

TECHNICAL ADVISORY PROCEDURE

**STARTING BATTERY TYPES
AND THEIR CHARGING**

EDITION 2 / November 2024

ATA Technical Advisory Procedure

Starting Battery Types and Their Charging Edition 2

Australian Trucking Association
25 National Circuit
Forrest
ACT 2603
T - 02 6253 900
E - ata@truck.net.au

DISCLAIMER

The ATA makes no representations and provides no warranty that the information and recommendations contained in this Technical Advisory Procedure are suitable for use by or applicable to all operators, up to date, complete or without exception. Reliance or use upon the information or recommendations is voluntary and the user accepts all risks and responsibility for any such reliance or use and to the maximum extent permitted by law the ATA excludes all liability to any person arising directly or indirectly out of any such reliance or use.

This work is copyright. Apart from uses permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Australian Trucking Association. Requests and inquiries concerning reproduction rights should be addressed to the Communications Manager, Australian Trucking Association, 25 National Circuit, Forrest ACT 2603 or ata@truck.net.au.

Blank Page

About this Technical Advisory Procedure (TAP):

This Technical Advisory Procedure (TAP) is published by the Australian Trucking Association Ltd (ATA) to assist the road transport industry by improving the understanding, handling, maintenance and charging of starting batteries of heavy vehicles.

This TAP is not, nor is it intended to be, complete or without exception.

The TAP is a guide only and its use is entirely voluntary. Recommendations or procedures may not be suitable for, or applicable to all operators. Operators should consider their own circumstances, practices and procedures when using this TAP.

Operators must comply with the Australian Design Rules (ADRs), the Australian Vehicle Standards Regulations, the Roadworthiness Guidelines and any specific information and instructions provided by manufacturers in relation to the vehicle's systems and components.

No endorsement of products or services is made or intended. Brand names, where used in this TAP, are for illustrative purposes only.

Suggestions or comments about this TAP are welcome. Please write to the Industry Technical Council, Australian Trucking Association, 25 National Circuit, Forrest ACT 2603.

About the ATA Industry Technical Council (ITC):

The Industry Technical Council (ITC) is a standing committee of the Australian Trucking Association (ATA). The ITC's mission is to improve trucking equipment, its maintenance and maintenance management. The ITC was established in 1995.

As a group, the ITC provides the ATA with robust professional advice on technical matters to help underpin the ATA's evidence-based policymaking. It is concerned with lifting technical and maintenance standards, improving the operational safety of the heavy vehicle sector, and the development of guidelines and standards for technical matters.

ITC performs a unique service in the Australian trucking industry by bringing operators, suppliers, engineers and other specialists together in a long-term discussion forum. Its members provide expert and independent advice in the field to inform the work of the ITC. The outcomes from ITC benefit all ITC stakeholders and the heavy vehicle industry at large.

The ITC operates under the Australian Trucking Association's Council, which formulates industry policy for implementation by the organisation.

We welcome applications to join the ITC. For further information, please call the ATA on (02) 6253 6900 or email ata@truck.net.au or download information from the ATA website www.truck.net.au, follow the links under the members tab to join.

Acknowledgement

The cover page was generously provided by Volvo Trucks Australia.

Contents

Introduction.....	7
1. Definitions.....	8
2. Safety Precautions When Handling Batteries.....	10
3. Key Types of Lead Acid Batteries.....	11
4. Handling Lead Acid Batteries.....	13
5. Installing a Battery.....	14
6. When is a Battery Flat?.....	15
7. Battery Charging.....	17
8. Testing a Battery.....	19
9. Jump Starting a Truck with Flat Batteries.....	20
10. Why do Batteries Fail and Problem Areas?.....	21
11. Dual Battery Installations.....	23
Drafting.....	24

Figures

Figure 1: Battery warnings.....	10
Figure 2: In built battery “state of charge” indicator.....	15
Figure 3: Typical load test circuit.....	16
Figure 4: The likely rub failure point of the positive (+) battery.....	21
Figure 5: Overview of battery’s location in the rear overhang of the prime mover.....	21
Figure 6: Jump start post example.....	21
Figure 7: Common battery location on a COE prime mover.....	22
Figure 8: Allows access when the body is lowered.....	22

Tables

Table 1: Indicative common battery characteristics.....	7
Table 2: Guide to a battery’s state of charge.....	15
Table 3: Load test minimum voltages with temperature compensation.....	16
Table 4: Charging guide for different battery types.....	18

Introduction

This Technical Advisory Procedure (TAP) is published by the Australian Trucking Association Ltd (ATA) to assist the road transport industry by improving the understanding, maintenance and charging of starting batteries of heavy commercial vehicles. The TAP's focus be on lead acid batteries which are commonly used in heavy vehicle applications. This TAP does not cover zero emission vehicle traction batteries.

