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HEALTH & SAFETY CONFERENCE

2015



49" EV Rim Safety

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Purpose

The purpose of this session is to create a greater understanding of potential hazards associated with heavy vehicle tyres and rims, with particular focus on the 49" EV style rim assembly.

This session will also examine new control measures that may be adopted to eliminate, and / or minimise as far as possible, the risks associated with sudden disassembly of 49" EV style rims.



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49" EV Style Rims – Technical Review

An external engineering team, supported by metallurgists from UQ, were engaged to focus on the 49" EV style rim componentry to verify design integrity and to determine possible disassembly modes. The technical review involved four key stages:

- Detailed examination of componentry that had failed in the past to identify damaged surfaces, deformations, or other irregularities.
- Simulations using new componentry.
- Comparison of damage evident on the simulation componentry and the componentry known to have suddenly disassembled in the past.
- Final correlation and analysis of results from simulations to confirm the disassembly mode.



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EV Style Section View – Key Components

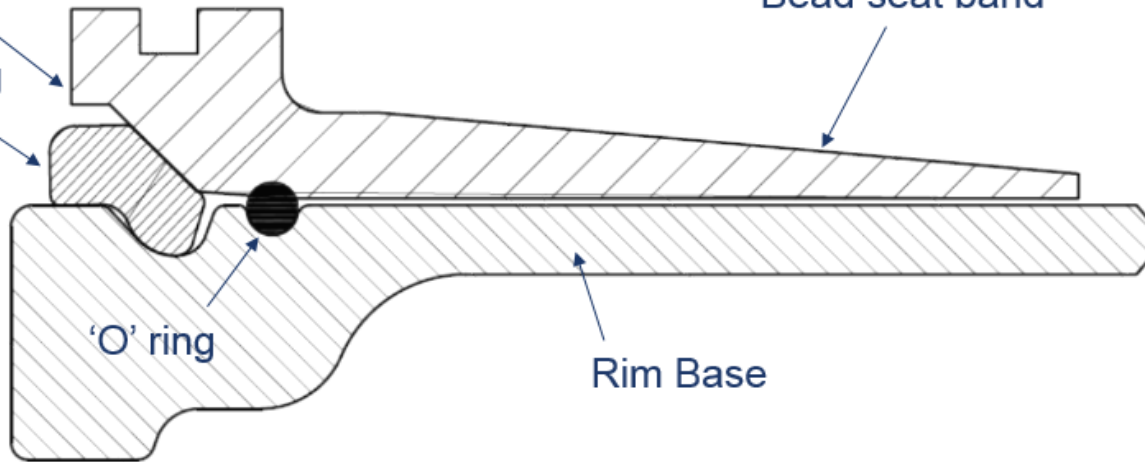
Bead Seat Band Hood

Lock ring

Bead seat band

'O' ring

Rim Base



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Simulations

- Simulations involving similar componentry, under similar loading and overloading conditions were conducted to explore conditions that either permit, or prevent a lock ring to eject.
- Hydraulic jacks were used to simulate pressure on the components. The lack of stored energy in the hydraulic jacks ensured safety during these simulations.



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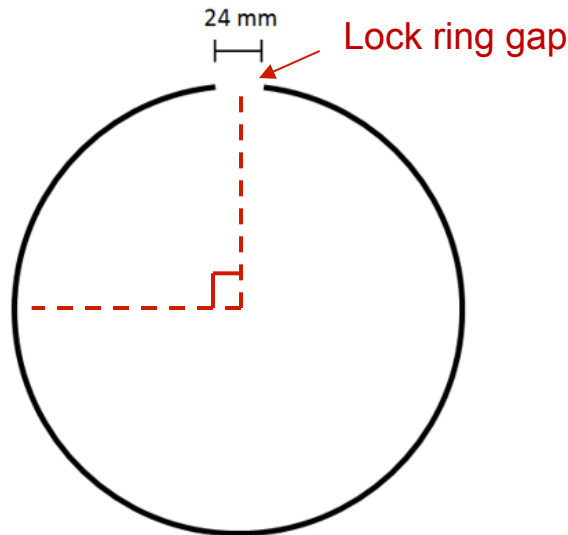
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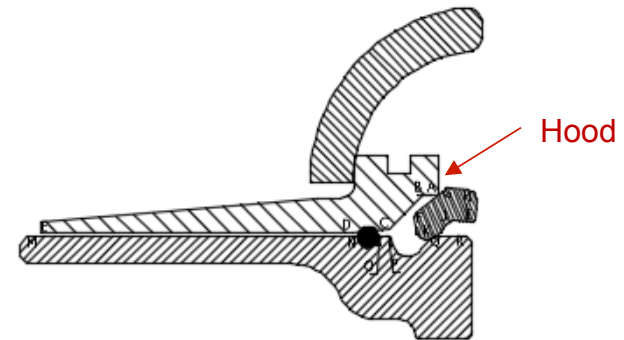
Disassembly Mode

