TUBE RATINGS

AND THEIR SIGNIFICANCE

A rating is a designation, as established by definite standards, of an operating limit of a tube. Tubes are rated by either of two systems, i.e., the "absolute maximum" system or the "design-center maximum" system. Of the two, the absolute maximum system is the older and dates back to the beginning of tubes. With either system, each maximum rating for a given tube type must be considered in relation to all other maximum ratings for that type, so that no one maximum rating will be exceeded in utilizing any other maximum rating. For convenience in referring to these two systems, the former will hereinafter be called the "absolute system," and the latter, the "design-center system."

In the **absolute system,*** the maximum ratings shown for each type thus rated are limiting values above which the serviceability of the tube may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The equipment should be designed to operate the filament or heater of each tube type at rated normal value for full-load operating conditions under average voltage-supply conditions. Variations from this normal value due to voltage-supply fluctuation or other causes, should not exceed ±5 per cent unless otherwise specified by the tube manufacturer.

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* Types rated according to the **absolute system** have no identification on their data pages issued prior to April 1, 1942. Sheets issued after that date carry the statement "Maximum Ratings Are Absolute Values" preceding the ratings.

TUBE RATINGS

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In the **design-center system**** adopted by the receiving-tube industry late in 1939, the maximum ratings shown for each type thus rated are working design-center maximums. The basic purpose underlying this system is to provide satisfactory average performance in the greatest number of equipments on the premise that they will not be adjusted to local power-supply conditions at time of installation. In the setting up of design-center ratings, consideration has been given to three important kinds of power supply commonly in use, i.e., a-c and d-c power lines, storage battery with connected charger, and dry batteries.

In the case of a-c or d-c power lines, the maximum ratings for tubes rated according to the design-center system have been chosen so that the tubes will give satisfactory performance at these maximum ratings in equipment operated from power-line supplies whose normal voltage including normal variations fall within ±10 per cent of a specified center value. In other words, it is basic to the design-center system of ratings for tubes operated from power-line supplies that filaments or heaters as well as positive- and negative-potential electrodes may have to operate at voltages differing as much as ±10 per cent from their rated values. It also recognizes that equipment may occasionally be used on power-line supplies outside the normal range, but since such extreme cases are the exception, they should be handled by adjustment made locally.

The choice of ±10 per cent takes care of voltage differences in power lines in the U.S.A. where surveys have shown that the voltages delivered fall within ±10 per cent of 117 volts. Therefore, satisfactory performance from tubes rated according to the design-center system will ordinarily be obtained

** Types rated according to the **design-center system** are identified on their data pages either by a large star in the index corner or by the statement "Maximum Ratings Are Design-Center Values" preceding the ratings. This statement is used on sheets issued since April 1, 1942.

anywhere in the U.S.A. in equipment designed so that the design-center maximum ratings are not exceeded at a line-voltage-center value of 117 volts. While 117 volts represents present-day conditions, the design-center system permits the utilization of a new line-center value as new surveys may indicate the necessity for such a change.

In the case of storage-battery-with-charger supply or similar supplies, the normal battery-voltage fluctuation may be as much as 35 per cent or more. This fluctuation imposes severe operating conditions on tubes. Under these conditions, latitude for operation of tubes is provided for by the stipulation that only 90 per cent of the design-center maximum values of plate voltages, screen-supply voltages, dissipations, and rectifier output currents is never exceeded for a terminal potential at the battery source of 2.2 volts per cell. While a tube's operating voltages in this service will at times exceed the maximum values, satisfactory performance with probable sacrifice in life will be obtained.

In the cases of dry-battery supply and rectified a-c supply for 1.4-volt tubes, recommended design practice is given in RMA Standard M8-210.

RMA Standard M8-210 (Jan. 8, 1940 Rev. 11-40) is reproduced here for the convenient reference of design engineers with permission of the Engineering Department of the Radio Manufacturers Association. Although worded to cover only receiving tubes, it can be applied to any tube having design-center-system ratings.

* * *

It shall be standard to interpret the ratings on receiving types of tubes according to the following conditions:

1. CATHODE—The heater or filament voltage is given as a normal value unless otherwise stated. This means that transformers or resistances in the heater or filament circuit should be designed to op-

TUBE RATINGS

(continued from preceding page)

erate the heater or filament at rated value for full-load operating conditions under average supply-voltage conditions. A reasonable amount of leeway is incorporated in the cathode design so that moderate fluctuations of heater or filament voltage downward will not cause marked falling off in response; also, moderate voltage fluctuations upward will not reduce the life of the cathode to an unsatisfactory degree.

A. 1.4-Volt Battery Tube Types—The filament power supply may be obtained from dry-cell batteries, from storage batteries, or from a power line. With dry-cell battery supply, the filament may be connected either directly across a battery rated at a terminal potential of 1.5 volts, or in series with the filaments of similar tubes across a power supply consisting of dry cells in series. In either case, the voltage across each 1.4-volt section of filament should not exceed 1.6 volts. With power-line or storage-battery supply, the filament may be operated in series with the filaments of similar tubes. For such operation, design adjustments should be made so that, with tubes of rated characteristics, operating with all electrode voltages applied and on a normal line voltage of 117 volts or on a normal storage-battery voltage of 2.0 volts per cell (without a charger) or 2.2 volts per cell (with a charger), the voltage drop across each 1.4-volt section of filament will be maintained within a range of 1.25 to 1.4 volts with a nominal center of 1.3 volts. In order to meet the recommended conditions for operating filaments in series from dry-battery, storage-battery, or power-line sources it may be necessary to use shunting resistors across the individual 1.4-volt sections of filament.

B. 2.0-Volt Battery Tube Types—The 2.0-volt line of tubes is designed to be operated with 2.0 volts across the filament. In all cases the operat-

TUBE RATINGS

(continued from preceding page)

ing voltage range should be maintained within the limits of 1.8 volts to 2.2 volts.

2. POSITIVE POTENTIAL ELECTRODES — The power sources for the operation of radio equipment are subject to variations in their terminal potential. Consequently, the maximum ratings shown on the tube-type data sheets have been established for certain Design Center Voltages which experience has shown to be representative. The Design Center Voltages to be used for the various power supplies together with other rating considerations are as given below:

A. AC or DC Power Line Service in U.S.A.—The design center voltage for this type of power supply is 117 volts. The maximum ratings of plate voltages, screen-supply voltages, dissipations, and rectifier output currents are design maximums and should not be exceeded in equipment operated at a line voltage of 117 volts.

B. Storage-Battery Service—When storage-battery equipment is operated without a charger, it should be designed so that the published maximum values of plate voltages, screen-supply voltages, dissipations, and rectifier output currents are never exceeded for a terminal potential at the battery source of 2.0 volts per cell. When storage-battery equipment is operated with a charger, it should be designed so that 90% of the same maximum values is never exceeded for a terminal potential at the battery source of 2.2 volts.

C. "B"-Battery Service—The design center voltage for "B" batteries is the normal voltage rating of the battery block, such as 45 volts, 90 volts, etc. Equipment should be designed so that under no condition of battery voltage will the plate voltages, the screen-supply voltages, or dissipations ever exceed the recommended respective maximum values shown in the data for each tube type by more than 10%.

TUBE RATINGS

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D. Other Considerations

a. Class A_1 Amplifiers—The maximum plate dissipation occurs at the "Zero-Signal" condition. The maximum screen dissipation usually occurs at the condition where the peak-input signal voltage is equal to the bias voltage.

b. Class B Amplifiers—The maximum plate dissipation theoretically occurs at approximately 63% of the "Maximum-Signal" condition, but practically may occur at any signal voltage value.

c. Converters—The maximum plate dissipation occurs at the "Zero-Signal" condition and the frequency at which the oscillator-developed bias is a minimum. The screen dissipation for any reasonable variation in signal voltage must never exceed the rated value by more than 10%.

d. Screen Ratings—When the screen voltage is supplied through a series voltage-dropping resistor, the maximum screen voltage rating may be exceeded, provided the maximum screen dissipation rating is not exceeded at any signal condition, and the maximum screen voltage rating is not exceeded at the maximum-signal condition. Provided these conditions are fulfilled, the screen-supply voltage may be as high as, but not above, the maximum plate voltage rating.

3. TYPICAL OPERATION — For many receiving tubes, the data show typical operating conditions in particular services. These typical operating values are given to show concisely some guiding information for the use of each type. They are not to be considered as ratings, because the tube can be used under any suitable conditions within its rating limitations.

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TUBE RATINGS

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RECEIVING TUBES

The ratings of all receiving tubes currently used in new equipment are set up according to the design-center system. Older and obsolescent types of receiving tubes still have absolute maximum ratings because these types are used only for renewal purposes and, therefore, design-center values are of no practical value. **Receiving-tube types rated on the design-center system are identified in the Receiving-Tube Section either by a large star in the index corner of each data page or by the statement "Maximum Ratings Are Design-Center Values" preceding the ratings on each data page.**

TRANSMITTING TUBES

The ratings of transmitting tubes grouped in the Transmitting-Tube Section are on the basis of the absolute system. This system enables the transmitter design engineer to choose his design values so as to obtain maximum performance within the tube ratings. Such design procedure has been considered practical for large transmitters where adequate controls are usually incorporated in the design, and ordinarily an experienced operator is present to make any necessary adjustments.

The maximum ratings given for each transmitting type on its data pages apply only when the type is operated at frequencies lower than some specified value which depends on the design of the type. As the frequency is raised above the specified value, the radio-frequency currents, dielectric losses, and heating effects increase rapidly. Most types can be operated above their specified maximum frequency provided the plate voltage and plate input are reduced in accordance with the information given in the table "Transmitting-Tube Ratings vs Operating Frequency" in the front part of the Transmitting-Tube Section.

For certain air-cooled transmitting tubes, two sets

TUBE RATINGS

(continued from preceding page)

of absolute maximum values are shown to meet diversified design requirements. One set is designated as CCS (Continuous Commercial Service) ratings, while the other is called ICAS (Intermittent Commercial and Amateur Service) ratings.

Continuous Commercial Service is defined as that type of service in which long tube life and reliability of performance under continuous operating conditions are the prime consideration. To meet these requirements, the CCS ratings have been established.

Intermittent Commercial and Amateur Service is defined to include the many applications where the transmitter design factors of minimum size, light weight, and maximum power output are more important than long tube life. These various factors have been taken into account in establishing the ICAS ratings.

Under the ICAS classification are such applications as the use of tubes in amateur transmitters, and the use of tubes in equipment where transmissions are of an intermittent nature. The term "intermittent" is used to identify operating conditions in all applications other than amateur in which no operating or "on" period exceeds 5 minutes and every "on" period is followed by an "off" or standby period of at least the same or greater duration.

ICAS ratings are considerably higher than CCS ratings. They permit the handling of greater power, but tube life under ICAS conditions, of course, is reduced. However, the transmitter designer may very properly decide that a small tube operated with ICAS ratings better meets his requirements than a larger tube operated with CCS ratings. Although such use involves some sacrifice in tube life, the period over which tubes will continue to give satisfactory performance in intermittent service can be extremely long depending on the exact nature of the service.

TUBE RATINGS

(continued from preceding page)

The choice of tube operating conditions best fitted for any particular application should be based on a careful consideration of all pertinent factors.

RECTIFIER TUBES

Rectifier tubes used principally in receiving equipment are rated according to the design-center system, while those used primarily in transmitting and laboratory equipment are rated according to the absolute system. The method of identifying which rating system is used for any rectifier tube in this Handbook is the same as that for other tubes in the particular section of the Handbook in which data for the rectifier tube are given.

The ratings of rectifier tubes are based on fundamental limitations in the operation of the tubes themselves, and in general include the following: maximum peak inverse plate voltage, maximum peak plate current, and maximum d-c output current.

Maximum peak inverse plate voltage is the highest instantaneous plate voltage which the tube can withstand recurrently in the direction opposite to that in which it is designed to pass current. For mercury-vapor tubes and gas-filled tubes, it is the safe top value to prevent arc-back in the tube operating within the specified temperature range.

In determining peak inverse plate voltage on a rectifier tube in a particular circuit, the equipment designer should remember that the relations between peak value of inverse plate voltage, rms value of input voltage, and average value of output voltage, depend largely on the characteristics of the particular rectifier circuit and the power supply. Furthermore, the presence of transients, such as line surges and keying surges, or waveform distortion, may raise the actual inverse plate voltage to a peak higher than that calculated for sine-wave voltages. Therefore, the **actual** inverse plate voltage on a rectifier tube should never exceed the maximum peak inverse plate voltage rating for that tube. The peak inverse plate voltage may be determined with an electronic peak voltmeter of the self-contained battery type.

In single-phase, full-wave rectifier circuits with sine-wave input and pure resistance load, the peak inverse plate voltage is approximately 1.4 times the rms value of the plate-to-plate voltage supply. In single-phase, half-wave circuits with sine-wave input and pure resistance load, the peak inverse plate voltage is approximately 1.4 times the rms value of the plate voltage supply, but with condenser input to filter, the peak inverse plate voltage may be as high as 2.8 times the rms value of the plate voltage supply.

Maximum peak plate current is the highest instantaneous plate current that a tube can safely carry recurrently in the direction of normal current flow. The safe value of this peak current in hot-cathode types of rectifier tubes is a function of the electron emission available and the duration of the pulsating current flow from the rectifier tube in each half-cycle.

The value of peak plate current in a given rectifier circuit is largely determined by filter constants. If a large choke is used at the filter input, the peak plate current is not much greater than the load current; but if a large condenser is used at the filter input, the peak current may be many times the load current. In order to determine accurately the peak plate current in any rectifier circuit, the designer should measure it with a peak-indicating meter or use an oscillograph.

Maximum d-c output current is the highest average plate current which can be handled continuously by a rectifier tube. Its value for any rectifier tube type is based on the permissible plate dissipation of that type. Under operating conditions involving a rapidly

TUBE RATINGS

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repeating duty cycle (steady load), the average plate current may be measured with a d-c meter. In the case of certain mercury-vapor tubes where the load is fluctuating, it is necessary to determine the average current over the time interval specified on the data pages for these types.

In addition to the above ratings for rectifier tubes, other ratings may be set up for a rectifier tube when the service in which the tube is to be used makes such ratings essential for satisfactory performance. Such ratings are: maximum surge plate current, and maximum heater-cathode potential.

Maximum surge plate current is the highest value of abnormal peak currents of short duration that should pass through the rectifier tube under the most adverse conditions of service. This value is intended to assist the equipment designer in a choice of circuit components such that the tube will not be subjected to disastrous currents under abnormal service conditions approximating a short circuit. This surge-current rating is not intended for use under normal operating conditions because subjecting the tube to the maximum surge current even only once may impair tube life. If the tube is subjected to repeated surge currents, its life will be seriously reduced or even terminated.

Maximum heater-cathode potential is the highest instantaneous value of voltage that a rectifier tube can safely stand between its heater and cathode. This rating is applied to certain rectifier tubes having a separate cathode terminal and used in applications where excessive potential may be introduced between heater and cathode. For convenience, this rating is usually given as a d-c value.

CATHODE-RAY TUBES

The ratings of some cathode-ray tubes are set up on the absolute system while others are set up on the design-center system. Initially, cathode-ray tubes

TUBE RATINGS

(continued from preceding page)

were all rated according to the absolute system. With the advent of television which presented design conditions similar to those in the receiving-set field, the method of rating popular types of cathode-ray tubes was changed to the design-center system. More recently, because of procedure standardized by the RMA Cathode-Ray-Tube Committee, newer types of cathode-ray tubes are being rated on the absolute system. **Cathode-ray types rated according to the design-center system are identified in the Cathode-Ray Types Section by a statement to that effect just ahead of the maximum ratings on each data page. The data pages of types rated according to the absolute system have either (1) no identifying statement as to the rating system, or (2) an identifying statement that the ratings are according to the absolute system.**

PHOTOTUBES

The ratings of all phototubes in the Phototube Section are on the absolute maximum basis. This basis enables the designing engineer to choose design values so as to obtain optimum performance within tube ratings. In the case of gas phototubes, the value to which the plate voltage and the plate current can be raised is abruptly limited by ionization effects. If these are allowed to occur, they may ruin the photosurface almost instantly. While phototubes in general might be rated on the design-center basis, such a procedure, with provision for an adequate factor of safety to take care of all conditions of operation, would impose undue limitations on the use of gas phototubes.

MISCELLANEOUS SPECIAL TUBES

The ratings of some of the various tube types grouped in the Miscellaneous-Types Section are according to the design-center system while others are according to the absolute system. **Miscellaneous types rated on the design-center basis are identified**

TUBE RATINGS

(continued from preceding page)

by a statement to that effect on the data pages or else refer back for ratings to a receiving-tube type whose rating basis is explained under TUBE RATINGS—Receiving Tubes. The data pages of types rated according to the absolute system have either (1) no identifying statement as to the rating system, or (2) an identifying statement that the ratings are according to the absolute system.

CHARACTERISTICS and TYPICAL OPERATING CONDITIONS

In addition to showing the ratings of each tube type, the data pages for many of the types in this Handbook include "characteristics," such as amplification factor, plate resistance, and transconductance, which help to distinguish between the electrical features of the respective types. Usually, the characteristics shown for any type are obtained for that type in class A service: where class A data are given for the type, the characteristics are included with that data for convenience. Based on a large number of tubes of a given type, the values shown for these characteristics are average values.

Range of Characteristics—The equipment designer should bear in mind that individual tubes of a given type may have characteristics values either side of the average values shown for the type. He should also realize that these characteristics change during the life of individual tubes. In designing equipment, therefore, he should allow for the maximum cumulative variation of any characteristic from the average value of that characteristic as shown in the tabulated data for the type. The exact percentage of the variation will be different for different types of tubes depending on the design of the tubes and their intended application, but in general the designer should consider a probable plus or minus variation of not less than 30 per cent.

Furthermore, the equipment designer should recognize the desirability of designing equipment so that the full range of the operating characteristics of tubes will be utilized. If this practice is not followed, he imposes on the equipment user special replacement problems in that the user will have to select tubes suitable for use in the equipment, and may not be able to obtain the full life capability of such tubes.

Typical Operating Values—Also included on the data pages is information on typical operating conditions for most of the various tubes when used in particular services. These typical operating values are intended to show concisely some guiding information for the use of each type. They must not be considered as ratings because each type can, in general, be used under any suitable conditions within its rating limitations. In referring to these values for transmitting tubes, it should be noted that the power output value is not a rating. It is an approximate tube output, i.e., tube input minus plate loss. Circuit losses must be subtracted from tube output in determining useful output.

Datum Point for Electrode Potentials—In the data for any type in the Handbook, the values for grid bias and positive-potential-electrode voltages are given with reference to a specified datum point as follows. For types having filaments heated with d.c., the negative filament terminal is taken as the datum point to which other electrode voltages are referred. For types having filaments heated with a.c., the mid-point (i.e., the center tap on the filament-transformer secondary, or the mid-point on a resistor shunting the filament) is taken as the datum point. For types having equipotential cathodes indirectly heated, the cathode is taken as the datum point.

Grid Bias vs Filament Excitation—If the filament of any type for which data are given on a d-c basis is to be operated with an a-c supply, the given grid bias should be increased by an amount approximately equal to one half the rated filament voltage and be referred to the filament mid-point. Conversely, if it is required to use d-c filament excitation on any filament type for which the data are given on an a-c basis, the grid-bias values as given on the data pages should be decreased by an amount approximately equal to one half the rated filament voltage and be referred to the negative filament terminal instead of the mid-point as in a-c operation.

In practice, the necessity for following this rule dep nds on circuit conditions and operating requirements. If the bias is relatively small compared with the filament voltage and hum is a consideration, adjustment of the grid bias is ordinarily essential. Conversely, if the bias is relatively large compared with the filament voltage, adjustment of the grid bias may be unnecessary.

When filament excitation of tubes used as Audio Amplifiers is changed from d.c to a.c., the grid return should, in general, be shifted to the mid-point of the filament circuit to minimize hum, and the bias adjusted accordingly. When the excitation is changed from a.c. to d.c., bias adjustment depending on the relative values of bias and filament voltage may be required to provide the full signal-handling capability of the tubes.

When filament excitation of tubes used as R-F Amplifiers is changed, bias adjustment is not required unless the change makes the circuit critical as to hum or signal-handling capability. For example, in class C amplifiers, the bias is usually so large in comparison with the filament voltage that adjustment is generally unnecessary.

