21DP4

KINESCOPE

Electrostatic Focus
Magnetic Deflection
Ion-Trap Gun

Rectangular Type
Metal-Shell Envelope
Frosted Filterglass Face Plate

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

TENTATIVE DATA

RCA-21DP4 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.

Utilizing electrostatic focusing, the 21DP4 features an electron gun of improved design to provide good uniformity of focus over the entire picture area. Furthermore, focus can be maintained automatically with variation in line voltage and with adjustment of picture brightness. Need for alignment of a focusing coil or focusing magnet is eliminated and therefore tube installation and adjustment for optimum performance are simplified. Because the electron gun is designed so that the focusing electrode (grid No.4) takes very little current, the voltage for the focusing electrode can be provided easily and economically.

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.

Providing pictures having high brightness, the 21DP4 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 face plate incorporates a neutral light-absorbing material which reduces ambient-light reflections from the phosphor and reflections within the face plate 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 deflection, the 21DP4 is designed with a funnel-to-neck section which facilitates centering of the yoke on the neck and, in combination with a well-centered 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 design features of the 21DP4 are its short overall length, its lesser weight than that of a similar all-glass type, and its 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
Face Plate (With about 66% light transmission). .	Frosted Filterglass	
Phosphor	No.4--Sulfide Type	
Fluorescence	White	
Phosphorescence.	White	
Persistence.	Short	
Focusing Method.	Electrostatic	
Deflection Method.	Magnetic	
Deflection Angles (Approx.):		
Diagonal	70°	
Horizontal	66°	
Vertical	50°	
Ion-Trap Gun . . . Requires External, Single-Field Magnet		
Maximum Overall Length	22-5/8"	
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 6-Pin (JETEC No.B6-63)		
Mounting Position.	Any	

Maximum Ratings, ***Design-Center Values:***

ULTOR● VOLTAGE	18000 max.	volts
GRID-No.4 VOLTAGE.	5000 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

Equipment Design Ranges:

For any ultor voltage (E_u) between 14000* and 18000 volts and grid-No.2 voltage (E_{c_2}) between 150 and 500 volts

Grid-No.4 Voltage for Ultor Current of 100 μamp.	19.7% to 26.7% of E_u	volts
Grid-No.1 Voltage for Visual Extinction of Undeflected Focused Spot.	11% to 25.7% of E_{c_2}	volts
Grid-No.4 Current.	-15 to +25	μamp
Grid-No.2 Current.	-15 to +15	μamp
Field Strength of Single-Field Ion-Trap Magnet (Approx.)□	$\sqrt{\frac{E_u}{14000}} \times 38$	gausses
Field Strength of Adjustable Centering Magnet . .	0 to 8	gausses

Examples of Use of Design Ranges:

For ultor voltage of	***14000***	***18000***	***volts***
and grid-No.2 voltage of	***300***	***300***	***volts***
Grid-No.4 Voltage for Ultor Current of 100 μamp	2750 to 3740	3150 to 4270	volts
Grid-No.1 Voltage for Visual Extinction of Undeflected Focused Spot.	-33 to -77	-33 to -77	volts
Ion-Trap Magnet (Rated Strength). .	40	40	gausses

Maximum Circuit Values:

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

● In the 21DP4, grid No.5, which has the ultor function, grid No.3, 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.

□ With a specimen ion-trap magnet similar to JETEC Ion-Trap Magnet No.111 located in optimum position and rotated to give maximum brightness, the ion-trap magnet current is approximately 75 milliamperes dc when the ultor voltage is 14000 volts.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the 21DP4 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 21DP4 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 21DP4 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 21DP4 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 face plate does not have especially high electrical resistance. It is essential, therefore, that any mask material bearing on the face plate 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 21DP4. Rough treatment may damage the face-plate 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 21DP4. It is recommended that a similar notice be prominently displayed on equipment using the 21DP4 and be included in the equipment service bulletin.

Do not allow the metal shell of the 21DP4 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 21DP4 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.

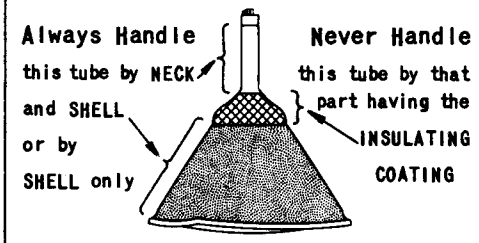
Shatter-Proof Cover Over The Tube Face. It is recommended that receivers be designed with a shatter-proof, clear glass or plastic cover over the face of the 21DP4 to protect it from being

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.

