ATLAS Apple Technical Learning Administration System

Embedded Battery Safety for Retail

Introduction

Rechargeable lithium-ion/polymer batteries have a high power density that provides a long battery life in a light package. Lithium-based battery technology is used in Apple products. Due to the delicate nature of these rechargeable batteries, special care must be exercised when servicing these portable products.

Course Description

This course covers important information regarding the safe handing of embedded batteries. This course is intended for personnel working in an Apple Retail Store.

This course is part of the Apple Service Fundamentals curriculum and is used to prepare for the Apple Service Fundamentals Exam (SVC-16A).

Progress:

Embedded Battery Safety for Retail

Overview

Lesson Objectives

After completing this course, you should be able to:

- Explain the importance of exercising special care when handling lithium-ion/polymer batteries.
- Demonstrate the proper and safe handling of batteries and portable computer case assemblies with built-in battery.
- Recognize and identify signs and symptoms of damaged batteries and portable computer case assemblies with built-in battery.
- Respond to events involving embedded batteries.

Audience	Prerequisites	Time Required	You will need...
Service Technicians	None	45 minutes	No additional materials or equipment.

Technician service qualification may be required

Some products may require a service qualification to perform repairs and order parts. Steps to obtaining service qualifications include the following:

- Completion of this course (Embedded Battery Safety)
- Completion of the product's self-paced training (SPT) course, or
- Passing the qualification exam for the particular product

Please refer toApple Support article, HT202594: Exams and courses for service technicians for additional information.

Progress:

Embedded Battery Safety for Retail

About Embedded Batteries

Batteries are directly embedded into Apple portable computers and iOS devices. This allows for thinner and lighter designs while still maintaining long battery life.

For additional information on battery safety, handling, and shipping, please refer to GSX article, "OP24: Safely handling lithium batteries and lithium battery-powered devices"

Embedded Battery Safety for Retail

About Embedded Batteries

Cell Packs

Cell packs are the actual parts of a battery that are recharged, hold energy, and provide power to the portable computer or device.

MacBook Pro (Retina, 15-inch, Mid 2015)

iPhone 6

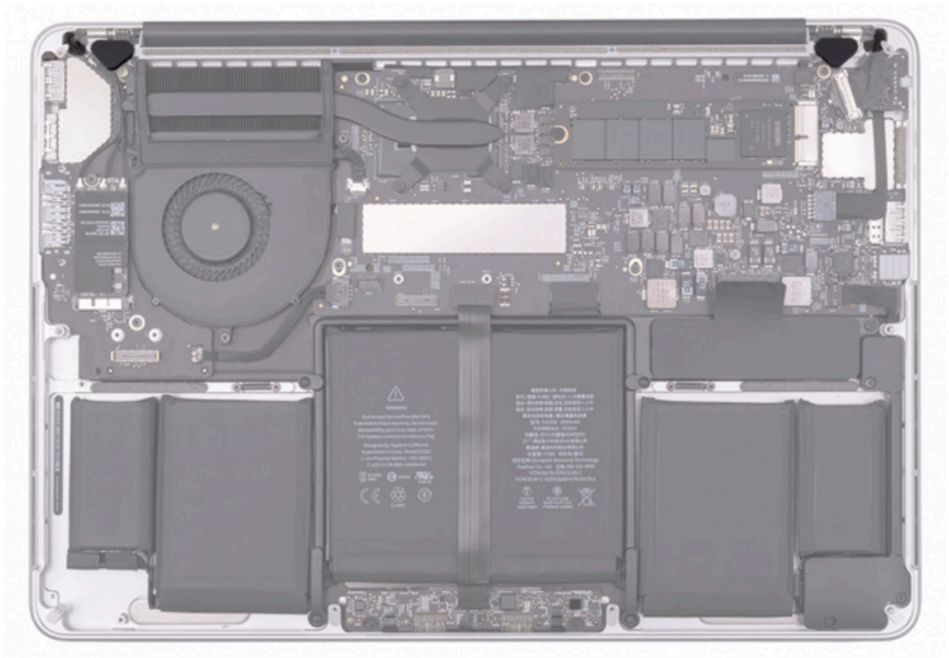
Cell packs can be inadvertently punctured or damaged during repair or testing as they are not shielded by a protective enclosure or cover.

Embedded Battery Safety for Retail

Case Assemblies with Battery

Some Apple portable computers have batteries built into the case assembly (bottom or top).

Replacing a defective battery in these instances will require replacement of the entire case assembly.



