TEXTRON Systems

PUSHING PAST POSSIBLE

AV BATTERY MAINTENANCE AND CARE PRIMER

March 2020

BACKGROUND, OBJECTIVE, & OVERVIEW

Background

- Recent survey of users discovered a refresher on proper AV battery maintenance would be helpful for the end users to ensure full 10 year service life of the AV battery.

Objective

- Simplify and consolidate the requirements to maintain AV batteries for a mission ready state of operation.

Battery Management Overview

- Proper battery management is crucial to ensuring batteries operate properly throughout their useful life span of 10 years.
- The battery maintenance schedule determines how often the batteries require service.
- The majority of the information listed in this document is drawn directly from the Shadow 200 Technical Manuals. The physical battery inspections and checkerboard pattern reference will be included in a future TM release.

AV BATTERY POTENTIAL ISSUES

Problems with the battery can occur under the following conditions:

- An improperly maintained battery (no recent charge or conditioning cycle performed) is installed in an AV.
- An AV is powered on initially solely by battery without an external power source applied.
- The battery has an internal issue.

SCHEDULED BATTERY MAINTENANCE (FROM THE TM)

Interval	Procedure
30 days (Unused)	Inspect battery charge screen. 1. If LEDs are illuminated, perform *'Battery Charging'* procedure 2. If LEDs are not illuminated, perform *'Battery Depletion Cycle'* procedure (conditioning procedure performed at the end of depletion cycle)
6 Months (Unused or uncharged)	1. Remove battery from AV or Storage 2. Perform *'Battery Conditioning'* procedure
500 Flight hours	Inspect battery by connecting to charger, if indicated by charger or battery status perform *'Battery Conditioning'* procedure
10 Years	1. Perform *'Battery Discharging'* procedure 2. Return battery to depot

Preventative/Scheduled Battery Maintenance IETM reference:

M00381-1-1550-1689 Charging
M02759-1-1550-1689 Depletion
M02760-1-1550-1689 Conditioning
M00858-1-1550-1689 Discharging

Additional Battery related Procedures from the TM:

T00463-1-1550-1689 Troubleshooting
T00171-1-1550-1689 Bus Voltage Limits
M00859-1-1550-1689 Internal Heater Test

Battery maintenance interval is important and must be followed

BATTERY MANAGEMENT QUICK REFERENCE

- Remove battery from AV or storage per maintenance schedule if unused (30 day and 6 month)
- Verify MFG Date
  a. If date of manufacture is greater than 10 years from inspection date, then return to Depot
- Perform Visual Inspection (Physical Damage)
  a. Connector/ Contact damage = Return to Depot
  b. Damaged pressure Vent = Return to Depot
  c. Missing hardware, gasket damaged = Return to Depot
  d. Missing security tape = Return to Depot
- View Charge Status Window every 30 days (if unused)
  a. LED visible = Run charging procedure
  b. No LED bars visible = Run depleted test procedure followed by conditioning procedure
  c. Checked board display = Return to Depot
- Perform Conditioning procedure every 6 months (if unused in AV or storage) or every 500 flight hours
- Return battery to storage or AV

VERIFY MANUFACTURE DATE

Verify the age of the battery.

AV batteries have a useful service life of 10 years from the date of manufacture. If the battery is older than 10 years replace it.

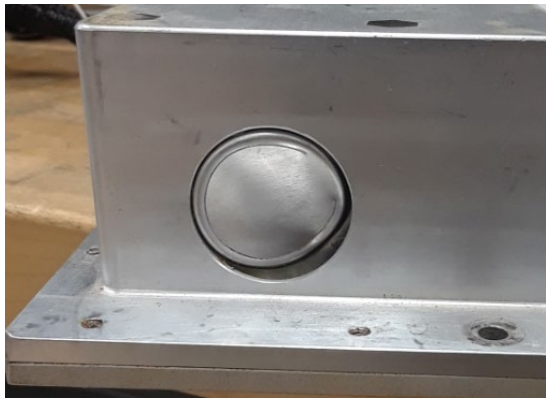
The date of manufacture is shown below in the red oval not the AAI manufacturing date.

Mfg Date:
Jan 2010

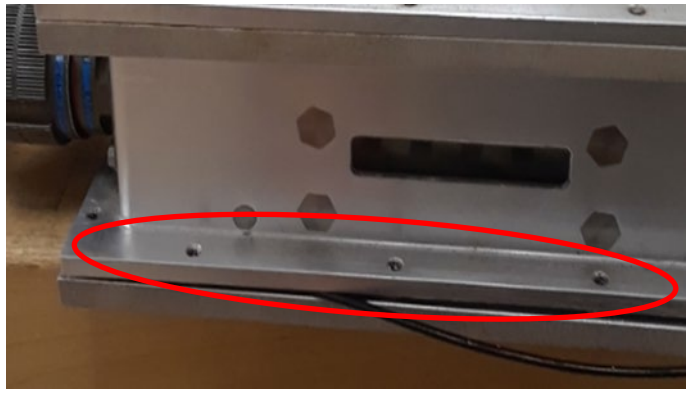
PERFORM VISUAL INSPECTION

Inspect the battery for physical defects. If the battery has the following defects, it should be returned to Depot.

