FIRST SUPPLEMENT

RECEIVING TUBE SUBSTITUTION GUIDE BOOK

BY

H. A. MIDDLETON

JOHN F. RIDER PUBLISHER, INC.
480 CANAL STREET NEW YORK 13, N. Y.

TABLE OF CONTENTS

First Printing, November, 1951
Second Printing, May, 1952
Third Printing, December, 1952
Fourth Printing, May, 1953
Fifth Printing, September, 1953

Printed in the United States of America

FOREWORD

Continued development and improvement of radios, television receivers, and other electronic equipment is to a great extent dependent on new and better vacuum tubes. Because of constant circuit changes and improvements, keeping a current list of tube substitutions for radios and television receivers is almost a never-ending job. Therefore, as the number of new substitutions justify it, supplements such as this one will be published periodically in order to keep your information up-to-date.

There are about 750 new substitutions listed in this supplement. Among these are some of the older tube types that were left out of the original Receiving Tube Substitution Guide Book. Substitutions are also listed here for some of the types for which we then thought were no substitutes. Most of the substitutions listed are for television receivers. When substituting tubes in television receivers, refer to the information given in the article "Tube Substitutions in Television Receivers" in this supplement.

It is not the object of these instructions to tell you how to improve radios, television sets, and other electronic equipment, but rather to help you in using the tubes you have to replace those that are not available.

It is important to understand that the information here calls for substitutes only. We do not recommend the use of these tubes when the original type is available. However, when you do not have the original tube types needed to repair electronic equipment, the Receiving Tube Substitution Guide Book and this supplement will prove invaluable to you. They will save you many hours and expedite repairs. In spite of over eight years experience in making and compiling these substitutions, there are no doubt some substitutions not listed here. Although a sincere effort has been made to list all the practical substitutions, to do so is practically an impossibility. We noticed while compiling these substitutions that one substitute served as a thought starter that brought others to mind. It may work the same way for you. You may find a substitute that we do not have listed. If you do work out a good substitute, do not trust your memory, but write it up in a form similar to that used here and attach it to the proper page in your Substitution Guide Book.

In addition to assisting you during times of tube shortages, this substitution information will help you to use tubes you have had on hand for long periods of time. Also, when tubes are plentiful, the information can be used for reconverting in cases where the substitute is less efficient than the original.

November, 1951

H. A. Middleton

SECTION 1

TUBE SUBSTITUTIONS IN TELEVISION RECEIVERS

Television sets of a few years ago, with their 7- to 10-inch picture tubes, used ordinary receiving tubes throughout except for the high-voltage rectifier tubes and, of course, the cathode-ray tubes. Consumer demand called upon the ingenuity of the television receiver and tube manufacturers for larger and larger pictures. Along with larger size picture tubes, it was necessary to develop other specialized types of television tubes. Special circuits in television receivers require characteristics in receiving tubes which are different from those of most ordinary radio receiving types.

Consider the use of magnetically deflected picture tubes. The magnetic picture tube requires sweep amplifiers capable of high power output. Tube manufacturers developed special tube types for these circuits which are capable of high plate current without the use of extremely high plate voltages. It is entirely possible that efficient operation in this circuit could have been accomplished by the use of higher output tubes which were already available and by increasing the size and output of the low-voltage power supply. However, the cost of building and maintaining this larger power supply, its greater size and weight, and the added danger are only a few of the reasons why this was not done. By designing new and special tube types, improved performance was made possible, circuits were simplified, and troubleshooting was made easier and safer for the television technician.

Although there are some twenty to thirty stages commonly used in television receivers, there are only about thirteen different tube classifications denoted by manufacturers in common use. There are many variations within each of these thirteen classifications. A large portion of tubes in a given similar classification which are designed for the same circuit application are enough alike to operate in some fashion when substituted for each other without change of circuit components. Sometimes a type designed for one circuit gives excellent results in another circuit. It is sometimes necessary to make mechanical changes in order to accomplish substitutions.

Because of the similarity of characteristics of many tubes, the more familiar the technician is with the circuit use of, the similarity between, and the satisfactory or unsatisfactory operation of one tube type compared to another, the more versatile and valuable his tube stock becomes. This is true especially in an emergency.

Listed on page 2 are thirteen classifications of tubes used in television receivers along with the commonly used types. Under each classification are listed the majority of individual circuits in which these tubes are used. A careful study of this chart will familiarize you with the tubes used in the most common television receiver circuits and will serve to expedite your service problems.

These listings will serve to indicate the most common usages of the tube types in each classification. Other types that are not listed may come to mind as you look over this list, or you may find additional listings in your Receiving Tube Substitution Guide Book. Differences in circuitry as used by various manufacturers may place some of the tubes into categories other than those shown here. As stated before, the object of the chart is to list the most common types in their most common circuits.

It has been found that substitutions in the front end or in the video strip can be more satisfactorily accomplished in television receivers located in strong signal areas than those located in fringe areas. A very small loss or gain that would go unnoticed when a substitution has been made in a receiver located in a strong signal area might be sufficient to seriously impair the picture quality in a fringe area.

In some areas, fringe conditions may exist on one channel while local conditions exist on another channel. Referring to the classifications

TELEVISION RECEIVER TUBES

Classification	Common Types	Specific Circuits
1. Low-voltage Rectifier	5U4, 5V4, 5Y3, 6AX5, 6X5, 25Z6	Low-voltage rectifier
2. High-voltage Rectifier	1B3, 1V2, 1X2, 1Y2, 1Z2, 5642	High-voltage rectifier
3. Pentode Power Amplifier and Beam Power Amplifier	6AQ5, 6F6, 6K6, 6L6, 6V6, 6Y6, 7B5, 7C5, 25L6, 35L6, 50L6	Audio output Vertical sweep output Horizontal sweep oscillator High-voltage r-f oscillator Video output
4. Duo-diode Triode	6AT6, 6AV6, 6SQ6, 6BF6, 6BK6, 6BT6, 6BU6, 12AT6, 12SQ6	First audio amplifier
5. High-frequency Triode	6AB4, 6C4	Local oscillator in front end Vertical sweep oscillator
6. R-f Pentode	6AG5, 6AJ5, 6AK5, 6AU6, 6BA6, 6BC5, 6BD6, 6BH6, 6CB6, 12AU6, 12BA6	Video i-f amplifier Sound i-f amplifier Radio-frequency amplifier Video output
7. Twin Triode	6BL7, 6F6, 6F8, 6J6, 6SL7, 6SN7, 7F7, 7F8, 12AT7, 12AU7, 12AV7, 12AX7, 12AY7, 12AZ7, 12SN7	Video amplifier Sync separator Mixer oscillator Vertical sweep output
8. High-power Beam Pentodes	6AU5, 6AV5, 6BD5, 6BG6, 6BQ6, 6CD6	Horizontal sweep output
9. Damper Rectifier	6AX6, 6V4, 6W4, 12AX4, 25W4	Damper
10. Twin Diode	6AL5, 6H6, 7A6, 12AL5, 12H6	Video detector circuit Horizontal discriminator Sound ratio detector
11. Triple-diode Triode	6R8, 6S8, 6T8	Ratio detector and first audio
12. Gated Beam Pentode	6BN6, 12BN6	FM detector Vertical sweep oscillator
13. High-frequency Triode Pentode	6U8, 6X8	Oscillator mixer

as specified in the performance column of your Substitution Guide, the substitution of a "G" or "P" classified type in the front end or video strip may impair the picture quality or even cause loss of the picture entirely in the case of the fringe area station while the local stations continue to be received satisfactorily. However, in times of tube shortages, when the original or a substitute with a classification of "E" is unavailable, this would be better than no reception at all.

The lack of uniformity of design and the variability of materials used in the manufacture of the same tube types by different manufacturers may cause premature failure in a given circuit in one run of tubes while a different run will hold up well. A certain run of 6BG6 tubes installed in sets with a 17-inch picture tube may fail after a week or two because of their lack of power-handling capabilities. Tubes from this same run may give good service in other sets where the power output requirements are less. The same may be found to be true of damper rectifier types where extremely high peak inverse voltages may cause flashover in an inferior run of 6U4 types. Low-voltage rectifiers in certain runs have been known to have inefficient filaments, and their output falls off rapidly when used in large-tube sets where output current requirements are high. When your service department finds such a run of tubes on hand, use them in the smaller-tube sets for most reliable service.

Low-voltage Rectifiers

Requirements for rectifier tubes in the low-voltage power supply of a television receiver are the same as for those used in ordinary radio receiving equipment, except that higher output current is usually required.

When choosing a substitute, it is only necessary to select a type which has sufficient current-carrying capacity and a peak inverse voltage rating equal to or greater than the original type. If the substitute type meets these requirements but also has higher filament current requirements that will reach the maximum rating of the available filament transformer winding, it is recommended as a substitute over another type that falls short of output current and does not have at least an equal peak inverse voltage. This is so even though this latter type has the same filament rating as the original tube.

Selenium rectifiers can be used as substitutes for tube-type rectifiers. When substituting with selenium rectifiers in the low-voltage power supply, it is good practice to use a large safety factor. For example, if the tube rectifier has a rated output current capacity of 225 ma, use at least a 300-ma selenium rectifier or a larger one if space permits. Rectifiers in the low-voltage power supply have had a high record for failure. Thus, the practice of using at least the next size larger as a substitution will help to eliminate expensive callbacks. Refer to the Receiving Tube Substitution Guide Book for additional information on selenium rectifiers.

High-voltage Rectifiers

There are only a limited number of types of high-voltage rectifiers being currently produced. When choosing a substitute, use the type that has an equal or higher peak inverse voltage rating than the type for which you are substituting. The output current requirement from these rectifiers is so small that little consideration need be given to this characteristic of the substitute type.

Since there are only a few of this type of tube available, mechanical alterations are frequently necessary when making a substitution. You must either extend the plate lead, install sockets, or do other rewiring. It is sometimes necessary to increase the size of the high voltage shield or modify it in some other way. Make sure that all high voltage leads are properly insulated and that the shield is fastened securely for safety's sake. One of the most difficult substitutions here is for the Sylvania type 5642 because of the small size of this subminiature tube. It is necessary to find space for mounting a tube socket and a shield can.

Pentode Power Amplifiers

Pentode power amplifier tubes and the small beam power types are generally used in five different circuits in television receivers. They are the audio output stage, the vertical sweep output, the horizontal sweep oscillator, the high-voltage r-f oscillator, and video output stage.

When substituting in the vertical output or high-voltage r-f oscillator circuits, be sure to choose a type whose output is equal to or

greater than the original because of the amount of power involved in these stages. The use of a lower-powered tube than the original can sometimes be made to give from fair to good results by altering the values of the circuit components. The interelectrode capacitances are not generally considered to be a critical characteristic of the tube used in this circuit.

The audio output circuits of television receivers are not different from those used in ordinary radio receivers. Only in cases where high audio power is required from the receiver are substitutions in this stage critical. Component part changes may sometimes be necessary in order to secure optimum output from the substitute tubes.

The video output stage is a wide-band amplifier and is not critical with respect to power output. This is true because it is feeding into a relatively high impedance load. It is important to choose a substitute with similar interelectrode capacitance in order to insure uniform amplification throughout the entire video band. It is better to choose a tube with lower interelectrode capacitance than the reverse. If the substitute tube has lower interelectrode capacitance than the original, over-peaking may result. This can be compensated for by the installation of small carbon resistors across the peaking coils. Their value will vary with the substitution and can be determined by experimentation.

The horizontal sweep oscillator circuit is the least critical of all stages discussed in this section. Therefore, when a receiver utilizes a similar tube in any of the other four stages just mentioned, make the substitution in the horizontal oscillator stage. For example, assume that the vertical output tube is the same type as that used in the horizontal oscillator. If the vertical output tube is to be substituted for, it is usually desirable to transfer the horizontal oscillator tube to the vertical output stage and then substitute for the horizontal sweep oscillator.

Duo-diode Triodes

Duo-diode triodes are generally used in only one stage of television receivers, namely, the first audio amplifier. This circuit is identical to those used in ordinary radio receivers. When choosing a substitute for this circuit, the main consideration is the amplification factor of the triode section. Try to choose a substitute that has approximately the same amplification factor for best results. These types are often used only as triodes and no connection is made to the diode terminals. Under these conditions, they can be substituted for with a triode tube having characteristics similar to those of the triode section.

High-frequency Triodes

These types are generally used in two television circuits, the local oscillator in the front end and the vertical sweep oscillator.

