

GL-7409, GL-7538

IMAGE ORTHICONS**FOCUS-MAGNETIC****DEFLECTION-MAGNETIC**

These low-light-level image orthicons are designed to meet a wide variety of requirements for industrial, military, and scientific applications. They provide an effective low-light-level sensitivity of 4×10^{-7} foot-candles photocathode illumination for resolution of 100 television lines per target-inch. The GL-7538 is designed for normal environmental operation. The 7409 is a ruggedized version especially designed to operate under severe shock and vibration conditions.

Both tubes feature a high-gain, thin-film magnesium-oxide target with a sensitivity ten to twenty times that of glass targets. The extreme thinness and the anisotropic property of this semiconductor target virtually eliminates lateral leakage and increases the resolution 25 to 50 percent over that of standard glass targets. Since operation of the target depends on electron conduction, which is not a depletion process, rather than on ion conduction, permanent stickiness and burn-in are virtually eliminated. Low gamma permits a very wide operating range.

These and other features of these image orthicons assure long life and reliable operation of the 7538 in such applications as surveillance, satellite tracking, and detection. The 7409 is particularly useful in tank fire control, drone guidance, missile-borne systems, and ground vehicle systems operating over rough terrain.

Electrical

Cathode—Unipotential	
Heater	
Voltage, AC or DC.....	6.3 \pm 10% Volts
Current.....	0.6 Amperes
Photocathode—Semi-Transparent	
Spectral Response—S-10	
Rectangular Image, 4 by 3 aspect ratio	
Useful Size, maximum diagonal.....	1.8 Inches
Orientation—Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and pin No. 7 of the shoulder base.	
Focusing Method—Magnetic	
Deflection Method—Magnetic	
Direct Interelectrode Capacitance	
Anode to all other Electrodes.....	12 μ f

Mechanical

Over-all Length.....	15.20 \pm 0.25	Inches
Greatest Bulb Diameter.....	3.00 \pm 0.06	Inches
Deflecting Coil		
Length.....	5	Inches
Minimum Inside Diameter.....	2 $\frac{3}{8}$	Inches
Focusing-Coil Length.....	10	Inches
Alignment-Coil Length.....	1 $\frac{5}{8}$	Inches
Photocathode Distance Inside		
End of Focusing Coil.....	1 $\frac{1}{2}$	Inches
Weight, approximate		
GL-7409.....	1.4	Pounds
GL-7538.....	0.8	Pounds
Operating Position—Any, except with diheptal base up and tube axis at an angle of less than 20 degrees from vertical.		

Thermal

Operating Temperature at any Part of Bulb, maximum.....	70	C
Operating Temperature of Bulb at Large		
End of Tube, Target Section, minimum.....	0	C
Temperature Difference Between Target Section and any Part of Bulb Hotter than Target Section.....		
	7.5	C

MAXIMUM RATINGS—ABSOLUTE VALUES

Photocathode			
Voltage.....	-600	Volts	
Illumination.....	50	Foot-candles	
Anode Supply Voltage*.....	1850	Volts	
Grid-No. 1 Voltage			
Negative Bias Value.....	135	Volts	
Positive Bias Value.....	0	Volts	
Grid-No. 2 and Dynode-No. 1 Voltage.....	380	Volts	
Grid-No. 3 Voltage.....	400	Volts	
Grid-No. 4 Voltage.....	300	Volts	
Grid-No. 5 Voltage.....	150	Volts	
Grid-No. 6 Voltage.....	-600	Volts	
Dynode-No. 2 to Dynode-No. 1 Voltage.....	350	Volts	
			Dynode-No. 3 to Dynode-No. 2 Voltage..... 350 Volts
			Dynode-No. 4 to Dynode-No. 3 Voltage..... 680 Volts
			Dynode-No. 5 to Dynode-No. 4 Voltage..... 350 Volts
			Anode to Dynode-No. 5 Voltage..... 100 Volts
			Voltage per Multiplier Stage..... 400 Volts
			Target Voltage
			Above Target Cutoff, positive direction..... 10 Volts
			Negative..... 10 Volts
			Peak Heater-Cathode Voltage
			Heater Negative with Respect to
			Cathode..... 125 Volts
			Heater Positive with Respect to
			Cathode..... 10 Volts

* Ratio of dynode voltages appears under Typical Operation.

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TYPICAL OPERATION—AVERAGE VALUES

	Normal Performance†	Maximum Sensitivity Performance‡
Photocathode Voltage, image focus	-400 to -540	-400 to -550 Volts
Grid-No. 1 Voltage for Picture Cutoff, Beam	-45 to -115	-45 to -115 Volts
Photocathode Illumination—See Page 5		
Scene Illumination—See Page 5		
Grid-No. 2 and Dynode-No. 1 Voltage	300	370 Volts
Grid-No. 3 Voltage, multiplier focus§	225-330	225-380 Volts
Grid-No. 4 Voltage, beam focus	140-180	140-250 Volts
Grid-No. 5 Voltage, decelerator	0-125	0-125 Volts
Grid-No. 6 Voltage, accelerator—75 percent of photocathode voltage, approximate	-300 to -405	-300 to -465 Volts
Dynode-No. 2 Voltage	600	770 Volts
Dynode-No. 3 Voltage	910	1080 Volts
Dynode-No. 4 Voltage	1200	1360 Volts
Dynode-No. 5 Voltage	1490	1610 Volts
Anode Voltage	1550	1700 Volts
DC Anode Current, maximum	30	30 Microamperes
Signal Output Current, peak-to-peak—See Light-Transfer Characteristic		
Target Cutoff Voltage¶	-3 to +1	-3 to +1 Volts
Target Temperature Range	15-55	15-55 C
Peak-to-Peak Blanking Voltage	5-20	5-20 Volts
Field Strength at Center of Focusing Coil**	75	75 Gauss
Field Strength of Alignment Coil, approximate#	0-3	0-3 Gauss

† Although these tubes will operate in standard equipment, modification to permit operation at these values will improve effective sensitivity for most applications.

