21AP4

KINESCOPE

Magnetic Focus
Magnetic Deflection
Ion-Trap Gun

Rectangular Type
Metal-Shell Envelope
Frosted Filterglass Faceplate

18-3/8" x 13-15/16" Picture Size
21" Max. Shell Diagonal
22-5/16" Max. Length

TENTATIVE DATA

RCA-21AP4 is a short, directly viewed, rectangular picture tube of the metal-shell type for use in television receivers. It has a picture size of 18-3/8" x 13-15/16" with slightly curved sides and rounded corners--a shape that provides a very pleasing frame for the picture.

The rectangular shape, which allows reproduction of the transmitted picture without waste of screen area, permits use of a cabinet having about 20 per cent less height than is required for a round-face tube having the same picture width. In addition, the chassis need not be depressed or cut out under the face of the tube and controls can be located as desired beneath the tube.

The 21AP4 provides pictures having high brightness and good uniformity of focus over the whole picture area. It has a high-efficiency, white fluorescent screen on a relatively flat, high-quality face made of frosted Filterglass to prevent specular reflection and to provide increased picture contrast. The frosted Filterglass faceplate incorporates a neutral light-absorbing material which reduces ambient-light reflections from the phosphor and reflections within the faceplate itself in a much higher ratio than it reduces the directly viewed light of the picture. As a result, improved picture contrast is obtained. In addition, frosting of the face diffuses reflections of bright objects in the room which might otherwise be objectionable.

Employing magnetic focus and magnetic deflection, the 21AP4 is designed with a funnel-to-neck section which facilitates centering of the yoke on the neck and, in combination with better centering of the beam inside the neck, contributes to the good uniformity of focus over the entire picture area. The diagonal deflection angle is 70° and the horizontal deflection angle is 66°.

Other features incorporated in the 21AP4 are short overall length; metal-shell construction which weighs substantially less than a similar all-glass tube; a higher-quality faceplate than is commonly used in all-glass tubes; and an ion-trap gun requiring only a single-field, external magnet.

DATA

General:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3	volts
Current	0.6	ampere
Direct Interelectrode Capacitances:		
Grid No.1 to All Other Electrodes	6	μμf
Cathode to All Other Electrodes	5	μμf
Faceplate (With about 66% light transmission)	Frosted Filterglass	
Phosphor	No.4--Sulfide Type	
Fluorescence	White	
Phosphorescence	White	
Persistence	Short	
Focusing Method	Magnetic	
Deflection Method	Magnetic	
Deflection Angles (Approx.):		
Diagonal	70°	
Horizontal	66°	
Vertical	50°	

Ion-Trap Gun	Requires External, Single-Field Magnet
Maximum Overall Length	22-5/16"
Greatest Diagonal of Tube at Lip	20-3/4" ± 1/4"
Greatest Width of Tube at Lip	19-23/32" ± 1/8"
Greatest Height of Tube at Lip	15-5/16" ± 1/8"
Screen Size	18-3/8" x 13-15/16"
Ultor● Terminal	Metal-Shell Lip
Base	Small-Shell Duodecal 5-Pin (JETEC No.B5-57)
Mounting Position	Any

Maximum Ratings, *Design-Center Values*:

ULTOR● VOLTAGE	18000 max.	volts
GRID-No.2 VOLTAGE	500 max.	volts
GRID-No.1 VOLTAGE:		
Negative bias value	125 max.	volts
Positive bias value	0 max.	volts
Positive peak value	2 max.	volts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode:		
During equipment warm-up period not exceeding 15 seconds	410 max.	volts
After equipment warm-up period	180 max.	volts
Heater positive with respect to cathode	180 max.	volts

Typical Operation:

Ultor Voltage*	14000	16000	volts
Grid-No.2 Voltage	300	300	volts
Grid-No.1 Voltage for Visual Extinction of Undeflected Focused Spot	-33 to -77	-33 to -77	volts
Focusing-Coil Current (DC)OO	104 ±6%	110 ±6%	ma
Field Strength of Single-Field Ion-Trap Magnet	45	50	gausses
Ion-Trap Magnet Current (DC, approx.)#	90	-	ma
Field Strength of Adjustable Centering Magnet	0 to 8	0 to 8	gausses

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	1.5 max.	megohms

● In the 21AP4, grid No.3, which has the ultor function, and collector are connected together within the tube and are conveniently referred to collectively as "ultor". The "ultor" in a cathode-ray tube is the electrode, or the electrode in combination with one or more additional electrodes connected within the tube to it, to which is applied the highest dc voltage for accelerating the electrons in the beam prior to its deflection.

