



Safety



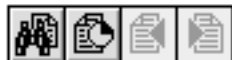
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General Safety Procedures

For your safety and the safety of others, review and follow all electrostatic discharge precautions, cathode-ray tube (CRT) procedures, and battery handling precautions presented in this manual.





ESD Damage Prevention

Follow the guidelines in this section to reduce the risk of electrostatic discharge (ESD) damage to equipment.

ESD Prevention Rules

Leads



Handle all ICs by the body. Do not touch the leads. Also, do not touch the edge connectors, exposed circuitry, or printed circuits on boards or cards. Handle ICs, boards, and cards by the edges, or use extractors.





Grounds

Before working on any device containing a printed circuit, ground yourself and your equipment to an earth or building ground. Use a grounded conductive workbench mat and grounding wriststrap, and ground your equipment to the mat.

⚠ Warning: Make sure you are **not** grounded when

- You work on plugged-in equipment
- You discharge a cathode ray tube (CRT)
- You work on an unplugged CRT that has not yet been discharged
- You are performing live adjustments



Metals

Never place components on any metal surface. Use antistatic, conductive, or foam rubber mats.





Bodies

Don't touch anybody who is working on integrated circuits. If that person is properly grounded, your "zap" may not cause any damage, but just to be on the safe side, do not touch or brush against other technicians.



Bags

Use static-shielding bags during storage, transportation, and handling of boards and chips. When you are ready to leave your bench and take a board to a storage place, put the board in a static-shielding bag. Leave all Apple replacement modules in their ESD-safe packaging until you need them.





Synthetics



Do not wear polyester clothing or bring plastic, vinyl, or styrofoam into the work environment. The electrostatic field around these nonconductors cannot be removed.

Atmosphere



If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas where an ion generator is routinely used.





Setting Up an ESD-Safe Workstation

Follow the guidelines in this section to set up an ESD-safe workstation.

To prevent electrical shock, you will need to make an exception to these guidelines when performing certain tasks on a CRT. When there is a risk of contacting high voltage, such as when you discharge a CRT or work with a powered-on CRT, do **not** wear a grounding wriststrap or heelstrap, and do **not** work on a grounded pad.

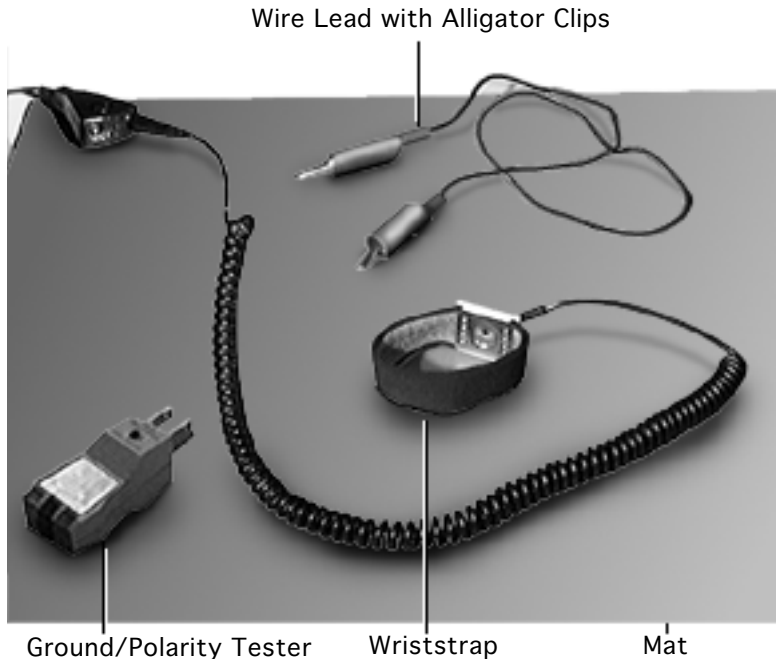




Materials Required

You will need the following materials to set up an ESD-safe workstation:

- Conductive workbench mat
- Wriststrap, with 1 megohm resistor and ground cord
- Wire lead with alligator clips
- Ground/polarity tester





Setup Procedure

Follow these steps to set up an ESD-safe workstation:

- 1 Remove all ESD hazards from the area including the following nonconductive materials:
 - Styrofoam
 - Common plastics
 - Synthetic clothing
 - Vinyl

Since these nonconductive materials cannot be grounded and can retain a charge for hours and even days, the static field surrounding them, when discharged, can easily damage sensitive components.

- 2 Use a ground/polarity meter to verify proper grounding of the power outlet. Though ground/polarity testers vary slightly in design, all are very easy to use. To use a tester, simply insert the three prongs of the tester into



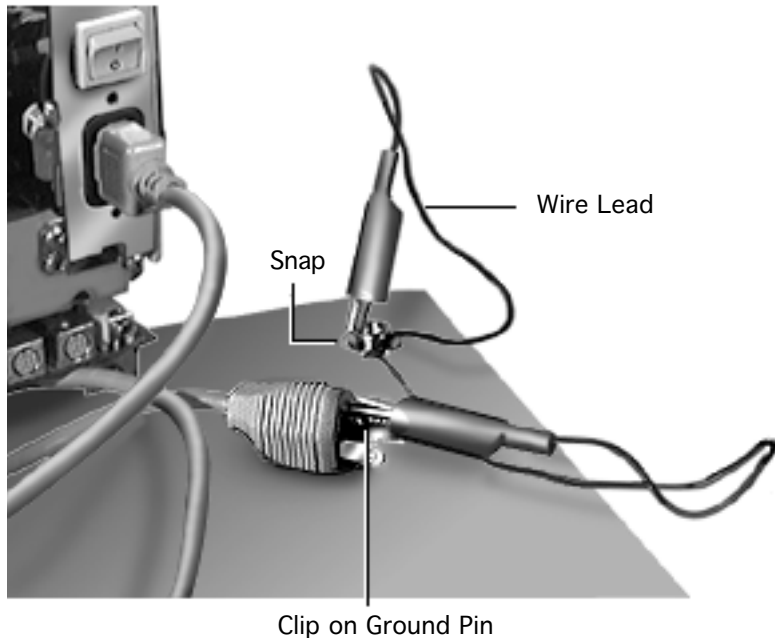


the three-pronged outlet. Most testers will display a light pattern that, when matched to the code on the tester, indicates whether the outlet has proper grounding. Connect the grounding cord of the workbench mat to ground.

