

OPERATING THE VEHICLE FOR OPTIMAL STATE OF CHARGE

Batteries ideally will remain in an optimal similar State of Health (SOH) if the vehicle's charging system is functioning properly. Loss of Cold Cranking Amps (CCA's) from starting the vehicle requires the engine to be run at 1200-1400 RPM's for approximately 45 minutes. Vehicles should be started at least once a week. Observe OPTEMPO and cold weather factors will require additional engine run time at state RPM's mentioned above to recuperate CCA's. The vehicle's charging system will only charge the Sponson Turret Electronic Batteries and Turret Emergency Battery when the vehicle is operating with the Turret Power switch on the System Control Box (SCB) in the ON position.

When performing on-vehicle testing with Master power or Turret power and a combination of the two being on simultaneously for extended periods of time, the engine needs to be run at 1200-1400 RPM's for the duration of the testing (excluding instructions that explicitly state to shut the engine off).

Longer run times will be required if batteries were not fully charged prior to starting the engine. Repeated or long intervals of operating the Turret, Engine Access Door, Ramp without the vehicle running the vehicle decreases the life of the batteries. Frequent starts and stops and only running the vehicle at normal engine idle for short periods of time does not generate enough current to adequately recharge the batteries which will also decrease the life of the batteries.

For Drivers, failure to properly maintain the vehicle by not starting and charging the batteries periodically will result in severe sulfating which is a condition that reduces battery capacity and further diminishes the battery's chance for recovery when attempted to be recharged. For Maintainer's, batteries are required to be removed, evaluated and charged during Semi-Annual services.

Current -10 Operator TM's does not provide guidance for the interval of Silent Watch operation. The A3 Performance Spec states the vehicle batteries shall have an adequate electrical power storage capacity to start the engine in accordance with the intervals in hours after continuous Silent Watch operations at ambient temperature provided below:

Start vehicle and run engine at 1200-1400 RPM's to recharge batteries after:

- 2.0 continuous hours of Silent Watch operation above +32°F (vehicle runtime ~ 45 minutes – 1 hour)**
- 1.7 continuous hours of Silent Watch operation between +32° and –25°F (vehicle runtime ~ 1 – 1.5 hours)**
- 0.5 continuous hours of Silent Watch operation between –25° and –65°F (vehicle runtime ~ 1.5+ hours)**

TESTING RESTED VEHICLE STORAGE BATTERIES

Using the Battery Analyzer

1. On vehicle battery testing is accomplished with connecting 490PT+ Battery Analyzer to Positive (+) and then Negative (-) Terminal on battery. Follow on-screen menu options for testing (select type AGM, On/Off Vehicle Testing), measure and record the SOC (Vdc and CCA's) to evaluate the vehicle ability to crank.
2. If Open Circuit Voltage (OCV) is above 12.80Vdc and 832.5 CCA then battery is good for issue to fleet and does not need to be recharged.
3. If OCV is below 70% SOC (12.6Vdc or below 647.5 CCA) charging is required
4. When batteries fall below 12.6 Volts direct current (Vdc), it is recommended all batteries are removed from the vehicle and recharged for 24-48 hours. The primary purpose is to ideally maintain an equalized SOC on all batteries to maximize the life of the battery. Under-charged or not maintained equalized will shorten the service life. Using batteries in an unbalanced SOC condition will draw down stronger batteries faster because they will be compensating for the weaker batteries and doing more of the workload than the weaker more depleted batteries.
5. Allow batteries to rest for 2 hours after running the vehicle prior to checking with the battery analyzer.
6. Replace unserviceable battery in the series with a new battery or a battery with a similar SOC. New or serviceable battery may require a top-off charge prior to placing into service.

CHARGING THE VEHICLE STORAGE BATTERIES

NOTE

The preferred method for charging batteries is to use the Pallet Charger due to the independent stations that auto sense when a battery is fully charged. Using either the Pro HD or Pallet Charger requires the batteries to be connected prior to applying power to the charger and commencing to charge batteries.

