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7295-A

IMAGE ORTHICON

For High-Quality Black-and-White TV Cameras

Magnetic Focus Magnetic Deflection	Outdoor and Studio Pickup Excellent Resolution Capability	4.500" Diameter 19.375" Length

This Type is Unilaterally Interchangeable with the 7295.

RCA-7295-A is a versatile 4-1/2-inch camera tube of the image-orthicon type intended for use in high-quality black-and-white TV cameras. The 7295-A requires only a very narrow range of camera control adjustment for optimum performance and stable day-to-day operation. Because of its excellent performance capability over a wide range of different lighting conditions, the 7295-A is well suited for either outdoor or studio pickup.

The superior quality of the picture signal from the 7295-A also permits the making of a series of successive recordings while still retaining excellent picture quality.

The 7295-A features a high signal-to-noise ratio, excellent resolution capability, good sensitivity, and a spectral response that approaches that of the eye. The 7295-A has high blue sensitivity, high green sensitivity, and negligible infrared sensitivity. The spectral sensitivity characteristic of the 7295-A is shown in Fig.1.

Other features of the 7295-A include a high-capacitance target assembly which has a usable area almost 3 times greater than that of conventional 3-inch image orthicons, a micro-mesh target-screen, and a field mesh.

The increased area of the high-capacitance target greatly improves the resolution capability of the 7295-A and provides black-and-white TV pictures, which in addition to having greater contrast, are sharper, clearer, and more realistic. Despite the increased size of its image section, the 7295-A uses the same optics and same optical-image size that are required with 3-inch tubes.

The micro-mesh screen, which has a fineness of 750 lines per inch, prevents mesh pattern and moiré effect without the need for defocusing and permits operation of the tube with aperture-correction circuitry to provide full response for fine-detail information.

The *field mesh* reduces "white-edge" effects and geometric distortion due to beam bending and, as a consequence, a picture of better photographic quality and realism is obtained. The field mesh also improves the beam trajectory and thus eliminates dark corners in the picture area.

PRINCIPLES OF OPERATION

The 7295-A has three sections — an image section, a scanning section, and a multiplier section — as shown in Fig.2.

Image Section

The image section contains a semitransparent photocathode, on the inside of the faceplate, a grid (grid No.6) which together with the photocathode provides an electrostatic accelerating field, and a target which consists of a very thin glass disc with a fine micro-mesh screen very closely spaced to it on the photocathode side. Focusing is accomplished by means of a non-uniform graded magnetic field produced by an external coil, and by the electrostatic accelerating field produced between the photocathode and grid No.6. Control of the electrostatic field shape for best focus is effected by the proper selection of photocathode voltage and adjustment of grid-No.6 voltage.

Light from the scene being televised is picked up by an optical system and focused on the photocathode which emits electrons from each illuminated area in proportion to the intensity of the light striking the area. The streams of electrons are focused on the target by the magnetic and electrostatic accelerating fields. The shape of the graded magnetic field is such that the optically-focused photocathode image is electro-optically magnified between the photocathode and the target.

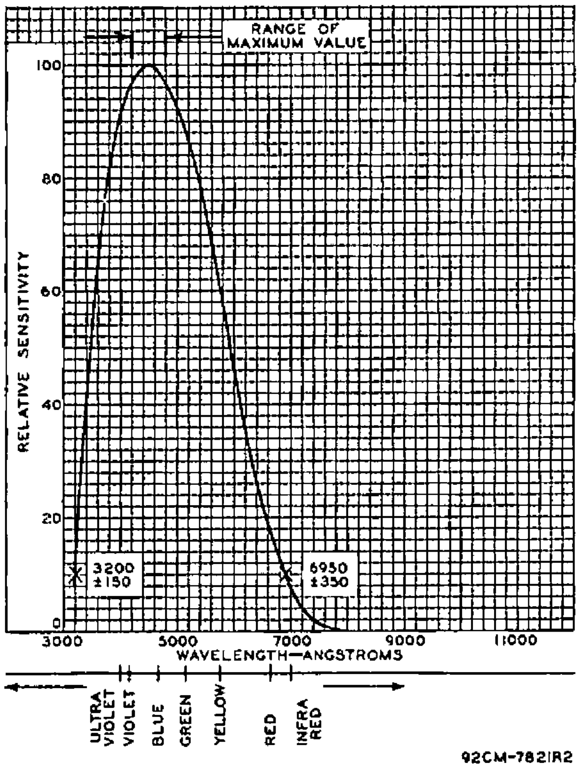


Fig. 1 - Spectral Sensitivity Characteristic of Type 7295-A which has S-10 Response. Curve is shown for Equal Values of Radiant Flux at All Wavelengths.

