

# QUAD BIKE SAFETY – FINAL REPORT TO MINISTER

## COMMENTS: ROSS H MACMILLAN

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**Page 43** . . . requirements for energy absorption should be adopted from the ISO 5700 and include both a lateral and longitudinal loading.

In testing an OPD as suggested below I agree with this recommendation.

**Page 45** *‘While Operator Protection Devices (OPDs) will not prevent a rollover incident, it has been demonstrated that they will help to minimise the severity of injury received by the operator during a rollover incident when designed and fitted properly.’ (NFF and Farmsafe Australia) (my emphasis).*

I generally agree with this statement. However the proposed Standard does nothing to test the existing OPD’s or those that might be offered for approval, particularly with respect to being ‘designed . . . properly’. And surely the fundamental purpose of a Standard to improve safety must include a test to determine whether the OPD will provide a ‘zone of clearance’ for the rider in the event of an accident. The question of whether it has been ‘designed . . . properly’ or not turns on the results of such a test.

Thus the proposed Standard is inadequate in not defining the functional requirements of any OPD submitted for approval. How is the user to be confident that they will be protected if they buy a QB on the basis that its TTR was greater than the minimum (or even the best on the market) but it was fitted with an OPD that was never tested with respect to providing a ‘zone of clearance’ against such a Standard.

More specifically I believe it is quite wrong for a Standard to effectively endorse the existing OPD’s (for I believe that is what it will do) unless it shows that they have been tested under the conditions required by that Standard and met its requirements.

I offer no comment on the Quadbar except those that I made in my personal communication.

However, in relation to the Lifeguard, I offer the following on the basis of what I have seen in the video advertisement with respect to the lateral instability, and the UNSW video with respect to lateral and longitudinal instability. I accept that these may not represent the true situation; in that case I remain to be convinced.

The advertising video of lateral instability in the field fails to show the whole event, leaving out how the QB, with the attached Lifeguard, reached the rider in exactly the right position to avoid injury. While not disputing that in this particular case the Lifeguard would have protected the rider, one is entitled to ask what happens to the rider if, in the not unlikely event, the Lifeguard does not contact the rider in exactly the right relative position. I believe that the advertisement is at best unclear and at worst deceptive.

The video of the longitudinal instability test on the tilt-table in the UNSW report shows the Lifeguard being loaded more or less perpendicular to plane of the ‘bow’. Lifeguard appears to do little or nothing to arrest the rearwards tip-up but, together with the rider, is ‘folded’ in what would have been a life threatening event. See the event at about 3 min 42 sec into the video. A screen at 3 min 34 sec also shows the complete failure of the Lifeguard to protect the rider in lateral instability.

For the Standard to effectively endorse this OPD appears to me to be professionally indefensible.

See conclusion be

**Page 69** *‘Despite the Consultation RIS recommending an OPD must be able to have a lateral energy absorption capacity greater than 1.75 times the vehicle mass . . .’*

This appears incorrect or incomplete as energy has different units to mass.

**Page 69** *The ACCC is of the view OPDs should not restrict innovation and should recognise manufacturers are best placed to assess design and structural requirements for OPDs. The requirements for an OPD standard should be flexible and allow manufacturers to develop innovative OPDs, or assess which aftermarket OPD to attach, based on the specifications and performance of its quad bike models.*

I agree generally that the manufacturers should be free to design according to their understanding but ultimate decision about its ‘suitability’ should be a test of the OPD itself against a relevant Standard.

**Page 72.** *Quad bikes need sufficient stability to provide an opposing static force to counteract lateral or longitudinal overturning forces acting on it (for example, gravitational forces from traversing an incline), to avoid rolling over.*

I suggest the following shows the difference between the stability in the two directions which is confused in the above statement partly due to its brevity

Quad bikes need sufficient stability to provide an opposing static force to counteract lateral or longitudinal overturning forces acting on it

For lateral static stability QB’s need the weight force to act inside the wheel track. On steeper slopes with good lateral traction conditions (on which the QB may not slide sideways) the weight force may fall outside the wheel track and the QB may roll.

For longitudinal rearward static stability QB’s need the weight force to act within the wheel base. With good longitudinal traction conditions (on which the wheels may not slip rotationally) the moment on the chassis may be sufficient to tip the QB rearwards.

One could also add a simple statement such as the following.

In addition to the static forces noted above there are dynamic forces which arise from cornering, accelerating and rough ground conditions. These generally make the operating conditions more dangerous and increase the likelihood of a lateral or longitudinal roll over. (Macmillan – Safety paper:<sup>1</sup>)

### **Page 77 Whether a QB will slide or roll over**

*When an operator loses control of a quad bike the quad bike may slide or rollover. Which, if any, of these will occur depends on a number of factors, including the type of terrain the quad bike is operated on.*

I suggest that it be rewritten

An operator loses control of a quad bike when it slides or rolls over sideways. Which, if either of these will occur depends on a number of factors, including the type of terrain and the shear strength of the soil the quad bike is operated on.

The above heading and the original and rewritten paragraph together with Figure 15 all refer to lateral instability. However the following paragraph is confusing because it appears to also refer to lateral and longitudinal slipping/ sliding. Although the two actions both involve soil shearing, the two names refer to the different directions.