* Brilliance and definition decrease with decreasing ultor voltage. In general, the ultor voltage should not be less than 14000 volts.

OO For specimen focusing coil similar to JETEC Focusing Coil No.109 positioned with air gap toward kinescope screen and center line of air gap 3 inches from Reference Line (see *Outline Drawing*). The indicated current is for condition with combined grid-No.1 bias voltage and video-signal voltage adjusted to produce a highlight brightness of 30 foot-lamberts on a 18-3/8" x 13-15/16" picture area sharply focused at center of screen. The indicated tolerance on focusing-coil current is on basis that distance from Reference Line to grid No.1 is controlled as shown in Detail of Grid-No.1 position on page 7.

\# For specimen ion-trap magnet similar to JETEC Ion-Trap Magnet No.111 located in optimum position and rotated to give maximum brightness.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the 21AP4 are working design-center maximums established according to the standard design-center system of rating electron tubes. Tubes so rated will give satisfactory performance in equipment designed so that these maximum ratings will not be exceeded when the equipment is operated from ac or dc power-line supplies whose normal voltage including normal variations falls within ± 10 per cent of line-center voltage value of 117 volts.

X-Ray Warning. When operated at ultor voltages up to 16 kilovolts, the 21AP4 does not produce any harmful x-ray radiation. However, because the rating of the tube permits operation at voltages as high as 19.8 kilovolts (absolute value), shielding of the 21AP4 for x-ray radiation may be needed to protect against possible injury from prolonged exposure at close range whenever the operating conditions involve voltages in excess of 16 kilovolts.

Corona Considerations. Adequate spacing between the lip of the 21AP4 and any grounded element in the receiver, or between the metal shell and any grounded element, should be provided to preclude the possibility of corona. Such spacing should be not less than 1-1/2 inches of air.

Insulating Material for Mask. The glass of the faceplate does not have especially high electrical resistance. It is essential, therefore, that any mask material bearing on the faceplate be adequately insulated to withstand the maximum applied ultor voltage. Unless this precaution is observed, picture distortion may be experienced.

Tube Handling. Care should be taken to prevent bumping or striking the lip of the 21AP4. Rough treatment may damage the faceplate seal. This seal is most vulnerable along the sides of the metal shell, particularly to a blow on the inside of the lip.

A caution notice incorporating the information shown on page 3 is affixed to the metal shell of each 21AP4. It is recommended that a similar notice be prominently displayed on equipment using the 21AP4 and be included in the equipment service bulletin.

Do not allow the metal shell of the 21AP4 to come in contact with a magnet and thus become permanently magnetized. A magnetized shell produces localized distortion of the picture edges.

Care of Tube Face. The frosted Filterglass face of the 21AP4 is more easily scratched and abraded than an unfrosted face and must, therefore, be handled more carefully. Finger marks may be removed from the face with a detergent, such as Dreft, or with a grease solvent, such as carbon tetrachloride.

Shatter-Proof Cover Over The Tube Face. It is recommended that receivers be designed with a shatter-proof, clear glass or plastic cover over the face of the 21AP4 to protect it from being struck accidentally and to protect against possible damage resulting from tube implosion under some abnormal condition.

Support for the 21AP4, which may be operated in any position, should be provided at the large end by suitable supporting insulators at the corners of the tube, and by the deflecting-yoke mounting on the neck. Support areas on the lip are indicated on the *Outline Drawing*. Other

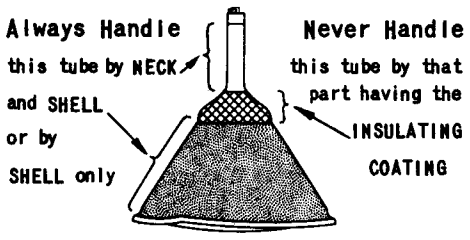
portions of the lip periphery should be left free to avoid the possibility of fracturing the face-plate-to-lip seal (see *Tube Handling*).

CAUTION-HIGH VOLTAGE

This METAL SHELL operates at HIGH VOLTAGE. DO NOT TOUCH while in operation. GROUND SHELL before touching after power is off.

X-RAY WARNING

Shielding of cathode-ray tubes for x-ray radiation may be needed to protect against possible danger of personal injury from prolonged exposure at close range when they are operated above 16 kilovolts.