Local oscillator circuits used in television receivers are basically the same as those used in radio receivers. Television oscillators, however, operate at a much higher frequency than do oscillators in ordinary radio receivers. For this reason, they are very critical as to any substitution. Even a very small change in the inductance or capacitance of the circuit may cause the circuit to become inoperative or operate at an incorrect frequency. Leads should be kept as short as possible. This should be kept in mind when making substitutions that require wiring changes. All of the mechanical characteristics of the circuit should be made as similar as possible to the original. Some oscillator tubes have more than one of the pins connected to the same element in the tube. When a substitution is made, the same method of connection should be followed.

The interelectrode capacitance of the substitute tube has a large effect on the circuit operation. The type of oscillator and the physical construction of the circuit afford different tolerances according to the specific case. If the grid-to-plate capacitance is higher in the substitute tube, the oscillator frequency would be lower in proportion to the increase in capacitance. If the capacitance is lower, the oscillator frequency will be higher. If the oscillator slug adjustment will not resonate the circuit to the proper frequency and the interelectrode capacitance is not too far off, it is possible that adjustment of the coils in the circuit will effect satisfactory operation. This, however, is no job for the novice, and, if you are not very sure of exactly how to go about it, let the job go until a satisfactory substitute or the original type becomes available. The adding or removal of a shield in this circuit will sometimes change the effective

circuit capacitance enough to make the difference between satisfactory and unsatisfactory operation.

The vertical sweep oscillator operates at 60 cps so that high-frequency triodes are not actually required for this circuit. However, they are sometimes used for this service. Under these conditions, they are not considered critical as to substitution. The ordinary radio receiving type triode will make a good substitution in this stage. If the local ordinary oscillator in the front end fails and the same type is used in the vertical oscillator stage, place the tube from the vertical oscillator stage into the local oscillator socket and make the substitution in the less critical vertical sweep oscillator stage.

R-f Pentodes

Radio-frequency pentodes are the most used classification of tubes in television receivers. Because of this, there have been many variations of this type produced. Many of these are of the miniature, seven-pin construction.

In addition to some miscellaneous applications, they are used in four different circuits of a television receiver. These are the radio-frequency amplifier in the front end, the video i-f amplifiers, the sound i-f amplifiers, and the video amplifiers.

The small size of the miniature version of this tube type makes possible higher efficiency circuits at the very high frequencies. Therefore, the substitution of a larger tube designed for operation at lower frequencies will usually not be satisfactory. For example, a 6SH7 could not be used as a substitute for a 6BC5 because of the higher interelectrode capacitance of the larger tube. This, in addition to the greater distributed capacitance in the circuit due to longer leads required when changing the tube socket, would make alignment of the circuit almost impossible.

The radio-frequency stage in the front end is used primarily as an isolation stage between the antenna and the mixer. This stage is required to have a wide pass band so that not too much amplification is possible. This tube is therefore considered to be reasonably non-critical as to substitutions. Even a large difference in the gain of the tube used has little effect on the overall operation of the receiver.

The video i-f strip utilizes three or more stages of amplification. Of these, the first and the last usually contribute the least to the amplification of the signal. These are, therefore, the least critical as to substitutions. It is suggested that, when substitution is necessary in the i-f strip and where several tubes of identical type are used, that you first attempt a substitution without changing either alignment or component parts. Refer to your Receiving Tube Substitution Guide Book for performance classifications as well as characteristics. Tubes with high transconductance are usually the most satisfactory in this circuit, where amplification requirements are high. Theoretically, when a substitution is made in any of the video i-f stages, complete realignment is mandatory. However, from a practical standpoint, this may not be necessary.

The sound i-f strip has a much narrower bandwidth than the video i-f strip, and the available amplification is ordinarily greater than is required. For this reason, a reasonable reduction in the gain of the sound i-f stage is considered unimportant, making the circuit less critical to substitutions than are the video i-f stages.

It may be found that one of the video i-f tubes in a given receiver is defective and that the tubes used in the sound i-f are of identical types. In this case, replace the defective video stage tube with one of the sound stage tubes and proceed with the substitution in the less critical sound stage.

In the circuits discussed above, it is very important that connecting leads be kept short. When changing a socket, be sure to reconnect the leads the same way as they were originally in order to avoid increasing the distributed capacitance of the circuit and to minimize the possibility of regeneration.

The video output stage is not very critical as to substitutions. If you have a variety of substitutes, it is recommended that you try them all and use the one that produces the best results. If over-peaking is evident in the picture after a substitution has been made, this can be eliminated by shunting the peaking coils with small carbon resistors, as mentioned previously.

Twin Triodes

Twin triodes have many equivalents and many uses. Some of these are the following:

mixer-oscillator, sync separator, video amplifier, vertical oscillator, horizontal oscillator, and horizontal frequency control.

In its application as mixer-oscillator in the front end, substitution is very critical. It is important to choose a substitute type tube whose interelectrode capacitance is very similar and which was designed for the same circuit. If the interelectrode capacitance is not too different from that of the original, adjustment of the oscillator tuning slug will resonate the oscillator circuit at the proper frequency. For further information on the operation of the oscillator section, refer to the paragraph discussing high-frequency triodes used as local oscillators in the front end. When twin triodes are used (with one triode as the local oscillator and the other as the mixer), so long as the oscillator circuit operates properly with the substitute, the mixer circuit can usually be relied upon to operate equally well. The mixer alignment should be checked and adjusted if necessary.

Sync separators operate at low frequencies and at low power. They are considered non-critical as to substitutions. In making your choice of a substitute for this circuit you need give little consideration to the interelectrode capacitance and to the recommended operating frequency of the type used. Try to choose a type in which the plate current, amplification factor and grid bias are approximately the same as the original.

Video amplifiers are wide-band amplifiers, and, therefore, when choosing a substitute type, select one that has similar interelectrode capacitance in order to insure uniform amplification throughout the entire band.

The vertical oscillator and the vertical output stage functions in television receivers are ordinarily performed by the same tube when a triode is employed. It is important when choosing a substitute for these stages that the substitute type have equal or higher power rating characteristics. All other characteristics are relatively unimportant, and the circuit is generally considered non-critical as to substitutions.

The horizontal oscillator and frequency control circuit functions are sometimes performed by the same tube. The circuits are also considered fairly non-critical as to substitutions. When choosing a substitute for these circuits, select one that has similar power rating characteristics. The interelectrode capacitance has little effect on the circuit.

High-power Beam Pentodes

These types, as used in television receivers, were especially designed for use with magnetically deflected picture tubes. Effectively, they are redesigned versions of the high-power audio output pentode tubes as used in low power amplifiers. They are highly insulated in order to withstand the high peak voltages in the horizontal output circuit of a television receiver. The high output power needed requires these tubes to be so designed that they draw high plate current while using low operating voltages. When substituting in this circuit, it is important that the substitute be capable of equal or higher output as compared with the original type.

Damper Rectifiers

Damper rectifiers with indirectly heated cathodes are especially designed for television service and are capable of withstanding high peak inverse voltages and of producing fairly high output currents. When choosing a substitute for the damper stage, be sure that it is capable of withstanding the high voltage without flashover and that it has at least an equal current rating as compared to the original. A high percentage of failure of this tube type is due to flashover between the heater and cathode. If no substitute tube is available that has an equal or higher peak inverse and output current rating, try an ordinary radio power rectifier that has the required output current rating. The filament must be heated by a separate transformer having a breakdown voltage rating of not less than 3,000 volts. When this substitution is made in a transformer-type television receiver, the original filament leads should be disconnected and securely taped. In transformerless receivers, where the damper tube filament is a part of a series circuit, the original filament leads must be disconnected from the socket and reconnected to a resistor of the correct value to properly complete the filament circuit. Data for computing the filament resistor necessary is contained in the Receiving Tube Substitution Guide Book.

Twin Diodes

Twin diode tubes are generally used in three different television circuits. These are the video detector, the horizontal discriminator, and the sound detector. There is a very limited choice in this classification. It may sometimes be found necessary to use the corresponding diodes in some multi-purpose tube to accomplish substitution in these stages. When this is done, connect all unused elements in the substitute tube to ground. If a substitute tube is not available, any of these circuits can be made operative by the use of a pair of germanium crystal diodes whose current ratings are comparable to the original tube. When a substitution has been made in the sound detector, the last i-f sound stage should be checked for alignment. When a substitute has been made in the video detector, the alignment of the last video i-f stage should be checked and realignment performed if necessary.

Triple-diode Triodes

Triple-diode triodes especially designed for television receivers are frequently used in the ratio detector and first audio circuits. There are a very limited number in this classification of tubes. The circuits are considered fairly non-critical as to substitutions, but the problem of finding a substitute with the necessary quantity of elements may be difficult. A good substitute, however, is a duo-diode triode having similar characteristics and the addition of a germanium crystal diode to take the place of the missing diode element. Where space is not a factor in the substitution, a combination of two tubes may be used to accomplish the same purpose. When making substitutions of this kind, select a tube with a triode section that has similar characteristics to the original type. Realignment of the last sound i-f stage is ordinarily necessary after this substitution has been made.

Gated Beam Pentodes

Designed especially for television and f-m receivers, the gated beam pentode is used in the f-m detector circuit and in the vertical oscillator circuit. No other tube type can be easily substituted in this circuit. The number of types available in this classification are very few.

When this tube is not available, it will be necessary to substitute another circuit using conventional tubes. A ratio detector should be substituted for the f-m sound detector. The reason for suggesting a ratio detector circuit is that a limiter stage is not usually required. Since the gated beam tube f-m detector does not require the limiter stage, the ratio detector circuit involves fewer circuit changes. This substitution could be accomplished with a triple-diode triode tube such as the 6T8 or with a duo-diode triode such as the 6AT6 in conjunction with a germanium diode crystal. It is necessary to change the last sound i-f transformer to a ratio detector transformer and to change any other components necessary for this new circuit.

If the gated beam pentode is used as the vertical oscillator, it will again be necessary to change the circuit when the original type or a similarly classified type tube is not available. Any conventional triode having the required characteristics may be used as the vertical oscillator if the blocking oscillator circuit is employed. Any conventional twin triode with the required characteristics may be used if the multivibrator oscillator circuit is employed.

High-frequency Triode Pentodes

These types are recent additions to special television types and are for use in the front end as the local oscillator and mixer. Like the high-frequency triode tube used as the local oscillator in the front end, they are very critical as to substitution. The type is composed of two separate sections: a high-frequency triode for use as the local oscillator and a pentode section for use as a mixer. The interelectrode capacitance of any substitution for these types must be very similar to the original. Shielding these types will change the circuit capacitance considerably. Since the variety of these types is very limited, it may be necessary to use two tubes as a substitute. The placement and the length of the connecting leads are a critical consideration when mechanical and wiring changes are required. The older type triode pentodes such as the 6F7, 6AD7, and 6P7 are not capable of operation on television frequencies and cannot be satisfactorily used as substitutes.

EXAMPLES OF PRACTICAL TELEVISION TUBE SUBSTITUTIONS

RCA 630TS. The following substitutions were made in an RCA 630TS television chassis. This chassis is not only used in RCA television receivers but also in a great many other brand sets.

Before the substitutions were made, all tubes and component parts in the set were carefully checked and found to be in good condition. The chassis was also carefully and completely realigned for peak performance. Suitable test equipment was used to show the differences in the response curves with the original and substitute tubes.

The procedure was as follows: The response curve of the stage in which the substitution was to be made was observed on an oscilloscope and the gain and bandwidth were carefully noted. The substitute tube was then installed and the difference in response and gain were tabulated. The set was then completely realigned for optimum output. The change in efficiency of operation was then noted. The original tube was then reinstalled and the set was again completely realigned and made ready for the next substitution.

Component parts were changed to adjust the bias and operating voltages of the substitute tube when required. In none of the following substitutions was there enough improvement to justify the use of the substitute rather than the original tube. A change in alignment was necessary in some cases in order to retain the correct response curve. In a few cases it was necessary to readjust the sound traps after making a substitution.

The results of making substitutions for the video i-f amplifiers follow. The original tube was a 6AG5.

RCA 630 TS Video I-f Amplifier Substitutions

Substitute	Stage	Circuit Changes and Results
6AU6	1st, 2nd, 3rd video i-f	No changes. Results equal to original after careful realignment.
6AU6	4th video i-f	This substitution is not recommended.
6BC5	1st, 2nd, 3rd video i-f	No changes. Results equal to original without realignment.
6BC5	4th video i-f	No changes. Results equal to the original after careful realignment.
6AK5	All video i-f	No changes. Different heater current but, because of parallel connection, no rewiring required.
6CB6	All video i-f	The cathode and suppressor grids are connected internally in the 6AG5 but these elements are separate on the 6CB6. Connect pins 2 and 7 together on the socket. If pin 2 is used as a tie point on the 6AG5, remove leads from pin. Solder these together and tape. Results equal to original.
9003	All video i-f	No changes. About 5 percent loss in gain after careful realignment.
6AH6	1st, 2nd, 3rd video i-f	Results equal to original after careful realignment.
6AH6	4th video i-f	This substitution is not recommended.

