

How To Restore Camera Tubes With The CR70

Camera tubes are guaranteed to go bad, eventually. Whether you replace one of them or a whole set at the same time, it's an expensive venture. For many years, Sencore CRT tester/restorers have been extending the life of television picture tubes by many months and even years, saving consumers hundreds of dollars. Extending the life of camera tubes with the CR70 is also cost-effective. The CR70 allows camera tubes to be restored with the same tried and proven success achieved in CRTs. To understand camera tube restoration, however, we must first review CRTs.

How Do CRTs Work?

Very simply, a CRT consists of four parts, the filaments, the cathode, the control grid, and the screen grid.

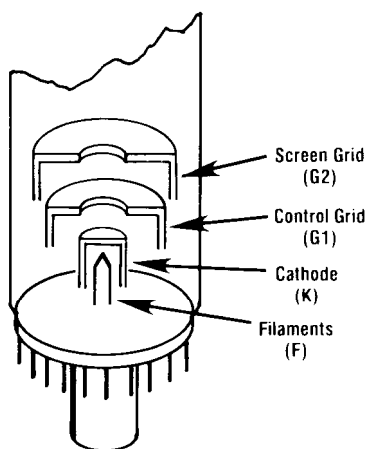


Fig. 1: The heart of a CRT is the electron gun made up of the filaments, cathode, control grid, and screen.

The cathode emits electrons after it is heated by the filaments. These electrons form a cloud which surrounds the cathode

until they are attracted away and formed into a beam by the control grids.

Directly in front of the cathode are several grids, each having a special function. The grid closest to the cathode, G1, has a negative bias applied to it. The amount of negative bias determines the magnitude of the electron beam which passes through G1 towards the screen. Located in front of G1 is another grid, G2. This grid has a positive voltage applied to it. This positive voltage pulls the electrons through G1, forming them into a thread-like stream. One or more grids beyond G2 further accelerate and focus the electron beam as it speeds on towards the screen.

The end result of the electron beam is that it scans the CRT screen forming the raster. The amount of light that the CRT screen gives off depends on how many electrons strike it. Therefore, it is very important that the cathode emits enough electrons. If it doesn't, the screen will not light brightly enough, if at all.

How Does Restoration Work In CRTs?

Restoration of a picture tube consists of reactivating the electron emitting properties of the CRT cathode. A cathode in good condition will emit electrons in large quantities, which form the surrounding cloud. Only a small percentage of these electrons are used to form an electron beam in a picture tube. Because small quantities of gas are produced in the tube, there is a constant bombardment of the cathode by positive ions. The electron cloud around the cathode affords some protection from the positive ion bombardment but enough ions get through to the cathode to start contamination of the oxide coating on the cathode. This reduces the emitting properties of the cathode and consequently reduces the size of the protective cloud around the cathode. Thus, because of this "snowballing" effect,

when a tube starts to become weak, it weakens very rapidly. The restoration process removes the contaminants from the surface of the cathode oxide coating restoring its ability to emit electrons in large quantities.

The CR70 "BEAM BUILDER" employs the safest method of restoring a CRT. The RESTORE functions apply a constant DC voltage between the control grid and cathode. AUTO RESTORE is automatically timed, while MANUAL 1 and MANUAL 2 are controlled by the length of time the REJUV OR RESTORE button is pushed. The current is limited in all three RESTORE modes to prevent G1 from overheating and consequent damage.

The CR70's REJUV function is used on CRTs that don't draw any restoring current at all. These CRT cathodes have such thick oxide coatings that no electrons can escape. The REJUV function produces a sudden surge that effectively cracks this coating, allowing restoration to take place.

How Do Camera Tubes Work?

While the objective of CRTs is to produce bright pictures, camera tubes, on the other hand, transform light into electronic signals. The light reflected from an object is focused onto a target. The target can be considered as having two parts: the signal electrode (the side closest to the incoming light), and the gun side.

The signal electrode is a transparent conductive layer and has a small positive voltage applied to it.

