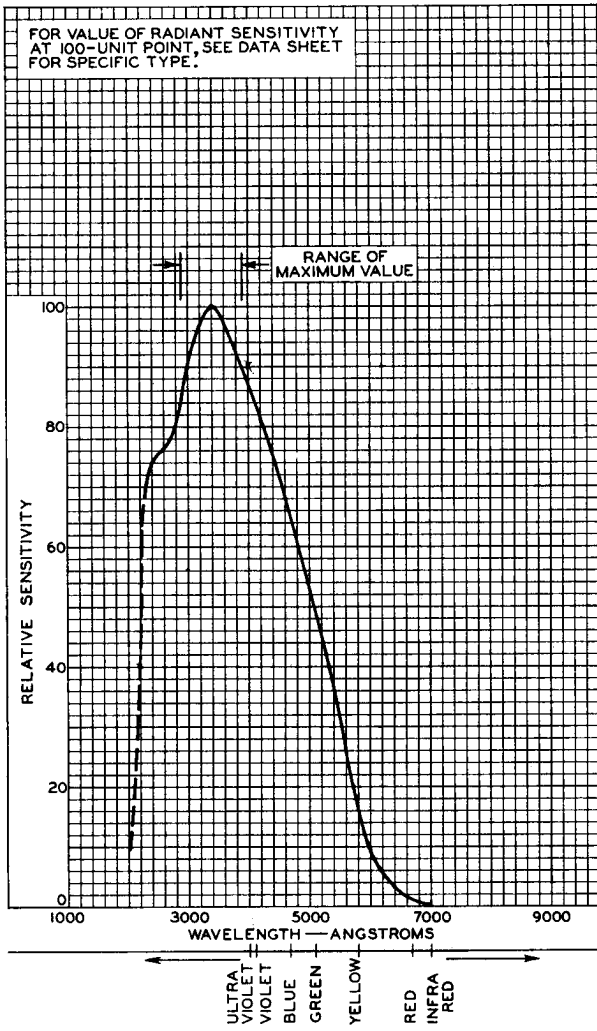
92CM-6652R3

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-5 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

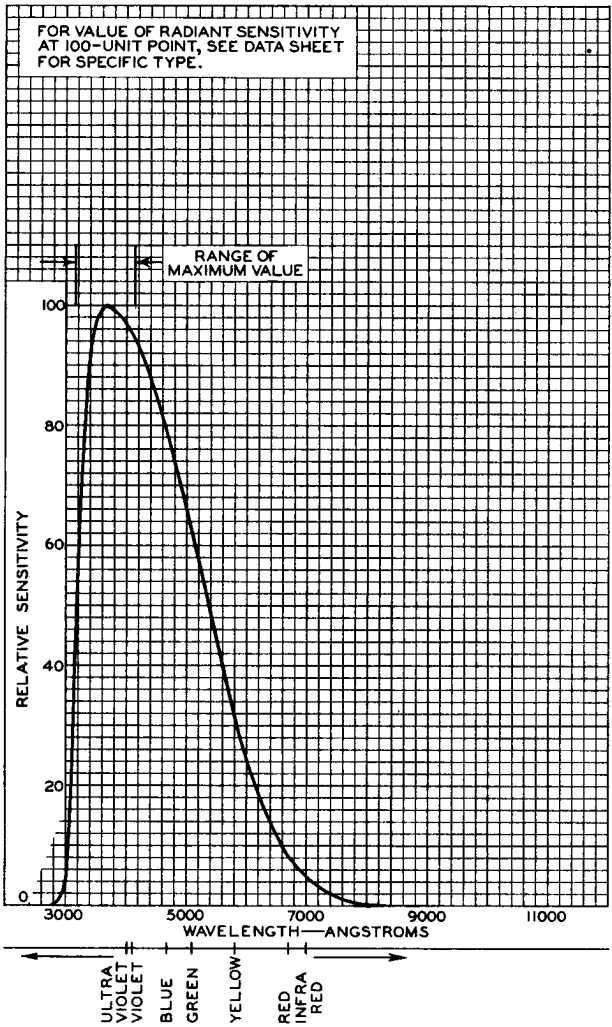


ELECTRON TUBE DIVISION

92CM-6814R2

SPECTRAL–SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-8 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

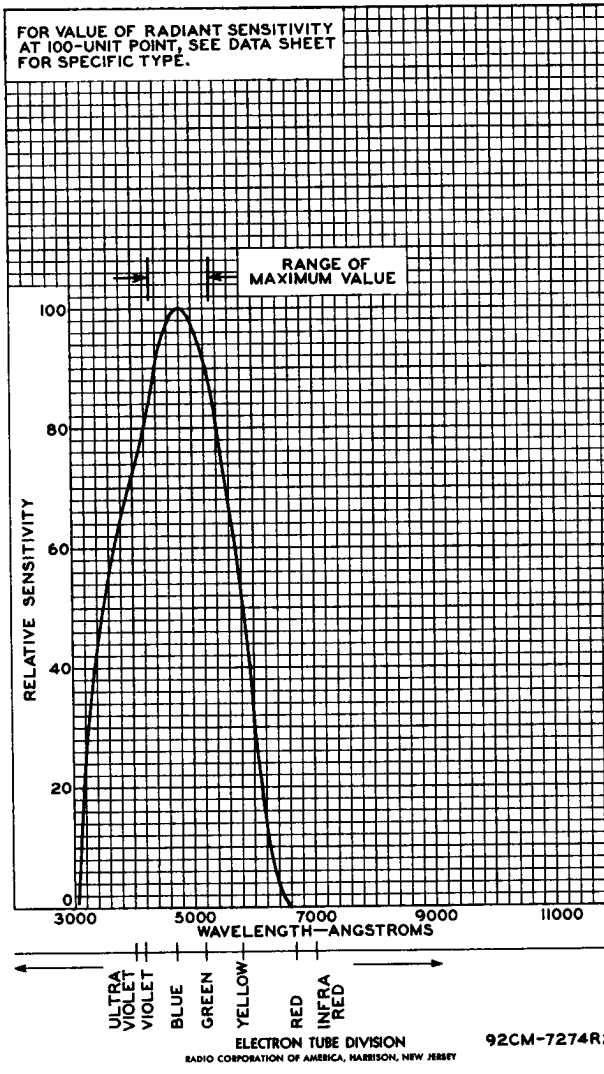


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6592R3

SPECTRAL—SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-9 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