The lock ring was held out of its landed position by the bead seat band 'hood' at a position approximately 90 degrees from the lock ring gap. This is where the failure mode commences.

The application of pressure subsequently results in a rotating/ extruding type of expulsion of the lock ring from the groove / bead seat band gap.



07-15-08-30 EJECTION IN PROGRESS



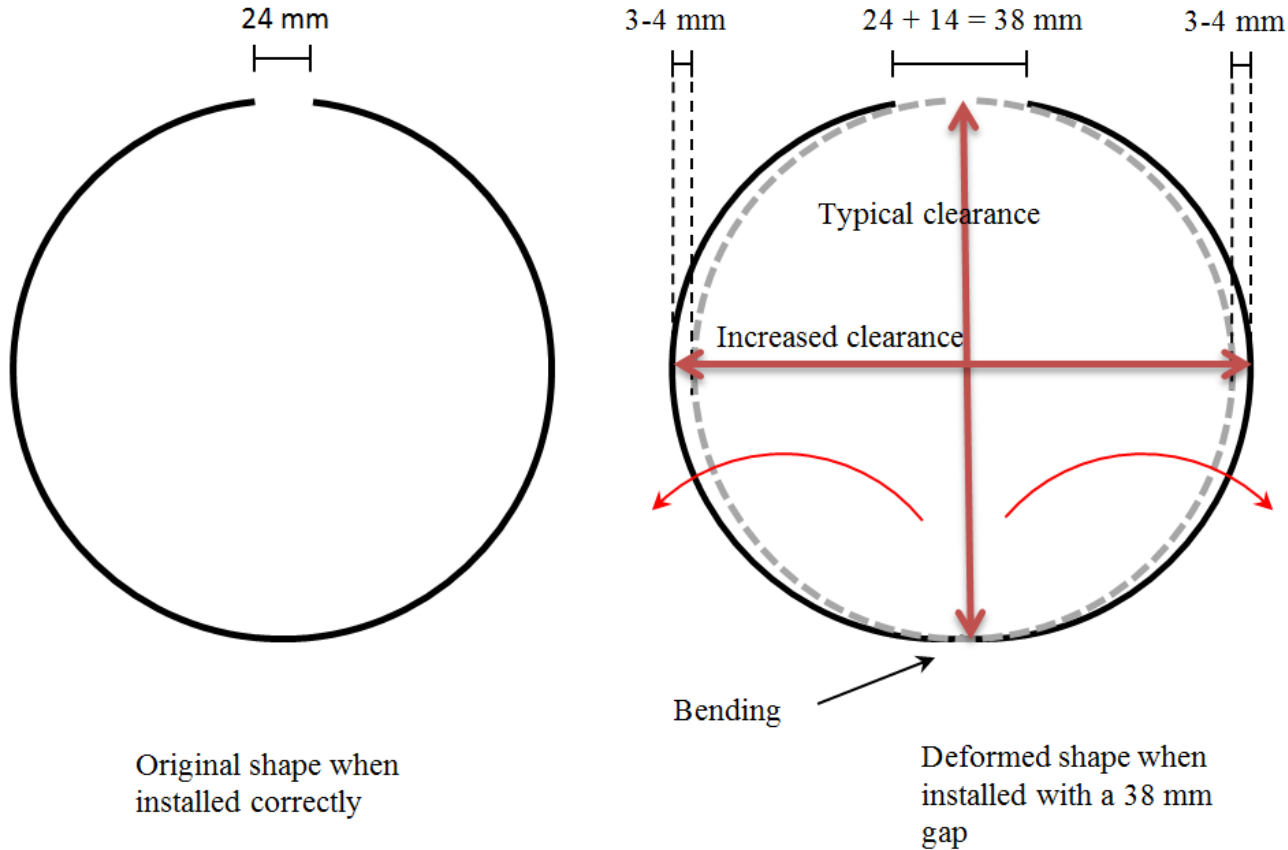
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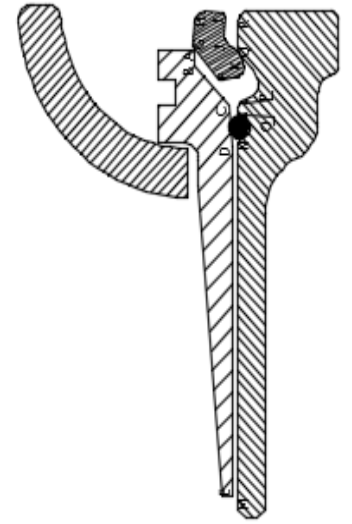
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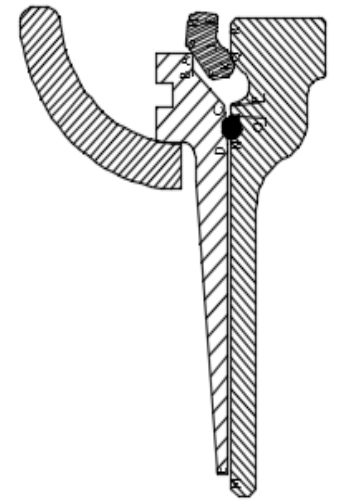
Lock Ring