On striking the target, the electrons cause secondary electrons to be emitted by the glass. The secondaries thus emitted are collected by the adjacent mesh screen which is held at a definite small positive potential with respect to target-cutoff voltage. Therefore, the potential of the glass disc is limited for all values of light and stable operation is achieved. Emission of the secondaries leaves on the photocathode side of the glass a pattern of positive charges which corresponds to the pattern of light from the scene being televised. Because of the thinness of the glass, the charges set up a similar potential pattern on the opposite or scanned side of the glass.

Scanning Section

The opposite side of the glass is scanned by a low-velocity electron beam produced by the electron gun in the scanning section. This gun contains a thermionic cathode, a control grid (grid No.1), and an accelerating grid (grid No.2). The beam is focused at the target by the magnetic field of an external focusing coil and the electrostatic field of grid No.4.

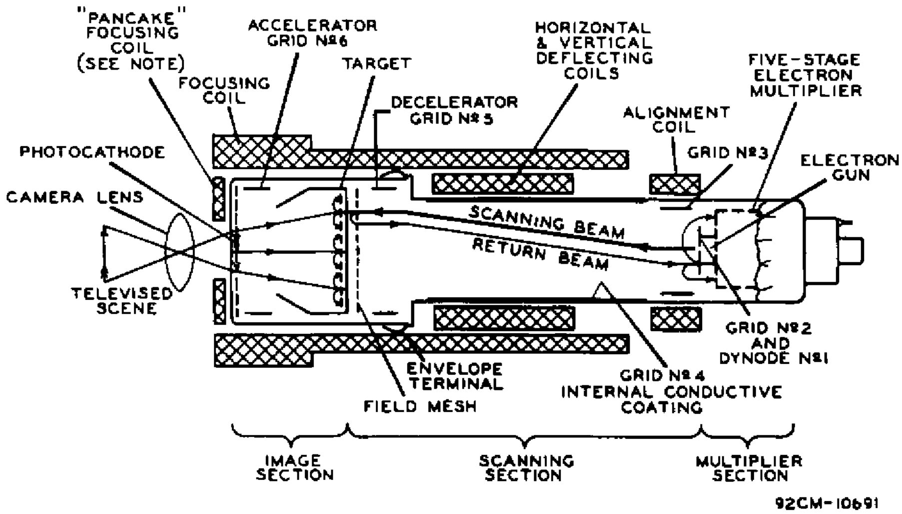
Deflection of the beam is accomplished by transverse magnetic fields produced by external deflecting coils.

Alignment of the beam from the gun is accomplished by a transverse magnetic field produced by external coils located at the gun end of the focusing coil.

By proper adjustment of potentials including that of grid No.5 and the field mesh, the beam is caused to approach the target perpendicularly and with zero or nearly zero velocity. Electrons which approach uncharged portions of the pattern on the glass stop their forward motion at the surface of the glass and are turned back and focused into a five-stage signal multiplier. Beam electrons that approach positively charged portions of the pattern on the glass are deposited from the scanning beam in quantities sufficient to neutralize the potential pattern on the glass before the beam is turned back and focused into the signal multiplier. Such deposition leaves the glass with a negative charge on the scanned side and a positive charge on the photocathode side. These charges neutralize each other by conductivity through the glass in less than the time of one frame.

The electrons turned back at the target form the return beam which has been amplitude modulated by absorption of electrons at the target in accord with the charge pattern whose more positive areas correspond to the highlights of the televised scene.

The *field mesh*—a fine-mesh screen of high electron transmission—acts to increase the strength of the decelerating field immediately in front of the target. The field mesh also defocuses the return beam so that the texture of the first dynode does not appear in the background of the picture. The uniform gradient of the decelerating field over the scanned area causes the beam to approach the target perpendicularly at all points on the target. The enhanced field also prevents the charge pattern on the target from bending the beam away from its proper trajectory. The over-all result of these two effects is to enable the 7295-A to produce a picture that is relatively free of unwanted bright edges or overshoots at the boundary of brightly illuminated portions of a scene. The strong decelerating field also allows the 7295-A to be operated with high values of target voltage, and thereby, to produce high signal-to-noise ratios.



