

ALUMINIZED PICTURE TUBES REPLACEMENT GUIDE



Techni-talk

on AM, FM, TV Servicing

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Requests for information have been received from service technicians who had apparently experienced difficulty in replacing a non-aluminized picture tube with an aluminized picture tube. Other requests have been received from technicians who have wanted to use the Aluminized Picture Tube for replacement but have been hesitant due to differences in the physical or electrical characteristics which are actually unimportant. The only changes required are given in the chart on page 5.

Since aluminized picture tubes offer a number of advantages to the viewer, the service technician should be in a position to recommend them whenever and wherever they can be used. In some cases the data published for Picture Tubes shows physical differences and/or electrical differences between the original tube and the Aluminized Picture Tube and these differences may confuse the technician since he may not be able to determine their importance.

An example of this would occur when the technician considers replacing a 12LP4-A with a 12KP4-A aluminized picture tube. The physical characteristics as well as the anode, G2 and G1 voltages are identical. The focus coil information, however, will probably "throw him for a loss." The 12LP4-A was calibrated with an RETMA (Radio-Electronics-Television Manufacturers Association) Focus Coil No. 109 whereas the 12KP4-A was calibrated with a No. 106. Focus coils are seldom, if ever, sold by these numbers and the focus coil manufacturers themselves do not make reference to the RETMA numbers in their literature. The Focus Current for these two tubes is also different as well as the position of the focus coil on the picture tube neck. The correct position of the focus coil is usually given as the "distance between the yoke reference line and center of focus coil air gap; in inches." This is easy if the yoke reference line and the focus coil air gap can be located. If the technician looks hard enough, he may find that "the yoke reference line is determined by the plane of the upper edge of the reference line gage (RETMA No. 112) when the gage is resting on the glass cone." This may be confusing to even the most experienced technician since few technicians know what a reference line gage looks like. Reference line gage drawings appear on pages 2 and 6.

This type of information plus differences in various ratings may cause the technician to adopt a policy of "type for type" replacement. This policy results in lower profit for the technician plus the loss of brighter pictures for his customers. Since many of the physical and electrical differences in picture tube ratings are relatively unimportant, it is the purpose of this article to point out *only* those differences which require either physical or electrical changes to obtain the *better* picture produced by an aluminized picture tube.

WHAT IS AN ALUMINIZED TUBE?

An aluminized picture tube is one which has a thin layer (about 0.000004 inch thick) of aluminum deposited in back of the phosphor screen. The metal is not actually in contact with the phosphor crystals but rather forms a smooth mirror-like surface an extremely small distance away.

WHAT ARE ITS ADVANTAGES?

There are several advantages which an aluminized picture tube has over one with no metal screen-backing. In the first place, the light radiated backwards from the phosphor screen which would otherwise be lost within the interior of the tube is reflected toward the viewer by the smooth metallic surface. This means that for similar operating conditions almost twice the brightness is obtained from an aluminized as from an ordinary tube. Or, if equal brightness is desired, the aluminized tube can be operated either at reduced anode voltage or reduced beam current. In the latter case, a smaller spot size results and better resolution is provided. In addition, the lower current drain usually means an extended useful life of the tube.

Second, greater contrast is obtained with an aluminized tube. Contrast is a measure of the brightness ratio between the brightest and the darkest portions of the picture. In the ordinary tube light from illuminated areas will be reflected from the inside walls and backlight the areas which should be black. This causes these black areas to appear gray. In the aluminized tube the black areas cannot be backlighted because the aluminized screen acts like a mirror and prevents any light penetration from either direction. Also, the white areas are brighter due to the effect of the aluminum mirror. Thus, with blacker blacks and whiter whites, the aluminized tube offers greatly improved contrast.