NOTE

Batteries come from the manufacturer fully charged, meeting the classification of wet-charged battery. Depending on the length of time held in storage, a top-off charge should be applied before placing the battery into service. Per the manufacturer's direction, the AGM battery shall be recharged before placing into service if the SOC is less than 12.6Vdc or 647.5 CCA's.

NOTE

Any battery that is older than 30 days from the date of manufacturer shall be topped off (recharged) before being placed into service. This will significantly increase the life expectancy of the battery and improve overall performance.

NOTE

With power applied to charger, if one battery is not detected, attach a similar battery with a higher voltage in parallel for several minutes. Once the charging process begins, remove the leads from battery in parallel and ensure charger continues to charge.

NOTE

If batteries are to be charged on a bus bar or in multiple sets, they should be grouped by OCV. Group range should be limited to 2.0Vdc for best recovery results, e.g., 12.5-10.5, 10.5-8.5.

NOTE

Climate/Temperature is another factor to consider, suggest battery charging not exceed 8-12 hours at a time without allowing batteries to be rested (cool) prior to charging or additional extended recovery charge cycles.

The recovery time for AGM batteries may be significantly longer than traditional flooded batteries. AGM batteries can take 24 to 48 hours or longer to recharge depending on the charger's output Amperage, the length of time the battery sat discharged, and the battery OCV before charging is started.

AGM State of Charge	
OCV	SOC (%)
>12.9	95-100
12.7	80
12.6	70
12.3	50
12.0	40
<11.4	25-30

If batteries are not recovered to a serviceable SOH after 48 hours, if applicable, tag and turn-in batteries (include the number of hours attempted to recover) to the Brigade Battery Maintenance Management Program (BMMP) for follow-on recovery attempt.

BMMP (Battery Maintenance Management Program)

The following steps are guidance for the Battery Maintainer to use for the follow-on recovery attempt. Ensure to account for any previous hours that were attempted by the unit per the turn-in tag. If no tag is present, assume battery was charged for 48 hours.

- Lab tests have shown severely depleted batteries can take up to 96 hours to recover.
- If the battery has not recovered to an OCV above 12.0 Vdc after 96 hours of charging, disposal is authorized.
- If the OCV is above 12.0 Vdc continue to charge an additional 24 hours and retest.

- d. If battery has not fully recovered to greater than or equal to 12.7Vdc with 740 CCA's or more after 120 hours of charging, disposal is authorized.

POST-CHARGE TESTING

1. PERFORM OCV & COLD CRANKING AMPS (CCA) TEST WITH BATTERY ANALYZER.
 - a. Batteries that are heated from charging process may give erroneous readings. The voltage reading may be higher than normal if battery has not cooled. Rest battery for 8 hours prior to testing.
 - b. Prior to placing any battery into service, check the OCV. For a new battery, OCV shall be greater than or equal to 12.80Vdc. For previously charged and recovered batteries, OCV shall be greater than or equal to 12.6Vdc after battery has been rested.
 - c. Verify CCA's with the analyzer. The accuracy of measuring CCA values is not emphasized in the TB's or TM's. The BUSK III Exide battery is rated at 925 CCA's. Experience has demonstrated that batteries can recover much higher CCA's than the rating on the battery. Maintainer's should document the CCA's of the batteries being placed into service and compare their values with the other batteries being installed on the vehicle. Ensure there are not any large discrepancies between CCA values. If battery is charged the full 48 hours cycle and there is a significant difference (greater than 277.5 CCA between the weakest and strongest battery regardless of the measured voltage, tag and turn-in weaker depleted battery to the BMMP for follow-on recovery procedure. Replace with a new or serviceable recovered battery.
 - d. The analyzer will indicate whether a battery is good, bad or needs to be recharged providing the battery has enough charge for the analyzer to detect it.
 - f. If OCV is above 12.80 Vdc battery is serviceable for use/issue to fleet and does not need to be recharged.
 - g. If OCV is below 12.6Vdc then additional charging is required. If at end of the 48 hour charge cycles and the OCV is identical (± 0.1 Vdc) to the previous cycle, battery has reached its potential. Proceed and use this value for all tests. This value may increase as battery rests (cools to ambient temperature).
 - h. Per Semi-Annual PMCS, the criteria for NMC is if battery is below 70% SOC.