NOTE: "PANCAKE" FOCUSING COIL IS CONNECTED IN SERIES AIDING WITH MAIN FOCUSING COIL.

Fig. 2 – Schematic Arrangement of Type 7295-A and Associated Components.

Multiplier Section

The return beam is directed to the first dynode of a five-stage electrostatically focused multiplier. This utilizes the phenomenon of secondary emission to amplify the modulated beam current more than 500 times. The electrons in the beam impinging on the first-dynode surface produce many other electrons. These secondary electrons are then directed to the second dynode and knock out more new electrons. Grid No.3 facilitates a more complete collection by dynode No.2 of the secondaries from dynode No.1. The multiplying process is repeated in each successive stage, with an ever-increasing stream of electrons until those emitted from dynode No.5 are collected by the anode and constitute the current utilized in the output circuit.

The signal-to-noise ratio of the output signal from the 7295-A is very high. The gain of the multiplier is such as to raise the output signal sufficiently above the noise level of the video amplifier stages so that they contribute no noise to the final video signal. The signal-to-noise ratio of the video signal, therefore, is determined primarily by random variation in the quantity of the electrons in the modulated electron beam.

As the beam moves from a less-positive portion on the target to a more-positive portion, the signal-output voltage across the load resistor changes in the positive direction. Hence, for highlights in the scene, the grid of the first video amplifier stage swings in the positive direction.

DATA

General:

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts.	0.6	ampere

Direct Interelectrode Capacitance:

Anode to all other electrodes .	12	μμf
Target-to-Mesh Spacing.	0.002	inch

Spectral Response S-10

Wavelength of Maximum Response. .	4500 ± 300	angstroms

Photocathode, Semitransparent:

Rectangular image (4 x 3 aspect ratio):

Useful size of.	1.6" max.	Diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of. . . . .Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and the grid No.6 terminal. The horizontal and vertical scan should start at the corner of the picture between the grid No.6 and the photocathode terminals.

Focusing Method . . . . .Magnetic

Deflection Method . . . . .Magnetic

Overall Length. . . . . 19.375" ± 0.310"

Greatest Diameter of Bulb . . . . 4.500" ± 0.094"

Envelope Terminals. 5

End Base. . . . . .Small-Shell Diheptal 14-Pin Base (JEDEC Group 5, No.B14-45)

Operating Position. .The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.). . . . . 2.3 lbs

Minimum Deflecting-Coil Inside Diameter . . . . 3.2"

Deflecting-Coil Length. . . . . 7"

Focusing-Coil Length. . . . . 15"

Alignment Coil:

Position on neck. . Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

Maximum Ratings, *Absolute-Maximum Values:*♦

PHOTOCATHODE:		
Voltage	-700 max.	volts
Illumination	50 max.	fc
OPERATING TEMPERATURE:		
Any part of bulb	65 max.	°C
Of bulb at large end of tube (image section)	35 min.	°C
TEMPERATURE DIFFERENCE:		
Between image section and any part of bulb hotter than image section	5 max.	°C
GRID-No.6 VOLTAGE	-700 max.	volts
TARGET VOLTAGE:		
Positive value	10 max.	volts
Negative value	10 max.	volts
FIELD-MESH VOLTAGE##	30 max.	volts
GRID-No.5 VOLTAGE	300 max.	volts
GRID-No.4 VOLTAGE	350 max.	volts
GRID-No.3 VOLTAGE	400 max.	volts
GRID-No.2 & DYNODE-No.1 VOLTAGE	350 max.	volts
GRID-No.1 VOLTAGE:		
Negative bias value	125 max.	volts
Positive bias value	0 max.	volts
VOLTAGE PER MULTIPLIER STAGE	350 max.	volts
ANODE-SUPPLY VOLTAGE#	1650 max.	volts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	125 max.	volts
Heater positive with respect to cathode	10 max.	volts

