

SAFETY BULLETIN

DATE: NOVEMBER 2019

Drive shaft failures causing fires

This safety bulletin provides safety advice for the NSW mining industry.

Issue

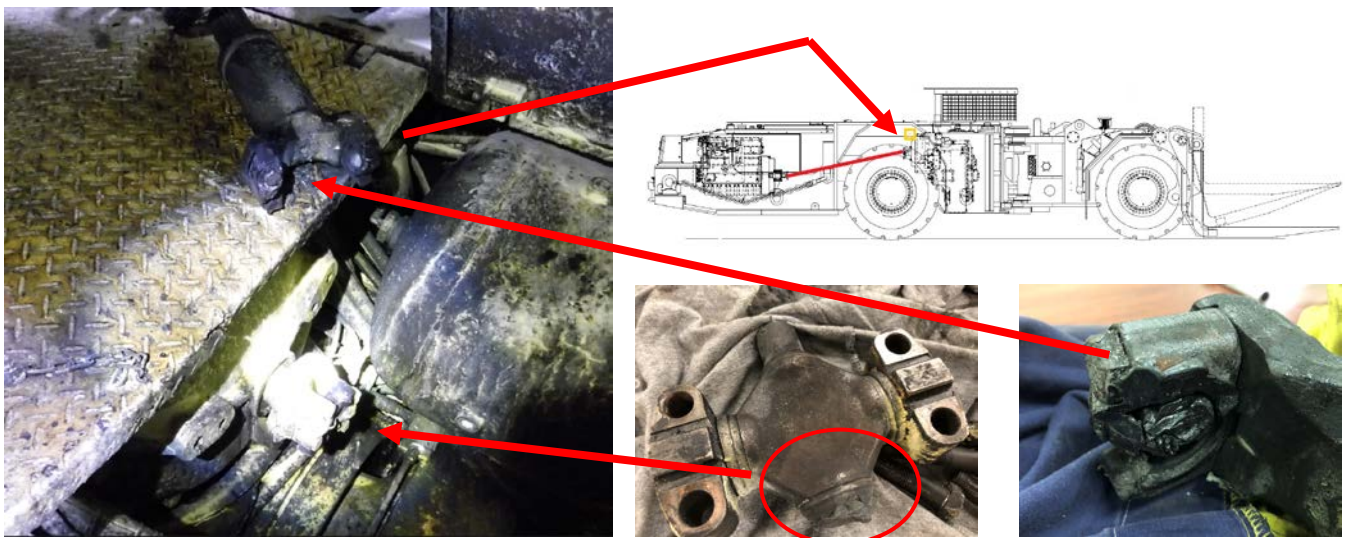
Several recent incidents involving universal joint or drive shaft failures resulting in fires on mobile plant has prompted the NSW Resources Regulator to issue this safety bulletin. Although no-one was injured in these incidents, different circumstances could have resulted in serious injuries or fatalities.

Two of the three incidents below involved catastrophic failure of the universal joints resulting in damage to adjacent hydraulic components from the whipping tail shaft. In both instances, the universal joint failures involved 'lube for life' universal joints and occurred within the original equipment manufacturer (OEM) specified operating life cycle of the component. The third incident was most likely the result of a manufacturing error in the bearing support bracket. This indicates that none of the reported incidents were caused by poor maintenance practices.

Circumstances

Incident 1:

Figure 1 Failed universal joint on underground coal, heavy haulage load haul dump (LHD) machine



A shield hauler was driving in an underground coal mine, when a bearing failed on the universal joint connecting the drive shaft from the engine to the torque converter, at the torque converter end. The drive shaft was not restrained by safety loops. Before the engine could be shut down, the drive shaft spinning at engine speed contacted components, hydraulic and pneumatic lines, which resulted in a spray of hydraulic fluid and compressed air that ignited. The operator manually activated the fire suppression system that extinguished the main fire. The operator also had to use a hand-held fire extinguisher to snuff a fire in the sound suppression material, which was on the underside of a transmission area access cover knocked open by the drive shaft.

Incident 2:

Figure 2 Watercart extensively damaged following drive shaft failure



An articulated water cart was travelling down a haul road at an open cut coal mine when the front main drive shaft universal joint failed. As it failed, the loose rotating shaft destroyed a guard and damaged the main hydraulic pump and hoses. This sprayed hydraulic oil onto the engine, which ignited on hot components. The operator stopped the truck and activated the fire suppression system. The operator safely exited the vehicle before the fire reignited, extensively damaging the truck.