RCA 630 TS Video I-f Amplifier Substitutions (cont'd)

Substitute	Stage	Circuit Changes and Results
6BA6	1st, 2nd video i-f	No changes. Results equal to original without realignment.
6BA6	3rd video i-f	No changes. About 20 percent loss in gain after careful realignment.
6BA6	4th video i-f	No changes. About 30 percent loss in gain after careful realignment.
6BD6	1st, 2nd, 3rd video i-f	Connect pins 2 and 7 together on socket. Results equal to original after careful realignment.
6BD6	4th video i-f	Connect pins 2 and 7 together on socket. Results equal to original without realignment.

The results of making substitutions for the 1st video amplifier follow. The original tube was a 6AU6.

RCA 630 TS 1st Video Amplifier Substitutions

Substitute	Circuit Changes and Results
6CB6	No changes. About 10 percent increase in gain.
6AG5	No changes. About 20 percent increase in gain after careful realignment of 4th video i-f stage.
6AK5	No changes. Heater current differs, but, since parallel connection is used, no rewiring required. About 30 percent increase in gain.
6BA6	No changes. Results equal to original without realignment.
6BH6	No changes. The suppressor grid and cathode pin connections are reversed but both are connected to the same point. Results equal to original without realignment.

The results of making substitutions for the 2nd video amplifier follow. The original tube was a 6K6.

RCA 630 TS 2nd Video Amplifier Substitutions

Substitute	Circuit Changes and Results
6F6	No changes. Heater currents differ, but this is a parallel circuit. Operates well without change or adjustment.

RCA 630 TS 2nd Video Amplifier Substitutions (cont'd)

Substitute	Circuit Changes and Results
6L6	No changes. Heater currents differ, but this is a parallel circuit. About 20 percent increase in gain without adjustment.
6U6	No changes. Heater currents differ, but this is a parallel circuit. About 20 percent increase in gain without adjustment.

The results of making substitutions for the first two sound i-f amplifiers follow. The original tube used in the first two stages was a 6BA6.

RCA 630 TS Sound I-f Amplifier Substitutions

Substitute	Circuit Changes and Results
6AU6	No changes. Equal results after realignment.
6BD6	No changes. About 50 percent loss in gain resulted. This substitution is not recommended in other than strong signal areas.
9003	No changes. Heater currents differ, but this is a parallel circuit. About 20 percent loss in gain resulted.

Because of slight differences in tube characteristics and variations in television receiver circuits and operating voltages, results obtained in every case may not match exactly those results given above. However, diffierences in results should not be too great.

Belmont 18DX21A. A Number of tube substitutions were made in a Raytheon Belmont television set, model number 18DX21A. Exactly the same procedure was used as in the case of the RCA 630 TS. The results of making substitutions for the limiter stage follow. The original tube was a 12AU6.

Belmont 18DX21A Limiter Substitutions

Substitute	Circuit Changes and Results
12BA6	No changes. Operation is equal to the original. Realignment does not improve operation.
12BD6	No changes. About 30 percent loss in gain. Realignment and changes in operating voltages were attempted without satisfaction. If the set is located in a strong signal area little change will be noticed. Do not attempt this substitution for fringe area operation.

Belmont 18DX21A Limiter Substitutions (cont'd)

Substitute	Circuit Changes and Results
12AW6	The suppressor grid and cathode are connected to opposite pins. In this set these elements are connected together; therefore, no change is required. Substitution gives a 30 percent increase in gain without realignment and is recommended for fringe area operation.

The results of making substitutions for the i-f stages follow. The original tubes used were 6BA6's.

Belmont 18DX21A I-f Amplifier Substitutions

Substitute	Stage	Circuit Changes and Results
6AU6	1st i-f	No changes. Results equal to original after careful realignment.
6AU6	2nd i-f	No changes. About 30 percent increase in gain after careful realignment. Recommended for fringe area operation.
6AU6	3rd i-f	No changes. Results equal to original. No realignment required.
6BD6	1st i-f	No changes. About 10 percent loss in gain after careful realignment.
6BD6	2nd, 3rd i-f	No changes. Results equal to original after careful realignment.
6AG5	All i-f	No changes. Results equal to original after careful realignment.
6CB6	1st i-f	No changes. Results equal to original after careful realignment.
6CB6	2nd, 3rd i-f	No changes. About 30 percent loss in gain after careful realignment.
6BC5	All i-f	No changes. Results equal to original after careful realignment.

In addition to the above, a 19C8 was substituted for the 19T8 FM discriminator and first audio amplifier. No changes were required. The only apparent result was a slight loss in audio gain.

As pointed out previously, because of slight differences in tube characteristics and variations in circuits and voltages, the exact results given above may not always be obtained. However, great differences should not be found.

SECTION 2

RECEIVING TUBE SUBSTITUTION GUIDE

This section includes the actual information on the tube substitutions. The same format is followed as was used in the Receiving Tube Substitution Guide Book. Four columns are used. The first column gives the tube type for which a substitute is desired. The listing is in numerical-alphabetical order. No distinctions are indicated insofar as glass or metal tubes are concerned and the letters G, GT, GT/G, GA, or GP all have been omitted. In most cases, these letters simply indicate a glass type whose characteristics are practically the same as the metal type having the corresponding type number.

Column three lists the performance rating. Substitutions that we have found through practical experience will operate with equal or very nearly equal results compared to the original and those that have equal or nearly equal electrical characteristics are given a performance classification of E for EXCELLENT. Substitutions that we have found to operate satisfactorily, although they do show a distinct loss, or those that have the same functional classification as the tube being substituted for but whose electrical characteristics are from 20 percent to 50 percent different, are classified G for GOOD. Others that are less efficient but which did operate in a fashion and those whose functional classification is different or whose critical characteristics are unlike the original by more than 20 percent are classified P for POOR. These are recommended for emergency use only.

Column four gives the necessary circuit changes. It is impractical to include a listing of component part changes in order to alter the circuit with the substitute tube. The changes would vary widely with the type of circuit and the applied voltages; therefore, information correct for some sets would be grossly incorrect for others. Because of this, substitutions other than those classified E are not completely worked out for you. However, those substitutions classified G are satisfactory in most cases without component part changes, thus saving the equipment owner added parts and labor changes. A complete discussion covering the technique of computing substitute bias and load resistance is contained in the Receiving Tube Substitution Guide Book. When making changes in component parts, always make a complete record of the original values of the circuit altered, and securely attach it to the chassis of the equipment.

The necessary wiring changes, socket changes, and filament voltage adjustments are described in detail for each substitution listed. The instruction "No changes" indicates that the base wiring for the substitute is the same and that the filament voltage and current ratings are equal. The note "Parallel circuits only" indicates that the filament current ratings of the two tubes are unequal. This note is appended to some types that are not usually used in other than parallel circuits. This has been done to make the information more uniform and less confusing to the novice.

A few substitutions are followed by the note "Series circuits only." In these, the filament current of the substitute is equal to that of the original but the filament voltage is unequal. If the filament voltage of the substitute is higher than the original, then the voltage is reduced on all the other tubes in the circuit. If the substitute has a lower filament voltage rating, the voltage is increased on all the other tubes in the circuit. A series filament resistor is recommended where the increase in voltage amounts to more than five percent. When making substitutions requiring rewiring or socket changes, always make a note showing the original type used and the circuit in which the substitution is made. Then attach the note securely to the chassis.

Some substitutions listed, like the nine-prong noval series, have a heater center-tap

connection which permits them to be operated at either 6.3 volts or 12.6 volts. These types are almost always numbered to indicate the higher heater voltage (12AT7, 12AU7). These types are listed as substitutes for the 6 and 7 series tubes having 6.3-volt heaters. When this is done the two halves of the noval tube heater are connected in parallel, thus cutting the necessary filament voltage in half and doubling the current required. Depending on the heater current of the type being substituted for, these types may be marked "Parallel circuits only" or they may be usable in either parallel or series circuits. These same tubes may be listed elsewhere as substitutes for 12.6-volt heater types. Whether these types are used as substitutes for 6.3-volt or 12.6-volt tubes, they will be operating at the proper voltage.

Some miniature tubes with 12.6-volt heaters do not have tapped heaters. These are usually used in series circuits that are connected directly to the line. Occasionally, a 12.6-volt winding is provided on the power transformer for the heaters in a parallel circuit.

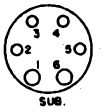
When substituting for 12.6-volt tubes in series circuits with 6.3-volt types having equal current ratings, the increase in voltage spread over all the other tubes is small and need not be considered. However, it is good practice to shunt a small resistor of about 300 ohms across the heater of the 6.3-volt tube in order to reduce the current flow through it during the time it takes for the tubes to heat. When a transformer winding is provided for the 12.6-volt tube and it is desired to use a 6.3-volt type, this can be done simply by moving one of the socket heater connections to the center-tap of the heater winding.

It should be pointed out that when "electric operation" is referred to in the substitutions which follow, the term is taken to mean non-battery operation. In other words, the receiver is to operate from the power line.

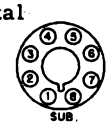
RECEIVING TUBE SUBSTITUTIONS

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
0A3	0B3	P	No changes.
0Z4	6AX5	E	Rewire as follows: Connect No. 2 to chassis Connect No. 7 to 6 volt filament.
	6AX6	E	Rewire as follows: Connect No. 4 and No. 8 together Connect No. 2 to chassis Connect No. 7 to 6 volt filament.
	6BY5	E	Rewire as follows: No. 3 to No. 4 Connect No. 1 and No. 8 together Connect No. 2 to chassis Connect No. 7 to 6 volt filament.
	6V4	E	Change socket to noval and rewire as follows:  No. 3 on octal to No. 1 on noval 5 to 7 8 to 3 Connect No. 4 to chassis Connect No. 5 to 6 volt filament. 
	6X4	E	Change socket to miniature and rewire as follows:  No. 3 on octal to No. 1 on miniature 5 to 6 8 to 7 Connect pin No. 3 to chassis Connect pin No. 4 to 6 volt filament. 

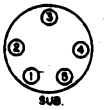
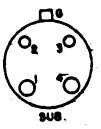
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
0Z4	6Y5	E	Change socket to six prong and rewire as follows: No. 3 on octal to No. 3 on six prong 5 to 5 8 to 4 Connect pin No. 1 on six prong to chassis Connect pin No. 6 to 6 volt filament.
	6Z5	E	Change socket to six prong and rewire as follows: No. 3 on octal to No. 3 on six prong 5 to 5 8 to 4 Connect No. 2 and No. 6 to chassis Connect No. 1 to 6 volt filament.
	6ZY5	E	Same as 0Z4 to 6AX5.
	7Z4	E	Change socket to loctal and rewire as follows:
	1274	E	No. 3 on octal to No. 3 on loctal 5 to 6 8 to 7 Connect No. 8 on loctal to chassis and No. 1 on loctal to 6V hot lead.
1A4	1A4P	G	No changes.
	1A4T	G	
1A5	1W4	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 7 on miniature 3 to 2 4 to 3 5 to 6 7 to 1
	3LE4	P	Electric operation only. Same as 6W6 to 7A5 except do not connect
	3LF4		No. 8 on octal to No. 7 on loctal.
1A5	3V4	P	Electric operation only. Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 2 4 to 3 5 to 6 7 to 7 Do not use pin No. 5.
1A7	1LB6	G	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 2 4 to 4 & 5 5 to 6 6 to 3 7 to 8 cap to 7
1AE4	1L4	P	Parallel circuits only. Not satisfactory
	1T4	P	for oscillator. No changes.
	1U4	P	
1AF5	1U5	G	Parallel circuits only. Change connections as follows: Remove, connect and tape up any wires connected to No. 2 Connect No. 5 to No. 2 Reverse connections between Nos. 3 and 4
1B3	1X2A	G	No changes.
	1Y2	G	Change socket to four prong and rewire as follows: No. 2 on octal to No. 1 on four prong 7 to 4 cap to cap Required filament voltage for 1Y2 is 0.25 volt higher but operates satisfactorily in most cases.