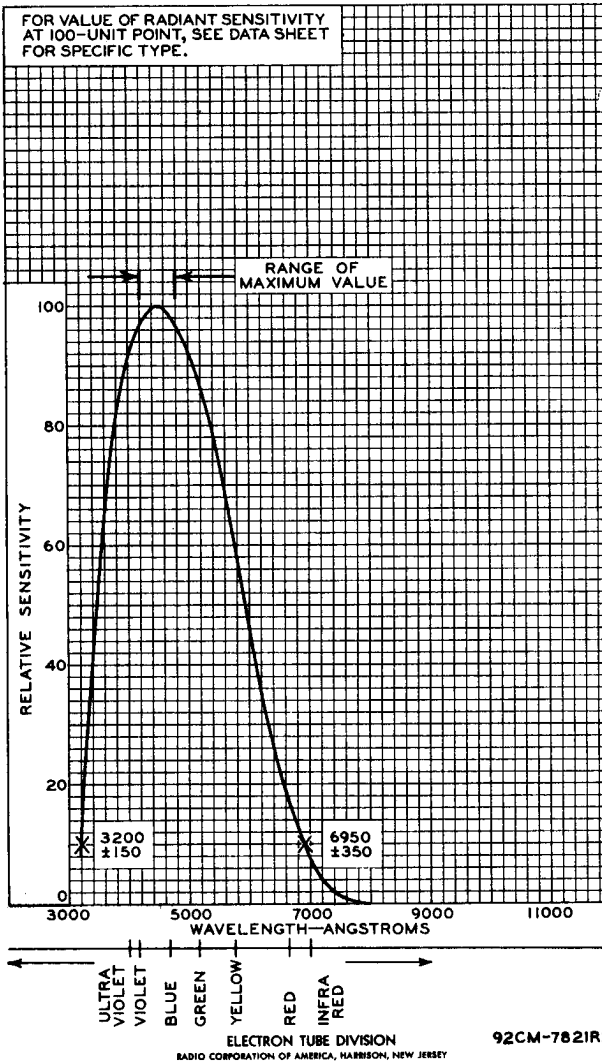


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-7274R2

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION

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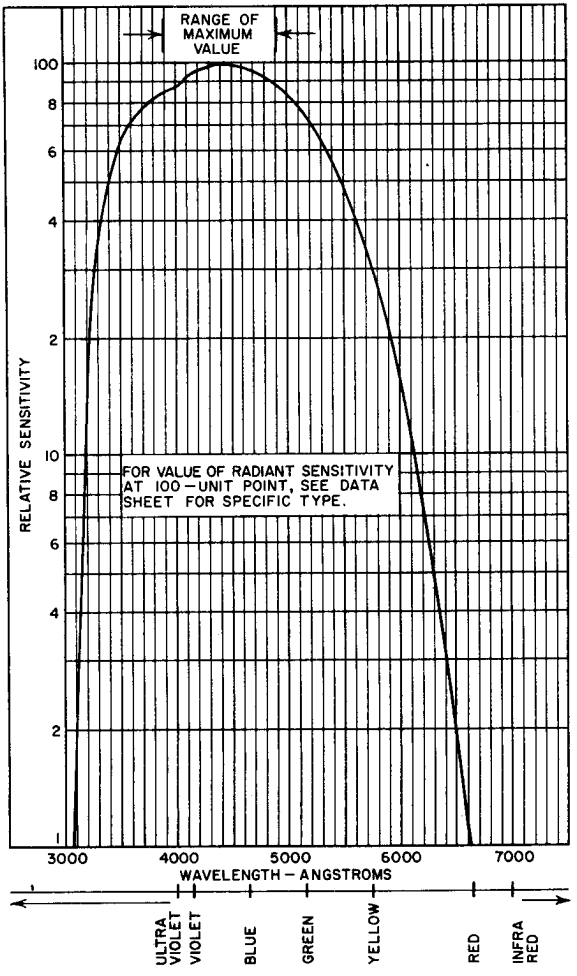
92CM-7821R2