Missing/ damaged contacts



Damaged pressure vent



Disassembly, missing hardware

Missing security tape

Batteries with any of these defects should be removed and replaced.

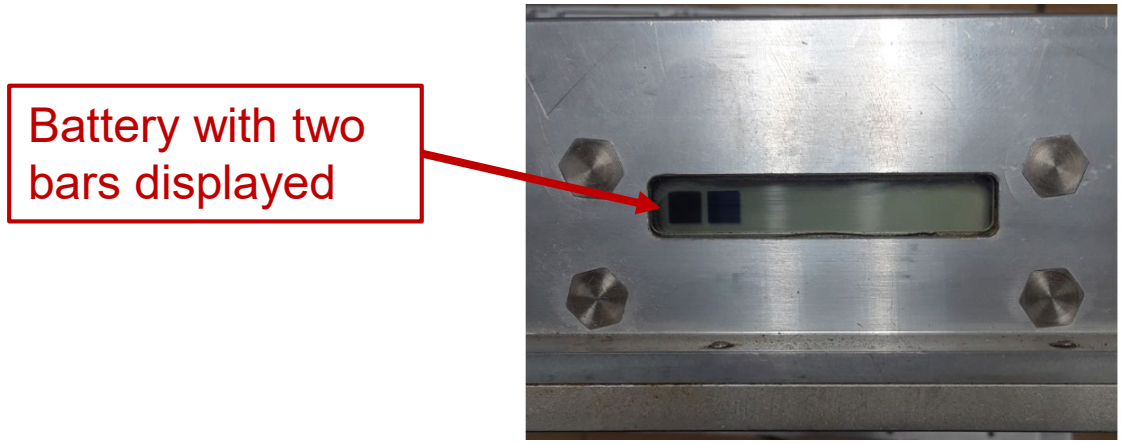
VIEW CHARGE STATUS WINDOW (EVERY 30 DAYS UNUSED)

This inspection is performed every 30 days when the battery is unused either in the AV or in storage.

View the battery State of Charge (SOC) status window to determine approximate charge capacity. Status window reads left to right, each bar equals ~12.5% SOC.

A fully charged battery will display 8 bars.

A functioning battery should have 1-8 bars displayed.



If 1 or more bars are displayed, perform the battery charging procedure to charge the battery up to 100%.

VIEW CHARGE STATUS WINDOW (EVERY 30 DAYS UNUSED)

If there are no bars displayed, the battery could be in one of the following states:

- **Low Capacity:** The battery has a very low SOC.
- **Depleted:** The battery's SOC has been low for an extended time period and has entered "Sleep Mode".
  - In sleep mode, the Battery Management System (BMS) prevents the battery from charging or discharging due to low battery cell voltages.
- **Disabled:** The battery has an internal malfunction and needs to be returned to the vendor.

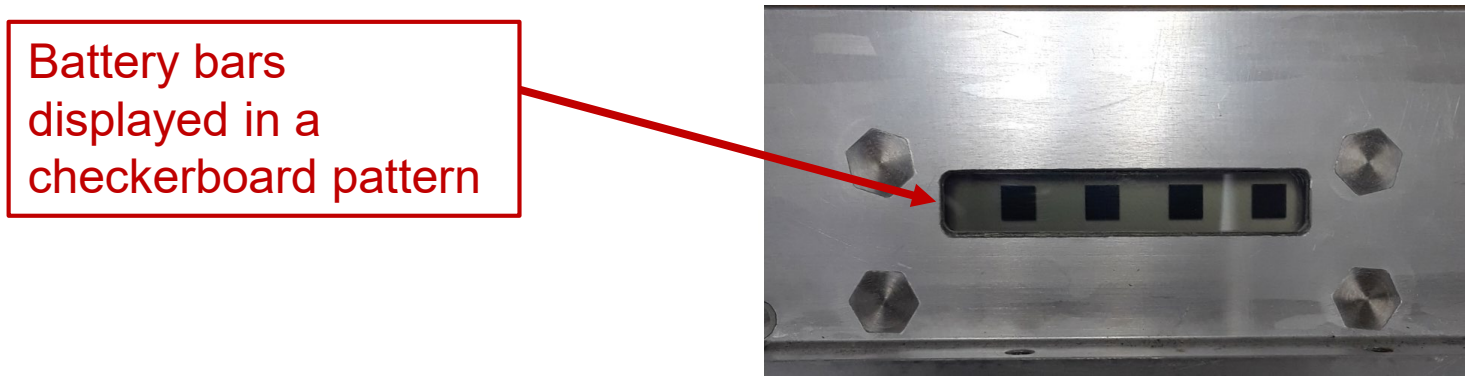
The battery depletion procedure should be performed to attempt to wake the battery.