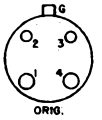
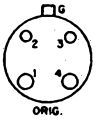
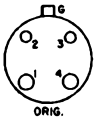
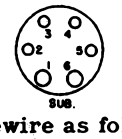
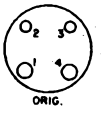
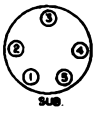
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1B3	1Z2	G	Parallel circuits only. Same as 1B3 to 1X2A Filament voltage 0.25 volts higher. Do not use on large sets where inverse peak voltage exceeds 20,000 volts.
1C5	1W4	G	Parallel circuits only. Same as 1A5 to 1W4.
	3LE4	G	Change socket to loctal and rewire as follows:
	3LF4	G	 No. 2 on octal to No. 1 & 8 on loctal 3 to 2 4 to 3 5 to 6 7 to 7 
	3V4	G	Change socket to miniature and rewire as follows:
			 No. 2 on octal to No. 1 & 7 on miniature 3 to 2 4 to 3 5 to 6 7 to 5 
1F4	1J5	G	Change socket to octal and rewire as follows:
			 No. 1 on five prong to No. 2 on octal 2 to 3 4 to 4 3 to 5 5 to 7 
	33	G	Parallel circuits only. No changes.
	950	G	No changes.
1F5	1J5	G	No changes.
	33	G	Reverse 1F4 to 1J5 procedure, parallel circuits only.
	950	G	Reverse 1F4 to 1J5 procedure.
1G5	1F4	E	Reverse 1F4 to 1J5 procedure.
	1F5	E	No changes.
	33	G	Reverse 1F4 to 1J5 procedure. Parallel circuits only.
	950	G	Reverse 1F4 to 1J5 procedure.
1G6	19	G	Parallel circuits only. Change socket to six prong and rewire as follows:
			 No. 2 on octal to No. 1 on six prong 3 to 2 4 to 3 5 to 4 6 to 5 7 to 6 
1H4	1G4	E	No changes.
1H5	1N6	G	Rewire as follows: Remove, connect, and tape up any wires anchored on No. 4 and No. 6 Connect No. 3 and No. 4 together. No. 5 to No. 6 Grid lead to No. 5
	1SB6	E	Change connections as follows: Remove, connect, and tape up any wires anchored on terminals No. 4 and No. 8. No. 4 to No. 3 Grid Lead to No. 8.
	1U5	G	Change socket to miniature and rewire as follows:
			 No. 2 on octal to No. 1 on miniature 3 to 2 & 3 5 to 4 Grid lead to 6 7 to 7 

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1J5	1F4	G	Reverse 1F4 to 1J5 procedure.
	1F5	G	No changes.
	33	G	Reverse 1F4 to 1J5 procedure. Parallel circuits only.
	950	E	Reverse 1F4 to 1J5 procedure.
1J6	1G6	G	Parallel circuits only. No changes.
1L4	1S5	G	Same as 1T4 to 1S5
	1U5	G	Cut off pin No. 4 on 1U5. Rewire as follows: Connect No. 1 & 5 together.
1L6	1R5	G	Reverse connections between No. 5 and No. 6.
	1U6	G	Connect a 56 ohm ½ watt resistor from terminal No. 1 to No. 7 when used in series circuits. Resistor not required in parallel circuits. No other changes.
1LA4	3D6/1299	G	Parallel circuits only. Same as 1LB4 to 3D6.
	3LE4 3LF4	P P	For electric operation only. Rewire as follows: Remove, connect, and tape up any wires connected to pin No. 7 of 1LA4.
	3LE4 3LF4	G G	Parallel circuits only. Change connections as follows: Remove No. 8 lead and connect to No. 7 Connect No. 1 and No. 8 together.
	3V4	P	Electric operation only. Change socket to miniature and rewire as follows:  ORIG. No. 1 on loctal to No. 1 on miniature 2 to 2 3 to 3 6 to 6 8 to 7  SUB.
	3V4	G	Parallel circuits only. Change socket to miniature and rewire as follows:  ORIG. No. 1 on loctal to Nos. 1 & 7 on miniature 2 to 2 3 to 3 6 to 6 8 to 5  SUB.
1LB4	3LE4 3LF4 3D6/1299	G G P	Parallel circuits only. Change connections as follows: Remove No. 8 lead and connect to No. 7 Connect No. 1 and No. 8 together.
	3V4	P	Same as 1LA4 to 3V4 for electric operation only.
	3V4	G	Same as 1LA4 to 3V4 for parallel circuits only.
1LE3	1L4 1T4 1U4	G G G	Change socket to miniature and rewire as follows:  ORIG. No. 1 on loctal to No. 1 on miniature 2 to 2 & 3 6 to 6 8 to 7  SUB.
	1LC5 1LG5 1LN5	G G G	Rewire as follows: Remove, connect, and tape up any wires anchored on No. 3. Do the same for No. 4. Connect No. 2 and No. 3 together. Connect No. 4 and No. 5 together.

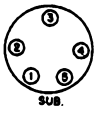
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1LE3	1LH4	G	Cut off pin No. 4 on 1LH4. This substitution operates well as an oscillator.
1LG5	1AF4	G	Parallel circuits only. Same as 1LG5 to 5910.
	1LN5	E	No changes.
	1N5	E	Change socket to octal and rewire as follows:
	1P5	G	No. 1 on loctal to No. 2 on octal 2 to 3 3 to 4 8 to 7 6 to cap  
	1S4	G	Parallel circuits only. Change socket to miniature and rewire as follows:
			No. 1 on loctal to No. 1 on miniature 2 to 2 3 to 4 4 to 1 6 to 3 8 to 7  
	1SA6	G	Change socket to octal and rewire as follows:
			No. 1 on loctal to No. 2 on octal 2 to 8 3 to 6 4 to 3 6 to 4 8 to 7  
	5910	G	Change socket to miniature and rewire as follows:
			No. 1 on loctal to No. 1 on miniature 2 to 2 3 to 3 4 to 5 6 to 6 8 to 7  
1LH4	1LD5	G	Rewire as follows: Remove and tape up any wires anchored on No. 3. Connect No. 2 and No. 3 together.
	1N6	G	Change socket to octal and rewire as follows:
			No. 1 on loctal to No. 2 on octal 2 to 3 & 4 4 to 6 6 to 5 8 to 7  
	1SB6	G	Change socket to octal and rewire as follows:
			No. 1 on loctal to No. 2 on octal 2 to 3 & 4 4 to 5 6 to 8 8 to 7  
	1U5	G	Change socket to miniature and rewire as follows:
			No. 1 on loctal to No. 1 on miniature 2 to 2 & 3 4 to 4 6 to 6 8 to 7  
	3A8	P	Parallel circuits only. Change socket to octal and rewire as follows:
			No. 1 on loctal to No. 1 on octal 4 to 8 6 to 5 8 to 2 & 7 Connect No. 3 and No. 4 to No. 1 Cap connection not used.  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1LH4	3A8	P	Electric operation only. Change socket to octal and rewire as follows: No. 1 on loctal to No. 2 on octal 2 to 6 4 to 8 6 to 5 8 to 7 Connect No. 2 and No. 3 to No.1.
1LN5	1L4	G	Same as 1LG5 to 5910.
	1T4	G	
	1U4	E	
	1LG5	G	No changes.
1N5	1U5	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 2 4 to 3 Grid lead to 6 7 to 7
1P5	1L4	G	Same as 1P5 to 1U4.
	1LC5	G	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 2 4 to 3 7 to 8 cap to 6 Short loctal terminals 4 and 5
	1LG5	G	
	1LN5	E	
	1S5	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 5 4 to 4 7 to 7 cap to 6
	1U4	G	Change socket to miniature or make adaptor as follows: No. 2 on octal to No. 7 on miniature. 3 to 2 4 to 3 7 to 1 cap to 6 This substitution squeals in some cases, works best as r-f tube.
	1U5	G	Same as 1N5 to 1U5.
1Q5	1LA4	G	Parallel circuits only. Same as 1A5 to 3LE4.
	1LB4	G	
	1S4	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 2 4 to 4 5 to 3 7 to 7
	1T5	G	Parallel circuits only. No changes.
	1W4	G	Parallel circuits only. Same as 1A5 to 1W4.
	3LE4	P	Same as 1C5 to 3LE4.
	3LF4	P	Same as 1C5 to 3LE4.
	3V4	P	Same as 1C5 to 3V4.
1S4	1W4	G	Parallel circuits only. Change connections as follows: No. 6 to No. 2 3 to 6 4 to 3 5 to 1

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1S4	3V4	G	Parallel circuits only. Change connections as follows: No. 6 to No. 2 3 to 6 4 to 3 5 to 1 7 to 5 Connect No. 1 and No. 7 together.
1S5	1AF5	G	Parallel Circuits only. Rewire as follows. Remove and tape up any wires connected to No. 5. No. 2 to No. 5
	1H5	E	Where space permits. Change socket to octal or make adaptor wiring as follows: No. 1 on miniature to No. 2 on octal 4 & 5 to 3 3 to 5 7 to 7 6 to cap  
1SA6	1LG5	G	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 8 to 2 6 to 3 3 to 4 4 to 6 7 to 8  
	1L4 1T4 1U4	G G G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 1 4 to 6 6 to 3 7 to 7 8 to 2  
1T4	1S5	G	Change connections as follows: No. 5 to No. 1 2 to 5 3 to 4
	1U5	G	Cut off pin No. 4 on 1U5. Connect terminals No. 1 & No. 5 together.
1T5	3LE4 3LF4	G G	Parallel circuits only. Same as 1C5 to 3LF4.
	1W4	G	Same as 1A5 to 1W4.
	3V4	P	Electric operation only. Same as 1A5 to 3V4.
1U4	1S5	G	Same as 1T4 to 1S5.
	1U5	G	Cut off pin No. 4 on 1U5. Rewire as follows: Connect No. 1 and No. 5 together.
1V	14Y4	G	Series circuits only. Same as 12Z3 to 14Y4.
	37 76	G G	Change socket to five prong and rewire as follows: No. 1 on four prong to No. 1 on five prong 2 to 2 & 3 3 to 4 4 to 5  
1W4	1S4	G	Parallel circuits only. Rewire as follows: No. 3 to No. 4 6 to 3 Do not use pin No. 6 as anchor.
1X2	1Y2	E	Change socket to four prong and rewire as follows: Nos. 1, 4, 6, & 9 on noval to No. 1 on four prong. Nos. 2, 5, & 8 on noval to No. 4 on four prong. Cap on Noval to cap on four prong.  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
1X2	1Z2	E	Change socket to miniature and rewire as follows: Nos. 1,4,6 & 9 on noval to Nos. 1, 3, 4, & 6 on miniature. Nos. 2,5, & 8 on noval to Nos. 2,5, & 7 on miniature. Cap on noval to cap on miniature.  
1X2A	1B3	E	Where space permits. Change socket to octal and rewire as follows: Nos. 1,3,4,6 on miniature to No. 2 on octal 2,5,7 to 7 cap to cap  
1Y2	1B3	E	Change socket to octal and rewire as follows: No. 1 on four prong to No. 2 on octal 4 to 7 cap to cap  
	1B3	G	Parallel circuits only. Reverse 1B3 to 1Y2 procedure. Filament voltage will be 0.25 volts high on 1B3 and will serve to shorten its life. A small piece of resistance wire placed in series with the filament will correct this.
	1X2	E	Change socket to four prong and rewire as follows: No. 1 on four prong to No. 2 on noval 4 to 4 cap to cap  
	1Z2	G	Change socket to miniature and rewire as follows: No. 1 on four prong to No. 1 on miniature 4 to 7 cap to cap Connect No. 1, 3, 4, and 6 together. Connect No. 2, 5, and 7 together. Do not use where inverse peak voltage exceeds 20,000 volts.  
1Z2	1X2	E	Change socket to noval and rewire as follows: Nos. 1,3,4, & 6 on miniature to Nos. 1,4,6, & 9 on noval. Nos. 2,5, & 7 on miniature to Nos. 2, 5, & 8 on noval. Cap on miniature to cap on noval.  
	1Y2	G	Reverse 1Y2 to 1Z2 procedure.
2A3	2A5	G	Parallel circuits only. Change socket to six prong and rewire as follows: No. 1 on four prong to No. 1 on six prong 2 to 2 & 3 3 to 4 4 to 5 & 6  
	47	G	Parallel circuits only. Change socket to five prong and rewire as follows: No. 1 on four prong to No. 1 on five prong 2 to 2 & 4 3 to 3 4 to 5  
3B5	3Q4	G	Same as 1Q5 to 1S4.
	3V4	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 1 on miniature 3 to 2 4 to 3 5 to 6 7 to 7 8 to 5  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
3LE4	3Q4	E	Change socket to miniature and rewire as follows:
	3S4	G	No. 1 on loctal to No. 1 on miniature 2 to 2 3 to 4 6 to 3 7 to 5 8 to 7
	3Q5	G	Change socket to octal and rewire as follows:
	3B5	G	No. 1 on loctal to No. 2 on octal 2 to 3 3 to 4 6 to 5 8 to 7 7 to 8
	3C5	G	
3LF4	3LE4	E	No changes.
	3Q4	E	Same as 3LE4 to 3Q4.
	3S4	G	
	3Q5	E	Same as 3LE4 to 3Q5.
	3B5	E	
	3C5	G	
6A6	6Y7	G	Parallel circuits only. Change socket to octal and rewire as follows:
	6Z7	G	No. 1 on seven prong to No. 2 on octal 2 to 3 3 to 4 5 to 5 6 to 6 7 to 7 4 to 8
6A7	6AN7	G	Parallel circuits only. Change socket to noval and rewire as follows:
			No. 1 on seven prong to No. 4 on noval 2 to 7 3 to 1 4 to 8 grid cap to 2 5 to 9 6 to 3 7 to 5
	6BA7	G	Change socket to noval and rewire as follows:
			No. 1 on seven prong to No. 4 on noval 2 to 9 3 to 1 4 to 6 cap to 7 5 to 2 6 to 3 7 to 5
	7A8	G	Parallel circuits only. Change socket to loctal and rewire as follows:
			No. 1 on seven prong to No. 1 on loctal 2 to 2 3 to 5 4 to 3 5 to 4 6 to 7 7 to 8
6A8	6AN7	G	Parallel circuits only. Change socket to noval and rewire as follows:
			No. 2 on octal to No. 4 on noval 3 to 7 4 to 1 5 to 9 cap to 2 6 to 8 7 to 5 8 to 3