MacBook Pro (Retina, 13-inch, Early 2015)

Never attempt to separate or remove the battery from a case assembly that has a built-in battery.

Information on which portable computers require complete replacement of the top case or bottom case assembly can be found in Global Service Exchange (GSX).

Embedded Battery Safety for Retail

Progress:

Always exercise proper safety procedures

Use care when handling the battery or case assembly with built-in battery. Damage to a battery may result in an unexpected and undesired event, such as a thermal event (see “Responding to Battery Events” for descriptions of potential events).

Never open or work on an embedded battery at the Genius Bar or location other than the Genius Room. Always work on embedded batteries at a workstation that has been properly set up.

1. Handle the battery or case assembly with built-in battery by the edges, with two hands at all times.
2. Do not lift or hold the battery or case assembly with built-in battery using the cable or connector.
3. Never drop, stack, puncture, press, crush, twist, torque, strike, squeeze or apply unnecessary pressure to an actual battery, its cell packs (or case assembly with built-in battery).
4. Inspect the battery for dents, scratches, or other possible defects. Refer to the "Visual Battery Inspection" section of this training module.
5. Always replace a battery or case assembly with built-in battery that has been dropped. These may have an abnormal charge current or voltage that can possibly lead to thermal issues.
6. Never expose batteries, cells, or case assemblies with built-in battery to liquid.
7. Never apply liquid or water onto a battery (or case assembly with built-in battery) that is experiencing a thermal event.
8. Keep batteries, case assemblies with built-in battery, and computers away from heat and open flames. Store them in a cool dry place.
9. When the bottom case is removed, keep the protective battery service cover on the battery at all times.
10. When replacing a battery (or case assembly with built-in battery), use the battery cover as directed by the product's service guide.
11. Always ship or transport a battery (or case assembly with built-in battery) in its original packaging. It should be bagged and properly packed in the original packaging as shown in the "Return Packaging" section of this training course. Be sure required International Air Transport Association (IATA) Caution and Packing List labels are attached to the packaging.

- Compromised batteries may not be shipped by air.
- If something unusual is noticed (such as an odor, swelling, discoloration, deformity, or overheating), disconnect and stop using the battery. Follow the safety guidelines contained in this training course.

Safety Precautions

Specific safety precautions can be found in OP24: Safely handling lithium batteries and lithium battery-powered devices or by searching for "Battery Safety Precautions" in GSX.

Progress:

Embedded Battery Safety for Retail

Workstation Setup

REMINDER

When servicing portable computers or iOS devices with embedded batteries, your primary concern should be your own safety and the safety of those around you.

Workstation Requirements

Repairs involving products containing embedded batteries should take place on designated workstations that meet the following criteria:

1. ESD-safe and non-flammable work bench
2. At least 2 feet (0.6m) away from paper and or other combustible materials
3. Within 20 feet (6.1m) of an appropriate fire extinguisher and yellow fire-proof safety cabinet.
   Do not use yellow cabinet for storage of combustible or flammable materials. Keep the cabinet clear.
4. Required: 8-10 cups of sand (clean, dry, untreated) in quick pour container within arm's reach (2 feet or 0.6m) on either side of the workstation
   Refer to OP685: About embedded battery safety for ordering.
5. Located in an area with adequate ventilation

Keep combustible materials away

Be sure to keep paper and other combustible materials at least 2 feet (0.6m) away from the workstation.

Additional safety procedures

- Always wear your safety glasses when performing repair work.
- Check with your store manager on additional protocols and procedures regarding workstation setup and safety.

Progress:

Embedded Battery Safety for Retail

Required Equipment

Personal Protective Equipment

- Nitrile/latex gloves
- Heat-resistant gloves
- Safety glasses
- Cleaning wipes (to clean your safety glasses before wearing)
- Cut-resistant gloves (although not specific to battery safety, these should be stored in the safety kit for handling things like broken glass)

Required Materials

- 8-10 cups of clean, dry, untreated sand in quick-pour dispenser (Refer to OP685: About embedded battery safety for ordering)
- Hand broom with dust pan
- Chemical absorbent pads
- Sealable disposable bags and boxes (large enough to fit a case assembly with built-in battery)
- Yellow fire-proof safety cabinet

Required Sand Specifications

- 8-10 cups of clean, dry, untreated sand
- Sand should be stored in a wide-mouthed, quick-pour plastic (non-breakable) container/dispenser with flip top lid
- Container holding sand should be within arm's reach (2ft or 0.6m), on either side of the workstation
- This container should be stored immediately adjacent to the workstation, to the side, for immediate access during an unexpected thermal event. It should not be stored above or below the workstation.