The depletion procedure uses the charger to provide a trickle charge to the battery while it communicates with its BMS. The depletion procedure also tests the battery to determine if the cells are too depleted to be fully charged.

If no bars appear after running the depletion procedure, then return the battery to the Depot.

VIEW CHARGE STATUS WINDOW (EVERY 30 DAYS UNUSED)

If the battery SOC window displays the bars in a checkerboard pattern, the battery has an internal fault and should be returned to the Depot for further evaluation.



BATTERY CONDITIONING (6 MONTHS UNUSED & 500 FLIGHT HOURS)

This procedure is performed every 6 months when the battery is unused either in the AV or in storage. This procedure is also performed every 500 flight hours for batteries installed in an AV.

Battery conditioning is used to balance the battery cells and recalculate its SOC levels.

Conditioning also clears and resets software buffers in the BMS processor circuitry.

BACKUP SLIDES

BATTERY TM PROCEDURES SUMMARIZED

BATTERY PROCEDURE QUICK REFERENCE

- Battery Charging (M00381-1-1550-1689)
  - Performed to charge the battery (if LEDs are present) or to charge the battery after receiving from shipment.

- Battery Depletion Cycle (M02759-1-1550-1689)
  - Performed as required from scheduled preventative maintenance when the battery has no charge (no LEDs present)
  - Trickle charge performed which results in a more thorough, reliable charge & longer battery life (charging from dead can prematurely wear battery out)

- Battery Conditioning (M02760-1-1550-1689)
  - Performed as required from scheduled preventative maintenance.
  - Full discharge followed by a full charge and cell balancing which helps make the SOC (0-100%) more accurate

- Battery Discharging (M00858-1-1550-1689)
  - Performed when returning a battery to the depot
  - Battery discharged to 50% capacity

BATTERY CHARGING IAW M00381-1-1550-1689

1. Connect Battery to charger.
2. Plug charger into 110 VAC power Source. Verify “Battery Detected” is displayed.
3. Verify Power LED is green or yellow; if Power LED is red, allow charger to cool to ambient temperature before proceeding.
4. Verify Status LED is green or yellow; if Status LED is red, either the battery requires a condition cycle or the battery has an issue, perform battery troubleshooting procedure.
5. Press the Scroll button until the Charge option is displayed then press the select button.
6. At this point, the charger will begin charging the battery; “Charging” will be displayed.
   - Throughout the charging process, the charger will display the charge current, voltage, SOC, and battery temperature.
   - The power LED may temporarily change from green to yellow as the charger warms during the charging process.
7. “Charged Battery” will be displayed when the battery is fully charged.
   - The battery SOC will be displayed as 100%.
   - The charger will automatically stop charging when the battery is fully charged.

BATTERY DEPLETION IAW M02759-1-1550-1689

1. Verify battery has no charge bars displayed in charge status window.
2. Connect to charger, the charger will initially display, “No Battery Detected”.
3. Hold the **Select** button down for 5 seconds to initiate the Depletion Test.
4. During the Depletion Test, the charger provides a trickle charge to the battery cells while testing to determine if the cells are too depleted to be fully charged.
5. After several minutes, “Discharged Battery” will display indicating the battery passed the Depletion test.
6. Perform Battery Charge Procedure to fully charge battery to 100%.
7. Disconnect battery from charger, wait 12 hours and perform battery conditioning procedure.

If “No battery Detected” is displayed on charger, the battery cannot be charged and needs to be returned to **Depot.**

BATTERY CONDITIONING IAW M02760-1-1550-1689

1. Connect battery to charger and resistor assembly (PN D35015-supplied with 2kW generator).
2. Select conditioning mode.
3. The charger will fully discharge then fully charge the battery during the process.
4. During conditioning, the battery information will be periodically displayed.
5. Wait for conditioning to finish and then turn everything off.

BATTERY DISCHARGING IAW M00858-1-1550-1689

1. Connect battery to charger and resistor assembly.
2. Turn on discharge mode. Select 50% capacity.
3. Once 50% is reached, disconnect everything.
4. The Discharge function is typically used only for reducing the charge capacity to allow for safe transportation.