Incident 3:

Figure 3 Heat damage to an underground haul truck



At an underground metalliferous mine, a loader operator saw a glow from under a haul truck. The loader operator radioed a truck operator who stopped and extinguished a small bearing fire on the tail shaft. Following the incident, the original equipment manufacturer (OEM) issued a safety bulletin.

In review

Universal joints and drive shaft bearings can fail prematurely:

- causing significant damage to surrounding components if not contained
- causing the release of hydrocarbon fuels
- achieving temperatures sufficient to ignite lubricating greases and atomise hydraulic oil, resulting in fire.

Legislation

Clause 26(4)(a) of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 requires the operator of a mine to prepare and implement a mechanical engineering control plan that sets out the means by which the operator will manage those risks in accordance with clause 9.

Schedule 2 clause 2(2)(f) of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 requires the mechanical engineering control plan to set out control measures for risks to health and safety from uncontrolled fires being initiated and fuelled by plant.

Recommendations

It is recommended that mine operators, contractors, overhaul workshops and other people in control of mobile plant review their safety management systems (SMS), focusing on:

1. conducting an audit of mobile plant to confirm suitable and adequate drive shaft safety loops are installed to retain the shaft in the event of universal joint failure
2. reviewing maintenance management systems to ensure universal joints, drive shafts, slip joints and bearings have been included in periodic maintenance scheduled activities
3. considering OEM recommendations, site environmental conditions, experienced maintenance worker feedback, duty cycles and relevant technical bulletins when establishing scheduled maintenance
4. reviewing fire risk assessments for the inclusion of catastrophic drive shaft failure. Assessment should identify potential ignition and fuel source risks and controls
5. reviewing fire suppression systems coverage for drive shaft and transmission areas
6. reviewing introduction to site checklists to include inspecting drive shaft safety loops and lifecycle management of universal joints
7. considering using thermal imaging tools to establish baseline temperature profiles of drive shaft bearings and universal joints for ongoing condition monitoring and early fault detection.

It is recommended that equipment designers and manufacturers review their safety documentation and equipment, focusing on:

1. fire risk controls for the failure of universal joints and bearings, including:
 - a. driveshaft design loads, angles of operation and expected design life
 - b. design of safety loops to contain drive shafts
 - c. quality controls to verify installed driveshaft angles and locations
 - d. information provided to users to maintain the lifecycle of drive shaft components.
2. protection for operators from catastrophic drive line failures
3. protection of personnel from live drive shafts
4. protection of potential fuel sources from catastrophic drive line failures
5. using fire suppression systems, placement of fire detection devices and suppression nozzles in the detection and suppression of fires from drive line failures.

Related information

OEM safety alerts and bulletins:

- Caterpillar, Technical Information Bulletin, Universal Joint May Fail on Certain Face Haulages, Load Haul Dumps, and Roof Support Carriers (dated 9 October 2019).
- Bucyrus, Technical Information Bulletin, BN-0431, applicable to Engine to Transmission driveshaft fitted to FBL10/15/40/55/55H/60, FBR15 and MH40 (dated 7 May 2010).
- Sandvik, Safety Bulletin, No. 2019-20, Potential Fire Hazard Resulting from High Operating Temperature of the rear driveline support bearing (dated 5 April 2019).

NOTE: Please ensure all relevant people in your organisation receive a copy of this safety bulletin and are informed of its content and recommendations. This safety bulletin should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's common area, such as your notice board where appropriate.

Visit our [website](#) to:

- find more safety alerts and bulletins
- use our searchable safety database
- sign-up to receive mine safety news.

© State of New South Wales through Department of Planning, Industry and Environment 2019. You may copy, distribute, display, download and otherwise freely deal with this publication for any purpose, provided that you attribute the Department of Planning, Industry and Environment as the owner. However, you must obtain permission if you wish to charge others for access to the publication (other than at cost); include the publication in advertising or a product for sale; modify the publication; or republish the publication on a website. You may freely link to the publication on a departmental website.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (October 2019) and may not be accurate, current or complete. The State of New South Wales (including the NSW Department of Planning, Industry and Environment), the author and the publisher take no responsibility, and will accept no liability, for the accuracy, currency, reliability or correctness of any information included in the document (including material provided by third parties). Readers should make their own inquiries and rely on their own advice when making decisions related to material contained in this publication.

DOCUMENT CONTROL

CM9 reference	DOC19/908454
Mine safety reference	SB-11
Date published	4 November 2019
Authorised by	Chief Inspector Office of the Chief Inspector