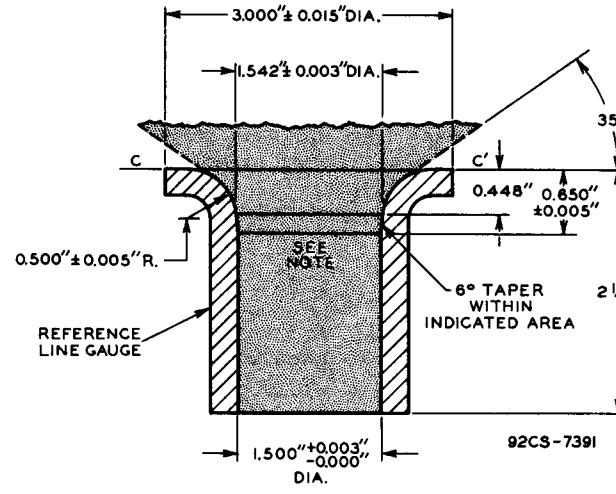
struck accidentally and to protect against possible damage resulting from tube implosion under some abnormal condition.

Support for the 21DP4, 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*).

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 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 deflec-



NOTE: INNER SURFACE OF YOKE MUST NOT EXTEND INTO SHADED REGION

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.

tion of the beam is about 1.15 inches from the Reference Line (see *Outline Drawing*). This position takes into account the use of a center-

ing magnet and provides some leeway for its 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 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.

Focusing of the beam in the 21DP4 is accomplished by adjustment of the voltage applied to grid No. 4. Because this electrode takes very low current, the focusing voltage can be easily provided. Any method used must take into account the grid-No. 4 leakage current as shown in the tabulated data. When the high-voltage supply is of the pulse-operated, limited-energy type commonly used, the focusing voltage can be obtained by means of a simple rectifier system connected to a suitable tap on the horizontal-deflection-output and high-voltage transformer. Such an arrangement produces negligible drop in the output voltage of the high-voltage supply.

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 21DP4, 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.

The use of an ion-trap magnet much stronger than indicated in the tabulated data tends to raise the focusing voltage beyond the indicated maximum value. Because of this fact and the absence of any shunting effect of the field by a focusing coil or magnet, it will be found that the optimum strength of the ion-trap magnetic field will be somewhat less than is required for a comparable magnetic-focus tube.

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.

Centering of the pattern may be accomplished by the use of a small, adjustable centering magnet located near the base end of the deflecting yoke. This magnet should provide a uniform field over the transverse section of the electron beam in order to prevent the formation of an elliptically shaped spot with consequent defocusing on the screen. The field is considered to be uniform when its field lines are straight instead of curved. The position of the centering magnet on the tube neck must be within a distance of 3-1/4 inches from the Reference Line (see *Outline Drawing*). When the magnet is positioned at the limiting distance, the ac field of the deflecting yoke is relatively weak and will have little demagnetizing effect. When placed closer to the deflecting yoke, the magnet must be made of material capable of withstanding a stronger ac field without demagnetization. If the magnet is placed too far from the deflecting yoke, appreciable deflection defocusing or neck shadow will result. 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.

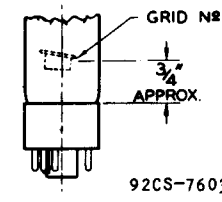


Fig. 2 - Location of Grid No. 2 in Tube Neck.

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.