Third, aluminizing eliminates undesirable screen charging and hand capacity effect. In normal operation of an ordinary tube the beam of electrons hitting the screen knock loose other electrons which fly off in all directions. Many of these so-called secondary electrons travel to the inside aquadag coating in the tube, thus completing the electrical circuit. Under some conditions not as many secondary electrons are set free as there are primary electrons reaching the screen in the beam. In such cases an excess of electrons gradually accumulates on the screen. This charges the screen negatively which has the same effect as lowering the anode voltage of the screen or of that portion of the screen where the excess of electrons has accumulated. This lowers the brightness of the screen, or a portion of it, and produces an objectionable effect. Since the aluminum coating is connected to the anode any excess of electrons will immediately

be drained away and proper screen brightness will be maintained. Since the electron excess is continually removed, that is, since the screen is not allowed to charge up like a capacitor, it does not attempt to discharge itself to any conductive object brought near it. Thus, distortion of the pattern due to the proximity of a person's hand or body is eliminated. Of greater importance: the prevention of screen charging in rectangular picture tubes prevents X-burn which was illustrated in Tele-Clue No. H-63.

HOW IS THE ALUMINUM APPLIED?

The application of a metallic layer to a phosphor screen is a very interesting process. In the first place, the aluminum cannot be deposited directly onto the phosphor crystals because it would then be a very bumpy mirror indeed. In addition, the phosphor would be irreparably damaged by contact with the hot vapors of aluminum. In order to avoid these obstacles, an extremely thin layer of a plastic film is first laid down on the screen. This both provides a smooth surface for the aluminum mirror and prevents the metal from coming in direct contact with the phosphor crystals. A small slug of aluminum supported on a wire filament is then introduced into the bulb. The opening is stoppered up and the air inside the bulb is pumped out. When a good vacuum has been achieved, electric current is passed through the filament. The aluminum is heated and melted. At the reduced pressure inside the bulb it boils and evaporates, and then it condenses on the relatively cold walls and face of the bulb. Thus a thin layer of aluminum is deposited on top of the plastic film mentioned above. Air is let into the bulb, the filament is removed, and the bulb passes through an oven where the plastic is baked out.

... and that is how a tube is aluminized.

PHYSICAL CHARACTERISTICS

Faceplate Shape

There are three major differences in picture tube faceplates. These are (1) round; (2) rectangular with spherical contour, and (3) rectangular with cylindrical contour. Since each of these types requires a specific type of mask, replacement with a different type faceplate is not recommended.

Over-all Length

Variations in the over-all length of picture tubes considered interchangeable are usually due to differences in the length of the tube neck only. If the replacement is shorter, the only change required *may* be a slight repositioning of the focus coil. If the replacement has a longer neck and this is seldom true, it *may* be necessary to provide physical accommodation for the longer neck. The focus coil may also have to be repositioned slightly toward the picture tube base.

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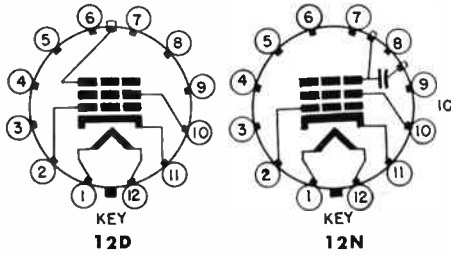
SCHENECTADY 5, N. Y.

R. G. KEMPTON—Editor

ELECTRICAL CHARACTERISTICS

Base Connections

Base connections for picture tubes that are considered interchangeable are generally the same. The only exception is the capacitor which is formed by the graphite coating on the outside



of glass cones. This is discussed below. If the original tube did not have this coating, a ground connection should be added to contact the coating on the new tube. Base diagram 12N shown above has the coating while 12D does not.

External Conductive Coating

Some picture tubes are manufactured with an external conductive coating which supplies part of the capacitance in the HV power supply filter circuit. Other picture tubes are manufactured without this coating. Receivers which use tubes without this coating may use an additional 500 mufd capacitor in the HV circuit.