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE

For Equal Values of Radiant Power at All Wavelengths

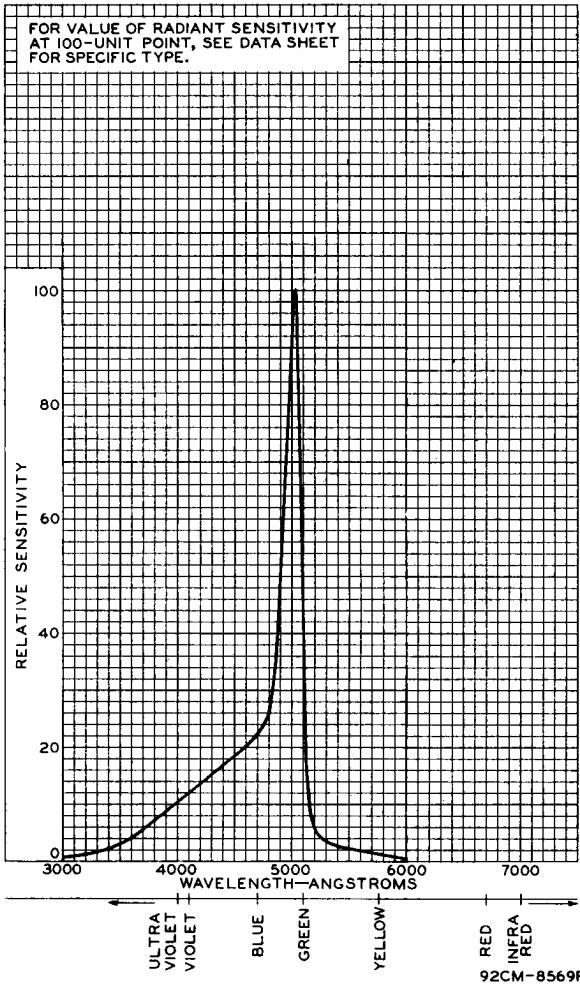


92CM-10662RI

Response S-12

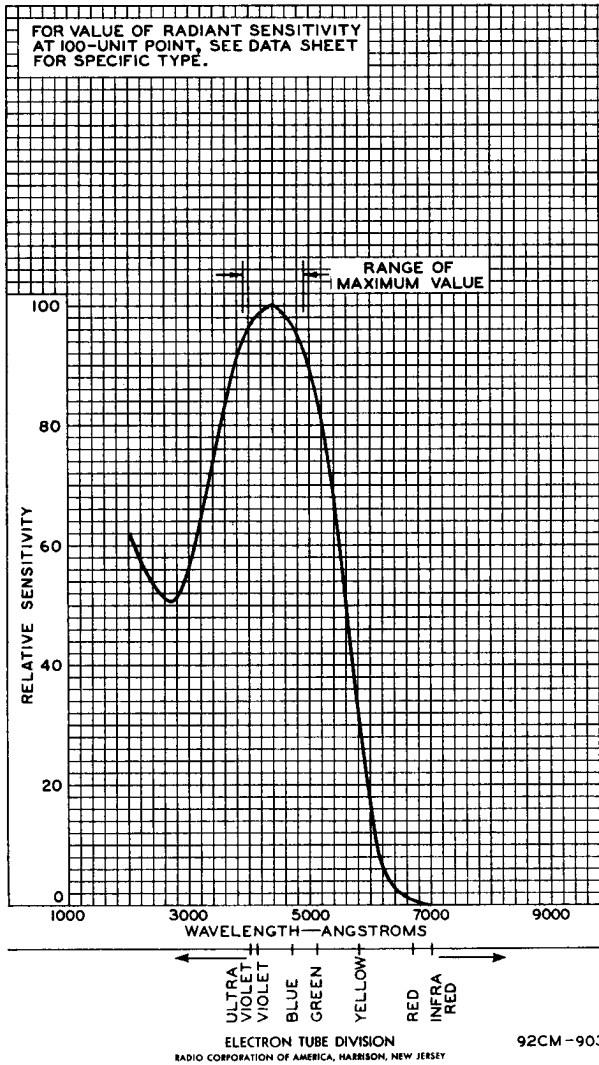
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-12 RESPONSE

For Equal Values of Radiant Power at All Wavelengths



TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-13 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

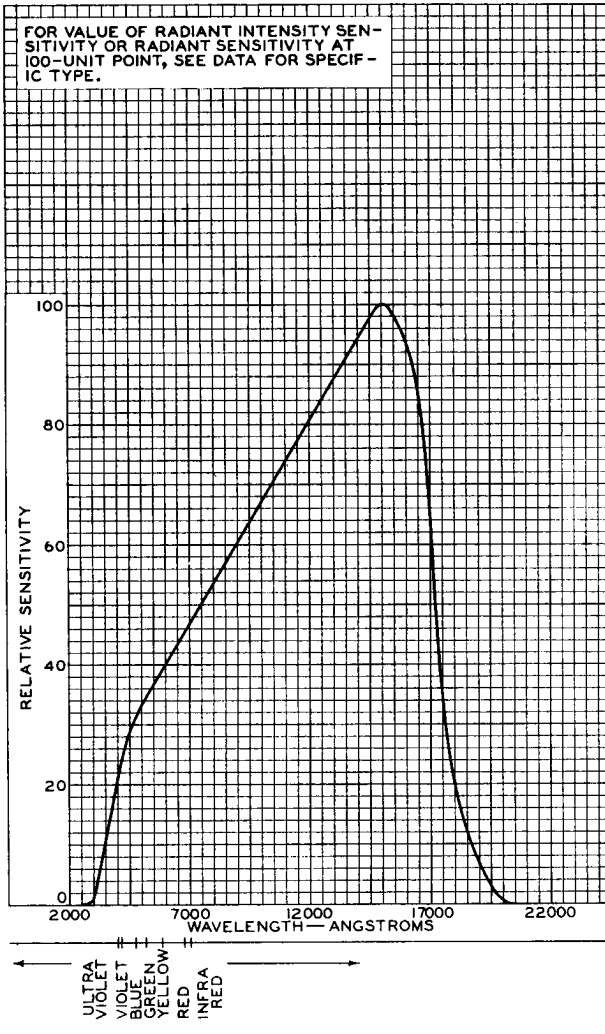


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9037RI

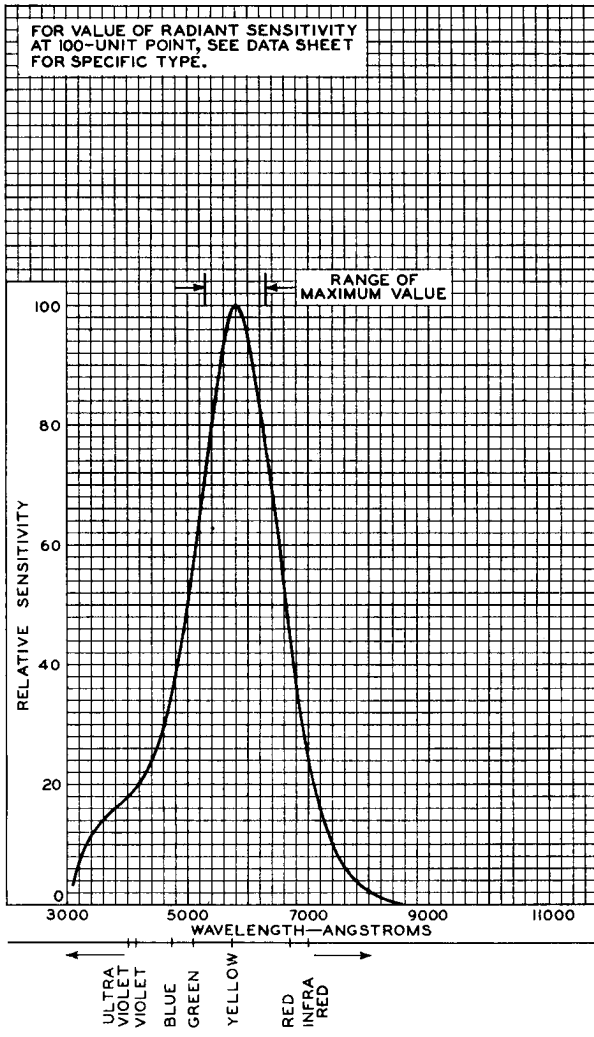
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOJUNCTION CELL HAVING S-14 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOCONDUCTIVE CELL HAVING S-15 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