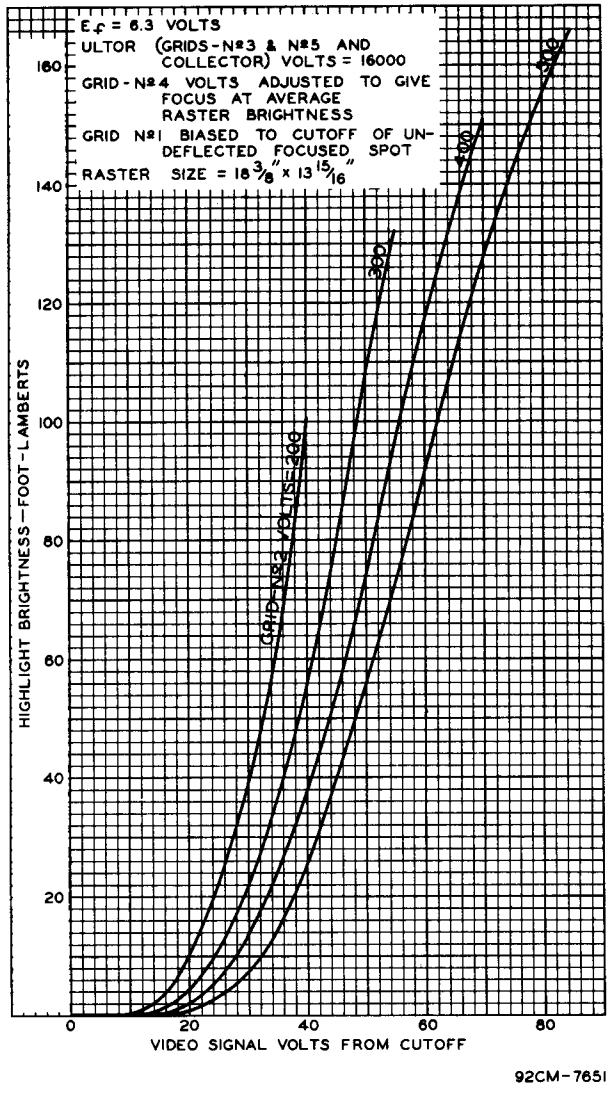


Fig. 3 - Average Grid-Drive Characteristics of Type 21DP4.