The area covered by this external conductive coating may vary in either size or position on different tube types. If a replacement is made with a tube type other than that originally used, be sure that contact is made between ground and this coating. If the external coating is left floating, it will charge up to the level of the high voltage resulting in a potential shock hazard.

The metal cone on metal tubes obviously cannot be used as part of a capacitor. If a glass tube is used to replace a metal tube, the outside conductive coating should be grounded.

Anode Contact

There are three types of connectors used to contact the anode on different types of picture tubes. These are (1) the clip type which is used to contact any portion of the metal cone on metal picture tubes; (2) the ball type which snaps over the prong on the side of some older types of picture tubes, and (3) the snap-button type used on most picture tubes. If the replacement has a different type anode contact, replace it with the correct connector.

Deflection Angle

Picture tubes which are considered interchangeable seldom have any great difference in deflection angle. You will notice, however, that the deflection angle on ten- or twelve-inch round glass tubes may be shown as 50, 52, 54 or 56 degrees. These differences are unimportant since they depend primarily on the method and equipment used by the manufacturer when the tube was first developed and registered. ALL PICTURE TUBES WHICH USE THE SAME BULB HAVE THE SAME DEFLECTION ANGLE REGARDLESS OF MANUFACTURER'S DATA.

Anode Voltage

Picture tubes will operate satisfactorily over a wide range of anode voltages. Since receiver

manufacturers seldom design a receiver to operate the picture tube at the maximum voltage level, there is very little chance that any picture tube which is considered interchangeable will not operate satisfactorily due to a difference in the anode voltage rating.

G₂ Voltage

The G₂ voltage is not critical and usually varies between 250 and 400 volts. The G₂ voltage, however, does affect the G₁ cutoff. This is the reason why tubes which indicate a typical operating voltage on G₂ of 250 volts usually show a G₁ cutoff range of 27 to 63 volts, and those tubes with a G₂ voltage of 300 usually have a G₁ cutoff range of 33 to 77 volts. These ratings are identical and can be interchanged since, as the G₂ voltage is increased, more negative voltage is required on G₁ to cut off the electron beam in the picture tube.

Focusing Method

Electrostatic and magnetic focus picture tubes are not considered interchangeable. This does not mean that they cannot be interchanged but merely that the changes involved are considered beyond the scope of this article.

Magnetic Focus

Before going into a detailed explanation of the variations in magnetic focus characteristics, there is one point that should be clarified. If a picture tube is listed as interchangeable the only adjustment which is ordinarily required to obtain optimum focus is a slight change in the focus adjustment. In a few cases it may be necessary to slightly reposition the focus unit by moving it either forward or backward on the tube neck.

Focus Coils

There are two focus coils which have been used as standards to determine the placement and current rating required for different types of picture tubes. These are RETMA focus coils Nos. 106 and 109. The Joint Electron Tube Engineering Council (JETEC) of RETMA has specified the following characteristics for these focus coils:

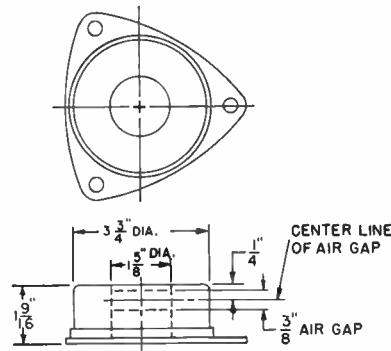


Fig. 1. Drawing of No. 106 Focus Coil.

No. 106—1500 turns No. 29F wire, wound on the form shown in Fig. 1. This has a resistance of 264 ohms.

No. 109—6800 turns No. 29E wire, wound on the form shown in Fig. 2. This has a resistance of 470 ohms.

The first focus coil which was accepted as a standard was the RETMA No. 106. This was used by manufacturers in their test equipment to prepare picture tube data. As newer types of picture tubes were developed it was found that some types required a stronger magnetic field. Therefore the RETMA No. 109 focus coil was developed and also accepted as a standard. Some manufacturers continued to use the older No. 106 focus coil when they prepared and registered new picture tube data whereas others used the newer No. 109 focus coil.