Typical Operating Values:*

Photocathode Voltage	-600	volts
Grid-No.6 Voltage (Image Focus) Approx. 50% of Photocathode Voltage□	-250 to -350	volts
Target Voltage Above Cutoff○	2 to 3	volts
Field Mesh Voltage##	15 to 25	volts
Grid-No.5 Voltage (Decelerator)	40	volts
Grid-No.4 Voltage (Beam Focus)	70 to 90	volts
Grid-No.3 Voltage⊕	250 to 275	volts
Grid-No.2 & Dynode-No.1 Voltage	280	volts
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	volts
Dynode-No.2 Voltage	600	volts
Dynode-No.3 Voltage	800	volts
Dynode-No.4 Voltage	1000	volts
Dynode-No.5 Voltage	1200	volts
Anode Voltage	1250	volts
Target Temperature Range	35 to 45	°C
Minimum Peak-to-Peak Blanking Voltage	5	volts
Field Strength of Focusing Coil:▲		
At center of scanning section (Approx.)	60	gausses
In plane of photocathode (Approx.)	120	gausses
Field Strength of Alignment Coil	0 to 3	gausses

Performance Data:

With conditions shown under Typical Operating Values, target voltage adjusted to 3 volts above cutoff, and with the camera lens adjusted so that the picture highlights are twice those required to reach the "knee" of the light transfer characteristic except as otherwise specified.

	Min.	*Average*	*Max.*	
Cathode Radiant Sensitivity at 4500 angstroms	-	0.028	-	μa/μw
Anode Current (DC)	-	30	-	μa
Signal-Output Current (Peak to Peak)	5	-	30	μa
Ratio of Peak-to-Peak High-light Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc	-	65:1	-	
Photocathode Illumination at 2870° K Required to Reach "Knee" of Light Transfer Characteristic	-	0.040	0.075	fc
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)**	40	56	-	%

♦ The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

With respect to grid No.4.

\# Dynode-voltage values are shown under *Typical Operating Values*.

* With 7295-A operated in RCA TK-12 camera at fixed photocathode voltage.

□ Adjust for optimum focus.

○ The target supply voltage should be adjustable from -5 to +5 volts.

⊕ 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.

** Measured with amplifier having flat frequency response.

OPERATING CONSIDERATIONS

Support for the 7295-A should be designed so that vibration and shock will not cause the tube to be displaced with respect to the focusing, deflecting, and alignment fields.

Proper orientation of the envelope terminal socket with respect to the deflecting field is essential, and is obtained when the plane that passes through the key on the diheptal base, the grid-No.6 terminal on the tube envelope, and the tube axis is parallel to the vertical deflection field. This orientation minimizes beat-pattern effects by placing the sides of the mesh holes at an angle of 45° with respect to the horizontal scanning lines.

The *deflecting yoke and focusing coil* used with the 7295-A incorporate means to prevent the magnetic field produced by the deflecting yoke from extending into the image section of the tube. Unless proper shielding is provided, cross talk from the deflecting yoke into the image section will cause the electron image to "jitter". This jitter produces a loss of picture sharpness.

A *blanking signal* should be supplied 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 period, the full beam current without video-signal modulation is returned to the multiplier and its multiplied output flows through the load resistance. Excessive amounts of blanking voltage applied to the target will impair resolution, because during retrace the emitted photoelectrons are no longer in focus with the target. A desirable amount of target blanking is 6 volts peak to peak.

Shading may be required even with optimum adjustment of voltage on grid No.3 in order to obtain a more uniformly shaded picture. A sawtooth waveform of adjustable amplitude and polarity at both the vertical- and horizontal-scanning frequency should be provided for insertion in the video amplifier to aid in obtaining a flat background.

Failure of scanning even for a few seconds may permanently damage the surface of the target. The damaged area shows up as a spot or line in the picture during subsequent operation.

The *operating temperature* of any part of the glass bulb should never exceed 65° C, and no part of the bulb at the large end of the tube (image section) should ever fall below 35° C during operation. For best results, it is recommended that the temperature of the entire bulb be held between 35° and 45° C. Operation at too low a temperature will be characterized by the appearance of a rapidly disappearing "sticking picture" of opposite polarity from the original when the picture is moved. Operation at too high a temperature will cause loss of resolution and possibly permanent damage to the tube. The loss of resolution is caused by the decreasing resistivity of the target glass disc with increasing temperature. As a result, lateral leakage of the image charge occurs. Tube temperature should always be checked if a loss in resolution occurs during tube operation. Resolution is regained by waiting for the temperature to drop. *No part of the bulb should run more than 5° C hotter than the image section to prevent cesium migration to the target.* Such migration will result in loss of resolution and in probable permanent damage to the tube. Like other photosensitive devices employing cesium, the 7295-A may show fluctuations in performance from time to time. Strict observance of the above recommendations with respect to operating temperature will not completely eliminate these variations but will greatly improve stability of the characteristics during the life of the tube.

