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Mr. Greg Knott
Vice President, Regulatory Affairs
Outdoor Power Equipment Institute
341 South Patrick Street
Alexandria, VA 22314

Dear Mr. Knott:

On October 30, 2015, U.S. Consumer Product Safety Commission ("CPSC") staff received a canvass draft of ANSI/OPEI B71.9-2016, *American National Standard for Multipurpose Off-Highway Utility Vehicles*.[1] Staff appreciates the opportunity to comment on the canvass draft and is very pleased to see OPEI taking significant steps to improve the voluntary standard with the addition of requirements in the areas of lateral stability, vehicle handling, and occupant protection. CPSC staff supports the proposed changes to the voluntary standard and believes the aggregate effect of improved vehicle stability, handling, and occupant protection will reduce injuries and deaths associated with ROV rollovers.

The proposed standard includes significant changes to ANSI OPEI B71.9 – 2012, as follows:

- Section 1. *Scope* – Deletion of 50 mph top speed from definition of "Multipurpose Off-Highway Utility Vehicles" (MOHUVs);
- Section 5.1.3.2 *Seat Belt Reminder System* ─ Additional requirements for the seat belt reminder system that limits vehicle speed;
- Section 5.1.4 *Occupant Side Retention Devices* ─ Additional requirements for side retention devices;
- Section 5.18 *Lateral Stability Hang Tag* ─ Addition of a hang tag requirement to include tilt table results at two-wheel lift;
- Section 8.6 (in 2012 standard) *Static Stability Coefficient (K_{st})* ─ Deletion of requirement for static stability coefficient (K_{st});

[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.

- Section 8.6 *Tilt Table Stability* ─ Increase in the minimum tilt table angle for vehicle loaded in operator-plus-passenger configuration;
- Section 8.7 *Dynamic Stability* ─ Addition to the speed and steering angles in J-turn test procedure; and
- Section 8.8 *Vehicle Handling* ─ Addition of a vehicle handling requirement based on yaw rate gain in a constant steer angle test.

Static Lateral Stability

Tilt Table Stability and Hang Tag

Tilt Table Stability Summary of Draft Provision. Section 8.6 specifies a procedure to place a vehicle, with test weights to simulate two different test load configurations, on a tilt platform and laterally tilt the platform until the vehicle achieves the minimum tilt angle requirements. A vehicle configured with two occupants must reach a minimum of 33 degrees before lateral tip over to meet the tilt table requirements. A vehicle configured with the maximum number of occupants and full cargo load must reach a minimum of 24 degrees before lateral tip over to meet the tilt table requirements.

In addition, the tilt table test platform is specified with a 1-inch high rail parallel to the tilt axis to engage the side of the downhill tires to prevent the vehicle from sliding during the tilt table test.

Tilt Table Hang Tag Summary of Draft Provision. Section 5.18 Lateral Stability Hang Tag requires that vehicles with a maximum speed greater than 30 mph be equipped with a hang tag that provides consumers with the tilt table angle ("TTA") at two-wheel lift ("TWL") for that vehicle when loaded in the operator-plus-passenger configuration.

CPSC Staff's Comments. CPSC contracted SEA Limited ("SEA") to measure the TTA, with and without a 1-inch trip rail, at two-wheel lift of several model year 2014 and 2015 ROVs.[2] The tilt table angles at two-wheel lift ranged from 36.0 to 40.7 degrees.

Based on these tests, staff believes that a TTA of 33 degrees is easy to achieve and should be considered a baseline minimum requirement. Staff believes it is more important to provide information on a vehicle's TTA at TWL to allow consumers to evaluate the stability of the vehicle in comparison with other vehicles. Therefore, staff supports OPEI's addition of a hang tag which provides consumers with needed safety-related information. CPSC staff understands that the OPEI members have not had sufficient time to draft and test a hang tag designs. Staff encourages the subcommittee to develop hangtags to convey the following:

1. ROVs that exhibit a higher TTA at two-wheel lift are generally more stable and more resistant to rollovers.
2. Rollovers can occur on a flat surface when ROVs turn too sharply or at too high a speed.

[2] Heydinger, G. (2015) Tilt Table Measurements on Twenty-Two Recreational Off-Highway Vehicles. Retrieved from http://www.cpsc.gov//Global/Research-and-Statistics/Injury-Statistics/Sports-and-Recreation/ATVs/SEAReportTiltTableResults22ROVsSept2015.pdf.

3. Consumers should use the stability metric to compare with other vehicles before they make a purchase.

CPSC staff believes that a hang tag should allow consumers to make informed decisions regarding the stability of ROVs when purchasing an ROV. The hang tag information should also provide a comparison between the rollover resistance of different ROV models. Therefore, the hang tag should be effective at conveying information and must be easily understood by the spectrum of consumers.

CPSC Staff Recommendation #1: Staff recommends that ROHVA form a task group after publication of the revised standard to develop and finalize the hang tag requirements. Staff will actively participate in such a task group.