This did not present any problem to the

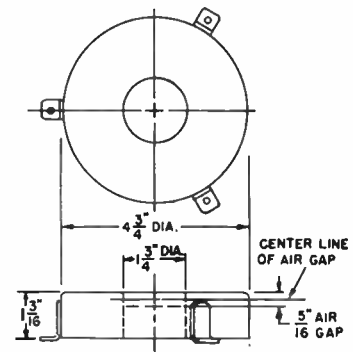


Fig. 2. Drawing of No. 109 Focus Coil

receiver manufacturer's design engineers since they were familiar with the electrical and physical characteristics of both types. It did, however, present a considerable problem to the technician since focus coils are not labeled or sold by these numbers.

If the focus characteristics for the 12LP4-A and the 12KP4-A are compared, it will be noted that the 12LP4-A indicates 96 ma current flow through a No. 109 focus coil and the 12KP4-A indicates 135 ma current flow through a No. 106 focus coil. There is also a difference in the placement of these on the neck of the picture tube. The position indicated for the 12LP4-A is 4 1/2 in. between the center of the focus coil air gap shown in Fig. 2 and the yoke reference line. The 12KP4-A requires 3 1/4 in. between these same two points. Actually there is no difference in the focusing characteristics of the 12LP4-A and the 12KP4-A. PICTURE TUBES HAVING THE SAME SIZE AND SHAPE BULB AND NECK LENGTH AND OPERATED AT THE SAME VOLTAGES REQUIRE THE SAME FOCUSING FIELD STRENGTH REGARDLESS OF MANUFACTURER'S DATA.

Yoke Reference Line

The yoke reference line is determined by the use of standard gages. Drawings of the 50-, 70- and 90-degree gages are shown in Figs. 3, 4, and 5. The yoke reference line is the C-C' line shown in these drawings.

A good general rule to use when adjusting the focus coil is that more current is required as the focus coil is moved toward the base of the tube. Therefore, less current is required to obtain optimum focus as the focus coil is moved toward the face or front of the picture tube. As previously mentioned, it will seldom be necessary to modify the focus coil circuit. If for any reason a modification of this type is required, first determine whether more or less current flow is needed by moving the focus coil and at the same time adjusting the focus control for the clearest line definition. If more current flow is required, the resistance of R1 in Fig. 6 should be increased. If less current flow is required, the resistance of R1 should be decreased. Be sure to use a resistor with a sufficient wattage rating, preferably of the 5- or 10-watt wire-wound type.

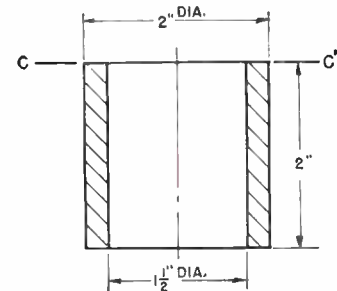


Fig. 3. Drawing of 50° Reference Line Gage

(Continued on page 6)