When the operating conditions are such that the maximum temperature rating or maximum temperature difference as given under *Maximum Ratings* will be exceeded, provision should be made to direct a blast of cooling air from the diheptal-base end of the tube along the entire length of the bulb surface, i.e., through the space between the bulb surface and the surrounding deflecting-coil assembly and its extension.

To keep the operating temperature of the large end of the tube from falling below 35° C, some form of controlled heating should be employed. Ordinarily, adequate heat will be supplied by the focusing coil, deflecting coils, and associated amplifier tubes so that the temperature can be controlled by the amount of cooling air directed along the bulb surface. If, in special cases, an image-section heater is required, it should fit between the focusing coil and the bulb near the shoulder of the tube, and be non-inductively wound.

A *mask* having a diagonal or diameter of 1.6 inches should always be used on the photocathode to reduce the amount of light reaching unused parts of the photocathode.

The *optical system* used with the 7295-A should be of high quality and should incorporate control of the amount of light entering the television camera lens. This control may consist of an iris or an iris and suitable neutral-density filters. The entire optical system should have all inside surfaces finished in mat black to prevent internal reflections from reaching the photocathode. Under almost all conditions, the use of a lens shade is beneficial.

OPERATING INSTRUCTIONS

The 7295-A is designed to have stable operating characteristics which ensure optimum performance from day-to-day with minimum camera control adjustment.

Installation of the 7295-A in the camera is accomplished by inserting the diheptal-base end of the tube through the coil assembly and then inserting the tube in the envelope terminal socket. Proper insertion aligns the white radial line on the face with the bottom terminal socket for grid No.6. The 7295-A has two complementary guides for inserting the tube correctly, the grouping of the envelope terminals and a white radial line on the face of the envelope.

The *operating position* of the 7295-A 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. Therefore, it is recommended that the tube never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

Full-size scanning of the target should always be used during operation. Full-size scanning can be assured by first adjusting the deflection circuits to overscan the target sufficiently to cause the edge of the target ring to be visible in the corners of the picture, and then reducing the scanning until the edge of the target ring just disappears. In this way, the maximum signal-to-noise ratio and maximum resolution can be obtained. Note that overscanning the target produces a smaller-than-normal picture on the monitor.

Underscanning the target, i.e., scanning an area of the target less than its sensitive area, should never be permitted. Underscanning produces a larger-than-normal picture on the monitor. If the target is underscanned for any length of time, a permanent change in target-cutoff voltage of the underscanned area takes place with the result that the underscanned area thenceforth is visible in the picture when full-size scanning is restored.

Retention of a scene by the 7295-A, sometimes called a "sticking picture", may be observed if the 7295-A is allowed to remain focused on a stationary bright scene, or if it is focused on a bright scene before reaching operating temperature in the range from 35° to 45° C. Often the retained image will disappear in a few seconds, but sometimes it may persist for long periods before it completely disappears. A persisting retained image can generally be removed by focusing the 7295-A on a clear white screen and allowing it to operate with an illumination of about 1 footcandle on the photocathode until the retained image disappears.

To minimize retention of a scene, it is recommended that the 7295-A always be allowed to warm up in the camera for 1/4 hour with the lens capped. Never allow the 7295-A to remain focused on a stationary bright scene, and never use more illumination than is necessary.

Occasionally, a *white spot* which does not change in size when the beam-focus voltage is varied, may be observed in the center of the picture. Such a spot, especially if it is visible on the monitor with the camera lens capped, is probably an ion spot. If the spot begins to grow in size with continuous operation, the 7295-A should be removed from service at once, and returned for re-processing. Continued operation of an image orthicon with an ion spot will eventually damage the target permanently.

Video Gain is controlled over a wide range by reducing the voltage on one of the multiplier dynodes. Provision to vary the voltage on dynode No.3 is generally provided in the camera as the *Video-Gain Control*. Because individual 7295-A's may have a dc output range of 10 to 1, such a gain control is required to prevent possible overload of the video amplifier when a 7295-A having a high signal output or high current amplification is used. However, this control should not be adjusted to reduce the output signal of the 7295-A to such a low value that noise in the video amplifier stages is contributed to the final video signal.

During *standby operation*, the lens of the camera should always be closed or capped. An effective method of performing the same end result is to cut off the photocathode voltage by means of a switch. The camera will instantly be ready for operation when the photocathode voltage is again turned on.

