

Bulletin 004/2015

NB – This bulletin replaces bulletin 23 released 17/04/2007

Subject	Battery and charging system hazards
Affected Product	All applications
Risk identified	Property damage, Personal injury

Hazard Overview

- Battery explosions can occur on stationary or mobile plant and have the potential to cause serious injury and property damage.
- Batteries contain sulphuric acid with the potential to cause severe burns including eye damage.
- Battery posts, terminals and some internal components contain lead or lead compounds.
- Lifting injuries caused by poor lifting practices, in some cases compounded by difficult to access battery locations.
- Short circuits can cause severe burns and initiate a fire.

Discussion

All 'automotive' type batteries produce hydrogen and oxygen during normal operation. Even when sitting idle, batteries generate small amounts of hydrogen due to self-discharge action. These gases are highly explosive. In some instances, damage to the battery makes it difficult to determine the exact cause of the explosion, but in most cases, one or more contributory causes can be identified. Battery explosions may be caused by any one, or a combination of the following issues:

- An ignition source in close proximity to battery, e.g. loose terminal.
- Loss of electrolyte due to overheating, overcharging or poor maintenance.
- A direct short circuit or sustained high current draw, e.g. sticking starter motor solenoid.

Maintenance Free Batteries

The term 'Maintenance Free' is widely used in the battery industry. It is used to describe the battery grid composition that is manufactured from lead-calcium alloys as opposed to the traditional lead-antimony batteries.

Batteries manufactured using lead-calcium alloys produce less gas when charging, resulting in less water consumption over the life of the battery. However, the term 'Maintenance Free' is misleading. These batteries can still lose water over an extended period, or if subjected to high temperatures. Failure to replenish the water/electrolyte level in the battery can result in an explosion.

Maintenance Free batteries can be either 'non-accessible' or 'accessible'. Accessible maintenance free batteries have caps to allow top up of the electrolyte.

Recommended Management Actions

- Refer to the manufacturer's service and repair procedures before working on any aspect of a vehicle electrical system.
- Always maintain batteries in accordance with the equipment or battery manufacturer's instructions. Maintain electrolyte levels approximately 13 mm above plates. Always top up with de-ionized or demineralised water.
- Before servicing batteries, engine should be stopped, and the battery isolation switch turned off (if fitted)*. Switch off and disconnect battery chargers.
- Wear suitable protective equipment during all maintenance and testing activities related to batteries and battery cables, including 'jump starting'. Protective equipment must include eye and face protection, hand protection and approved industrial clothing.
- Remove metallic jewellery, watches and wristbands prior to working near batteries, battery cables, starter motors and alternators.
- Never lean over a battery when boosting, testing, charging, or 'jump starting'.
- Keep all ignition sources away from batteries, e.g. flames, cigarettes, sparks (a loose terminal can cause a spark).
- Never clean batteries with compressed air. In the presence of dust, static electricity may be generated with the potential to cause a battery explosion.
- Exercise caution when working near batteries with metallic tools or conductors, to prevent short circuits and sparks.
- Always disconnect the ground (black) cable first, before removing positive (red) cable. When reconnecting battery leads, always connect the positive (red) cable before connecting the earth (black) cable. Disconnecting ground cable at 'frame' end can reduce the danger of sparks at battery.
- Inspect cables at all service intervals for insulation damage, clamp and cable security. Loose clamps or plastic coated P-clamps can cause chaffing damage. Inspect under clamps - refer illustrations, page 4.
- Keep battery tops clean using approved methods, e.g. use a solution of 100 grams of baking soda added to 1 litre of clean water, followed by a clean water rinse.
- Keep battery terminals and cable connections clean and tight. Use fine sandpaper or a specifically designed terminal brush to clean corrosion from terminals, e.g. Cat part # 1U9921. After securing terminals, coat with grease or other terminal protectant to prevent corrosion.
- Replacement batteries should have the same dimensions as those specified by the OEM. This will ensure batteries have adequate clearance and are properly restrained by OEM's clamps. Increased height batteries may contact covers and cause short circuits.
- Ensure battery hold down clamps are in good condition and tightened securely.
- Starting systems with two or more interconnected batteries require batteries of the same type and rating. All batteries should be replaced at the same time. Failure to observe these points can lead to overcharging and overheating of one of the batteries.
- Do not connect a 12V appliance to one battery in a 24V system. This can lead to overcharging and overheating of one battery and damage to the appliance. Use a voltage convertor designed for the task.

