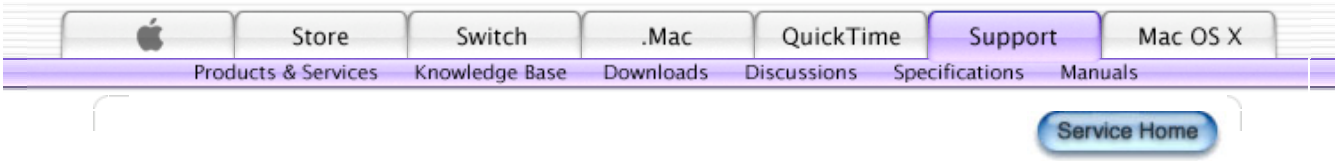

Store
Switch
.Mac
QuickTime
Support
Mac OS X
Products & Services
Knowledge Base
Downloads
Discussions
Specifications
Manuals
Service Home

Safety Information

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

I. ESD Damage Prevention

ESD Prevention Rules
Setting Up an ESD-Safe Workstation

ESD Prevention Rules

Leads

Handle all ICs by the body. Do not touch the leads. Also, do not touch the edge connectors on 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 (such as a metal filing cabinet). Use antistatic, conductive, or foam rubber mats.

Return to Start of Section

Bodies

Do not 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

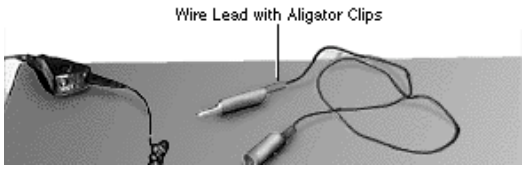
If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas where an ion generator is routinely used.

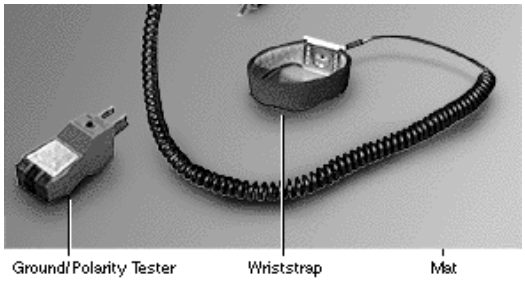
Return to Start of Section

Setting 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

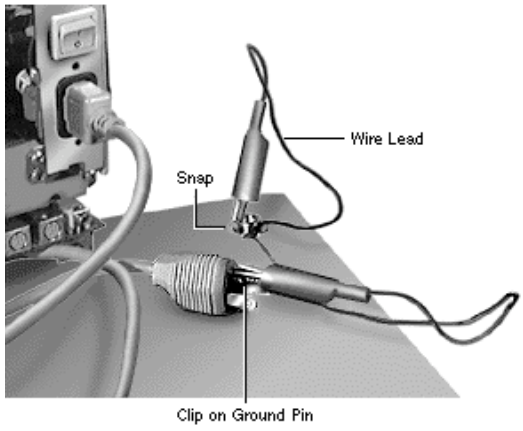
    Since these nonconductive materials cannot be grounded and can retain a charge for hours and even days, the static field surrounding them, when discharged, can easily damage sensitive components.

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.

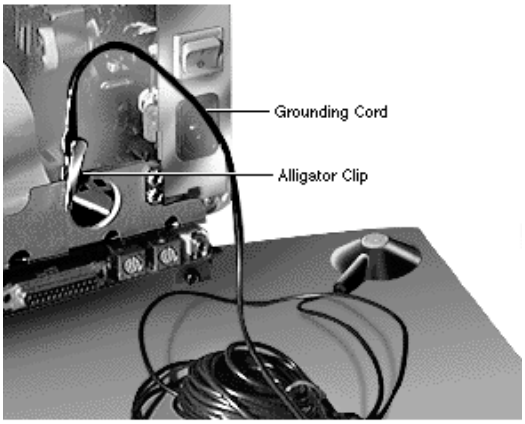
4. Attach the snap fastener of the grounding cord to the snap on the workbench mat. Then, slip the wriststrap onto your wrist, allowing the metal part of the wriststrap to touch your skin.

    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.

Return to Start of Section

Return to Top of Page

II. CRT Safety

Return to Top of Page

CRT Safe Electrical Setup Precautions

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.

General Setup Rules

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 monitors 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.