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6A8	6BA7	G	Change socket to noval and rewire as follows: No. 2 on octal to No. 4 on noval 3 to 9 4 to 1 5 to 2 cap to 7 6 to 6 7 to 5 8 to 3  
6AD7	6U8 6X8	E E	Parallel circuits only. Change socket to noval and rewire as follows: No. 1 on octal to No. 9 on noval 2 to 4 3 to 6 4 to 3 5 to 2 6 to 1 7 to 5 8 to 7 & 8 These miniature tubes must be well shielded.  
6AE5	6F5	G	Make adaptor as follows: No. 1 on base to No. 1 on top 2 to 2 3 to 4 5 to cap 7 to 7 8 to 8
	6K5	G	Change connections as follows: No. 5 to cap.
	6L5	G	No changes. Parallel circuits only.
	7A4 XXL	G G	Same as 6W6 to 7A5. Series or parallel circuits.
	37 76	G G	Change socket to five prong and rewire as follows: No. 2 on octal to No. 1 on five prong 3 to 2 5 to 3 7 to 5 8 to 4  
6AF5	7A4 XXL	G G	Same as 6AE5 to 7A4.
	37 76	G G	Same as 6AE5 to 37.
6AG5	6AH6 6AS6 6BH6 6BJ6	G P P P	Parallel circuits only. No changes.
	6BA6 6BD6 6CB6	G G G	No changes.
6AK5	6AS6 6BA6 6BD6 6BJ6 6BH6 6CB6	P G P G G G	Parallel circuits only. Change connections as follows: Connect No. 2 and No. 7 together.
	6BC5 5590 5591 9001 9003	P G E P G	Parallel circuits only. No changes.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6AL5	7A6	G	Parallel circuits only. Where space permits, change socket to loctal and rewire as follows:

No.	1 on miniature	to No.	7 on loctal
	2	to	3
	4	to	8
	5	to	2
	3	to	1
	7	to	6

	12AT7	G	Change socket to noval and rewire as follows:
	12AU7	G	
	12AX7	G	

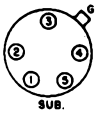
No.	1 on miniature	to No.	8 on noval
	2	to	1
	3	to	4 & 5
	4	to	9
	5	to	3
	7	to	6

	12AV7	G	Parallel circuits only. Same as 6AL5 to 12AT7.
	12AY7	G	
	5726	G	No changes.
6AL6	6BG6	E	Change connections as follows:

No.	8	to No.	3
	4	to	8

	6CD6	E	Parallel circuits only. Same as 6AL6 to 6BG6. Use only where additional current is available in the filament supply.
	807	E	Change socket to five prong and rewire as follows:

No.	2 on octal	to No.	1 on five prong
	4	to	2
	5	to	3
	7	to	5
	8	to	4
	cap	to	cap



6AQ5	6F6	G	Parallel circuits only. Where space permits, change socket to octal and rewire as follows:
	6G6	G	
	6K6	G	
	6U6	G	

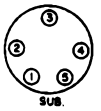
No.	1 on miniature	to No.	5 on octal
	2	to	8
	3	to	2
	4	to	7
	5	to	3
	6	to	4
	7	to	5

6AQ6	12AT6	G	Series circuits only. No changes.
6AR6	6BG6	G	Parallel circuits only. Change connections as follows:

No.	3	to	cap
	1	to No.	3
	8	to	2
	5	to	8
	7	to	5
	6	to	7

	6CD6	G	Parallel circuits only. Same as 6AR6 to 6BG6. Use only where additional current is available from the filament power supply.
	807	G	Parallel circuits only. Change socket to five prong and rewire as follows:

No.	1 on octal	to No.	4 on five prong.



6AU5	6BQ6	G	Change connections as follows:

No.	8	to No.	4
	3	to	8
	5	to	cap
	1	to	5

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6AU6	6CB6	P	Rewire as follows: Reverse connections between No. 2 and No. 7.
	5590	P	Parallel circuits only. No changes.
	5591	P	
	9001	P	
	9003	P	
6AX4	6U4	E	No changes.
	6W4	G	
6BA6	6AG5	G	No changes.
	6BC5	G	
	6CB6	G	
	9003	G	Parallel circuits only. No changes.
6BC5	6AN5	P	Parallel circuits only. No changes.
	6AS6	P	
	6BH6	P	
	6BJ6	P	
	5590	P	
	5591	G	
	5654	G	
	5725	P	
	6AU6	P	No changes.
	6CB6	G	
6BG6	KT66	G	Parallel circuits only. Reverse 6L6 to 6BG6 procedure.
	807	G	Reverse 807 to 6BG6 procedure.
6BH6	12AW6	G	Series circuits only. No changes.
6BL7	6SL7	P	Parallel circuits only. No changes.
	6SN7	G	
	6SU7	P	
	5591	P	
	5592	G	
6BN7	6BQ7	G	Parallel circuits only. Change connections as follows: Reverse connections between Nos. 6 and 8.
	12AT7	P	Parallel circuits only. Change connections as follows:
	12AU7	P	Reverse connections between Nos. 6 and 8.
	12AV7	P	Connect No. 5 to No. 9.
	12AX7	P	Connect Nos. 4 and 5 together.
	12AY7	P	
	12AZ7	G	
	12BH7	G	
6BQ7	6BN7	G	Parallel circuits only. Change connections as follows: Remove, connect, and tape up any wires on No. 9 No. 6 to No. 9 8 to 6
	12AT7	P	Parallel circuits only. Rewire as follows:
	12AU7	P	Move wires connected to No. 5 to No. 9.
	12AV7	P	Connect Nos. 4 and 5 together.
	12AX7	P	
	12AY7	P	
	12AZ7	G	
	12BH7	G	
6C5	6L5	G	Parallel circuits only. No changes.
	6SJ7	E	Change connections as follows: No. 5 to No. 4 8 to 5 3 to 8 & 6 Connect Nos. 3 and 5 together.

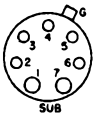
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6CB6	6AG5	G	No changes.
	6BC5	G	
	6AJ5	P	Parallel circuits only. No changes.
	6AK5	G	
	6AN5	P	
	5590	G	
	5591	G	
	5654	G	
	9001	P	
	9003	P	
	6AK6	G	Parallel circuits only. Change connections as follows: Reverse connections between terminals 2 and 7.
	6AU6	G	Change connections as follows: Reverse connections between terminals 2 and 7.
	6BA6	G	
	6BD6	G	
6CD6	KT66	G	Parallel circuits only. Reverse 6L6 to 6BG6 procedure.
	807	P	Parallel circuits only. Reverse 807 to 6BG6 procedure.
6CG6	6AG5	G	No changes.
	6AU6	G	
	6BA6	G	
	6BC5	G	
	6BD6	G	
	6AH6	G	Parallel circuits only. No changes.
	6AJ5	P	
	6AK5	G	
	5590	P	
	5591	G	
	5654	G	
	9001	P	
	9003	P	
6E6	6N7	G	Parallel circuits only. Same as 3LE4 to 3Q5.
	6Z7	G	
	6Y7	G	Same as 3LE4 to 3Q5.
6F6	6AQ5	G	Parallel circuits only. Change socket to miniature and rewire as follows:

No.	5 on octal	to No.	1 on miniature
	8	to	2
	2	to	3
	7	to	4
	3	to	5
	4	to	6
	5	to	7

	5881	G	Parallel circuits only. No changes.
6F7	6F7S	E	No changes.
6F8	7AF7	G	Parallel circuits only. Same as 6F8 to 7N7.
	7N7	G	Change socket to loctal and rewire as follows:

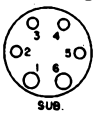
No.	2 on octal	to No.	1 on loctal
	3	to	2
	4	to	2
	5	to	5
	6	to	6
	7	to	8
	8	to	7
	cap	to	4

6J5	6SJ7	E	Same as 6C5 to 6SJ7.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6J6	6SL7	P	Change socket to octal and rewire as follows: No. 1 on miniature to No. 2 on octal 2 to 5 3 to 7 4 to 8 5 to 4 6 to 1 7 to 3 & 6  
	7F8	E	Parallel circuits only. Where space permits. Change socket to loctal and rewire as follows: No. 1 on miniature to No. 3 on loctal 2 to 6 3 to 2 4 to 7 5 to 1 6 to 8 7 to 4 & 5  
	12AT7 12AU7 12AY7	P P P	Parallel circuits only. Same as 6J6 to 12AV7.
	12AV7	G	Change socket to noval and rewire as follows: No. 1 on miniature to No. 1 on noval 2 to 6 3 to 4 & 5 4 to 9 5 to 7 6 to 2 7 to 3 & 8  
6J8	6AN7	G	Parallel circuits only. Same as 6A8 to 6AN7.
6K6	6AQ5	G	Parallel circuits only. Change socket to miniature and rewire as follows: No. 5 on octal to No. 1 on miniature 8 to 2 2 to 3 7 to 4 3 to 5 4 to 6 5 to 7  
	5881	G	Parallel circuits only. No changes.
6K8	6A7	E	Change socket to seven prong and rewire as follows: No. 2 on octal to No. 1 on seven prong 3 to 2 4 to 3 5 to 5 6 to 4 7 to 7 8 to 6 cap to cap  
	6AN7	G	Parallel circuits only. Same as 6A8 to 6AN7.
	6BA7	G	Same as 6A8 to 6BA7.
6L5	6SJ7	G	Parallel circuits only. Same as 6C5 to 6SJ7.
6L6	6BG6	E	Change connections as follows: No. 3 to cap 8 to 3 4 to 8
	6CD6	E	Parallel circuits only. Same as 6L6 to 6BG6. When making this substitution be sure the filament power supply is capable of supplying an additional 1.6-ampere load.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6L6	41	G	Parallel circuits only. Change socket to six prong and rewire as follows:
	42	G	

No. 2 on octal	to No. 1 on six prong
3	to 2
4	to 3
5	to 4
7	to 6
8	to 5



	KT66	E	Parallel circuits only. No changes.
	807	E	Change socket to five prong and rewire as follows:

No. 2 on octal	to No. 1 on five prong
3	to cap
4	to 2
5	to 3
7	to 5
8	to 4

	5881	E	Parallel circuits only. No changes.
6P5	6SJ7	G	Same as 6C5 to 6SJ7.
6P7	6U8	G	Parallel circuits only. Change socket to noval and rewire as follows:
	6X8	G	

No. 2 on octal	to No. 4 on noval
3	to 5
4	to 6
5	to 3
cap	to 2
6	to 1
7	to 9
8	to 7 & 8

6Q7	6AT6	E	Change socket to miniature and rewire as follows:
	6AV6	G	
	6BK6	G	
	6BT6	E	
	6BU6	P	

No. 2 on octal	to No. 3 on miniature
3	to 7
4	to 5
5	to 6
7	to 4
8	to 2
cap	to 1

6R7	6AT6	P	Same as 6Q7 to 6AT6.
	6AV6	P	
	6BK6	P	
	6BT6	P	
	6BU6	E	
6R8	6V8	P	Same as 6T8 to 6V8.
6S4	12AT7	G	Parallel circuits only. Same as 6S4 to 12BH7.
	12AU7	G	
	12AV7	G	
	12AX7	G	
	12AY7	G	
	12BH7	G	Rewire as follows:

Remove wires from No. 5.
Connect No. 4 and No. 5 together.

