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Design of a Belt Retractor to Better Represent In-Vehicle Response when Conducting Sled Tests

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Child occupant protection: Latest knowledge and challenges in future mobility

Göteborg, September 4, 2019

Transport Canada Transports Canada

Canada

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Research Context

Crashworthiness research is conducted in support of regulations. This includes:

- Monitoring current regulations & proposed test protocols to ensure that they address the safety needs of Canadians;
- Investigating test methodologies including the biofidelity of crash test dummies and the introduction new technologies;
- Providing the Department with the necessary scientific basis on which to base policy decisions and future regulatory initiatives.

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Research Context cont'd

Child restraints & booster seats are installed in test vehicles to

- Compare dummy types and evaluate dummy capabilities;
- Describe how design features/ characteristics influence dummy responses
- Help in the development of test methodologies

The research programs are not intended to rate or rank the effectiveness of vehicles, child restraints or booster seats.

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Development of test methodologies

Field accidents

hd-carwallpapers.blogspot.com

Laboratory crash tests

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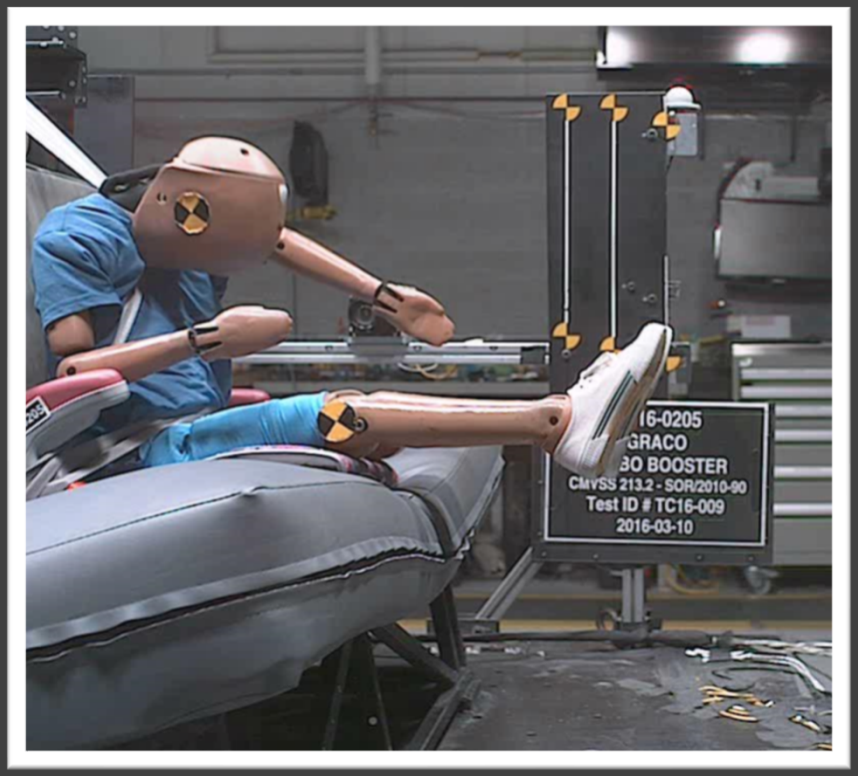
C/FMVSS 213.2 Regulatory Tests



REGULATORY CRITERIA

- Excursion
- Chest acceleration
- Head acceleration (inertial only)

TEST BENCH VS. PASSENGER CAR

- No retractor
- Anchor at the rear
- Seatbelt is **locked and pre-loaded**
- Cushion is flat, soft & sticky
- Seat back is unyielding

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Proposed FMVSS 213.2 Bench

CRITERIA

- Excursion
- Chest acceleration
- Head acceleration (inertial only)

PROPOSED NHTSA TEST BENCH

- No retractor
- Anchor at the rear
- Seatbelt is **locked and pre-loaded**
- Cushion is stiffer than current bench
- Seat back is unyielding