ALUMINIZED PICTURE TUBE REPLACEMENT CHART

Picture Tube Type No. Aluminized Other ▼ ▼	Physically Interchangeable	Electrically Interchangeable	Instructions
10FP4-A			
103P4	Yes	Yes (See Instructions)	Discard ion-trap magnet. Discard ion-trap magnet. Replace anode connector with snap-button type. Neck of 10FP4-A is one inch longer.
10BP4-A	Yes	Yes (See Instructions)	
10CP4	Yes (See Instructions)	Yes (See Instructions)	
10FP4	Yes	Yes	Discard ion-trap magnet. Connect pin 10 to B+ (250-400 volts d-c).
10MP4	Yes	Yes (See Instructions)	
10MP4-A	Yes	Yes (See Instructions)	
12KP4-A			
12KP4	Yes	Yes	Discard ion-trap magnet. Move focus coil approx. 1 inch closer to yoke. Neck of 12KP4-A is 1 1/8" shorter.
12LP4	Yes (See Instructions)	Yes (See Instructions)	
12LP4-A	Yes (See Instructions)	Yes (See Instructions)	
12QP4	Yes	Yes (See Instructions)	Discard ion-trap magnet. Ground external conductive coating. Replace anode connector with snap-button type.
12QP4-A	Yes	Yes (See Instructions)	
12TP4	Yes (See Instructions)	Yes (See Instructions)	Discard ion-trap magnet. Move focus coil approx. 1 inch closer to yoke. Neck of 12KP4-A is 1 1/8" shorter. Ground external conductive coating.
12UP4	Yes (See Instructions)	Yes (See Instructions)	
12UP4-A	Yes (See Instructions)	Yes (See Instructions)	Neck of 12KP4-A is 7/8" shorter. Ground external conductive coating. Discard ion-trap magnet. Add snap-button type anode connector. Remove block under insulating cone support bracket.
12UP4-B	Yes (See Instructions)	Yes (See Instructions)	
12VP4	Yes	Yes (See Instructions)	Discard ion-trap magnet. Connect pin 10 to B+ (250-400 volts d-c).
12VP4-A	Yes	Yes (See Instructions)	
16KP4-A			
16KP4	Yes	Yes	Ground external conductive coating. Use single-field ion-trap magnet.
16QP4	Yes	Yes (See Instructions)	
16RP4	Yes	Yes (See Instructions)	Make sure external conductive coating is in contact with grounding spring.
16TP4	Yes	Yes	
16UP4	Yes	Yes (See Instructions)	Ground external conductive coating. Ground external conductive coating. Use single-field ion-trap magnet.
16XP4	Yes	Yes (See Instructions)	
17BP4-B			
17AP4	Yes	Yes	Ground external conductive coating.
17BP4	Yes	Yes (See Instructions)	
17BP4-A	Yes	Yes	
17BP4-C	Yes	Yes	
17CP4	Yes	Yes (See Instructions)	
17CP4-A	Yes	Yes (See Instructions)	Ground external conductive coating. Add well-insulated snap-button type anode connector. 17BP4-B is 3/4" longer.
17JP4	Yes	Yes	
17ASP4	Yes	Yes	
21EP4-B			
21EP4	Yes	Yes (See Instructions)	Ground external conductive coating.
21EP4-A	Yes	Yes	
21YP4-A			
21YP4	Yes	Yes	Ground external conductive coating.
21AFP4	Yes	Yes (See Instructions)	
21ZP4-B			
21ZP4	Yes	Yes (See Instructions)	Ground external conductive coating.
21ZP4-A	Yes	Yes	
24CP4-A			
24CP4	Yes	Yes	
24QP4	Yes	Yes	
24TP4	Yes	Yes	
24VP4	Yes	Yes	
27RP4			
27EP4	Yes	Yes (See Instructions)	Ground external conductive coating.
27GP4	Yes	Yes (See Instructions)	
27NP4	Yes	Yes	

BENCH NOTES

Contributions to this column are solicited. For each question, short-cut or chronic-trouble note selected for publication, you will receive \$10.00 worth of electronic tubes. In the event of duplicate or similar items, selection will be made by the editor and his decision will be final. The Company shall have the right without obligation beyond the above to publish and use any suggestion submitted to this column. Send contributions to The Editor, Techni-talk, Tube Department, General Electric Company, Schenectady 5, N. Y.

STRIP TRANSFER MAKES CHANNELS 5 AND 11 ADJACENT

In the twin cities we now have channels 4, 5 and 11. When channel 11 came on the air it was common complaint to hear—"why did they have to move the new station so far away." I find that set owners really appreciate having the 6 and 11 channel strips interchanged since this places 4, 5 and 11 together. This can only be done however, in receivers which use turret-type head-ends.