‡ These values will permit the best low-light-level-sensitivity capability of the tube to be realized and will assure the maximum useful multiplier gain required in extreme low-light-level applications. The resolution sensitivity information in this data sheet was derived with these higher multiplier voltages.

§ Adjust to give the most uniformly shaded picture near maximum signal.

|| 75 to 85 percent of photocathode voltage.

¶ The target supply voltage should be adjustable from -3 to +5 volts with blanking voltage off. Maximum target voltage is +10 volts above target cutoff. Recommended target voltage is +2 volts above cutoff. Slight readjustment, usually only a small fraction of a volt, may be necessary to minimize microphonics.

**Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

Adjust to produce flattest field with maximum response. Alignment is correct when the center of the picture merely goes through focus and does not rotate when beam focus (Grid No. 4) is varied. For most commercial focus coils a 75-gauss field results from a focus-coil current of 75 milliamperes.

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ENVIRONMENTAL

Shock: Per specification MIL-E-5272C (ASG) Paragraph 4.15.5 except:

A 12 impact shocks of 30g

B The shock shall be applied in the following directions:

1—Vertically perpendicular to longitudinal axis, 3 shocks in each direction.

2—Parallel to the minor horizontal axis, 3 shocks in each direction.

C The shock pulse width is defined by the use of a 0.2 to 250-cycle-per-second filter.

Vibration: Per MIL-E-5272C (ASG) Paragraph 4.7.12 Procedure XII except at operating temperature only. Center horizontal resolution at 3×10^{-5} maximum foot-candles, photocathode illumination will be at least 350 lines (EIA) with 5g applied acceleration in the frequency range from 50 to 500 cycles per second and a double amplitude of 0.036 inch from 5 to 50 cycles per second. Picture resolution of 350 TV lines (EIA) is defined as readable through any interference that may occur.

Humidity: Per MIL-E-5272C (ASG) Paragraph 4.4.1 Procedure 1. Following this test, the interelectrode insulation of the end pins 5, 6, 7, 8, 9, and 10 each with respect to all other end base pins grounded and with 350 volts (minimum) applied is greater than 500 ohms.

Acceleration: Constant acceleration when applied perpendicular to the longitudinal axis of the tube for 10 minutes. (70g)

OPERATING NOTES

Some magnesium-oxide targets may be damaged permanently if directly and intermittently exposed, while in operation, to extremely bright sources which cause high photoelectron densities to occur at the target. Such sources include the sun, photoflash lamps, and exploding wire flashes. Damage, if it does occur, takes the form of black image spots burned in the target by the intense light.

In most cases an 80-megohm, $\frac{1}{4}$ -watt resistor in series with the photocathode in the camera will protect the tube. This resistor will not interfere with normal operation of these or other image orthicons which may be used in the modified camera.

If these or similar bright sources are to be observed continuously, appropriate exposure control of photocathode illumination can be supplied by neutral-density filters.

SPECIFIC PARAMETERS ON RECORDED DATA

All curves except spectral-sensitivity characteristics were recorded under the following conditions:

- Camera Chain:** General Electric TE-5 (modified)
Amplifier bandwidth—total 20 mc, flat to 6 mc
- Resolution Chart:** National Bureau of Standards Lens Test Chart, 100% contrast transparency.
- Window Chart:** 100% contrast, 1% area window for signal-noise and transfer characteristic data.
- Light Source:** 2870⁰ Kelvin—tungsten
- Light Level:** Aperture and neutral density controlled (within specially constructed low-light-level box) to provide range from 10^{-8} to 10^{-2} foot-candles illumination on photocathode. For corresponding scene brightness in foot-lamberts when using Leitz f/1.5 lens (85 mm), multiply photocathode illumination in foot-candles by 12.
- Operating Temperature for Image End:** 25 to 30 C.
- Target Raster:** Target diameter is 1.40 inches. For corners of scanning raster just touching target edge raster dimensions are:

<u>Aspect Ratio</u>	<u>Horizontal</u>	<u>Vertical</u>
1 x 1 (square)	0.99"	0.99"
4 x 3 (standard)	1.12"	0.84"

Horizontal TV lines = 1.12 x TV lines per target inch

Vertical TV lines (EIA) = 0.84 x TV lines per target inch

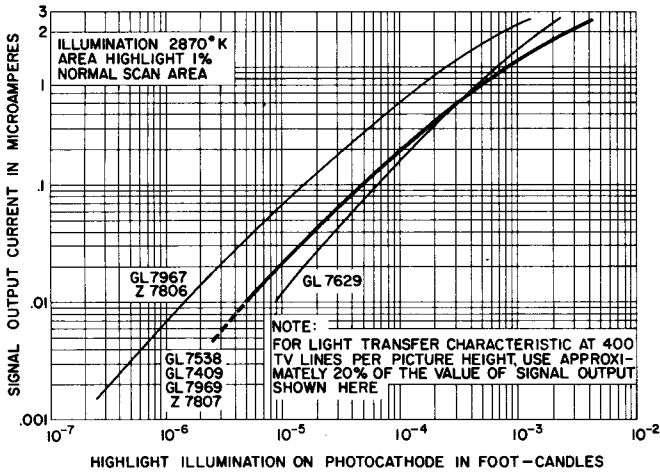
Resolution sensitivity data is recorded in TV lines per target inch

Therefore, 700 TV lines per target inch = 784 horizontal lines
= 588 vertical lines (EIA)