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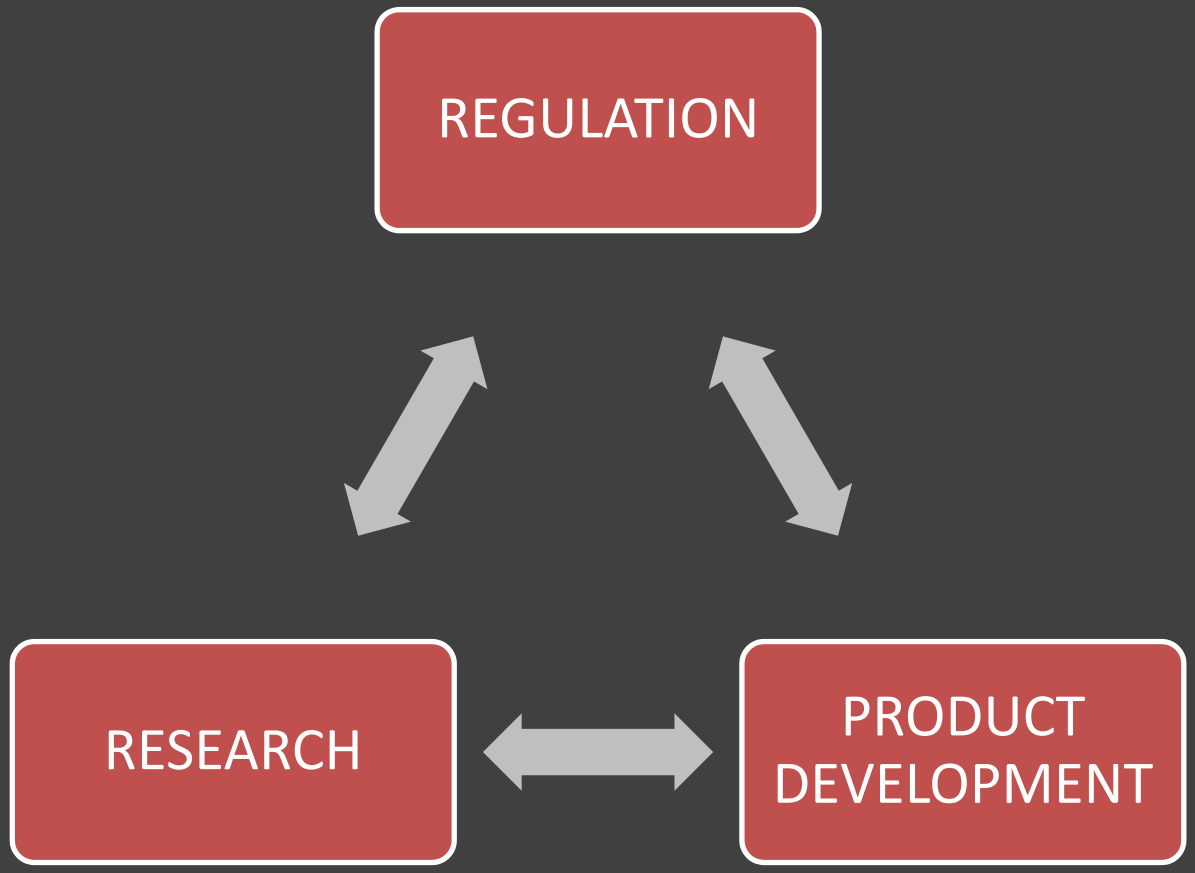
Importance of Regulatory Benches