The gun side of the target is made of a photoconductive layer that changes its resistance in proportion to the amount of light that strikes it. Therefore, as the light strikes the target, a pattern of positive charges corresponding to the visual image is produced on the gun side of the target.

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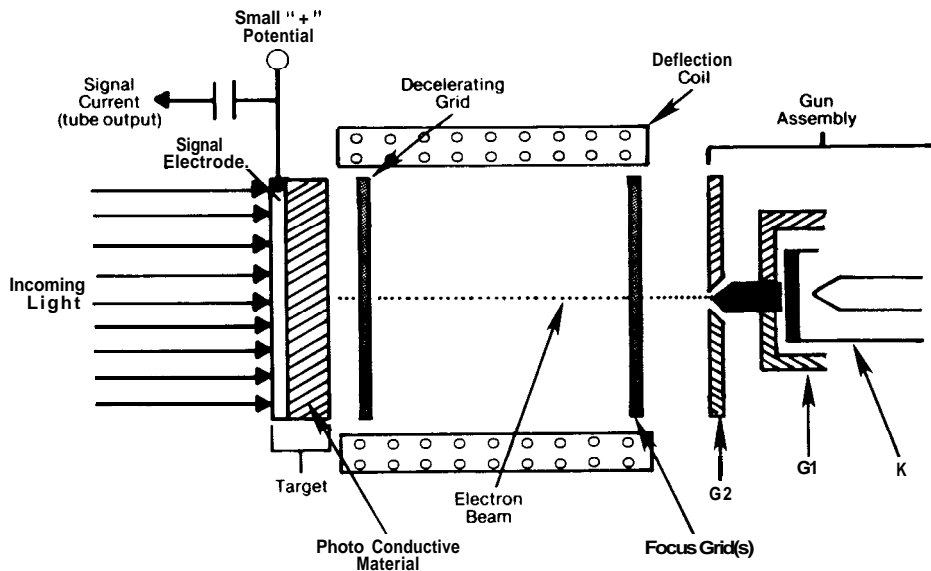


Fig. 2: The basic construction of a camera tube. The gun assemblies of camera tubes and CRTs are nearly identical.

An electron beam scans the gun side of the target and neutralizes the positive portions of the electrical pattern. The amount of current needed to neutralize the positive potentials is called the "signal current." This signal current, after amplification in the tube's photo multiplier, is the output of the tube.

The beam that scans the target is formed into a very fine beam by what might be called a "brute force" action of the G2 grid. It can be called brute force because the 400-500 microamps of beam current which arrives at the gun side of G2 is forced into a beam of only 300 nanoamps by the tiny 1 mil diameter hole in G2. Several grids after G2 tightly focus the beam and help pull it through G2. The electron beam that reaches G2 is produced by a hot cathode (as in a CRT electron gun) and, in fact, camera tube gun assemblies and CRT gun assemblies are the same except for the smaller G2 opening and the "brute force" beam forming used in camera tubes.

The Tubes Are The Same Regardless Of The Name

Camera tubes are known by many names, such as vidicon, Plumbicon*, Leadicon*, and Saticon*, to list a few. Many of these names are trademarks for similar tubes. The differences in these tubes lie in the makeup of the photoconductive target. Examples of these differences are different lag characteristics, better response to low light, and different response to various light wavelengths. The bottom line is that

when it comes to gun failures and restoration, modern electron gun-type camera tubes are the same - they all use a heated cathode to emit an electron beam.

How Do Camera Tubes Fail?

As the cathode in a camera tube ages, it becomes poisoned and cannot produce a strong enough electron beam to quickly neutralize the high positive potentials that correspond to bright picture elements. The result is that these objects "stick" as the camera is panned or as the scene changes. This condition is often called "lag". In applications where lag is not as critical, the result of weak camera tubes is insufficient signal output. In these cases it becomes very difficult to keep all the tube outputs balanced.

Using the CR70, weak camera tubes can be restored. Restoration in a camera tube has the same effect as it does in CRTs - it brings fresh emitting material to the surface of the cathode. With the new emitting material exposed, the electron beam can once again quickly neutralize the target.