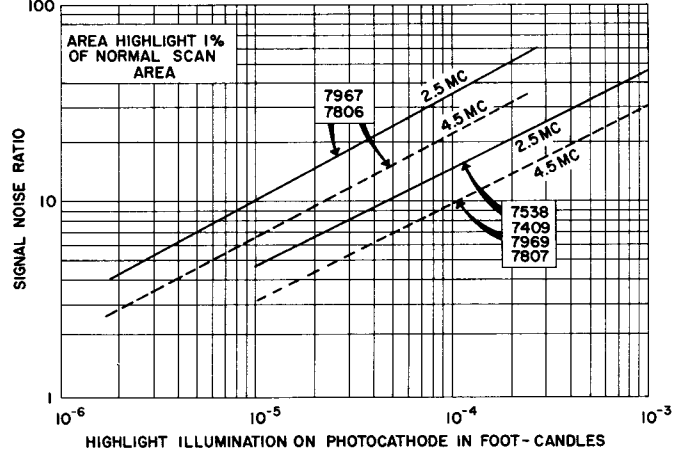
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LIGHT TRANSFER CHARACTERISTICS

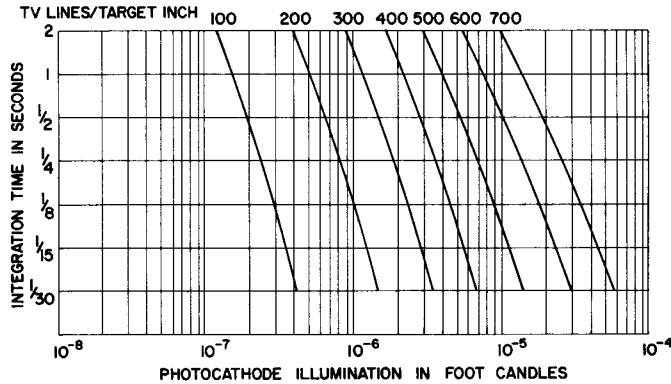


TYPICAL SIGNAL: NOISE CHARACTERISTICS VS.
BANDWIDTH AND ILLUMINATION

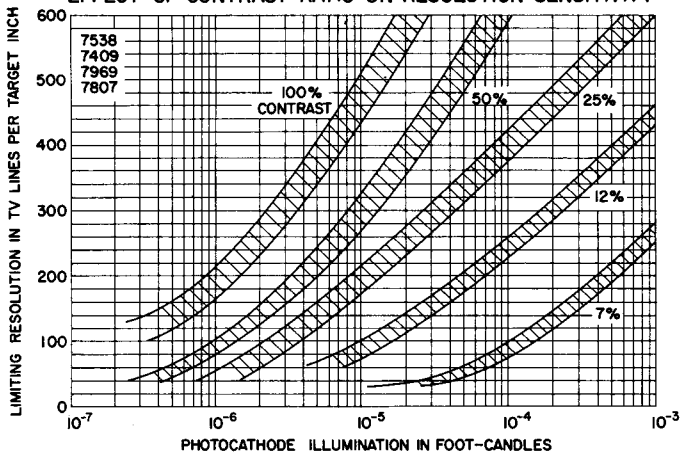


INTEGRATION EFFECT ON RESOLUTION SENSITIVITY

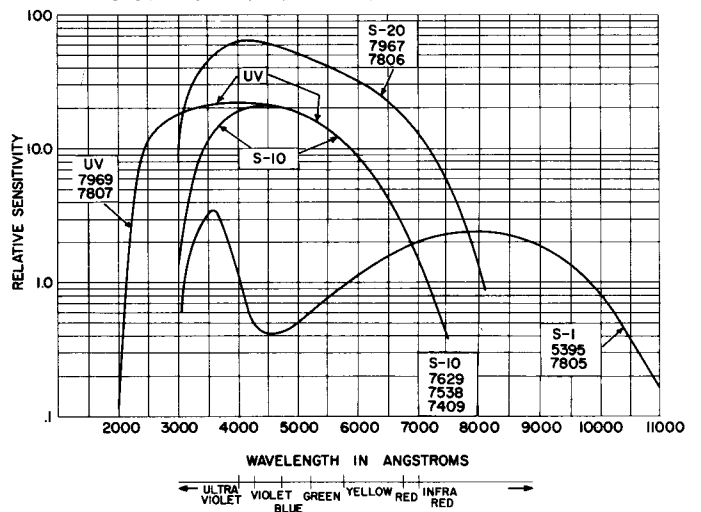
TYPES 7538 7409 7969 7807



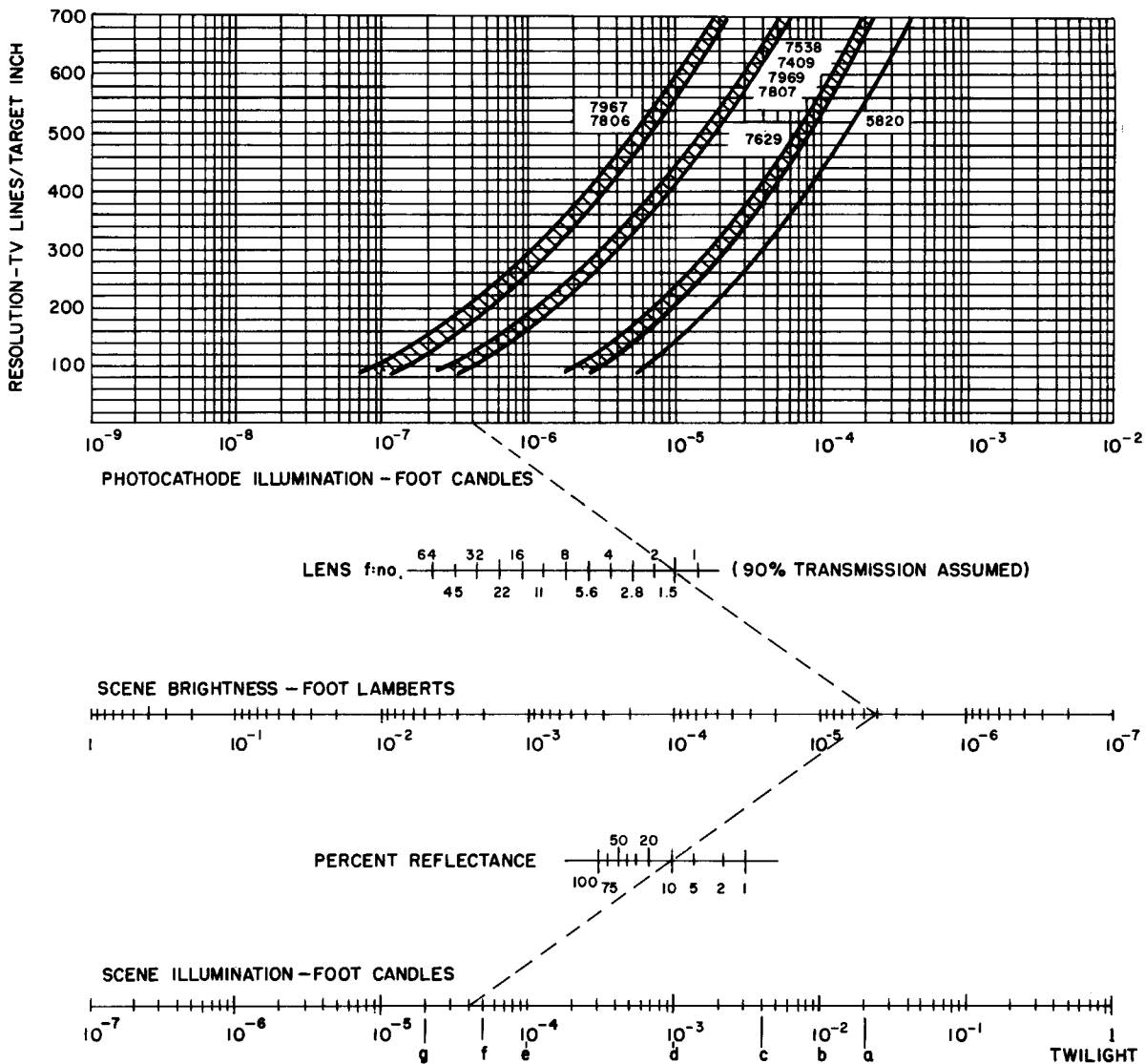
EFFECT OF CONTRAST RATIO ON RESOLUTION SENSITIVITY



PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS



SCENE ILLUMINATION VS TYPICAL RESOLUTION SENSITIVITY BY TYPE*



Code	Ambient Condition	Scene Illumination
