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

Dear Mr. Yager:

On December 22, 2010, the U.S. Consumer Product Safety Commission (CPSC) staff received the Canvass Draft of the proposed American National Standard for Recreational Off-Highway Vehicles, ANSI/ROHVA 1-201X.[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.

Vehicle Stability

The Canvass Draft includes a significant change to the ANSI ROHVA 1-2010 standard in section eight, where a new dynamic test for lateral stability has been added. The added test is a fixed steering dynamic test, similar to the one included in SAE J266, which sets the steering angle to produce a constant turn radius of 25 feet, based on the Ackerman Angle for that radius.[2] The test vehicle load, drive line settings, and instrumentation are also specified. The test is conducted on an asphalt surface by driving the vehicle at the set turn radius, while slowly increasing the speed. The test is concluded when the vehicle achieves a corrected lateral acceleration of 0.6 g, or the vehicle encounters either a two-wheel lift condition or a speed limitation.

CPSC staff is encouraged that ROHVA has proposed a dynamic test for the measurement of vehicle lateral stability threshold as a requirement in the standard. Staff agrees that such a test is necessary, that the test should be conducted on asphalt, and that the loading for the test should

[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] Society of Automotive Engineers Surface Vehicle Recommended Practices J266, Steady-State Directional Control Test Procedures for Passenger Cars and Light Trucks.

approximate the condition of a driver, plus a passenger. Further, staff agrees that the proposed data parameters are the correct ones to determine vehicle rollover performance. However, staff does not agree that the specific test method, or the acceptance limits proposed, will be adequate to identify and discriminate problematic vehicle behavior.

ROHVA has proposed a very high steering angle (turn radius of 25 feet) for the fixed steering test. At a very high steering angle, it is possible that a test vehicle will become speed limited before the characteristic of interest is observed. The acceptance limits for the test are set such that a test vehicle that reaches a speed limitation before achieving the minimum acceptable lateral acceleration would be accepted. In addition, any vehicle that experiences oversteer could reach its speed limitations early in the test, which would result in a spiraling-in spin prior to producing data on the lateral stability threshold. Therefore, the dynamic test proposed could accept a vehicle that has the most undesirable combination of characteristics—low lateral stability threshold and oversteer. CPSC staff does not agree with a test method that promotes the design of vehicles with oversteer tendencies. Further, CPSC staff believes that the proposed minimum lateral stability threshold of 0.6 g is too low, based on staff's experience with dynamic lateral stability threshold testing of vehicles. CPSC staff recommends a J-turn type test that directly measures the minimum lateral acceleration to achieve vehicle rollover. CPSC staff's experience with this type of test indicates that a relevant value for minimum lateral acceleration at two-wheel lift can be defined.

Vehicle Handling

CPSC staff continues to believe that steady state oversteer is an undesirable and unstable steering control mode for ROVs. Therefore, staff believes that a test to measure steering gradient and an acceptance criterion for handling characteristics is necessary for ROVs. CPSC staff's experience with vehicle dynamic testing has shown that altering the steering characteristics of a vehicle is not difficult. Staff successfully altered the steering characteristics of a vehicle that originally exhibited steady state oversteer by performing minor modifications to the vehicle's track width and suspension stiffness. The modifications to the vehicle consisted of adding spacers to the rear wheels and removing the rear sway bar (see Figure 1).

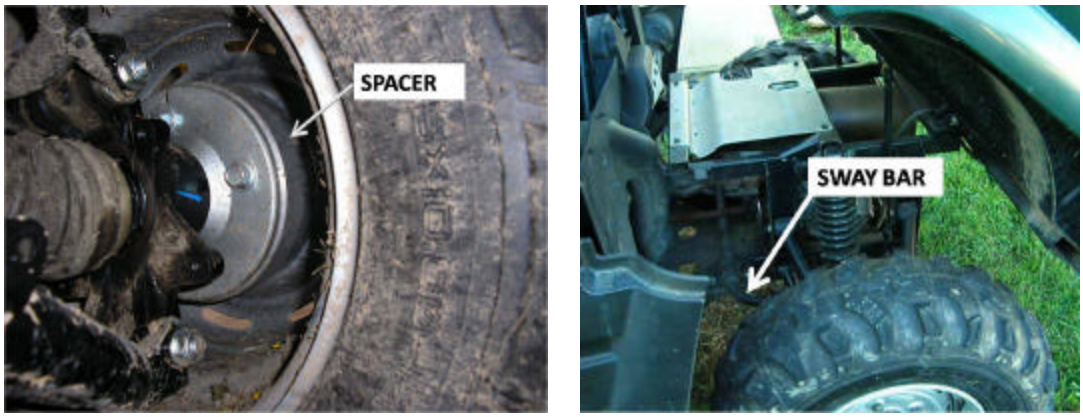


**Figure 1. Modifications to ROV to improve steering characteristics.**

The effectiveness of the modifications in improving the vehicle from oversteer (blue lines) to understeer (red and orange lines) is illustrated in the vehicle diagram shown in Figure 2.