- 3 Connect the end of the ground cord that contains the solderless terminal to ground.
- 4 Attach the snap fastener of the grounding cord to the snap on the workbench mat. Then, slip the wriststrap onto your wrist, allowing the metal part of the wriststrap to touch your skin.

All objects in the service area should be grounded to the same potential. Touching the chassis of a machine will bring you to the same potential as the machine. However, since the act of shifting your weight from one foot to the other can generate static charge, momentary “touch grounding” is not enough. You need the continuous





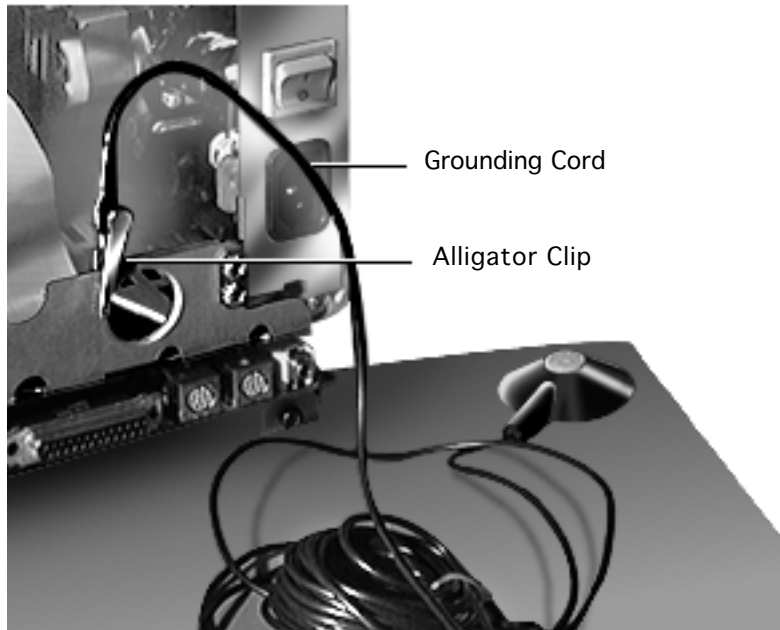
grounding provided by a grounding wriststrap.

- 5 Ground the equipment you are working on.

Note: The product should **not** be plugged into the wall outlet.

If you are working on a product that has a three-pronged power cord, you can attach the ground pin to the conductive workbench mat using a wire lead with alligator clips. Put one clip on the snap of the mat and the other on the ground pin.





Or, if you have a grounding cord with alligator clips, attach the clip to any metal part of the device you are working on.





CRT Safety

A cathode-ray tube (CRT) provides the video display for the Macintosh or Performa compact computers, modular monitors, and Apple II computers. The CRT is a picture tube that operates at very high voltages and contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself) and scatter fragments of glass. When working on or near a CRT, follow all safety rules and take every precaution against breaking the tube, especially at the neck where the tube is thinnest.

The following precautions must be taken to ensure your safety, especially when you are making adjustments on a live CRT.





CRT Safe Electrical Setup Precautions

Electric Outlet



Be sure your outlet is correctly wired and properly grounded. Polarity and ground testers are available from most electronics stores. Test all outlets in your service shop before working on any electrical equipment. If you have any doubts about the wiring in your building, consult a qualified electrician.



Adapter Plug

Never use an adapter plug to connect a monitor's three-pronged power plug to a two-pronged wall outlet. Adapters defeat the ground pin, which is a safety feature.





Buddies

Do **not** work on a CRT alone. If there is an accident, having someone else nearby could save your life. Apple recommends that your staff be trained in cardiopulmonary resuscitation (CPR).



Metal Jewelry

Remove rings, wristwatches, hanging necklaces, and other jewelry before performing repairs on a CRT. Metal jewelry is an excellent conductor of electricity. Removing jewelry will reduce the possibility of electrical shock.





Grounding Devices



Never use a grounding wriststrap or heelstrap or work on a grounded workbench mat when discharging a CRT or when performing live adjustments. Even though the straps and mats contain one-megohm resistors and conduct only small electrical charges, Apple recommends that straps and mats be used only when working on “dead” (uncharged) equipment.



Safety Goggles

Wear safety goggles when working with a CRT. The CRT contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself) and scatter fragments of glass.





Power

Before working inside a monitor or a Macintosh containing a CRT, turn off the power and disconnect the AC power cord. Certain parts of a monitor or Macintosh chassis are hot (electrified) when the unit is under power. Except when you must have the power on (for example, when making live adjustments), never work on a plugged-in monitor or Macintosh with video.



One Hand

Keep one hand in your pocket or behind your back when working on a live monitor or Macintosh with video. Working with only one hand reduces the risk of current passing through your heart, should you accidentally contact high voltage.





Anode

Discharge the anode before working inside the unit. See “Discharging the Cathode Ray Tube (CRT)” in this manual. Some monitors and some Macintosh computers containing CRTs have a bleeder resistor on the anode that drains the charge when the power is turned off. Nevertheless, in case the resistor fails and leaves the anode fully charged, you must perform the discharge procedure.