No. 6	to No. 7
9	to 6

Connect wires removed from No. 5 to No. 9.
Reverse No. 2 and No. 3 connections.
Connect No. 3 and No. 8 together.
Connect No. 1 and No. 9 together.

6S8	6R8	P	Parallel circuits only. Change socket to noval and rewire as follows:
	6T8	G	

No. 1 on octal	to No. 1 on noval
2	to 7
3	to 2
4	to 6
5	to 3
6	to 9
7	to 4
8	to 5
cap	to 8

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6SA7	6BA7	E	Change socket to noval and rewire as follows: No. 1 on octal to No. 6 on noval 2 to 4 3 to 8 4 to 1 5 to 2 6 to 3 7 to 5 8 to 7  
	6BE6	E	Change socket to miniature and rewire as follows: No. 1 on octal to No. 2 on miniature 2 to 3 3 to 5 4 to 6 5 to 1 6 to 2 7 to 4 8 to 7  
	7A8	G	Parallel circuits only. Change socket to loctal and rewire as follows: No. 1 on octal to shield connection on loctal socket 2 to No. 1 3 to 2 4 to 5 5 to 4 6 to 7 7 to 8 8 to 6   The 7A8 heats faster than the other tubes and a 200 ohm 1/2 watt resistor must be connected across the filament terminals 2 and 7 or its life will be very short.
6SB7Y	6BA7	E	Same as 6SA7 to 6BA7.
	6SA7	G	No changes.
	7A8	G	Parallel circuits only. Same as 6SA7 to 7A8.
	7B8	P	Same as 6SA7 to 7A8. Series or parallel circuits.
	7J7	P	
	7S7	P	
	7Q7	E	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 2 4 to 3 5 to 4 6 to 7 & 5 7 to 8 8 to 6  
6SC7	12AT7	P	Change socket to noval and rewire as follows: No. 2 on octal to No. 1 on noval 3 to 2 4 to 7 5 to 6 6 to 8 & 3 7 to 4 & 5 8 to 9  
	12AU7	P	
	12AY7	G	
	12AZ7	P	
	12AX7	E	
	12AV7	P	Parallel circuits only. Same as 6SC7 to 12AT7.
	12BH7	P	
6SG7	6BA6	E	Change socket to miniature and rewire as follows: No. 2 on octal to No. 3 on miniature 3 to 7 4 to 1 6 to 6 7 to 4 8 to 5  
	6AU6	P	
	6BD6	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6SH7	6AU6	G	Same as 6SG7 to 6BA6.
	6BA6	P	
	6BD6	G	
6SJ7	6AG5	G	Change socket to miniature and rewire as follows:
	6BC5	P	

No.	2 on octal	to No.	3 on miniature
	3	to	7
	4	to	1
	5	to	2
	6	to	6
	7	to	4
	8	to	5

	6AJ5	P	Parallel circuits only. Same as 6SJ7 to 6AG5.
	6AK5	P	
	5591	P	
	9001	P	
	9003	G	
6SK7	6AG5	G	Same as 6SJ7 to 6AG5.
	6BC5	G	
	6AJ5	P	Same as 6SJ7 to 6AJ5.
	6AK5	G	
	6AN5	P	
	5591	P	
	9001	G	
	9003	G	
	6BH6	G	Parallel circuits only. Same as 6SK7 to 6CB6.
	6BJ6	G	
	6CB6	G	Change socket to miniature and rewire as follows:

No.	2 on octal	to No.	3 on miniature
	3	to	7
	4	to	1
	5	to	2
	6	to	6
	7	to	4
	8	to	5

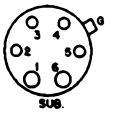
6SL7	7F8	P	Change socket to loctal and rewire as follows:

No.	1 on octal	to No.	1 on loctal
	2	to	3
	3	to	4
	4	to	8
	5	to	6
	6	to	5
	7	to	7
	8	to	2

	12AT7	G	Change socket to noval and rewire as follows:
	12AU7	P	
	12AX7	G	
	12AY7	G	

No.	1 on octal	to No.	2 on noval
	2	to	1
	3	to	3
	4	to	7
	5	to	6
	6	to	8
	7	to	4 & 5
	8	to	9

	12AV7	P	Parallel circuits only. Same as 6SL7 to 12AT7.
	12BH7	P	
6SN7	12AT7	P	Parallel circuits only. Same as 6SL7 to 7F8.
	12AU7	G	
	12AV7	P	
	12AX7	P	
	12AY7	P	
	12BH7	G	Same as 6SL7 to 12AT7.
	12SZ7	G	
6SQ7	6SZ7	E	Parallel circuits only. No changes.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6SR7	7B6	P	Change socket to loctal and rewire as follows:
	7E6	G	No. 2 on octal to No. 3 on loctal 3 to 4 or 7 4 to 5 5 to 6 6 to 2 7 to 1 8 to 8
			 
	7C6	P	Same as 6SR7 to 7B6.
	85	G	Change socket to six prong and rewire as follows:
			No. 2 on octal to cap on six prong 3 to No. 5 4 to 3 5 to 4 6 to 2 7 to 6 8 to 1
			 
6T8	6S8	G	Parallel circuits only. Where space permits, change socket to octal and rewire as follows:
			No. 1 on noval to No. 1 on octal 2 to 3 3 to 5 4 to 7 5 to 8 6 to 4 7 to 2 8 to cap 9 to 6
			 
	6V8	G	Change connections as follows: Remove wires from No. 1.
			No. 9 to No. 1 6 to 9 8 to 6 3 to 8 7 to 3 2 to 7 Connect wires removed from No. 1 to No. 2.
6U4	6AX5	G	No changes.
6U5/6G5	6AB5	G	Parallel circuits only. No changes.
	6N5	G	
	6T5	G	No changes.
6U6	5881	G	Parallel circuits only. No changes.
6U8	6X8	P	No changes. It may be necessary to shield the 6X8 in some cases in order to obtain satisfactory results.
6V6	6BF5	P	Parallel circuits only. Change socket to octal and rewire as follows:
			No. 5 on octal to No. 1 on miniature 8 to 2 2 to 3 7 to 4 3 to 5 4 to 6 5 to 7
			 
	6BG6	G	Parallel circuits only. Same as 6L6 to 6BG6.
	6W6	G	Parallel circuits only. No changes.
6V8	6R8	P	Reverse 6T8 to 6V8 procedure.
	6T8	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
6V8	6S8	G	Parallel circuits only. Change socket to octal and rewire as follows: No. 1 on noval to No. 6 on octal 2 to 1 3 to 2 4 to 7 5 to 8 6 to cap 7 to 3 8 to 4 9 to 5  
6W4	6AX4	E	No changes.
	6AX5	G	Rewire as follows: No. 8 to No. 2 3 to 8 Connect No. 3 and No. 5 together.
	6AX6	E	Parallel circuits only. Rewire as follows: No. 8 to No. 2 3 to 8 Connect No. 3 and No. 5 together. Connect No. 4 and No. 8 gogether.
	6BY5	G	Parallel circuits only. Rewire as follows: No. 8 to No. 2 3 to 1 Connect No. 4 and No. 5 together. Connect No. 1 and No. 8 together
	6W5	G	Parallel circuits only. Same as 6W4 to 6AX5.
	6X5	G	
	6ZY5	G	
	1274	G	
6W6	6AQ5	P	Parallel circuits only. Same as 6K6 to 6AQ5 procedure.
	6BF5	P	Same as 6K6 to 6AQ5 procedure. Series or parallel circuits.
	6F6	P	Parallel circuits only. No changes.
	6G6	G	
	6K6	G	
	6U6	G	
	6V6	G	
	6Y6	G	
	7A5	G	Parallel circuits only. Change socket to loctal and rewire as follows:
	7C5	G	No. 2 on octal to No. 1 on loctal
	7B5	P	3 to 2 4 to 3 5 to 6 7 to 8 8 to 7  
6X8	6U8	P	No changes.
7A4	7A7	G	Same as 7A4 to 7C7.
	7B7	P	Parallel circuits only. Change connections as follows:
	7C7	E	Connect No. 2 and No. 3 together. Connect No. 4 and No. 7 together.
	7E6	G	Same as 7B4 to 7B6.
7A7	6AU6	P	Change socket to miniature and rewire as follows:
	6BA6	E	No. 1 on loctal to No. 3 on miniature
	6BC5	G	2 to 5
	6BD6	P	3 to 6 4 to 2 6 to 1 7 to 7 8 to 4  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
7A7	6BH6	P	Parallel circuits only. Same as 7B7 to 6BH6.
	6BJ6	P	
7A8	6AN7	G	Parallel circuits only. Change socket to noval and rewire as follows:

No.	1 on loctal	to No.	4 on noval
	2	to	7
	3	to	8
	4	to	9
	5	to	1
	6	to	2
	7	to	3
	8	to	5

7AF7	7F8	G	Rewire as follows: Remove wires from No. 4 No. 2 to No. 4 1 to 2 Connect wires removed from No. 4 to No.1. Remove wires from No. 5. No. 7 to No. 5 8 to 7 Connect wires removed from No. 5 to No. 8.
7B4	7B6	E	Rewire as follows: Remove and tape up any wires anchored on terminal No. 3. Do the same for No. 4 and No. 5. No. 6 to No. 3 Connect Nos. 4, 5, and 6 together.
	7C6	E	Parallel circuits only. Same as 7B4 to 7B6.
7B5	6AQ5	G	Parallel circuits only. Change socket to miniature and rewire as follows:

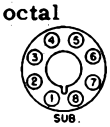
No.	1 on loctal	to No.	3 on miniature
	2	to	5
	3	to	6
	6	to	7
	7	to	2
	8	to	4

7B6	6AT6	G	Same as 7C6 to 6AQ6.
	6AV6	G	
	6BF6	P	
	6BK6	G	
	6BT6	G	
	6BU6	P	
7B7	6AU6	G	Parallel circuits only. Same as 7A7 to 6AU6.
	6BA6	E	
	6BC5	G	
	6BD6	G	
	6BH6	G	Change socket to miniature and rewire as follows:
	6BJ6	G	

No.	1 on loctal	to No.	3 on miniature
	2	to	5
	3	to	6
	4	to	7
	6	to	1
	7	to	2
	8	to	4