Staff notes that the center of gravity height of a 95th percentile male in the seated position is approximately 10 inches above the seat, instead of the minimum 6 inches specified in the canvass draft, and 10 inches forward of the seat back.[3]

CPSC Staff Recommendation #2: Staff recommends that the tilt table test methodology include the following to provide additional detail on the test methodology for evaluating TTA at TWL, reducing ambiguity and possible variances in the way the tilt table test is conducted:

- Test occupant weight equivalent requirements with the CG location for each occupant that is 10 inches above the seat and 10 inches forward of the seat back.
- A specific test procedure to measure the TTA at TWL for the operator plus passenger configuration.
- Clarification that the angle measurement of the tilt table needs to be with an accuracy of ± 0.1 degree.

Vehicle Handling

Summary of Draft Provision. Section 8.8 Vehicle handling introduces a method to: (1) measure and evaluate the extent of oversteer behavior in a vehicle; (2) identify vehicles that could exhibit divergent instability; and (3) establish performance criteria that limit the amount of permissible oversteer.

The test procedure describes a tire break-in procedure, followed by procedures to establish the steer angle required to drive the test vehicle on a 50-foot radius at a slow speed. Once the steer angle is established and the test vehicle's steering wheel is locked at this angle, the driver slowly increases the speed of the vehicle until one of the following occurs:

- The vehicle no longer accelerates, or
- The vehicle achieves two-wheel lift.

[3] Schultz, R. et al. (1996) Whole Body Center of Gravity and Moments of Inertia. Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ada328863.

The test procedure requires five test runs in the right/clockwise and five test runs in the left/counter-clockwise directions, with instrumentation recording the vehicle speed, yaw rate, and steer angle. Plots of the vehicle's yaw rate versus speed are used to determine the pass/fail criteria for vehicle handling. The proposed test computations calculate the slope of the yaw rate from 0.1 to 0.2 g[4] (a condition when the vehicle is moving slowly around the circle) and the slope of the yaw rate from 0.4 to 0.5 g (a condition when the vehicle is moving around the circle at higher speed). The ratio R is defined as the slope of the yaw rate plot at the end of the test, divided by the slope of the yaw rate plot at the start of the test, as follows:

$$R = \frac{(Y2/V2)}{(Y1/V1)}$$

Where:

Y2/V2 = Linear slope of yaw velocity versus time plot divided by linear slope of vehicle speed versus time plot in region between 0.4 and 0.5 g of lateral acceleration

Y1/V1 = Linear slope of yaw velocity versus time plot divided by linear slope of vehicle speed versus time plot in region between 0.1 and 0.2 g of lateral acceleration

The R values for the five test runs in the right/clockwise direction are averaged for the Final Slope Ratio Right and the R values for the five test runs in the left/counter-clockwise are averaged for the Final Slope Ratio Left. The performance requirements state that no test shall result in two-wheel lift, and the ratio Final Slope Ratio Right and Final Slope Ratio Left cannot exceed a value of 4.5.

CPSC Staff's Comments. On August 21, 2015, CPSC staff sent a letter to OPEI explaining staff's concerns that the methods used to calculate yaw rate slopes and ratios in a pre-canvass draft version of the vehicle handling requirement did not accurately capture the vehicle's handling and the resulting performance requirement was not effective in preventing divergent instability. In response, OPEI revised the vehicle handling requirements in Section 8.8 and staff is encouraged that OPEI addressed staff's concerns by normalizing the yaw rate data to speed, fully defining the slope regions, and separating the performance of the vehicle in the right/CW and left/CCW directions. In addition, at a public meeting on October 5, 2015, OPEI member representatives stated that manufacturers will build ROVs with R values below 4.5 due to reproducibility concerns and manufacturing margins and tolerances. Based on OPEI's efforts in addressing staff's concerns, staff supports OPEI's vehicle handling requirement specified in the canvass draft.

Staff recommends that OPEI specify the test surface for the handling tests, the condition of the tires, and the tolerances for the center of gravity height of the loaded test vehicle.

CPSC Staff Recommendation #3: Staff recommends the following edit to the test methodology in the voluntary standard to improve the standardization of the test methodology:

Add - Section 7.5.2 Test Course for the Dynamic Stability and Handling Tests

[4] Acceleration is expressed as a multiple of free-fall gravity (g), which is equal to 9.81 m/s^2 (32.2 ft/s^2).

c) The test surface shall be concrete or asphalt that is dry and free from loose material or surface contamination.

Change - Section 8.7.2 Test Vehicle Configuration

a) The tires shall be new and inflated to the manufacturer's recommended tire pressure for the test weight. Tires shall be replaced during the test and the test continued if wear exceeds half the tread depth of a new tire at any point during the test.

Add - Section 8.7.2 Test Vehicle Configuration

h) The center of gravity of the instrumented and loaded test vehicle shall be within 0.5 inch of the center of gravity of the vehicle loaded with an operator and passenger configuration.