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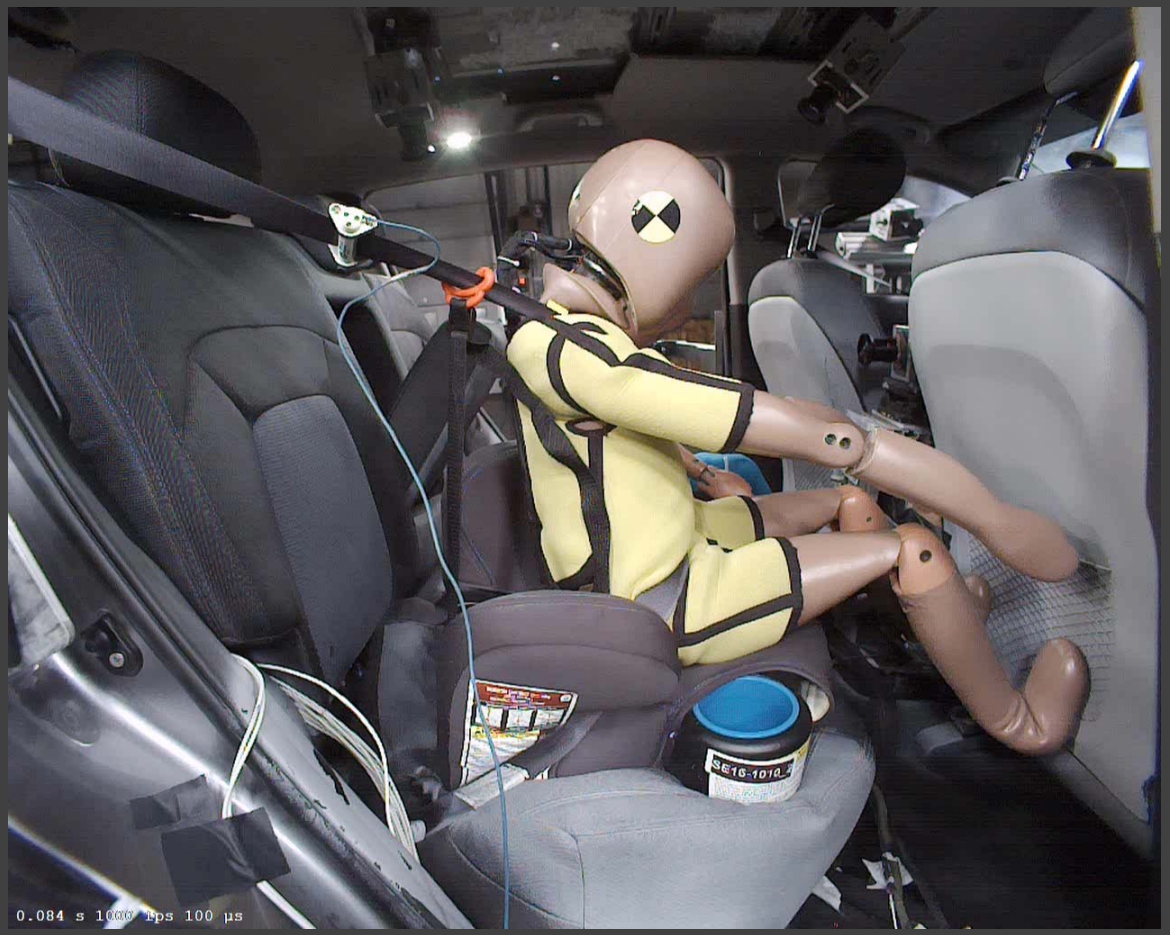
In-vehicle frontal barrier test, large forward excursion arrested by the feet



