DG ENTR Framework Contract
New UN Regulation on CRS

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UN Informal Group on CRS 16th April 2013

Terms of Reference for Phase 2 and Phase 3

Adopted text based on GRSP-49-01-Rev.1

- Phase 2 will develop definitions, performance criteria and test methods for **non-integral CRS** with ISOFIX attachments
- In Phase 2, the **test pulse** for frontal impact (increased severity and CRS integrity) will be reviewed in light of recent accident data
- In Phase 2, the strict application of recognised and accepted **injury criteria** related to the new generation of baby/child crash test Q-dummies, as supported through EEVC and other EU research programmes, will be reviewed in the light of recent accident data

Project objectives

- To support the Commission during Phase 2 of draft new Regulation on “Enhanced Child Restraint Systems”
- To contribute to evidence base for technical aspects of new Regulation; including assessments of
  - Definitions, performance criteria and test methods for **non-integral CRS** with ISOFIX attachments
  - The **test pulse** for frontal impact
  - How best to apply recognised and accepted **injury criteria** related to the Q-Series
  - Other issues identified by the Commission related to validation of the Regulation

Work completed so far

First results presented today

- Measuring and assessing abdomen loading in non-integral ISOFIX CRS
  - 12 front impact experiments
  - Q3 and Q10 with abdomen sensors
- Further validation of the side impact test procedure
  - Full-scale car-to-car side impact experiment with Q3 and Q1
  - 8 sled side impact experiments
- Investigation of the front impact test pulse
  - Full-scale car-to-car front impact experiment

Measuring and assessing abdomen loading in non-integral ISOFIX CRS

Background

- Abdomen is common injury location in non-integral CRS
- CRS performance assessment made in UN Regulation 44
  - Modelling clay on lumbar spine
- New UN Regulation should maintain (and ideally enhance) CRS performance assessment in abdomen
- No method to detect abdomen loading in Q-Series
  - Modelling clay or instrumentation
  - Prototype sensor(s) developed in CHILD / CASPER
- Shortcomings in lap belt interaction
  - Dummy accessories evaluated in CASPER for Q3
  - Humanetics proposal for Q10

Objectives

- Investigate state-of-the-art of Q-Series dummies and sensors for measuring and assessing abdomen loading
- Propose and validate a solution that can be implemented in the draft new UN Regulation

- Do proposed accessories improve belt interaction?
- Are dummy / sensors sensitive to differences in CRS?
  - Especially those likely to influence abdomen injury risk
- Are changes to the test procedure needed to improve the assessment of non-integral ISOFIX CRS?

Experiment matrix

Dummy	Abdomen sensor	Accessory	CRS attach.	Lap belt guide	Seat cushion 5°	'UMTRI' seating
Q10	X	X	ISOFIX	X	X	X
Q10 / Q3	✓	X	ISOFIX	X	X	X
Q10 / Q3	✓	✓	ISOFIX	X	X	X
Q10 / Q3	✓	✓	ISOFIX	✓	X	X
Q10 / Q3	✓	✓	Seatbelt	X	X	X
Q10 / Q3	✓	✓	ISOFIX	X	✓	X
Q10	✓	✓	ISOFIX	X	X	✓

Pelvis inserts (Q3)

Hip shields (Q10)