It is not, nor is it intended to be, complete or without exceptions.

The most common rechargeable battery types are NiCd, NiMH, Li-ion and lead acid. Their key characteristics are :-

- Nickel-cadmium (NiCd) is a mature and well understood technology. They are used where long service life, high discharge current and extreme temperatures are required. NiCd is one of the most rugged and enduring batteries. It's chemistry allows fast charging with minimal stress. Main applications are power tools, medical devices, aviation, and uninterruptable power supply (UPS). Due to environmental concerns, NiCd batteries are being replaced with other types.
- Nickel-metal-hydride (NiMH) is replacing NiCd in many applications as it contains only mild toxic metals and provides higher specific energy. NiMH is used for medical instruments, hybrid cars and industrial applications.
- Lithium-ion (Li-ion) is replacing lead and nickel-based batteries in many applications, due to safety concerns and higher energy density. However, Li-ion needs a protection circuit and it is a more expensive option. High cycling capability and low maintenance demands reduce the cost per cycle over many other types. With rapid advances being made with Lithium – Ion battery technologies, their relative performance will continue to improve over coming years.
- Lead Acid is the oldest rechargeable battery technology. Lead acid is rugged and is economically priced, but it has a low specific energy and limited cycle count. Lead is toxic and cannot be disposed in landfills. There are a range of types lead acid used in heavy vehicles.

The following table compares the characteristics of the four commonly used rechargeable battery systems with typical performance ratings.

Specifications	NiCd	NiMH	Li-Ion	Lead acid
Energy density (Wh/kg)	45-80	60-120	150-250	30-50
Internal resistance	Very low	Low	Moderate	Very low
Charging time (hours)	1 to 2	2 to 4	Up to 4	8 to 16
Voltage per cell (volt)	1.2	1.2	Up to 3.7	2
Toxicity	Very High	Low	Low	Very High
Cost	Moderate	Moderate	High	Low

Table 1: Indicative common battery characteristics

1. Definitions

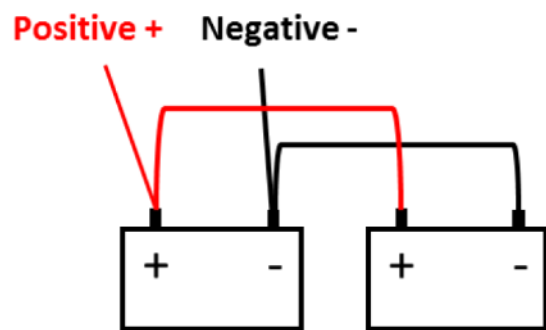
ADR [Australian Design Rules 3rd Edition.](#)

Amp or Ampere Ampere, symbol (A), is the unit of electric current. It is named after French mathematician and physicist Andre Marie Ampere.

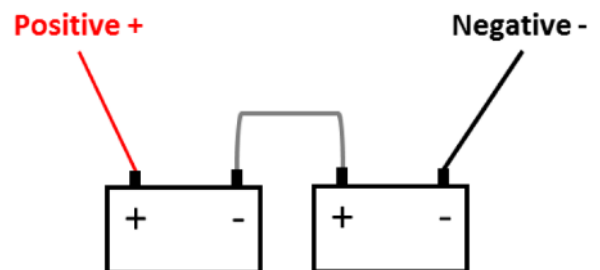
Capacity Capacity represents specific energy in ampere-hours (Ah). Ah is the discharge current a battery can deliver over time. You can install a battery with a higher Ah than specified and get a longer runtime and you can also use a slightly smaller pack and expect a shorter runtime. Chargers have some tolerance as to Ah rating (with same voltage and chemistry). A larger battery will simply take longer to charge than a smaller pack, but the Ah discrepancy should not exceed 25 per cent. European starter batteries are marked in Ah. North America uses Reserve Capacity (RC). RC reflects the discharge time in minutes at a 25A discharge.

Cold cranking amps (CCA) - Starting batteries, also known as SLI (starter light ignition) are marked with CCA. The number indicates the current in ampere that the battery can deliver at -18°C. American and European test requirements differ slightly.