Anode Aperture

Anode Cap

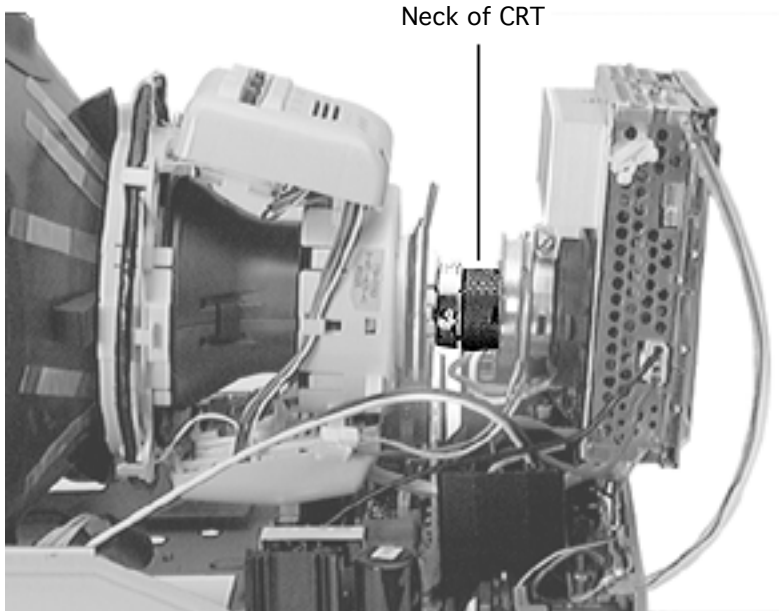


Anode Connector

Anode Connector and Aperture

⚠ Warning: Never touch the anode connector or the anode aperture. Normally, the anode aperture has a connector plugged into it. When a CRT is replaced, the anode connector is removed, exposing the anode aperture. If the bleeder resistor fails, the anode can retain a charge of several thousand volts (even when power is off) and can regain some charge even after it has been discharged.





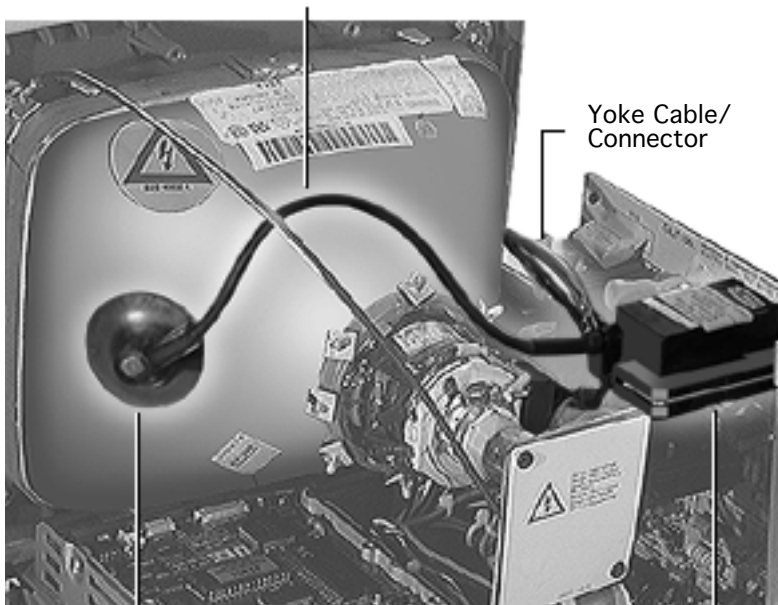
CRT Neck

⚠ Warning: Do not pick up or handle a CRT by its neck, where the tube is the thinnest. To prevent an implosion, take every precaution against breaking the CRT.





High Voltage Cable

Yoke Cable/
Connector

Anode Cap

Flyback Transformer

CRT Live Adjustment Rules

Plastic Adjustment Tool

When performing live adjustments, use a plastic adjustment tool or insulated screwdriver only.

Live Components

When adjusting a live monitor, never touch the components shown here (the actual location of these components will vary by product).





Yoke Cable/Connector



⚠ Warning: Serious injury could result if you touch any of these components with the power on:

- High Voltage Cable
- Anode Cap
- Yoke Cable/Connector
- Flyback Transformer

In general, also avoid touching any soldered connections or exposed uninsulated wires.





Discharging the Cathode Ray Tube (CRT)

In the following steps, you will discharge the high voltage from a cathode-ray tube (CRT). Discharging the tube before working on it lessens the chance of an electric shock.

Most later Macintosh video monitors are equipped with a bleeder resistor that automatically drains the charge from the CRT when the power is shut off. However, if the resistor fails, the anode may retain a charge. Thus, to ensure your safety, perform the following discharge procedure.