Ordering safety equipment and supplies

Information on ordering recommended safety equipment and supplies can be found in OP685: About embedded battery safety.

Embedded Battery Safety for Retail

Service Tools

Special tools are used to remove and replace batteries (or case assemblies containing batteries) in Apple portables and iOS devices. As required tools may vary from product to product, consult the appropriate service guide in GSX for required tools and use instructions.

Always use the correct tools as instructed by the product's service guide. Incorrect tools or improper use can result in damage.

Progress:

Embedded Battery Safety for Retail

Battery Covers for Portables

The battery cover (for portable computers) can prevent items such as loose parts, tools, and screws from unintended contact with the actual battery surface.

Apply and attach the battery cover:

- Immediately after opening the computer (removing the bottom case)
- Before beginning battery removal (or case assembly with built-in battery removal)
- Prior to installing a replacement battery (if a cover is not already attached)
- When preparing to package a battery for shipment

Depending on the computer model, covers are equipped with tabs, adhesive, magnetic or plastic clips used to secure the cover to the battery.

Protect the exposed cells of embedded batteries at ALL times!

Progress:

Embedded Battery Safety for Retail

Battery Covers for Portables

Use the Correct Battery Cover

Depending on the product, battery covers vary in size and design. Only use the correct battery cover for the product being serviced.

If the correct battery cover is not available, or it is worn, torn, or damaged in any way, STOP the repair and order a replacement battery cover.

Refer to the product's service guide in GSX for the correct part number.

Progress:

Embedded Battery Safety for Retail

Battery Covers for Portables

When to Remove Battery Cover

Only remove the battery cover immediately before installing the computer's bottom case.

Upon removal of the battery cover:

- Inspect the battery for any damage or debris.
- Pay special attention to any dents, dots, or scratches; these may cause thermal events with prolonged use.

Battery covers can be reused as long as they are free of dust, dirt, or damage.

Progress:

Embedded Battery Safety for Retail

Embedded Battery Safety for Retail

Visual Battery Inspection

To ensure safety and performance of the batteries, inspect and verify the condition of the cells when performing service.

Inspection instructions

1. Make sure there is sufficient lighting in the area.
2. View the battery from about one foot away.
3. Exercise special care to avoid accidental damage to the cell packs when measuring cosmetic issues.

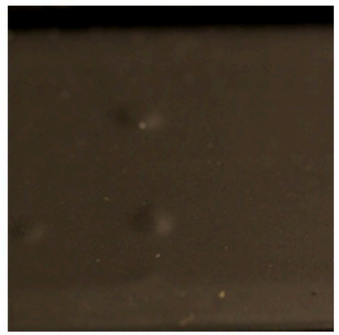
Note: If you have an imminent safety concern about a scenario you have encountered (regardless if the scenario falls outside of these guidelines) follow your normal safety escalation path.

Progress:

Embedded Battery Safety for Retail

Visual Battery Inspection

Cosmetic Issue: Dents or Dot Imprints



If dents or dots exceed these guidelines, replace the battery/case assembly with battery.

Diameter	Total Number of Dents/Dots
Less than or equal to 0.5mm	-
Greater than 0.5mm, equal to or lesser than 1.0mm	10 or less
Greater than 1.0mm, equal to or lesser than 1.5mm	6 or less
Greater than 1.5mm, equal to or lesser than 2.0mm	3 or less

Important: The depth of any dent or dot shouldn't exceed a depth greater than half the diameter of the dent or imprint. For example, a dent 1mm wide should not be greater than .5mm deep.

Progress:

Embedded Battery Safety for Retail

Visual Battery Inspection

Cosmetic Issue: Scratches

If scratches exceed these guidelines, replace the battery/case assembly with battery.

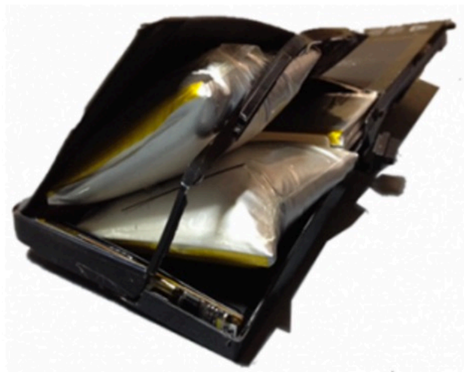
Diameter	Total Number of Scratches
Less than or equal to 15mm	5 or less
Greater than 15mm, equal to or lesser than 30mm	3 or less
Greater than 30mm, equal to or lesser than 40mm	2 or less

Progress:

Embedded Battery Safety for Retail

Visual Battery Inspection

Cosmetic Issue: Swollen



If the battery is swollen, replace the battery/case assembly with battery. Follow the guidelines in the "Expanded Enclosure" and "Responding to Battery Events" chapters of this training.