PERFORMANCE CHARACTERISTICS

The *light transfer characteristic* of the 7295-A changes for different illumination levels (see Reference 5). The basic light transfer characteristic of the 7295-A is shown in Fig.3. The light values shown are applicable only for the indicated kinds of illumination incident on the photocathode. This curve is representative only for small-area highlights.

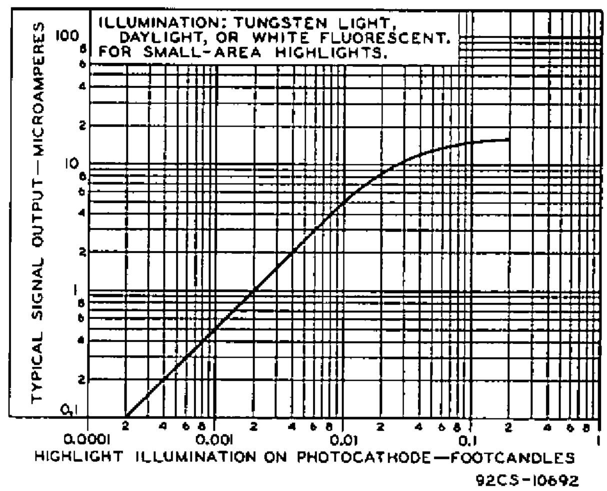


Fig. 3 - Basic Light Transfer Characteristic of Type 7295-A.

Sensitivity and Illumination. The image orthicon is a device exceeding in relative sensitivity most high-speed photographic film. When related to photographic film and compared at shutter speeds of 1/60 second which is the effective storage time of the image orthicon in a standard broadcast television system, the 7295-A exposed with the highlights on the photocathode of 0.060 footcandle will have an equivalent ASA exposure index of approximately 3000. This equivalent film-speed rating can be used in conjunction with a photographic exposure meter set for a shutter speed of 1/60 second to determine the approximate light level or lens-stop setting necessary for operating the 7295-A in a standard broadcast system.

The illumination on the photocathode of the 7295-A is related to the scene illumination as follows:

$$I_s = \frac{4f^2 \, I_{pc} \, (m+1)^2}{TR}$$

where

I_s = scene illumination in footcandles

f = f-number setting of lens

I_{pc} = photocathode illumination in footcandles

m = linear magnification from scene to photocathode

T = total transmission of lens

R = reflectance of principal subject in scene

Except for very close shots, the linear magnification (m) from scene to photocathode may be neglected.

For example, assume that the lens is set at f:8, that it has a transmission (T) of 75%, that the required photocathode highlight illumination is 0.060 footcandle, and that the highlight reflectance (R) is 50%.

Then,

$$I_s = \frac{4 \times 8^2 \times 0.060}{0.75 \times 0.50} = 41 \text{ footcandles}$$

Optimum resolution and best performance is obtained when the 7295-A is operated with the lens set no more than one lens stop above the knee of the light transfer characteristic. Under certain lighting conditions, such as direct sunlight, it may not be possible to stop the lens down far enough to obtain this level of highlight illumination on the photocathode. When such a condition is encountered, the use of a neutral-density filter selected to give the required reduction in illumination is recommended.

The low illumination level utilized on the photocathode of the 7295-A makes it necessary that no stray light from without or within the camera fall on the face of the tube. See *optical system* under *Operating Considerations*.

SET-UP PROCEDURE

The *set-up procedure* described below should be followed carefully to obtain optimum performance from the 7295-A. Before the proper voltages are applied to the tube as indicated under *Typical Operating Values*, the lens should be uncapped and the lens iris opened to allow light to fall on the photocathode. *This is a very important step for this type of image orthicon.* The proper voltages should then be applied to the 7295-A. Grid-No.1 voltage should immediately be adjusted to produce a small amount of beam current. This procedure will prevent the mesh from being electrostatically pulled into contact with the glass disc. Make certain that the deflection circuits are functioning properly to cause the electron beam to scan the target. Adjust the deflection circuits so that the beam will "overscan" the target, i.e., so that the area of the target scanned is greater than its sensitive area. This procedure during the warm-up period is recommended to prevent burning on the target a raster smaller than that used for on-the-air operation. Note that over-scanning the target results in a smaller-than-normal picture on the monitor. The lens should then be capped and the tube allowed to warm up for 15 minutes before use or before other adjustments are made.