a	Full moon-clear	2×10^{-2} ft-c
b	Half moon	1×10^{-2} ft-c
c	Full moon-moderately cloudy	4×10^{-3} ft-c
d	Quarter moon-clear	1×10^{-3} ft-c
e	No moon-clear	1×10^{-4} ft-c
f	No moon-moderately cloudy	5×10^{-5} ft-c
g	No moon-heavy cloud	2×10^{-5} ft-c

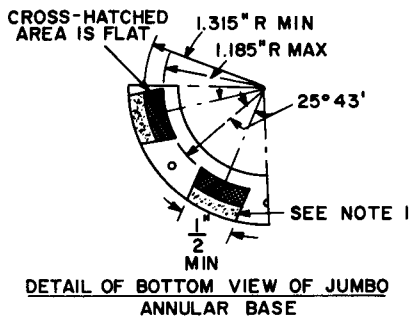
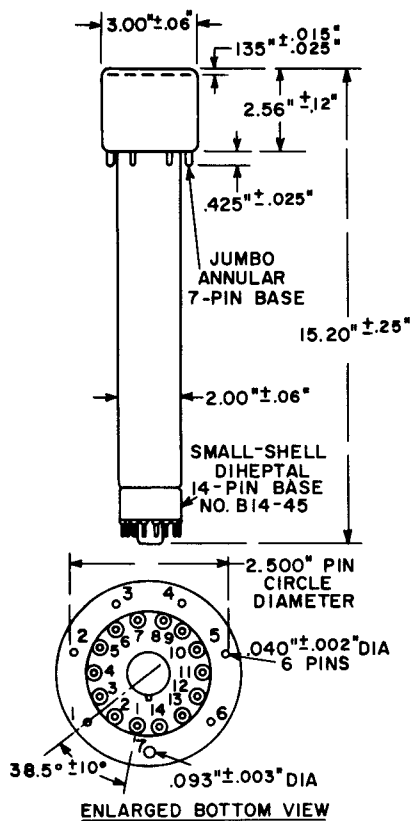
NEUTRAL DENSITY FILTERS FOR EXPOSURE CONTROL

TYPE AND DENSITY	PERCENT TRANSMITTANCE	NUMBER OF STOPS
ND .30	50.0	1
ND .60	25.0	2
ND .90	13.0	3
ND 1.00	10.0	3.3
ND 2.00	1.0	6.6
ND 3.00	0.10	10.0
ND 4.00	0.010	13.2

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NOTE 1: DOTTED AREA IS FLAT OR EXTENDS TOWARD DIHEPTAL-BASE END OF TUBE BY 0.060" MAX.