Progress:

Embedded Battery Safety for Retail

Expanded Enclosure

When a device's enclosure has separated, is bulging, or is split apart, it may be due to an expanded or swollen battery. The device may still turn on and appear to work as expected.

An expanded/swollen battery is usually not a safety concern. For example, in older batteries, or batteries with very few charging cycles remaining, swelling may indicate end-of-life, which is a non-hazardous condition. The battery is essentially dead and has no energy left in it. The electrolyte has been fully consumed and no liquid remains inside the pouch. The gas present in the swollen pouch is likely carbon dioxide, an inert gas.

If the cell appears to be suddenly and actively swelling in real time, this is not an “expanded” cell situation. Instead, this is considered a “swelling battery” and should be treated differently. See the “Scenario: Swelling Batteries” page in the "Responding to Battery Events" chapter later in this training.

Enclosure separation due to expanded battery

Service guidelines for expanded batteries can be found in HT204762: Enclosure separation due to expanded battery and RS139: Processing Repairs for Swollen or Expanded Batteries.

Warning

Do not puncture, crush or attempt to flatten an expanded battery cell or enclosure.

Progress:

Embedded Battery Safety for Retail

Removal and Replacement

Portables

Important First Steps

Immediately after opening the computer (removing the bottom case):

1. Apply a battery cover to the battery.
2. Disconnect the battery from the logic board
   (disconnect battery cable or remove BMU interlock screw).

Next Steps: Battery/case assembly with battery removal and replacement techniques vary from product to product. As a result, specific procedures will not be covered in this course. Refer to the appropriate service guide in GSX for product-specific instructions.

Reminder: Case assembly with battery

Batteries for some products are built into the case assembly. **NEVER** attempt to separate or remove the battery from the case assembly as it is not a standalone part.

For these products, replacing a defective battery will require replacement of the entire case assembly. Refer to GSX for more information.

Do not overtighten screws

When replacing a battery, turn the screwdriver until the battery's screws are finger tight. Over-tightened screws may cause irreparable damage to the battery pack.

Progress:

Embedded Battery Safety for Retail

Removal and Replacement

iOS Devices

Do not reuse or reinstall a loose battery

Do not reuse or reinstall a loose battery or a battery that has been removed. Replace with a new battery, or a whole unit when a battery is unavailable.

Service Considerations

- If battery removal tab, adhesive tab or strip breaks off, do not use tools to pry up the battery. In this situation, replace the phone as a whole unit.
- If you feel any resistance when removing the battery, STOP. Reinstall display assembly and replace whole unit.
- If the battery is dented, punctured, swollen, or otherwise damaged, do not remove battery from iPhone. Reassemble and replace whole unit.

ATLAS Apple Technical Learning Administration System

Emily Nahmanson

Embedded Battery Safety for Retail

Progress:

Embedded Battery Safety for Retail

Return Packaging

Embedded batteries and case assemblies with built-in battery ship in special packaging. Always use this original packaging when transporting or returning these parts to Apple.

If either box has been damaged or lost, order a replacement service package.

Service Package (Portable Computers)

The service package for portable computers include the following items:

Outer cardboard box

Inner cardboard box

ESD bag and yellow label (see next page)

ATLAS Apple Technical Learning Administration System

Emily Nahmanson

Embedded Battery Safety for Retail

Progress:

Embedded Battery Safety for Retail

Embedded Battery Safety for Retail

Return Packaging

Service packages for case assemblies with built-in battery include the following items:

Outer cardboard box, foam frame and padding, labels, and an ESD bag.

ATLAS Apple Technical Learning Administration System

Emily Nahmanson

Embedded Battery Safety for Retail

Progress:

Embedded Battery Safety for Retail

- Introduction
- Overview
- About Embedded Batteries
- Case Assemblies with Battery
- Battery Safety Procedures
- Workstation Setup
- Required Equipment
- Service Tools
- Battery Covers for Portables
- Visual Battery Inspection
- Expanded Enclosure
- Removal and Replacement
- Return Packaging
- Responding to Battery Events
- First Aid Response

Embedded Battery Safety for Retail

Return Packaging

Always use tape to seal boxes. Do not use staples!