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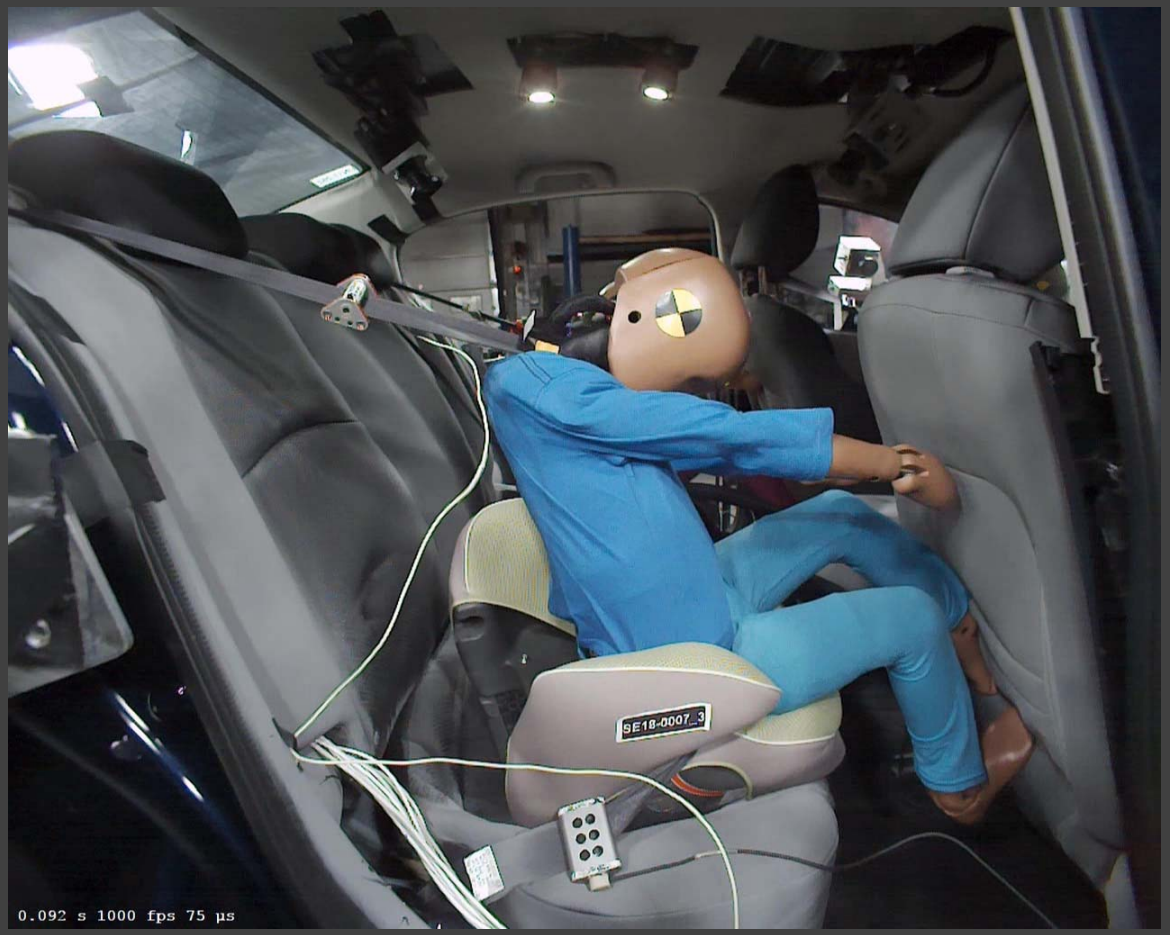
In-vehicle frontal barrier test: example of dummy motion when lap belt is redirected forward of the hips, chest engages the shoulder belt before the pelvis



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Vehicle buck: paired comparisons, shoulder belt can sometimes slip over the armrest during forward excursion

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In vehicle frontal rigid barrier test at 55 km/h Q6 vs. HIII 6-year-old on an inflatable booster seat, the dummies move very differently

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HIII 6-year-old on an inflatable booster seat tested on C/FMVSS sled bench does not simmulate motion that is observed in the rear seats of passenger cars

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HIII 6-year-old on a feather pillow can also appear to perform well when tested on C/FMVSS sled bench, because relative displacement cannot occur

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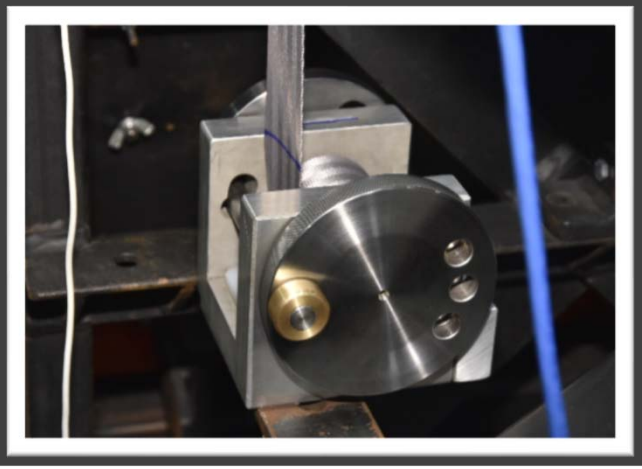
We are exploring retractor and belt stalk designs to improve the forward excursion acceleration responses that are observed in passenger cars