Finger prints or dust on the insulating coating may cause electrical breakdown during humid weather.

HANDLE WITH CARE

Breakage of this tube, which contains a high vacuum, may result in injury from flying glass. Do not strike or scratch the tube. Never subject it to more than moderate pressure when installing in or removing from equipment.

The deflecting-yoke mounting, sometimes called the mounting hood, should provide adjustment for alignment of the yoke on the neck and should also provide sufficient pressure to hold the yoke firmly against the glass funnel. Some good insulating material, such as Neoprene, is required between the hood and the glass funnel not only to provide a cushion between them but also to prevent abrasion of the insulating coating on the funnel and resultant arcing from the metal shell to the hood. The hood should be designed so that it can be placed as close as possible to the Reference Line (see *Outline Drawing*) without interfering with the yoke in order to reduce the amount of insulation required between hood and funnel. It is also essential that no electrical contact be made from the hood to the funnel because any such contact will decrease the length of the leakage path across the insulating coating on the glass funnel. Furthermore, the hood should not exert undue pressure on the deflecting yoke.

The yoke should be held firmly against the glass funnel (see proper location under *Deflecting Yoke*), but any thrust should be absorbed by the insulating cushion. The hood, which also usually serves as the mounting for the focusing coil, should be specially braced to prevent lateral and longitudinal motion caused by buckling of the chassis which may occur during transportation of the receiver. A simple brace from the edge of the chassis usually provides the extra stiffness required; or a small foot placed directly under the yoke may be sufficient. Unless the precaution against thrust on the yoke is observed, the tube or yoke may be damaged during transportation of the receiver.

The *deflecting yoke* should have an effective length of not more than 1-11/16 inches and be designed so that the effective center of deflection of the beam is about 1.15 inches from the Reference Line (see *Outline Drawing*). This position takes into account centering by means of the focusing device or by the use of a centering magnet, and provides some leeway for their effect on the beam without causing the beam to strike the neck when deflection is sufficient to reach the edge of the screen.

The yoke should have an inside contour which conforms in general to the dimensions and shape shown in Fig. 1. It is to be noted that the inner

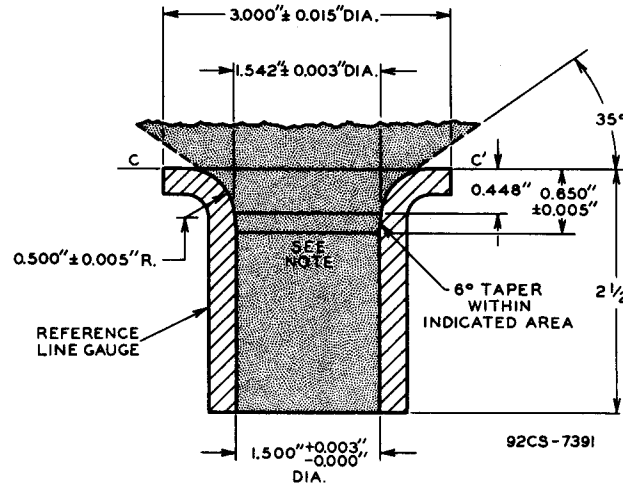


Fig. 1 - Reference-Line Gauge (JETEC No. 110) with Supplementary Information on Recommended Inside Contour of Yoke to Provide Proper Location of Yoke on Neck-Funnel Section.

surface of the end of the yoke adjacent to the glass funnel should not come closer to the funnel than indicated by the 35° line in Fig. 1 if adequate insulation is to be maintained across the glass funnel between the point of yoke contact and the metal shell.

A *focusing field*, supplied by an electromagnetic coil, permanent magnet, or a combination of the two, is required to concentrate the electron beam into a focused spot at the screen. The field should have excellent radial symmetry. When a coil is used, it should be supplied with direct current from a well-filtered source. The field strength to produce a focused spot is indicated in the tabulated data. For other voltages than those shown, the coil current will be approximately proportional to the square root of the ultor voltage. Regardless of the kind of focusing device used, provision should be made for adjusting the field strength to cover the ultor-operating range and the normal variation between individual tubes.

The focusing field should be spaced at least 1/2 inch from the end of the deflecting-coil windings to reduce interaction between the focusing and deflecting fields. If the focusing field is placed too close to the deflecting fields, interaction between them may reduce deflection sensitivity and corner resolution, as well as cause objectionable rotation of the fluorescent pattern as the focus is varied. On the other hand, if the focusing field is too close to the electron gun, resolution will be reduced and pattern distortion may occur as a result of interaction with the ion-trap-magnet field.