Grid Current and Driving Power—The typical values of d-c grid current and driving power shown for triodes and tetrodes in class B r-f service and in class C service are subject to variations depending on the impedance of the load circuit. High-impe-

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dance load circuits require more grid current and driving power to obtain the desired output. Low-impedance circuits need less grid current and driving power, but plate-circuit efficiency is sacrificed. In comparison, the d-c grid current and driving power shown for beam tubes and pentodes in class B r-f service and in class C service are not as critical to variations in load-circuit conditions. In any event, sufficient grid current should be used so that the stage is "saturated," i.e., so that a small change in grid current results in negligible change in power output. Regardless of the type of tube used, the driving stage should have a tank circuit of good regulation and should be capable of delivering power in excess of the indicated power by a factor of several times.

RCA

TYPES OF CATHODES

AND THEIR USE

In electron tubes, a cathode is an electrode which is the primary source of electron or ion emission. There are two broad classes of cathodes, i.e., hot and cold. ' Hot cathodes" are defined as cathodes which are heated or otherwise operate at elevated temperature (frequently incandescent) in order to function as emitters. In contrast, "cold cathodes" are defined as cathodes which do not rely on heat or on elevated temperature in order to function as emitters.

HOT CATHODES

Hot cathodes commonly in use in electron tubes are classified as directly heated, indirectly heated, and ionic-heated.

A **directly heated cathode**, or filament-cathode, is a wire or ribbon which is heated by the passage of current through it. It is further classified by identifying the filament material or the electron-emitting material. Such materials in regular use are pure tungsten, thoriated tungsten, and metals coated with alkaline-earth oxides. Each of these materials has distinctive advantages which are utilized in the design of tubes for particular applications.

PURE-TUNGSTEN FILAMENTS are used in certain tubes, especially those for high-voltage transmitting service. Since these filaments must operate at a high temperature of about 2500°C (a dazzling white) to emit sufficient electrons, a relatively large amount of filament power is required. The operating life of these filaments is determined by the rate of tungsten evaporation. Their failure, therefore, occurs through decreased emission or burn-out.

Pure-tungsten filaments give best life performance when they are operated so as to conserve their emitting capability. They are designed with voltage and current ratings in accord with the service expected of the particular tube type. However, in applications where the normal emission at rated voltage is not

TYPES OF CATHODES

(continued from preceding page)

required, the filament can be operated at a somewhat reduced voltage. The extent of the reduction depends on the peak emission requirements of the application as well as on the percentage regulation of the filament voltage. When these are known, the correct operating filament voltage for any tungsten-filament type can be calculated from its filament-emission characteristic. The permissible regulation in transmitters may be checked by reducing the filament voltage (with the transmitter under normal operation) to a value such that reduction in output can just be detected. The filament voltage must then be increased by an amount equivalent to the maximum percentage regulation of the filament-supply voltage and then increased further by approximately 2 per cent to allow for minor variations in emission of individual tubes. It follows that the better the regulation, the less the filament operating voltage and, therefore, the longer the filament life.

It should be noted that a reduction of 5 per cent in the filament voltage applied to tubes with pure-tungsten filaments will approximately double their life. A reduction of 15 per cent will increase the filament life almost tenfold.

During long or frequent standby periods, pure-tungsten-filament tubes may be operated at decreased filament voltage to conserve life. When the average standby time is an appreciable portion of the average duty cycle and is less than 2 hours, it is recommended that the filament voltage of all but the largest types be reduced to 80 per cent of normal; and that for longer periods, the filament power be turned off. For the largest types, such as the 898, it is recommended that the filament voltage be reduced to 80 per cent of normal during standby operation up to 12 hours; and that for longer periods, the filament power be turned off.

For turning on filament power, a filament starter should be used so as to increase the voltage gradually and to limit the high initial rush of current through

TYPES OF CATHODES

(continued from preceding page)

the filament. It is important that the filament current never exceed, even momentarily, a value of more than 150 per cent of normal, unless the tube data specify otherwise. Similarly, as an added precaution, the filament power should be turned off gradually to prevent cooling strains in the filament.

THORIATED-TUNGSTEN FILAMENTS are now used mainly in certain transmitting and special tubes. Thoriated-tungsten filaments are made from tungsten impregnated with thoria. Due to the presence of thorium, these filaments liberate electrons at a more moderate temperature of about 1700°C (a bright yellow), and are, therefore, much more economical of filament power than are pure-tungsten filaments. The operating life of thoriated-tungsten filaments is ordinarily ended by a decrease in electron emission. Decreased emission, however, may be caused by the accidental application of too high filament, screen, or plate voltage. If the over-voltage has not been continued for a long time, the activity of the filament can often be restored by operating the filament at its normal voltage for 10 minutes or longer without plate, screen, or grid voltage. The reactivation process may be accelerated by raising the filament voltage to not higher than 120 per cent of normal value for a few minutes. This reactivation schedule is often effective in restoring the emission of thoriated-tungsten filaments in tubes which have failed after normal service. Sometimes a few hundred hours of additional life may be obtained after reactivation.

The operating voltage of a thoriated-tungsten filament should, in general, be held to within ±5 per cent of its rated value. However, in transmitting applications where the tube is lightly loaded, the filament may be operated on the low side—as much as 5 per cent below normal voltage. As conditions require, the voltage should be increased gradually to maintain output. Toward the end of life, additional service may be obtained by operating the fila-

TYPES OF CATHODES

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ment above its rated voltage. It should be noted that a tube having a thoriated-tungsten filament should never be operated under emission-limited conditions since this type of operation may overheat the tube and cause permanent loss of emission.

During standby periods in transmitting service, thoriated-tungsten filaments may be operated according to the following recommendations to conserve life. For short standbys of less than 15 minutes duration, the filament voltage of all but the largest types should be reduced to 80 per cent of normal; for longer periods, the filament power should be turned off. For the largest types, such as the 827-R and 861, it is recommended that the filament voltage be reduced to 80 per cent of normal during standby operation up to 2 hours; and that for longer periods, the filament power be turned off.

COATED FILAMENTS are used in receiving tubes, certain transmitting tubes, most mercury-vapor rectifiers, and some special tubes. Coated filaments employ a relatively thick coating of alkaline-earth compounds on a metallic base as a source of electronic emission. The metallic base carries the heating current. These filaments operate at a low temperature of about 800°C (a dull red) and require relatively little power to produce a copious supply of electrons.

For proper performance of these types, rated filament voltage should, in general, be applied at the filament terminals. However, when coated-filament, high-vacuum tubes are used in transmitting service with light loading, the filament voltage may be reduced as much as 5 per cent below normal to conserve life. Then, as conditions require, the voltage should be increased gradually to maintain output. Toward the end of life, the gradual increase may be carried above rated filament voltage to obtain additional service. In the case of gas or vapor tubes, it is important that these types be operated, in general, at rated filament voltage. However, if the line regulation regularly and consistently does not exceed 1 to 2 per cent, it is practical to reduce the filament voltage slightly (not over 5 per cent) with benefit to tube life.

During standby periods of less than 15 minutes, the filament voltage of quick-heating, high-vacuum types, such as the 1616 and 1624, should be reduced to 80 per cent of normal; for longer periods, the filament power should be turned off. In contrast, the voltage of coated filaments in gas or vapor tubes should not be reduced during standbys except under conditions explained in the preceding paragraph. In general, the filament voltage of small and medium types, such as the 866-A/866 and 872-A/872, should be maintained at normal rated value during standbys up to 2 hours; for longer periods, the filament power should be turned off. For large types, such as the 857-B, the filament voltage should be maintained at normal rated value during standbys up to 12 hours; for longer periods, the filament power should be turned off.

After having given normal service or after having been operated at excessive voltage, coated filaments lose their emission. When such is the case, their usefulness may be considered as terminated.

An **indirectly heated cathode**, or heater-cathode, consists of a heater wire enclosed in a thin metal sleeve coated on the outside with electron-emitting material similar to that used for coated filaments. The sleeve is heated by radiation and conduction from the heater through which current is passed. Useful emission does not take place from the heater wire. An important feature of this kind of cathode construction is that the functions of heating and emission can be independent of each other.

HEATER-CATHODES, or unipotential cathodes as they are frequently called, are used in high-vacuum tubes operating at low plate voltage, such as receiv-

TYPES OF CATHODES

(continued from preceding page)

ing tubes, low-power transmitting tubes, and small special tubes. They also find application in mercury-vapor tubes and in cathode-ray tubes. Heater-cathodes, like coated filaments, provide a copious supply of electron emission at low cathode temperature (a dull red).

For proper performance of heater-cathode tubes, rated heater voltage should, in general, be applied at the heater terminals. However, when heater-cathode high-vacuum tubes are used in transmitting service and are lightly loaded, the heater voltage may be reduced as much as 5 per cent below normal to conserve life. As conditions require, the voltage should be increased gradually to maintain output. Toward the end of life, the gradual increase may be carried above rated heater voltage to obtain additional service.

During standby periods of less than 15 minutes, the heater voltage of high-vacuum tubes should be maintained at normal rated value; for longer periods, the heater power should be turned off. In the case of vapor or gas tubes, the heater voltage should be maintained at normal during standby periods up to 12 hours; for longer periods, the heater power should be turned off.

An **ionic-heated cathode** is one which liberates electrons when it is subjected to intense positive ion bombardment. The bombardment may be so intense as to raise the temperature of the cathode, frequently causing it to become visibly hot. The ionic-heated cathode in radio tubes has found application in gas rectifiers intended primarily for automobile receiver service.

COLD CATHODES

The designation "cold cathode" is commonly used in referring to those cathodes which emit electrons when they are subjected to bombardment by other electrons, ions, or metastable atoms. Cathodes of

TYPES OF CATHODES

(continued from preceding page)

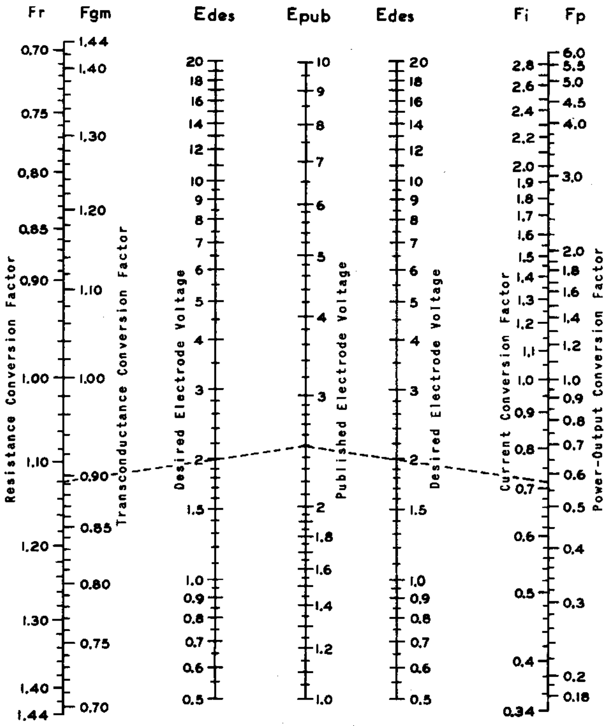
this type are sometimes designated as secondary-emission cathodes. They are used in certain glow-discharge tubes, and also in multiplier phototubes where they contribute to electron multiplication in the successive dynode stages.

Not customarily referred to as cold cathodes, although they are such, is another group of emitters known as photocathodes. By definition, a **photocathode** is one which emits electrons when it is energized with radiant flux, such as light, infra-red radiation, or ultra-violet radiation. Such cathodes are used in phototubes. When used in gas phototubes, these cathodes not only emit under the influence of radiant flux but also as a result of bombardment and thus become partial secondary-emission cathodes.

Photocathodes are classified according to the spectral response characteristics of their respective photoactive surfaces. The S1 photosurface gives high response to red and near infra-red radiation. The S2 photosurface is similar to the S1 surface but extends somewhat further into the infra-red region. The S3 photosurface has a spectral response characteristic which is closest to that of the eye. The S4 photosurface has exceptionally high response to blue and blue-green radiation with negligible response to red radiation.

Exposure of photocathodes to intense light, such as direct sunlight, may decrease the sensitivity of the tubes in which they are used, even though there is no voltage applied. The magnitude and duration of the decrease depend on the length of the exposure. Permanent damage to a phototube may result if it is exposed to radiant energy so intense as to cause excessive heating of the cathode.

CONVERSION FACTORS



CONVERSION FACTOR NOMOGRAPH

The Conversion Factor Nomograph shown above may be used to determine the approximate characteristics of an electron tube when all the electrode voltages are changed in the same proportion from the published or measured values.

The conversion factors obtained from the nomograph are applicable to triodes, tetrodes, pentodes, and beam power tubes when the plate voltage, grid-No.1 voltage, and grid-No.2 voltage are changed simultaneously by the same factor. They may be used for any class of tube operation (class A, AB_1, AB_2, B, or C).

The nomograph may be used to determine the proper value for each conversion factor for a specified relationship (F_e)

CONVERSION FACTORS

between published or measured values (E_{pub}) and desired values (E_{des}) of operating voltage. The dashed lines on the nomograph indicate the correct procedure for determining each of these conversion factors when it is desired to reduce the operating electrode voltage from 250 to 200 volts.

EXAMPLE

Published characteristics for a typical pentode are listed below for a plate voltage of 250 volts. If it is desired to determine the characteristics of this tube for a plate voltage of 200 volts, the voltage conversion factor, F_e, is equal to 200/250 or 0.8. The values for the other conversion factors are obtained from the nomograph. By use of these factors characteristics values at a plate voltage of 200 volts are obtained.

	Published Value	*Conversion Factor*	*Desired Value*	
Plate Voltage	250	0.8	200	volts
Grid-No.2 Voltage	250	0.8	200	volts
Grid-No.1 Voltage	-15	0.8	-12	volts
Plate Current	30	0.72	21.6	ma
Grid-No.2 Current	6	0.72	4.3	ma
Plate Resistance (Approx.). . .	0.13	1.12	0.15	megohm
Transconductance.	2000	0.89	1780	μmhos
Load Resistance	10000	1.12	11200	ohms
Total Harmonic Distortion . . .	10	unchanged	10	%
Max.-Signal Power Output. . . .	2.5	0.57	1.42	watts

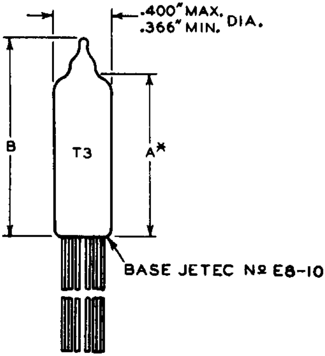
LIMITATIONS

Because this method for conversion of characteristics is necessarily an approximation, progressively greater errors will be introduced as the voltage conversion factor ($F_e = E_{des}/E_{pub}$) departs from unity. In general, it may be assumed that results obtained will be approximately correct when the value of F_e is between 0.7 and 1.5. When F_e is extended beyond these limits (down to 0.5 or up to 2.0), the accuracy becomes considerably reduced and the results obtained can serve only as a rough approximation.

It should be noted that this method does not take into account the effects of contact potential or secondary emission in electron tubes. Contact potential, however, may safely be neglected for most applications because its effects are noticeable only at very low grid-No.1 voltages. Secondary emission may occur in conventional tetrodes at low plate voltages. For such tubes, therefore, the use of conversion factors should be limited to regions of the plate characteristic in which the plate voltage is greater than the grid-No.2 voltage. For beam power tubes, the regions of both low plate currents and low plate voltages should also be avoided.

OUTLINES—Glass Tubes

SUBMINIATURE--Flexible-Lead Types

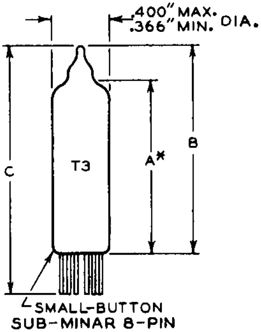


OUTLINE JETEC No.	DIMENSION	
	A ± 0.060 INCHES	B Max. INCHES
3-1	1.075	1.375
3-2	1.200	1.500
3-3	1.450	1.750
3-4	1.700	2.000
3-8	1.325	1.625
3-11	0.950	1.250

* Measured from base seat to bulb-top line as determined by a ring gauge of 0.210" ± 0.001" inside diameter.

OUTLINES—Glass Tubes

SUBMINIATURE--Small-Button Sub-Minar 8-Pin Base Types



OUTLINE JETEC No.	DIMENSION		
	A ± 0.060 INCHES	B Max. INCHES	C Max. INCHES
3-5	1.200	1.500	1.750
3-9	1.075	1.375	1.625
3-10	1.450	1.750	2.000
3-12	0.950	1.125	1.500
3-13	1.325	1.625	1.875
3-14	1.575	1.875	2.125
3-15	1.700	2.000	2.250

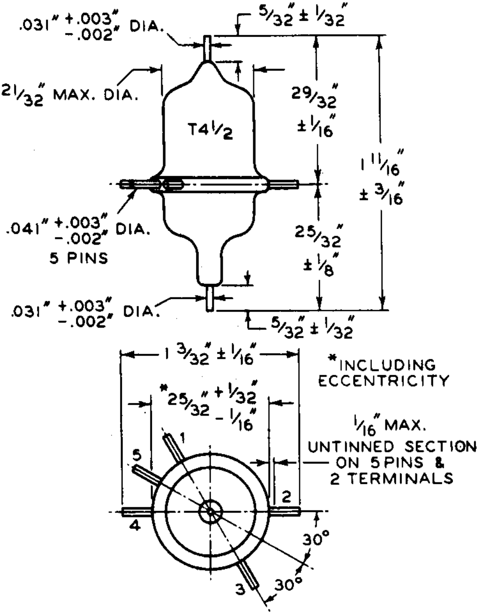
* Measured from base seat to bulb-top line as determined by a ring gauge of 0.210" ± 0.001" inside diameter.

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES — Glass Tubes

ACORN--Radial 5-Pin Base Type with End Terminals

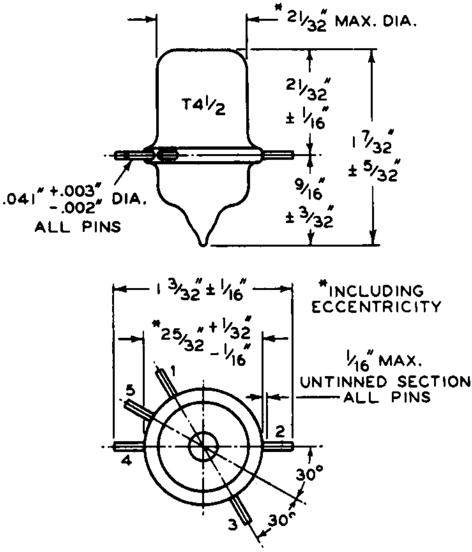


JETEC No.4-3

For additional socket design information, see back of "Outlines 3" sheet

OUTLINES—Glass Tubes

ACORN--Radial 5-Pin Base Type



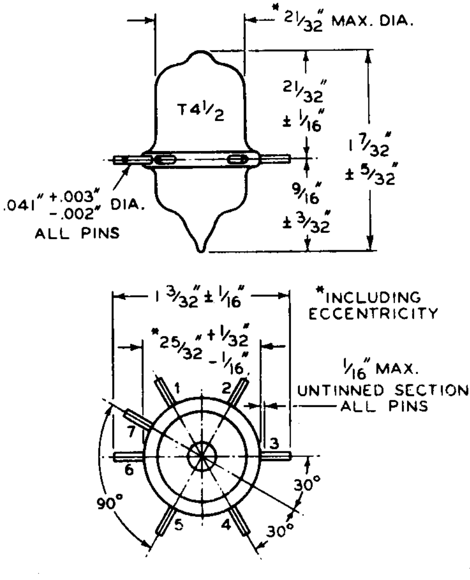
JETEC No.4-1

For additional socket design information, see back of "Outlines 3" sheet

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

ACORN--Radial 7-Pin Base Type



JETEC No.4-2

For additional socket design information,
see back of this sheet

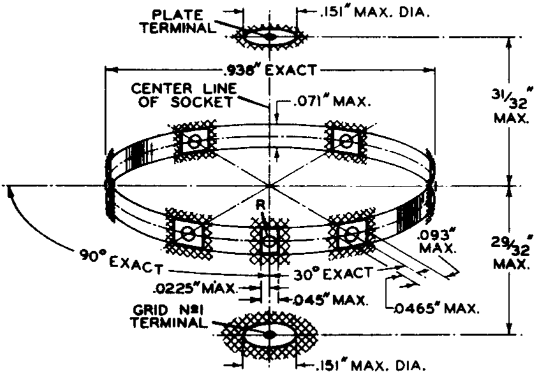
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

ACORN TYPES

MAXIMUM PIN AND TERMINAL VARIATIONS AT SOCKET CLIPS AND TERMINAL CONNECTORS

ESSENTIAL DIMENSIONS
FOR SOCKET DESIGN



Reference Pin (R)

Base Type	*Pin No.**
Radial 5-Pin	5
Radial 5-Pin with End Terminals.	5
Radial 7-Pin	7

The above composite diagram shows the ideal positions of radial-pin cross-sections at socket clips located on a circle of 0.938" diameter, as well as end-terminal cross-sections at terminal ends.