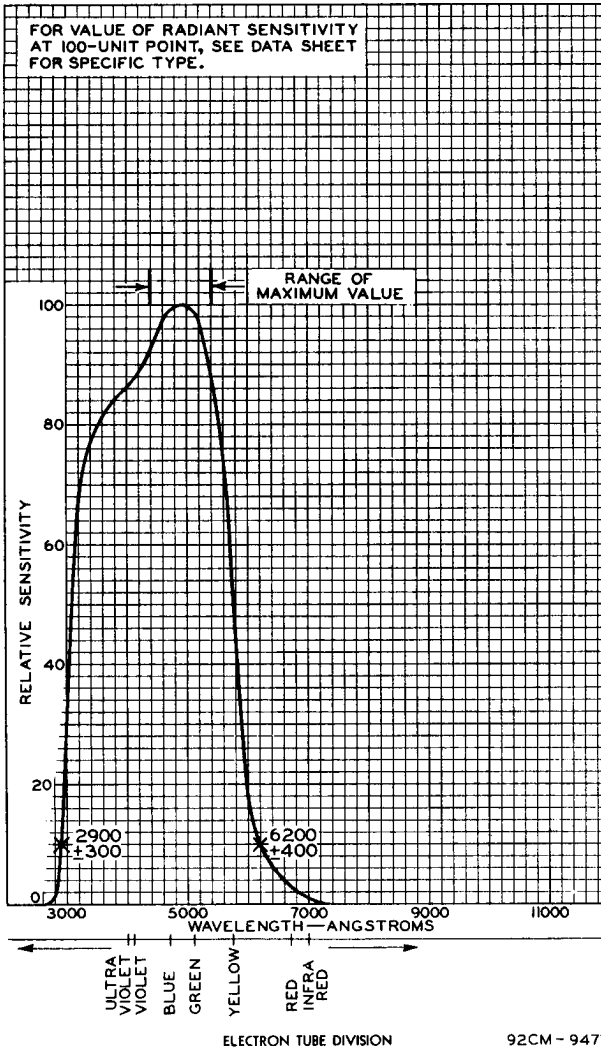


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9206RI

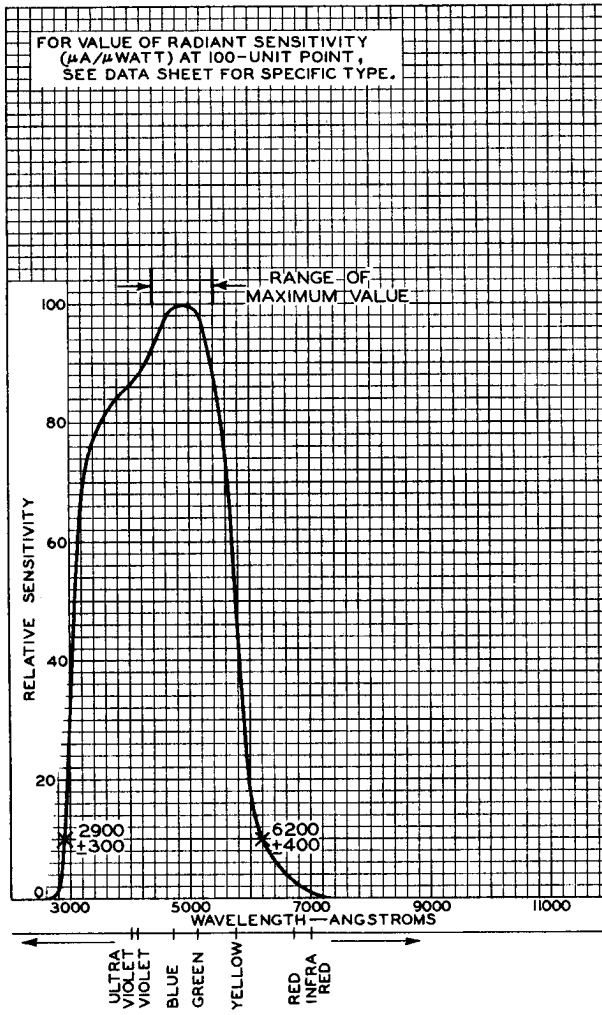
TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-17 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-17 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