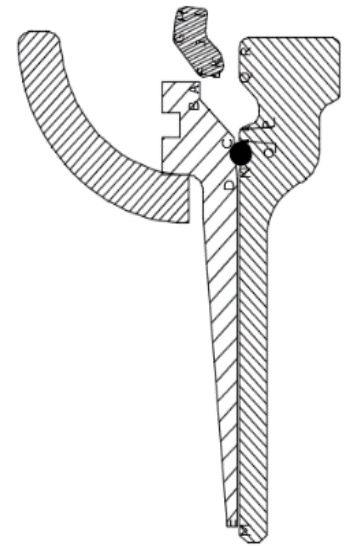
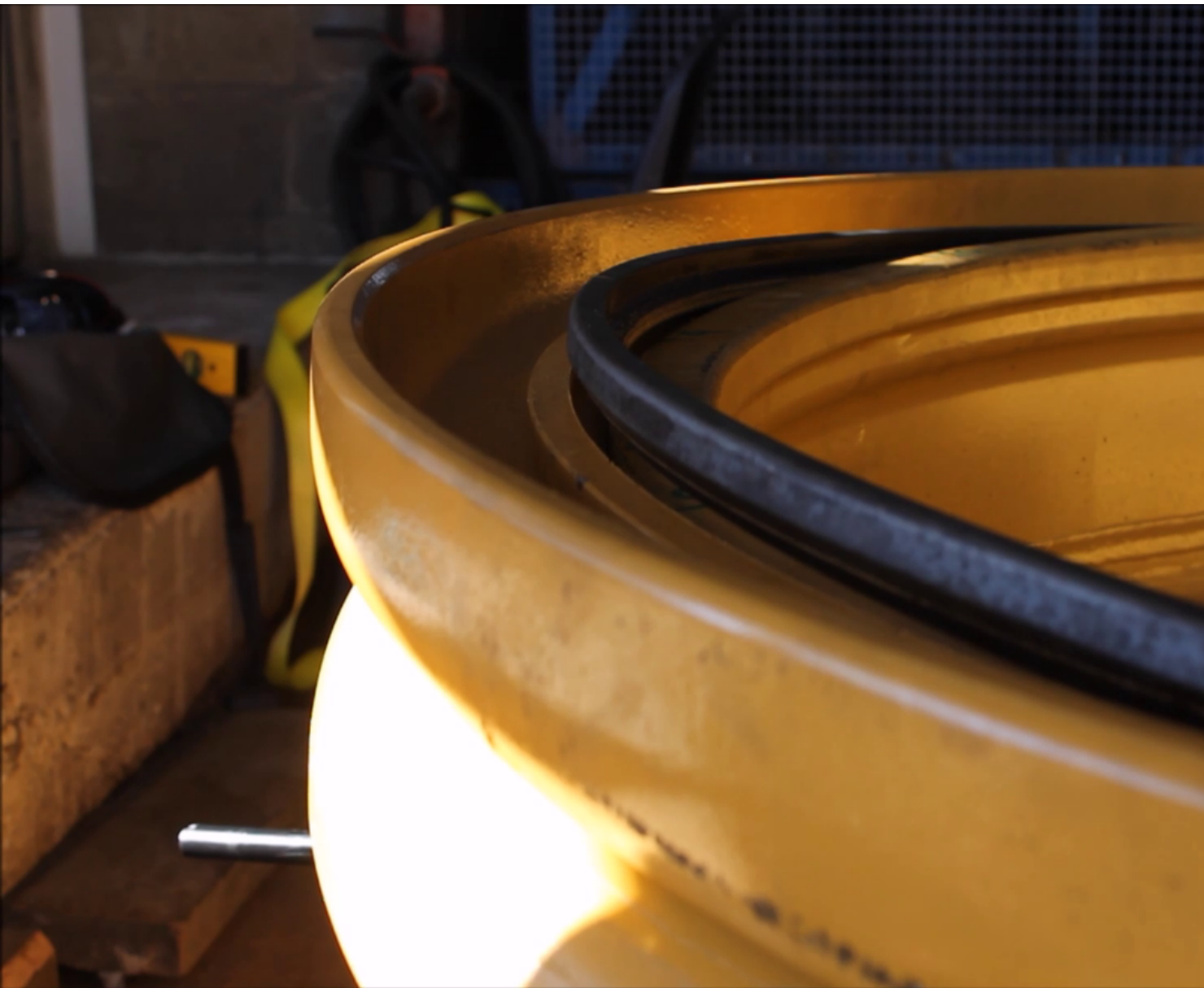