The areas within the cross-hatching show actual variations of radial-pin and end-terminal cross-sections, and indicate the maximum variations which socket clips and terminal connectors should accommodate.

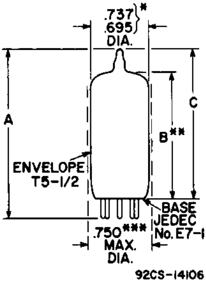
The clear area for pin position R is narrower than the others because pin position R is used as a reference for the other pins.

Sockets should be designed so that the maximum diametric clearance between socket clips is never less than 0.850".

* For pin numbering of each of these bases, see respective Dimensional Outline on preceding pages.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

MINIATURE — Miniature 7-Pin Base Types
with T5-1/2 Bulbs



DIMENSIONS IN INCHES

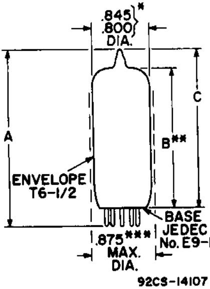
OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)			
	A	B		C
	Max	Min	Max	Max
–	1.625	.906	1.094	1.375
5-1	1.750	1.031	1.219	1.500
5-2	2.125	1.406	1.594	1.875
5-3	2.625	1.906	2.094	2.375

* Major diameter as checked by ring gauges of 0.25 inch thickness. The maximum gauge should clear the bulb above 0.38 inch from the base seat and the minimum gauge should not.

** Measured from the base seat to the bulb-top line as determined by a ring gauge of 0.437 inch I.D.

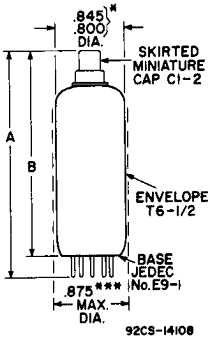
*** The diameter of the boundary cylinder as defined by the barriers of the pin alignment gauge (Gauge No.GE7-1, Sheet 24, Section 3 of EIA Standard RS-209A).

MINIATURE — Noval 9-Pin Base Types with T6-1/2 Bulbs



DIMENSIONS IN INCHES

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)			
	A	B		C
	Max	Min	Max	Max
6-1	1.750	1.031	1.219	1.500
6-2	2.187	1.469	1.656	1.937
6-3	2.625	1.906	2.094	2.375
6-4	3.062	2.344	2.531	2.812



DIMENSIONS IN INCHES

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A	B	
	Max	Min	Max
6-5	1.969	1.437	1.687
6-6	2.406	1.875	2.125
6-7****	2.844	2.312	2.562
6-8	3.281	2.750	3.000

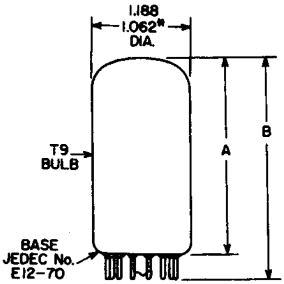
* Major diameter as checked by ring gauges of 0.25 inch thickness. The maximum gauge should clear the bulb above 0.38 inch from the base seat and the minimum gauge should not.

** Measured from the base seat to the bulb-top line as determined by a ring gauge of 0.437 inch I.D.

*** The diameter of the boundary cylinder as defined by the barriers of the pin alignment gauge (Gauge No.GE9-1, Sheet 30, Section 3 of EIA Standard RS-209A).

**** Jedec Outline No.6-7 may also use non-standard CI-33 cap.

DUODECAR—12-Pin Base Types with T9 Bulbs

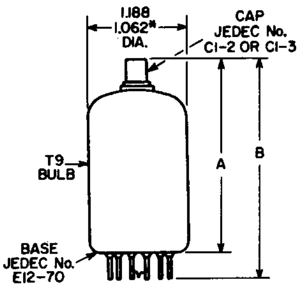


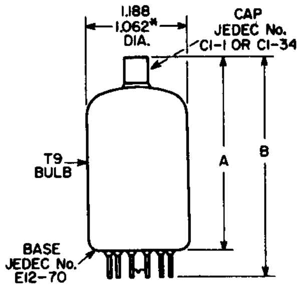
DIMENSIONS IN INCHES

* Applies to minimum diameter except in area of seal.

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
9 – 55	1.000	1.250	1.625
9 – 56	1.250	1.500	1.875
9 – 57	1.500	1.750	2.125
9 – 58	1.750	2.000	2.375
9 – 59	2.000	2.250	2.625
9 – 60	2.250	2.500	2.875
9 – 61	2.500	2.750	3.125
9 – 62	2.750	3.000	3.375

Outlines with Top Cap





92CS-12526

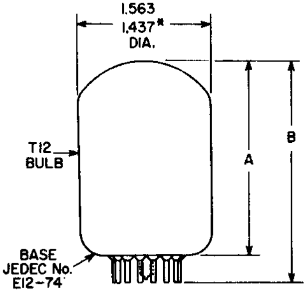
DIMENSIONS IN INCHES

* Applies to minimum diameter except in area of seal.

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
9 – 88	2.000	2.250	2.625
9 – 89	2.250	2.500	2.875
9 – 90	2.500	2.750	3.125
9 – 91	2.750	3.000	3.375
9 – 92	3.000	3.250	3.625
9 – 93	3.250	3.500	3.875
9 – 94	3.500	3.750	4.125
9 – 95	3.750	4.000	4.375

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
9 – 96	2.000	2.250	2.625
9 – 97	2.250	2.500	2.875
9 – 98	2.500	2.750	3.125
9 – 99	2.750	3.000	3.375
9 – 100	3.000	3.250	3.625
9 – 101	3.250	3.500	3.875
9 – 102	3.500	3.750	4.125
9 – 103	3.750	4.000	4.375

DUODECAR—12-Pin Base Types with T12 Bulbs

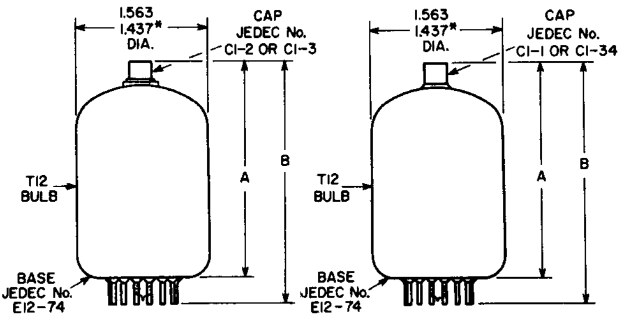


DIMENSIONS IN INCHES

* Applies to minimum diameter except in area of seal.

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES) A		B
	Min.	Max.	Max.
12 - 52	1.250	1.500	1.875
12 - 53	1.500	1.750	2.125
12 - 54	1.750	2.000	2.375
12 - 55	2.000	2.250	2.625
12 - 56	2.250	2.500	2.875
12 - 57	2.500	2.750	3.125
12 - 58	2.750	3.000	3.375
12 - 59	3.000	3.250	3.625
12 - 60	3.250	3.500	3.875
12 - 61	3.500	3.750	4.125
12 - 62	3.750	4.000	4.375

Outlines with Top Cap



92CS-12525

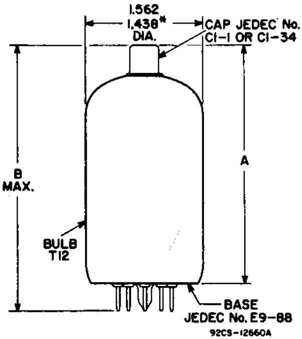
DIMENSIONS IN INCHES

* Applies to minimum diameter except in area of seal.

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES) A		B
	Min.	Max.	Max.
12 - 75	2.000	2.250	2.625
12 - 76	2.250	2.500	2.875
12 - 77	2.500	2.750	3.125
12 - 78	2.750	3.000	3.375
12 - 79	3.000	3.250	3.625
12 - 80	3.250	3.500	3.875
12 - 81	3.500	3.750	4.125
12 - 82	3.750	4.000	4.375

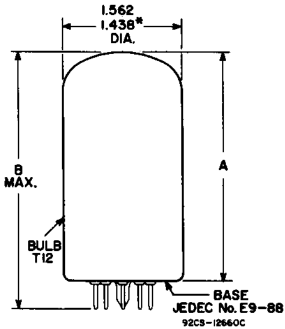
OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES) A		B
	Min.	Max.	Max.
12 - 83	2.000	2.250	2.625
12 - 84	2.250	2.500	2.875
12 - 85	2.500	2.750	3.125
12 - 86	2.750	3.000	3.375
12 - 87	3.000	3.250	3.625
12 - 88	3.250	3.500	3.875
12 - 89	3.500	3.750	4.125
12 - 90	3.750	4.000	4.375

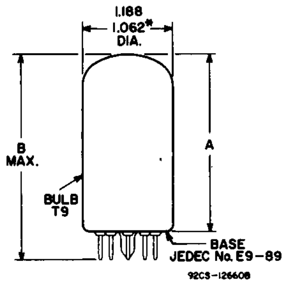
NOVAR—9-Pin Base Types



OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
12-116	3.500	3.750	4.130

OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
12-95	2.250	2.500	2.880
12-96	2.500	2.750	3.130
12-99	3.250	3.500	3.880

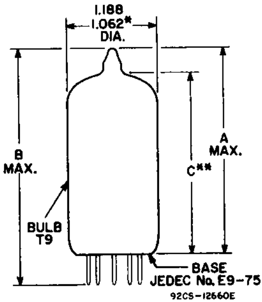




OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
9-107	1.750	2.000	2.380
-	2.375	2.625	3.005

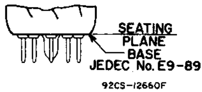
* Applies to the minimum diameter except in the area of the seal.

NOVAR—9-Pin Base Types

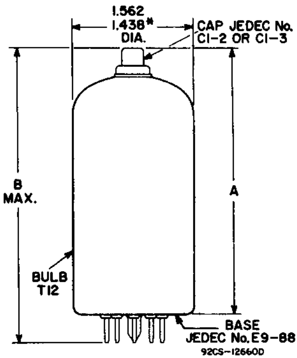


OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)			
	C		B	A
	Min.	Max.	Max.	Max.
—	2.050	2.230	3.080	2.700
—	2.405	2.585	3.110	2.730

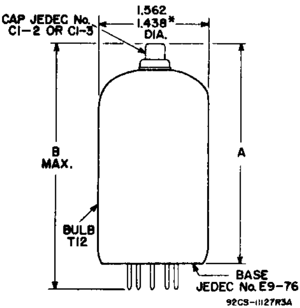
Botton-exhaust type has the same A & B dimensions as top-exhaust type shown



**Measured from the base seat to bulb top line as determined by a ring gauge of 0.600" I.D.



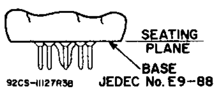
OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
—	2.875	3.125	3.505



OUTLINE DRAWING NUMBER (JEDEC)	DIMENSIONS (INCHES)		
	A		B
	Min.	Max.	Max.
12-70●	2.910	3.170	3.550

Bottom-exhaust type has the same dimensions as top-exhaust type shown

● For E9-76 base



OUTLINES—Glass Tubes

GLASS OCTAL--Octal Base Types with T9 Bulbs

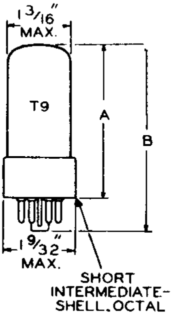


Fig. 1

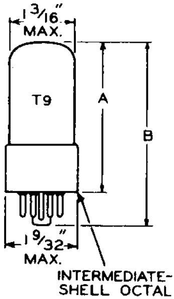


Fig. 2

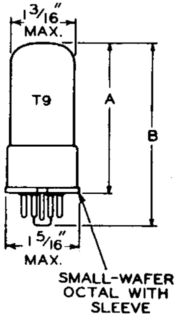
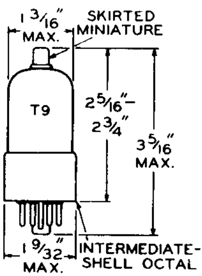
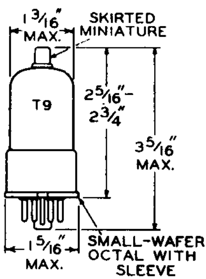


Fig. 3

OUTLINE			DIMENSION	
JETEC No.			A Max. INCHES	B Max. INCHES
Fig. 1	Fig. 2	Fig. 3		
-	9-1	-	1-3/4*	2-5/16
-	9-7	-	2-1/2	3-1/16
9-41	9-11	9-12	2-3/4	3-5/16
-	9-13	-	2-13/16	3-3/8
-	9-15	-	2-7/8	3-7/16
-	9-33	-	3-1/4	3-13/16



JETEC No. 9-17



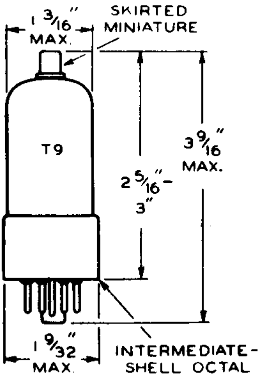
JETEC No. 9-18

* For electron-ray tubes, the seated height is 1-11/16" + 1/16" - 1/4".

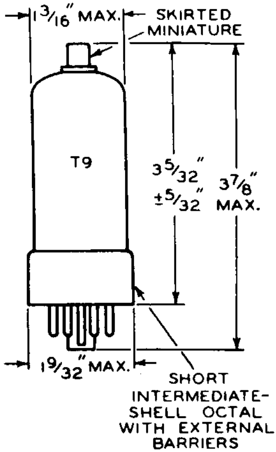
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

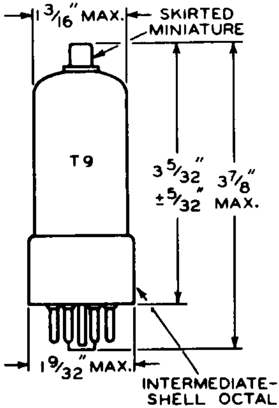
GLASS OCTAL--Octal Base Types with T9 Bulbs



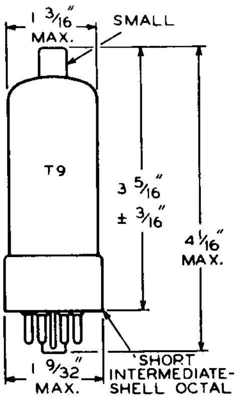
JETEC No.9-23



JETEC No. None



JETEC No. None

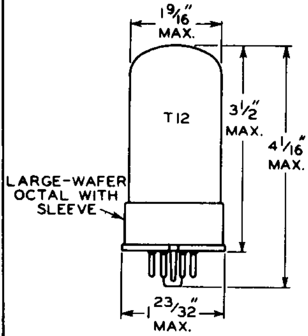


JETEC No.9-51

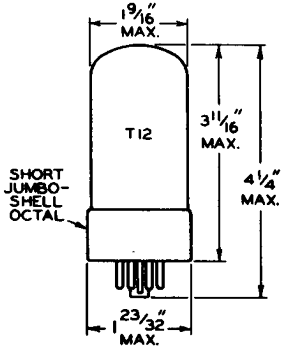
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

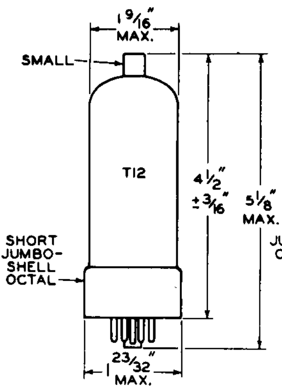
GLASS OCTAL--Octal Base Types with T12 Bulbs



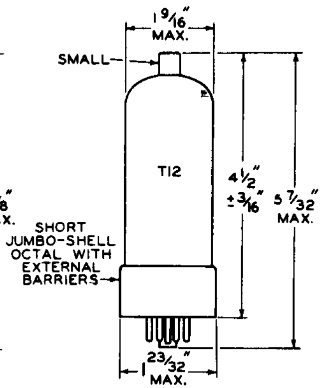
JETEC No. None



JETEC No. None



JETEC No. None

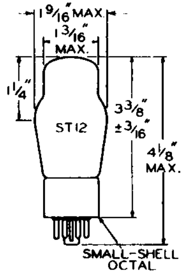


JETEC No. None

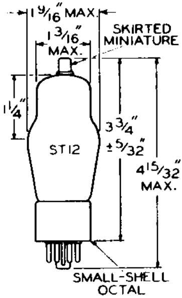
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

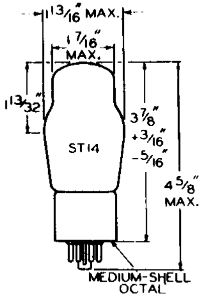
GLASS OCTAL--Octal Base Types with ST Bulbs



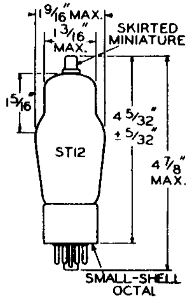
JETEC No. 12-7



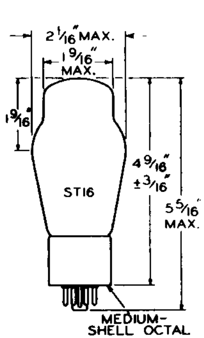
JETEC No. 12-8



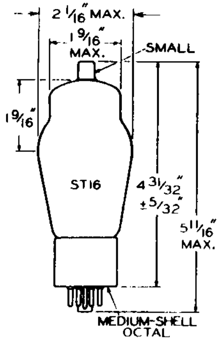
JETEC No. 14-3



JETEC No. None



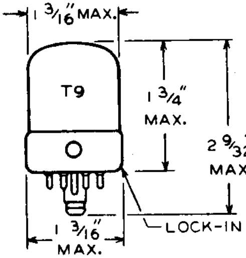
JETEC No. 16-3



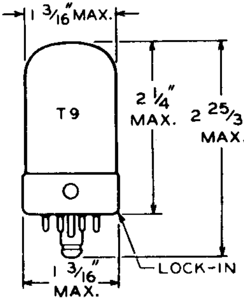
JETEC No. 16-5

OUTLINES—Glass Tubes

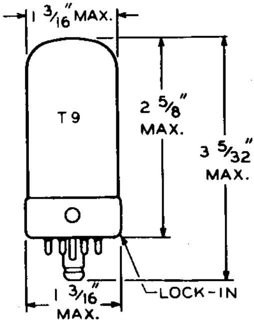
LOCK-IN--Lock-In 8-Pin Base Types



JETEC No.9-32



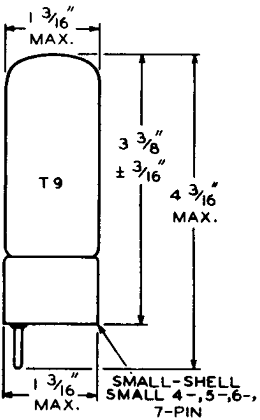
JETEC No.9-30



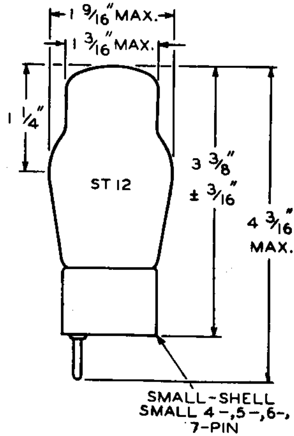
JETEC No.9-31

OUTLINES—Glass Tubes

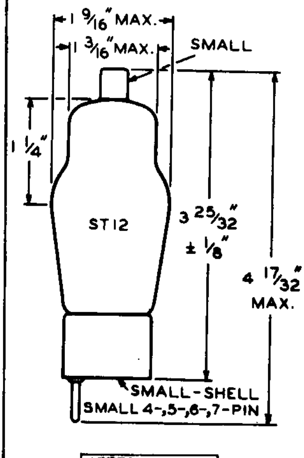
SMALL 4-PIN, SMALL 5-PIN, SMALL 6-PIN, & SMALL 7-PIN BASE TYPES



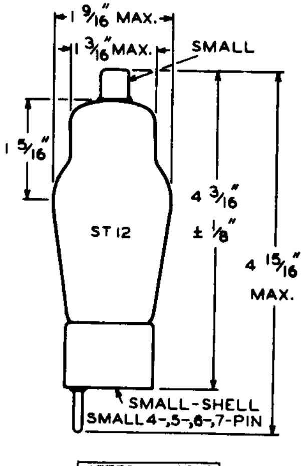
JETEC No.9-26



JETEC No. 12-5



JETEC No. 12-6

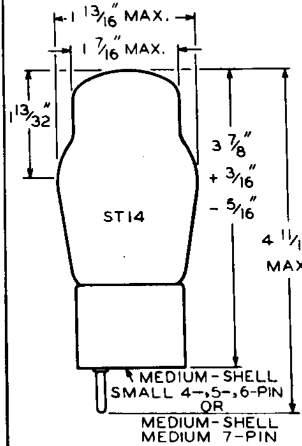


JETEC No. 12-2

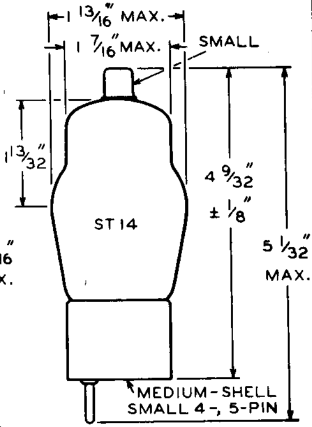
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Glass Tubes