ANNULAR BASE GAGE

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 GAGE WITH:

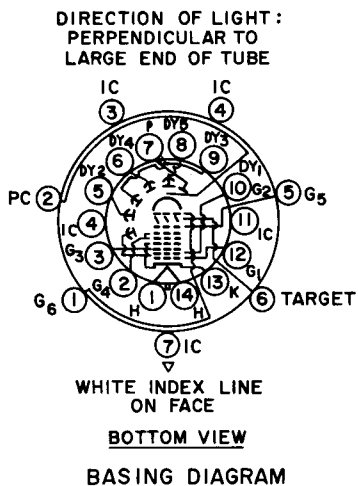
- a. SIX HOLES HAVING DIAMETER OF 0.065 ± 0.001 " AND ONE HOLE HAVING DIA OF 0.150 ± 0.001 ". ALL HOLES HAVE DEPTH OF 0.265 ± 0.001 ". THE SIX 0.065 " HOLES ARE ENLARGED BY 45° TAPER TO DEPTH OF 0.047 ". ALL HOLES ARE SPACED AT ANGLES OF $51^\circ 26' \pm 5'$ ON CIRCLE DIAMETER OF 2.500 ± 0.001 ".
- b. SEVEN STOPS HAVING HEIGHT OF 0.187 ± 0.001 ", CENTERED BETWEEN PIN HOLES, TO BEAR AGAINST FLAT AREAS OF BASE.
- c. RIM EXTENDING OUT OF A MINIMUM OF 0.125 " FROM 2.812 " DIAMETER AND HAVING HEIGHT OF 0.126 ± 0.001 ".
- d. NECK-CYLINDER CLEARANCE HOLE HAVING DIAMETER OF 2.200 ± 0.001 ".

SMALL-SHELL DIHEPTAL 14-PIN BASE

- | | |
|---------------------------------------|--|
| PIN 1: HEATER | PIN 9: DYNODE NO.3 |
| PIN 2: GRID NO.4 & FIELD MESH | PIN 10: DYNODE NO.1, GRID NO.2 |
| PIN 3: GRID NO.3 | PIN 11: INTERNAL CONNECTION-DO NOT USE |
| PIN 4: INTERNAL CONNECTION-DO NOT USE | PIN 12: GRID NO.1 |
| PIN 5: DYNODE NO.2 | PIN 13: CATHODE AND SUPPRESSOR GRID |
| PIN 6: DYNODE NO.4 | PIN 14: HEATER |
| PIN 7: ANODE | |
| PIN 8: DYNODE NO.5 | |

KEYED JUMBO ANNULAR 7-PIN BASE

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



POWER TUBE DEPARTMENT

Pickup Tube Operation

Syracuse, New York

IMAGE ORTHICON

FOCUS—MAGNETIC

DEFLECTION—MAGNETIC

ENVIRONMENTALIZED

The GL-7409 is an environmentalized image orthicon designed to meet industrial and military applications where adverse environment precludes the use of standard tubes. It has an S-10 photo-surface. Because of the low gamma, the tube has a very wide operating range at low light levels.

This tube features a high-gain, thin-film, magnesium-oxide target with a sensitivity ten to twenty times that of glass-target tubes such as the 5820. This target has several advantages. Its extreme thinness and anisotropic property virtually eliminates target leakage, which increases the resolution as much as 50 percent over that of the standard target. It adapts the tube for service where the signal is stored for long periods be-

fore being read off, which permits additional sensitivity by use of low frame rates or by beam pulsing. It completely eliminates both stickiness and permanent burn-in since operation depends on electron conduction, which is not a depletion process, rather than on ion conduction. The curve shown on page 3 compares the resolution sensitivity of the 7409 with that of a 5820 with equivalent photocathode.

The target characteristics also assure a higher amplitude response than that of the 5820. Another advantage of the GL-7409 is a considerable reduction in the redistribution of target secondary electrons, which reduces image-edging effect, particularly at black-to-white transitions.

Electrical

Cathode—Unipotential	
Heater Voltage, AC or DC	6.3 ± 10% Volts
Heater Current	0.6 Ampere
Photocathode—Semi-transparent	
Response—S 10	
Rectangular Image, 4 x 3 aspect ratio	
Useful Size, maximum diagonal	1.8 Inches
Orientation	Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and pin-No. 7 of the shoulder base.
Focusing Method	Magnetic
Deflecting Method	Magnetic
Direct Interelectrode Capacitance	
Anode to all other Electrodes	12 μmf

Mechanical

Over all Length	15.20 ± 0.25	Inches
Greatest Diameter of Bulb	3.00 ± 0.06	Inches
Minimum Deflecting-Coil Inside Diameter	2 3/4	Inches
Deflecting-Coil Length	5	Inches
Focusing Coil Length	10	Inches
Alignment-Coil Length	1 1/2	Inch
Photocathode Distance Inside End of Focusing Coil	1/2	Inch
Weight, approximate	1.4	Pounds
Operating Position	Any, except with diheptal base up and the tube axis at an angle of less than 20 degrees from vertical.	