As the air gap of the focusing device is moved away from the deflecting yoke, the corner resolution will be improved at the expense of slight loss in center resolution. The strength of the focusing field required increases appreciably as the distance between the deflecting-yoke windings and the air gap of the focusing device is increased.

The *ion-trap magnet*, required to recenter the electron beam in the gun structure, should be of the single-field type. It should provide a uniform field across the transverse section of the tube neck to produce a round, focused spot. Direction of the field of the ion-trap magnet should be such that the north pole is adjacent to vacant pin position No.8 and the south pole to pin No.2.

To operate properly with the electron gun in the 21AP4, the ion-trap magnet should have a field strength such that the optimum position of the magnet is in the region of grid No.2 (see Fig.2), with any departure being in the direction of the base rather than toward the metal shell. The optimum position should result in a properly centered pattern having full brightness and no shadowing at the edges. If full brightness is accompanied by an unsymmetrical raster shape and poor focus, it is an indication that the ion-trap magnet has incorrect rotational positioning and that the focusing field has been displaced to counteract incorrect positioning of the ion-trap magnet.

The strength of the ion-trap magnet for other ultor voltages than those indicated will be proportional to the square root of the ultor voltage.

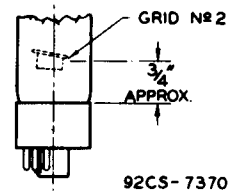


Fig.2 - Location of Grid No.2 in Tube Neck.

Centering of the pattern may be accomplished by decentering or tilting the focusing device, or by the use of a small, adjustable centering magnet located near the base end of the deflecting yoke. The dc component of the deflecting currents should be filtered out of the deflecting yoke in order to minimize the amount of centering adjustment needed.

REFERENCES

1. *"Medical X-ray Protection Up To Two Million Volts"*, National Bureau of Standards Handbook H41.
2. *"Safety Code for Industrial Use of X-rays"*, American Standards Association. ASA Code Z54.1-1946.

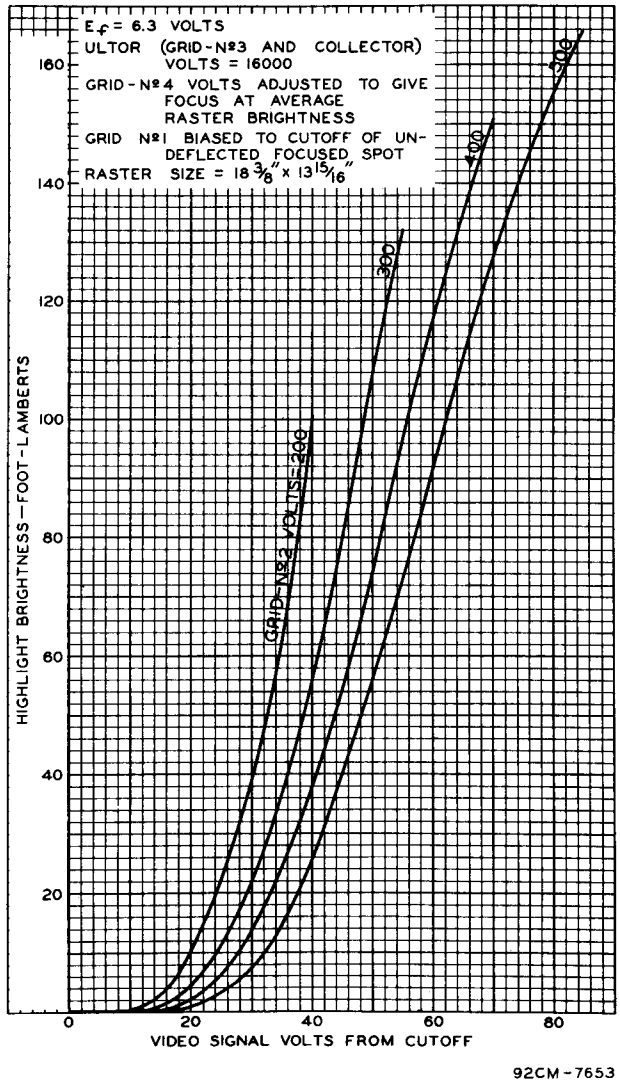


Fig. 3 - Average Grid-Drive Characteristics of Type 21AP4.