Parallel Parallel battery connections. Batteries are connected from terminals to the same terminals of the other batteries. The positive (+) terminal of one battery is connected with positive (+) terminal of the other battery, the negative (-) terminal of one battery is connected with negative (-) terminal of the other battery with the system cables connected to their respective negative (-) terminal or positive (+) terminal.



Series Series battery connections. Batteries are connected with the positive (+) terminal of one battery connected to the negative (-) terminal of the other battery with the system leads connected to the available positive (+) and negative (-) terminals.



SoC	State of Charge, a method to describe the level or state of charge in a battery as a percentage. A fully charged battery is said to be at 1000% SoC
VRLA Battery	<p>Valve Regulated Lead Acid Battery, is a battery that uses one-way valves to retain oxygen produced during charging and excludes atmospheric oxygen, the oxygen recombines suppressing hydrogen evolution and water loss when charged correctly. VRLA batteries include AGM and GEL. Refer to section 3 for details.</p> <p>Warning Under no circumstances should any attempt be made to open a VRLA battery.</p>
Voltage	<p>Voltage, symbol (V) also known as electrical potential difference, electric pressure, or electric tension is the difference in electric potential between two points.</p> <p>Batteries are marked with nominal voltage, however, the open circuit voltage (OCV) on a fully charged battery is 5–7 percent higher. Chemistry and the number of cells connected in series provide the OCV. The closed-circuit voltage (CCV) is the operating voltage. Always check for the correct nominal voltage before connecting a battery.</p>
Volt-amps	Volt-amps, symbol (VA). VA is the apparent power that is affected by a reactive load, while Watts is the real power that is being measured. On a purely resistive load, watt and VA readings are alike. Reactive loads are due to inductive motors or fluorescent lights which are not extensively used on vehicles.
Watt	<p>Watt, symbol (W), is the unit of power. It is used to quantify the rate of energy transfer. The watt is named in honour of James Watt.</p> <p>Watt (W) = Voltage (V) x Current (A)</p>

For further definitions and terms refer to [ATA's ITC Dictionary \[LINK\]](#)

2. Safety Precautions When Handling Batteries

When fitting and handling batteries, please make sure you and your colleagues are aware of all safety precautions and handling procedures. Do adhere to the safety recommendations and advice below, as well as instructions of your local regulator



Figure 1: Battery warnings

- Always refer to the Safety Data Sheet (SDS) for more information.
- Keep the battery away from flammable areas and objects.
- Always wear safety glasses and rubber gloves when handling the battery.
- Note that the battery fluid may emit hydrogen gas, which can cause fire or explosion.
- Charge the battery in a well-ventilated area.
- Prevent short-circuiting and/or emission of sparks.
- The battery's electrolyte fluid (sulfuric acid) can cause blindness and/or severe burns. Keep the battery away from the eye, skin, clothes and other objects. If you come into contact with the battery fluid, wash the affected area with water immediately and thoroughly. If swallow, drink a large quantity of water or milk immediately. If battery fluid is swallowed or comes into contact with the eye, you should see a doctor as soon as possible.
- Keep the battery away from high temperatures and humidity. Avoid rain, snow or direct sunlight.
- Do not tilt or attempt to disassemble the battery.
- Do not attempt to quick-charge the battery.
- Dispose of discarded batteries according to local regulations.

Safety precautions when charging:

- ✓ Be sure to wear protective glasses before assessing or handling the battery.
- ✓ Do not conduct charging near fire or sparks.
- ✓ Do not charge a frozen battery.
- ✓ If the human body or clothes come into contact with battery acid, rinse the affected area immediately with water.
- ✓ If your eye comes into contact with battery acid, wash thoroughly with water and seek medical help immediately.

Source Delkor Australia

3. Key Types of Lead Acid Batteries

There are a range of types lead acid used in heavy vehicles: -

- Flooded - generally have the highest water usage and must be accessible.
- Low or maintenance free - are designed to use less water. Generally, do not need water added during normal vehicle service life.
- Valve Regulated Lead Acid (VRLA), either absorbed glass mat (AGM) or gel design, are sealed from the atmosphere by one-way valves. Adding water is not necessary.
- Calcium - is usually sealed/maintenance free. They have advantages with improved corrosion resistance, reduced gassing, lower water usage and lower self-discharge.

Flood battery

- The electrode plates of flooded batteries must always be fully submerged in electrolyte. Fill the battery with distilled or de-ionized water to cover the plates, if fluid levels are low. Never add electrolyte (acid).
- Fill water level to designated level after charging. Overfilling when the battery is on low charge can cause acid spillage during charging.
- The formation of gas bubbles in a flooded lead acid indicates that the battery is reaching full state-of-charge. Hydrogen is produced on the negative plate and oxygen on the positive plate.
- Lower the float charge voltage if the ambient temperature is higher than 30°C.