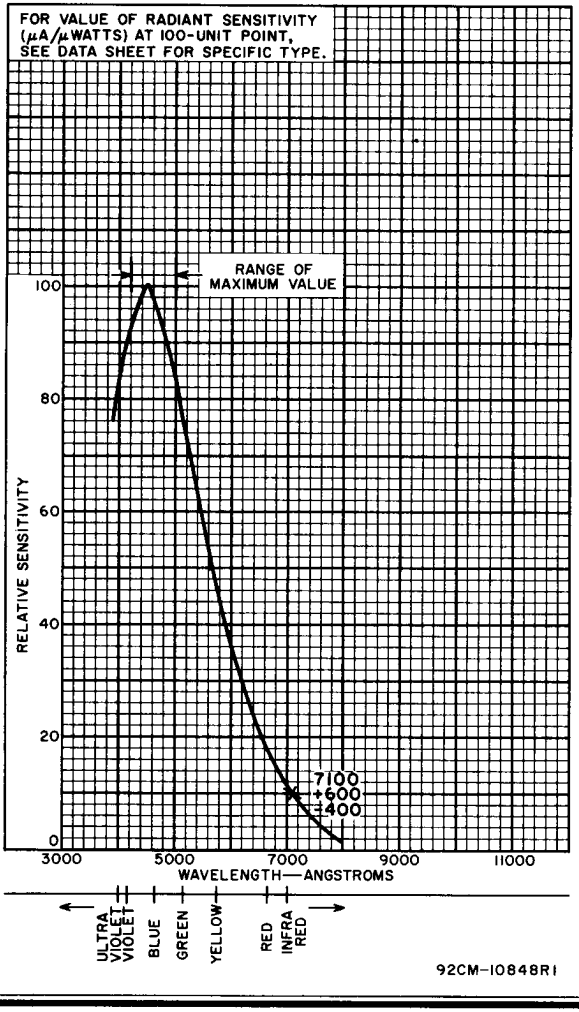


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9477

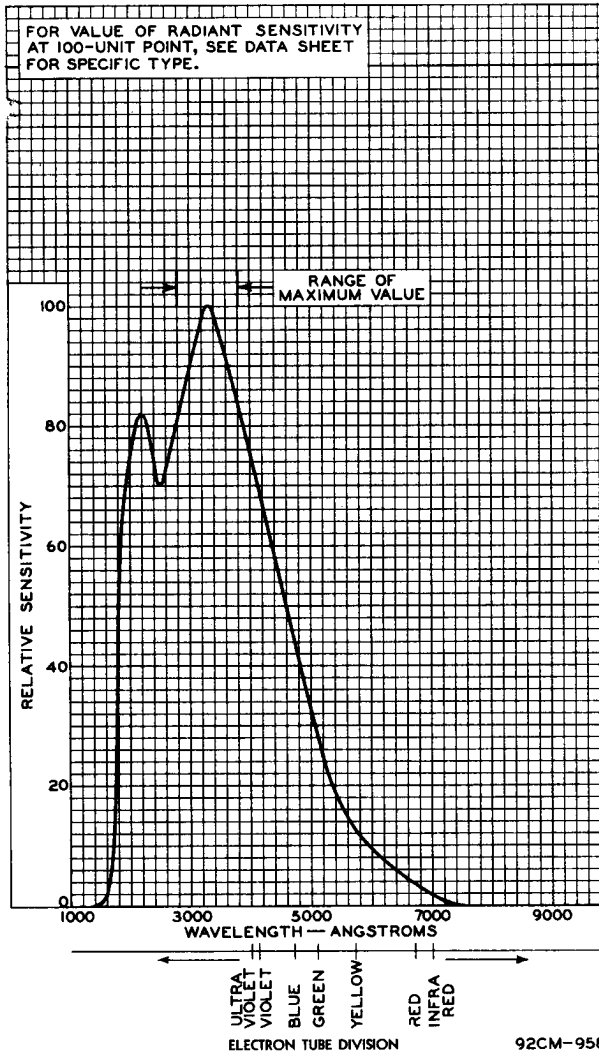
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-18 RESPONSE

For Equal Values of Radiant Power at All Wavelengths



TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-19 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



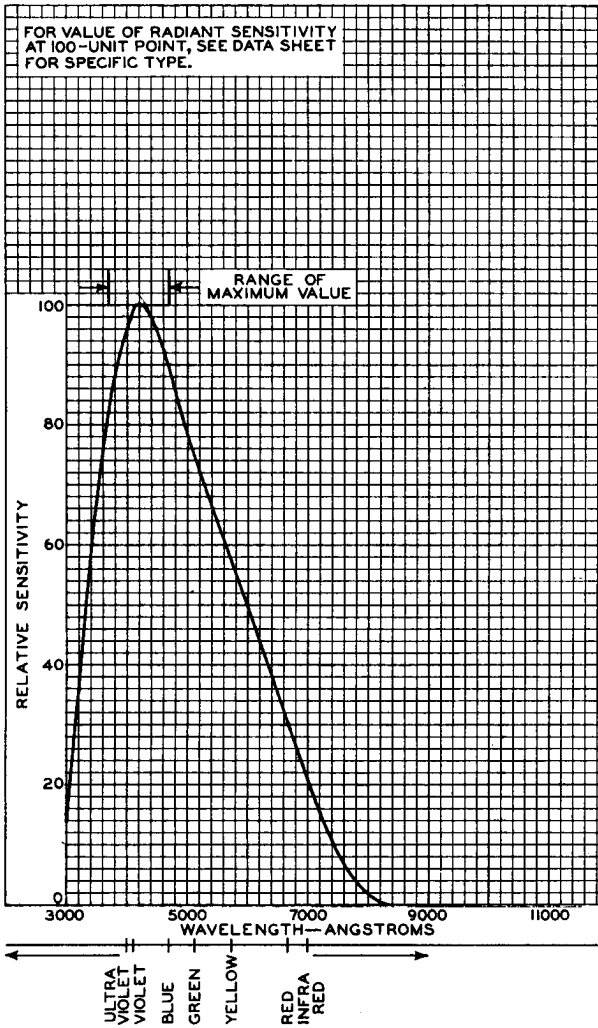
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9582

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-20 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