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With the addition of a retractor and by extending belt buckle forward of the seat cushion byte we are able to increase the dummy excursion

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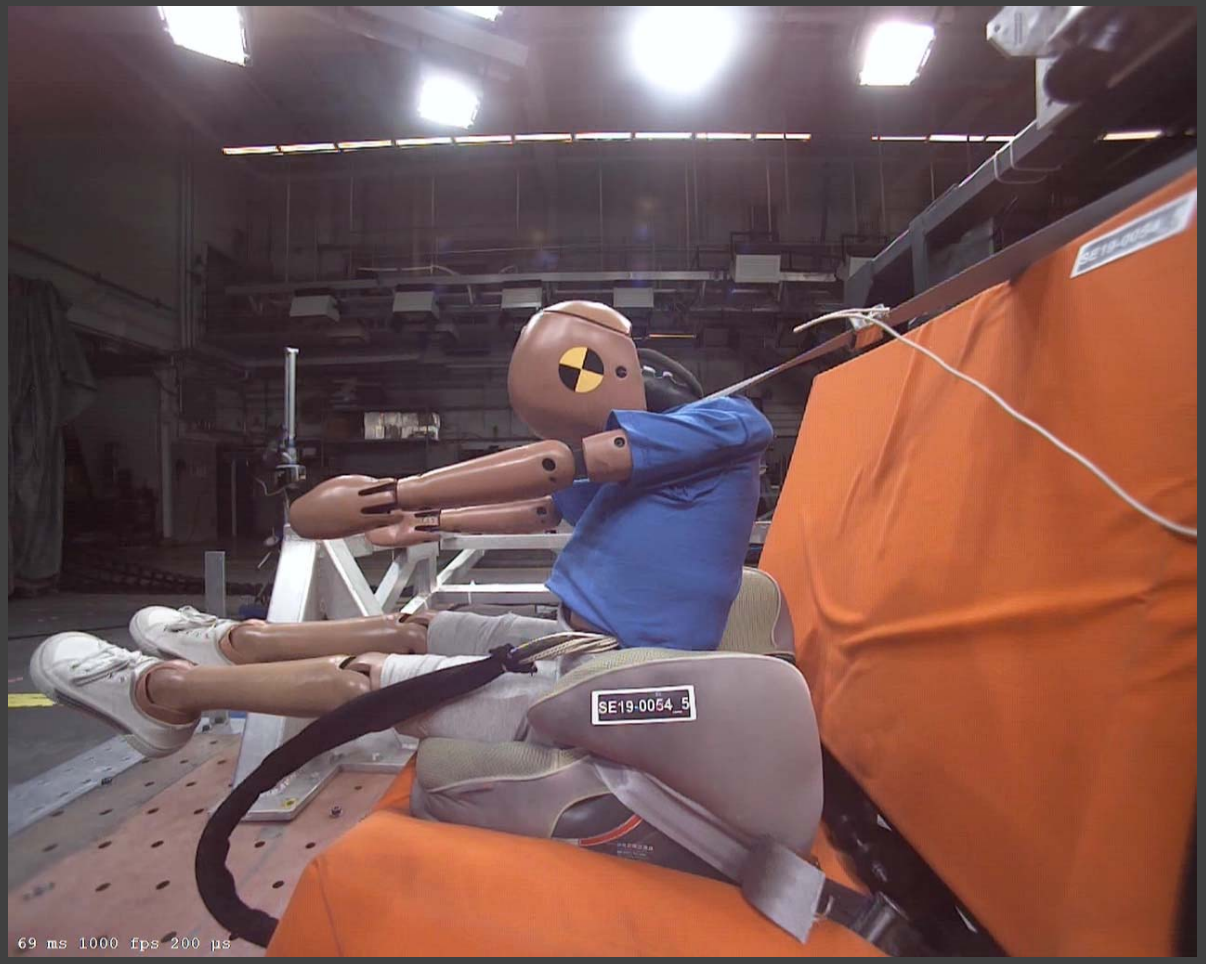

