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Dear Mr. Lomonoco,

Permit me to introduce myself. I am the president of Seattle Safety a dynamic sled system manufacturer. Our sled systems are used in the automotive and aerospace industries for compliance testing to various government safety regulations. We take an active interest in developments in regulations requiring sled testing, and as a company we are dedicated to help industry and government attain the highest feasible levels of safety in their products.

It has come to our attention that Japan is proposing to adopt ECE 44.03 as a national standard. This would of course include the dynamic test as specified in Annex 7 Appendix 1 and 2 standards. These rules at present specify a decelerating trolley, and give acceleration pulse boundaries, specify impact velocity, and specify a stopping distance.

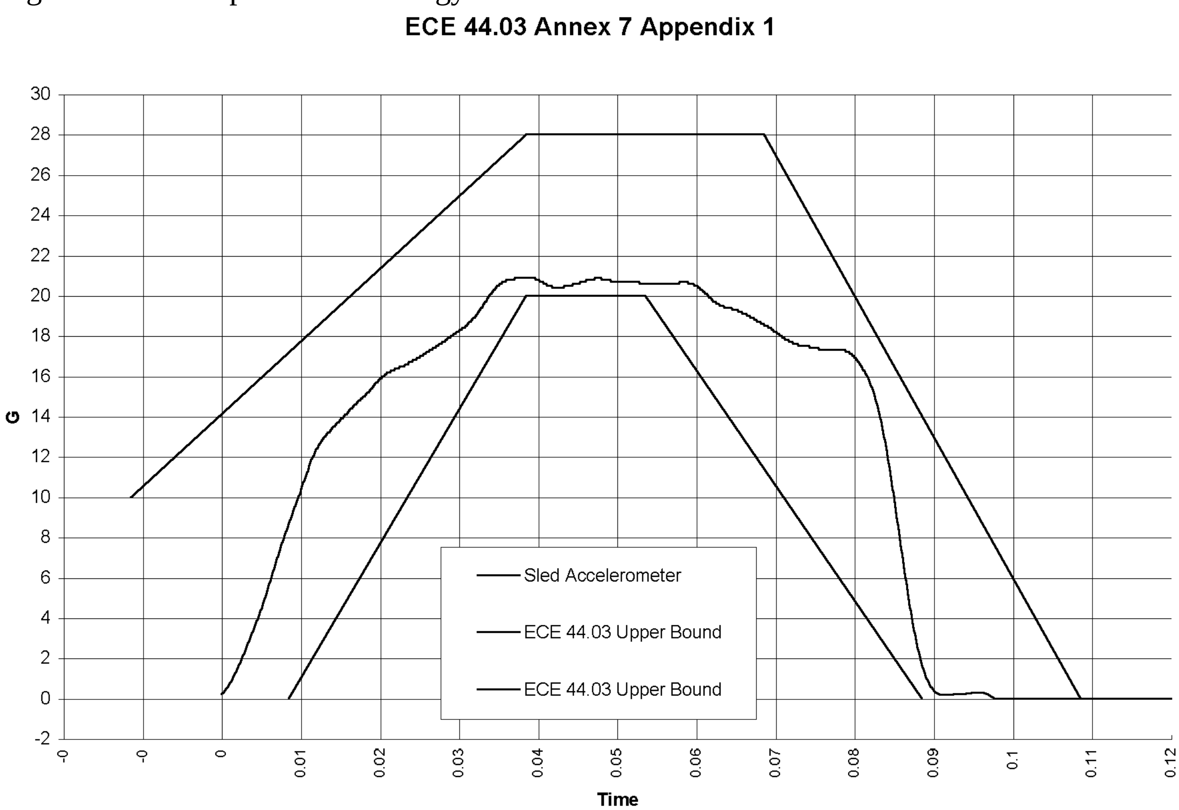
We understand from our contacts in Japan that the Japanese have presented a proposal to modify the requirements to allow the use of accelerator type sleds. This raises some technical concerns; since the trolley in an accelerator system is initially at a standstill and is accelerated to speed during the crash pulse, there is no impact velocity, but a change in velocity. Similarly, since the sled continues moving after the pulse, direct measurement of the acceleration distance is more difficult.

We understand that it is proposed that accelerometer data be double integrated to provide velocity and acceleration distance data for use in accelerator systems, yielding an exit velocity and a distance allowing accelerator sleds to be used for these tests.