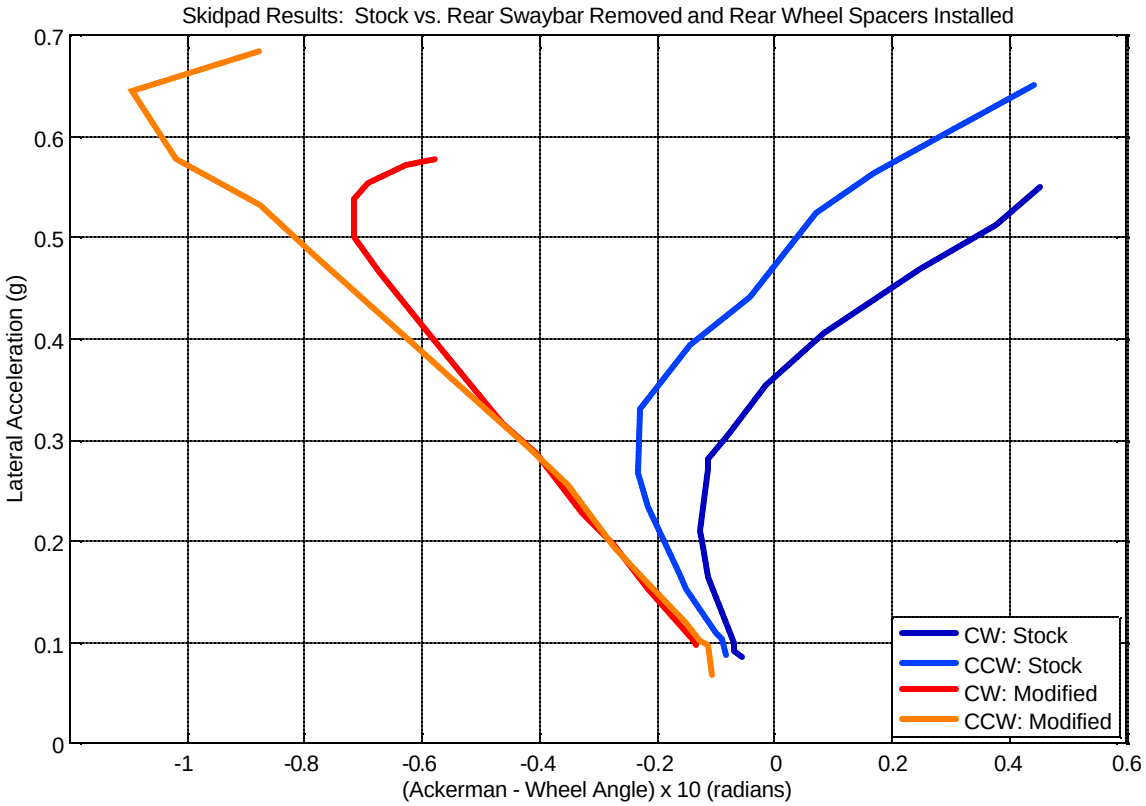


**Figure 2. Steering diagram of unmodified vehicle and modified vehicle in clockwise (CW) and counterclockwise (CCW) directions.**

## Occupant Protection

The Canvass Draft includes the addition of an Occupant Retention System (ORS) section to the ANSI/ROHVA 1-2010 standard. Section 11.1 *Seat Belts* requires a minimum of a three-point seat belt; and Section 11.2 *Seat Belt Reminder* requires a visual seatbelt-use reminder that remains active for at least eight seconds. Section 11.3 *ORS Zones* describes four zones that cover operator leg/foot (Zone 1), shoulder/hip (Zone 2), arm/hand (Zone 3), and head/neck (Zone 4) areas.

### *Seat Belt Reminder*

CPSC staff does not believe the proposed 8-second reminder light will be as effective in changing user behavior as the seat belt warning requirements for passenger cars in the Federal Motor Vehicle Safety Standards (FMVSS) Standard No. 208 *Occupant Crash Protection*. FMVSS 208 requires an active seat belt reminder that is dependent on the latch status of the seat belt; the user is motivated to latch the seat belt to remove the reminder. In comparison, the 8-second light requirement proposed in the Canvass Draft has no feedback to educate or motivate the users to latch the seat belts.