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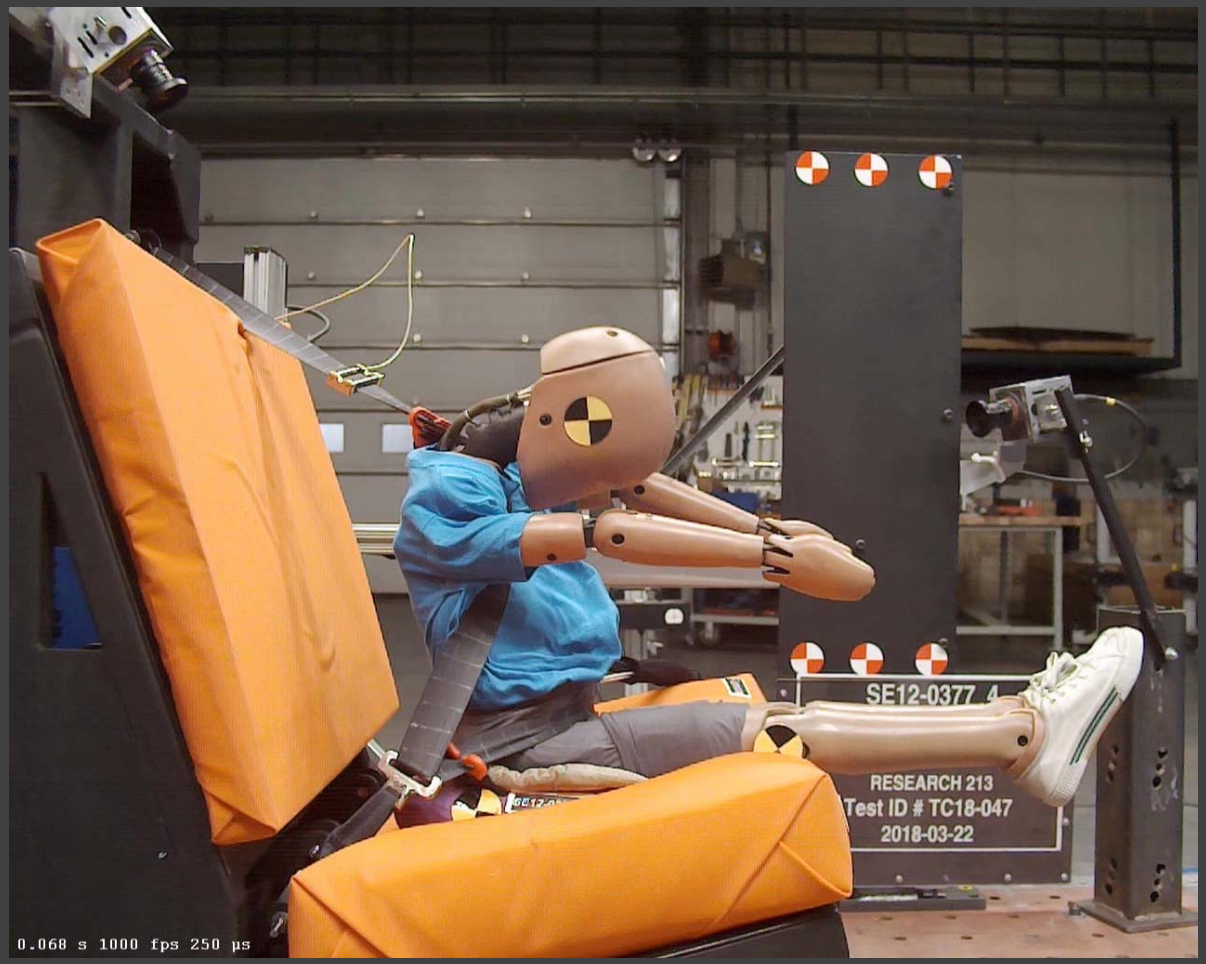
The study is on-going and continues to investigate different combinations of belt adjustments and different booster seat types.