Return to Start of Section

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

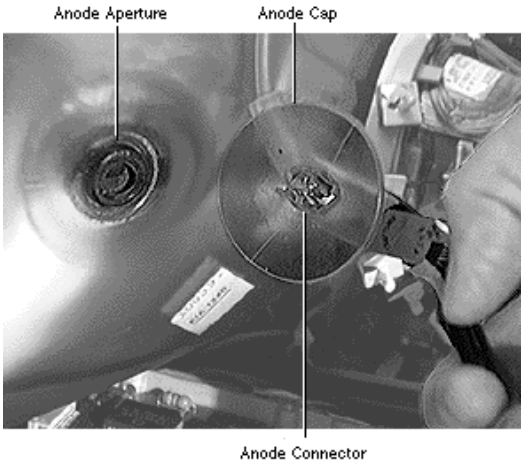
Discharge the anode before working inside the unit. See **Discharging the Cathode Ray Tube (CRT)** in this manual. Some monitors and some Macintosh computers containing CRTs have a bleeder resistor on the anode that drains the charge when the power is turned off. Nevertheless, in case the resistor fails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

Isolation Transformer

When performing live adjustments, use an isolation transformer between the monitor power cord plug and the power outlet. This setup decreases the hazard of electric shock in case you were to accidently touch a hot component or chassis. Isolation transformers are available at some stores that specialize in electronics components. Select one that is rated to handle the products you service.

Return to Start of Section

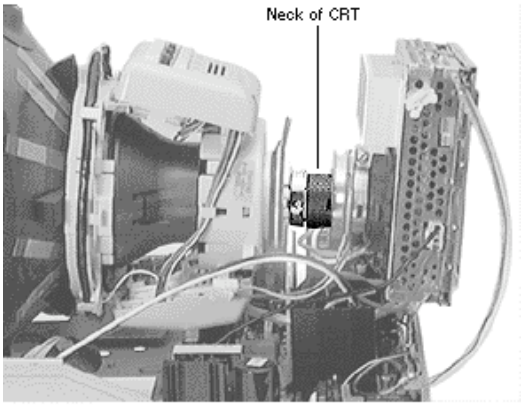
Anode Connector and Aperture



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.

Return to Start of Section

CRT Neck



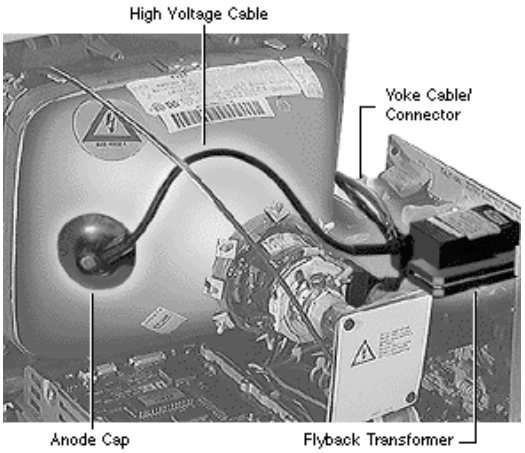
Warning: Do not pick up or handle a CRT by its neck, where the tube is the thinnest. To prevent an implosion, take every precaution against breaking the CRT.

Return to Start of Section

CRT Live Adjustment Rules

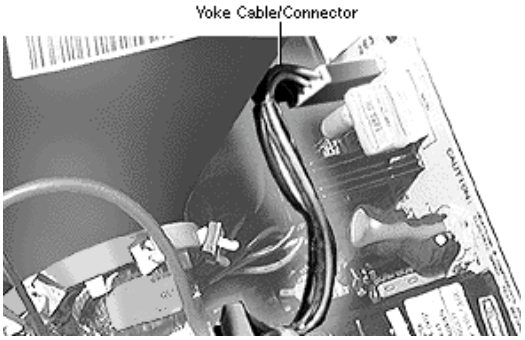
Plastic Adjustment Tool

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).



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.

Return to Start of Section

Discharging the Cathode Ray Tube (CRT)

In the following procedures, 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

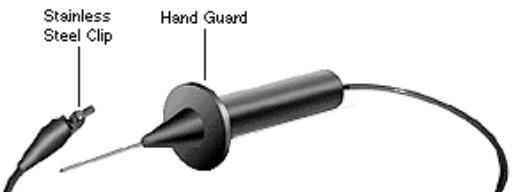
There are three types of discharge tools:

- 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!