Child restraint system

Harness removed for all experiments

No lap belt guides

Lap belt guides

Effect of abdomen sensor – Q10

No sensor

Left (bar)	Right (bar)
n/a	n/a

Sensor fitted

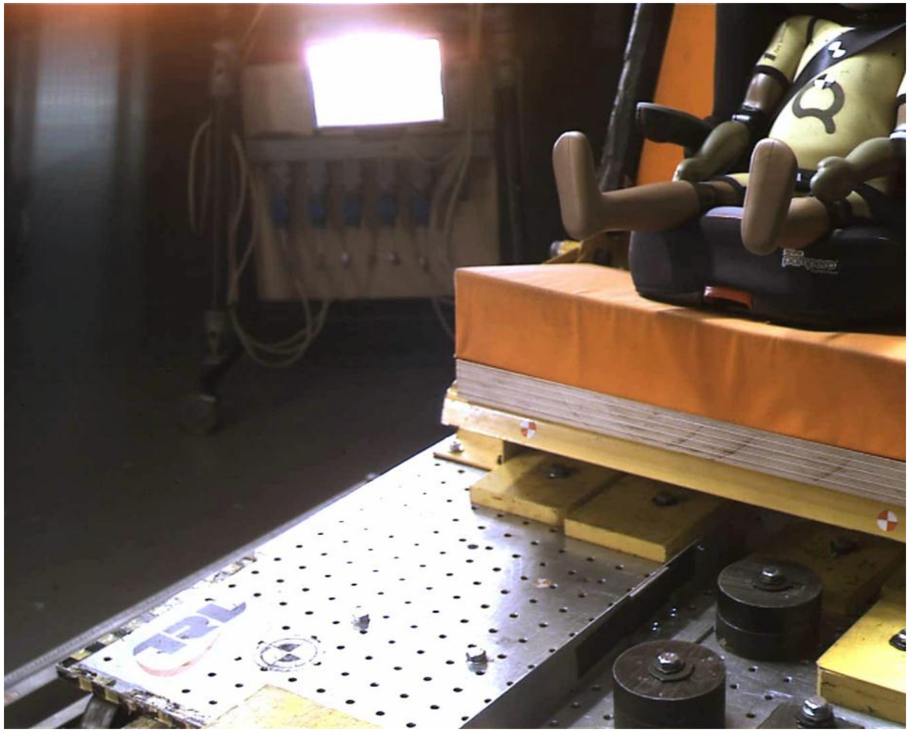
Left (bar)	Right (bar)
0.72	1.22

Effect of accessory (IFSTTAR pelvis insert) – Q3

No pelvis insert

Left (bar)	Right (bar)
0.28	0.21

Pelvis insert



Left (bar)	Right (bar)
0.21	0.12

Effect of accessory (Humanetics hip shields) – Q10

No hip shields	Hip shields
	

No hip shields

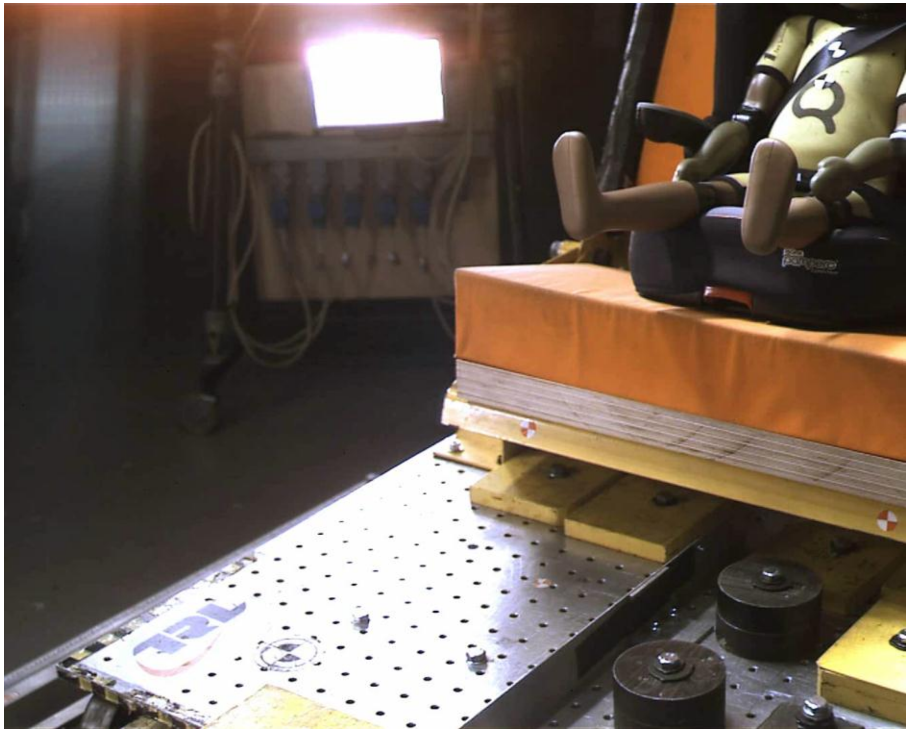
Left (bar)	Right (bar)
0.72	1.22

Hip shields

Left (bar)	Right (bar)