Materials Required

- Safety goggles
- Ungrounded foam pad
- Needlenose pliers
- Alligator lead with clips at both ends
- CRT discharge tool





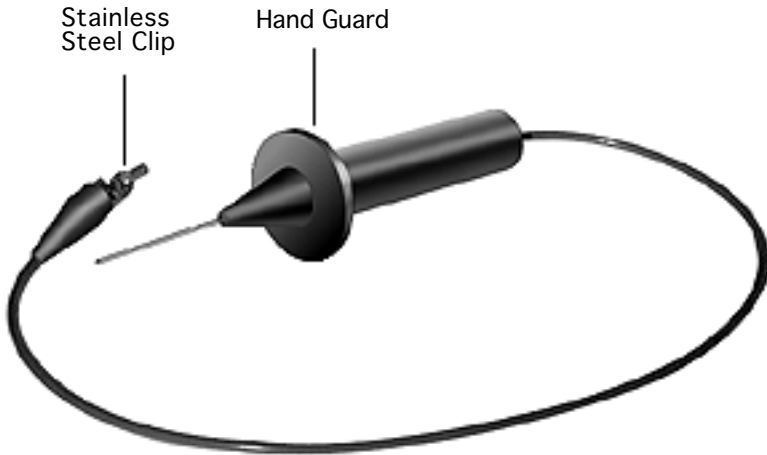
CRT Discharge Tools

There are three types of discharge tools:

- Apple CRT Discharge Tool
- Older Apple CRT Discharge Tool
- Screwdriver and wire lead

Caution: Use the older Apple CRT Discharge Tool or screwdriver with wire lead on a Macintosh or Macintosh Plus. If you use the newer Apple CRT Discharge Tool on a Macintosh or Macintosh Plus, you **must** discharge to the ground lug to avoid destroying the logic board!

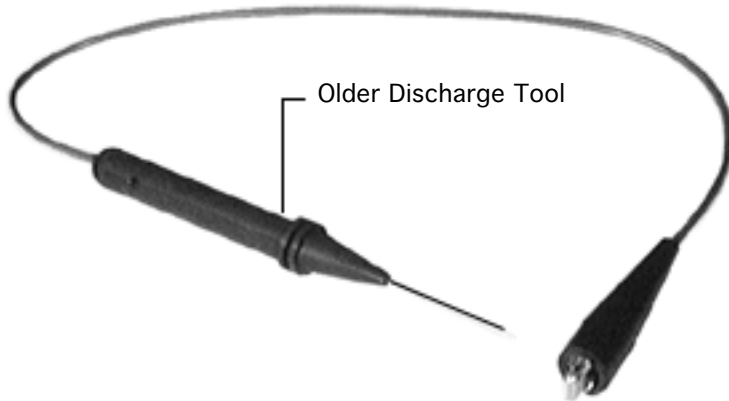




Apple CRT Discharge Tool

Apple recommends the version of the Apple CRT Discharge Tool (Part No. 076-0381) shown here. This version features a stainless steel alligator clip, thicker insulation, and a hand guard. No internal resistor is installed, so the tool gives auditory feedback (the electrostatic “crack”) to assure the technician, when discharging any monitor without a bleeder resistor, that the CRT is indeed discharged.





Older Apple CRT Discharge Tool

The older version of the Apple CRT Discharge Tool (Part No. 076-0243) has a copper alligator clip but no hand guard. It has a built-in 100-megohm resistor, which means you will **not** hear an electrostatic crack when the CRT discharges, even if the monitor has no bleeder resistor. This older tool was designed for the original Macintosh or Macintosh Plus logic board. A resistor was installed to





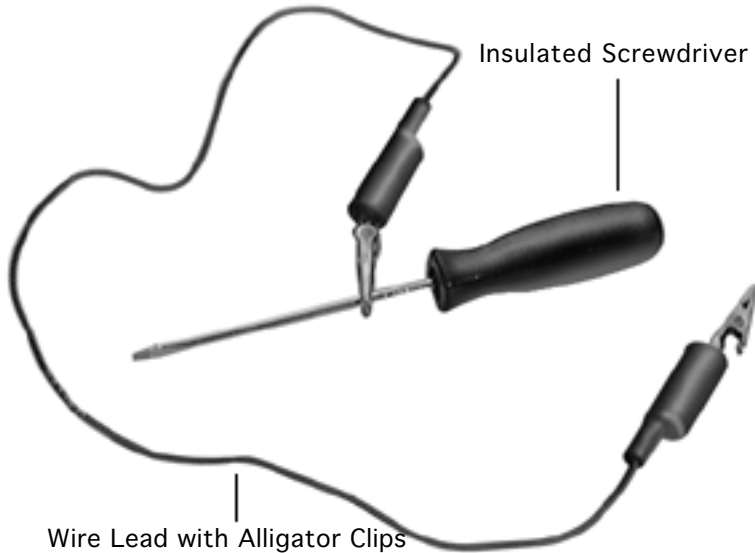
diminish the impact of the electrostatic discharge if a technician accidentally discharged the CRT to the metal chassis instead of to the ground lug. (The Macintosh logic board circuitry is grounded to the chassis.) This older tool is safer for use on the Macintosh or Macintosh Plus CRT.





Screwdriver and Wire Lead

If you do not have a discharge tool, you can use an insulated screwdriver attached to a wire lead with alligator clips on both ends as shown here. You should also use this discharge method as a follow-up after using the older Apple CRT discharge tool to ensure that the CRT is discharged.





CRT Discharge Procedure Overview



Click to see CRT
discharge movie

These are the major steps for discharging a CRT:

- 1 Set up a CRT-safe electrical area.
- 2 Remove the housing.
- 3 Attach the discharge tool to the ground lug on a built-in monitor. Attach the discharge tool to the metal chassis on a stand-alone monitor.
- 4 Touch the discharge tool probe to the anode aperture.

Detailed steps for the CRT discharge procedure follow.





Set Up CRT-Safe Electrical Area

- 1 Read the “CRT Safe Electrical Setup Precautions” section in this manual before you proceed!
- 2 Turn off the power and disconnect the AC power cord.

⚠ Warning: To prevent serious injury, do not touch the yoke assembly, yoke cable/connector, high voltage cable, anode connector, flyback transformer, the inside of the AC power switch, the primary fuse, any soldered connections, or exposed uninsulated wires. If you have questions as to the location of these parts in the monitor or computer on which you are working, refer to the manual for that product.