Thermal

Operating Temperature of Any Part of Bulb	70	Max C
Operating Temperature of Bulb at Large End of Tube, Target Section	15	Min C
Temperature Difference Between Target Section and Any Part of Bulb Hotter than Target Section	7.5	Max C

MAXIMUM RATINGS—ABSOLUTE VALUES

Photocathode Voltage	-550	Volts	Target Voltage	
Photocathode Illumination	50	Foot-Candles	Positive Voltage	6
Anode Supply Voltage	1850	Volts	Negative Voltage	10
Grid-No. 1 Voltage			Peak Heater-Cathode Voltage	
Negative Bias Value	125	Volts	Heater Negative with Respect to Cathode	125
Positive Bias Value	0	Volts	Heater Positive with Respect to Cathode	10
Grid-No.2 and Dynode-No. 1 Voltage	350	Volts	Shock (Note 1)	100
Grid-No. 3 Voltage	400	Volts	Vibration (Note 2)	10
Grid-No. 4 Voltage	300	Volts	Humidity (Note 3)	
Grid-No. 5 Voltage	150	Volts	Acceleration (Note 4)	70
Grid-No. 6 Voltage	-550	Volts		
Dynode-No. 2 to Dynode-No. 1 Voltage	350	Volts		
Dynode-No. 3 to Dynode-No. 2 Voltage	350	Volts		
Dynode-No. 4 to Dynode-No. 3 Voltage	680	Volts		
Dynode-No. 5 to Dynode-No. 4 Voltage	350	Volts		
Anode to Dynode-No. 5 Voltage	100	Volts		

TYPICAL OPERATION

Photocathode Voltage, image focus	-400 to -540	Volts	Dynode-No. 2 Voltage	600	Volts
Grid-No. 1 Voltage for Picture Cut-off, beam	45 to -115	Volts	Dynode-No. 3 Voltage	910	Volts
Grid-No. 2 and Dynode-No. 1 Voltage	300	Volts	Dynode-No. 4 Voltage	1200	Volts
Grid-No. 3 Voltage*, multiplier focus	225 to 330	Volts	Dynode-No. 5 Voltage	1400	Volts
Grid-No. 4 Voltage, beam focus	140 to 180	Volts	Anode Voltage	1550	Volts
Grid-No. 5 Voltage, decelerator	0 to 125	Volts	DC Anode Current	3	Microamperes
Grid-No. 6 Voltage, accelerator			Target Voltage, without blanking voltage	0 to 2.0	Volts
75 Percent of Photocathode Voltage, approximate	-300 to -405	Volts	Peak-to-Peak Blanking Voltage	5 to 20	Volts
			Target Temperature Range	15 to 55	C
			Field Strength at Center of Focusing Coil†	75	Gausses
			Field Strength of Alignment Coil, approximate	0 to 3	Gausses

* Adjust to give the most uniformly shaded picture near maximum signal.
 † Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil with the indicator located outside of and at the image end of the focusing coil.

Note 1: Per specification MIL-E-5272C (ASG) Paragraph 4.13.5 with the following differences:

A) 12 impact shocks of 30 G.

B) The shock shall be applied in the following directions:

1.) Vertically perpendicular to longitudinal axis, 3 shocks in each direction.

2.) Parallel to the minor horizontal axis, 3 shocks in each direction.

C) The shock pulse width is defined by the use of a 0.2 to 250-cycle-per-second filter.

Note 2: Under the conditions specified in MIL-E-5272C (ASG) Paragraph 4.7.12 Procedure XII except at operating temperature only. Center horizontal resolution at 3×10^{-5} minimum foot-candles, photocathode illumination will be at least 350 lines with 5 G applied acceleration in the frequency range from 50 to 300 cycles per second and a double amplitude of 0.036 inch from 5 to 50 cycles per second.

Note 3: Under the conditions specified in MIL-E-5272C (ASG) Paragraph 4.4.1 Procedure I. Following this test, the interelectrode insulation of the end pins 5, 6, 7, 8, 9 and 10 each with respect to all other end base pins grounded and with 350 volts (minimum) applied is greater than 500 ohms.

Note 4: Constant acceleration when applied perpendicular to the longitudinal axis of the tube for 10 minutes.

OPERATING NOTES

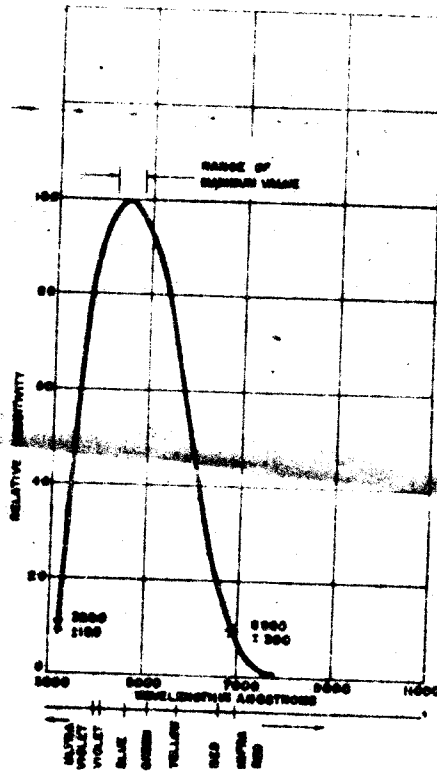
Normally a new tube will exhibit some slight after-image, characterized by a rapid and complete decay, which will gradually diminish with life. This can be minimized by use of an orbiter or by eliminating forced-air cooling for short periods of time.

Although a warm-up time of one hour is desirable, the tube can be used immediately after alignment as it cannot be damaged permanently by target burn-in.

Some tubes may exhibit microphonic bars if used immediately while relatively cool. These will disappear as the tube warms up and can be minimized during this period by slight readjustments in target voltage.

The target used in this tube greatly reduces the probability of permanent burn-in damage should a stationary highlight be imaged on the target for an extended period. However, imaging directly on the sun or other extremely bright sources should be avoided.