07:15 -08:30 LOAD INCREASING



07:15-08:30 EJECTION IN PROGRESS



07:15-08:30 EJECTION CASCADES



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Component Damage Comparison

The damage on components involved in a past disassembly events were compared with the components used in the simulation.

The comparison noted:

- Strong similarities in the location and types of witness marks on each rim base and bead seat band (simulation and a past known disassembly)
- Both the simulation and past disassembly event components had the same *lack* of damage 90 degrees from the lock ring gap (the failure initiation point)
- Both lock rings (simulation and past known disassembly) were no longer planar. Both had a bend in a similar location.



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49" Technical Review Outcomes

- The lock ring was “caught” outside out of position by the bead seat band hood at approximately 90 degrees offset to lock ring gap.
- Following application of pressure, the lock ring rotated slightly altering the contact point between the lock ring and the lock ring groove on the rim base.
- The lock ring then extruded from that point, creating a leading edge that allowed the lock ring to peel out, in both directions, around the circumference of the rim.

Failure in this mechanism is not a structural failure.



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49" Technical Review - Notes

- The Bead Seat Band Hood is a good feature and assists in lock ring centring and retainment.
- The assembly maintains structural capacity even if the lock ring is not fully seated, but remains under the hood. Note – this is not an endorsement. The lock ring must be fully seated.
- Mating surfaces of parts from various OEMs appear compatible. Note – this is not an endorsement. Components should not be mixed.
- Tolerances of components appeared to vary between OEM's.
- Elliptical (oval) shaped bead seat band and rims were observed in some cases.