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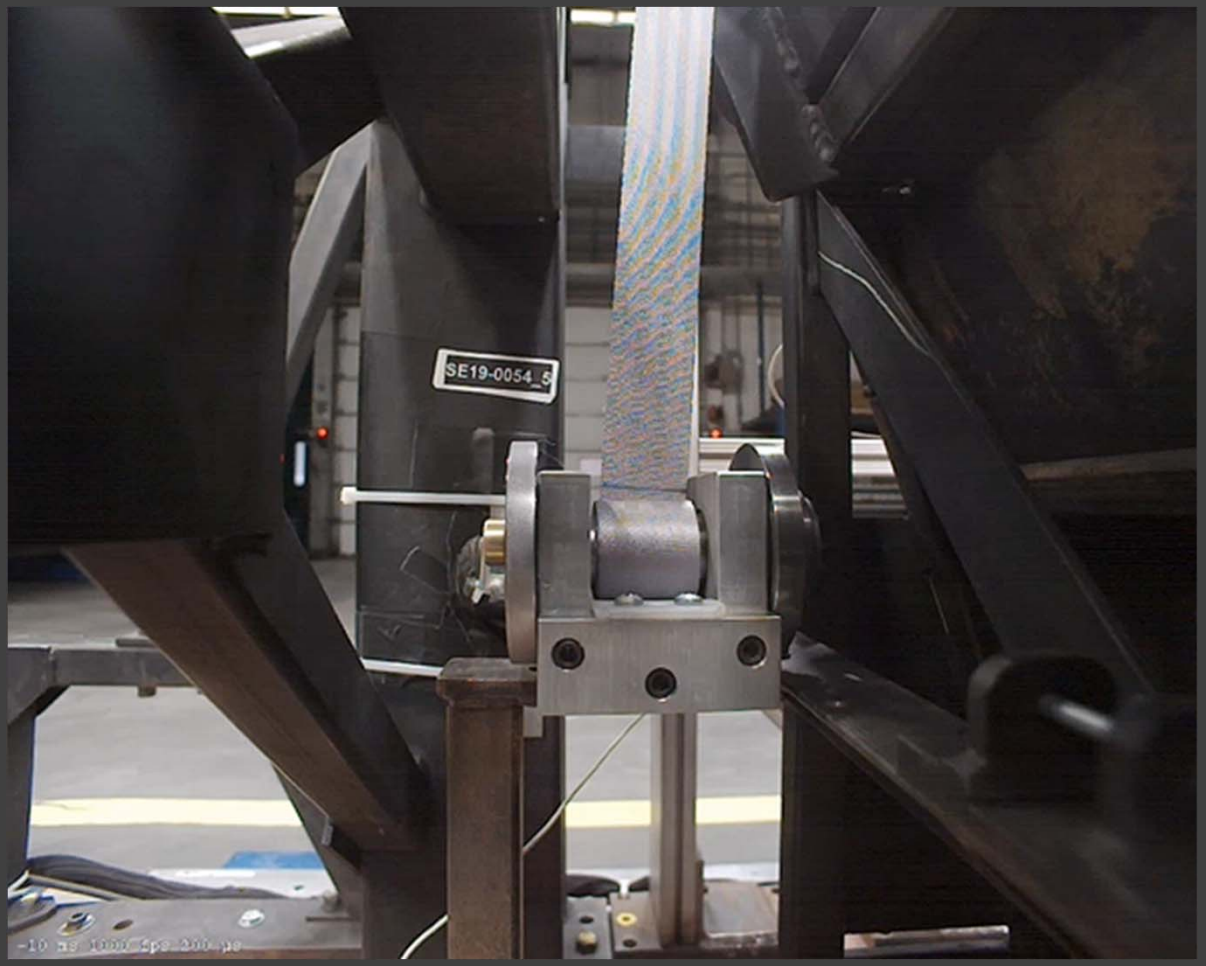