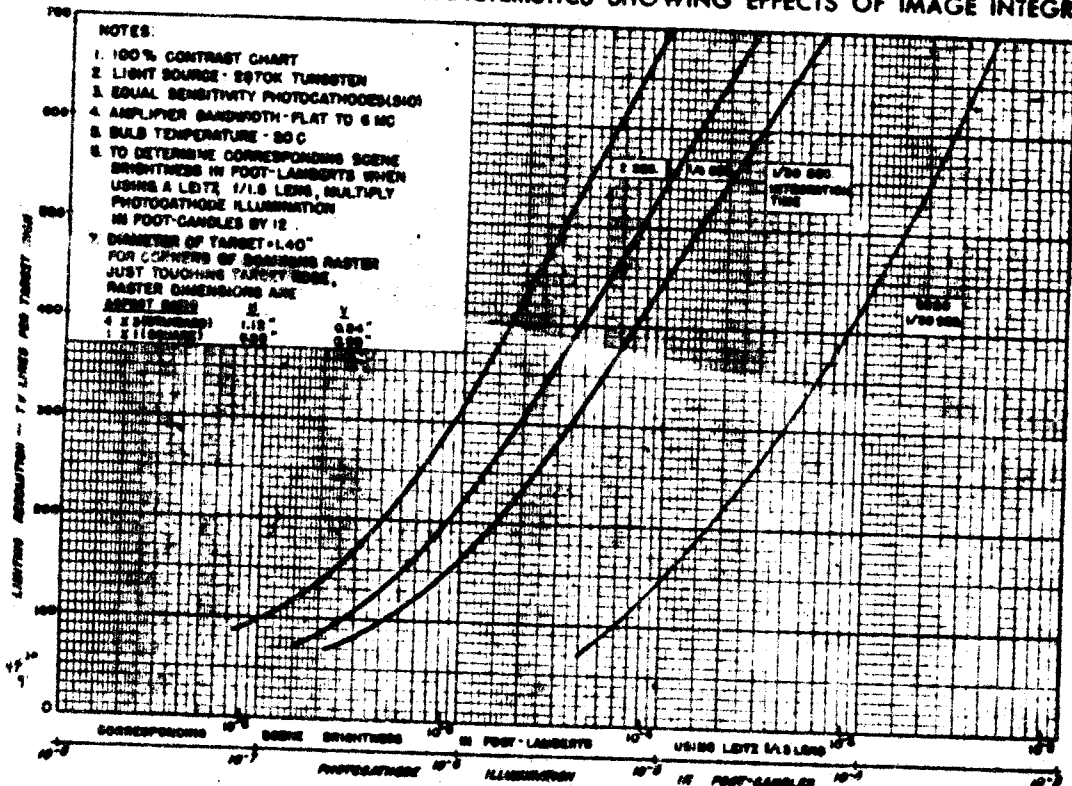
SPECTRAL-SENSITIVITY CHARACTERISTIC—S10 RESPONSE
For Equal Values of Radiant Flux at All Wavelengths



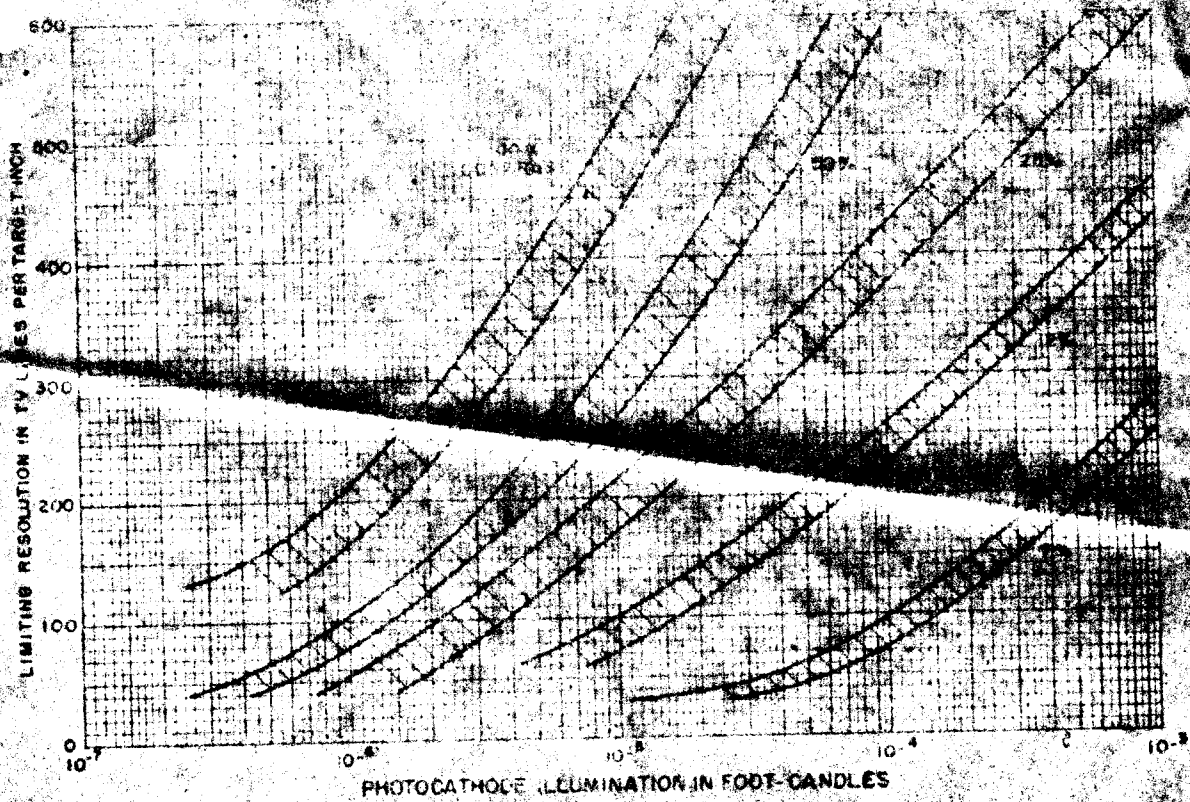
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TYPICAL RESOLUTION—SENSITIVITY CHARACTERISTICS SHOWING EFFECTS OF IMAGE INTEGRATION