Low or maintenance free battery

These look very similar to flood type batteries with a reduced need to add water and are often not fitted with easily assessable battery cell caps.

Gel battery

A gel battery (also known as a “gel cell”) is a sealed, valve regulated lead-acid deep cycle battery and has a gel electrolyte. Unlike flooded lead-acid (wet cell) batteries, these batteries do not need to be kept upright. Gel cells virtually eliminate evaporation of the electrolyte, spillage (and subsequent corrosion issues) common to the flooded lead acid battery, and boast greater resistance to extreme temperatures, shock, and vibration. As a result, they are often used in car, boats, aircraft and other vehicles.

Absorbent Glass Mat (AGM) battery

AGM technology became popular in the early 1980s as a sealed lead acid battery for military aircraft, vehicles and UPS to reduce weight and improve reliability. The sulphuric acid is absorbed by a very fine fiberglass mat, making the battery spill-proof.

AGM has very low internal resistance, can deliver high currents on demand and offers a relatively long service life, even when deep cycled. AGM is maintenance free, provides good electrical reliability and is lighter than the flooded lead acid type. While regular lead acid batteries need a topping charge every six months to prevent the buildup of sulphation, AGM batteries are less prone to sulphation and can sit in storage for longer before a float charge becomes necessary. The battery stands up well to low temperatures and has a low self-discharge.

The leading advantages of AGM batteries include recharge up to five times faster than the flooded versions, and the ability to deep cycle. AGM offers a depth-of-discharge (DoD) of 80 per cent. The flood type battery is specified at 50 per cent DoD to attain the same cycle life. The negatives are slightly lower specific energy and higher manufacturing costs than the flooded.

Being sealed, AGM reduces acid spilling in an accident, lowers the weight for the same performance and allows installation at odd angles. AGM and other sealed batteries do not like heat and should be installed away from the engine compartment. Manufacturers recommend halting charge if the battery core reaches 50°C.

As with all gel and sealed units, AGM batteries are sensitive to overcharging. A charge to 2.40V/cell (and higher) is acceptable, however, the float charge should be reduced to between 2.25 and 2.30V/cell (summer temperatures may require lower voltages). Automotive charging systems for flooded lead acid batteries often have a fixed float voltage setting of 14.40V (2.40V/cell). A direct replacement with a sealed unit could overcharge the battery on an extended trip.

Calcium battery

Calcium replaces the element antimony in the plates of the battery to give it some advantages including improved resistance to corrosion, no excessive gassing, less water usage, and lower self-discharge. Calcium batteries require a higher charge voltage than conventional flood batteries. If used in a deep cycle situation, it is advisable to use a charger designed for calcium batteries with a suitable charging mode to get the maximum life out of the battery.

Deep cycle batteries

Many trucks may have two different battery groups: normal batteries for truck operations/engine starting and deep cycle batteries for stand-by/auxiliary systems of sleeper cab lighting/ entertainment modules and cooling when parked or to support auxiliary equipment such as tail gate lifters, cranes, and hydraulics. Preferential charging of the main batteries should always occur. This is commonly done in the off-road camper / outdoor markets.

Deep cycle batteries may be flood, gel, or AGM style in construction. They are built for maximum capacity and high cycle count. Although the battery is designed for cycling, full discharges still induce stress. It is advised to keep the cycles moderate by preventing a full discharge and allowing the battery to charge more often.

Deep cycle batteries are specially designed with denser active material and thicker plates to withstand deep discharge-recharge service. They are also reinforced by envelope and glass mat separators to reduce shedding of the active material and damage from the jolting vibration. Typically, starting car batteries use porous active material and thin plates so that high-amp energy can be quickly delivered for maximum starting power. Repeated cycling weakens the positive plates and makes the active material shed from the grids. Thus, in repeated deep discharge-recharge applications, the capacity of the car battery drops below desired levels in about 50 cycles.

Warning

Never mix different battery types within a bank of batteries. They all work and perform differently, and mixing them will result in premature battery failures.

Specialist battery charging units or charge equalizers can be used when different battery types as are charged off the one alternator.

4. Handling Lead Acid Batteries

Warning

All lead acid batteries contain an electrolyte which is a solution of water and sulphuric acid. This material is extremely hazardous and corrosive. If the fluid encounters flesh, particularly the eyes, flush the affected area with plenty of clean water immediately and seek medical attention quickly!