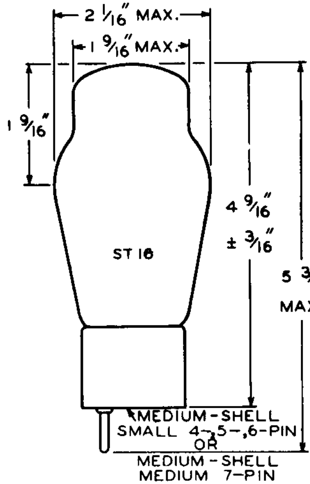
SMALL 4-PIN, SMALL 5-PIN, SMALL 6-PIN, & MEDIUM 7-PIN BASE TYPES



JETEC No. 14-1



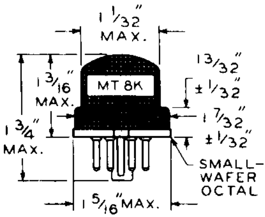
JETEC No. 14-2



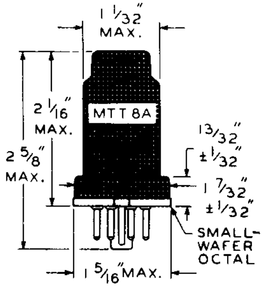
JETEC No. 16-1

OUTLINES — Metal Tubes

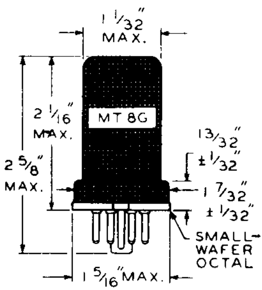
For correlation of
TUBE TYPE, ENVELOPE DESIGNATION, & OUTLINE No.,
see KEY on back of this sheet



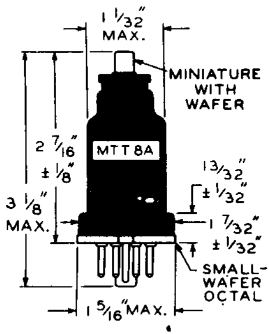
JETEC No.8-5



JETEC No.8-3



JETEC No.8-1

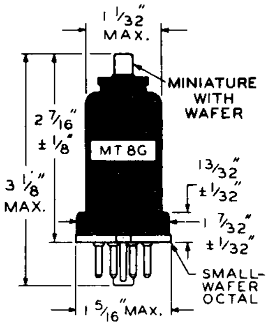


JETEC No.8-4

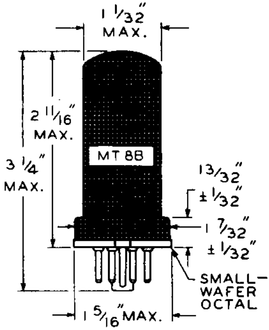
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OUTLINES—Metal Tubes

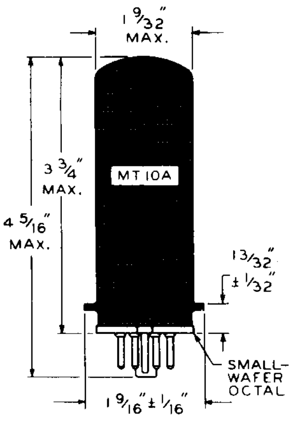
For correlation of
TUBE TYPE, ENVELOPE DESIGNATION, & OUTLINE No.,
see KEY on back of this sheet



JETEC No. 8-2



JETEC No. 8-6



JETEC No. 10-1

OUTLINES — Metal Tubes

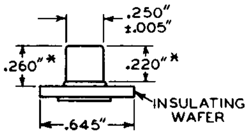
KEY

Type No.	Envelope Designation	Outline Jetec No.	Type No.	Envelope Designation	Outline Jetec No.
0Z4	MTT8A	8-3	6ST7	MT8G	8-1
5T4	MT10A	10-1	6SZ7	MT8G	8-1
5W4	MT8B	8-6	6V6	MT8B	8-6
5Z4	MT8B	8-6	6X5	MT8B	8-6
6A8	MTT8A	8-4	12A6	MT8B	8-6
6AB7	MT8G	8-1	12C8	MTT8A	8-4
6AC7	MT8G	8-1	12H6	MT8K	8-5
6AG7	MT8B	8-6	12K8	MT8G	8-2
6B8	MTT8A	8-4	12SA7	MT8G	8-1
6C5	MT8G	8-1	12SC7	MT8G	8-1
6F5	MTT8A	8-4	12SF5	MT8G	8-1
6F6	MT8B	8-6	12SF7	MT8G	8-1
6H6	MT8K	8-5	12SG7	MT8G	8-1
6J5	MT8G	8-1	12SH7	MT8G	8-1
6J7	MTT8A	8-4	12SJ7	MT8G	8-1
6K7	MTT8A	8-4	12SK7	MT8G	8-1
6K8	MT8G	8-2	12SQ7	MT8G	8-1
6L6	MT10A	10-1	12SR7	MT8G	8-1
6L7	MTT8A	8-4	12SW7	MT8G	8-1
6N7	MT8B	8-6	12SY7	MT8G	8-1
6Q7	MTT8A	8-4	25A6	MT8B	8-6
6R7	MTT8A	8-4	25L6	MT8B	8-6
6S7	MT8G	8-2	25Z6	MT8B	8-6
6SA7	MT8G	8-1	502-A	MT8G	8-1
6SB7-Y	MT8G	8-1	1611	MT8B	8-6
6SC7	MT8G	8-1	1612	MTT8A	8-4
6SF5	MT8G	8-1	1613	MT8B	8-6
6SF7	MT8G	8-1	1614	MT10A	10-1
6SG7	MT8G	8-1	1619	MT10A	10-1
6SH7	MT8G	8-1	1620	MTT8A	8-4
6SJ7	MT8G	8-1	1621	MT8B	8-6
6SK7	MT8G	8-1	1622	MT10A	10-1
6SQ7	MT8G	8-1	1631	MT10A	10-1
6SR7	MT8G	8-1	1632	MT8B	8-6
6SS7	MT8G	8-1	1634	MT8G	8-1
			5693	MT8G	8-1

BASES

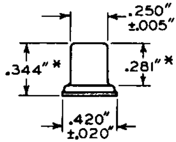
1-TERMINAL TYPES (CAPS)

MINIATURE WITH WAFER



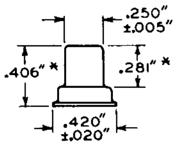
JETEC No.CI-4
RCA No.M399

SKIRTED MINIATURE



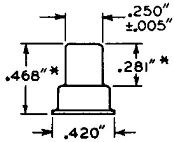
JETEC No.CI-3
RCA No.3933

SKIRTED MINIATURE



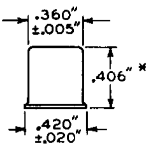
JETEC No.CI-2
RCA No.3927

SKIRTED MINIATURE



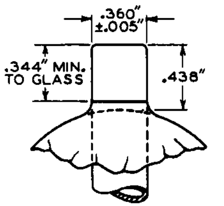
JETEC No.CI-33

SMALL



JETEC No.CI-1
RCA No.3907

SMALL WITH TUBULAR SUPPORT



CONNECTOR SHOULD NOT EXERT MORE THAN 7 POUNDS RADIAL COMPRESSION AT ANY POINT AROUND THE CIRCUMFERENCE OF THE CAP.

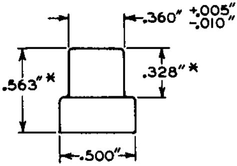
JETEC No.CI-34
RCA No.3999

* Add 0.020" for solder on finished tube.

BASES

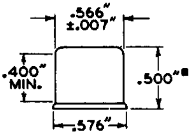
1-TERMINAL TYPES (CAPS)

SKIRTED SMALL



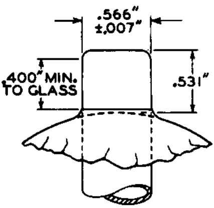
JETEC No.CI-22

MEDIUM



JETEC No.CI-5
RCA No.3903

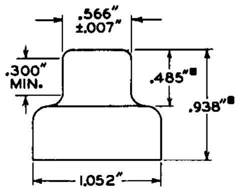
MEDIUM WITH TUBULAR SUPPORT



CONNECTOR SHOULD NOT EXERT MORE THAN 10 POUNDS RADIAL COMPRESSION AT ANY POINT AROUND THE CIRCUMFERENCE OF THE CAP.

JETEC No.CI-39
RCA No.R7062

SKIRTED MEDIUM

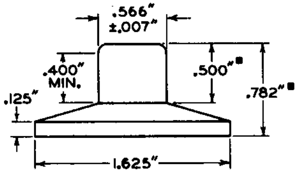


JETEC No.CI-14
RCA No.3980

* Add 0.020" for solder on finished tube.
■ Add 0.040" for solder on finished tube.

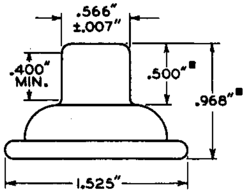
1-TERMINAL TYPES (CAPS)

SKIRTED MEDIUM



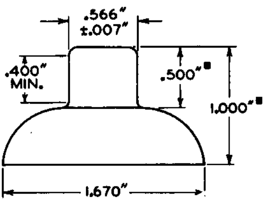
JETEC No.C1-29

SKIRTED MEDIUM WITH ROLLED EDGE



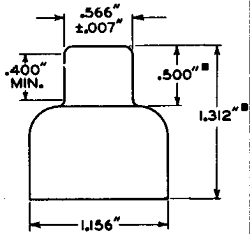
JETEC No.C1-19
RCA No.3940

SKIRTED MEDIUM



JETEC No.C1-27
RCA No.3985

SKIRTED MEDIUM



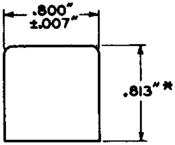
JETEC No.C1-6
RCA No.3904

■ Add 0.040" for solder on finished tube.

BASES

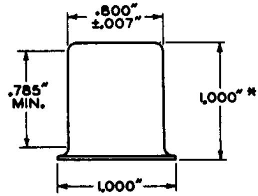
1-TERMINAL TYPES (CAPS)

LARGE



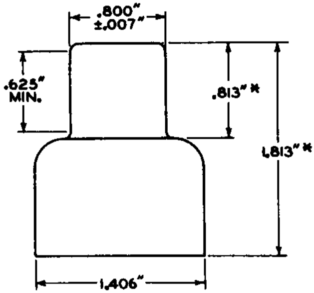
JETEC No.C1-15
RCA No.3917

LARGE



JETEC No.C1-8
RCA No.3910

SKIRTED LARGE



JETEC No.C1-9
RCA No.3905

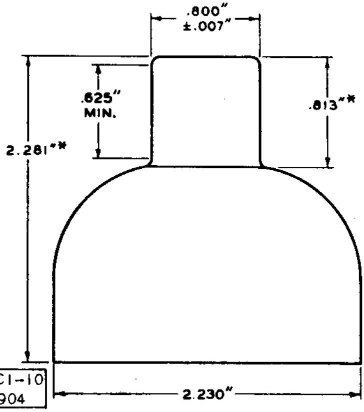
* Add 0.060" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

BASES

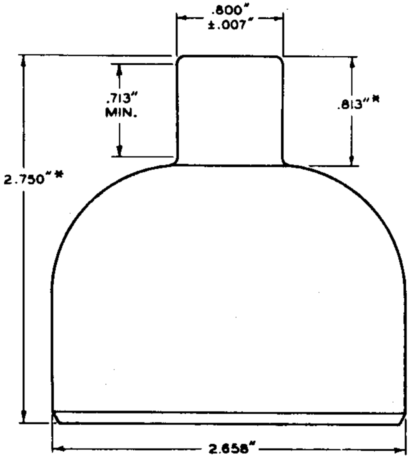
1-TERMINAL TYPES (CAPS)

SKIRTED LARGE



JETEC No.C1-10
RCA No.1904

SKIRTED LARGE

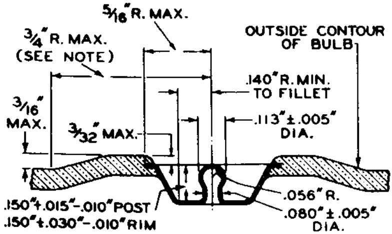


JETEC No.C1-30
RCA No.1902

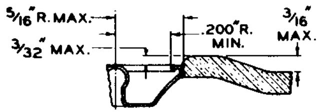
* Add 0.060" for solder on finished tube.

DETAILS OF RECESSED SMALL BALL CAP & BULB ASSEMBLY

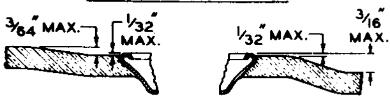
JETEC No. J1-22



ALTERNATE EDGE DESIGN



VARIANT SEAL SHAPES



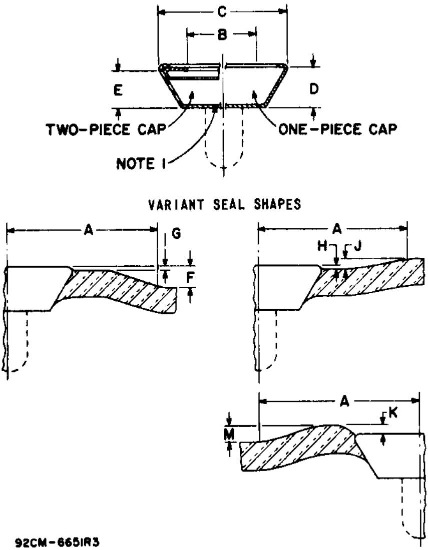
NOTE: PROTRUSION OF GLASS AROUND CAP ABOVE BULB CONTOUR IS LIMITED TO AREA BOUNDED BY CIRCLE CONCENTRIC WITH CAP AXIS AND HAVING RADIUS OF 3/4" MAX.

FOR ATTACHING OR DETACHING, THE CONNECTOR SHOULD REQUIRE NOT MORE THAN 8 POUNDS TOTAL FORCE PERPENDICULAR TO THE PLANE OF THE RIM OF THE CAP.

ANGLE BETWEEN PLANE OF THE RIM OF CAP AND PLANE TANGENT TO ORIGINAL CONTOUR OF BULB AT CENTER OF CAP WILL NOT BE MORE THAN 10°.

92CM-6535R4

Details of Recessed Small Cavity Cap & Bulb Assembly
JEDEC No.J1-21



DIMEN-SION	INCHES			MILLIMETERS			NOTES
	Min	Nom	Max	Min	Nom	Max	
A	–	–	0.750	–	–	19.05	2
B	0.307	0.312	0.317	7.798	7.925	8.051	
C	–	–	0.570	–	–	14.47	
D	0.153	–	0.173	3.89	–	4.39	
E	0.136	–	0.166	3.46	–	4.21	
F	–	–	0.188	–	–	4.78	
G	–	–	0.031	–	–	0.78	
H	–	–	0.031	–	–	0.78	
J	–	–	0.047	–	–	1.19	3
K	–	–	0.094	–	–	2.38	
M	–	–	0.188	–	–	4.78	

See Notes on reverse side.

Note 1: Connector shall not extend beyond this line. Bottom contour optional.

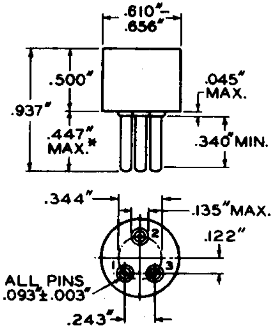
Note 2: Protrusion or depression of glass around cap above bulb contour is limited to areas bounded by circle concentric with cap axis and having radii as shown above.

Note 3: When measured in a plane perpendicular to axis of contact cone.

Note 4: When attaching or detaching the connector the total force required should not exceed eight pounds as applied perpendicular to the plane of the rim of the cap.

Note 5: The angle between plane of the rim of the cap and plane tangent to original contour of bulb at center of cap shall not exceed 10°.

SMALL-SHELL PEEWEE 3-PIN



JETEC No.A3-1
RCA No.3313

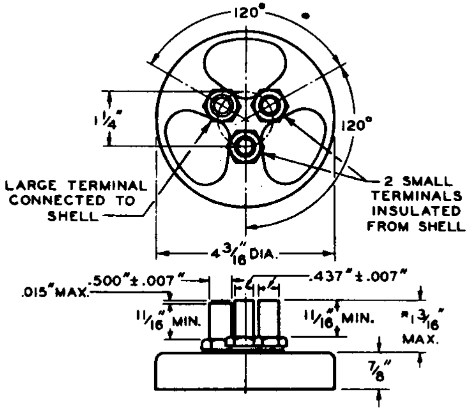
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GA3-1) having thickness of 1/4" and three holes with diameters of 0.1030"- 0.1035" so located on a 0.3440" ± 0.0005" diameter circle that the distance along the chord between two adjacent hole centers is 0.2340" ± 0.0005" and the distance along the chord between the remaining pin and the two adjacent pins is 0.3175" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 2 pounds will not be lifted when pins are withdrawn.

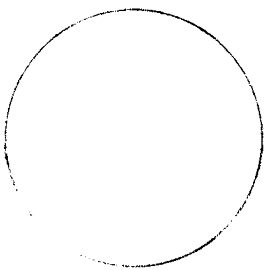
* Add 0.020" for solder on finished tube.

BASES

3-TERMINAL TYPES



JETEC No. A3-80
RCA No. 3232



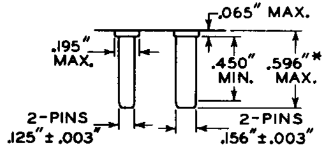
* Add 1/8" for solder on finished tube.

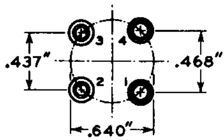
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

BASES

4-PIN TYPES

"SMALL 4-PIN"
PIN DIMENSIONS AND ORIENTATION

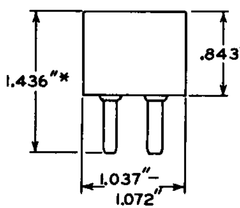




Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GA4-1) having thickness of 1/4" and four holes, two with diameters of 0.1650" ± 0.0005" and two with diameters of 0.1340" ± 0.0005" so located on a 0.6400" ± 0.0005" diameter circle that the distance between the adjacent 0.1650" diameter pins is 0.4680" ± 0.0005" and the distance between the adjacent 0.1340" diameter pins is 0.4370" ± 0.0005".