0.68	1.27

Sensitivity to CRS (attachment) – Q3

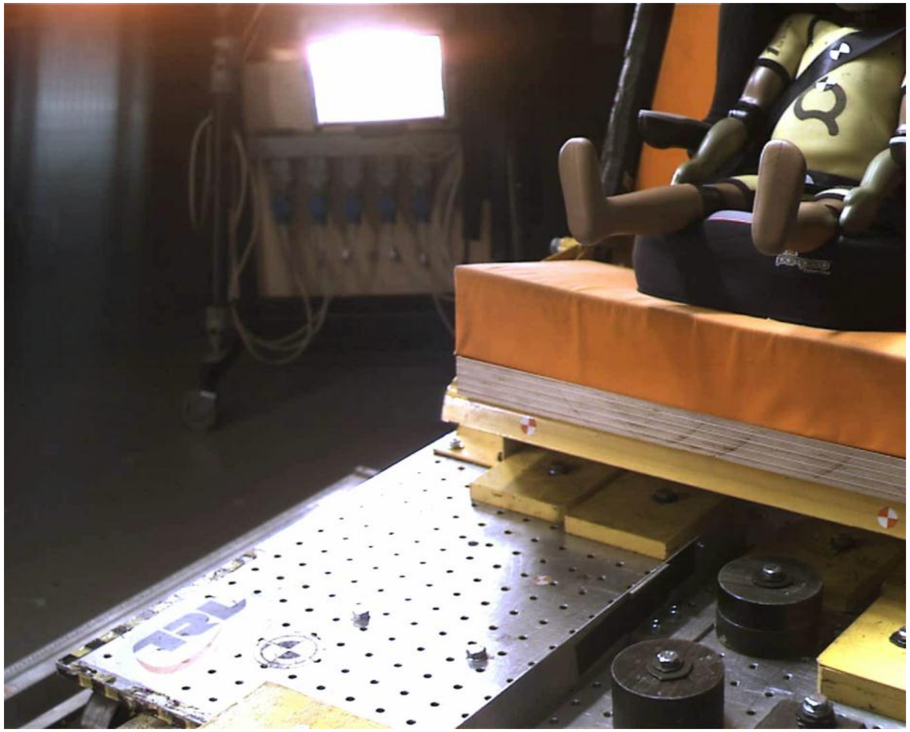
ISOFIX



Left (bar)	Right (bar)
0.21	0.12

Lap belt force = 1.3 kN

Belt-attached



Left (bar)	Right (bar)
0.16	0.20

Lap belt force = 3.0 kN

Pelvis inserts fitted in both experiments

Sensitivity to CRS (attachment) – Q10

ISOFIX

Left (bar)	Right (bar)
0.68	1.27

Lap belt force = 3.5 kN

Belt-attached

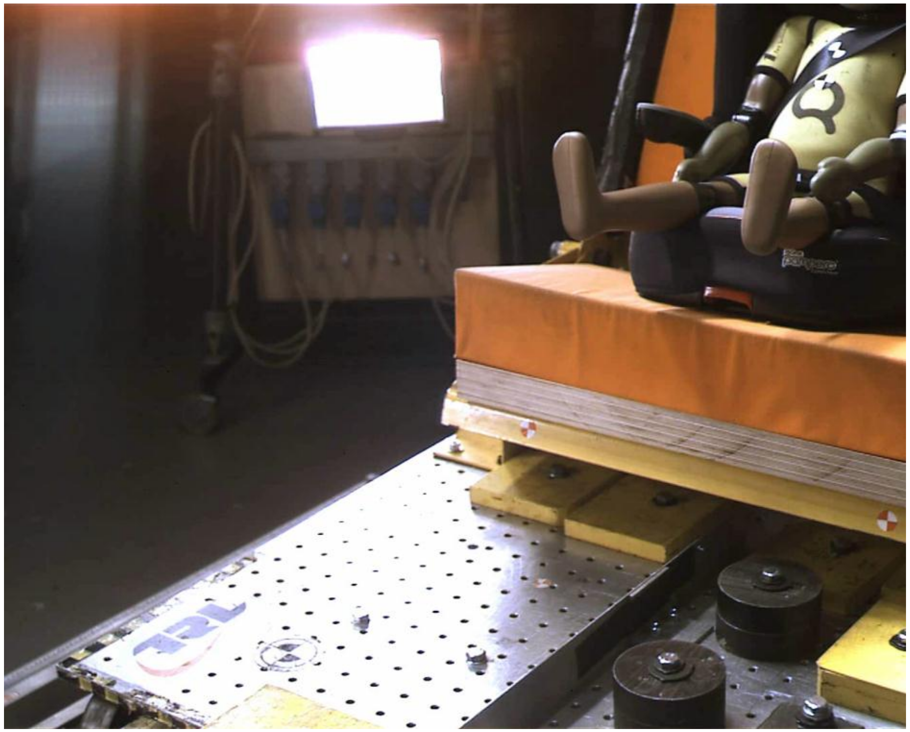
Left (bar)	Right (bar)
0.79	1.37

Lap belt force = 4.3 kN

Hip shields fitted in both experiments

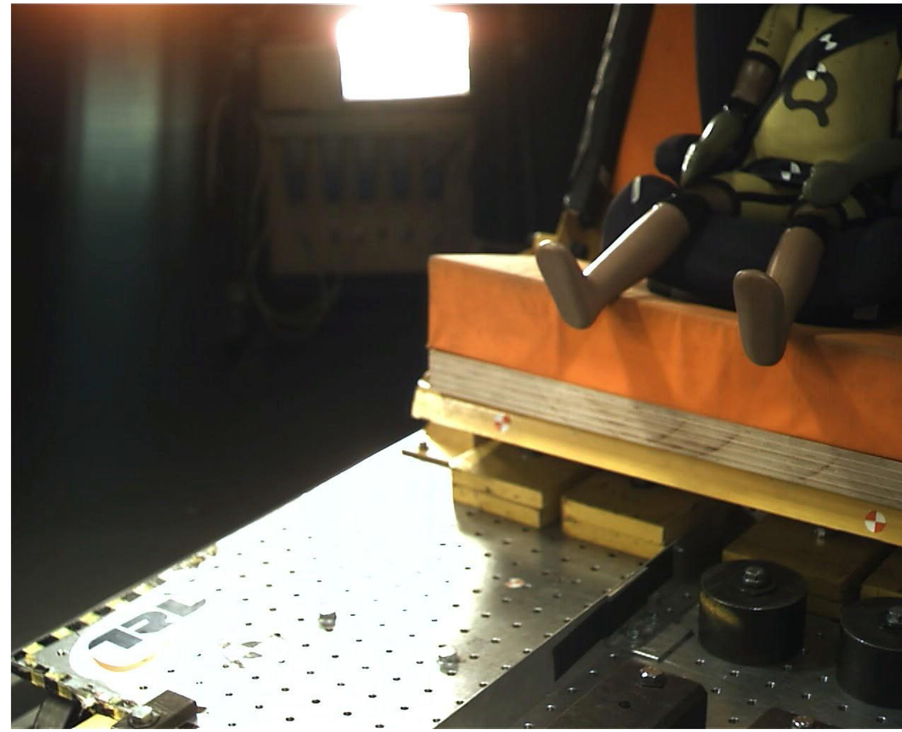
Sensitivity to CRS (lap belt guides) – Q3