Always wear eye protection.

Batteries produce a mixture of hydrogen and oxygen gases during charging and discharging. This mixture can be explosive. Always store, conduct charging and testing of batteries in a well-ventilated area. Be mindful of any ignition source including sparks generated when jump starting vehicles! Truck batteries are designed to produce very high currents for engine starting and when the terminals are shorted by any metal, it often melts, possibly leading to fires. Remove any conductive jewellery when working around batteries.

Disposal

Refer to the [Australian Battery Recycling Initiative \(ABRI\) \[LINK\]](#), which provides information on disposal, storage and transport of lead acid batteries used in the automotive area. Most suppliers of batteries will assist in the disposal of old batteries, or search for a [recycler near you \[LINK\]](#). Metal recyclers will also take lead acid batteries. The term 'car batteries' is used extensively throughout the site, but it is used as a generic term for automotive lead acid batteries.

Storage

Batteries have a limited shelf life and when stored will gradually discharge. On average, a fully-charged battery takes about 13 weeks to discharge to less than its optimum operating level.

Storing in a cool and dry area will preserve the battery, while warm, hot or humid areas will accelerate self-discharge. Maintaining batteries in a good state of charge (above 12.4 volts) whilst in storage is important to prevent the formation of crystalline sulphate on the plates.

Whilst in storage, batteries that have not been recharged and allowed to go flat may be permanently damaged. They should be checked monthly and put on trickle charge as required.

Note

If the truck is not being driven for a month or more – disconnect the battery or use the battery isolation switch, as modern vehicles can have significant parasitic loads, even in key off situations.

In-vehicle maintenance

Always use hand tools to tighten battery terminals and hold down clamps. Terminals must be kept clean and secure (refer to the manufacturer for recommendations). Terminals and connectors should be clean and free of deposits.

Terminals should be clean and inspected at all preventative maintenance inspections or at least annually. A baking soda/water solution should be used to wash away any build-up of corrosion that may have occurred.

5. Installing a Battery

Battery installation should only be undertaken by a suitably qualified or experienced professional with appropriate safety equipment always worn, including safety glasses.

Refer to vehicle's operating manual before removing or installing a battery.

Steps:-

1. Connect memory minder (to avoid the loss of radio pin codes and other key vehicle data), if required.
2. Activate or turn off the truck's battery isolation switch. Note: this switch may not isolate all the circuits. Some critical ones require constant power.
3. Locate the positive (+) terminal and mark polarity on the cable. Typically, the cables are colour coded with **RED** for positive (+) and **BLACK** for negative (-) or ground.
4. Remove the negative (-) cable first.
5. Remove the positive (+) cable.
6. Remove the hold down clamps and battery.
7. Inspect the tray for corrosion. If necessary, remove corrosive residue and treat with baking soda/water solution as required.
8. Place the new battery in the tray and ensure the battery is level and the terminal posts are in the same position as the old battery.
9. Replace the hold down clamp and ensure battery is secure.
10. Replace the positive (+) cable and tighten.
11. Finally, replace the negative (-) cable and tighten.

The negative (-) terminal should always be replaced last!

Warning

Never over tighten or hammer terminal onto the battery as this can damage the posts and battery cover voiding the warranty.

6. When is a Battery Flat?

When it can no longer perform its design function, starting the engine.

The voltage should only be read when the engine is off and no loads are connected. The battery should rest for at least 12 hours to remove the surface charge or turning on your high beam for about 1 minute will remove this surface charge.

Note

Different batteries, even of the same type, may have slightly different characteristics due to the variation in compounds used in the main ingredient – lead.

State of Charge Indicative	Battery Voltage for flood batteries (V)	Battery Voltage for VRLA (AGM/GEL) (V)	Specific Gravity of electrolyte for flood batteries
100%	12.70 – 12.60	12.95 – 12.85	1.265
75%	12.40	12.65	1.225
50%	12.20	12.35	1.190
25%	12.00	12.00	1.155
0%	11.80	11.80	1.120

Table 2: Guide to a battery's state of charge

Alternatively, some battery manufacturers include a state of charge indicator.

