# Mines Safety Bulletin No. 126

**Subject:** Inspection and re-certification of a roll-over or falling-object protective structure (ROPS or FOPS)

**Date:** 09 October 2015

## Background

A roll-over protective structure (ROPS) or falling-object protective structure (FOPS) is used to protect individuals travelling correctly (e.g. seatbelt fastened, doors closed) in the cabin of mobile equipment from the consequences of a roll-over or objects falling on the cabin.

These structures are designed and destructively tested in accordance with International Standards ISO 3471 and ISO 3449 to provide full protection to the operator. They are certified as compliant by the manufacturer or supplier at the time of delivery. Prior to acceptance of the design of any ROPS or FOPS, destructive tests must be carried out on a prototype of each structure and the test results must comply with the standard.

However, the ISO standards do not provide guidance for ongoing periodic maintenance, inspection or re-certification to ensure the structure continues to provide full protection for the life of the equipment. Also, there is duty holder confusion regarding the application of some standards and the Mines Safety and Inspection Regulations 1995.

Example of typical ROPS/FOPS structure
for protection of small excavator cab.

### Regulatory requirements for a ROPS or FOPS

The requirements applicable to these structures under the Mines Safety and Inspection Regulations 1995 are described below.

- Powered mobile plant must be fitted with appropriate operator protective devices if there is an otherwise uncontrolled risk of exposure to overturning or falling objects. [rr. 6.4(2)(b) and (c)]

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- Earth-moving machinery used at a mine must be fitted with a ROPS that complies with Australian Standard AS 2294. [r. 4.15]

  *Note: The latest (1997) version of this standard effectively adopted the ISO standards. The Mines Safety and Inspection Amendment Regulations 2012 (gazetted in January 2013) adopted the latest versions of Australian Standards, therefore AS 2294:1997 is now mandatory for equipment manufactured after January 2013.*

- The definition of "earth-moving machinery" is extended to include earth-moving machinery that has been modified to perform other service functions (e.g. off-highway haul trucks converted to water trucks). [r. 4.15(1)]

  *Note: Because regulation 4.15(1) excludes earth-moving machinery that is only used underground, regulation 4.15 only applies to "quarry operations" as defined in Section 4 of the Mines Safety and Inspection Act 1994. This includes any associated roads, ore stockpiles, waste dumps and tailings dams and all areas of the mine where earth-moving machinery is used for mining production or development work.*

- Depending on risk assessment, on-highway type trucks used in quarry operations, particularly as water trucks, may also be expected to have a ROPS. [rr. 6.4(2)(b) and (c) may apply; refer to guidance in Mines Safety Bulletin No. 28 *Rollover protection for surface earth moving machinery*]
- Any agricultural tractor used at a mine must have a ROPS that complies with AS 1636. [r. 4.15]
- All trackless underground mining equipment (with an on-board operator) and underground service units must be fitted with a FOPS that complies with AS 2294. [r. 10.46]

The regulations require a ROPS or FOPS to be fully functional whenever the vehicle is in service, regardless of age or condition. It is expected that, as part of the mining operation's safety management system, a ROPS or FOPS is appropriately inspected and maintained to confirm its function is not impaired.

- If the ROPS or FOPS on a vehicle is structurally damaged, the vehicle must be withdrawn from service until the structure is repaired or replaced to a fully functional condition so that it conforms with AS 2294. [rr. 4.15 and 10.46]
- Whenever any plant is damaged to the extent that its function or condition is impaired and hazards increase, the damage must be assessed by a competent person, and any repair, inspection and, where necessary, testing is carried out by a competent person. [r. 6.22]

## Summary of hazard

A ROPS or FOPS provides protection during a roll-over or when objects (e.g. rocks) fall on the cabin because the structure and its mountings absorb energy. However, if the structure's integrity is compromised, the cabin may be damaged or crushed in an incident, and occupants harmed.

## Contributory factors

### Reduced performance

The performance of a ROPS or FOPS may reduce over time due to factors such as:

- corrosion arising from age and exposure to moisture (e.g. water trucks, underground equipment) or corrosive dust (e.g. nickel sulphide ores)
- excessive flexing of vehicle chassis leading to metal fatigue (e.g. poor road conditions, cracked welds)

- exposure to excessive vibration (i.e. metal fatigue)
- unauthorised modifications to the structure
- general damage to the structure (e.g. impacts, accident damage)
- vehicle fire or excessive heat
- a ROPS or FOPS relocated from an old vehicle to a new vehicle with a higher mass (i.e. may not be fit for purpose)
- incorrect re-installation of a ROPS or FOPS when relocated from an old vehicle to a new vehicle.

**Lack of understanding of requirements**

Some common sources of misunderstanding and confusion in industry are discussed below.

- Earlier versions of the ISO ROPS standards only included criteria for "mid-range" sized earth-moving machines. In the past, therefore, some very small and very large machines were often delivered without a ROPS, or with a ROPS that was not certified to the standard.