Recommended Management Actions – continued

- Refer to the manufacturer's instruction when 'jump starting' engines. Incorrect procedures can cause a battery explosion and damage electronic components.
- Read the manufacturer's instruction before connecting a battery charger.
- Investigate rapid depletion of electrolyte levels. Excessive charge rates and high ambient or battery operating temperatures are possible causes.
- If using 'Maintenance Free' batteries, 'accessible type' batteries are recommended in applications where high temperatures may be encountered. Accessible batteries allow electrolyte to be topped up.
- Risk assess all battery lifts, and utilize suitable battery lifting practices.
- Batteries contain products harmful to health and the environment if disposed of incorrectly. Dispose of batteries in accordance with local laws and regulations.

Unattended applications

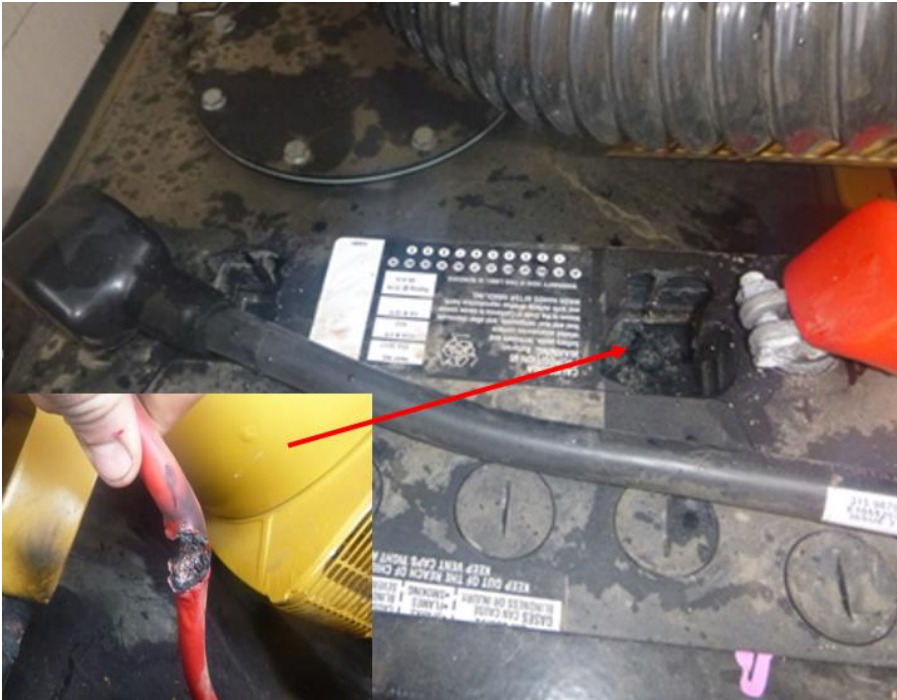
Reports of explosions on stationary and unattended plant are more common than OEM designed mobile installations. Some examples of unattended applications include Generator sets, compressors, and mobile crushing plants. These applications have the potential to encounter additional problems:

- Battery maintenance and regular inspections can be overlooked on unattended engines, e.g. stand-by generator sets.
- Batteries are often located within engine enclosure – this can result in poor ventilation and high battery temperatures. High ambient and operating temperatures will accelerate the loss of electrolyte.
- Stand-by generator sets often have 'trickle' chargers to keep batteries fully charged*. Electrolyte loss will still occur when set is on 'stand-by'.

Additional battery maintenance recommendations for unattended engines

- Use conventional or accessible type maintenance free batteries.
- Replace existing non accessible type maintenance free batteries within 2.5 years of installation in warmer geographical regions (above 20 to 25 degrees Celsius), and no later than 3 years in other regions.
- Ensure 'ceiling' area of enclosures are well ventilated to prevent hydrogen gas accumulating (Hydrogen is lighter than air).
- Check battery electrolyte levels weekly. Investigate abnormal loss of electrolyte – often due to excess charge rate or high temperatures.
- Switch off and disconnect battery chargers before removing battery leads.

* **Warning.** Solid-state equipment like electronic governors and speed sensors may be damaged by transient currents and voltage spikes. Seek advice from suitably qualified people, to select the best charging options, and before modifying starting and charging systems in any way, including the installation of battery-isolation switches.



Battery explosion damage caused by poorly secured cable (inset)



8S-0948 clip & 2V-1771 Grommet
(12mm ID)

4S-1962 Clip & 7V-6571 Grommet
(16mm ID)

Recommended clip type (do not use plastic coated P-clips).



Example of cable chaffing under clamp

Useful Publications:

- Battery Service Manual - produced by Battery Council International. Also available as Caterpillar form number SEBD0625
- Cat Battery Care & Maintenance Guide wall chart, form number PEWP4050

Contact Details:

If further information is required about this bulletin, contact your nearest Hastings Deering branch on 131 228 and ask to speak to a Mining or Product Support Representative.

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