Next, uncap the lens and partially close the lens iris. Increase the target voltage until information appears on the monitor. Then adjust beam focus, image focus, and optical focus until detail can be discerned in the picture. Adjust the alignment-coil-current controls until picture response is maximum. If the picture appears in negative contrast, increase the beam current. Further adjust the alignment-coil current so that the center of the picture does not move when the beam-focus control (grid No.4) is varied, but simply goes in and out of focus. During alignment of the beam, and also during operation of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, focus the camera on a test pattern. The target voltage is then advanced or reduced to the point where a reproduction of the test pattern is just discernable on the monitor. This value of target voltage is known as the "target-cutoff voltage". The target voltage should then be increased to between two and three volts above cutoff, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights. If two or more cameras are to be used concurrently in the studio, it is important that each camera use the same value of target voltage so that the reproduced pictures are easily matched. It is to be noted that the use of high target voltage produces a higher signal-to-noise ratio and better contrast than the signal-to-noise ratio and contrast produced using low target voltages. However, high target voltages result in shorter tube life and may introduce microphonic noise.

The lens is then adjusted to produce best optical focus, and the voltages on grid No.6 and grid No.4 adjusted to produce the sharpest picture.

If the 7295-A is used in cameras other than RCA TK-12, the range of grid-No.4 voltage should be varied to obtain that focus mode which yields the "flattest" picture, produces the least interference from mesh in the background at low lights, eliminates dark corners, and gives the best center-to-edge focus.

In cameras where both grid-No.6 and the photocathode voltages are variable, the photocathode voltage should be adjusted to produce the best focus with grid No.6 set at approximately 50% of the photocathode voltage. This value of grid-No.6 voltage should minimize picture distortion and produce best center-to-edge focus.

At this point, attention should be given to the grid-No.5 control. If grid-No.5 voltage is adjustable, it should be varied to produce the best center-to-edge focus and the best picture geometry. When changing grid-No.5 voltage, it will be necessary to refocus the scanning section by adjusting grid-No.4 voltage control.

After the above-mentioned controls are properly set, the grid-No.3 control should be adjusted for maximum signal output. The deflecting yoke and 7295-A should be rotated, if necessary, so that the horizontal scanning of the camera is parallel to the horizontal plane of the scene.

The above adjustments constitute a rough setup for the 7295-A. Final adjustments necessary for the 7295-A to produce the best possible picture are as follows:

The proper illumination level should first be determined. Adjust the target voltage to 2 or 3 volts above the target-cutoff value. Focus the camera on a neutral (black-and-white) test pattern consisting of progressive tonal steps from black to white. Open the lens iris just to the point where the highest step of the test pattern does not rise as fast as the lower steps when viewed on a video-waveform oscilloscope. Then open the camera lens 1 stop above this setting. This operating point assures the maximum signal, best gray scale, freedom from "black borders", and the sharpest picture.

Then adjust the grid-No.1 voltage control to just discharge the brightest highlight of the pattern.

Next, adjust the grid-No.3 voltage control so that the video signal has a maximum value consistent with a flat-background signal when the lens is capped. This background represents the black level of the picture.

The video gain control is adjusted to produce the maximum output signal without overloading the camera amplifier.

From this point on, the waveform monitor for the camera should be used to determine the lens opening necessary to produce the maximum desired highlight signal as determined with the neutral step pattern, and no changes should be made on the video-amplifier or image-orthicon multiplier-gain controls.

If a wider range of tonal values is desired, black-stretch circuitry or gamma-correction circuitry should be used instead of opening the lens further. The high value of signal-to-noise ratio produced by the 7295-A permits the use of gamma-correction circuitry to achieve a good range of tonal values in the picture without encountering excessive noise. In addition, operation with this correction will prolong the life of the tube by reducing the amount of current pulled through the target glass.