  The latest versions of the standards now include criteria for all sizes of machines. The current version of AS 2294 and the reference ISO standards were in place in January 2013 when the Mines Safety and Inspection Regulations 1995 were amended to update Australian Standards. This means the later criteria are enforceable for machines purchased after January 2013.

- AS 2294.1:1997 effectively adopted the ISO standards. However, since 1997, Parts 2, 3 and 4 of AS 2294 have been discontinued. Because the regulations only refer to AS 2294, some duty holders have interpreted that the ISO standards are not mandatory. However, AS 2294 Part 1 (which has not been updated) is still in place and adopts the ISO standards.
- As neither the Australian nor ISO standards recommend any periodic inspection intervals, some duty holders only inspect a ROPS or FOPS when damage or incidents are reported. In some circumstances, this may not be a sufficiently safe system of work.
- There is uncertainty about what is considered to be "minor damage" not requiring immediate action to repair. AS 2294 defines minor damage as deformations that are "well outside the deflection-limiting volume with no damage to welds or any cracks in the structure". ISO 3164 has further guidance on determining the deflection-limiting volume.

## Actions required

The following actions are recommended for duty holders to help maintain the structural integrity of a ROPS or FOPS so it performs as designed.

**Compliance plates and documentation**

- Confirm that any ROPS or FOPS on site includes an appropriate manufacturer’s compliance plate on the machine that is visible and legible.
- Confirm that documentary evidence is available on site that the ROPS or FOPS is certified compliant with AS 2294, AS 1636, ISO 3471 or ISO 3449 as appropriate.

  *Note: Acceptable documentary evidence may include either a copy of the destructive test report (see “Further Information”) from an acceptable certifying body and/or a signed compliance statement from the manufacturer referencing the correct test report. Details in the test report or compliance statement should be complete, correct and match the information on the compliance plate.*

- Immediately re-certify and re-plate, or replace, any ROPS or FOPS in service that has no legible compliance plate, and for which insufficient supporting documentation is available to demonstrate compliance.
- Do not swap a ROPS or FOPS between vehicles. Compliance plates and compliance statements should include the vehicle identification number (VIN) or another unique vehicle identifier to help discourage such practices.

### Maintenance and inspection

- Implement a system of periodic inspections by suitably competent persons to ensure a ROPS or FOPS is not damaged to an extent that its function may be impaired. Use a risk assessment to select the interval between inspections.
- Where possible, contact the original ROPS or FOPS designer, manufacturer or supplier to inspect and re-validate the certification of the structure.
- Provide a pre-start checklist for the machine operator that includes visual checks of the ROPS or FOPS. Train operators so they are aware of the defects to look for.
- Assign a competent person or the original manufacturer or supplier to assess significant damage to a ROPS or FOPS in accordance with the ISO standards and sound engineering practice.
- A significantly damaged ROPS or FOPS should be removed from service until the structure is replaced or properly repaired and re-inspected by a competent person or to the satisfaction of the original manufacturer or supplier (i.e. re-certified and re-plated).
- When a ROPS or FOPS is repaired or modified, confirm that documentary evidence is available on site showing compliance with the appropriate standard (i.e. re-certified and re-plated).

  *Note: Do not repair or modify structural members by actions such as welding on additional parts, drilling holes, cutting, grinding or bending because these changes can affect the rigidity of the ROPS or FOPS and therefore its performance.*

## Further information

### Standards and safety alerts

- International Standards Organisation, www.iso.org

  ISO 3471:2008 *Earth-moving machinery – Roll-over protective structures – Laboratory tests and performance requirements*

  ISO 3449:2005 *Earth-moving machinery – Falling-object protective structures – laboratory tests and performance requirements*

  ISO 3164:2013 *Earth-moving machinery – Laboratory evaluations of protective structures – Specifications for deflection-limiting volume*

- Standards Australia, www.standards.org.au

  AS 2294.1:1997 *Earthmoving machinery – Protective structures – General*

  AS 1636:1996 (Parts 1, 2 and 3) *Tractors – Roll-over protective structures – Criteria and tests*

- Department of Mines and Petroleum, www.dmp.wa.gov.au/ResourcesSafety

  Mines Safety Bulletin No. 28 *Rollover protection for surface earth moving machinery*

**Destructive test report for a ROPS or FOPS**

A test report from a suitably accredited certifying body is required for each ROPS or FOPS. The report should include:

- identification details of the machine and the prototype tested
- the tare weight range, gross vehicle mass range or other mass-related design criteria for the structure, whichever is required in accordance with the relevant standard.
- location of the deflection-limiting volume (DLV)
- calculations of the test forces required
- confirmation of the performance of the tests
- a photograph of the prototype in the test rig
- copies of any relevant design drawings
- name and address of the test facility
- date of the test
- name and signature of the person carrying out the test.

ROPS and FOPS manufacturers or suppliers must provide operators with either:

- a copy of the test report, or
- other compliance documentation that references the correct test report.

ROPS and FOPS manufacturers or suppliers should retain the original test reports. If the test report is unavailable, operators should consider having the ROPS or FOPS recertified or replaced.

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