	7AH7	G	No changes.
	5590	P	Same as 7A7 to 6AU6.
	5591	P	
	9001	P	
	9003	G	
7B8	6AN7	G	Parallel circuits only. Same as 7A8 to 6AN7.
7C5	6AQ5	G	Same as 7B5 to 6AQ5.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
7C6	6AQ6	G	Change socket to miniature and rewire as follows: No. 1 on loctal to No. 3 on miniature 2 to 7 3 to 1 4 & 7 to 2 5 to 5 6 to 6 8 to 4  
	6AT6	G	Parallel circuits only. Same as 7C6 to 6AQ6.
	6AV6	G	
	6BF6	P	
	6BK6	G	
	6BT6	G	
	6BU6	P	
7C7	6AU6	E	Parallel circuits only. Same as 7A7 to 6AU6.
	6BA6	G	
	6BC5	E	
	6BU6	E	
	6BH6	G	Same as 7B7 to 6BH6.
	6BJ6	G	
	7AB7/1204	P	Rewire as follows: Remove wires from terminal No. 1 No. 3 to No. 1 2 to 3 Connect wires removed from No. 1 to No. 2 Remove wires from No. 8 No. 7 to No. 8 Connect wires removed from No. 8 to No. 7 No. 6 to No. 5 Do not use terminals No. 4 or No. 6.
	7AG7	P	No changes.
	7AH7	G	
7E6	6AT6	P	Same as 7C6 to 6AQ6.
	6AV6	P	
	6BF6	G	
	6BK6	P	
	6BT6	P	
	6BU6	E	
7F8	7F8W	E	No changes.
	12AT7	G	Same as 7F8 to 12AV7.
	12AU7	G	
	12AX7	P	
	12AY7	G	
	12AV7	P	Parallel circuits only. Change socket to noval and rewire as follows:
	12BH7	G	No. 3 on loctal to No. 1 on noval 1 to 2 4 to 3 2 to 4 2 to 5 6 to 6 8 to 7 5 to 8 7 to 9  
7G8	1206	E	No changes.
7J7	6AN7	G	Parallel circuits only. Same as 7A8 to 6AN7.
7N7	12AT7	E	Parallel circuits only. Same as 7N7 to 12BH7.
	12AU7	E	
	12AV7	G	
	12AX7	P	
	12AY7	P	
	12AZ7	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
7N7	6SN7	E	Change socket to octal and rewire as follows: No. 1 on loctal to No. 8 on octal 2 to 3 3 to 2 4 to 1 5 to 4 6 to 5 7 to 6 8 to 7  
	12BH7	E	Change socket to noval and rewire as follows: No. 1 on loctal to Nos. 4 & 5 on noval 2 to 3 3 to 1 4 to 2 5 to 7 6 to 6 7 to 8 8 to 9  
7Q7	7A8	G	Parallel circuits only. Same as 14Q7 to 7A8.
	7B8	G	Same as 14Q7 to 7A8. Series or parallel circuits.
	7J7	G	
7R7	6N8	P	Change socket to noval and rewire as follows: No. 1 on loctal to No. 4 on noval 2 to 6 3 to 7 4 to 8 5 to 1 6 to 2 7 to 3 8 to 5  
7S7	6AN7	G	Parallel circuits only. Same as 7A8 to 6AN7.
7Y4	0Z4	E	Same as 7Y4 to 6AX5. Filament leads need not be connected.
	6AX5	E	Parallel circuits only. Change loctal socket to octal and rewire as follows: No. 1 on loctal to No. 2 on octal 3 to 3 6 to 5 8 to 7 7 to 8  
	6X4	E	Parallel circuits only. Change socket to miniature and rewire as follows: No. 1 on loctal to No. 3 on miniature 3 to 1 6 to 6 7 to 7 8 to 4  
7Z4	0Z4	G	Same as 7Y4 to 6AX5. Filament leads need not be connected. If required output current exceeds 70 ma. this substitution is not recommended.
	6AX5	G	Parallel circuits only. Same as 7Y4 to 6AX5. 6AX5 has lower output current rating. If required current exceeds 70 ma. this substitution is not recommended.
12A6	12A5	P	Parallel circuits only. Change octal socket to seven prong and rewire as follows: No. 2 on octal to No. 1 on seven prong 3 to 2 4 to 3 5 to 4 8 to 5 7 to 7  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
12A8	7A8	P	Series circuits only. Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 2 4 to 5 5 to 4 6 to 3 7 to 8 8 to 7 cap to 6  
12AH7	12AU7 12AX7 12AY7 12AZ7	P E E P	Change socket to noval and rewire as follows: No. 1 on octal to No. 2 on noval 2 to 3 3 to 1 4 to 8 5 to 7 6 to 6 7 to 5 8 to 4 Do not use socket terminal No. 9 as tie point.  
	12BH7	P	Parallel circuits only. Same as 12AH7 to 12AU7.
12AT6	6AQ6	G	Same as 12AW6 to 6BH6.
12AT7	12AZ7	G	Parallel circuits only. No Changes.
	14F8	G	For 12 volt operation only. Change socket to loctal and rewire as follows: No. 1 on noval to No. 3 on loctal 2 to 1 3 to 4 4 to 2 5 to 7 6 to 6 7 to 8 8 to 5  
12AU7	7F8	P	Change socket to loctal and rewire as follows: No. 1 on noval to No. 3 on loctal 2 to 1 3 to 4 4 to 2 5 to 2 6 to 6 7 to 8 8 to 5 9 to 7  
	12AZ7	P	Parallel circuits only. No changes.
	14F8	G	For 12 volt operation only. Same as 12AT7 to 14F8.
12AV7	6SN7	P	Parallel circuits only. Change socket to octal and rewire as follows: No. 1 on noval to No. 2 on octal 2 to 1 3 to 3 4 to 7 5 to 7 6 to 5 7 to 4 8 to 6 9 to 8  
	12AZ7	E	No changes.
	14F8	P	For 12 volt operation in parallel circuits only. Same as 12AT7 to 14F8.
12AW6	6BH6	G	No wiring changes necessary in series circuits. Install a 300 ohm, ½ watt resistor from terminal No. 3 to terminal No. 4 on the socket. In parallel circuits disconnect and tape up filament supply lead connected to terminal No. 3. Install new wire from terminal No. 3 to center tap of 12.6 volt filament winding.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
12AX4	6AX4	E	Parallel circuits only. No changes. Insert a 5 ohm, 20 watt resistor in series with one side of the filament circuit.
	6U4	G	
	6W4	G	
12AX7	12AZ7	P	Paralle circuits only. No changes.
	14F8	P	For 12 volt operation only. Same as 12AT7 to 14F8.
12AY7	12AZ7	P	Parallel circuits only. No changes.
	14F8	G	For 12 volt operation only. Same as 12AT7 to 14F8.
12AZ7	12AT7	G	Parallel circuits only. No changes. Best results can sometimes be obtained by shielding the substitute tube.
	12AU7	P	
	12AX7	P	
	12AY7	P	
	12BH7	G	
	12AV7	E	No changes.
12BA6	12BD6	G	No changes.
12BH7	12AZ7	G	Parallel circuits only. No changes.
	14F8	P	For 12 volt operation in parallel circuits only. Same as 12AT7 to 14F8.
12BN6	6BN6	E	Parallel circuits only. No changes. Insert 40 ohm 10 watt resistor in series with filament circuit.
12K7	12AU6	P	Change socket to miniature and rewire as follows:
	12BD6	E	
	12BA6	E	

No.	2 on octal	to No.	3 on miniature
	3	to	5
	4	to	6
	5	to	2
	7	to	4
	8	to	7
	Grid lead	to	1

12K8	7A8	P	Series circuits only. Same as 12A8 to 7A8.
12Q7	12AT6	P	Change socket to miniature and rewire as follows:
	12AV6	P	
	12BF6	G	
	12BK6	P	
	12BT6	P	
	12BU6	G	

No.	2 on octal	to No.	3 on miniature
	3	to	7
	4	to	5
	5	to	6
	cap	to	1
	7	to	4
	8	to	2

12SA7	12BA7	E	Same as 6SA7 to 6BA7.
	12SY7	E	No changes.
12SC7	12AT7	P	Change socket to noval and rewire as follows:
	12AU7	P	
	12AX7	E	
	12AY7	G	
	12AZ7	P	

No.	2 on octal	to No.	1 on noval
	3	to	2
	4	to	7
	5	to	6
	6	to	8 & 3
	7	to	4
	8	to	5

	12AV7	G	Parallel circuits only. Same as 12SC7 to 12AT7.
	12BH7	G	
12SF5	12SQ7	E	Change connections as follows: Reverse connections between Nos. 2 & 3 Move No. 5 to No. 6 Do not use Nos. 4 & 5 on socket.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
12SG7	14A7/12B7	G	Change socket to loctal and rewire as follows:
	14C7	G	
	14H7	G	

No.	2 on octal	to No.	1 on loctal
	3 & 5	to	7
	4	to	6
	6	to	3
	7	to	8
	8	to	2

12SH7	14A7/12B7	G	Same as 12SG7 to 14A7/12B7.
	14C7	G	
	14H7	G	
12SJ7	12AU6	G	Change socket to miniature and rewire as follows:
	12BA6	P	
	12BD6	G	

No.	2 on octal	to No.	3 on miniature
	3	to	2
	4	to	1
	5	to	7
	6	to	6
	7	to	4
	8	to	5

	12AW6	P	Change socket to miniature and rewire as follows:

No.	2 on octal	to No.	3 on miniature
	3	to	7
	4	to	1
	5	to	2
	6	to	6
	7	to	4
	8	to	5

12SK7	12AW6	P	Same as 12SJ7 to 12AW6.
12SL7	12AT7	G	Change socket to noval and rewire as follows:

No.	1 on octal	to No.	2 on noval
	2	to	1
	3	to	3
	4	to	7
	5	to	6
	6	to	8
	7	to	4
	8	to	5

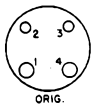
Do not use No. 9 on noval.

	12AV7	P	Parallel circuits only. Same as 12SL7 to 12AT7.
	12BH7	P	
12SN7	12AT7	P	Parallel circuits only. Same as 12SL7 to 12AT7.
	12AU7	G	
	12AV7	P	Any of these types that draw 0.3 ampere at 6.3 volts by paralleling the two
	12AX7	P	halves of the filament can be used to substitute for 12SN7 in series circuits by
	12AY7	P	referring to 6SL7 to 12AT7 and rewiring in the manner shown there.
	12AZ7	G	
	12BH7	G	Same as 12SL7 to 12AT7.
	14AF7/XXD	G	Parallel circuits only. Change socket to loctal and rewire as follows:
	14F7	P	

No.	1 on octal	to No.	4 on loctal
	2	to	3
	3	to	2
	4	to	5
	5	to	6
	6	to	7
	7	to	8
	8	to	1

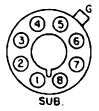
	14N7	E	Same as 12SN7 to 14AF7. Series or parallel circuits.
12SQ7	14X7	G	Change socket to loctal and rewire as follows:

No.	2 on octal	to No.	3 on loctal
	3	to	4
	4	to	5
	5	to	6
	6	to	2
	7	to	8
	8	to	1

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
12SR7	6ST7	P	Series circuits only. No changes.
	6T7	P	Series circuits only. Make adaptor as follows: No. 1 on base to No. 1 on top 2 to cap 3 to 8 4 to 4 5 to 5 6 to 3 7 to 7 8 to 2
	7C6	P	Series circuits only. Change socket to loctal and rewire as follows: No. 2 on octal to No. 3 on loctal 3 to 7 4 to 5 5 to 6 6 to 2 7 to 8 8 to 1  
	14X7	P	Same as 12SQ7 to 14X7.
12SW7	6ST7	P	Series circuits only. Co changes.
	6T7	P	Same as 12SR7 to 6T7. Series circuits only.
	7C6	P	Same as 12SR7 to 7C6. Series circuits only.
	14X7	P	Same as 12SQ7 to 14X7.
12SY7	12BE6	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 3 on miniature 3 to 5 4 to 6 5 to 1 6 to 2 7 to 4 8 to 7  
12Z3	14Y4	G	Change socket to loctal and rewire as follows: No. 1 on four prong to No. 1 on loctal 2 to 3 & 6 3 to 7 4 to 8  
14A7	12AU6	P	Same as 7A7 to 6AU6.
	12BA6	G	
	12BD6	E	
14AF7	12AT7	G	Change socket to noval and rewire as follows:
	12AU7	G	No. 1 on loctal to No. 4 on noval
	12AX7	P	2 to 3
	12AY7	P	3 to 1
	12AZ7	G	4 to 2
			5 to 7
			6 to 6
			7 to 8
			8 to 5
			 
	12AV7	P	Parallel circuits only. Same as 14AF7 to 12AT7.
	12BH7	G	
14B6	12AT6	G	Change socket to miniature and rewire as follows:
	12AV6	G	No. 1 on loctal to No. 3 on miniature
	12BF6	P	2 to 7
	12BK6	G	3 to 1
	12BT6	G	5 to 5
	12BU6	P	6 to 6
			7 to 2
			8 to 4
			 

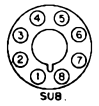
TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
14C7	6S7	P	Series circuits only. Change socket to octal and rewire as follows:

No.	5 on loctal	to No.	1 on octal
1		to	2
2		to	3
3		to	4
4		to	5
8		to	7
7		to	8
6		to	cap



	6SS7	P	Series circuits only. Change socket to octal and rewire as follows:

No.	1 on loctal	to No.	2 on octal
4		to	3
6		to	4
7		to	5
3		to	6
8		to	7
2		to	8

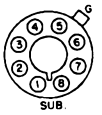
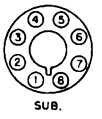


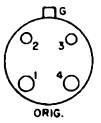
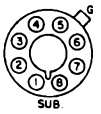
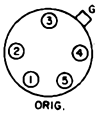
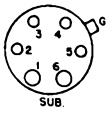
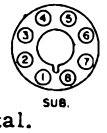
	6W7	P	Same as 14C7 to 6S7. Series circuits only.
	12AU6	E	Same as 14A7 to 12AU6
	12BA6	G	
	12BD6	G	
	12J7	G	Same as 14C7 to 6S7.
	12K7	P	
	12SG7	P	Same as 14C7 to 6SS7.
	12SH7	P	
	12SJ7	G	
	12SK7	P	
14E6	7C6	P	Series circuits only. No changes.
	12AT6	P	Same as 14B6 to 12AT6.
	12AV6	P	
	12BF6	E	
	12BK6	P	
	12BT6	P	
	12BU6	E	
14F7	12AT7	G	Same as 14AF7 to 12AT7.
	12AU7	G	
	12AX7	P	
	12AY7	P	
	12AZ7	G	
	12AV7	P	Parallel circuits only. Same as 14AF7 to 12AT7.
	12BH7	G	
14F8	12AT7	E	Change socket to noval and rewire as follows:
	12AU7	G	
	12AX7	P	
	12AY7	P	
	12AZ7	G	

No.	1 on loctal	to No.	2 on noval
2		to	4
3		to	1
4		to	3
5		to	8
6		to	6
7		to	5
8		to	7

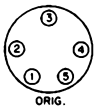
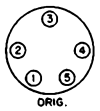
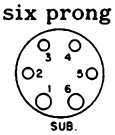
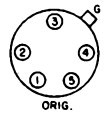
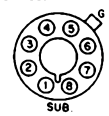
Substitutes classified "P" not recommended for oscillator-mixer service.