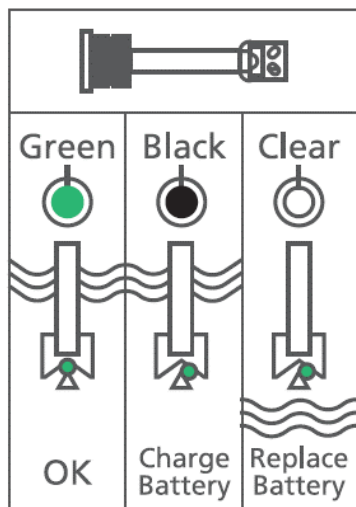


Figure 2: In built battery “state of charge” indicator

Source Delkor Australia

Load Testing of Batteries

For a Load Test, use the appropriate test equipment with the setup as shown in Figure 3. Note the electrolyte or the recent average ambient temperature of the battery.

A recently charged battery (either in vehicle operation or on a charger) may have a surface charge which must be removed to ensure reliable test results. This can be achieved by 150amp discharged for 10 seconds. Allow the battery to rest for a few minutes before proceeding with the load test.

Identify the load test value which should be detailed on the label or otherwise published. If no load test value is provided, the load the battery to half the cold cranking ampere (CCA).

Load Test Minimum Voltages (12 Volt Battery)	
Estimated Temperature (°C)	Minimum acceptable Voltage at 15 seconds
48.9	10.1
43.3	10.0
37.8	9.9
32.3	9.8
26.7	9.7
21.1	9.6
10.0	9.5
4.40	9.4
-1.10	9.3
-6.70	9.1

Table 3: Load test minimum voltages with temperature compensation

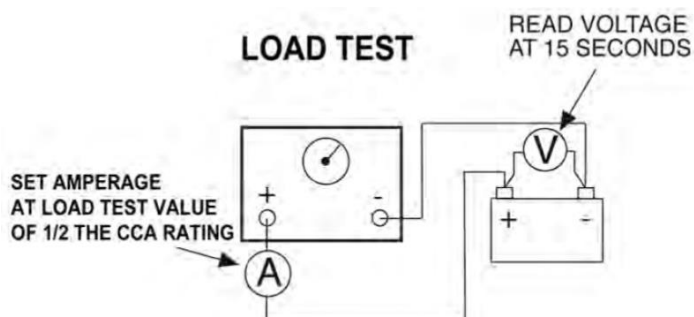


Figure 3: Typical load test circuit

Ensure the battery terminals and test equipment connectors are clean and corrosion free.

Follow the test equipment manufacturers instructions.

To perform the load test, turn on and quickly increase the current to the load test value for the battery being tested. Once amperage has been reached, wait 15 seconds and record the voltage while still under load. Turn-off the test equipment.

Refer to Table 3 to assess the batteries condition for the temperature. If the voltage is below the minimum, the battery should be replaced.

7. Battery Charging

Warning

The alternator of a heavy vehicle should never be used to charge a flat battery. If it is the alternator can fail prematurely.

The lead acid battery typically uses a constant current / constant voltage (CC/CV) charge method. A regulated current raises the terminal voltage until the upper charge voltage limit is reached, at which point the current drops due to saturation. The charge time is 12 to 16 hours with higher charge currents but with a multi-stage charge method this can be reduced to 8 to 10 hours.

During the constant-current charge, the battery charges to about 70 percent in 5–8 hours and the remaining 30 percent is filled with the lower topping charge that takes another 7–10 hours. The topping charge is essential for the life of the battery. If continually deprived, the battery will eventually lose the ability to accept a full charge and the performance will decrease due to sulphation. The float charge in the third stage maintains the battery at full charge.

Before charging begins, provide plenty of ventilation and ensure safety glasses or face shield are worn. Sparks from loose connections or metal tools making contact between the terminals or the un-grounded terminal and nearby grounded metal parts can also be hazardous. Do not remove the vent caps (maintainable batteries only) and do not charge the battery unless you are thoroughly familiar with the step-by-step procedure of recharging a battery. Ensure you have read the manufacturer's instructions for the specific charger you are using prior to commencing the charging procedure.

Battery charging steps

Refer to vehicle's operating manual before charging the battery.

- a) For maintainable battery types only - loosen the vent caps and then place a damp cloth over the vent caps, prior to commencing. For maintenance free product, continue to step b.
- b) Connect the charger leads to the battery terminals, **RED** positive (+) cable to positive (+) terminal and **BLACK** negative (-) cable to the negative (-) terminal. Rock the charger lead clamps to make certain a good connection has been made.
- c) Assess the type of battery (AGM/GEL) and adjust the battery charger settings accordingly. Refer to table 3.
- d) Set the electric timer to the desired charge time.
- e) Turn on the charger and slowly increase the charging rate until the desired amps is reached. Do not charge in the red zone. If the battery starts to emit smoke or dense vapour, shut off the charger and reject the battery. If violent gassing or spewing of electrolyte occurs, reduce or temporarily halt the charging.