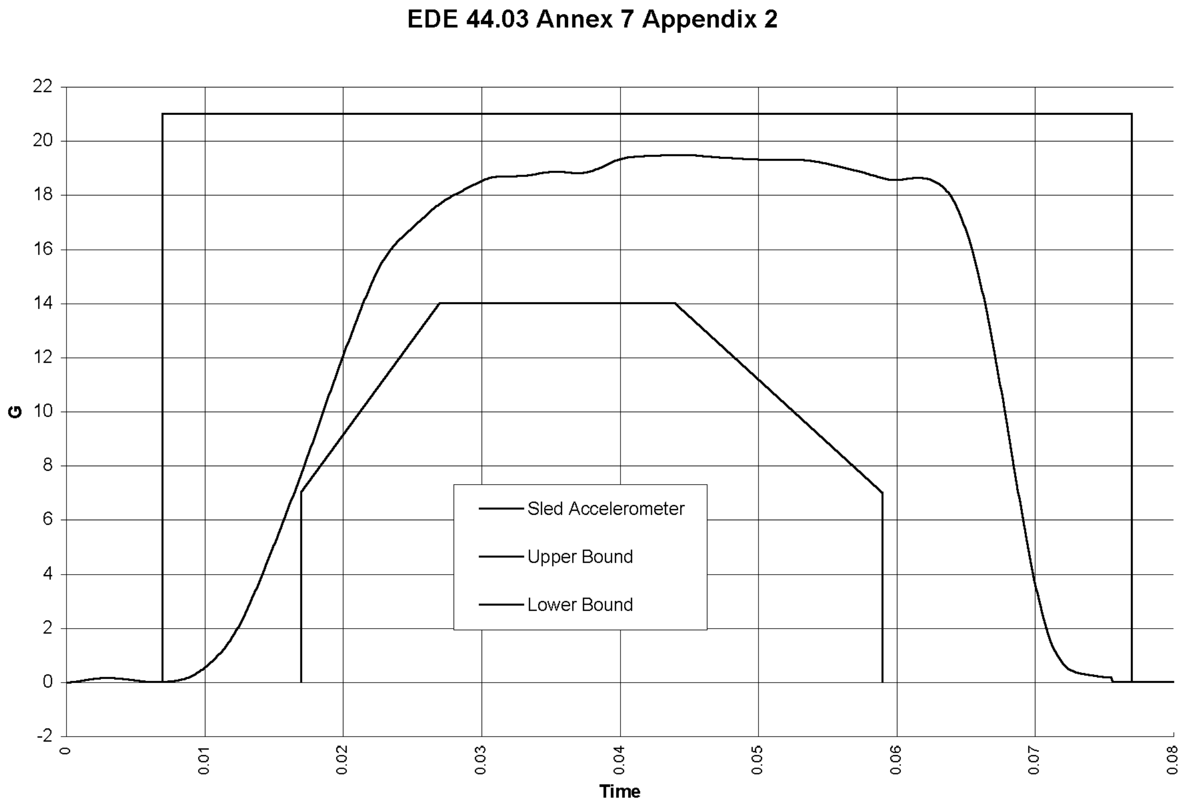
The proposed substitute measurements are not equivalent to the measurements required under the present regulation. This is because decelerator sleds always rebound somewhat after impact, as all energy-absorbing materials have some resilience. The rebound effect is well known to all decelerator sled facilities that customarily integrate the accelerometer curves and have equipment that directly measures impact velocity. Integrating the accelerometer data automatically includes the acceleration of the sled in the rebound phase, and for that reason the integrated delta velocity is always significantly higher than the impact velocity. Similarly, the integrated decelerator stroke is always longer than the directly measured distance. The magnitude of these effects is significant. Below is a compliant ECE 44.03 Annex 7 Appendix 1 pulse from a decelerator sled. Also presented in the table are integrated delta velocity and stroke, and directly measured impact velocity and stroke. The impact velocity was measured with a GHI VS200 velocimeter, and the stroke was measured from a groove cut in a plasticene strip by a sled-mounted blade. The accelerometer data was measured per SAE J211.

	Directly Measured Values	Integrated Values
Velocity	48.91 kph	50.49 kph
Stroke	625.5 mm	665.7 mm

Although the pulse is comfortably within the limits when measured per the existing rule, it is not compliant when integrated values are used. The kinetic energy from the delta velocity is 6.6% higher than the impact kinetic energy.



This test was not an isolated case. In fact, the difference in values is even greater when an ECE 44.03 Annex 7 Appendix 2 pulse is analyzed. This is because the pulse falloff is more rapid, so more strain in the system is elastically relieved. Below is the pulse and related data:



	Directly Measured Values	Integrated Values
Velocity	28.31 kph	30.30 kph
Stroke	269.9 mm	331.8 mm

Delta velocity kinetic energy is in this case 14.6% higher than impact energy kinetic energy. The data strongly indicates that using an accelerator sled with integrated delta velocity and stroke substituted for impact velocity and directly measured stroke is not an equivalent test. In practice, 'compliant' pulses on an accelerator sled would be significantly softer than compliant pulses on a decelerator sled. Further complicating the issue, the results presented above are only two cases. These discrepancies would be larger and smaller if various decelerator designs and pulse shapes are considered.

Allowing accelerator sleds to be used for testing to ECE standards, will, unless decelerator sleds are also allowed to use integrated measures, give an unfair compliance advantage to manufacturers using accelerator sleds. If decelerator sleds are allowed to use the integrated measures, accelerator sleds would not have a relative advantage, but decelerator sleds could then certify seats using gentler pulses than are presently compliant. In either case the standard of safety would be lowered, as the new measures allow a significantly softer pulse to be compliant.

Nonetheless, we believe that replacing the directly measured velocity and stroke with integrated measures has technical merit. Integration accounts for the rebound energy, and can reduce the discrepancies in results from different laboratories that have been observed over the years. It can also allow the use of accelerator systems while maintaining a level playing field for all manufacturers. It is a change that should not be made without an adjustment to compensate for the decelerator sled rebound effect.

We suggest that the magnitude of the rebound effect should be carefully measured in the various major laboratories. The differences in rebound energy for each pulse type can be calculated as in the example above, and the required delta velocity and integrated stroke can be raised by an amount that broadly represents the rebound energy seen in the various systems in use in government and industry. At that time the standard can be responsibly changed, resulting in a new standard that will improve both consistency of results and test equipment flexibility, but will not result in a reduction in the safety of the final product. For consistency, the new rules should allow only integrated values to be used for decelerator and accelerator sleds alike.

Sincerely,

Thomas Wittmann,
President, Seattle Safety LLC