Return to Start of Section

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.

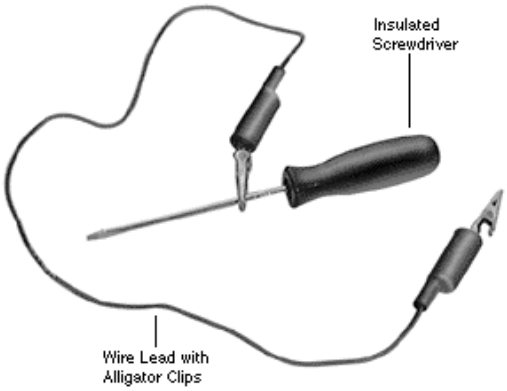
Return to Start of Section

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.

Return to Start of Section

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.

Return to Start of Section

CRT Discharge Procedure Overview

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 CRT Discharge Steps

1. Set Up CRT-Safe Electrical Area

- Read the **CRT Safe Electrical Setup Precautions** section in this manual before you proceed!
- 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.
- Remove any metal jewelry and grounding wriststrap.
- Disconnect the snap fastener on the grounded workbench mat.
- Put on safety goggles.

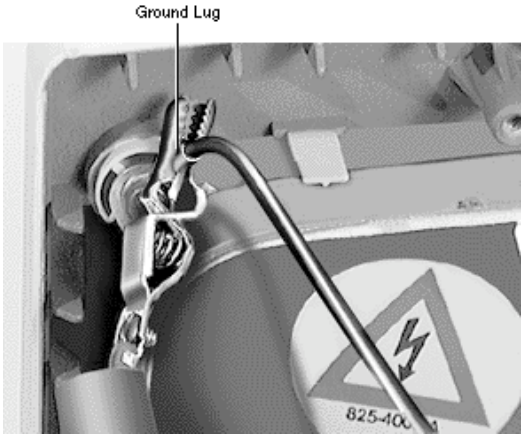
Return to Start of Section

2. Remove Housing

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

3. Attach Discharge Tool to Ground

- Ground for Computer with Built-in Monitor

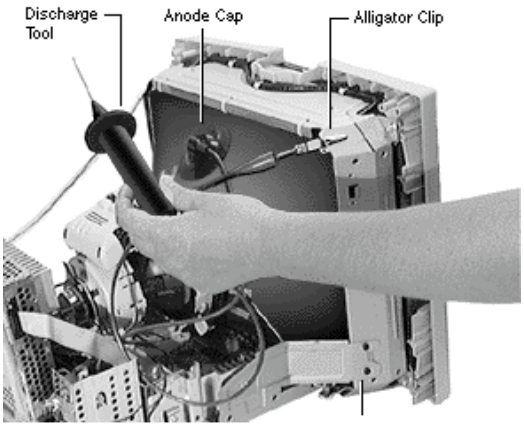


Caution: If you are working on a compact Macintosh that contains a CRT and incorrectly discharge the CRT to the metal chassis, you may destroy the logic board. You must discharge to the ground lug!

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

Return to Start of Section

- 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 chassis.

Return to Start of Section

4. Touch Probe to Anode Aperture

- Put one hand behind your back, and grasp the handle of the discharge tool with your other hand.
- 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.
- Remove the probe of the CRT discharge tool from under the anode cap.
- Detach the discharge tools alligator clip from the metal chassis or Macintosh ground lug.
- **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.

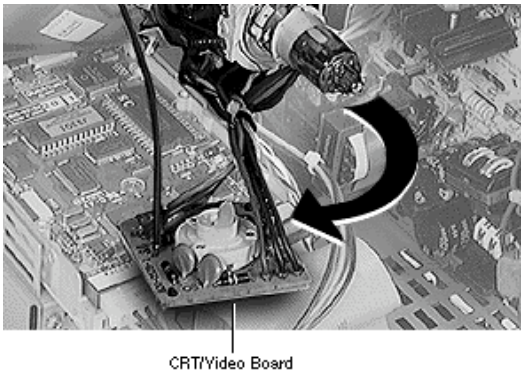
Return to Start of Section

Removing the CRT/Video Board

Do this only if you are replacing the 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.



