U.S. Department of Transportation, National Highway Traffic Safety Administration
West Building, Ground Floor, Rm. W12-140
1200 New Jersey Ave SE Washing-
ton, DC 20590

SUBJECT : Comments and Suggestions
Docket no. *NHTSA-2020-0093-0013*

To Whom it may concern,

Thank you for the opportunity to pose comments and suggestions related to the above docket. For context, I have been involved in the global testing and all compliance for BubbleBum the inflatable car booster seat from its conception. I hope that the information provided below will prove helpful.

A. Experimental data from Transport Canada shows that submarining occurs in **some but not all** tests with inflatable boosters. As mentioned in the NPRM, Transport Canada conducted five vehicle crash tests with two inflatable booster seats, one of which is the booster seat developed, tested and sold by BubbleBum. Three crash tests (four seating positions) were conducted with the BubbleBum, two with 6 year old ATDs and two 10 year old ATDs. For the vehicle testing with the 6 year old, the pelvis was placed in the "upright" position before the crash. Images from high-speed video indicate that the belt remained on the pelvis and did not penetrate the abdomen. For the vehicle testing with the 10 year old and the BubbleBum, the spine of the ATD was set to a "relaxed or slouched" posture. In those tests, the belt migrated from the pelvis and penetrated the abdomen. In addition to the vehicle tests, the authors conducted an undisclosed number of sled tests with the 6 year old ATD on the BubbleBum. The high speed video images from those tests indicate that the lap belt remained on the pelvis and did not penetrate the abdomen. The authors highlighted differences between the 213 test bench and the vehicle seats, which certainly supports the revised test bench proposed in the NPRM.

B. Experimental data shows that submarining **also occurs with conventional boosters.** In 2012, Transport Canada conducted a series of 42 full-scale rigid barrier frontal vehicle crash tests (40 to and 56 km/h) with children in (Tylko S and Bussieres A – 2012 – Responses of the Hybrid III 5th Female and 10-year-old ATD seated in the rear seats of passenger vehicle in frontal crash tests. Paper number IRC-12-65 International Research Council on Biomechanics of Injury.) The authors qualitatively assessed lap belt migration, defined as the upward displacement of the lap belt into the abdominal cavity, using a Hybrid III 10 year old dummy. Results showed that lap belt migration into the abdomen occurred in 31% of tests with the booster seat. I emphasize that all the boosters tested were conventional rigid booster seat of similar design to those sold by the millions in North America, and the laboratory results showed greater than 30% having submarining.

   In 2018, TRL UK conducted a series of 12 sled tests with 6 and 10 year old ATDs on conventional rigid booster seats over a range of different realistic lap belt paths. (Visvikas et al – 2018 - Assessing Lap Belt Path and Submarining Risk in Booster Seats: Abdominal Pressure Twin Sensors vs. Anterior-superior Iliac Spine Load

Cells. IRCOBI Conference). Like the tests from Tylko et al 2012, the authors tested conventional rigid booster seats, not inflatable booster seats. Through an objective assessment method of submarining, the authors found that the vast majority of booster seats tested exhibited unfavourable kinematics, indicating submarining.

C. Field observations of conventional booster seats show that they are extremely effective in mitigating injury. In North America, the research conducted by the Children's Hospital of Philadelphia is the most definitive study on booster seat effectiveness (Arbogast et al. – 2009 - Effectiveness of Belt Positioning Booster Seats: An Updated Assessment. PEDIATRICS Volume 124, Number 5, November 2009). That study found that children aged 4 to 8 years and using BPB seats were 45% less likely to sustain injuries than similarly aged children who were using the vehicle seat belt. Most notably, in backless booster seats there was a complete absence of abdominal injuries.

Taken together, the findings above indicate that experimental observations of booster seat performance indicate (points A and B) that we should observe substantial abdominal injury the field, yet such injuries are not observed in the field (points C). At the risk of stating the obvious, when the experiment does not match reality, there is a problem with the experiment.

As part of the development and ongoing evaluation of our products, BubbleBum has conducted extensive crash testing on regulatory test benches and real vehicle seats. Because of the successful safety record of conventional semi-rigid booster seats in mitigating injury, we used conventional booster seats as controls in our testing. Similar to the way the pharmaceutical industry compares a novel drug with an existing product control group through a series of pre-clinical and clinical trials, we compare the kinematic, kinetic and injury criteria responses of ATDs restrained on our products with the same kinematic, kinetic and injury criteria responses of ATDs on conventional boosters. By this approach, we acknowledge that there are limitations in the realness of laboratory testing, but also acknowledge that by including a control group in the testing we can mitigate those limitations. In all of our testing, we found that the 6 year old ATD did not submarine on the BubbleBum nor on conventional booster seats. This is consistent with Transport Canada's findings (Tylko writes on "For the [6 year old] ATD placed on the booster seat without a back [BubbleBum], the lap belt remained on the molded, seated pelvis" page 18). BubbleBum has 11 years of field experience, with over a million units in the field around the world and 70% of these seats in the USA. Our testing is consistent with our field performance over the years following our testing, where with over 1M products in the field we have found no reported injuries including submarining injuries in crashes involving the BubbleBum.

In addition, I should note that the BubbleBum has been crash tested and approved to the UNECE requirements in Europe in the *deflated state.* In accordance with the regulation, the seat must be crash tested in "the worst case scenario," which for an inflatable seat is deemed to be punctured. The BubbleBum is able to perform well in this test because even with a large bore puncture, the BubbleBum is able to maintain its structural integrity. This is because the BubbleBum seat does not rely only on air to create stability, but on the High Density Cellular Structure and webbing harness which are integral to the functionality and performance of the seat. In order to prove this further, in the USA we conducted testing in a recognised 3rd Party Laboratory simulating a large bore puncture of the booster, and because of the unique construction of the BubbleBum product the BubbleBum still restrained the occupant even with the large bore puncture. It is not immediately clear if other inflatable products follow the same rigorous design and testing process.

Adding compression deflection testing to the regulation would not result in a 'measurable benefit' to the health and safety of children.

Thank you for your consideration and the opportunity to provide this feedback,

Sincerely,

Grainne Kelly
Founder & CEO BubbleBum USA LLC
Baby Products Association UK Executive & Technical Committee Member Member of Prime Minister's Business Council, 10 Downing Street