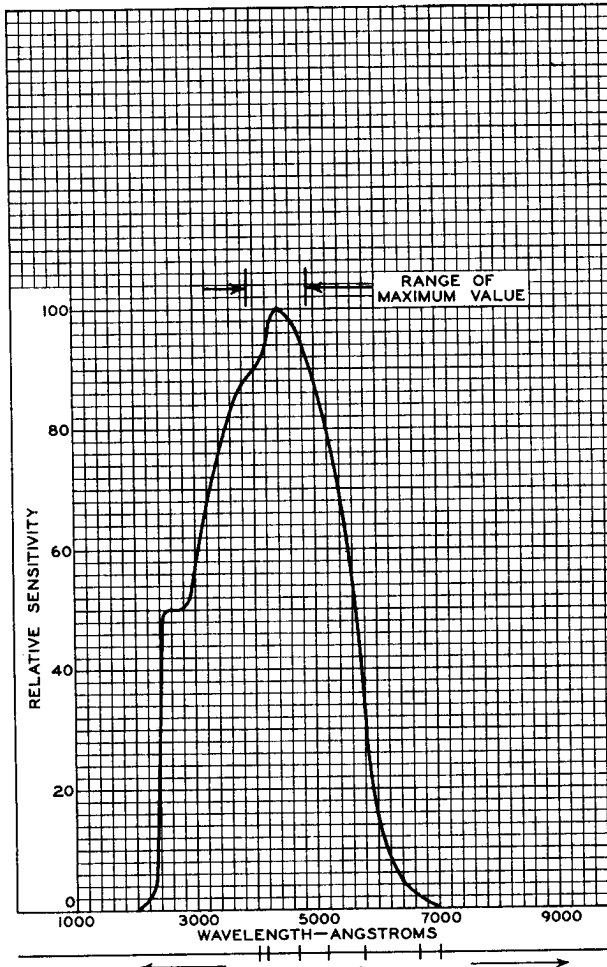
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9779

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-21 RESPONSE

FOR EQUAL VALUES OF RADIANT POWER AT ALL WAVELENGTHS



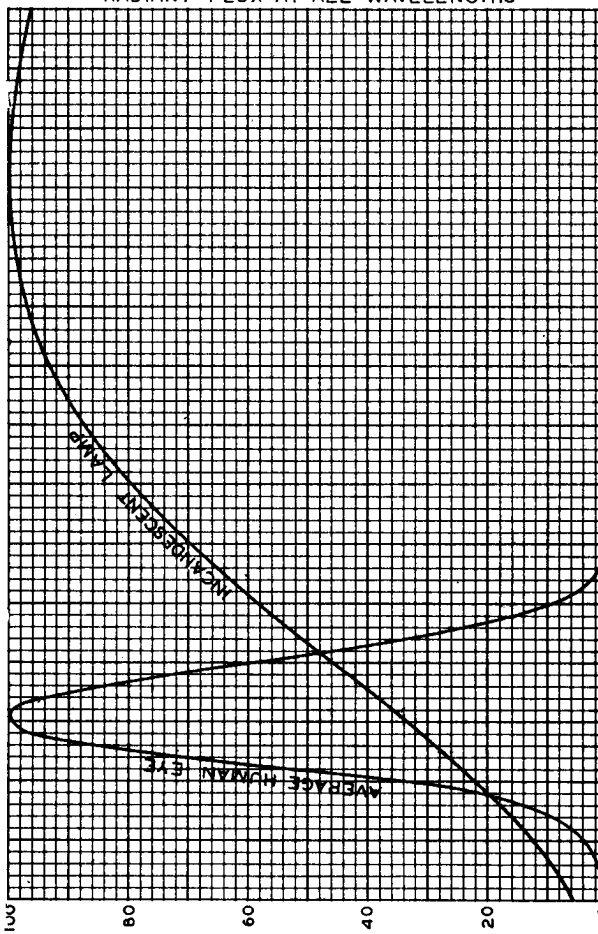
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9980

SPECTRAL CHARACTERISTIC OF HUMAN EYE & OF TUNGSTEN LAMP AT COLOR TEMPERATURE OF 2870 °K

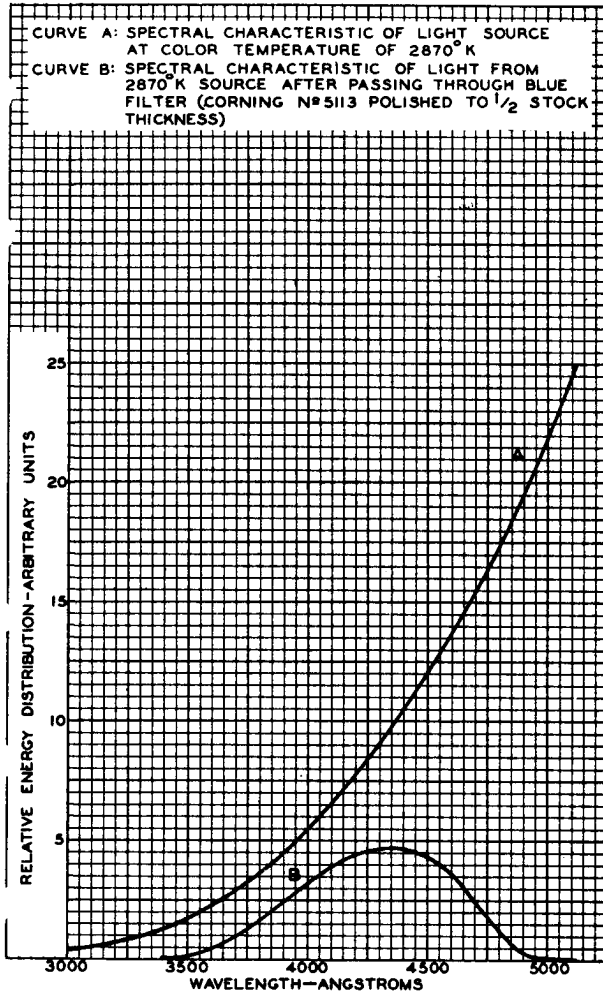
EYE CURVE IS ON BASIS OF EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