REFERENCES

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   Part III—*Electro-Optical Characteristics of Camera Systems"*, RCA Review, September, 1948:

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DOS and DON'TS on Use of RCA-7295-A

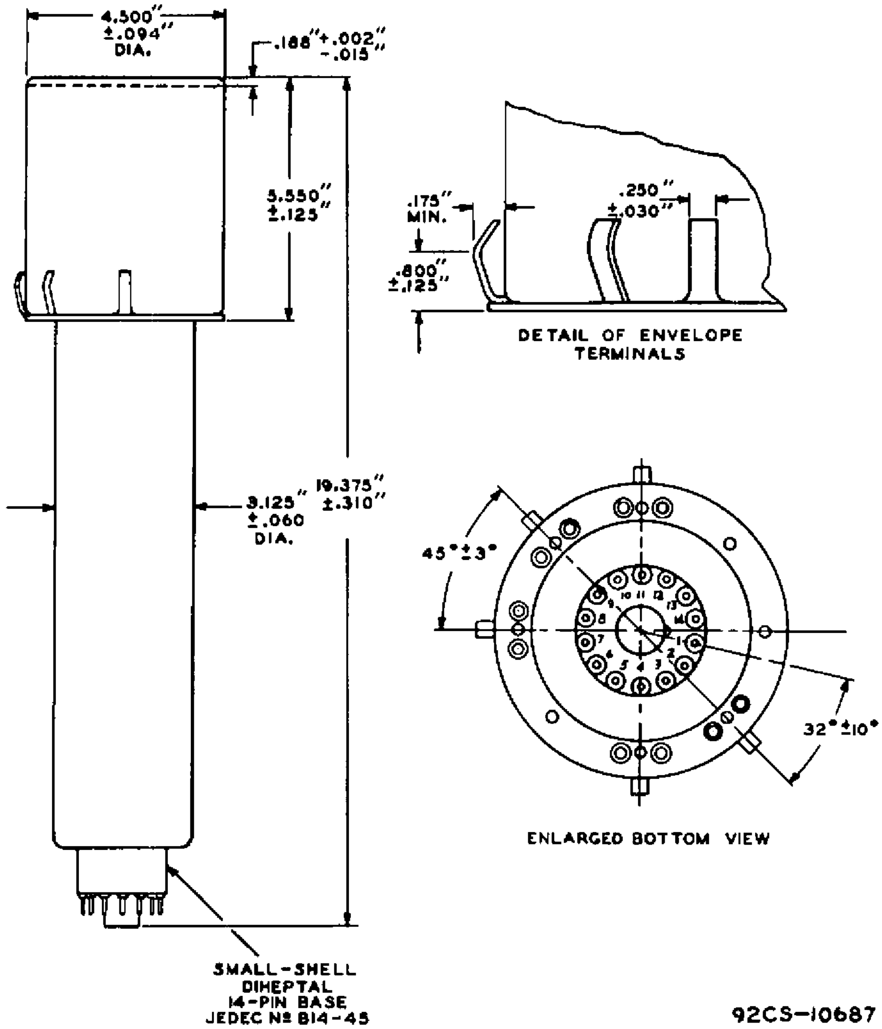
Here are the "dos"—

1. Allow the 7295-A to warm up prior to operation.
2. Hold temperature of the 7295-A within operating range.
3. Make sure alignment coil is properly aligned.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 7295-A's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to the desired voltage above target-cutoff.
7. Open lens before voltages are applied to the 7295-A.

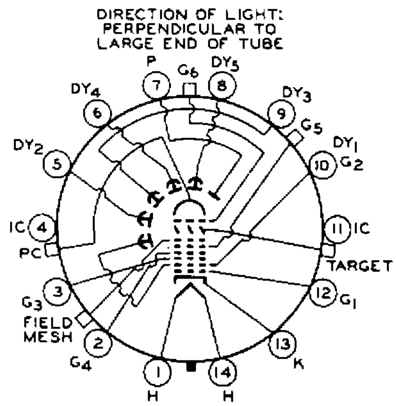
Here are the "don'ts"—

1. Don't force the 7295-A into its envelope terminal socket.
2. Don't operate the 7295-A without scanning.
3. Don't underscan target.
4. Don't focus the 7295-A on a stationary bright scene.
5. Don't operate a 7295-A having an ion spot.
6. Don't use more beam current than necessary to discharge the highlights of the scene.
7. Don't operate 7295-A with target voltage greater than 3 volts above cutoff.
8. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.

DIMENSIONAL OUTLINE



BASING DIAGRAM
Bottom View



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

ENVELOPE TERMINALS

TERMINAL OVER PIN 2:	FIELD MESH
TERMINAL OVER PIN 4:	PHOTOCATHODE
TERMINAL ON SIDE OF ENVELOPE OPPOSITE BASE KEY:	GRID No.6
TERMINAL OVER PIN 9:	GRID No.5
TERMINAL OVER PIN 11:	TARGET