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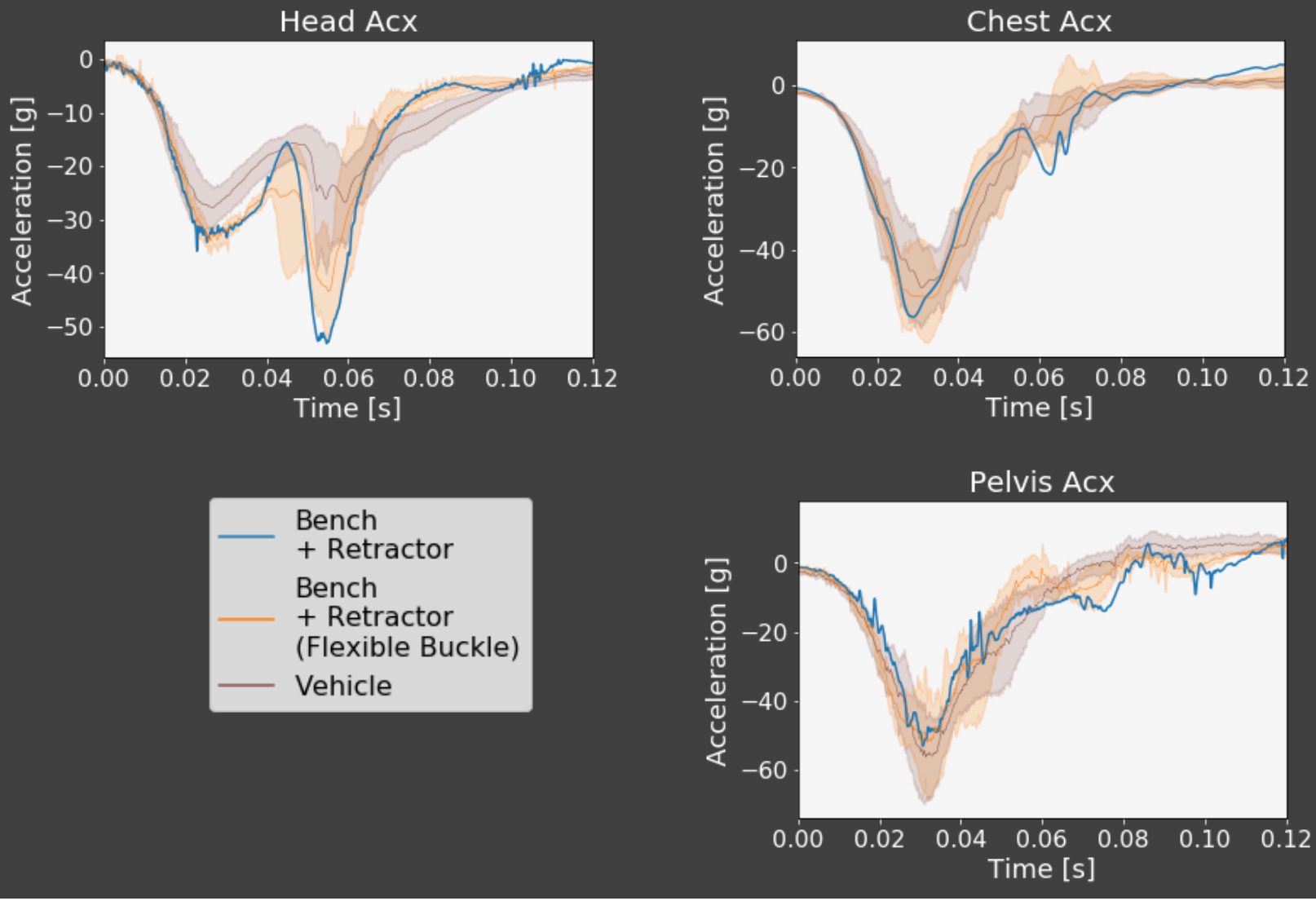
Monitoring ATD Responses



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Interim Findings

- The motions of the Hybrid III 6-year-old observed in vehicle crash tests are not comparable to the motions observed on the C/FMVSS 213 test bench
- The introduction of the retractor and belt stalk have increased the dummy excursion and appear to be more representative of the movement that is observed in vehicle tests.
- The head, chest, and pelvis acceleration responses of the ATD on the bench with the surrogate retractor were within or close to the range of responses observed in vehicles.
- We will continue to investigate how best to simulate the responses that are observed in vehicle tests on the test bench.

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Acknowledgments

Thank you to SAFER for hosting this valuable workshop

Thank you to PMG Technologies, especially the crash lab for your dedication to safety and commitment to testing accuracy

Thank you all for your continued commitment to safety

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