Warning

Never touch the charger leads when the charger is ON. This could break a connection at the battery terminal and create a spark which could ignite the explosive gases in the battery. Never break a 'live' circuit at the battery terminal for the same reason. Always turn the charger OFF before removing a charger lead from the battery.

Choose the appropriate charge program for flooded, gel, AGM and calcium batteries. Check the manufacturer’s specifications on recommended voltage thresholds.

Charging Voltage Types of lead acid battery	Maximum (volts)	Typical range (volts)	Voltage for 100% state of charge
Flood, low or maintenance free	15.5	13.8 to 15.0	
Gel	14.4	14.1 to 14.4	
AGM	14.7	14.6 to 14.7	12.96
Calcium	16.0	14.6 to 15.1	12.78

Table 4: Charging guide for different battery types.

Note

These voltages are a guide only.
Always refer to the batteries manufacturers for recommendations.

Permissible temperature limits

Batteries can be discharged over a large temperature range, but the charging temperature is limited. For best results charge between 10°C and 30°C. Lower the charge current when cold. Avoid charging at temperatures above 50°C. Do not allow a lead acid battery to freeze. A flat battery freezes sooner than one that is fully charged. Never charge a frozen battery.

8. Testing a Battery

Batteries must be tested regularly to ensure their starting capacity is maintained.

A battery must be inspected for any physical damage which may reduce battery life and starting performance such as broken or damaged posts and leaks in the battery case or lid or evidence of corrosion around the terminals.

All non-sealed batteries should be checked using a hydrometer. It is a cheap and reliable method of determining the state of charge. The hydrometer also reveals differences between cells and allows visual inspection of the electrolyte colour. Where the hydrometer reading shows no significant difference between cells and produces a reading of 1.23 V or above (at 20 to 25 °C), the battery has sufficient charge for a load test.

Sealed batteries must produce a voltage of 12.5 or greater before a load test may be performed. Since the loss/fail criteria varies depending on the make of load tester used, be sure to consult the instruction manual provided with the tester to ensure success.

Measuring the Open Circuit Voltage (OCV) while in storage provides a reliable indication as to the state-of-charge of the battery. A cell voltage of 2.10V (or 12.6V for a battery) at room temperature reveals a charge of about 90 percent. Such a battery is in good condition and needs only a brief full charge prior to use.

9. Jump Starting a Truck with Flat Batteries

Determine if the truck with flat batteries has an operating voltage of 12 or 24 volts. Typically for heavy trucks, American sourced trucks have a system voltage of 12 volts while the Japanese/European suppliers have a system voltage of 24 volts. Use a donor vehicle with the same operating system voltage!

Jumping starting steps.

Refer to vehicle's operating manual before jump starting.

1. Park the booster vehicle or batteries close to your vehicle, but do not let them touch or a circuit may be made.
2. If all the parasitic electrical loads cannot be isolated from the system, turn the heater fans or lights on, in both vehicles. Adding these loads will assist in absorbing potential voltage spikes which could damage sensitive electrical components.
3. Connect the (+) **RED** jumper cable to the (+) **RED** terminal of your vehicle then do the same on the booster vehicle.
4. Connect the (–) **BLACK** jumper cable to the (–) **BLACK** terminal or preferably a suitable earth point on your vehicle and then do the same on the booster vehicle or battery.
5. Start the engine on the booster vehicle and let it run for a few minutes.
6. Start the engine on the vehicle with the flat battery and let it run while connected to the booster vehicle for a few minutes.
7. Remove the cables in reverse order of connection.

10. Why do Batteries Fail and Problem Areas?

Keep electrolyte levels up

Maintain electrolyte levels. Use distilled or deionised water only, never over fill and ensure plates are always covered. Flood type batteries should be checked regularly. Low maintenance batteries will require the addition of water only once or twice per year, depending on conditions. Maintenance free batteries will usually not require topping up of the water.

Check electrical connections

Make sure battery terminals and cable connections are clean and tight. The application of a thin layer of petroleum jelly on the outside can help reduce corrosion.

Vibration

Location and mounting box of batteries has a big impact on how the road induced vibrations affect batteries. Mount batteries close to the frame and away from heat sources. Vibration can damage battery plates, so make sure your battery is firmly held by a suitable hold down clamp. Excessive vibration can damage internal battery cells, such as cracking, resulting in sparking and a potential explosion due to internal hydrogen gas. Inspect battery terminals regularly as loose terminals can cause breakdowns.