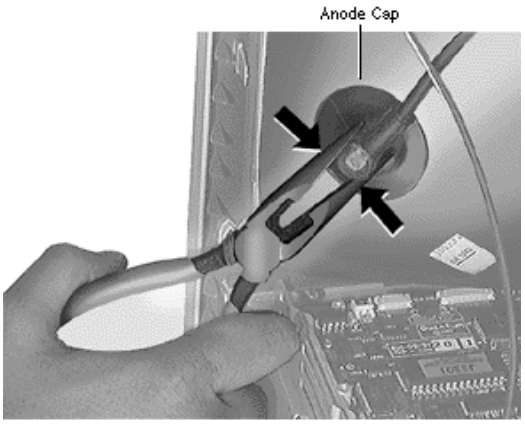
Remove the CRT/video board assembly from the neck of the CRT. Refer to the Take Apart chapter of the monitor or computer for steps to remove the CRT/video board.

Return to Start of Section

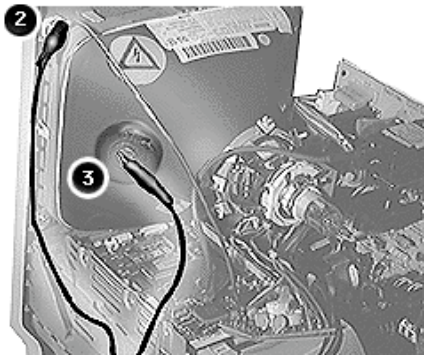
Establishing an Ongoing Lead to Ground

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.

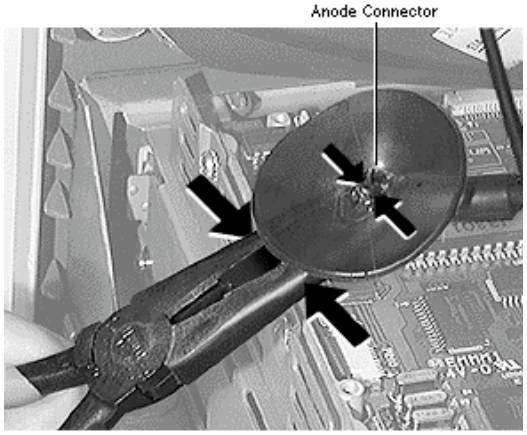
Warning: Be sure to discharge the CRT before attempting to establish an ongoing lead to ground.



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.



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. 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 to Start of Section

Return Worn-Out CRTs

CRTs contain potentially hazardous material, however, intact CRTs are safe to handle. For proper disposal in the U.S. and Canada, return worn-out intact CRTs from serviced Apple products in their original packaging to Apple at the following address:

Apple Computer, Inc.
Global Service Operations Warehouse
10175 Iron Rock Way
Elk Grove, CA 95624
ATTN: CRT Disposal

If you no longer have the original packaging or the CRT is broken, dispose of the CRT according to your local hazardous waste ordinances. Regions outside the U.S. and Canada should dispose of the CRT according to their local hazardous waste ordinances.

For full instructions, go to Service Source Online, Service Programs Manual, Determining Warranty Status, Packing and Shipping Instructions, CRT Returns.

Return to Start of Section

LCD Safety

Return Worn-Out LCDs

LCDs (liquid crystal displays from flat-panel displays) may contain mercury lamps and other hazardous materials. For proper disposal in the U.S. and Canada, return worn-out intact LCDs from serviced Apple products in their original packaging to Apple at the following address:

Apple Computer, Inc.
Global Service Operations Warehouse
10175 Iron Rock Way
Elk Grove, CA 95624
ATTN: LCD Disposal

If you no longer have the original packaging or the LCD is broken, dispose of the LCD according to your local hazardous waste ordinances. Regions outside the U.S. and Canada should dispose of the LCD according to their local hazardous waste ordinances.

For full instructions, go to Service Source Online, Service Programs Manual, Determining Warranty Status, Packing and Shipping Instructions, LCD Returns.

Return to Start of Section

Return to Top of Page

III. Battery Handling

Battery Disposal

Lithium thionyl chloride batteries, the type used 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 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 batteries cannot be recharged 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.

1. 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.

Warning: If packaging more than one battery, the batteries must be wrapped individually in nonconductive material so they do not touch other batteries. To avoid a fire hazard, package batteries individually in zip-locked wrappers before placing them in the shipping box.

2. 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.

Return to Top of Page

Service Site Index | Export Compliance

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