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December 15, 2009

Mr. Thomas S. Yager
Vice President
Recreational Off-Highway Vehicle Association
2 Jenner Street, Suite 150
Irvine, California 92618-3806

Dear Mr. Yager:

On October 15, 2009, the U.S. Consumer Product Safety Commission (CPSC) staff received the second canvass draft of the proposed American National Standard for Recreational Off-Highway Vehicles, ANSI/ROHVA 1-200X.[1] CPSC staff has reviewed the draft standard and continues to believe that the proposed standard does not adequately address vehicle stability, vehicle handling, and occupant retention and protection.

ROHVA requested the data, research, and analyses that served as the basis for the staff's comments on the first canvass draft of ANSI/ROHVA 1-200X, as well as the positions expressed in the ANPR on ROVs. This letter, along with the 181 ROV-related fatality and injury incidents which were made publicly available on November 20, 2009, constitute the staff's response to ROHVA's request for information.

Lateral Stability

The National Highway Traffic Safety Administration (NHTSA) Rollover Resistance Rating System provides the risk of rollover in a single-vehicle crash based on a vehicle's static stability factor (SSF), as shown in Figure 1.[2] The risk of rollover for automobiles in a single-vehicle crash ranges from over 40% (1 star) to less than 10% (5 star) with a vehicle SSF range from 1.03 to 1.45.

NHTSA also describes a causal relationship between the Static Stability Factor (SSF) and vehicle rollover. When a vehicle is about to rollover, the moment arm for the principal

[1] The comments in this letter are those of the CPSC staff and have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.
[2] http://www.nhtsa.gov/cars/rules/rulings/roll_resistance/index.html

overturning force is the vehicle's center of gravity height, and the moment arm of the principal restoring force is the vehicle's track width divided by two. The SSF is the ratio of these two moment arms, ½ the track width divided by the center of gravity height. When the front and rear track widths are not equal, the average track width is used in calculating the SSF.

Similarly, the stability coefficient, Kst, equates the righting and tipping moments of a vehicle, but as a three-dimensional vector analysis that introduces the effects of wheelbase length and longitudinal center of gravity location when the front and rear track widths are not equal.[3] When the front and rear track widths are equal, the Kst formula is identical to the SSF.

Whether one is speaking of SSF or Kst, the center of gravity height and the track width are critical to the measure of a vehicle's stability. Accordingly, for ROVs, any meaningful stability coefficient must be defined in the condition that the vehicle will be used (i.e., with occupants). An ROV with two occupants has a significantly higher center of gravity than an empty ROV. Deaths and injuries are occurring on occupied ROVs that roll over; therefore, the stability coefficient should be defined for an ROV with an occupant in each seating position.

CPSC staff tested several ROV models with two occupants and found the SSF values for the vehicles ranged from 0.84 to 0.92. This range is below the 1.03 to 1.45 range of NHTSA's rating system, but the upper range indicates that ROVs are probably capable of at least meeting a SSF value of 1.0 for a fully occupied vehicle.