- 3 Remove any metal jewelry and grounding wriststrap.
- 4 Disconnect the snap fastener on the grounded workbench mat.
- 5 Put on safety goggles.





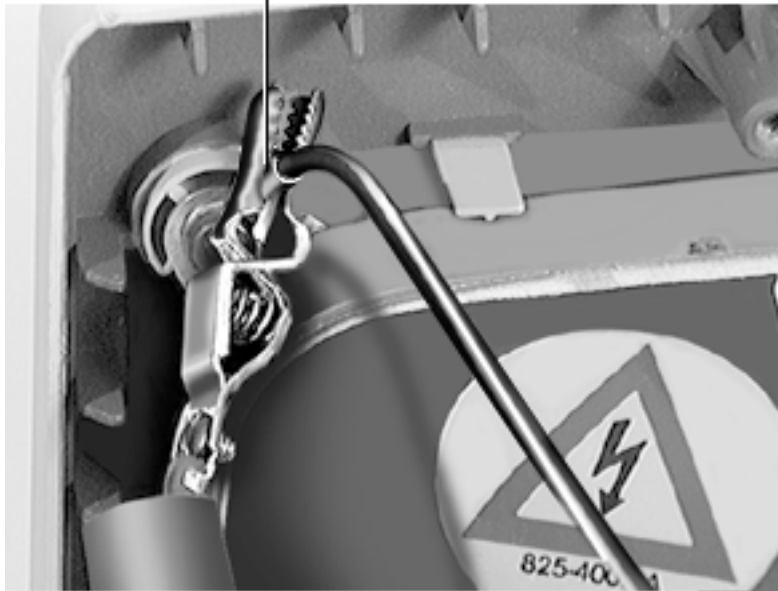
Remove Housing

- 1 Remove the cover and any internal shielding (refer to the Take Apart chapter for the monitor or Macintosh computer on which you are working).
- 2 Set the monitor or Macintosh upright on the ungrounded foam pad, with the back facing you.





Ground Lug



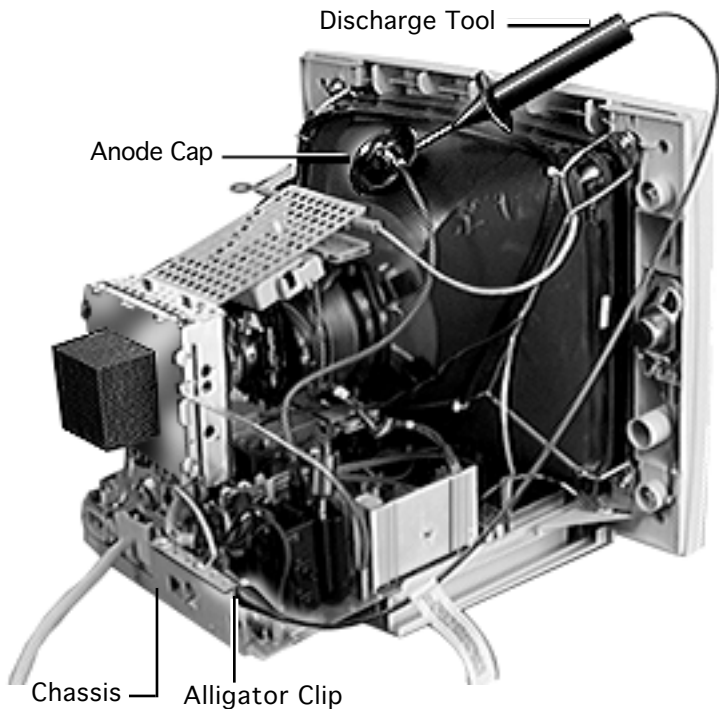
Attach Discharge Tool to Ground

Ground for Computer with Built-in Monitor

Caution: If you are working on a compact Macintosh that contains a CRT and incorrectly discharge the CRT to the metal chassis, you may destroy the logic board. You must discharge to the ground lug!

Attach the clip of the CRT discharge tool to the ground lug of the computer.

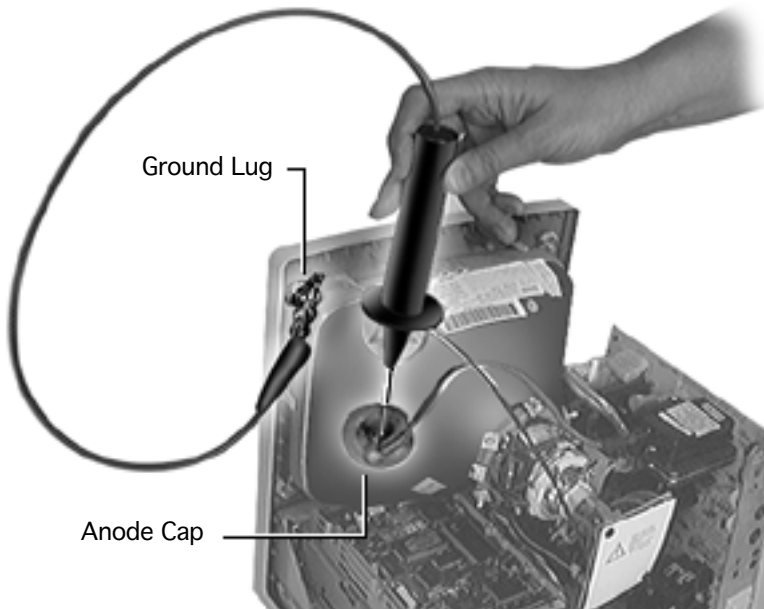




Ground for Stand-Alone Monitor

If you are working on a stand-alone monitor, attach the clip of the CRT discharge tool to the monitor's metal chassis.