No lap belt guides



Left (bar)	Right (bar)
0.21	0.12

Lap belt guides



Left (bar)	Right (bar)
0.47	0.37

Pelvis inserts fitted in both experiments

Sensitivity to CRS (lap belt guides) – Q10

No lap belt guides

Left (bar)	Right (bar)
0.68	1.27

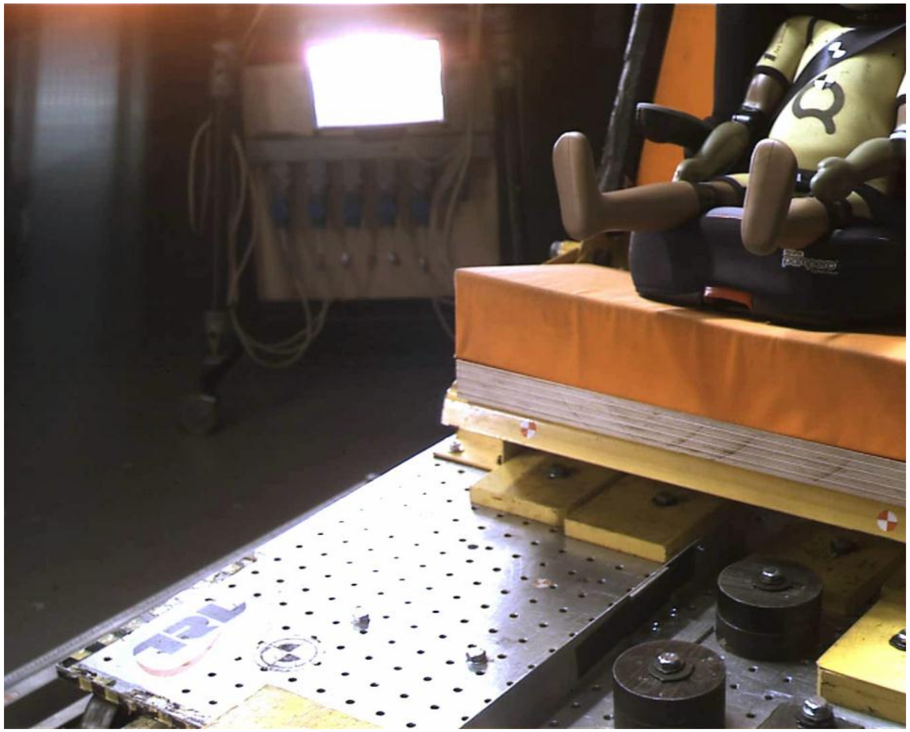
Lap belt guides

Left (bar)	Right (bar)
0.74	1.25

Hip shields fitted in both experiments

Effect of seat cushion angle – Q3

Standard seat cushion



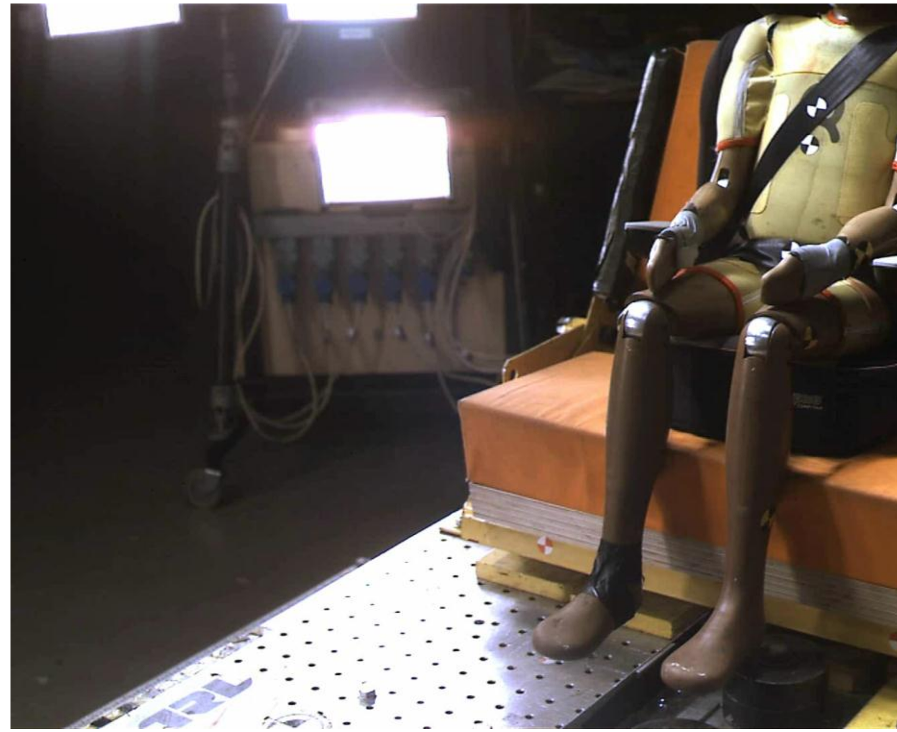
Left (bar)	Right (bar)
0.21	0.12

5° seat cushion

Left (bar)	Right (bar)
0.19	0.27

Pelvis insert fitted in both experiments

Effect of seat cushion angle – Q10

Standard seat cushion	5° seat cushion
	

Left (bar)	Right (bar)
0.68	1.27

Left (bar)	Right (bar)
0.71	1.25

Hip shields fitted in both experiments

Effect of positioning procedure – Q10

Standard procedure

Left (bar)	Right (bar)
0.68	1.27

UMTRI procedure

Left (bar)	Right (bar)
0.56	0.75

Hip shields fitted in both experiments

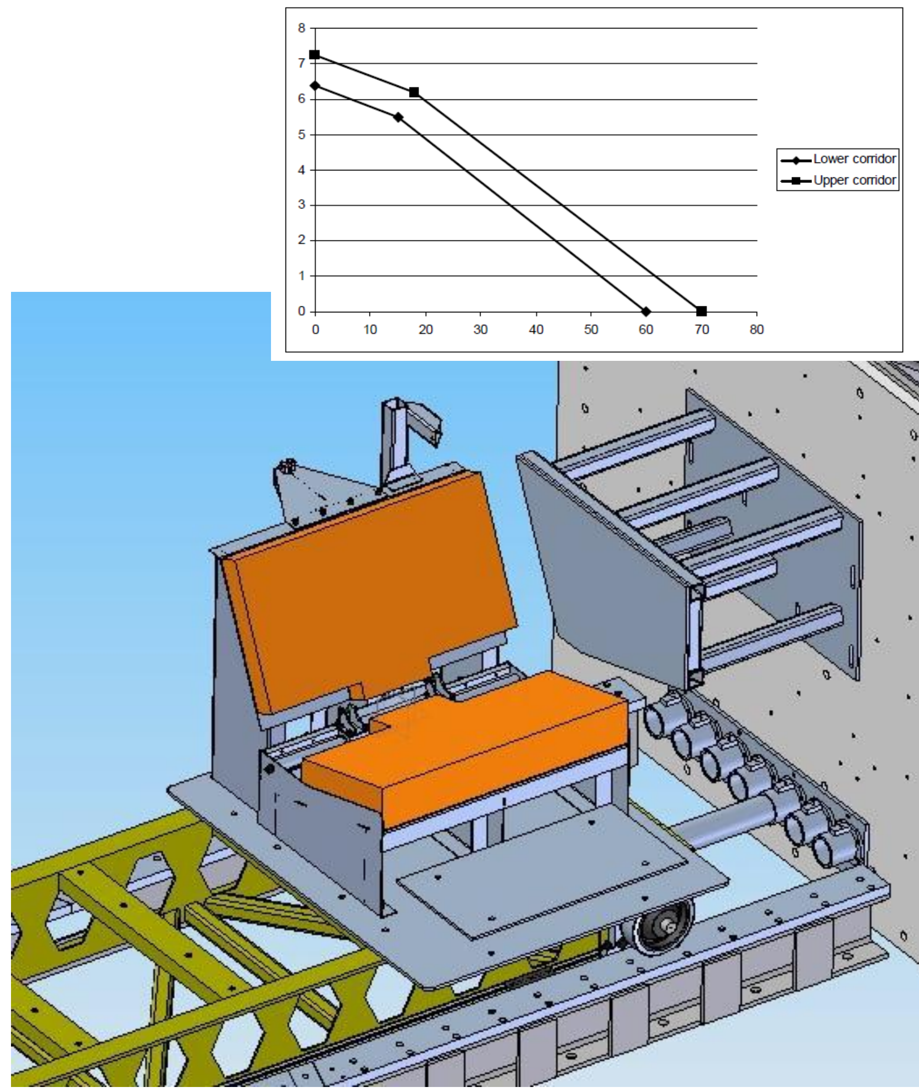
Summary

- Dummy kinematics and abdomen measurements reasonably consistent regardless of conditions
- Current procedure (dummy AND test bench) may not discriminate between non-integral ISOFIX CRS
- Will non-integral ISOFIX CRS be enhanced?
  - Test procedure may not encourage desirable features
- There may be benefits for other CRS types
  - E.g. impact shields
- We don't know real human response in these conditions
  - Is there a role for human body simulation?

Further validation of the side impact test procedure

Background

- Static intrusion panel
  - Max. intrusion 250 mm
- Replicates intrusion velocity at time of max. head loading
- ISOFIX anchorages free to move
  - Unrealistic?
- Comparison with real vehicle promising (Johannsen *et al.*, 2011)
  - Not worst-case vehicles
  - Severity has reduced



Johannsen, H., Bendjellal, F., Renaudin, F., and Claeson, P. (2011). *Update on lateral impact test procedure for child restraint systems* (Paper No. 11-0291). 22nd International Technical Conf. on the Enhanced Safety of Vehicles.

Objectives

- Investigate whether side impact test procedure is broadly comparable to a real side impact collision
- Investigate whether the side impact test procedure is capable of distinguishing between child restraints with different levels of side impact protection

- Can the side impact test procedure predict dummy loads in a typical collision?
- Will the side impact test encourage CRS features that are desirable for side impact?