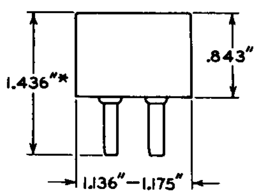
Pin fit in gauge is such that gauge together with supplementary weight totaling 4 pounds will not be lifted when pins are withdrawn.

DWARF-SHELL SMALL 4-PIN



JETEC No.A4-26
RCA No.4107

SMALL-SHELL SMALL 4-PIN



JETEC No.A4-5
RCA No.4108

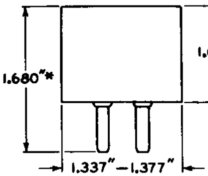
* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

BASES

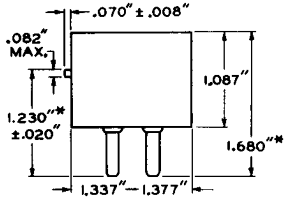
4-PIN TYPES

MEDIUM-SHELL SMALL 4-PIN



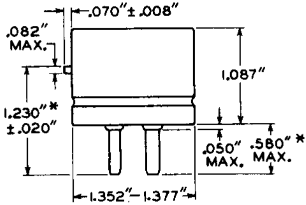
JETEC No. A4-9
RCA No. 4106

MEDIUM-SHELL SMALL 4-PIN WITH BAYONET



JETEC No. A4-10
RCA No. 4102

MEDIUM-METAL-SHELL SMALL 4-PIN WITH BAYONET



JETEC No. A4-89
RCA No. 4102-M1

For other dimensions, see first page of the "Small 4-Pin" series.

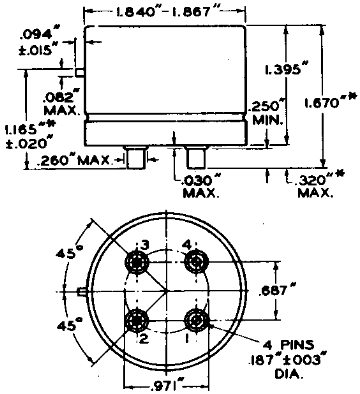
* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

BASES

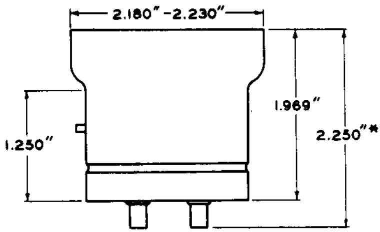
4-PIN TYPES

MEDIUM-METAL-SHELL JUMBO 4-PIN WITH BAYONET



JETEC No. A4-29
RCA No. 1839B

SKIRTED MEDIUM-METAL-SHELL JUMBO 4-PIN WITH BAYONET

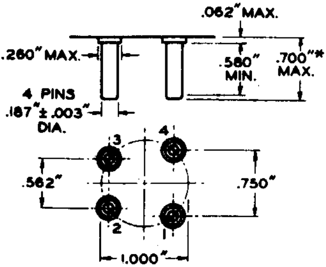


JETEC No. A4-69
RCA No. 4260A

Other dimensions are same as Base JETEC No. A4-29 above.

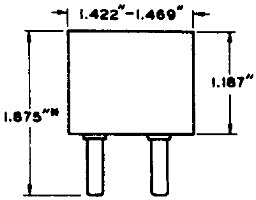
* Add 0.060" for solder on finished tube.

SUPER-JUMBO 4-PIN
PIN DIMENSIONS AND ORIENTATION



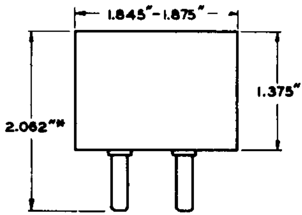
Base-pin positions are held to tolerances such that pin centers may deviate a maximum distance of 0.010" from their true geometric position.

SMALL-SHELL SUPER-JUMBO 4-PIN



JETEC No. A4-15
RCA No. 411

MEDIUM-SHELL SUPER-JUMBO 4-PIN



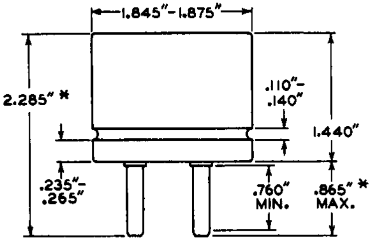
JETEC No. A4-16
RCA No. 412

* Add 0.060" for solder on finished tube.

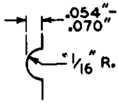
TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

MEDIUM-METAL-SHELL SUPER-JUMBO 4-PIN



Detail of Groove

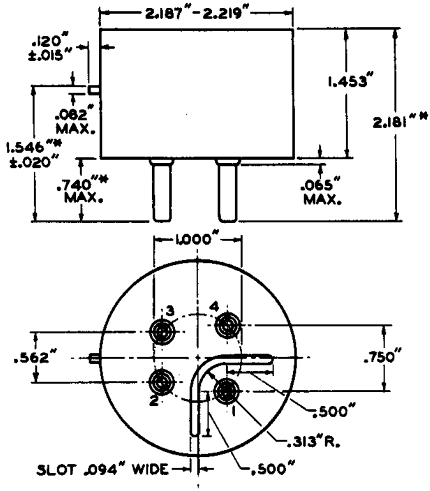


JETEC No.A4-81

For other dimensions, see first page of the "Super-Jumbo" series.

* Add 0.060" for solder on finished tube.

LARGE-SHELL SUPER-JUMBO 4-PIN WITH BAYONET



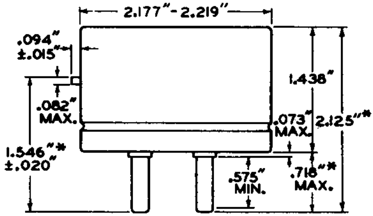
JETEC No. A4-88
RCA No. 3982

For other dimensions, see first page of the "Super-Jumbo" series.

* Add 0.060" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

LARGE-METAL-SHELL SUPER-JUMBO 4-PIN
WITH BAYONET



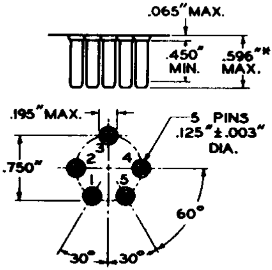
JETEC No. A4-18	
RCA No. 4310	

For other dimensions, see first page of the "Super-Jumbo" series.

* Add 0.060" for solder on finished tube.

5-PIN TYPES

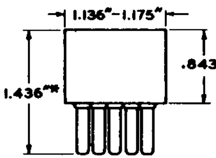
"SMALL 5-PIN"
PIN DIMENSIONS AND ORIENTATION



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No. GA5-1) having thickness of 1/4" and five holes with diameters of 0.1360" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance between centers of the four adjacent holes is 0.3750" ± 0.0005" and the distance between the center of the remaining hole and its adjacent hole centers is 0.5300" ± 0.0005".

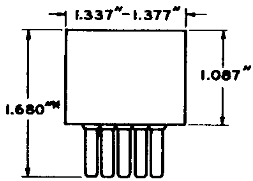
Pin fit in gauge is such that gauge together with supplementary weight totaling 4 pounds will not be lifted when pins are withdrawn.

SMALL-SHELL SMALL 5-PIN



JETEC No. A5-6
RCA No. 5108

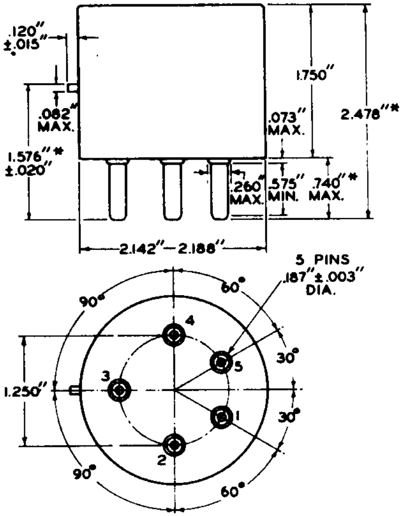
MEDIUM-SHELL SMALL 5-PIN



JETEC No. A5-11
RCA No. 5106

* Add 0.030" for solder on finished tube.

MEDIUM-SHELL GIANT 5-PIN WITH BAYONET



JETEC No. A5-19
RCA No. 5325

SPECIAL METAL-SHELL GIANT 5-PIN

See Tube Types 4-125A/4D21 and 4-250A/5D22

SPECIAL METAL-SHELL SUPER-GIANT 5-PIN

See Tube Type 4-1000A

* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5-PIN TYPES

SMALL-SHELL DUODECAL 5-PIN

For details of this base, see corresponding DUODECAL 12-PIN type

DWARF-SHELL OCTAL 5-PIN
SMALL-SHELL OCTAL 5-PIN
SMALL-WAFER OCTAL 5-PIN
SMALL-WAFER OCTAL 5-PIN WITH SLEEVE
INTERMEDIATE-SHELL OCTAL 5-PIN
SHORT INTERMEDIATE-SHELL OCTAL 5-PIN
SHORT INTERMEDIATE-SHELL OCTAL 5-PIN WITH EXTERNAL BARRIERS
MEDIUM-SHELL OCTAL 5-PIN
SHORT JUMBO-SHELL OCTAL 5-PIN

For details of above bases, see corresponding OCTAL 8-PIN type

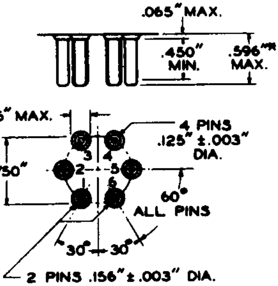
SMALL RADIAL 5-PIN

See OUTLINES--Glass Types

MEDIUM-MOLDED-FLARE SEPTAR 5-PIN

See Tube Type 4-65A

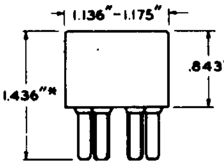
"SMALL 6-PIN"
PIN DIMENSIONS AND ORIENTATION



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GA6-1) having thickness of 1/4" and six holes, two adjacent with diameters of 0.1650" ± 0.0005" and four with diameters of 0.1360" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance between any two adjacent hole centers is 0.3750" ± 0.0005".

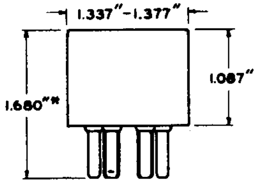
Pin fit in gauge is such that gauge together with supplementary weight totaling 4 pounds will not be lifted when pins are withdrawn.

SMALL-SHELL SMALL 6-PIN



JETEC No.A6-7
RCA No.6108

MEDIUM-SHELL SMALL 6-PIN



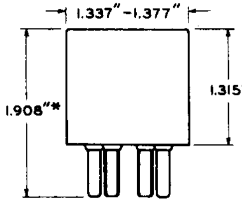
JETEC No.A6-12
RCA No.6106

* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6-PIN TYPES

LONG MEDIUM-SHELL SMALL 6-PIN



RCA No.6105

For other dimensions, see first page of the "Small 6-Pin" series.

SMALL-SHELL DUODECAL 6-PIN

For details of this base, see corresponding DUODECAL 12-PIN type

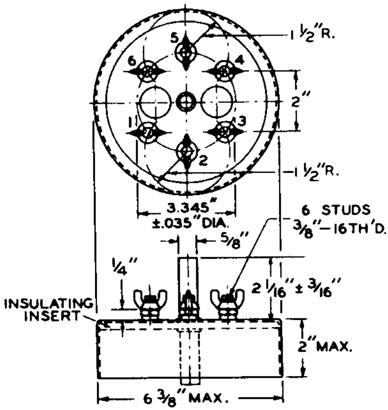
SMALL-SHELL OCTAL 6-PIN
INTERMEDIATE-SHELL OCTAL 6-PIN
SHORT INTERMEDIATE-SHELL OCTAL 6-PIN
SHORT INTERMEDIATE-SHELL OCTAL 6-PIN WITH EXTERNAL BARRIERS
MEDIUM-SHELL OCTAL 6-PIN
SHORT JUMBO-SHELL OCTAL 6-PIN
SMALL-WAFER OCTAL 6-PIN
SMALL-WAFER OCTAL 6-PIN WITH SLEEVE

For details of above bases, see corresponding OCTAL-8 PIN type

* Add 0.030" for solder on finished tube.

BASES

6-TERMINAL TYPES

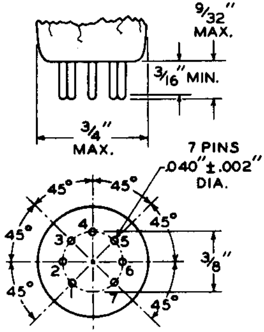


SPACE FOR CONNECTOR BETWEEN WING NUT AND LOCK NUT IS 3/16" MAX.

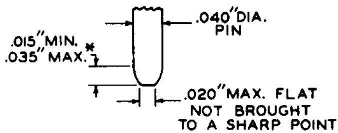
JETEC No. FO-6
RCA No. 6628

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SMALL-BUTTON MINIATURE 7-PIN



Miniature Base Pin Contour



JETEC No. E7-1

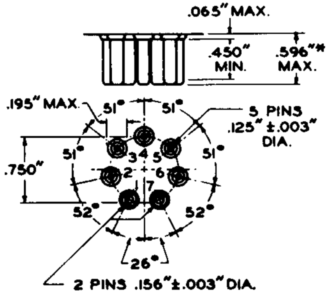
Base-pin positions are held to tolerances such that entire length of pins will without undue force pass into and disengage from flat-plate gauge (part of gauge JETEC No. GE7-1) having thickness of 1/4" and eight holes with diameters of 0.0520" ± 0.0005" so located on a 0.3750" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1434" ± 0.0005".

The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 1/8" from the bottom of the seated tube.

* This dimension around the periphery of any individual pin may vary within the limits shown.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

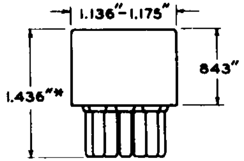
"SMALL 7-PIN"
PIN DIMENSIONS AND ORIENTATION



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GA7-1) having thickness of 1/4" and seven holes, two adjacent with diameters of 0.1650" ± 0.0005" and five with diameters of 0.1360" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance between centers of the adjacent 0.1650" diameter holes is 0.3288" ± 0.0005" and the distance between centers of the adjacent 0.1360" diameter holes is 0.3229" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 4 pounds will not be lifted when pins are withdrawn.

SMALL-SHELL SMALL 7-PIN



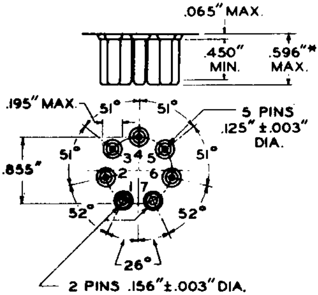
JETEC No.A7-8
RCA No.7108

* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7-PIN TYPES

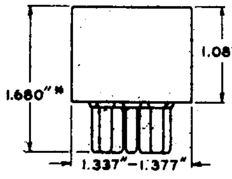
"MEDIUM 7-PIN"
PIN DIMENSIONS AND ORIENTATION



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No. GA7-2) having thickness of 1/4" and seven holes, two adjacent with diameters of 0.1650" ± 0.0005" and five with diameters of 0.1360" ± 0.0005" so located on a 0.8550" ± 0.0005" diameter circle that the distance between centers of the adjacent 0.1650" diameter holes is 0.3748" ± 0.0005" and the distance between centers of the adjacent 0.1360" diameter holes is 0.3681" ± 0.0005".

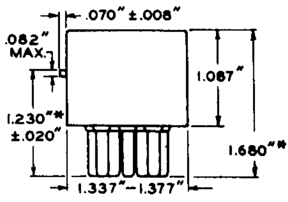
Pin fit in gauge is such that gauge together with supplementary weight totaling 4 pounds will not be lifted when pins are withdrawn.

MEDIUM-SHELL MEDIUM 7-PIN



JETEC No. A7-13
RCA No. 7306

MEDIUM-SHELL MEDIUM 7-PIN WITH BAYONET

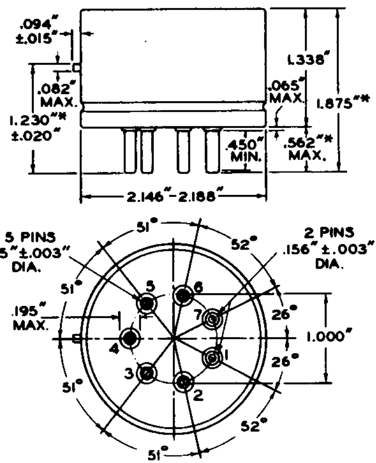


JETEC No. A7-14
RCA No. 7302

* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

MEDIUM-METAL-SHELL GIANT 7-PIN WITH BAYONET



JETEC No. A7-17
RCA No. 7609

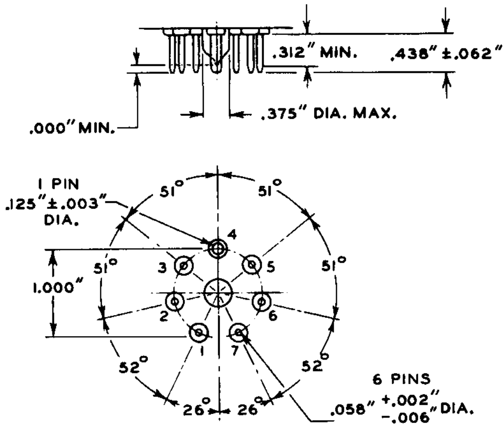
VENTILATED MEDIUM-METAL-SHELL GIANT 7-PIN

See Tube Type 4E27A/5-125B

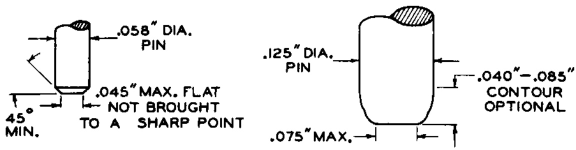
* Add 0.060" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

"SEPTAR"
PIN DIMENSIONS AND ORIENTATION



Septar Base Pin Contour



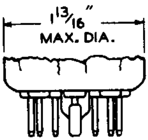
Base-pin positions are held to tolerances such that entire length of pins will without undue force pass into and disengage from flat-plate gauge having thickness of 3/8" and seven holes, one with diameter of 0.1450" ± 0.0005" and six with diameters of 0.0800" ± 0.0005" located on a 1.0000" ± 0.0005" diameter circle at specified angles with a tolerance of ±5' for each angle. Gauge is also provided with a hole 0.500" ± 0.010" concentric with pin circle.

It is essential that the socket shall be constructed with floating-contact clips.