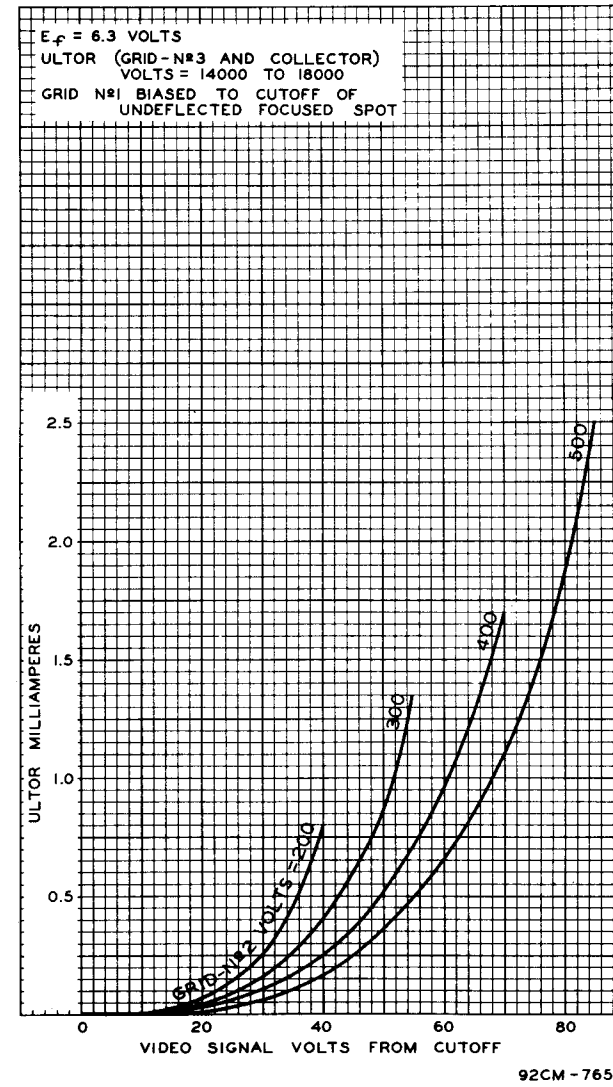
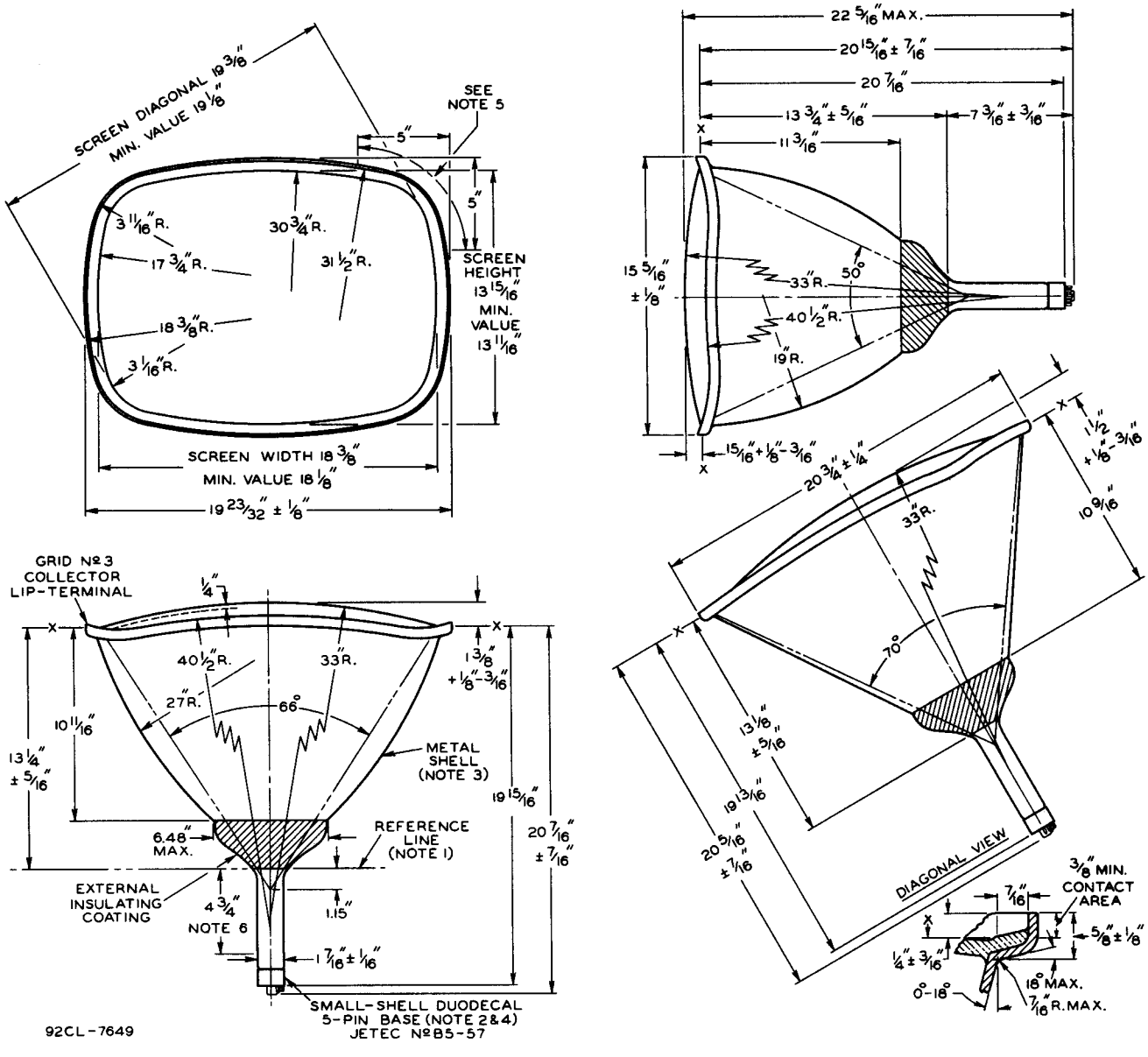