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EDITOR'S NOTE: This is an excellent suggestion and can be used in any location where two or more stations are received.

NEW USE FOR PM'S

Occasionally one will find it necessary to drill out the rivet mountings on some component part fastened on the chassis. On such occasions, small cuttings may become lodged at some point where it can cause an intermittent ground, or short. The old-time cure for this has been to turn the chassis over after drilling, and jar it several times to shake out the cuttings.

In my shop, the procedure is much simpler. I have removed the bar magnets from a discarded ion-trap. This type had two bar magnets about one inch in length and rectangular in shape. PM speaker magnets can also be used. I merely place one of these magnets on the chassis below the rivet. (Magnetic attraction holds magnet to

chassis.) All ferrous drill cuttings are caught by the magnet which prevents them from causing any trouble.

Jerry Litwak
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HV FOR TUBE SOCKET LEAKAGE

I had an Emerson No. 651 with a continuous roll that couldn't be stopped at any setting of the vert. hold control. I either replaced or tested all components in the vert. osc. and vert. output section—uses a 12BH7—with absolutely no change. I decided it was a high resistance short within the tube socket—pins No. 1 and 7—but rather than replace the socket, I used the HV anode to try to burn it out. I replaced the HV lead, and turned the set on. It settled down immediately and has continued to work fine ever since.

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EDITOR'S NOTE: The sparker shown on p. 6 of the Vol. 5 No. 1 issue of Techni-talk could also be used and without any possibility of affecting HV components in the receiver.

HEAT TREATMENT

I have had different sets come in with "creeping" Vertical Oscillators and drifting Horizontal Oscillators. Often the trouble will fail to appear on the bench because the chassis runs much cooler out of the cabinet. Rather than build a "heat-cabinet" for cooking the sets, the lazy way is to shine a G-E Infrared Heat Lamp on the suspected condenser or resistor, shielding other nearby components with a thin sheet of asbestos or cardboard. Particularly troublesome was the .01 mfd condenser across the Horizontal Sync Coil in Hallierafters Model 21-940, which would only DRIFT after an hour or more of operation. With the Heat Lamp, the trouble was located in a few minutes.

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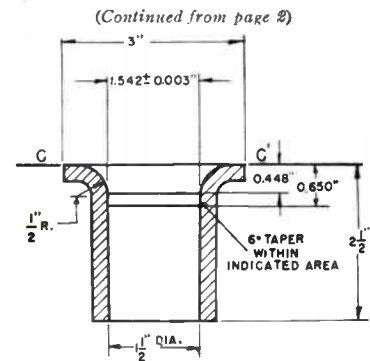


Fig. 4. Drawing of 70° Reference Line Gage

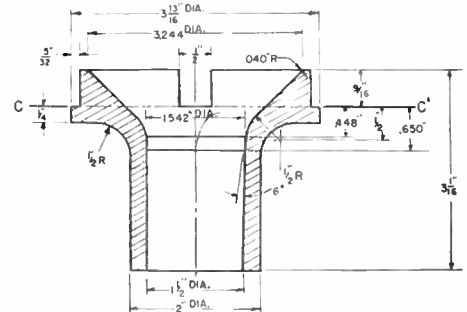


Fig. 5. Drawing of 90° Reference Line Gage

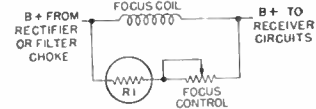


Fig. 6. Typical Focus Coil Circuit

Ion-trap Magnets

Some types of picture tubes do not require an ion-trap magnet. Other types specify either a single- or double-field ion-trap magnet depending on the type of gun used. Picture tube data generally indicates whether a single- or double-field ion-trap magnet is required. However, in practice it has been found that a single-field ion-trap magnet will function satisfactorily on tubes designed for double-field magnets. Because of manufacturing considerations some aluminized picture tubes require an ion-trap magnet whereas others do not.

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