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

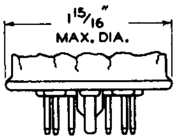
7-PIN TYPES

MEDIUM-BUTTON SEPTAR 7-PIN



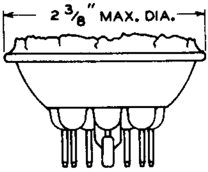
JETEC No. E7-20
RCA No. FSB6014

SMALL-WAFER SEPTAR 7-PIN



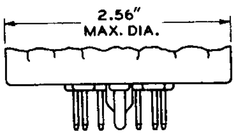
JETEC No. E7-21
RCA No. FSB712

MEDIUM MOLDED-FLARE SEPTAR 7-PIN



JETEC No. E7-2
RCA No. FSB603

JUMBO-BUTTON SEPTAR 7-PIN



JETEC No. E7-46
RCA No. FSB6038

For other dimensions of above bases, see first page of the "Septar" series

7-PIN TYPES

SMALL-SHELL DUODECAL 7-PIN

For details of this base, see corresponding SMALL-SHELL DUODECAL 12-PIN type

SMALL-BUTTON EIGHTAR 7-PIN

For details of this base, see corresponding SMALL-BUTTON EIGHTAR 8-PIN type

SMALL-SHELL OCTAL 7-PIN

SHORT INTERMEDIATE-SHELL OCTAL 7-PIN

SHORT INTERMEDIATE-SHELL OCTAL 7-PIN WITH EXTERNAL BARRIERS

INTERMEDIATE-SHELL OCTAL 7-PIN

SHORT MEDIUM-SHELL OCTAL 7-PIN WITH EXTERNAL BARRIERS, STYLES A AND B

MEDIUM-SHELL OCTAL 7-PIN

SHORT JUMBO-SHELL OCTAL 7-PIN WITH EXTERNAL BARRIERS

SMALL-WAFER OCTAL 7-PIN

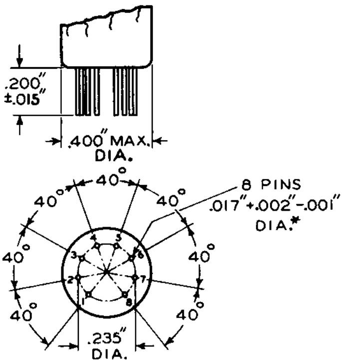
SMALL-WAFER OCTAL 7-PIN WITH SLEEVE

For details of above bases, see corresponding OCTAL 8-PIN type

SMALL RADIAL 7-PIN

See OUTLINES--Glass Tubes

SMALL-BUTTON SUB-MINAR 8-PIN



JETEC No.E8-9

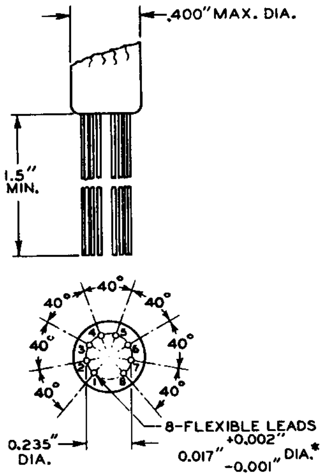
Base-pin positions are held to tolerances such that entire length of pins will without undue force pass into and disengage from flat-plate gauge JETEC No.GE8-1. This gauge contains a flat-plate section having thickness of 13/64" and nine holes with diameters of 0.0240" ± 0.0005" so located on a 0.2350" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.0804" ± 0.0005".

The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 0.050" from the bottom of the seated tube.

* The specified pin diameter applies only in the zone between 0.050" from the base seat and the end of the pin.

BASES

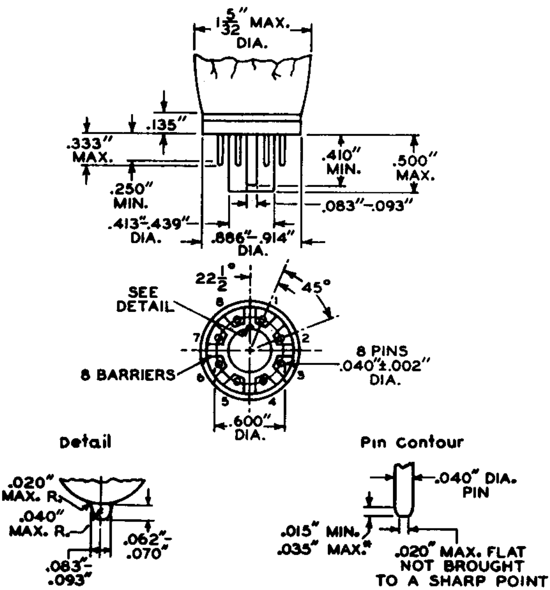
8-LEAD TYPES



JETEC No. E8-10

* The specified lead diameter applies only in the zone between 0.050" and 0.250" from the base seat. Between 0.250" and 1.500", a maximum diameter of 0.021" is held. Outside of these zones, the lead diameter is not controlled.

SMALL-BUTTON NEOEIGHTAR



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.#*
8-Pin	1,2,3,4,5,6,7,8	B8-218	80001
7-Pin■	1,2,3,4, 6,7,8	B7-208	80001
7-Pin▲	2,3,4,5,6,7,8	B7-219	80001

Base-pin positions are held to tolerances such that the base will fit a flat-plate gauge having a thickness of 3/8" and eight equally spaced holes of 0.0550" ± 0.0005" diameter located on a 0.6000" ± 0.0005" diameter circle. The gauge is also provided with a center hole to provide 0.010" diametric clearance for the lug and key. Pin fit in the gauge shall be such that the entire length of pins will, without undue force, enter into and disengage from the gauge.

* This dimension around the periphery of any individual pin may vary within the limits shown.

\# This number applies to wafer only.

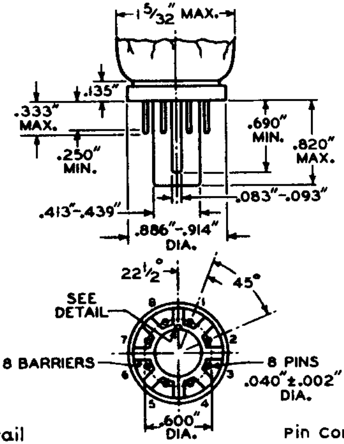
■ Arrangement 1.

▲ Arrangement 2.

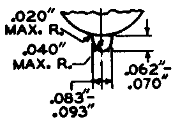
BASES

8-PIN TYPES

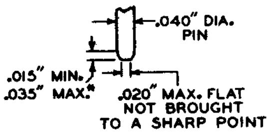
SMALL-BUTTON EIGHTAR



Detail



Pin Contour



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*#
8-Pin	1,2,3,4,5,6,7,8	B8-181	80000
7-Pin■	2,3,4,5,6,7,8	B7-182	80000
7-Pin▲	1,2,3,4, 6,7,8	B7-183	80000

Base-pin positions are held to tolerances such that the base will fit a flat-plate gauge having a thickness of 3/8" and eight equally spaced holes of 0.0550" ± 0.0005" diameter located on a 0.6000" ± 0.0005" diameter circle. The gauge is also provided with a center hole to provide 0.010" diametric clearance for the lug and key. Pin fit in the gauge shall be such that the entire length of pins will, without undue force, enter into and disengage from the gauge.

* This dimension around the periphery of any individual pin may vary within the limits shown.

\# This number applies to wafer only.

■ Arrangement 1.

▲ Arrangement 2.

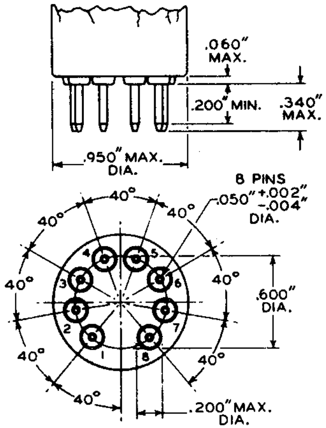
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

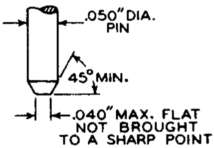
BASES

8-PIN TYPES

SMALL-BUTTON NEODITETRAR 8-PIN



Neoditetrar-Base Pin Contour



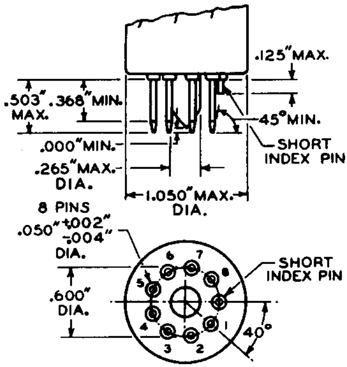
JEDEC No. E8-49
RCA No. FSB6006#

Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having thickness of 1/4" and nine holes with diameters of 0.0700" ± 0.0005" so located on a 0.6000" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2052" ± 0.0005".

This number applies to stem only.

8-PIN TYPES

SMALL-BUTTON DITETRAR 8-PIN

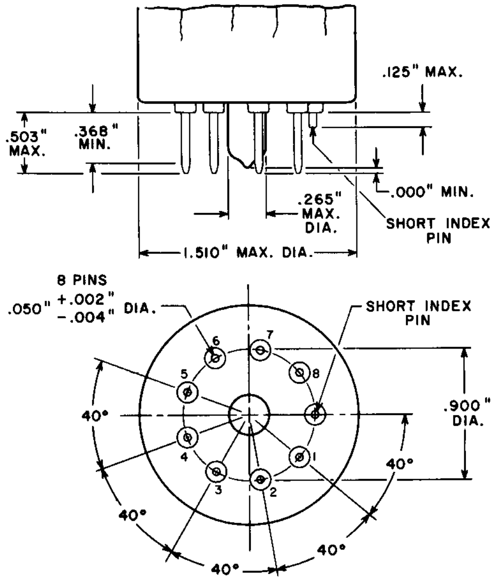


JEDEC No. E8-11	
RCA No.	FSB675#
	FSB6015#

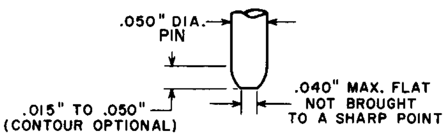
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having thickness of 1/4" and nine holes with diameters of 0.0700" ± 0.0005" so located on a 0.6000" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2052" ± 0.0005". Gauge is also provided with a hole having diameter of 0.300" ± 0.001" concentric with the pin circle.

This number applies to stem only.

SMALL-BUTTON SUPERDITETRAR
Pin Dimensions and Orientation



Superditetrar-Base-Pin Contour



JEDEC No.E8-78
RCA No.FSB6055#

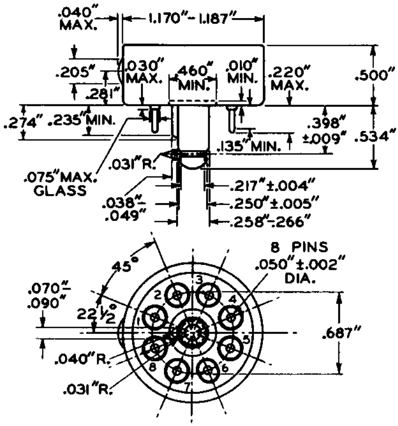
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from a flat-plate gauge having a thickness of

This number applies to stem only.

1/4" and nine holes with diameters of 0.0700" ± 0.0005" so located on a 0.9000" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.3078" ± 0.0005". Gauge is also provided with a hole having diameter of 0.300" ± 0.001" concentric with the pin circle.

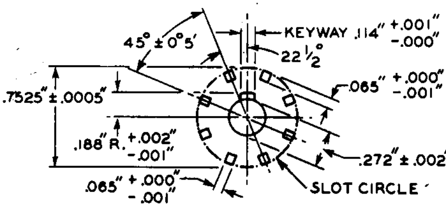
8-PIN TYPES

LOCK-IN 8-PIN



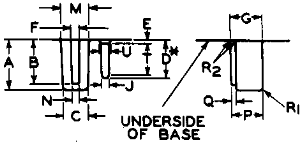
JETEC No. D8-1

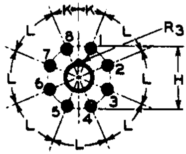
Base-pin positions are held to tolerances such that entire length of pins will without undue force pass into and disengage from gauge JETEC No. GD8-1. This gauge contains a flat-plate section having thickness of 1/4" and eight slots located and dimensioned as shown on the following diagram. Flat-plate section is also provided with a hole having diameter of 0.272" ± 0.002" concentric with slot circle, and with a keyway as shown on the diagram.



8-PIN TYPES

"OCTAL"
PIN DIMENSIONS AND ORIENTATION AND INDEX GUIDE





	Min.	*Center*	*Max.*		*Min.*	*Center*	*Max.*
A	.550"	.560"	.570"	L	-	45°	-
B	.490"	.500"	.510"	M	.305"	.312"	.317"
C	.300"	.308"	.315"	N	.075"	.080"	.085"
D	.427"	.437"	.447"	P	.343"	.353"	.363"
E	-	-	.050"	Q	.040"	.047"	.055"
F	.085"	.090"	.095"	R_1	-	.031"	-
G	.352"	.362"	.372"	R_2	-	-	.050"
H	-	.687"	-	R_3	-	.040"	-
J	.090"	.093"	.096"	T	.340"	-	-
K	-	22.5°	-	U	-	-	.135"

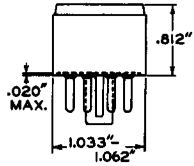
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GB8-1) having thickness of 1/4" and eight holes with diameters of 0.1030" ±0.0005" so located on a 0.6870" ±0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2629" ±0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 2 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

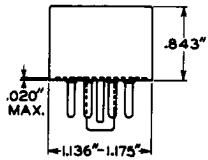
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

DWARF-SHELL OCTAL



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
5-Pin	1, 3, 5, 7,8	B5-45	-

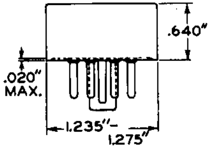
SMALL-SHELL OCTAL



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-1	8529
7-Pin	1,2,3,4,5, 7,8	B7-2	7529
6-Pin	1,2,3, 5, 7,8	B6-3	6529
5-Pin	1,2, 4, 6, 8	B5-5	5529

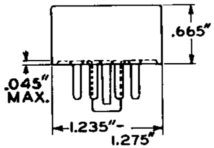
For other dimensions, see *first page of the "Octal" series*

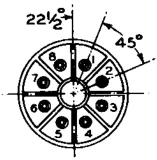
SHORT INTERMEDIATE-SHELL OCTAL



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-46	8555
7-Pin	1,2,3,4,5, 7,8	B7-47	7555
6-Pin	1,2,3, 5, 7,8	B6-48	6555
5-Pin	1,2, 4, 6, 8	B5-49	5555

SHORT INTERMEDIATE-SHELL OCTAL
WITH EXTERNAL BARRIERS



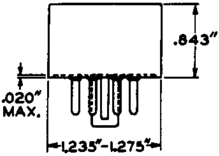


No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-58	8565
7-Pin[a]	1,2,3,4,5, 7,8	B7-59	7565
7-Pin[b]	1,2,3, 5,6,7,8	B7-211	-
6-Pin[a]	1,2,3, 5, 7,8	B6-60	6565
6-Pin[b]	2,3,4,5, 7,8	B6-84	6765
5-Pin[a]	1,2, 4, 6, 8	B5-62	5565
5-Pin[b]	2,3, 5, 7,8	B5-85	5765
5-Pin[c]	2, 4,5, 7,8	B5-187	-

For other dimensions, see *first page of the "Octal" series*

[a] Arrangement 1.
[b] Arrangement 2.
[c] Arrangement 3.

INTERMEDIATE-SHELL OCTAL

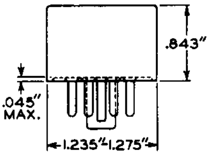


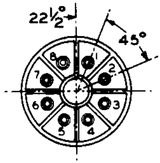
No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-6	8537
7-Pin[a]	1,2,3,4,5, 7,8	B7-7	7537
7-Pin[b]	1,2,3, 5,6,7,8	B7-166	39100
6-Pin[a]	1,2,3, 5, 7,8	B6-8	6537
6-Pin[b]	2,3,4,5, 7,8	B6-81	6737
5-Pin[a]	1,2, 4, 6, 8	B5-10	5537
5-Pin[b]	2,3, 5, 7,8	B5-82	5737

For other dimensions, see *first page of the "Octal" series*

[a] Arrangement 1.
[b] Arrangement 2.

INTERMEDIATE-SHELL OCTAL
WITH EXTERNAL BARRIERS





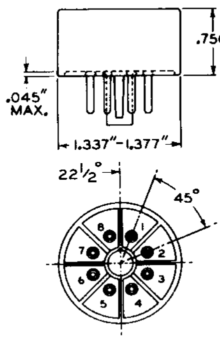
No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-142	8566
7-Pin	1,2,3,4,5, 7,8	B7-143	7566
6-Pin[a]	1,2,3, 5, 7,8	B6-144	6566
6-Pin[b]	2,3,4,5, 7,8	B6-145	6766
6-Pin[c]	2,3, 5,6,7,8	B6-229	39111
5-Pin[a]	1,2, 4, 6, 8	B5-146	5566
5-Pin[b]	2,3, 5, 7,8	B5-147	5766

For other dimensions, see *first page of the "Octal" series*

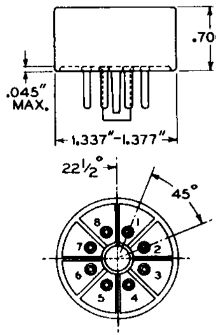
[a] Arrangement 1.
[b] Arrangement 2.
[c] Arrangement 3.

SHORT MEDIUM-SHELL OCTAL
WITH EXTERNAL BARRIERS

STYLE A



STYLE B

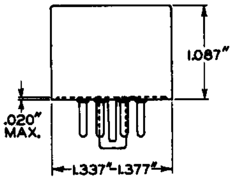


No. of Pins	*Pins*	*Style*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	A	B8-110	39081
8-Pin	1,2,3,4,5,6,7,8	B	B8-118	8564
7-Pin[a]	1,2,3,4,5, 7,8	A	B7-111	-
7-Pin[a]	1,2,3,4,5, 7,8	B	B7-119	7564
7-Pin[b]	1,2,3, 5,6,7,8	B	B7-227	39113
7-Pin[c]	1,2,3,4, 6,7,8	B	B7-235	-
6-Pin[a]	1,2,3, 5, 7,8	A	B6-112	-
6-Pin[a]	1,2,3, 5, 7,8	B	B6-120	6564
6-Pin[b]	2,3,4,5, 7,8	A	B6-148	-
6-Pin[b]	2,3,4,5, 7,8	B	B6-122	6764
5-Pin[a]	1,2, 4, 6, 8	A	B5-113	-
5-Pin[a]	1,2, 4, 6, 8	B	B5-121	5564
5-Pin[b]	2,3, 5, 7,8	A	B5-149	-
5-Pin[b]	2,3, 5, 7,8	B	B5-123	5764
5-Pin[c]	1,2,3, 5, 7	A	B5-234	-
5-Pin[c]	1,2,3, 5, 7	B	B5-239	39116
5-Pin[d]	2, 4,5, 7,8	B	B5-190	39110

For other dimensions, see *first page of the "Octal" series*

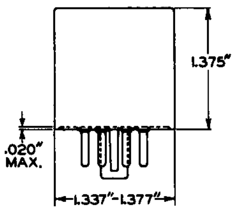
[a] Arrangement 1.
[b] Arrangement 2.
[c] Arrangement 3.
[d] Arrangement 4.

MEDIUM-SHELL OCTAL



No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-11	8533
7-Pin	1,2,3,4,5, 7,8	B7-12	7533
6-Pin	1,2,3, 5, 7,8	B6-13	6533
5-Pin[a]	1,2, 4, 6, 8	B5-15	5533
5-Pin[b]	2,3, 5, 7,8	B5-224	5733

LONG MEDIUM-SHELL OCTAL

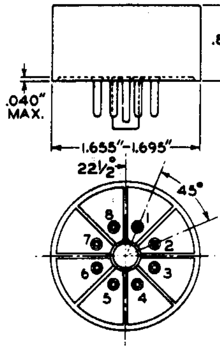


No. of Pins	*Pins*	*JEDEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-65	8545
5-Pin	2,3, 5, 7,8	B5-80	5545

For other dimensions of above bases, see *first page of the "Octal" series*

[a] Arrangement 1.
[b] Arrangement 2.

