# Mines Safety Bulletin No. 183

**Subject:** Hazard of lightning strikes on vehicles

**Date:** 24 May 2021

## Background

Over the past three years, the Department has been notified of several vehicles on mining operations being struck by lightning, with some experiencing tyre pyrolysis following the event. Pyrolysis may result in tyres exploding unexpectedly, and this poses a risk of serious or fatal injury to workers due to the sudden release of energy. This type of catastrophic failure may occur after a delay of several hours.

Electrical storms occur year-round throughout Western Australia. Lightning is episodic, highly variable and cannot be prevented, and poses a workplace hazard.

Due to the uncontrolled electricity, every dangerous occurrence involving lightning, whether or not it resulted in any bodily injury to any person or damage to property, is a notifiable event under s. 78(h) of the *Mines Safety and Inspection Act 1994*.

## Summary of hazard

A lightning strike on a vehicle may cause pyrolysis within the tyre. This is where heating of the rubber (inner liner) releases gaseous, volatile organic compounds into the air chamber of the tyre. Under certain temperature, pressure and concentration conditions, this volatile combination of air and fuel can become an explosive mixture and ignite.

Such events can lift the vehicle or cause debris to be propelled into the vehicle or over hundreds of metres. This sudden release of energy can be potentially fatal to people near, or inside, the vehicle.

During a lightning strike, the arc temperature rises to around 30,000 degrees Celsius. The rapid heating and cooling of the surrounding air causes a sound shock wave known as thunder. The pressure generated by thunder may exceed 10,000 kPa. This shock wave may injure a person in the close vicinity of the lightning strike. An eardrum can rupture when the pressure exceeds 275 kPa and lethal injury will occur when the pressure exceeds 635 kPa.

While sheltering in a vehicle during an electrical storm is safer than being in the open, vehicles, including haul trucks and other heavy vehicles, are not designed to protect occupants from the potential effects of a lightning strike or to be a Faraday cage. Vehicles in exposed locations may even serve to attract lightning.

A lightning strike on a moving vehicle may introduce other hazards to workers, including:

- fires from short circuiting batteries, tyres and flammable material resulting in burns
- temporary blindness from the arc strike resulting in a loss of control
- failure of electric assisted braking and steering resulting in a loss of control.

## Contributory factors

- Hazards associated with lightning are not always identified, and this includes the potential effects of a lightning strike on a vehicle.
- Vehicles, including those with heavy tyres, are not designed to protect occupants from the potential effects of a lightning strike.
- Pyrolysis events may result in tyres exploding unexpectedly, and this poses a risk of serious or fatal injury to workers due to the sudden release of energy. This type of catastrophic failure may occur after a delay of several hours.

## Actions required

- Review the risk assessment for workers being in the open or operating vehicles during an electrical storm where there is a possibility of lightning strikes occurring.
- Control the hazards and risks related to electrical storms and lightning strikes adequately to reduce the exposure of workers to potential harm.
- Review procedures related to working in the open or operating vehicles when there is the potential for exposure to lightning, and ensure they adequately address the risk assessment.
- Provide workers with sufficient warning of a potential lightning event and allow time for them to take shelter in a building that has lightning protection.

## Further information

Department of Mines, Industry Regulation and Safety

- *Tyre safety for earth-moving machinery on Western Australian mining operations*–Guideline www.dmp.wa.gov.au/Documents/Safety/MSH_G_TyreSafetyEarthMovingMachineryWAMines.p
- SIR No. 260 – *Autonomous truck significantly damaged by lightning strike* www.dmp.wa.gov.au/Documents/Safety/MSH_SIR_260.pdf
- MSB No. 46 – *Lightning - hazards and safeguards* www.dmp.wa.gov.au/Documents/Safety/MSH_SB_046.pdf
- ThinkSafe Magazine Vol. 2 No. 2 May 2020 www.issuu.com/dmirs_wa/docs/thinksafe_may20

Standards Australia

- AS/NZS 1768 – Lightning protection

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