Occupant Protection

The canvass draft proposal includes significant changes to Section 5.1 Occupant Protective Systems in ANSI OPEI B71.9 – 2012, with additional requirements for the seat belt reminder system in Section 5.1.3.2, and the side retention devices in Section 5.1.4.

Seat Belt Reminder/Speed Limitation

Summary of Draft Provision. Section 5.1.3.2 Seat Belt Reminder requires a seat belt reminder system that activates a visual reminder to the driver for at least 8 seconds if the driver's seat belt is unbuckled when the vehicle is started. In vehicles with a maximum speed over 30 mph, an additional requirement specifies a seat belt reminder system that limits the vehicle's maximum speed to 15 mph if the driver's seat belt is not buckled. The proposal specifies a maximum speed test on level ground with the vehicle loaded in the curb weight plus one operator configuration. The vehicle speed cannot exceed 15 mph with the driver's seat belt unbuckled, thus increasing seat belt use by motivating the driver to use the seat belt to achieve higher vehicle speed.

CPSC Staff's Comments. CPSC staff supports OPEI's effort to strengthen significantly the occupant protection of ROVs by introducing a seat belt reminder system that limits the speed of the ROV to 15 mph if the driver's seat belt is unbuckled.

Seat Belts

Summary of Draft Provision. Section 5.1.3.1 Seat Belts requires a Type 2, 3-point seat belt (lap/shoulder belts) that conforms to SAE J2292, *Combination Pelvic/Upper Torso (Type 2) Operator Restraint Systems for Off-Road Work Machines*. In addition to the requirements of SAE J2292, vehicles shall be equipped with Emergency Locking Retractors (ELR) that lock at an angle, determined by the manufacturer based on vehicle use, that is less than 60 degrees.

CPSC Staff's Comments. On July 7, 2015, CPSC staff sent a letter to OPEI explaining staff's concerns that the seat belt requirements in a pre-canvass draft version of the voluntary standard appeared to allow manufacturers to omit ELR technology in seat belts. Staff provided results from roll simulation tests showing that a seat belt without ELR technology did not lock during a

90 degree roll, and consequently failed to restrain an occupant during a simulated rollover event. In response, OPEI revised the seat belt requirements in Section 5.1.3.1 to state explicitly that ELR are required. Based on OPEI's efforts in addressing staff's concerns, staff supports OPEI's seat belt requirement specified in the canvass draft.

Occupant Side Retention Devices

Summary of Draft Provision. Section 5.1.4 Occupant Side Retention Devices and Section 8.10 Occupant Side Retention Devices require physical barriers or design features of the vehicle to reduce the possibility of entrapment of a properly belted occupant's head, upper torso and limbs, between the vehicle and the terrain in the event of a quarter-turn rollover. The occupant side retention device in vehicles with a maximum speed above 30 mph must withstand an outward force of 163 lbf and not deflect more than 4 inches past the vehicle width. The force is applied through a 3 inch diameter disk-shaped probe at a point that is 17 inches above the occupant seat and 6 inches forward of the seat back.

CPSC Staff's Comments. The occupant side retention devices requirements in the pre-canvass draft of ANSI/OPEI B71.9-201X specify a performance requirement that limits the allowable barrier deflection during a probe test to 2 inches, instead of the 4-inch deflection proposed in the draft canvass. Specifically, the June 2015 pre-canvass draft states:

> **8.10.5 Performance Requirements.** The occupant side retention device shall encompass Point R, as shown in Figure X, and shall not deflect more than 50 mm (2 in) past the vehicle width as a result of the force applied in 8.10.4.

CPSC staff performed rollover simulations, with and without side retention, and tests showed that a belted occupant is likely to remain within the protection zone of the rollover protective structure ("ROPS") if a rigid barrier is in place near the occupant's shoulder. Staff believes a barrier that deflects less than 2 inches, as proposed in the June 2015 pre-canvass draft of the ANSI/OPEI standard, will perform as well as the vehicles with rigid shoulder barriers tested in the roll simulation tests.

Staff is confident that robust shoulder barriers and seat belts will keep occupants contained within the vehicle during quarter-turn rollover events; therefore, staff supports ROHVA's shoulder/hip zone requirements in the canvass draft. However, staff does not have any data to evaluate the effectiveness of a side barrier that deflects more than 2 inches and up to 4 inches. Staff plans to conduct future roll simulation tests of model year 2014-2015 vehicles with passive and one-hand operation barriers, and plans to study the effects of nets with 4 inches of displacement. The results of these future tests will then be used to inform any possible staff recommendations to future improvements to the voluntary standard.

In summary, CPSC staff supports the proposed changes to the voluntary standard and believes the aggregate effect of improved vehicle stability, handling, and occupant protection will reduce injuries and deaths associated with ROV rollovers.

Thank you for this opportunity to comment. CPSC staff looks forward to continued communication with OPEI regarding the ANSI/OPEI B71.9-2016 draft standard. If you have any questions or comments, please feel free to contact me.

Sincerely,

Caroleene Paul

cc: Scott Heh, CPSC Voluntary Standards Coordinator