Full-scale side impact experiment

Overview

- Based on UN Regulation 95
  - Deformable barrier replaced by second car
  - Front seat moved forwards approx. 20 mm
- Identical cars – typical supermini (probable worst-case)

Car	Seating position	Dummy	Child restraint
Vauxhall Corsa #1 (target)	Front left (struck side)	Q3	FF ISOFIX integral (Maxi-Cosi PrioriFix)
Vauxhall Corsa #1 (target)	Rear left (struck side)	Q1.5	RF ISOFIX integral (Britax Baby-Safe)
Vauxhall Corsa #2 (bullet)	No dummies (moderate front impact only)		

Corsa not equipped with side impact air bags

Full-scale side impact experiment

Full-scale side impact experiment

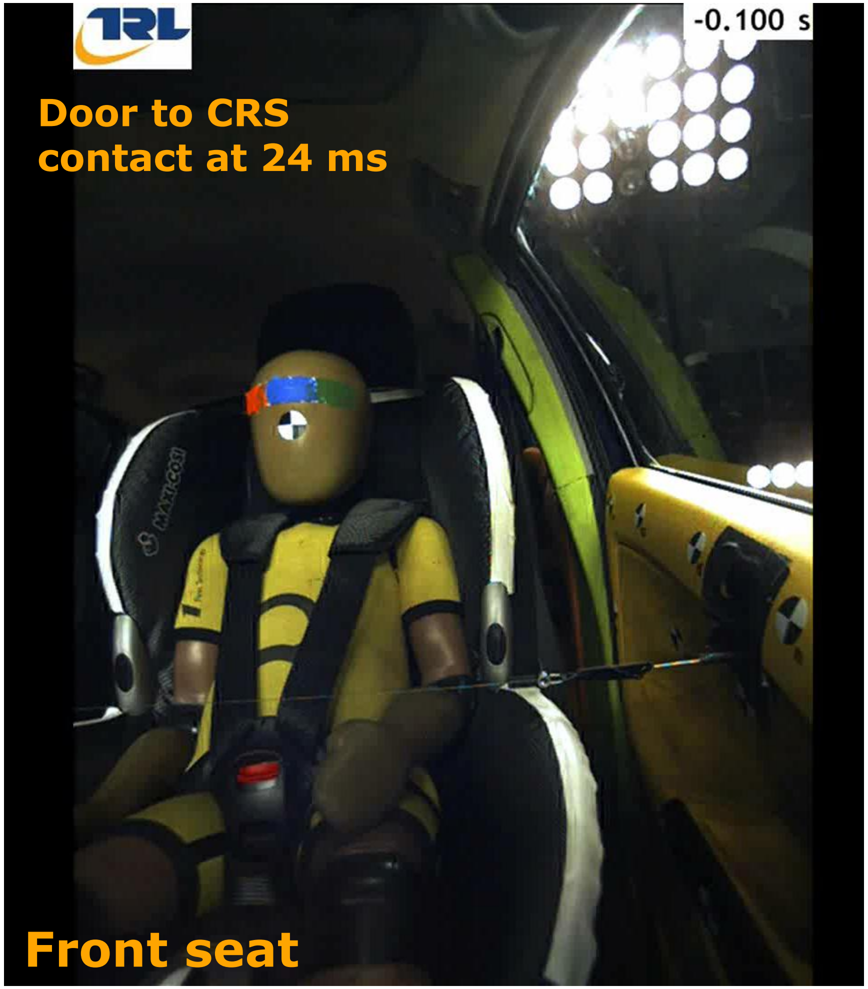
Vehicle damage

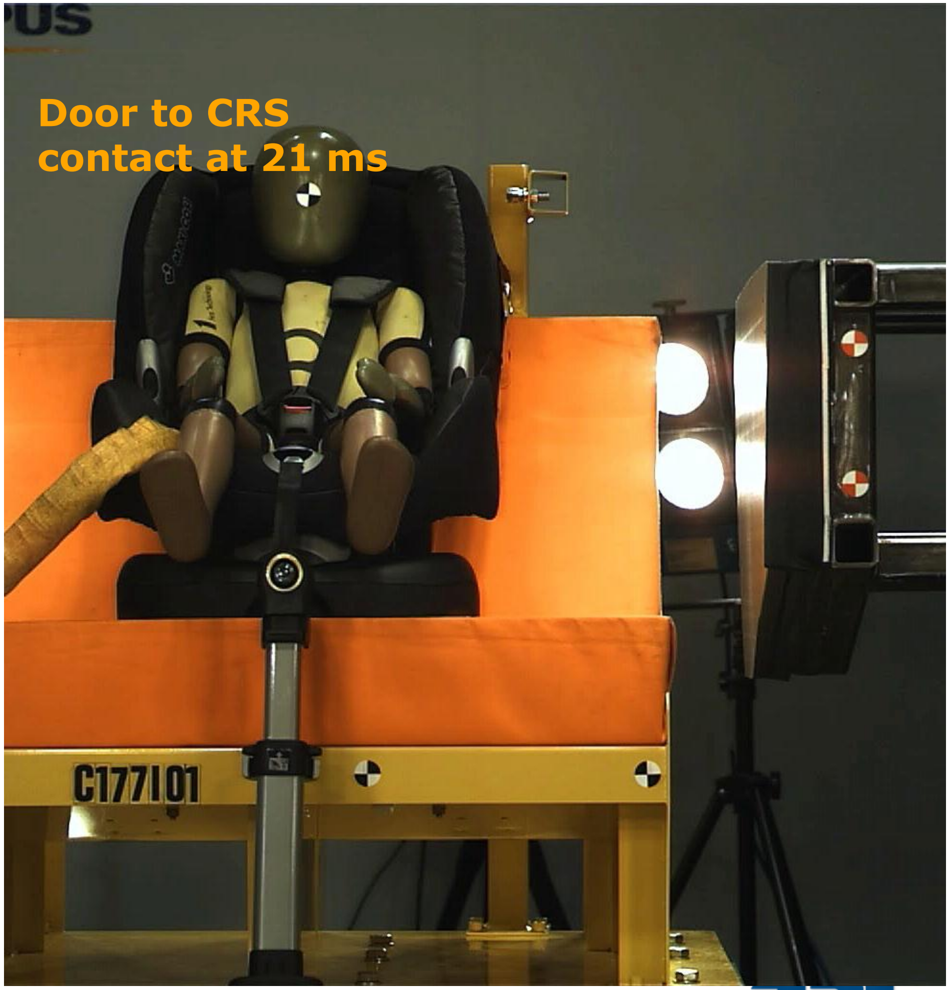
Bullet car – Vauxhall Corsa

Target car – Vauxhall Corsa

Comparison with side impact test procedure

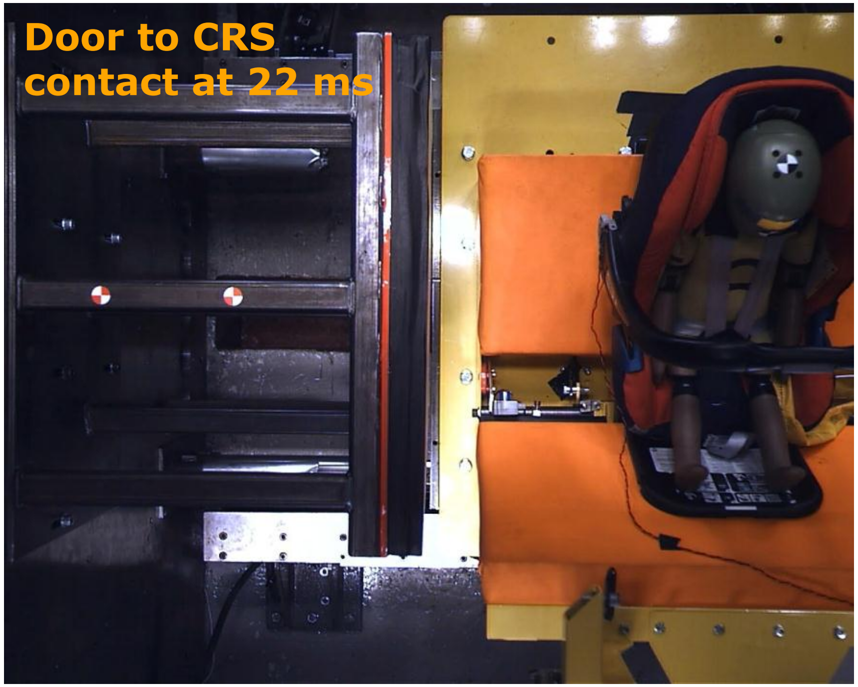
Q3 dummy in FF ISOFIX integral CRS





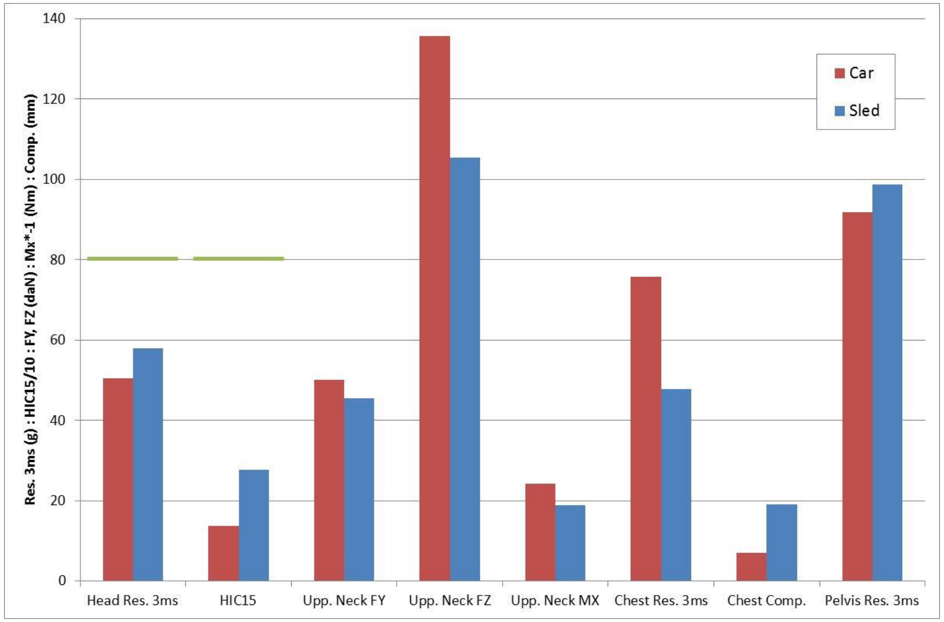
Comparison with side impact test procedure