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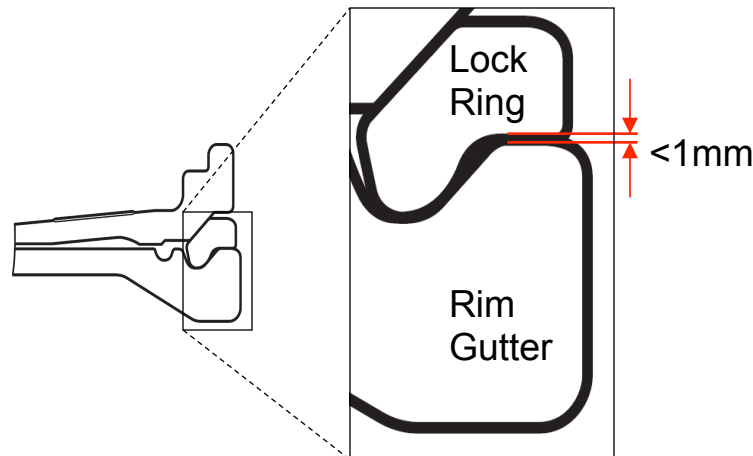
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Ongoing Actions

- The EV style lock ring, like most rim assemblies, demands high attention to component cleanliness and condition, correct seating, and strict adherence to component tolerances.
- Review of minimum requirements for designated tyre fitting facilities at sites underway.
- Further analysis and testing is currently underway to validate 'fail safe' rim assembly components such as 'Shur-Lok'.



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“Shur-Lok” – Engineering Solution

- Even when misplaced, simulations indicate that structural capacity is maintained provided the lock ring remains under the bead seat band hood. See Figure 1.
- When the lock ring is caught by the bead seat band hood, if a Shur-Lok is fitted, the O-ring is not engaged. This prevents the build up of hazardous energy, i.e. the design fails in a safe mode. See figure 2.

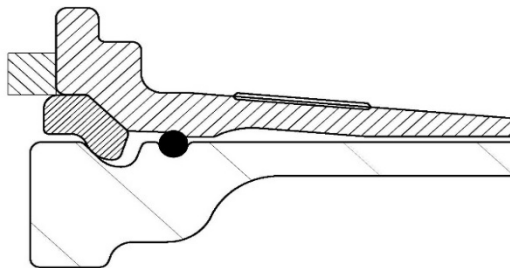


Figure 1 – Shur-Lok with lock ring misplaced but captured under bead seat band hood.

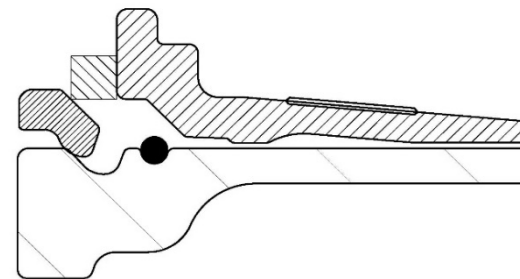
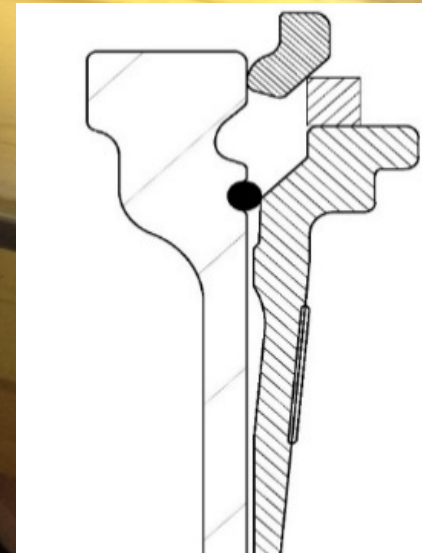


Figure 2 – Shur-Lok with lock ring misplaced caught by bead seat band hood as in the failure mode



LR out of the groove by approximately 20mm.
O-ring just contacted.



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Questions