In theory anything below 647.5 CCA which is equal to 70% SOC if battery rating of 925 CCA = 100% SOC.

CCA differential between a battery being at 70% and 100% SOC is 277.5 CCA (30%).

From the voltage perspective, if 12.9Vdc = 95-100% SOC then 9.03Vdc = 70% SOC. $12.8\text{Vdc} / 832.5 \text{ CCA} = 90\%$ SOC approximately.

We already discussed that maintaining the battery for optimal life requires keeping the batteries equalized, at what acceptable percentage do we determine should we state to maintain the batteries equalized 10%, 15%, 25%?

DISPOSAL PROCEDURES

1. BUSK III Exide batteries shall be inspected, tested and a final attempt made to recover batteries before permission to dispose is granted. Disposal authority is given to the applicable BMMP.
2. The Exide battery is a lead-acid battery. Follow local procedures for handling of Hazardous Waste Materials.

NOTE

Do not dispose of by placing with trash. Most States or Countries require disposal through a local Defense Reutilization & Marketing Office site (DRMO).

PALLET CHARGER

The Pallet Charger has not yet been authorized by CASCOM, but we recommend obtaining authorized. Our justifications are the following:

The January 2014 edition of PS Magazine featured an article that recommends Pulse Tech's 12Vdc Pallet Charger.

One of the key differences between the Pallet and Pro HD charges is the Pallet Charger only has the capability of 12Vdc charging. By comparison the Pro HD has the advantage being that it has the capability to do both 12Vdc & 24Vdc charging.

Another point to make is the Pallet Charger has 12 independent charging output channels that can charge multiple types of batteries at various stages and intervals simultaneously. This is one of the Pallet Charger's superior features over the Pro HD. The Pallet Charger like the Pro HD is a "Smart Charger" it demonstrates that they both feature auto sensing capabilities of the type of battery and current SOC of the battery.

The advantage leans in favor of the Pallet Charger because the Pallet Charger is the "Smarter" of the two chargers. The Pro HD Charger only has one output channel to charge one battery or with additional connections, charge two in series or more up to 8 in a series-parallel connection. No additional connections other than the one battery to one charging channel is needed with the Pallet Charger.

When a battery is connected to the Pallet Charger, each individual output charging channel has its own built-in monitoring logic and algorithms to calculate the amount of voltage and cold cranking amperage of each battery detected.

Both Pro HD and Pallet Charger have automatic shut-off's. When charging multiple batteries the Pro HD's shut-off is calculated by when the charger thinks all of the batteries are topped off. As it was explained to me by counterpart retired CW3/Mr. TACOM LAR of the Year, the Pro HD will shut off when it has detected the weakest battery has reached its top-off potential which may not be the top-off potential of the rest of the batteries.

Again advantage goes to the Pallet Charger for each output charging channel has its own Built-In-Test (BIT) that sense when the battery has recovered to its full potential. A realistic example for the Pallet Charger would be one battery may recover after 8 hours on the charger and another may take 16 or more hours. Theoretically, this means as batteries finish charging other batteries can be put on the Pallet Charger and not have to wait like you would with the Pro HD to shut off or go the full 24-48 hour charging cycle to determine if the batteries are serviceable.

Last point if it wasn't clear is maximum batteries the Pro HD can recharge is 8. Pallet Charger 12. Approximately how many Bradley's are in a Brigade 116-118 x 8 batteries? 928-944 batteries per brigade. How many Pro HD Chargers does a Brigade have? How long does it take to charge the batteries?