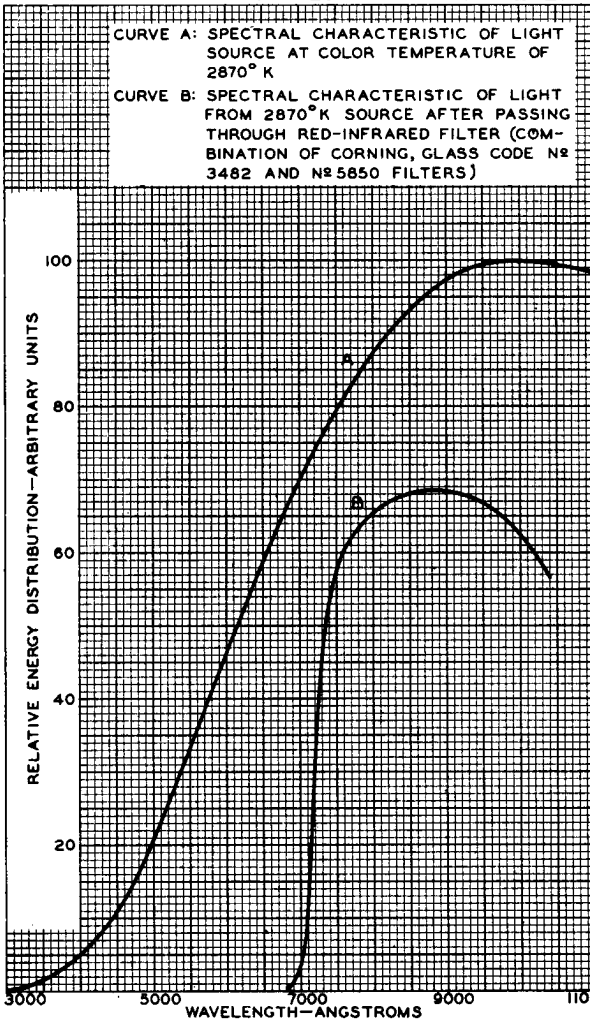
RELATIVE ENERGY DISTRIBUTION OF LAMP-ARBITRARY UNITS

RELATIVE SENSITIVITY OF EYE-ARBITRARY UNITS

SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER



SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED RED-INFRARED FILTER

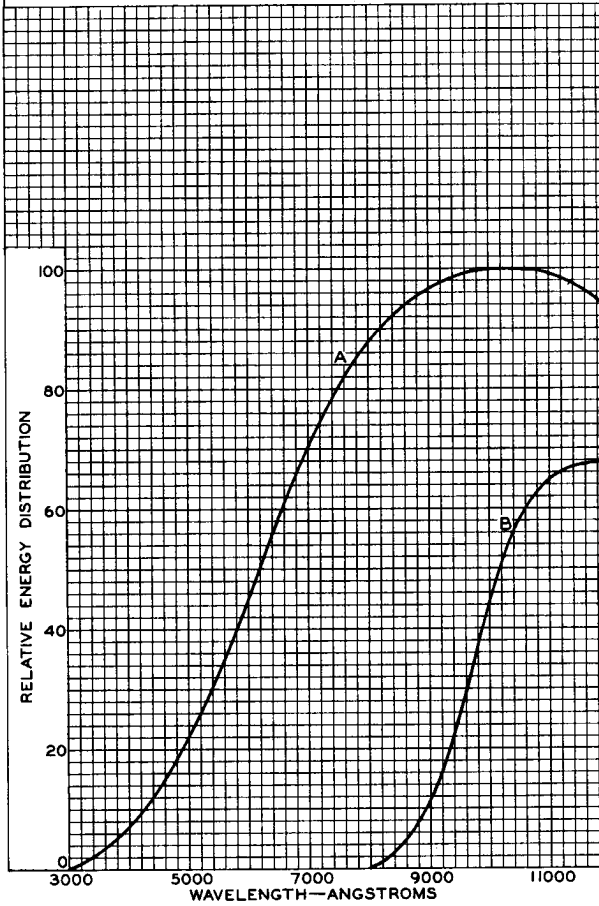


SEPT. 3, 1952 TUBE DEPARTMENT 92CM-7838

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

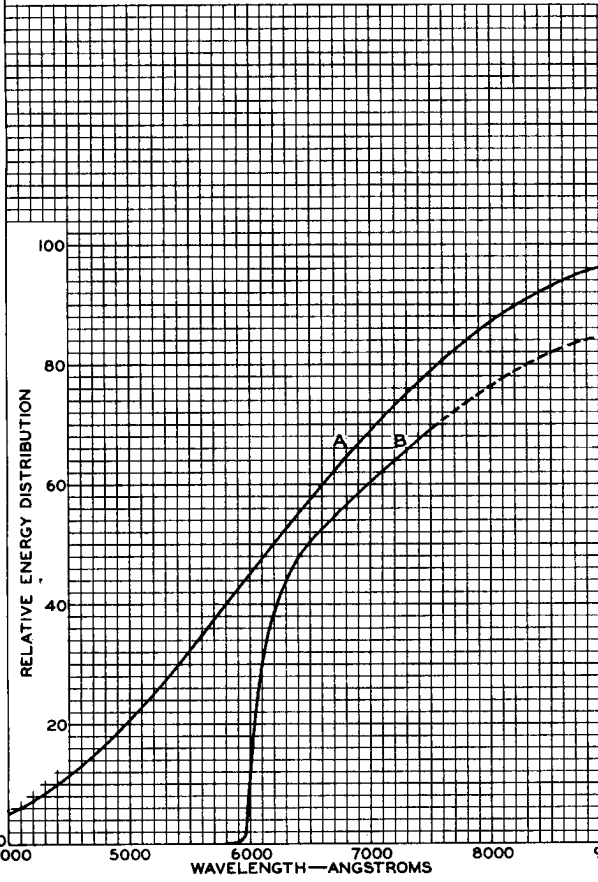
SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED INFRARED FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K.
CURVE B: SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INFRARED FILTER (CORNING Nº 2540).



SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED RED FILTER

CURVE A : SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K.
CURVE B : SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH RED FILTER (CORNING Nº 2418).
DASHED PORTION IS EXTRAPOLATED.