*Zone 1 – Leg/Foot*

ROHVA has proposed requirements for the leg/foot area (Zone 1) that can be met by a construction-based permanent barrier that meets specific design criteria. The construction-based method defines the dimensions for a physical barrier and requires that the barrier withstand a horizontal outward force of 50 lbf and have no opening that permits passage of a 3-inch diameter cylinder. ROHVA has not presented the studies, tests, or research that was used in defining the barrier's dimensions or its effectiveness. CPSC staff would like to review the research that was used in developing the leg/foot Zone 1 requirements. In addition, the use of a net is specified as an acceptable permanent barrier for Zone 1; CPSC staff does not believe a net is a suitable barrier because it can be cut or removed by the user.

*Zone 2 – Shoulder/Hip*

ROHVA has proposed requirements for the shoulder/hip area (Zone 2) that can be met by a construction-based passive barrier that meets specific design criteria or by a performance-based vehicle tilt test that meets occupant excursion criteria. The construction-based method defines a barrier zone and requires that the barrier withstand a horizontal outward force of 163 lbf. CPSC staff's experience with vehicle rollover simulation tests shows that a 172 lbm occupant ($50^{th}$ percentile male Hybrid III dummy) in a rollover event will impact the shoulder guard with an impact force that is likely to exceed the 163 lbf proposed force. CPSC staff recommends that the ROHVA members conduct vehicle rollover simulation tests to determine the minimum force that a shoulder barrier needs to withstand during a rollover event and also determine the effectiveness of the proposed barrier design in retaining the full range of occupants (from $5^{th}$ percentile females to $95^{th}$ percentile males) within the vehicle during a rollover event.

The performance-based method proposed by ROHVA uses a 172 lbm $50^{th}$ percentile Hybrid III dummy that is seat belted into the vehicle. The vehicle is then tilted to 45 degrees along its roll axis, and the excursion of the dummy is measured. The dummy cannot extend more than 5 inches outside the vehicle's width to pass the requirement. CPSC staff is concerned that a 45-degree tilt will not simulate accurately the dynamics of a rollover event. The lateral acceleration in a 90-degree, quarter-turn rollover event will most likely exceed the 0.7g that is simulated by a 45-degree tilt angle. Staff also believes that the performance requirement should relate to the hazard patterns identified with ROV-related incidents; namely, full and partial excursion of an occupant's torso during a 90-degree, quarter-turn rollover of the vehicle in a turn. CPSC staff recommends that the ROHVA members perform vehicle rollover simulation tests to determine the effectiveness of the proposed tilt table tests in retaining the full range of occupants (from $5^{th}$ percentile females to $95^{th}$ percentile males) within the vehicle during a rollover event.

*Zone 3 – Arm/Hand*

ROHVA has proposed requirements for the arm/hand area (Zone 3) that can be met by a construction-based permanent barrier that meets specific design criteria or by a performance-based vehicle tilt test that meets occupant arm/hand excursion criteria. The construction-based method defines a barrier zone and requires that the barrier withstand a horizontal outward force

of 50 lbf and have no opening that permits passage of a 3-inch diameter cylinder. ROHVA has not presented the studies, tests, or research that it used in defining the barrier's dimensions or effectiveness. CPSC staff would like to review the research that was used in developing the arm/hand Zone 3 requirements. In addition, the use of a net is specified as an acceptable permanent barrier for Zone 3; CPSC staff does not believe that a net is a suitable barrier because it can be cut or removed by the user.

The performance-based method proposed by ROHVA uses a 50$^{th}$ percentile male Hybrid III dummy that is seat-belted into the vehicle. The dummy's hands are affixed to appropriate handholds, and the joints are set to simulate the occupant's grip. The vehicle is then tilted to 45 degrees along its roll axis, and the excursion of the dummy's hand and arm is measured. The dummy's hand and arm cannot extend more than 7 inches outside the vehicle's width to pass the requirement. CPSC staff is concerned that a 45-degree tilt will not simulate accurately the dynamics of a rollover event and that the dummy's hand grip force is not specified with a rationally supported value. Staff also is concerned that a quasi-static test with hand grip forces set at an unrealistically high level will not test accurately the performance of the vehicle in limiting the excursion of an occupant's arm/hand.

*Zone 4 – Head/Neck*

ROHVA has proposed requirements for the head/neck area (Zone 4) that can be met by recommending that occupants wear seat belts and helmets. Beyond that, no guidance is provided on the content, format, or location of the recommendations. CPSC staff has identified occupant head crush by the vehicle (in many cases, the vehicle's rollover protective structure) as a significant hazard pattern associated with ROV-related incidents. While the benefits of a helmet are not disputed for head impact scenarios, the benefit of a helmet in situations where the occupant's head is crushed by the vehicle is questionable. CPSC staff recommends that the ROHVA members perform vehicle rollover simulation tests to develop a performance-based occupant protection performance test that limits the head excursion of occupants (from 5$^{th}$ percentile females to 95$^{th}$ percentile males) within the vehicle during a rollover event.

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

Sincerely,

Caroleene Paul

cc: Colin Church, CPSC Voluntary Standards Coordinator