



SAFETY ALERT

Maintenance of Safety Critical Systems - Braking, Steering & Warning Systems

INCIDENTS

There have been several incidents relating to the failure of braking and steering systems on mobile equipment. One incident resulted in a workplace fatality.

Incidents involved mobile equipment in **both above-ground and below ground applications.**

Note: Safety critical systems in this safety alert includes those systems which are critical to the safe operation of the truck such as braking, steering, warning systems, operator restraints and operator protection.



The failure of safety critical systems can lead to trucks becoming out of control causing severe injury, property damage or death

CIRCUMSTANCES

In all circumstances the mobile equipment was descending a grade and then due to the failure of a safety critical system, control was lost. The backup emergency/secondary braking and steering systems were unable to prevent the mobile equipment from collision.

While the majority of incidents involved off road and on road trucks, incidents also involved underground personnel carriers, load haul dump vehicles and mobile cranes.

On four occasions the initiating event for the incident was a failure of the engine or transmission retarder (retard brake). On three occasions there was a mechanical or electrical component failure which initiated the event. On one occasion it appears the initiating event was the truck running out of diesel fuel.

In some incidents the truck's service and emergency/secondary brake performance was not capable of pulling up the truck on the decline upon failure of the retarder brake.

Other common factors were seat belts in conjunction with fit for purpose operator protection, prevented serious injury when worn.

INVESTIGATION

The investigations found that on all occasions the failure of safety critical systems from poor maintenance practices were contributing factors.

Common failure modes included:

Safety Critical System	Failure Mode
<i>Emergency steering system</i>	<ul style="list-style-type: none"> - Loss of gas pressure in the accumulator - Mechanical structural failure
<i>Service & emergency/ secondary brakes</i>	<ul style="list-style-type: none"> - Seal wear failure of air over hydraulic pressure converter - Seal failure of wheel axle leaking onto brake disc - Brake disc pads missing - Brake pads worn out - Air leaks reducing brake application pressure - Loss of brake fluid - Mechanical structural failure
<i>Transmission / engine retarder</i>	<ul style="list-style-type: none"> - Mechanical linkage failure to retarder - Loss of air pressure - Electrical component failure - Loss of diesel fuel causing engine to stop - Human error – Incorrect gear selection, going too fast prior to decline
<i>Park brake</i>	<ul style="list-style-type: none"> - Out of adjustment - Brake pads worn out - Mechanical linkage failure
<i>Brake over stroke warning</i>	<ul style="list-style-type: none"> - Physical damage
<i>Low steering pressure warning</i>	<ul style="list-style-type: none"> - Physical damage of electrical cables

The investigation has also found that on most occasions:

- There was inadequate or no daily prestart safety checks being carried out which should have identified the defect and placed the mobile equipment out of service.
- Maintenance was not being carried out by competent people familiar with the safety critical systems.
- Safety critical systems were not being periodically checked and tested for functionality.
- Maintenance was not being carried out in accordance with the equipment manufacturer's recommendations.
- Documentation on daily safety checks, maintenance activities and defect rectification was inadequate.
- Manufacturer's documentation was inadequate to confirm the integrity of all safety critical systems.

Examples of Some Faults Found on Braking Systems



Brake pads worn off



Drive shaft failure



Oil encapsulating brake calliper

RECOMMENDATIONS

All **mines** should immediately review their mine safety management plan (MSMP) to ensure:-

1. All foreseeable hazards associated with mobile plant becoming out of control have been addressed, including:-
 - Failure of the primary retardation system or failure of other mechanical components.
 - Condition of roads including signage, and bunding.
 - Operator error such as incorrect gear selection.
 - Operator actions in an emergency.
2. Maintenance managements systems:-
 - Identify and document all safety critical systems on mobile equipment.
 - Periodically check and test all safety critical systems to confirm their functionality.
 - Are in accordance with the equipment manufacturer's recommendations with consideration to site operational conditions.

Note: Some site conditions require more rigorous maintenance than that specified by the manufacturer due to the operating environment
3. Daily prestart safety checks are rigorously carried out with all identified defects being assessed by a competent person before the equipment is put to use.
4. Operators, supervisors and maintenance people involved with mobile plant are familiar with all safety critical systems, trained and competent for their task.

5. A competent person inspects mobile equipment periodically and verifies it is safe to operate.
6. A documented safety file is maintained throughout the life of the mobile equipment and the safety file contains all information relating to:-
 - Checks and tests of safety critical systems.
 - Daily prestart safety checks.
 - Defect notification and rectification.
 - Preventative maintenance activities.
 - Training and competency records for operators, supervisors and maintenance personnel.
 - Results of actions from periodic audits and reviews.
7. Auditing of site maintenance practices and daily safety checks is carried out periodically against the documented MSMP.
8. Mobile equipment is assessed against relevant requirements of MDG 15.
9. Operator and passenger protection is provided and being worn.

All **mobile equipment designers, manufacturers and suppliers** should review designs and documentation to ensure:-

1. Documentation provided to the end user includes:
 - The identification of all safety critical systems.
 - The systematic and periodic examination and testing of all safety critical systems.
2. All safety critical systems will remain functional over the mobile equipment's lifecycle if maintained in accordance with the documentation provided and the specified requirements are practicable with consideration to the designed operating environment.
3. All safety critical systems have been assessed and the appropriate integrity level applied in accordance with AS 4024, AS 62061, AS 61508 or other similar standards.
4. A Failure Modes and Effects Analysis (FMEA) or other similar risk assessment method has been carried out to confirm the integrity of all safety critical systems.
5. Warning systems are designed such that failure of the warning system will give rise to the activation of an audible alarm.

Signed



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