IMPORTANT: Always ship or transport with a battery cover

When returning a battery to Apple, reuse the battery cover that was included with the known-good battery (or case assembly with battery). If the battery cover was lost or damaged, order a new one. **Never** attempt to transport or ship a battery (or case assembly with battery) without the battery cover.

Part numbers

Correct replacement service package or replacement battery cover part number(s) can be found in Global Service Exchange (GSX).

Battery Handling and Storage

Specific battery handling and storage procedures can be found by searching for "Battery Handling and Storage" in GSX.

ATLAS Apple Technical Learning Administration System

Embedded Battery Safety for Retail

First Aid Response

In case of exposure to electrolyte, vapors, or smoke from a leaking, venting, or thermal runaway battery, follow these general first aid procedures.

After exercising first aid procedures, raise an In-Store Safety Incident Report. If employees were injured or feel ill, notify management and complete an Injury Report as well. Contact EHS if you have specific questions.

Inhalation

1. Move the affected person to fresh air.
2. If irritation persists, seek medical attention.

Skin or eye contact

1. Remove and isolate contaminated clothing.
2. In case of contact with internal battery materials or fluids, immediately flush skin or eyes with cool running water in bathroom sink for 10 minutes or longer if possible.
3. If irritation persists, seek medical attention.

Progress:

Embedded Battery Safety for Retail

Return/Recycle Procedures

Under normal circumstances, batteries should be sent back to Apple for proper disposal. See RS12: Returning Damaged Batteries and Cathode Ray Tubes (CRTs) for specific procedures.

When to dispose of a battery or case assembly with battery

Lithium cells, batteries or battery-powered devices in the following condition require special handling:

- Thermal event, multi-cell battery or product
- External physical damage to battery
- Leaking, leaked, or vented battery or product
- Unknown battery condition

Refer to OP24, Safely handling lithium batteries and lithium battery-powered devices in Global Service Exchange (GSX) and the transportation matrix located in HT204643, Prepare shipments of lithium batteries and battery-powered equipment.

If listed transportation options are not available in your location, recycle or dispose of these batteries according to local laws and regulations. If recycling or disposal options are not available in your country, storing these batteries may be appropriate. If you are unsure, please contact ACS for more information.

Air shipment regulations for lithium batteries

The International Civil Aviation Organization (ICAO) regulates air shipment of lithium batteries. ICAO regulations require special labeling on most packages containing devices with lithium batteries or standalone lithium batteries.

Specifics of these regulations can be found in RS12: Returning Damaged Batteries and Cathode Ray Tubes (CRTs).

For general information regarding safe handling of lithium batteries and battery-powered devices and when to return or not return a battery or device to Apple refer to OP24, Safely handling lithium batteries and lithium battery-powered devices in Global Service Exchange (GSX).

For general information regarding labeling, packaging and documentation requirements for shipping lithium batteries refer to HT204643, Prepare shipments of lithium batteries and battery-powered equipment in GSX. For additional information on ICAO regulations and the impacts on repair processing, search GSX using the search term “ICAO Battery.”

ATLAS Apple Technical Learning Administration System

Emily Nahmanson

Embedded Battery Safety for Retail

Progress:

Embedded Battery Safety for Retail

- Introduction
- Overview
- About Embedded Batteries
- Case Assemblies with Battery
- Battery Safety Procedures
- Workstation Setup
- Required Equipment
- Service Tools
- Battery Covers for Portables
- Visual Battery Inspection
- Expanded Enclosure
- Removal and Replacement
- Return Packaging
- Responding to Battery Events
- First Aid Response

Embedded Battery Safety for Retail

Summary

Having completed this course, you should be able to:

- Explain the importance of exercising special care when handling lithium-ion/polymer batteries.
- Demonstrate the proper and safe handling of batteries and portable computer case assemblies with built-in battery.
- Recognize and identify signs and symptoms of damaged batteries and portable computer case assemblies with built-in battery.
- Respond to events involving various battery and portable computer case assemblies with built-in battery.

This concludes the Embedded Battery Safety for Retail course.

For other courses in the Apple Service Fundamentals curriculum, see Apple Support article, HT205332: AppleCare Service Certifications, or search for Apple Service Fundamentals in ATLAS.