



Significant Incident Report No. 208

Subject: Bystander struck by component ejected from accumulator

Date: 17 November 2014

Summary of incident

A bystander in a mining heavy vehicle workshop had his arm broken when he was struck by a component ejected from a suspension hydraulic accumulator that was being worked on by a fitter.

Before the incident, the accumulator had been checked to a point where it was believed that it had been made safe. Check steps included:

- several days before the incident, when removing the accumulator from the haul truck, opening the poppet valve at the gas end of the accumulator to vent nitrogen gas to atmosphere
- closing the poppet valve after the gas had vented
- on the day of the incident, re-opening the poppet valve as a precaution to check for gas pressure — the valve body was then briefly removed from the accumulator, and loosely screwed back in a couple of turns, but left sufficiently loose to allow oil to continue draining through the open valve and a relief groove in the valve body.

After ejection of the piston, the oil draining out of the accumulator foamed for some time (see “Further information” for explanation).

Direct causes

- Contrary to original equipment manufacturer (OEM) disassembly instructions, the hydraulic end cap was removed while the poppet valve was still in the gas end cap.

Contributory causes

- The phenomenon of dissolved gas bubbling from the oil had not been identified nor allowed for during the disassembly process.
- The repair was considered such a frequent and routine task that it appeared not to warrant a detailed risk assessment nor a review of the task methodology.
- Detailed written procedures specifically for work on accumulators were not readily available.
- The information that was available on site had not been reviewed for some time.

Actions required

This incident highlights the need to ensure that pressure vessels, such as accumulators, are handled and managed appropriately. In particular, OEM instructions should be followed to:

- fully depressurise the pressure vessel before disassembly
- open the vessel to the atmosphere before and during disassembly
- disassemble the pressure vessel.

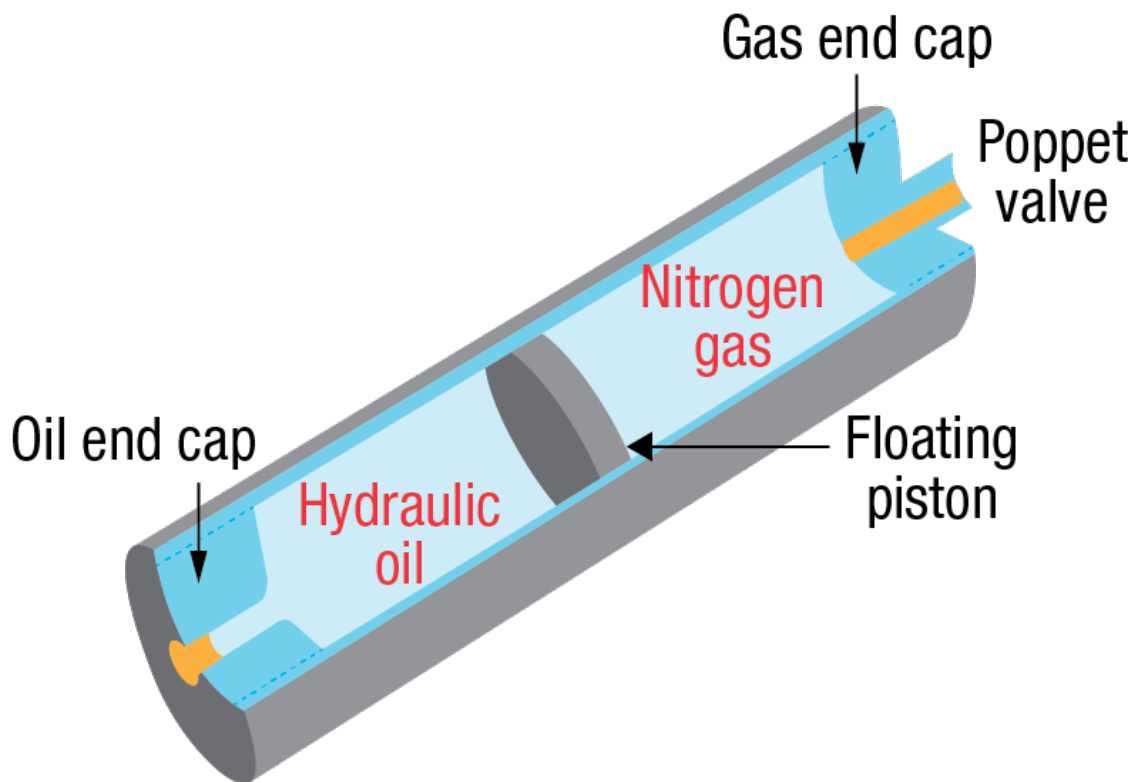
Industry and vocational training needs to clearly emphasise the importance of following OEM and site procedures when working on pressure equipment.

Mine operators are reminded of the importance of maintaining safe systems of work for tasks involving pressure vessels. They should ensure that:

- written work procedures are maintained and made available to workers
- maintenance is only carried out by competent workers using appropriate tooling, parts and materials produced to the current design specification.

The possibility that residual pressure may remain in the vessel needs to be considered as it can lead to unexpected component movement during removal.

Further information



Schematic sectional view of a hydraulic accumulator. The piston is not fixed but is free to slide inside the accumulator barrel as the oil and gas pressures vary.

Accumulator failure is commonly attributed to the piston seal wearing out. The performance of the suspension system deteriorates, leading to poor ride quality, vehicle damage and stability issues.

When the piston seal fails, hydraulic oil leaks from the hydraulic chamber, passing the floating piston and entering the accumulator's gas chamber. As oil slowly fills the gas chamber, the high pressure exerted on the oil by the gas during operation can force gas to dissolve into the oil. There can be excessive foaming when the pressure is released (e.g. during maintenance). As gas bubbles from the oil, it can build to sufficient pressure that, when the hydraulic end cap is removed, the piston can be ejected from the accumulator.

Examples of incidents involving hydraulic accumulators are listed below:

- www.worksafenb.ca/docs/HA_ExplodingHydraulicPistonAccumulator.pdf

Hazard alert: Exploding hydraulic piston accumulator (July 2014)

Note: In the diagram of the hydraulic accumulator in this hazard alert, the labels for oil and N2 are transposed and should be switched.

- www.ohsu.edu/xd/research/centers-institutes/oregon-institute-occupational-health-sciences/outreach/or-face/reports/upload/ORFACE-Final-Report-2011-16-hydraulic-accumulator.pdf

Fatality investigation report: Millwright fatality involving a hydraulic accumulator (November 2013)

- www.maqohsc.sa.gov.au/news_detail.cfm?NewsID=114

Unexpected ejection of piston from hydraulic accumulator (May 2013)

This Significant Incident Report was approved for release by the State Mining Engineer on 17 November 2014