Touch Probe to Anode Aperture

- 1 Put one hand behind your back, and grasp the handle of the discharge tool with your other hand.
- 2 Hold the CRT discharge tool to the tube surface, and slide the tool probe under the anode cap until the probe touches the anode aperture.
- 3 Remove the probe of the CRT discharge tool from under the anode cap.





- 4 Detach the discharge tool's alligator clip from the metal chassis or Macintosh ground lug.
- 5 **⚠ Warning:** If you performed this procedure using the older version of the discharge tool (and thus did not hear the electrostatic crack that confirms that the monitor discharged), ensure that the CRT is discharged by repeating the preceding four steps using the insulated flatblade screwdriver and alligator lead. Attach one alligator clip to ground, and the other clip to the blade of the screwdriver.





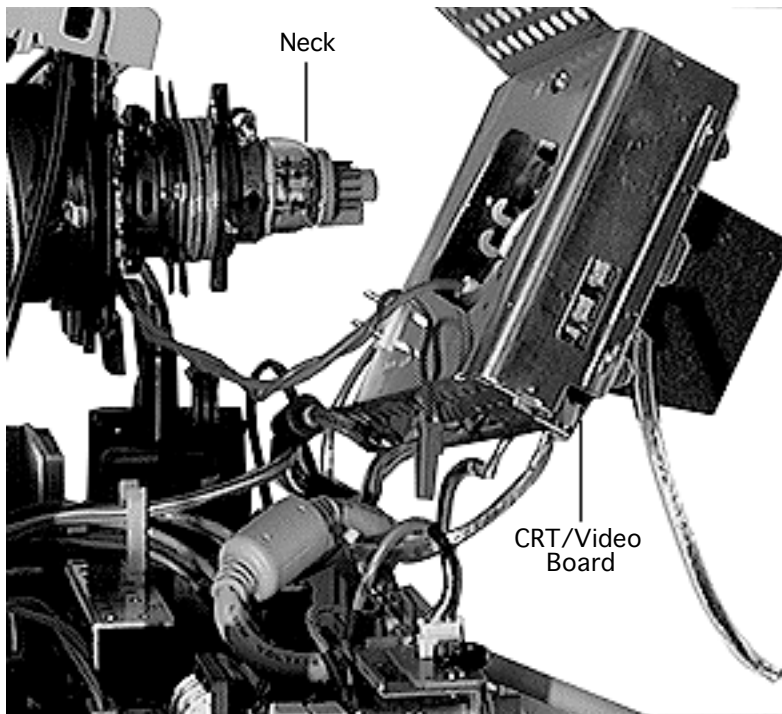
Remove the CRT/Video Board

Perform this procedure only if you are replacing the CRT/video board or removing the CRT.

⚠ Warning: Be sure to discharge the CRT before attempting to remove the CRT/video board.

Caution: Twisting, bending, or applying force to the CRT/video board could damage the neck of the CRT.





Remove the CRT/video board assembly from the neck of the CRT. Refer to the Take Apart chapter of the monitor or computer manual for steps to remove the CRT/video board.





Establish an Ongoing Lead to Ground

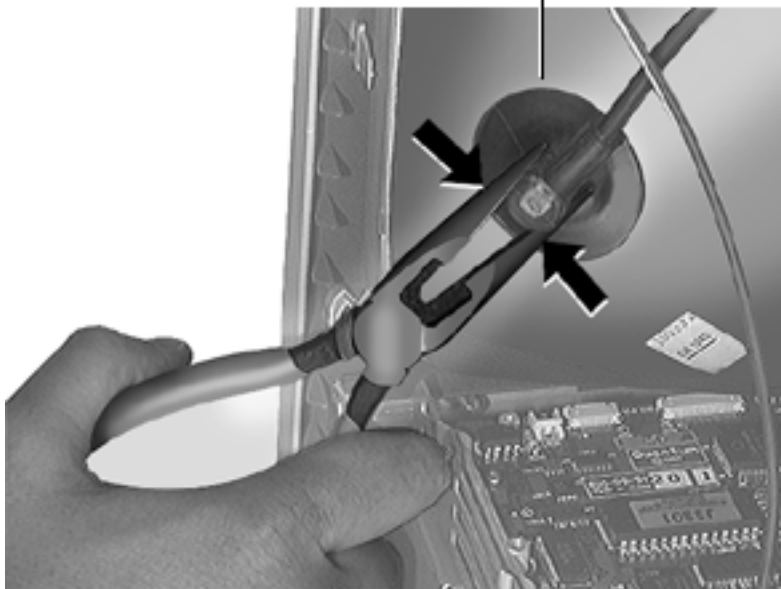
A discharged CRT can build up a charge. If a discharged CRT must remain exposed for any length of time, you must establish an ongoing lead to ground.

⚠ Warning: Be sure to discharge the CRT before attempting to establish an ongoing lead to ground.



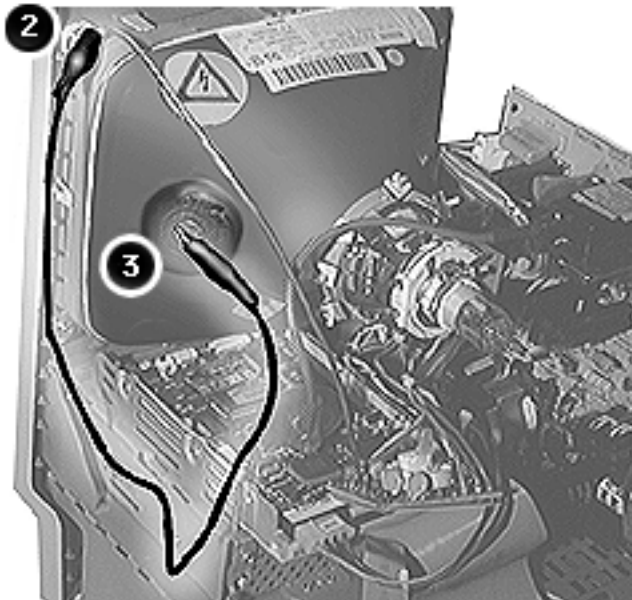


Anode Cap



- 1 Using needlenose pliers, compress the anode cap to free it from the anode aperture.