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<sup>1</sup> Quad-Bike Operational Instability

R. H. Macmillan *Safety*. 2017; 3(2) <http://www.mdpi.com/2313-576X/3/2/15>

**Page 77** Macmillan explains that for a quad bike to become unstable and tip instead of slipping/sliding, the shear strength of the soil/wheel patch (the force resisting slip) must exceed the component of gravitational force at the wheels (the force causing slip).<sup>149</sup>

I suggest that this should be deleted as you do not consider rolling over rearwards here. If desired it could be placed elsewhere.

**Page 77** In figure 15, the black vertical blocks are lateral static stability results (TTR values) for commercially available quad bikes tested by UNSW TARS.<sup>150</sup> The grey horizontal band covers the range of lateral traction coefficients on Australian agricultural soils for tractors (data is not available for quad bikes).<sup>151</sup> A higher lateral traction coefficient is representative of a higher friction surface, for example a hard, dry surface. Below the grey horizontal band, surfaces are more slippery.

The underlined section mis-quotes the source. I suggest that the underlined sentence be rewritten as follows -

The grey horizontal band represents the fundamental shear strength of English agricultural soils as measured by Payne and Fountaine.<sup>2</sup> They were applied by Reece<sup>3</sup> to traction with tractor tyres giving a reasonable prediction and similarly by Macmillan (Safety paper) to traction with QB tyres.

I believe that, given there are no local values available, this is a very reasonable assumption to make for shearing of soil under a QB tyre in either lateral or longitudinal directions.

### **Standard: Consumer Goods (Quad Bikes) Safety Standard 2019**

Given the limited application of the proposed Standard, I consider that this name is a misnomer and over-states its actual relevance.

#### **Article 15**

*A general use quad bike must have one of the following devices fitted, or integrated into its design:*

*(c) a device of a type that offers the same, or better, level of protection for operators from the risk of serious injury, or death, as a result of being crushed or pinned in the event of a rollover, as is offered by a device of a type mentioned in paragraph (a) or (b).*

I consider that this requirement is seriously flawed.

(i) The standard does not test the ‘level of protection for operators from the risk of serious injury, or death, as a result of being crushed or pinned in the event of a rollover, . . .’ offered by the OPD. It tests the static stability of the QB on which the OPD is fitted, admittedly a related factor. To tie the acceptable ‘level of protection’ to that of OPD’s that are untested under the Standard is unacceptable, especially when one (at least in my opinion) does not offer, or has not been shown to offer, an acceptable level of protection. If it is claimed that the existing OPD’s do offer an acceptable level of protection, how was this ‘level’ measured and reported?

(ii) Which type of ‘roll-over’ is intended – lateral? Longitudinal? Must both be acceptable for the new OPD to be acceptable?

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<sup>2</sup> Payne, P.C.J.; Fountaine, E.R. The shear strength of top soils. Nat. Inst. Agric. Eng. 1952, 3, 136–144.

<sup>3</sup> Reece A.R. (1964) Theory and Practice of Off-the-Road Locomotion. Journal and Proceedings Institution of British Agricultural Engineers, Annual Conference 1964, 82 – 90.

(iii) If a new OPD reaches the ‘level of protection’ of one existing OPD and not the other , would it be acceptable?

## **Conclusion**

I concede that the Standard will adequately define the TTR’s for static lateral and longitudinal instability. However, as argued previously, these TTR values, which are the focus of the Report, suffer from two inadequacies, one related to the QB and the other related to the OPD.

(i) in relation to the QB, the operational angle of instability, where dynamic factors play a part, will be less and may be much less than the static angle that is measured on the tilt table. The implied accuracy of the angle of instability, given to 3 significant figures, only serves to mask this reality.

(ii) In relation to the OPD, the Report does not clearly acknowledge that the ability of the OPD to provide a zone of clearance that will afford at least some protection for the rider, is an issue.

The functions of the QB and the OPD are of course quite different to each other and the suppliers have different interests – one to do with avoiding the ‘failure’ of instability and the other the ‘failure’ if the rider is not protected. It is therefore perhaps not surprising that the suppliers cannot come to one mind on the solution.

This distinction between the two interests may not be understood or even realised by the users. The danger is therefore that the user, having bought a QB with a high TTR may assume that they have done all that is reasonable in their circumstances to ensure that they are ‘safe’ – or relatively so.

The Report has done little or nothing to clarify this matter or take action to avoid it. To satisfy this crucial need I suggest that:

(i) all reference to the existing OPD’s be removed from the Standard as proposed.

(ii) notice is given that research work will commence in the near future to facilitate the preparation of a second Standard which will include energy based tests to determine whether an OPD satisfies the provision of a zone of clearance for the protection of the rider.

(iii) if necessary, existing OPD’s be granted temporary approval pending the completion of this second standard; following this they would be tested under its provisions in the normal way.\*

The interests of the users and of the manufacturers alike would be best served by having two Standards – one that seeks to promote more statically stable QB’s and a second to promote OPD’s that seek to provide a zone of clearance an instability event occurs.

**I should also affirm that I have had no contact with the QB manufacturers or dealers nor with either of the OPD manufacturers mentioned above. Nor do I have any financial or other interest in the industry. However, having been quoted approvingly in the Report, I feel professionally obliged to respond to the Report in the long-term interests of the users.**

**I suggest that it may not be appropriate to acknowledge the parts of the Report where technical corrections have been made, or any of my comments if you so wish.**

**I would be willing to discuss these matters further.**

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\* There is no suggestion here that the tests which have been formally reported are in any way unreliable.

**Ross Macmillan**

**5 June 2019**