Testing Camera Tubes

Camera tubes test differently than CRTs because of the way the electron beam that reaches the target is formed. The cathode (K), control grid (G1), and screen grid (G2) are virtually identical to the similar elements in a CRT except for the opening in G2. The electron beam is formed into an extremely fine beam, focused, and sent to the target.

The CR70 measures the beam current that reaches G2 (not the fine beam passing through the opening in G2). Because of this, you must use the operation of the tube in the camera as the main indication of a weak tube since the tube's cathode emission does not directly correlate to the tube's quality. Once you have decided the tube is weak, however, you can use the CR70 Emission Life Test to monitor your progress during restoring.

The shorts tests are used the same as when testing CRTs. Remove any G1 shorts with the REMOVE G1 SHORTS function before making any other tests or attempting restoration.

Then, perform the CUTOFF, EMISSION, and LIFE tests. Hold the EMISSION LIFE TEST button down until the meter reading stops dropping, and note the meter reading on the FILAMENT or RESTORING CURRENT scales. Then, use these results to note any major improvements in operation during restoration. The emission scale of the CR70 is not linear. Therefore a small increase in the LIFE test indication may mean a large increase in beam current. Double-check the results by firing up the camera if you think the cathode current has been improved enough to return an acceptable picture. When restoring camera tubes and CRTs, you are looking for an improvement in the operation of the tube. Do not expect restored tubes to perform exactly like a brand new tube.

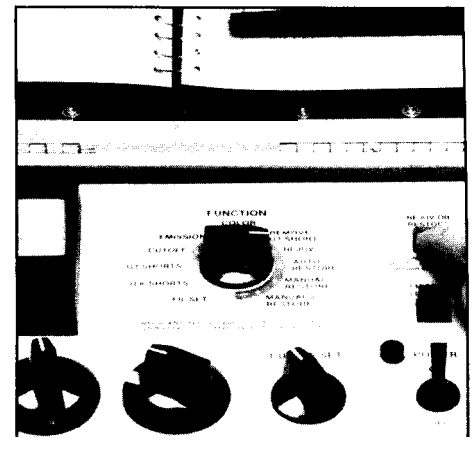


Fig. 3: Always start camera tube restoration with the lowest level (AUTO RESTORE).

Restoring Camera Tubes

Camera tube restoration is identical to CRT restoration. Use the following guidelines for best results:



Fig. 4: The Universal Adapter and the CR70 let you test mounted camera tubes.

1. Be sure you have connected to the tube correctly. If you're using the Universal Adapter to test the tube, remember to set the CR70 switches to match the Universal Adapter (F1-1, F2-2, K-3, G1-4, G2-5).

2. Start with the lowest level of restoration (AUTO RESTORE). Only move up to higher levels of restoration if the tube has not responded to the lower levels.

3. If you don't get a restoring current meter reading using AUTO RESTORE, the cathode is probably very badly poisoned.

Try one shot of REJUV to open an area on the cathode surface, followed by the AUTO RESTORE restoring function.

4. After noting a major improvement in the LIFE TEST results, double-check the operation of the tube in the camera. The CR70 does an excellent job of restoration, but the true test of the tube's quality will have to be based on its operation in the circuit. The chances of stripping a cathode with the CR70 are slim compared to many other restorers, but stripping is possible if too much restoring current is applied too

many times. To reduce the risk of stripping the cathode, don't attempt to further restore the tube if the camera produces an acceptable picture.

5. Remember: Restoration cannot improve a bad target. Problems like burned images, spots, or variations in picture intensity in particular areas of the picture indicate permanent, and non-repairable target damage. Excessive lag ("sticking") may also be caused by a bad target, although restoring a weak cathode often reduces lag.

Restore The Camera Tube Mounted In Place

You don't even have to remove the camera tube from the camera to restore it. The Universal Adapter lets you connect to the tube while it is still mounted, as shown in figure 4. Testing the tube in place saves you the time of repositioning and realignment.

**For More Information,
Call Toll Free i-800.SENCORE
(1 -800-736-2673,**

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3200 Sencore Drive Sioux Falls, South Dakota 5710