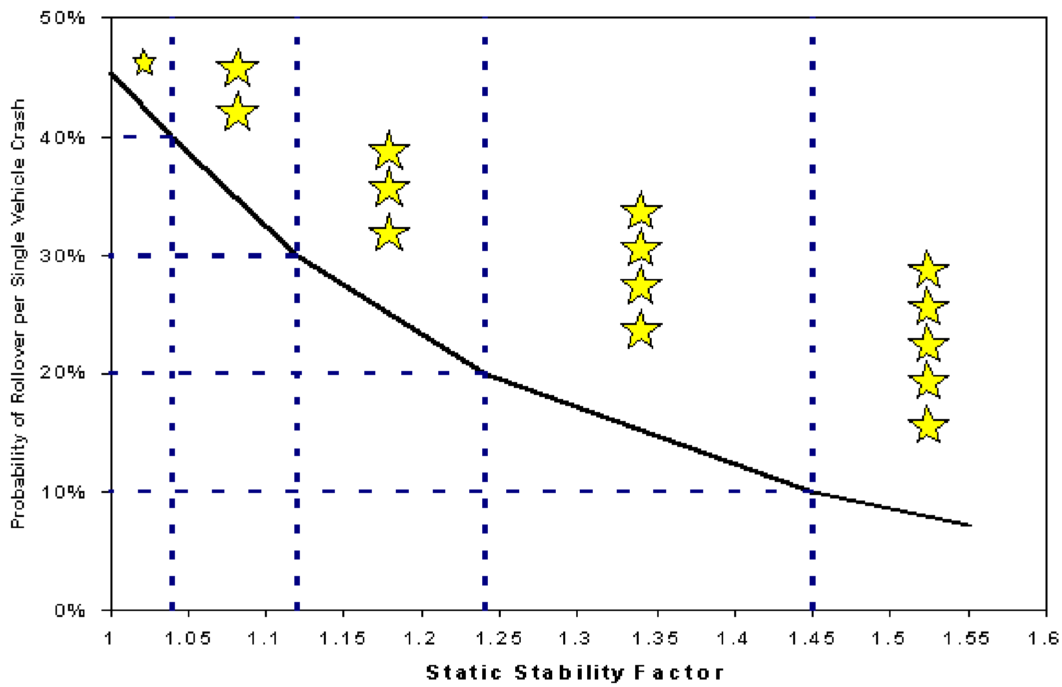

Figure 1. NHTSA Star Rating System Based On SSF And Risk Of Rollover In Single-Vehicle Crash

[3] Deppa, R.W., and Hauser, J.A., "All Terrain Vehicle Lateral Stability and the Limits of Control," SAE Paper No. 891108, Society of Automotive Engineers, 1989.

Vehicle Handling

CPSC staff maintains its recommendation that the voluntary standard should include a requirement for steering characteristics. For vehicles with relatively low SSF values, vehicle system steering characteristics can play an important role in rollover performance as well as controllability performance. Vehicles that transition to oversteer in steady state turns (i.e., change in mid turn) can cause unpredictable driver reactions and sudden rollovers. CPSC staff has tested two representative ROVs, one that exhibits reliable and consistent understeer through the operational range for turning and one that exhibits a transition to severe oversteer in mid turn. Figure 2 shows a graphical representation of the steering performance of these two vehicles. The slope of the lines described by the data points indicates the steering characteristic. Lines sloping up and to the left indicate understeer and lines sloping up and to the right indicate oversteer. Figure 2 shows that Vehicle 1 maintains understeer through the range from 0 to 0.55 g of lateral acceleration and that Vehicle 2 transitions from understeer to neutral at approximately 0.3 g and achieves a severe level of oversteer at approximately 0.35 g of lateral acceleration.