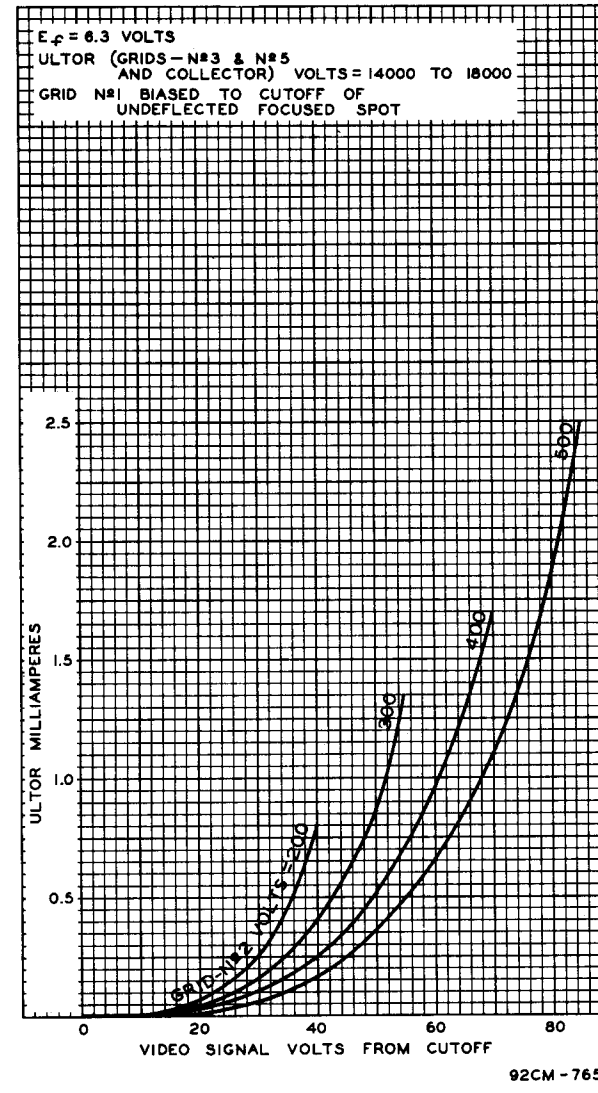
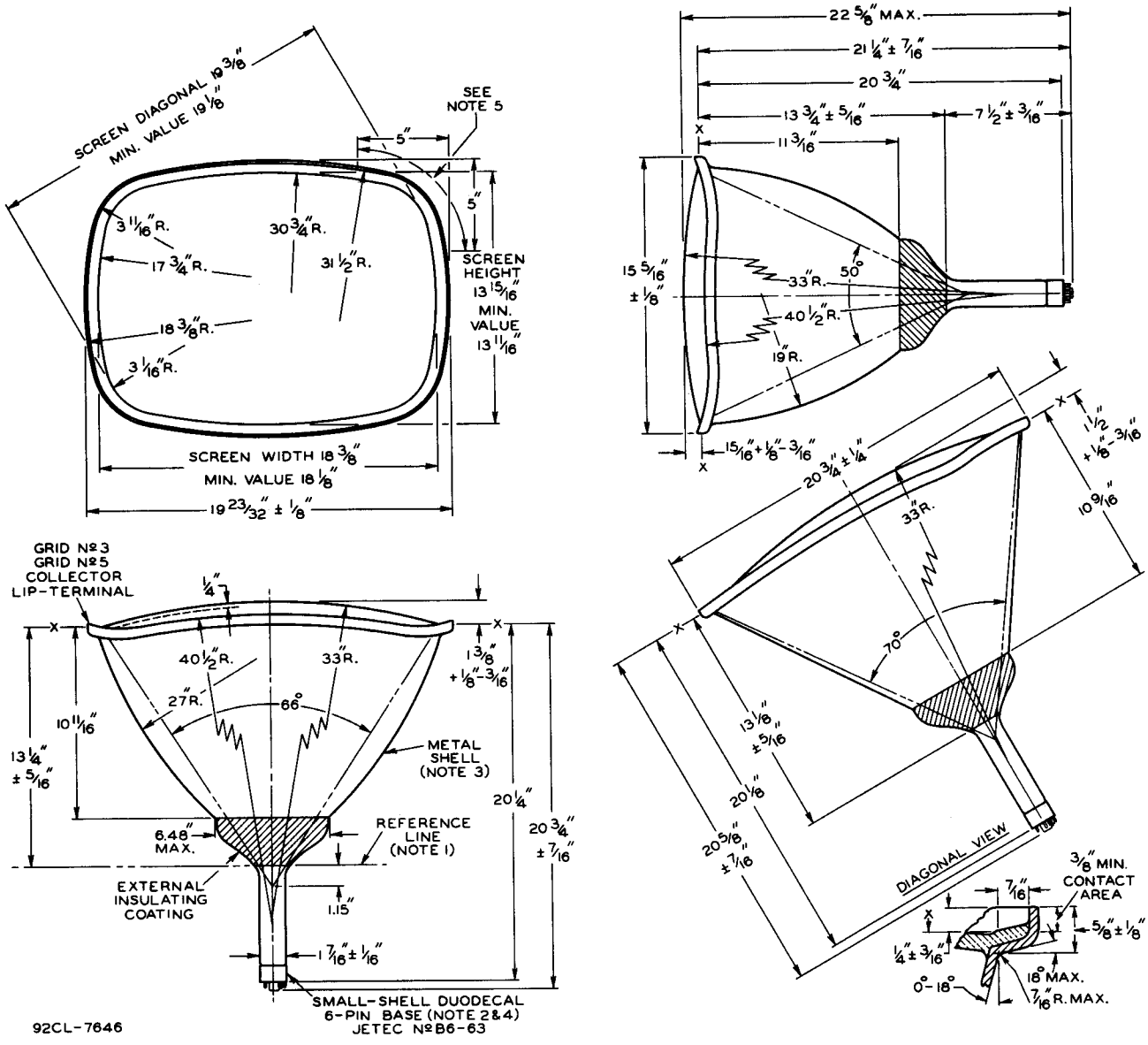


Fig. 4 - Average Grid-Drive Characteristics of Type 21DP4.

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".

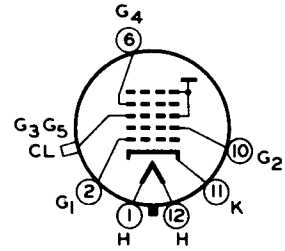
NOTE 3: METAL SHELL AND GLASS FACE OPERATE AT HIGH VOLTAGE. ANY MATERIAL IN CONTACT WITH THE SHELL OR THE FACE MUST BE INSULATED TO WITHSTAND THE MAXIMUM APPLIED ULTOR VOLTAGE.

NOTE 4: THE PLANE THROUGH THE TUBE AXIS AND PIN 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.

SOCKET CONNECTIONS

Bottom View



PIN 1: HEATER
PIN 2: GRID NO.1
PIN 6: GRID NO.4
PIN 10: GRID NO.2
PIN 11: CATHODE
PIN 12: HEATER
METAL-SHELL LIP: GRID NO.3,
GRID NO.5, COLLECTOR