ELECTRON TUBE DIVISION
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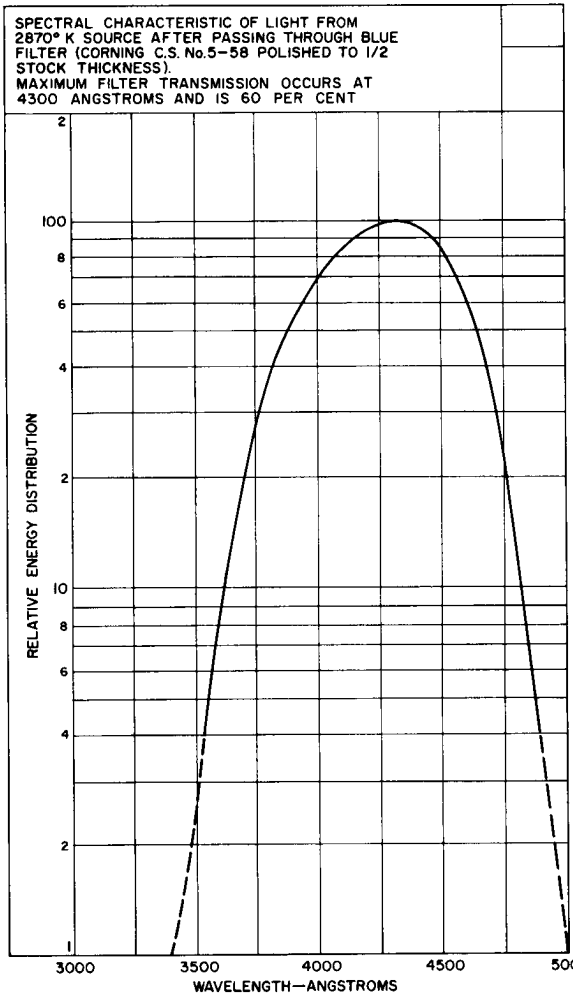
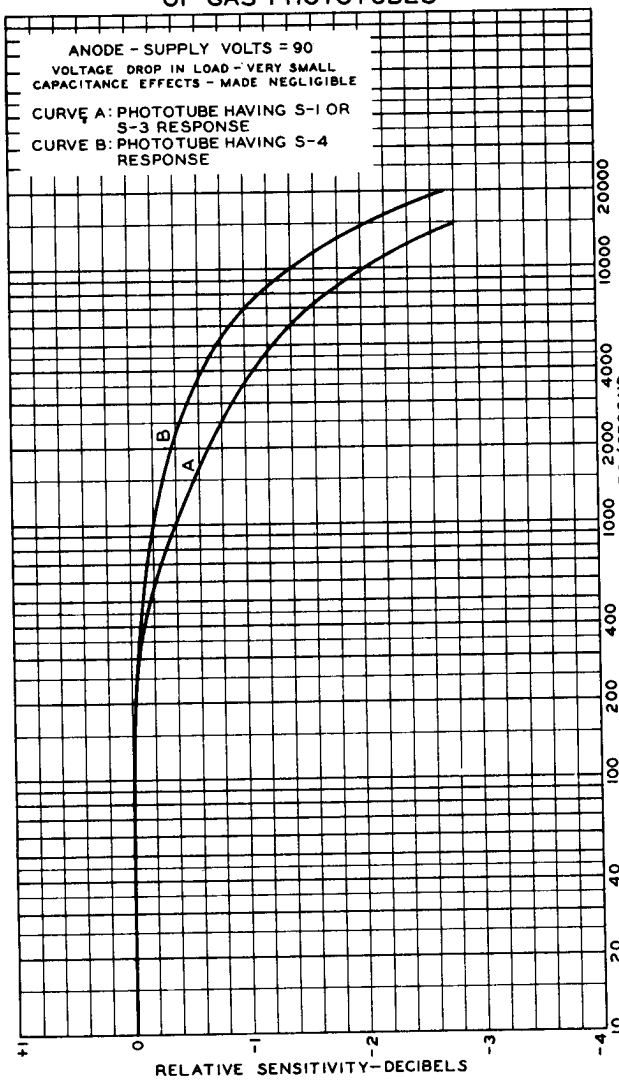
92CM-9883

SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



92CM-1108IRI

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES



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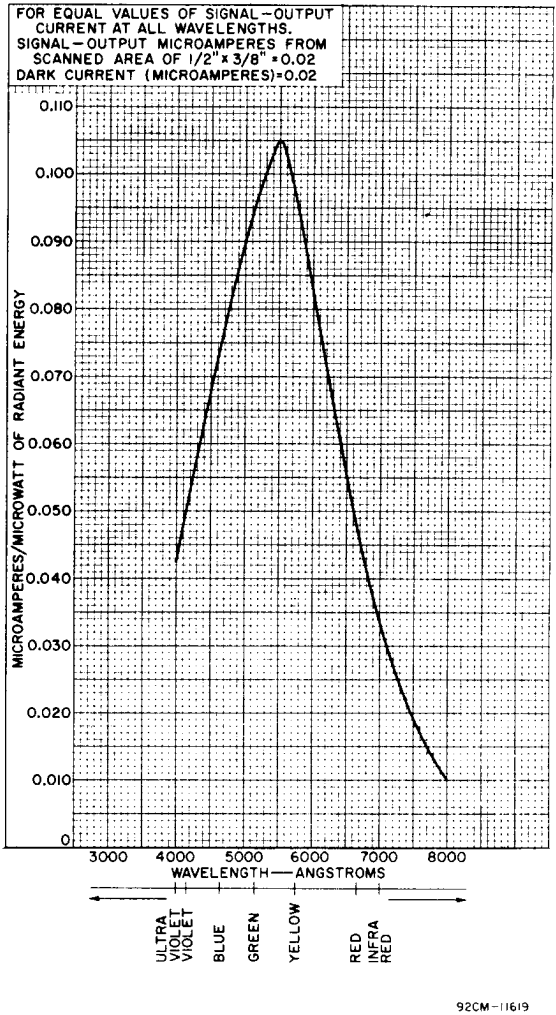
RCA Type II Spectral Response



RCA Type IV Spectral Response