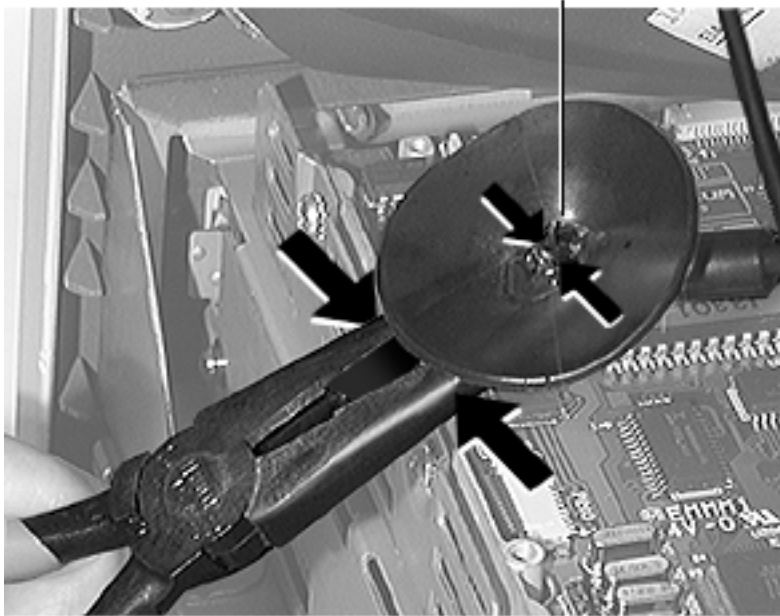


- 2 Connect one end of an alligator lead to ground.
- 3 Connect the other end of the alligator lead to the anode aperture.





Anode Connector



Replacement Note: To replace the anode cap, use needlenose pliers to press together the plastic cup outside of the anode connector so that you can insert it into the anode aperture. After inserting the connector, tug on the high voltage cable to make sure it is firmly seated. Then press down around the edges of the rubber anode cap to ensure a firm seal.





Return Defective Color Cathode Ray Tubes (CRTs)

See Service Information, Service Programs/Repairing—Packing and Shipping for information about returning defective color CRTs.





Properly Dispose of Black and White CRTs

⚠ Warning: You must devacuum a defective black and white CRT before throwing it in a trash receptacle. Discarded black and white CRTs that have not been devacuumed may become cracked and implode, injuring anyone who happens to be near. Instructions for disposing of black and white CRTs follow.

Materials Required

- Thick cardboard box large enough to contain the CRT
- Safety goggles
- Gardening gloves
- Needlenose pliers
- Large sharp diagonal cutters
- Duct tape
- 12-in. x 12-in. piece of cloth or heavy paper





Disposal Procedure

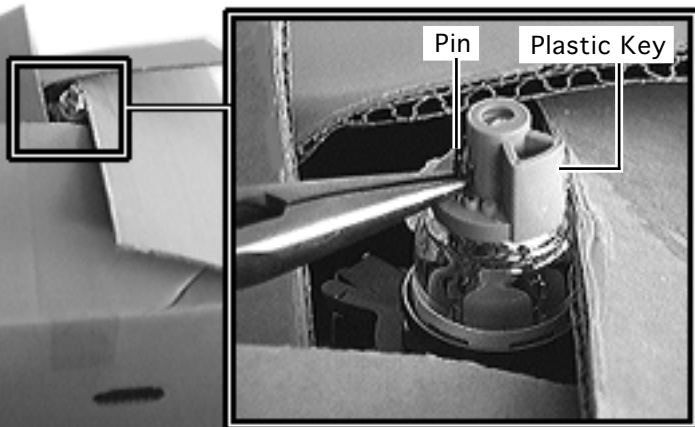
Follow these steps when disposing of a black and white CRT:

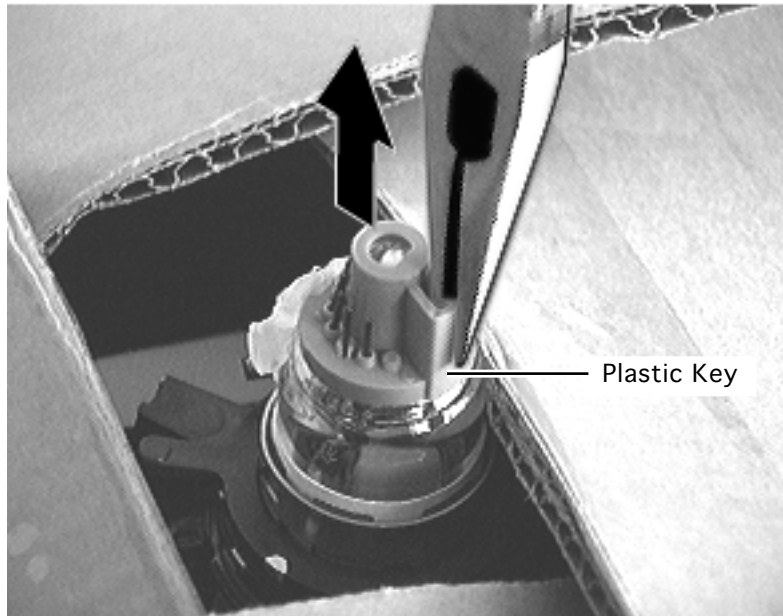
- 1 Put on safety goggles.
- 2 Place the black and white CRT inside a box with the CRT neck pointing up. Fold down the box flaps so just the tip of the CRT neck protrudes through the box opening.
- 3 Put on gloves.