SHORT JUMBO-SHELL OCTAL
WITH EXTERNAL BARRIERS



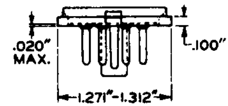
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-71	8556
7-Pin	1,2,3,4,5, 7,8	B7-72	7556
6-Pin	1,2,3, 5, 7,8	B6-73	6556
5-Pin	1,2, 4, 6, 8	B5-74	5556

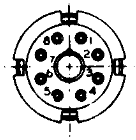
For other dimensions, see first page of the "Octal" series

BASES

8-PIN TYPES

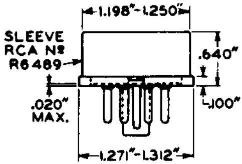
SMALL-WAFER OCTAL





No. of Pins	Pins	JETEC No.	RCA No.
8-Pin	1,2,3,4,5,6,7,8	B8-21	8527
7-Pin	1,2,3,4,5, 7,8	B7-22	7527
6-Pin	1,2,3, 5, 7,8	B6-23	6527
5-Pin	1,2, 4, 6, 8	B5-25	5527

SMALL-WAFER OCTAL
WITH SHORT SLEEVE



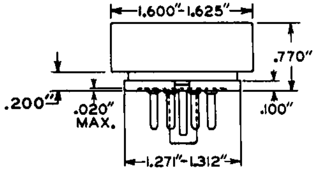
No. of Pins	Pins	JETEC No.	RCA No.
8-Pin	1,2,3,4,5,6,7,8	B8-44	-

For other dimensions of above bases, see first page of the "Octal" series

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

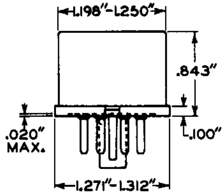
8-PIN TYPES

SMALL-WAFER OCTAL
WITH "770" SLEEVE



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*	
8-Pin	1,2,3,4,5,6,7,8	B8-150	MB8540-7	MB8527-603
7-Pin	1,2,3,4,5, 7,8	B7-151	MB7540-4	-
6-Pin■	1,2,3, 5, 7,8	B6-152	MB6540-5	-
6-Pin▲	2,3,4,5, 7,8	B6-153	MB6740-1	-
5-Pin■	1,2, 4, 6, 8	B5-154	MB5540-1	-
5-Pin▲	2,3, 5, 7,8	B5-155	MB5740-1	-

SMALL-WAFER OCTAL
WITH "843" SLEEVE



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*	
8-Pin	1,2,3,4,5,6,7,8	B8-26	MB8527-1	MB8540-3
7-Pin	1,2,3,4,5, 7,8	B7-27	MB7527-1	MB7540-1
6-Pin	1,2,3, 5, 7,8	B6-28	MB6527-1	MB6540-3
5-Pin	1,2, 4, 6, 8	B5-30	MB5527-1	MB5540-2

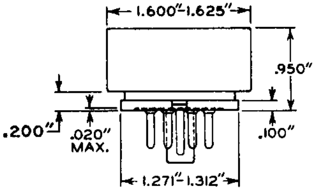
For other dimensions of above bases, see first page of the "Octal" series

■ Arrangement 1.
▲ Arrangement 2.

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

8-PIN TYPES

SMALL-WAFER OCTAL
WITH "950" SLEEVE



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-191	MB8540-8
7-Pin	1,2,3,4,5, 7,8	B7-192	MB7540-5
6-Pin■	1,2,3, 5, 7,8	B6-193	MB6540-6
6-Pin▲	2,3,4,5, 7,8	B6-194	MB6740-2
5-Pin■	1,2, 4, 6, 8	B5-195	MB5540-3
5-Pin▲	2,3, 5, 7,8	B5-196	MB5740-2

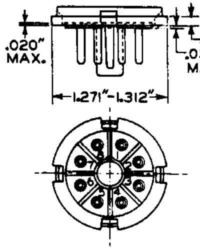
For other dimensions of above base, see first page of the "Octal" series

■ Arrangement 1.
▲ Arrangement 2.

BASES

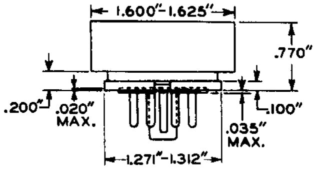
8-PIN TYPES

SMALL-WAFER OCTAL
WITH EXTERNAL BARRIERS



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-67	8559
7-Pin	1,2,3,4,5, 7,8	B7-68	7559
6-Pin■	1,2,3, 5, 7,8	B6-69	6559
6-Pin▲	2,3,4,5, 7,8	B6-205	6759
5-Pin■	1,2, 4, 6, 8	B5-70	5559
5-Pin▲	2,3, 5, 7,8	B5-206	5759

SMALL-WAFER OCTAL
WITH EXTERNAL BARRIERS AND "770" SLEEVE

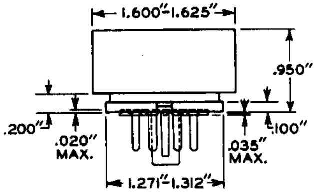


No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-159	MB8559-2
7-Pin	1,2,3,4,5, 7,8	B7-160	MB7559-1
6-Pin■	1,2,3, 5, 7,8	B6-161	MB6559-1
6-Pin▲	2,3,4,5, 7,8	B6-162	MB6759-1
5-Pin■	1,2, 4, 6, 8	B5-163	MB5559-1
5-Pin▲	2,3, 5, 7,8	B5-164	MB5759-1

For other dimensions of above bases, see first page of the "Octal" series

■ Arrangement 1.
▲ Arrangement 2.

SMALL-WAFER OCTAL
WITH EXTERNAL BARRIERS AND "950" SLEEVE



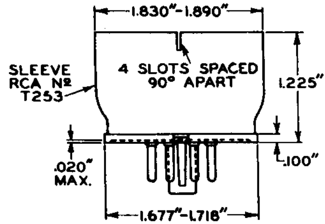
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	B8-197	MB8559-4
7-Pin	1,2,3,4,5, 7,8	B7-198	MB7559-2
6-Pin■	1,2,3, 5, 7,8	B6-199	MB6559-2
6-Pin▲	2,3,4,5, 7,8	B6-200	MB6759-2
5-Pin■	1,2, 4, 6, 8	B5-201	MB5559-2
5-Pin▲	2,3, 5, 7,8	B5-202	MB5759-2

For other dimensions of above base, see first page of the "Octal" series

■ Arrangement 1.
▲ Arrangement 2.

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

LARGE-WAFER OCTAL
WITH FLARED SLEEVE

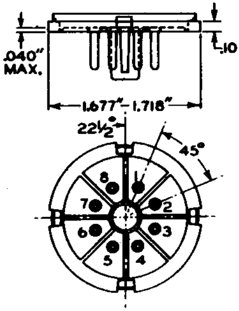


No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1,2,3,4,5,6,7,8	–	–

For other dimensions, see first page of the "Octal" series

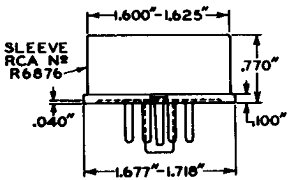
8-PIN TYPES

LARGE-WAFER OCTAL
WITH EXTERNAL BARRIERS



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1, 2, 3, 4, 5, 6, 7, 8	B8-94	8554

LARGE-WAFER OCTAL
WITH EXTERNAL BARRIERS AND SLEEVE

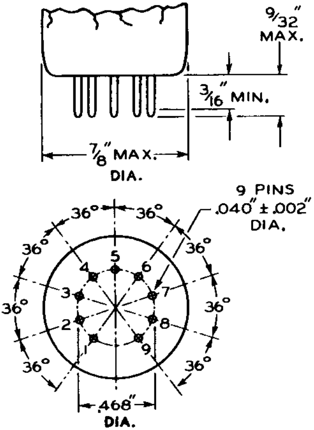


No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
8-Pin	1, 2, 3, 4, 5, 6, 7, 8	B8-98	-

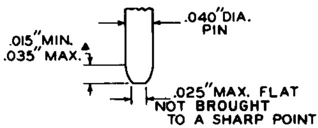
For other dimensions of above bases, see first page of the "Octal" series

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SMALL-BUTTON NOVAL 9-PIN
Pin Dimensions and Orientation



Noval-Base-Pin Contour



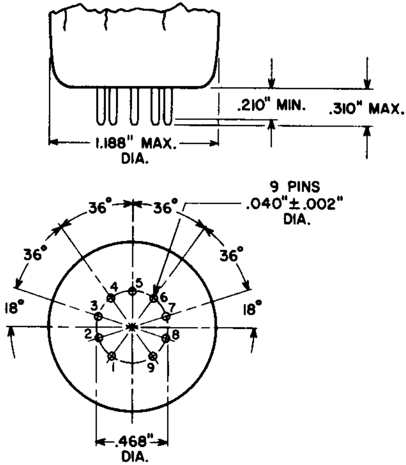
JEDEC No. E9-1
RCA No. FSD169

Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from gauge JEDEC No. GE9-1. This gauge contains a flat-plate section having thickness of 1/4" and ten holes with diameters of 0.0520" ± 0.0005" so located on a 0.4680" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1446" ± 0.0005".

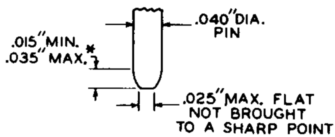
The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 1/8" from the bottom of the seated tube.

* This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

LARGE-BUTTON NEONOVAL 9-PIN
Pin Dimensions and Orientation



Neonoval-Base-Pin Contour



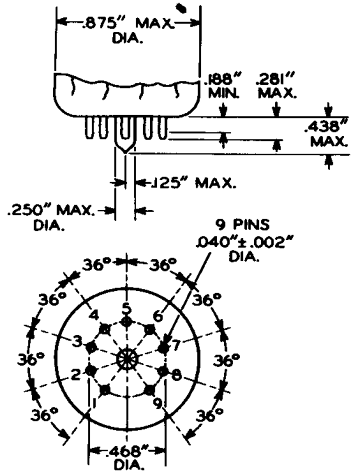
JEDEC No.E9-68
RCA No.FSD171

Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from gauge JEDEC No.GE9-4. This gauge contains a flat-plate section having thickness of 1/4" and ten holes with diameters of 0.0520" ± 0.0005" so located on a 0.4680" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1446" ± 0.0005".

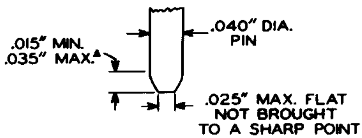
The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 1/8" from the bottom of the seated tube.

* This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

SMALL-BUTTON NINAR 9-PIN
Pin Dimensions and Orientation



Ninar-Base-Pin Contour



JEDEC No.E9-37
RCA No.FSB6047

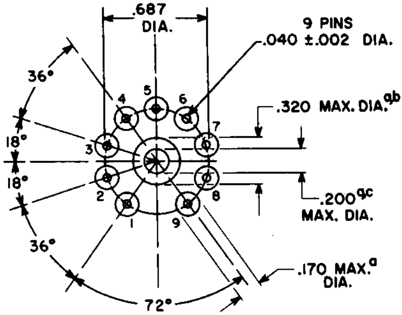
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from gauge JEDEC No.GE9-2. This gauge contains a flat-plate section having thickness of 0.250" and ten holes with diameters of 0.0520" ± 0.0005" so located on a 0.4680" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1446" ± 0.0005". Gauge is also provided with a hole 0.281" minimum diameter concentric with the pin circle.

▲ This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

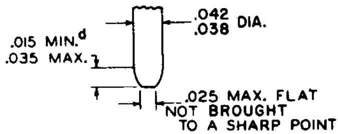
SMALL-BUTTON NINAR 9-PIN (CONT'D)

The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 1/8" from the bottom of the seated tube.

NOVAR
Pin Dimensions and Orientation



Novar-Base-Pin Contour



DIMENSIONS IN INCHES

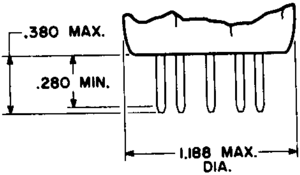
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having a thickness of 0.350" and ten holes with diameters of 0.0520" ± 0.0005" so located on a 0.6870" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2123" ± 0.0005". Gauge is also provided with a hole 0.330" + 0.005" − 0.000" diameter concentric with the pin circle.

[a] This dimension applies only to JEDEC Base Nos. E9-88 and E9-89.
[b] Limit of exhaust tube fillet diameter.
[c] Exhaust tube maximum diameter.
[d] This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

Bases
9-Pin Types

TOP EXHAUST NOVAR

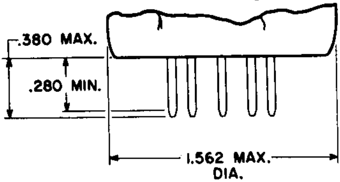
Small-Button Base



JEDEC No.E9-75
RCA No.FSE36

Fits Gauge
JEDEC No.GE9-5

Large-Button Base

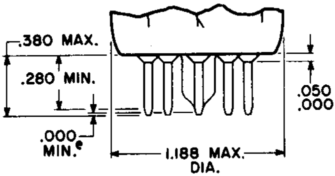


JEDEC No.E9-76
RCA No.FSE22A

Fits Gauge
JEDEC No.GE9-6

BOTTOM EXHAUST NOVAR

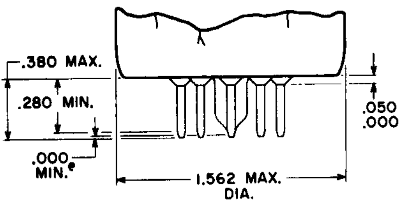
Small-Button Base



JEDEC No.E9-89
RCA No.FSE43G

Fits Gauge
JEDEC No.GE9-5

Large-Button Base



JEDEC No.E9-88
RCA No.FSE43C

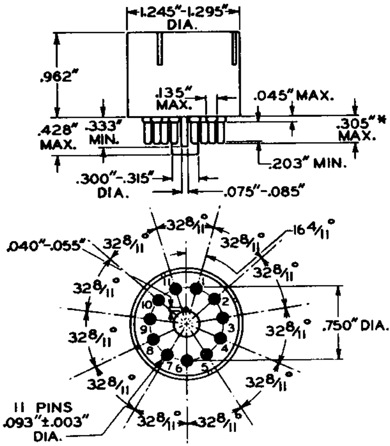
Fits Gauge
JEDEC No.GE9-6

92CM-11300R1

DIMENSIONS IN INCHES

[e] The exhaust tip shall not extend beyond the plane of the base pin ends.

SMALL-SHELL NEOSUBMAGNAL 11-PIN
Pin Dimensions and Orientation



JEDEC No. B11-104
RCA No. 11442

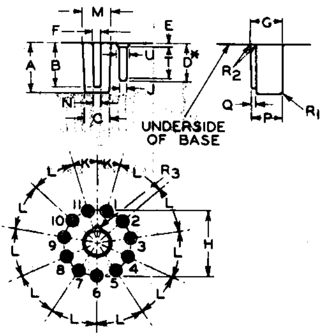
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JEDEC Group 2, No. GB11-2) having thickness of 1/4" and eleven holes with diameters of 0.1030" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.213" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

11-PIN TYPES

"SUBMAGNAL"
PIN DIMENSIONS AND ORIENTATION AND INDEX GUIDE



	Min.	*Center*	*Max.*		*Min.*	*Center*	*Max.*
A	.550"	.560"	.570"	L	–	32-8/11°	–
B	.490"	.500"	.510"	M	.305"	.312"	.317"
C	.300"	.308"	.315"	N	.075"	.080"	.085"
D	.427"	.437"	.447"	P	.343"	.353"	.363"
E	--	–	.050"	Q	.040"	.047"	.055"
F	.085"	.090"	.095"	R_1	–	.031"	–
G	.352"	.362"	.372"	R_2	–	–	.050"
H	–	.750"	–	R_3	–	.040"	–
J	.090"	.093"	.096"	T	.340"	–	–
K	–	16-4/11°	–	U	–	–	.135"

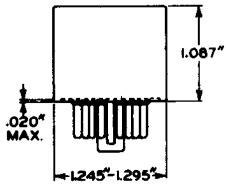
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No. GB11-2) having thickness of 1/4" and eleven holes with diameters of 0.1030" ±0.0005" so located on a 0.7500" ±0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2113" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

11-PIN TYPES

SMALL-SHELL SUBMAGNAL



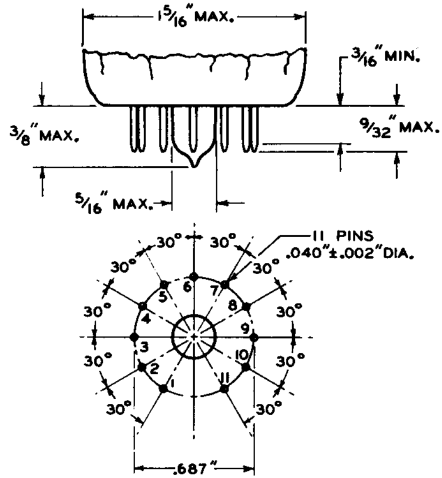
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
11-Pin	1,2,3,4,5,6,7,8,9,10,11	B11-88	11344

For other dimensions, see first page of the "Submagnal" series

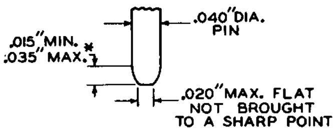
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

11-PIN TYPES

SMALL-BUTTON UNIDEKAR 11-PIN



Unidekar Base Pin Contour



JETEC No. E11-22
RCA No. FSB6019

Base-pin positions are held to tolerances such that entire length of pins will without undue force pass into and disengage from flat-plate gauge having thickness of 1/4" and twelve holes with diameters of 0.0520" ± 0.0005" so located on a 0.6870" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1778" ± 0.0005". Gauge is also provided with a hole 0.3750" ± 0.0100" concentric with the pin circle.

* This dimension around the periphery of any individual pin may vary within the limits shown.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

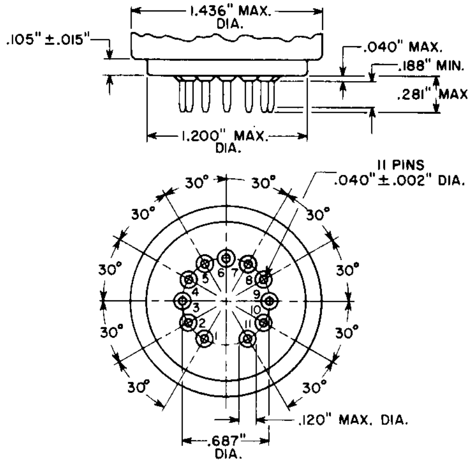
SMALL-BUTTON UNIDEKAR 11-PIN (CONT'D)

The design of the socket should be such that circuit wiring can not impress lateral strains through the socket contacts on the base pins. The point of bearing of the contacts on the base pins should not be closer than 1/8" from the bottom of the seated tube.

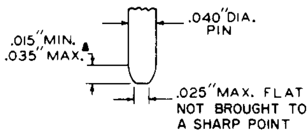
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

LARGE-WAFER ELEVENAR 11-PIN WITH RING

Pin Dimensions and Orientation



Elevenar-Base-Pin Contour



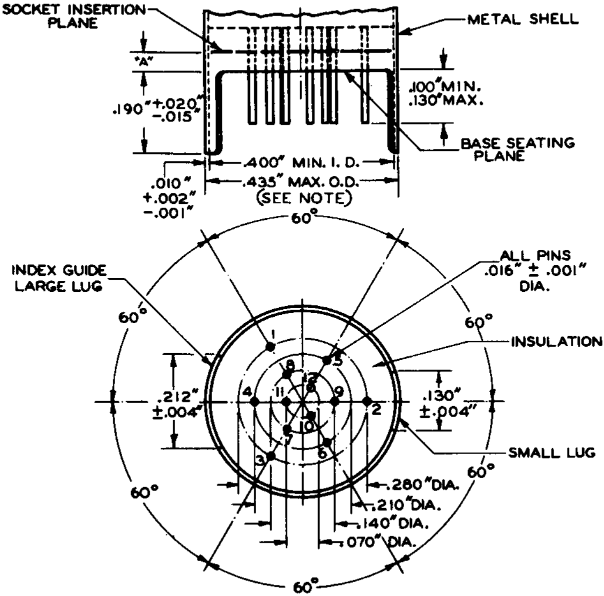
JEDEC No.E11-81

Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge (JEDEC No.GE11-1) having a thickness of 0.250" and twelve holes with diameters of 0.0520" ± 0.0005" so located on a 0.6870" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1778" ± 0.0005". Gauge is also provided with a hole 0.3750" ± 0.0005" diameter concentric with the pin circle.

▲ This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

MEDIUM CERAMIC-WAFER TWELVAR BASE

Pin Dimensions and Orientation and Index Guide



NOTE: MAXIMUM OUTSIDE DIAMETER OF 0.440" IS PERMITTED ALONG THE 0.190" LUG LENGTH.

No. of Pins	*Pins*	*Dimension "A" Max.*	*JEDEC No.*	*RCA No.*
12 - Pin	1,2,3,4,5,6,7,8,9,10,11,12	0.040"	E12-64	-
7 - Pin[a]	1,2, 4, 6,7, 10, 12	0.040"	E7-83	-
7 - Pin[b]	1, 3, 5,6,7, 10, 12	0.020"	E7-77	-
5 - Pin[c]	2, 4, 8, 10, 12	0.040"	E5-79	-
5 - Pin[d]	2, 4, 8, 10, 12	0.040"	E5-65	-

[a] Pins 3,5,8,9 are of a length such that their ends do not touch the socket insertion plane. Pin 11 is omitted.