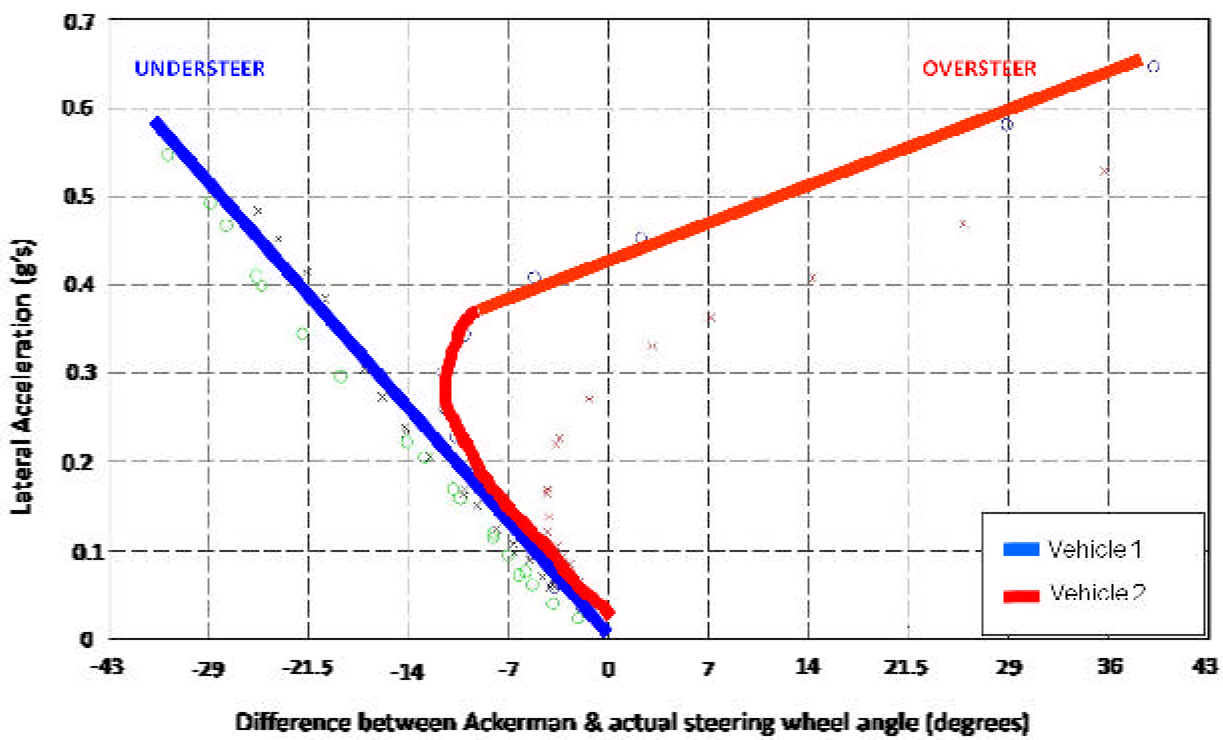

Figure 2. Handling Diagram for ROVs Tested By CPSC

When a driver is in a turn and operating in a condition of full traction (i.e. no tires skidding), the vehicle's steering characteristics can affect the rate of change in direction without input from the driver. Vehicles with understeer tendencies reduce the rate of change in direction and therefore reduce the lateral acceleration level. Vehicles with oversteer tendencies increase the rate of change in direction and therefore increase the lateral acceleration level which can lead to a sudden rollover or loss of control.

CPSC staff also continues to believe that the evaluation of steering characteristics on a surface with a high coefficient of friction (asphalt or concrete pavement) is not only relevant for off-highway vehicles but is also essential to understanding the full traction characteristics of a vehicle's steering performance. Steering characteristics are fundamental to a given vehicle's configuration, and the evaluation of such a fundamental characteristic is not dependent on the surface of operation. In fact, testing vehicles on a high friction surface such as asphalt has the advantage of maintaining traction for more of the vehicle's operating range for a more complete assessment of the vehicle's capabilities. While ROVs are intended for use on dirt and other low friction surfaces, it is reasonable to expect that a user will drive the vehicle at speed on asphalt or concrete. If these higher friction surfaces represent the worst case for rollover performance or steering performance, it is reasonable to test the vehicles on those surfaces. Evaluating steering performance on paved surfaces will produce results in a controlled environment that are measurable and repeatable.

Occupant Protection

CPSC staff reviewed the second canvass draft of ANSI/ROHVA 1-200X and noted the addition of performance requirements for handholds in Section 4.6 and the addition of specifications for a restraint warning system, if the vehicle is so equipped, in Section 4.8. CPSC staff believes that the requirement for a restraint warning system should be mandatory and not optional. Furthermore, while CPSC staff believes these additions are improvements in the area of occupant retention and protection, a component specific approach does not adequately address CPSC staff's concern that it is absolutely critical that an occupant does not exit a vehicle in the event of a rollover.

CPSC staff's testing of sample ROVs to static and dynamic rollover simulations indicated some models of ROVs provided better restraint for occupants than other models. As seen in Figure 3, during a quarter turn rollover of the vehicle, the Hybrid II test dummy in Vehicle A remained within the vehicle while the test dummy in Vehicle B leaned out of the vehicle and made contact with the ground. Similar results were observed during dynamic rollover simulations down a hill. CPSC staff observed that the occupant seating location in Vehicle A is significantly lower within the vehicle than the occupant seating location in Vehicle B. In addition, physical shoulder guards on the passenger and driver sides of Vehicle A helped in keeping the upper torso of the occupant within the vehicle.

CPSC staff recommends the development of an occupant retention and protection performance requirement that ensures that an occupant, as well as the occupant's limbs and torso, remains within a vehicle during rollover.

Vehicle A | **Vehicle B**

Figure 3. Quarter Turn Rollover Tests With Seat Belted Test Dummy

Thank you for this opportunity to comment. CPSC staff looks forward to continued communication with ROHVA regarding the ANSI/ROVHA voluntary standard. If you have any questions or comments, please feel free to contact me.

Sincerely,

Caroleene Paul