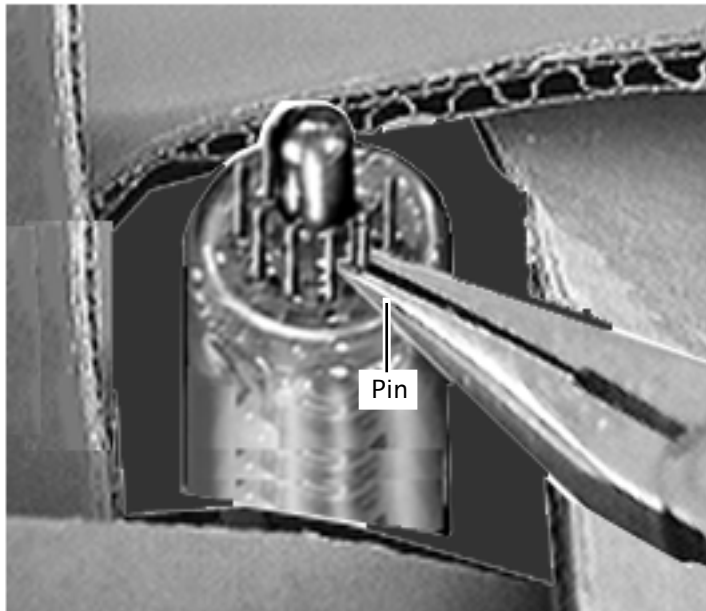
- 4 If the tip of the neck has a plastic key, go to the next step; otherwise, go to step 9.
- 5 Using needlenose pliers, grasp one of the connector pins on the end of the CRT neck.
- 6 Firmly pull the connector pin until you hear a hissing sound (the devacuum noise) emit from the CRT. If no hissing sound is heard, keep pulling pins until you hear the sound.





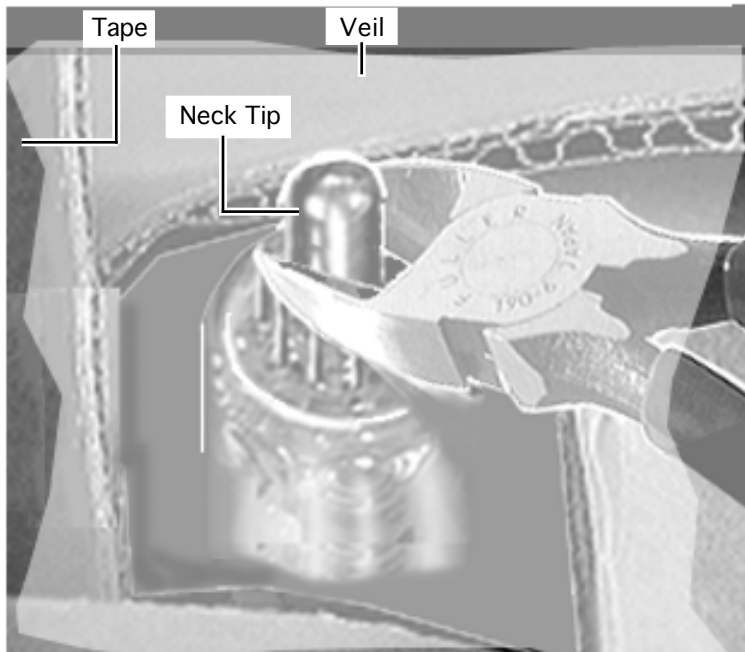
- 7 If pulling connector pins does not work, you can remove the plastic key by grasping it with needlenose pliers and pulling it straight off the CRT neck.
- 8 Tape the box shut.





- 9 For a CRT without a plastic key, use needlenose pliers to grasp one of the connector pins on the end of the CRT neck.
- 10 Firmly pull the connector pin until you hear a hissing sound emit from the CRT. If no hissing sound is heard, keep pulling pins until you hear the sound.
- 11 If pulling connector pins does not work, go to the next step.





- 12 Tape a piece of cloth or paper onto the box so that it forms a veil over the opening while still allowing access to the tip of the CRT.
- 13 Position the diagonal cutters under the veil and at the tip of the CRT.
- 14 **⚠ Warning:** Because of the possibility of flying bits of glass, ensure no one is nearby. Avert your eyes, and clip off the tip of the CRT.
- 15 Tape the box shut.





Battery Handling

Lithium thionyl chloride batteries, the type used for backup batteries in most modular Macintosh models, have some potential for explosion if improperly handled.

⚠ Warning: Lithium batteries should be stored in a designated, well-marked area with limited access.

Apple's lithium batteries are sealed in individual zip-locked wrappers. Upon receipt, inspect the integrity of the wrappers, and store the batteries in the same packaging in which they were received.





Battery Disposal

Lithium backup batteries cannot be reused and, therefore, require disposal when exhausted. In addition to its explosive potential, lithium is water-reactive and must be disposed of as hazardous waste. Apple recommends the following course of action.

After removing an exhausted battery from the board, clip off the lead wires (necessary for soldered batteries) and place the battery into the zip-locked wrapper and packaging used for the replacement battery. Mark the battery DEAD and return it to Apple, where it will be disposed of following EPA guidelines. See *Service Programs/Repairing—Packing and Shipping* for additional shipping instructions.