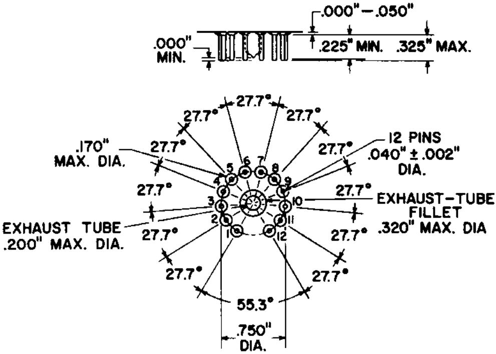
[b] Pins 2,4,8,9 are of a length such that their ends do not touch the socket insertion plane. Pin 11 is omitted.

[c] Pin 7 is of a length such that its end does not touch the socket insertion plane. Pins 1,3,5,6,9,11 are omitted.

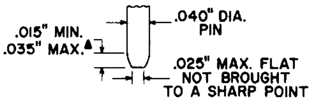
[d] Pins 1,3,5,6,7,9 are of a length such that their ends do not touch the socket insertion plane. Pin 11 is omitted.

Base-pin positions and lug positions shall be held to tolerances such that entire length of pins and lugs will without undue force pass into and disengage from flat-plate gauge (JEDEC No.GE12-5) having thickness of 0.250" and twelve holes of 0.0350" ± 0.0005" diameter located on four concentric circles as follows: Three holes located on 0.2800" ± 0.0005", three holes located on 0.2100" ± 0.0005", three holes located on 0.1400" ± 0.0005", three holes located on 0.0700" ± 0.0005" diameter circles at specified angles with a tolerance of ± 0.08° for each angle. In addition, gauge provides for two curved slots with chordal lengths of 0.2270" ± 0.0005" and 0.1450" ± 0.0005" located on 0.4200" ± 0.0005" diameter circle concentric with pin circles at 180° ± 0.08° and having a width of 0.0230" ± 0.0005".

DUODECAR 12-PIN
Pin Dimensions and Orientation



Duodecar-Base-Pin Contour



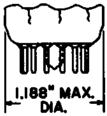
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having a thickness of 0.250" and thirteen holes with diameters of 0.0520" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1795" ± 0.0005". Gauge is also provided with a hole 0.375" + 0.005" - 0.000" diameter concentric with the pin circle.

▲ This dimension around the periphery of any individual pin may vary within the limits shown. The surface of the pin is convex or conical in shape and not brought to a sharp point.

Bases

12-Pin Types

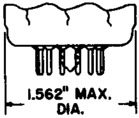
SMALL-BUTTON DUODECAR 12-PIN



JEDEC No. E12-70

Fits Gauge JEDEC No. GE12-3

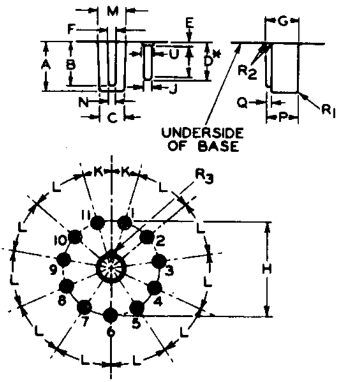
LARGE-BUTTON DUODECAR 12-PIN



JEDEC No. E12-74

Fits Gauge JEDEC No. GE12-4

"MAGNAL"
PIN DIMENSIONS AND ORIENTATION AND INDEX GUIDE



	Min.	*Center*	*Max.*		*Min.*	*Center*	*Max.*
A	.550"	.560"	.570"	L	-	32-8/11°	-
B	.490"	.500"	.510"	M	.305"	.312"	.317"
C	.300"	.308"	.315"	N	.075"	.080"	.085"
D	.427"	.437"	.447"	P	.343"	.353"	.363"
E	-	-	.050"	Q	.040"	.047"	.055"
F	.085"	.090"	.095"	R_1	-	.031"	-
G	.352"	.362"	.372"	R_2	-	-	.050"
H	-	1.063"	-	R_3	-	.040"	-
J	.090"	.093"	.096"	T	.340"	-	-
K	-	16-4/11°	-	U	-	-	.135"

Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GB11-1) having thickness of 1/4" and eleven holes with diameters of 0.1030" ± 0.0005" so located on a 1.0630" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2995" ± 0.0005".

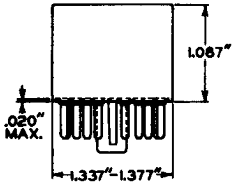
Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

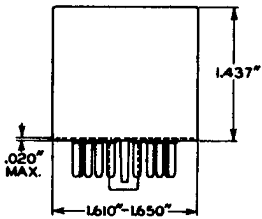
11-PIN TYPES

SMALL-SHELL MAGNAL



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
11-Pin	1,2,3,4,5,6,7,8,9,10,11	B11-33	11247

MEDIUM-SHELL MAGNAL

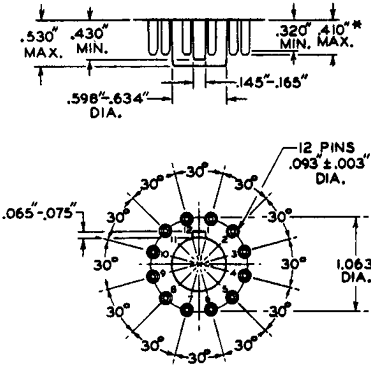


No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
11-Pin	1,2,3,4,5,6,7,8,9,10,11	B11-66	11248

For other dimensions of above bases, see first page of the "Magnal" series

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

"DUODECAL"
PIN DIMENSIONS AND ORIENTATION AND INDEX GUIDE



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GB12-1) having thickness of 1/4" and twelve holes with diameters of 0.1030" ± 0.0005" so located on a 1.0630" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2751" ± 0.0005".

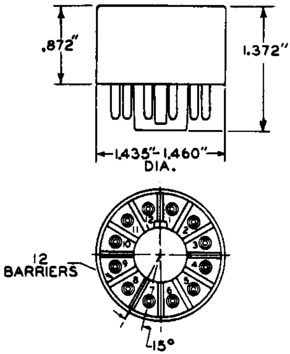
Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

BASES

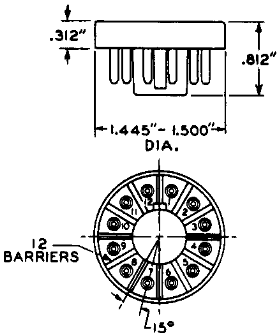
12-PIN TYPES

DWARF-SHELL DUODECAL



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
12-Pin	1,2,3,4,5,6,7,8,9,10,11,12	B12-157	12263
6-Pin	1,2,3, 10,11,12	B6-158	6263

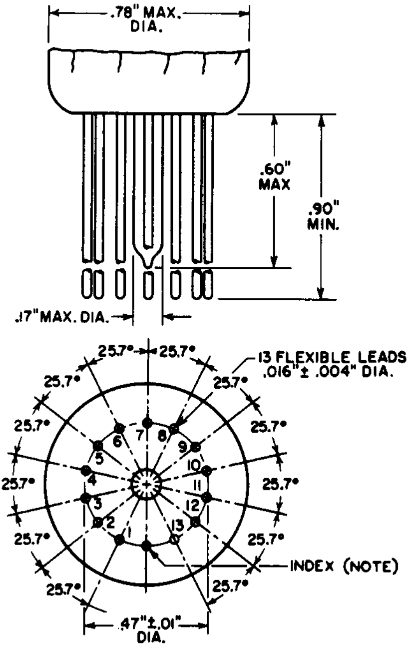
ULTRASHORT SMALL-SHELL DUODECAL



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
12-Pin	1,2,3,4,5,6,7,8,9,10,11,12,	B12-186	12261

For other dimensions of above bases, see first page of the "Duodecal" series

SMALL-BUTTON THIRTEENAR

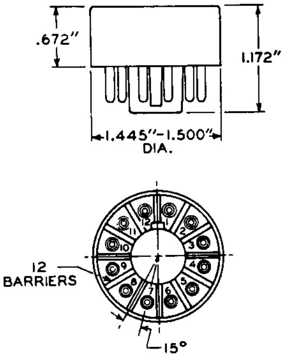


NOTE: LEAD IS CUT OFF WITHIN 0.04 INCH FROM THE GLASS BUTTON.

No. of Leads	*Leads*	*JEDEC No.*	*RCA No.*
13-Lead	1,2,3,4,5,6,7,8,9,10,11,12,13	E13-71	–
12-Lead▲	1,2,3,4,5,6,7,8,9,10,11,12,	E12-72	–

▲ Lead 13 is cut off within 0.04 inch from the glass button.

SHORT SMALL-SHELL DUODECAL



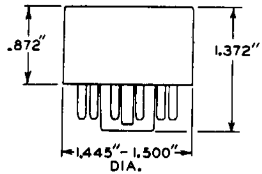
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
12-Pin	1,2,3,4,5,6,7,8,9,10,11,12	B12-207	12267
6-Pin	1,2, 6, 10,11,12	B6-203	6267

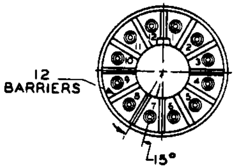
For other dimensions, see first page of the "Duodecal" series

BASES

12-PIN TYPES

SMALL-SHELL DUODECAL





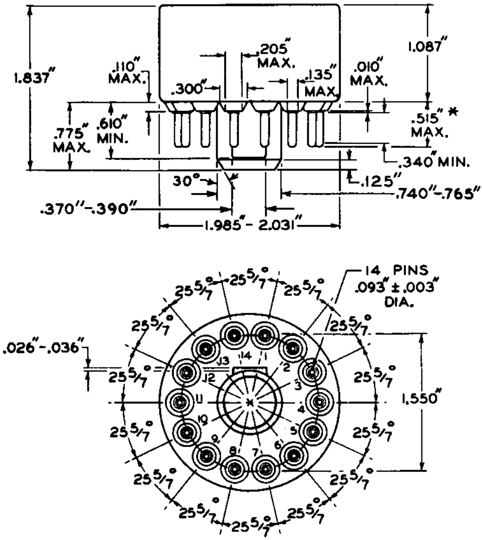
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
12-Pin	1,2,3,4,5,6,7,8,9,10,11,12	B12-43	12253
10-Pin	1,2,3,4, 6,7,8,9,10, 12	B10-75	10253
7-Pin■	1,2, 6,7, 10,11,12	B7-51	7253
7-Pin▲	1,2,3, 6, 10,11,12	B7-179	–
6-Pin■	1,2, 6, 10,11,12	B6-63	6253
6-Pin▲	4,5,6,7,8, 12	B6-180	–
5-Pin	1,2, 10,11,12	B5-57	5253

For other dimensions, see first page of the "Duodecal" series

■ Arrangement 1.
▲ Arrangement 2.

BASES

SMALL-SHELL NEODIHEPTAL



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
14-Pin	1,2,3,4,5,6,7,8,9,10,11,12,13,14	B14-130	14560
12-Pin	1,2,3,4,5,6,7, 9, 11,12,13,14	B12-131	12560

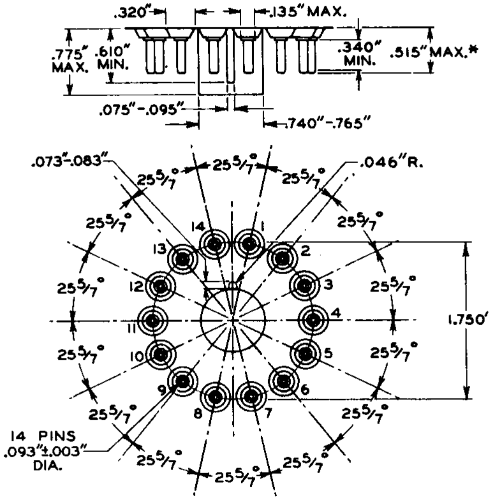
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No.GB14-2) having thickness of 1/4" and fourteen holes with diameters of 0.1030" ± 0.0005" so located on a 1.5500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.3449" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

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

"DIHEPTAL"
PIN DIMENSIONS AND ORIENTATION AND INDEX GUIDE



Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No. GB14-1) having thickness of 1/4" and fourteen holes with diameters of 0.1030" ± 0.0005" so located on a 1.750" ± 0.0005" diameter circle that the distance along the chord between any two hole centers is 0.3895" ± 0.0005".

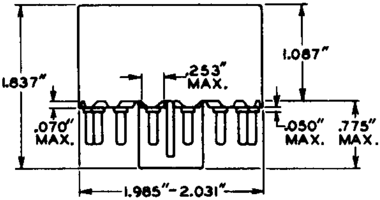
Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

BASES

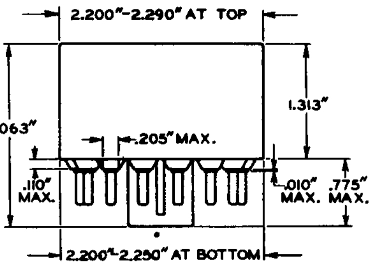
14-PIN TYPES

SMALL-SHELL DIHEPTAL



No. of Pins	Pins	JETEC No.	RCA No.
14-Pin	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	B14-45	14151
12-Pin	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14	B12-105	12151

MEDIUM-SHELL DIHEPTAL



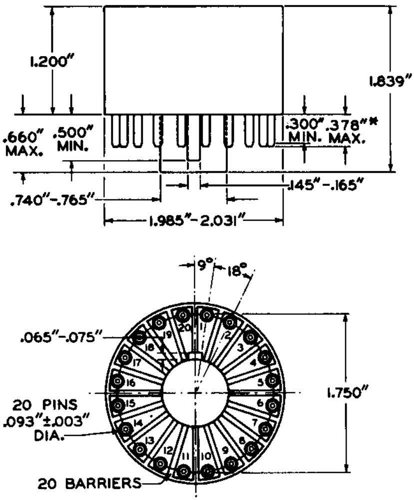
No. of Pins	Pins	JETEC No.	RCA No.
14-Pin	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	B14-38	14146
12-Pin	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 14	B12-37	12146

For other dimensions of above bases, see first page of the "Diheptal" series

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

20-PIN TYPES

SMALL-SHELL BIDECAL



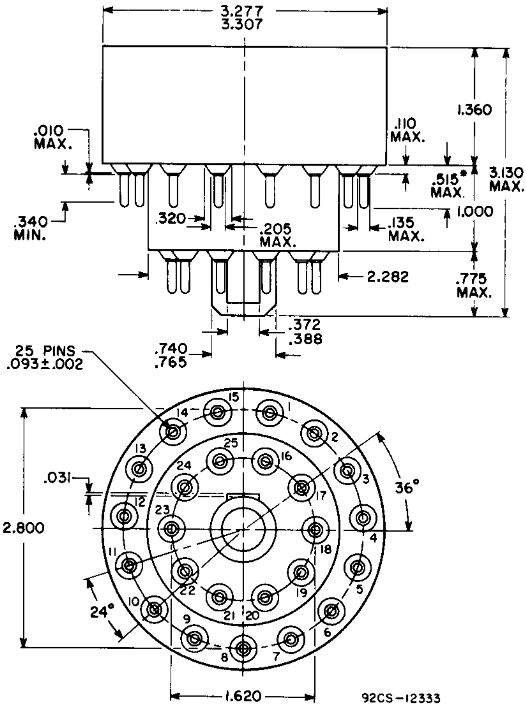
No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
20-Pin	1 through 20	B20-102	20158

Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge (JETEC No. GB20-1) having thickness of 1/4" and twenty holes with diameters of 0.1030" ± 0.0005" so located on a 1.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.2738" ± 0.0005".

Pin fit in gauge is such that gauge together with supplementary weight totaling 3 pounds will not be lifted when pins are withdrawn.

* Add 0.030" for solder on finished tube.

JEDEC No.B25-216

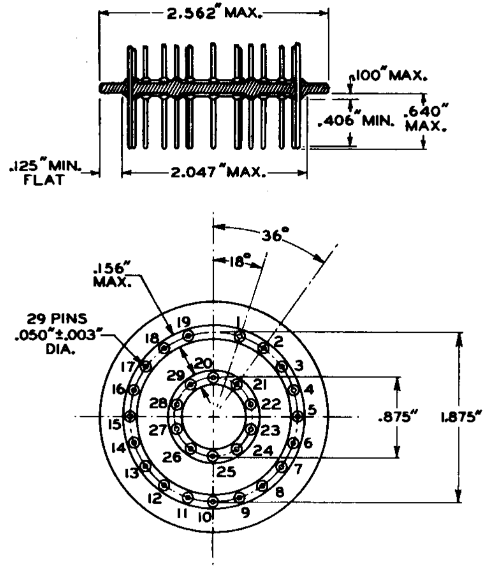


DIMENSIONS IN INCHES

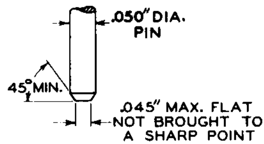
* Add 0.030 inch for solder.

29-PIN TYPES

SMALL-BUTTON TWENTYNINAR



Twentyninar Base Pin Contour



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
29-Pin	1 through 29	E29-17	-
22-Pin	1 through 19,21,25,28	E22-16	FSB693
8-Pin	2,6,10,14,18,21,25,28	E8-19	FSB693A

SMALL-BUTTON TWENTYNINAR (CONT'D)

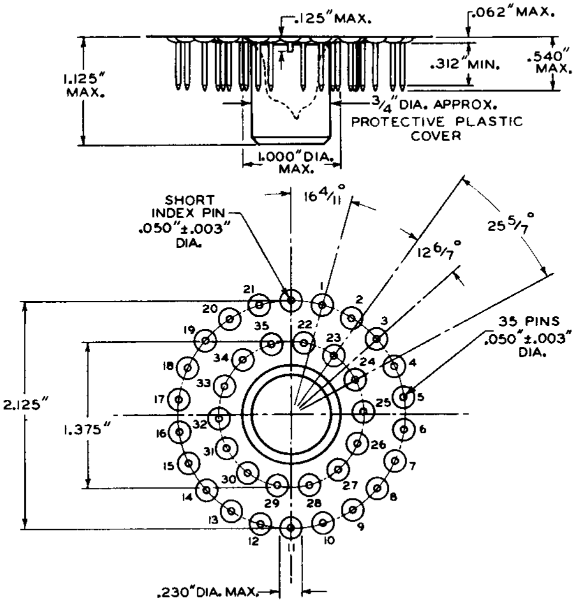
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge having thickness of 3/8" and twenty-nine holes with diameters of 0.0700" ± 0.0005", nineteen of which are located with hole centers corresponding to the specified location of pin centers on a 1.8750" ± 0.0005" diameter circle, and ten of which are located with hole centers corresponding to the specified location of pin centers on a 0.8750" ± 0.0005" diameter circle concentric with the 1.8750" circle.

Pin fit in gauge is such that entire length of pins will, without undue force, enter into and disengage from the gauge.

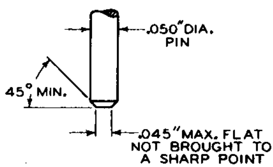
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

35-PIN TYPES

"THIRTYFIVAR"
PIN DIMENSIONS AND ORIENTATION



Thirtyfivar-Base Pin Contour



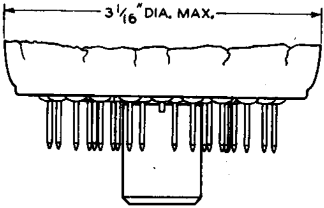
Base-pin positions are held to tolerances such that entire length of pins will enter flat-plate gauge having thickness of 3/8" and thirty-six holes with diameters of 0.0700" ± 0.0005", twenty-two of which are located with hole centers corresponding to the specified location of

THIRTYFIVAR (CONT'D)

pin centers on a 2.1250" ± 0.0005" diameter circle, and fourteen of which are located with hole centers corresponding to the specified location of pin centers on a 1.3750" ± 0.0005" diameter circle concentric with the 2.1250" circle.

Pin fit in gauge is such that entire length of pins will, without undue force, enter into and disengage from the gauge. Gauge is also provided with a hole 1.000" diameter minimum concentric with pin circles.

SMALL-BUTTON THIRTYFIVAR



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
35-Pin	1 through 35	E35-28	-
33-Pin	Omit pins 24 and 30	E33-29	-
31-Pin	Omit pins 24 and 30; pins 23 and 31 are trimmed to same dimension as index pin.	E31-36	-
21-Pin	1 through 21	E21-40	-

For other dimensions of above base, see first page of the "Thirtyfivar" series

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