Batteries supported and mounted close to the frame tend to experience less vibration issues.

Additionally, this location in the rear overhang between the chassis rails, frees up chassis side rail space and will take mass off the steer axle, but makes jump starting of the unit significantly harder when under a trailer is coupled, unless an auxiliary jump start post is available.

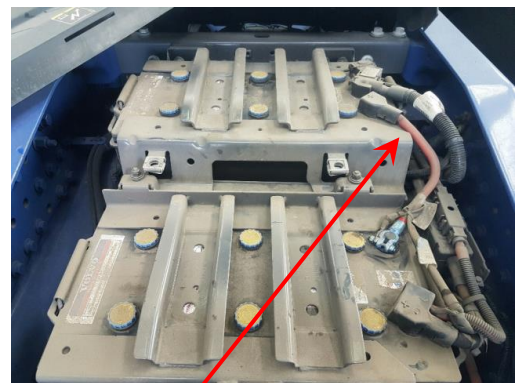


Figure 4: The likely rub failure point of the positive (+) battery.

The batteries are in the rear overhang of a prime mover



Figure 5: Overview of battery's location in the rear overhang of the prime mover

Figure 6: Jump start post example



Avoid overcharging or undercharging

Overcharging produces rapid deterioration and corrosion, shortening battery life. Some batteries (AGM and maintenance free batteries) are very susceptible to this. A battery needing to be topped up continually with water is a sign that the electrical system requires checking. Under and over-charging will reduce battery life, so have the charge rate checked at every major service.

Keep batteries clean and dry

Dirt on a battery's surface leads to discharge and corrosion. Avoid spilling oil or grease onto the top of the battery. To remove dirt or moisture, wash with a solution of baking soda/water solution. Rinse afterwards with clean water. Ensure vent plugs are always in place.

Sulphation

An undercharged battery or underutilised battery will slowly discharge (go flat) over time and reduce its life. This is common in boats (over winter) or vehicles left unused for long periods of time such as seasonal farm vehicles. Always keep a battery fully charged to maximise life.

Cable rubs

Rubs on main cables is a common cause of vehicle fires. The rubs can be in the battery box or on the wire run between the battery box and the starter motor. These cables are unfused. Look for rub points and correct them.

Heat

Heat plays a significant role in the life of a battery. Batteries get hot being charged or discharged. Placed in a hot air flow under the bonnet or behind the cab's in the air flow engine tunnel in Cab Over Engine (COE) increases the deterioration. Heat also increases the rate of water evaporation from the cells, leading to loss of water from the electrolyte.

Warning

- Never add acid to a battery.

Warning signs for failing batteries

- Excessive water usage with a flood type battery. All lead acid batteries produce gases during charging and discharging from the breakdown of the water.
- Battery is excessively hot, boiling of the electrolyte and its release from the battery.
- Difficulty starting the engine.
- Lights dimming on starting.



Figure 7: Common battery location on a COE prime mover

Figure 8: Allows access when the body is lowered



11. Dual Battery Installations

Mixed voltage systems

There are setups where there are separate vehicle systems at 24 volts and the auxiliary systems operating at 12 volts with separate battery packs. This has typically resulted from 12 volt equipment being more commonly available and often, more cost effective.

The 12 volt battery pack should be charged via a voltage reducer from the 24 volt system. Never tap into a single battery of 24 volt system to provide a 12 volt power source. This is detrimental to the battery's life.

Preferential charging of the main batteries should always occur versus the auxiliary or secondary battery systems. This is commonly done in the off-road camper / outdoor markets using a dedicated auxiliary battery charger.

Electronic Control Unit (ECU) controlled variable voltage alternators

Recent truck models have an ECU-controlled variable voltage alternators. They are designed to achieve better fuel economy with increased performance and protection that will cut out the alternator, if it senses too high a current draw which often occurs with auxiliary battery packs. These systems vary the voltage from the alternator based on driving conditions. When the alternator voltage is low, the system voltage can drop below 12.7 volts. They feature lower voltage settings so they can continue to operate with a low input voltage from the alternator.

These vehicles will require an in-vehicle battery charger to support the auxiliary battery pack.

Drafting

Editors

– Chris Loose – ATA

Contributors

- ITC Members

Peer Review

- Ngee Chong/PACCAR Trucks Australia

Version Index

Version: 2

Written by ITC: October 2024

Approved by ATA Council: November 2024