Fig. 4 - Average Grid-Drive Characteristics of Type 21AP4.

DIMENSIONAL OUTLINE



NOTE 1: WITH TUBE NECK INSERTED THROUGH FLARED END OF REFERENCE-LINE GAUGE (JETEC No.110) AND WITH TUBE SEATED IN GAUGE, THE REFERENCE LINE IS DETERMINED BY THE INTERSECTION OF THE PLANE CC' OF THE GAUGE WITH THE GLASS FUNNEL.

NOTE 2: SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH METAL-SHELL AXIS AND HAVING A DIAMETER OF 3-1/4".

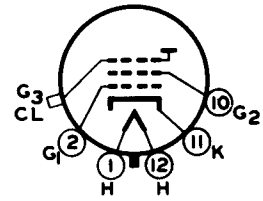
NOTE 3: METAL SHELL AND GLASS FACE OPERATE AT HIGH VOLTAGE. ANY MATERIAL IN CONTACT WITH THE SHELL OR THE FACE MUST BE INSULATED TO WITHSTAND THE MAXIMUM APPLIED ULTOR VOLTAGE.

NOTE 4: THE PLANE THROUGH THE TUBE AXIS AND VACANT PIN POSITION NO.6 MAY VARY FROM THE HORIZONTAL AXIS OF THE GLASS FACE BY AN ANGULAR TOLERANCE (MEASURED ABOUT THE TUBE AXIS) OF ± 10°.

NOTE 5: SUPPORT TUBE IN LIP REGION ONLY AT CORNERS WITHIN THIS SPACE.

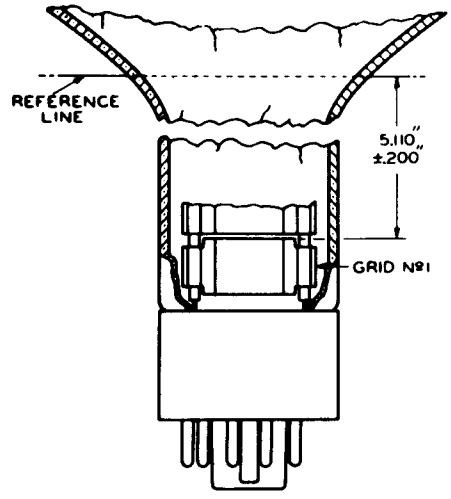
NOTE 6: LOCATION OF DEFLECTING YOKE AND FOCUSING DEVICE MUST BE WITHIN THIS SPACE.

SOCKET CONNECTIONS
Bottom View



PIN 1: HEATER
PIN 2: GRID No.1
PIN 10: GRID No.2
PIN 11: CATHODE
PIN 12: HEATER
METAL-SHELL LIP:
GRID No.3,
COLLECTOR

DETAIL OF GRID-No.1 POSITION



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