	12AV7	G	Parallel circuits only. Same as 14F8 to 12AT7. 12BH7 is not recommended
	12BH7	P	for oscillator-mixer service.
14J7	12A8	P	Reverse 12A8 to 7A8 procedure.
	12K8	G	
14N7	12AT7	P	Parallel circuits only. Same as 14AF7 to 12AT7.
	12AU7	G	
	12AV7	P	
	12AX7	P	
	12AY7	P	
	12AZ7	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
14N7	12BH7	G	Same as 14AF7 to 12AT7. Series or parallel circuits.
14Q7	7A8	G	Series circuits only. Rewire as follows: Remove wires from terminal No. 5 and tape up. No. 5 to No. 3
	12A8	P	Change socket to octal and rewire as follows:
	12K8	G	 ORIG. No. 1 on loctal to No. 2 on octal 2 to 3 3 to 4 4 to 5 5 to 8 6 to cap 7 to 8 8 to 7  SUB.
	12BA7	G	Change socket to noval and rewire as follows:
			 ORIG. No. 1 on loctal to No. 4 on noval 2 to 9 3 to 1 4 to 2 5 to 6 6 to 7 7 to 3 8 to 5  SUB.
	12BE6	G	Change socket to miniature and rewire as follows:
			 ORIG. No. 1 on loctal to No. 3 on miniature 2 to 5 3 to 6 4 to 1 5 to 2 6 to 7 7 to 2 8 to 4  SUB.
	14B8	G	Same as 14Q7 to 7A8.
19C8	19V8	G	Reverse 19V8 to 19C8 procedure.
19T8	19V8	G	Reverse 19V8 to 19C8 procedure.
19V8	19C8	G	Rewire as follows:
	19T8	G	Remove wires from No. 9 No. 1 to No. 9 2 to 1 7 to 2 3 to 7 8 to 3 6 to 8 Connect wires removed from No. 9 to No. 6.
25N6	43	P	Same as 6L6 to 41. Series or parallel circuits.
26Z5W	25X6	G	Parallel circuits only. Change socket to octal and rewire as follows:
	25Z6	G	
	35Z6	P	 ORIG. No. 1 on noval to No. 3 on octal 3 to 4 4 to 2 5 to 7 6 to 5 8 to 8  SUB. This substitution is not practical when the 26Z5W is operated on 13 volt filament supply with the two halves of its filament in parallel.
33	1F5	G	Parallel circuits only. Same as 1F4 to 1J5.
	1G5	G	
	1J5	G	

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
34	1D5	G	Change socket to octal and rewire as follows:
	1E5	G	 No. 1 on four prong to No. 2 on octal; 2 to 3; 3 to 4; 4 to 7; cap to cap 
35/51	57	E	Parallel circuits only. Change socket to six prong and rewire as follows:
	58	E	 No. 1 on five prong to No. 1 on six prong; 2 to 2; 3 to 3; 4 to 4 and 5; 5 to 6; cap to cap 
35L6	14A5	P	Change socket to loctal and rewire as follows:
			 No. 2 on octal to No. 1 on loctal; 5 to 2; 4 to 3; 5 to 6; 8 to 7; 7 to 8 
			Add 150 ohms, 10 watt in series with filament circuit.
35Y4	50X6	P	Remove any wires anchored on No. 3, connect and tape up. Do the same for No. 6. Change connections as follows:
			Connect No. 2 to No. 3 and No. 6.
			Connect No. 2 and No. 7 together.
			Connect 40 ohms, 1 watt resistor from No. 1 to No. 4.
	50Y6	P	Same as 35Y4 to 50Y7. Also insert 40 ohm, 1 watt resistor between No. 2 and No. 6.
	50Y7	P	Change socket to octal and rewire as follows:
	50Z7	P	 No. 1 on loctal to No. 2 on octal; 2 to 3 & 5; 4 to 6; 7 to 4 & 8; 8 to 7 
35Z3	50X6	P	Rewire as follows:
			Remove, connect and tape up any wires anchored on No. 3.
			Do the same for No. 6.
			Connect No. 2 to No. 3.
			Connect No. 3 and No. 6 together.
			Connect No. 2 and No. 7 together.
	50Y6	P	Change socket to octal and rewire as follows:
			 No. 1 on loctal to No. 2 on octal; 2 to 3 & 5; 7 to 4 & 8; 8 to 7 
	50Y7	P	Same as 35Z3 to 50Y6. Except do not use terminal No. 6 on octal.
	50Z7	P	
35Z4	50Y6	P	Rewire as follows:
			Remove and tape up wires on No. 3. Do the same for No. 4.
			Connect No. 3 and No. 5 together.
			Connect No. 4 and No. 8 together.
	50Y7	P	Rewire as follows:
	50Z7	P	Remove and tape up wires on No. 3. Do the same for Nos. 4 & 6.
			Connect No. 3 and No. 5 together.
			Connect No. 4 and No. 8 together.
			Do not use terminal No. 6.
35Z5	35Z3	E	Change socket to loctal and rewire as follows:
			 No. 2 on octal to No. 1 on loctal; 3 to 3; 5 to 2; 7 to 8; 8 to 7 
			Connect 40 ohm, 1 watt resistor from No. 1 to No. 3.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
35Z5	50Y6	P	Same as 35Z5 to 50Y7. Also connect a 40 ohm, 1 watt resistor from No. 2 to No. 6.
	50Y7	P	Rewire as follows:
	50Z7	P	Remove and tape up wires on No. 4. Do the same for No. 6 Connect No. 3 to No. 6. Connect No. 3 and No. 5 together. Connect No. 4 and No. 8 together.
40Z5			Refer to type 45Z5 for substitute.
45	2A5	G	Parallel circuits only. Same as 2A3 to 2A5.
	47	G	Parallel circuits only. Same as 2A3 to 47.
45Z5	35Y4	G	Change socket to miniature and rewire as follows: No. 2 on octal to No. 3 on miniature. 3 to 6 5 to 5 7 to 4 8 to 7   Do not connect to unused terminals.
	50Y6	G	Same as 35Z5 to 50Y6.
	50Y7	G	Same as 35Z5 to 50Z7.
	50Z7	G	
50A5	12A6	P	Change socket to octal and rewire as follows: No. 1 on loctal to No. 2 on octal 2 to 3 3 to 4 6 to 5 7 to 8 8 to 7   Place a 250 ohm, 10 watt resistor in series with filament.
	14A5	G	Put a 250 ohm, 10 watt resistor in series with filament.
50B5	35C5	E	Rewire as follows: Interchange No. 1 and No. 2 connections. Interchange No. 5 and No. 7 connections. Place 100 ohm, 10 watt resistor in series with filament.
50C5	35B5	E	Same as complete 50B5 to 35C5 procedure. Except that for 50B5 no filament resistor is required.
	35C5	E	
	50B5	E	
50C6	35A5	E	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 2 4 to 3 5 to 6 8 to 7 7 to 8   Place 100 ohm, 10 watt resistor in series with filament.
	35B5	E	Change socket to miniature and rewire as follows: No. 2 on octal to No. 3 on miniature 3 to 5 4 to 6 5 to 1 7 to 4 8 to 2   Do not use No. 7 on miniature. Place 100 ohm, 10 watt resistor in series with filament.
	35C5	E	Change socket to miniature and rewire as follows: No. 2 on octal to No. 3 on miniature 3 to 7 4 to 6 5 to 2 7 to 4 8 to 1   Do not use terminal No. 5 on miniature. Place 100 ohm, 10 watt resistor in series with filament.

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
50C6	50B5	E	Same as 50C6 to 35B5.
50L6	14A5	G	Same as 35L6 to 14A5 except place a 250 ohm, 10 watt resistor in series with filament.
	50A5	E	Same as 35L6 to 14A5. Except do not add filament resistor.
	50C6	E	No changes.
50Y6	50X6	E	Change socket to loctal and rewire as follows: No. 2 on octal to No. 1 on loctal 3 to 3 4 to 2 5 to 6 7 to 8 8 to 7  
57	35/51	G	Parallel circuits only. Same as 34 to 1D5.
	24A	G	
58	24A	E	Same as 57 to 35/51
	35/51	G	
KT66	6AL6	G	Parallel circuits only. Same as 6L6 to 6AL6.
	6BG6	G	Parallel circuits only. Same as 6L6 to 6BG6.
	6CD6	G	
	6L6	G	Parallel circuits only. No changes.
71A	12A	P	No changes.
	182B/482B	G	Parallel circuits only. No changes. If push-pull circuit, change both tubes.
	183/483	G	
84/6Z4	0Z4	E	Change socket to octal and rewire as follows: No. 1 on five prong to No. 2 on octal 2 to 3 3 to 5 4 to 8 5 to 7 Filament leads need not be connected.  
	6Y5	G	Parallel circuits only. Change socket to six prong and rewire as follows: No. 1 on five prong to No. 1 on six prong 2 to 3 3 to 5 4 to 4 5 to 6  
	6ZY5	G	Same as 84/6Z4 to 0Z4 procedure. Parallel circuits only.
89	89Y	E	No changes.
117N7	117L7	E	Make adaptor as follows:
	117M7	E	No. 1 on base to No. 8 on top 2 to 2 3 to 3 4 to 4 5 to 5 7 to 7 8 to 6 AC line must connect to No. 7.
807	6AL6	G	Reverse 6AL6 to 807 procedure.
	6AR6	G	Parallel circuits only. Reverse 6AR6 to 807 procedure.
	6BG6	E	Change socket to octal and rewire as follows: No. 1 on five prong to No. 2 on octal 2 to 8 3 to 5 4 to 3 5 to 7 cap to cap  

TUBE	SUB.	PERF.	CIRCUIT CHANGES NECESSARY
807	6CD6	E	Parallel circuits only. Same as 807 to 6BG6. When making this substitution be sure the filament power supply is capable of an additional 1.6 ampere load.
	6L6	G	Reverse 6L6 to 807 procedure.
1614	6AL6	G	Same as 5881 to 6AL6.
	6AR6	G	Parallel circuits only. Rewire as follows: No. 2 to No. 8 8 to 1 4 to 5 5 to 7 7 to 6
	6BG6	E	Same as 6L6 to 6BG6.
	6CD6	E	Parallel circuits only. Same as 6L6 to 6BG6. Use only where addidional current is available from the filament power supply.
	5881	E	No changes.
5642			Substitution can be accomplished by using 1X2, 1X2A, 1V2, 1Y2, 1Z2, 1B3GT only if space is available for mounting sockets and shield can. Refer to section 1 of book.
	1B3	E	Install octal socket and rewire as follows: Remove wires connected to the pair of filament leads protruding from one end of the 5642 and reconnect to Nos. 2 and 7 respectively on the 1B3 socket. Remove the wires connected to the plate lead protruding from the other end of the 5642 and reconnect to the cap of the 1B3.
	1X2	E	Install noval socket and rewire as follows: Remove wires connected to the pair of filament leads protruding from one end of the 5642 and reconnect to Nos. 1, 4, 6, & 9 and 2, 5,& 8 on the 1X2 socket respectively. Remove the wires connected to the plate lead protruding from the other end of the 5642 and reconnect them to the cap of the 1X2.
	1Y2	E	Install four prong socket and rewire as follows: Remove wires connected to the pair of filament leads protruding from one end of the 5642 and reconnect to Nos. 1 and 4 respectively. Remove wires connected to the plate lead protruding from the other end of the 5642 and reconnect to the cap of the 1Y2.
	1Z2	E	Install miniature socket and rewire as follows: Remove wires connected to the pair of filament leads protruding from one end of the 5642 and reconnect to Nos. 1, 3, 4,& 6 and 2, 5,& 7 respectively on the 1Z2 socket. Remove wires connected to the plate lead protruding from the other end of the 5642 and reconnect to the cap on the 1Z2.
5881	6AD7	P	Parallel circuits only. Remove and tape up any wires anchored on pins Nos. 1 and 6. The 5881 is an industrial type 6L6 with identical characteristics.
	6AL6	P	Parallel circuits only. Rewire as follows: Connect No. 3 to cap.
	6AR6	P	Parallel circuits only. Same as 1614 to 6AR6.
	6F6 6K6 6U6 6V6	P P P P	Parallel circuits only. No changes.
	6L6	E	No changes.
	1614	E	No changes.
XXD			Same as type 14AF7 substitutes.