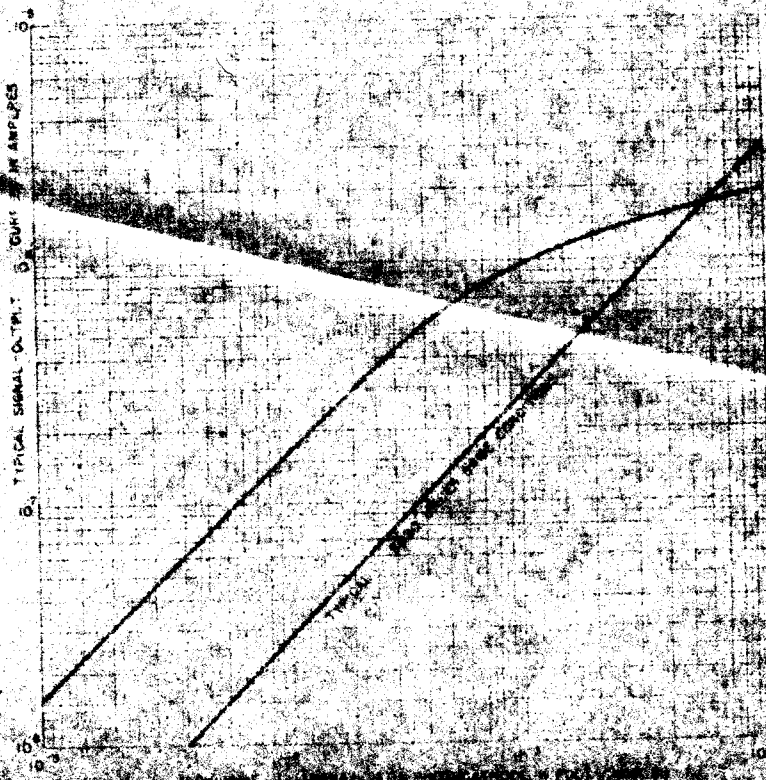
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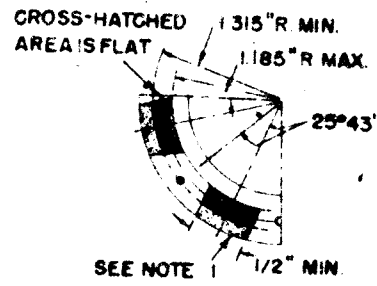
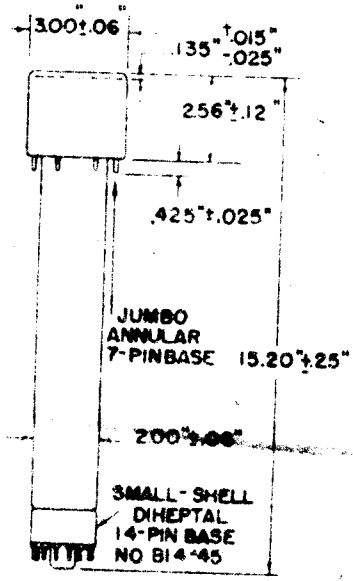
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TRANSFER CHARACTERISTIC

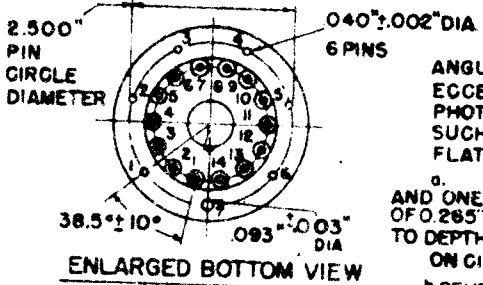


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DETAIL OF BOTTOM VIEW OF JUMBO ANNULAR BASE

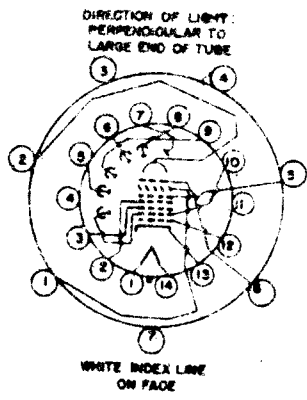
NOTE: DOTTED AREA IS FLAT OR EXTENDS TOWARD DHEPTAL-BASE END OF TUBE BY 0.060" MAX.



ANNULAR BASE GAGE

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 GAGE WITH

- a. SIX HOLES HAVING DIAMETER OF 0.065 ± 0.001" AND ONE HOLE HAVING DIA. OF 0.150 ± 0.001". ALL HOLES HAVE DEPTH OF 0.285 ± 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' ± 6' ON CIRCLE DIAMETER OF 2.500 ± 0.001"
- b. SEVEN STOPS HAVING HEIGHT OF 0.187 ± 0.001", CENTERED BETWEEN PIN HOLES, TO BEAR AGAINST FLAT AREAS OF BASE.
- c. RIM EXTENDING OUT OF A MINIMUM OF 0.125" FROM 2.812" DIAMETER AND HAVING HEIGHT OF 0.126 ± 0.001".
- d. NECK-CYLINDER CLEARANCE HOLE HAVING DIAMETER OF 2.200 ± 0.001".



BASING DIAGRAM

SMALL-SHELL DHEPTAL 14-PIN BASE

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

KEYED JUMBO ANNULAR 7-PIN BASE

PIN 1 GRID NO 6	PIN 5 GRID NO 5
PIN 2 PHOTOCATHODE	PIN 6 TARGET
PIN 3 INTERNAL CONNECTION DO NOT USE	PIN 7 INTERNAL CONNECTION DO NOT USE
PIN 4 INTERNAL CONNECTION DO NOT USE	