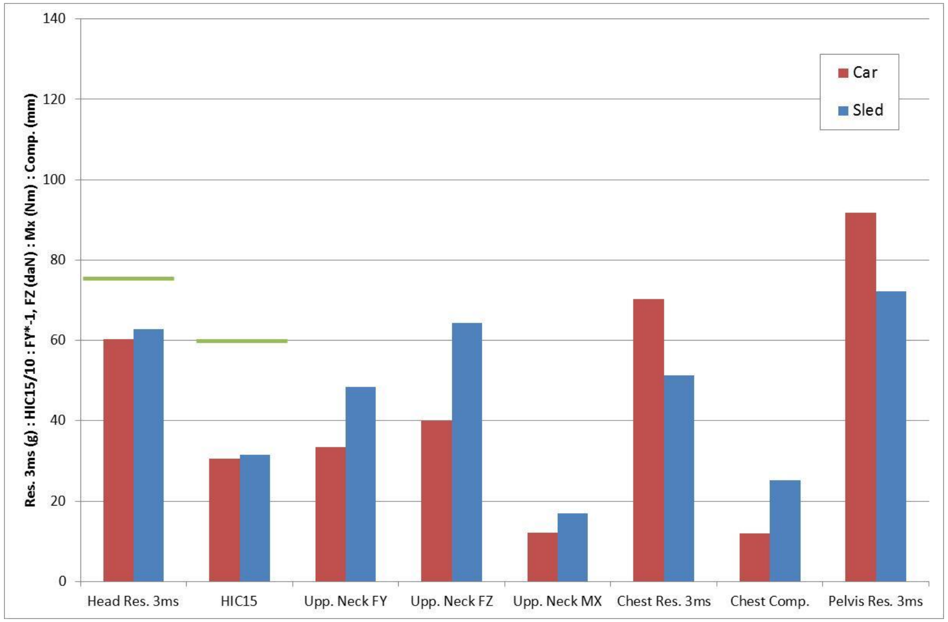
Q1.5 dummy in RF ISOFIX integral CRS



Comparison with side impact test procedure

Principal dummy measurements





Q3 in FF ISOFIX integral CRS
Front seat in car

Q1.5 in RF ISOFIX integral CRS
Rear seat in car

Summary

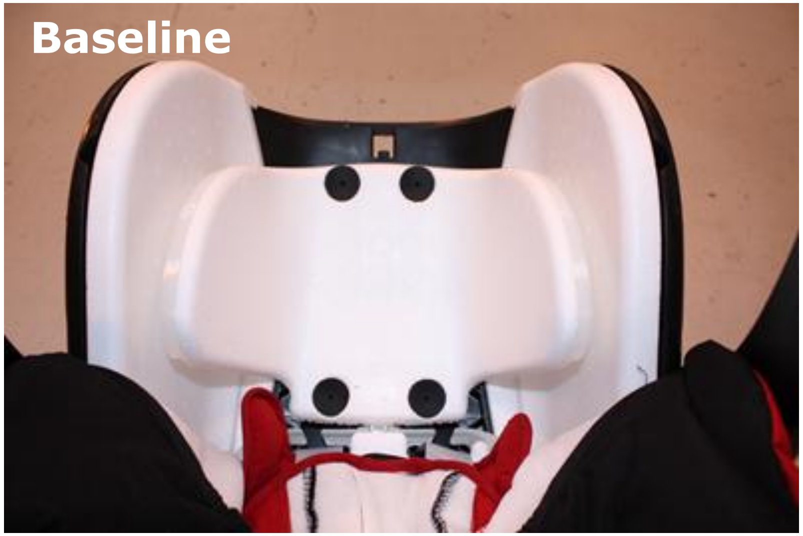
- Side impact sled test procedure reproduced head load levels from a full-scale side impact collision
  - Head Res. 3ms and HIC15
  - Performance requirements in new UN Regulation
- Some differences observed in neck load levels
  - Sled underestimated Neck Fz for Q3 in front seat
  - Sled overestimated Neck Fy and Fz for Q1.5 in rear seat
  - No neck performance requirements in new UN Regulation
- Sled test procedure loaded chest differently
  - Sled underestimated chest acceleration but overestimated chest compression
  - No chest performance requirements in new UN Regulation

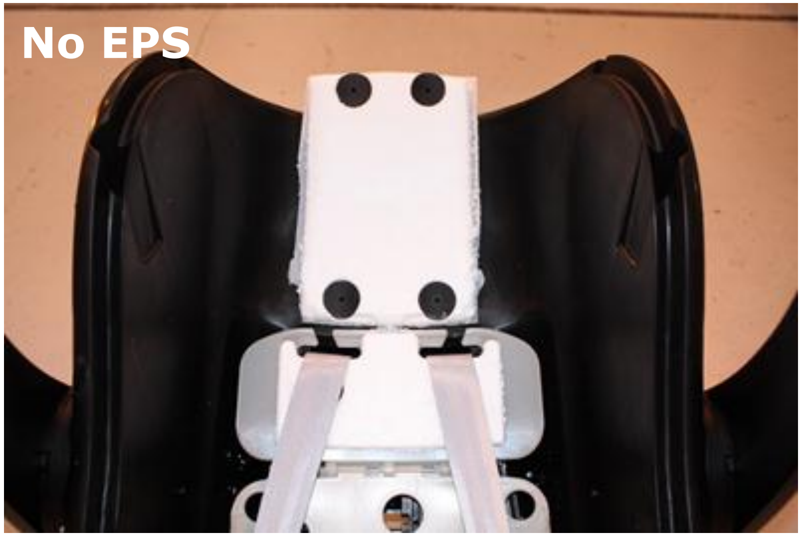
Sensitivity of side impact test procedure

Experiment matrix

Dummy	CRS Type	Side impact features
Q3	FF ISOFIX integral	Baseline experiment
		No EPS foam
		Reduced side wings
		Extra EPS
Q1.5	RF ISOFIX integral	Baseline experiment
		No EPS foam
		Reduced side wings
		Extra EPS

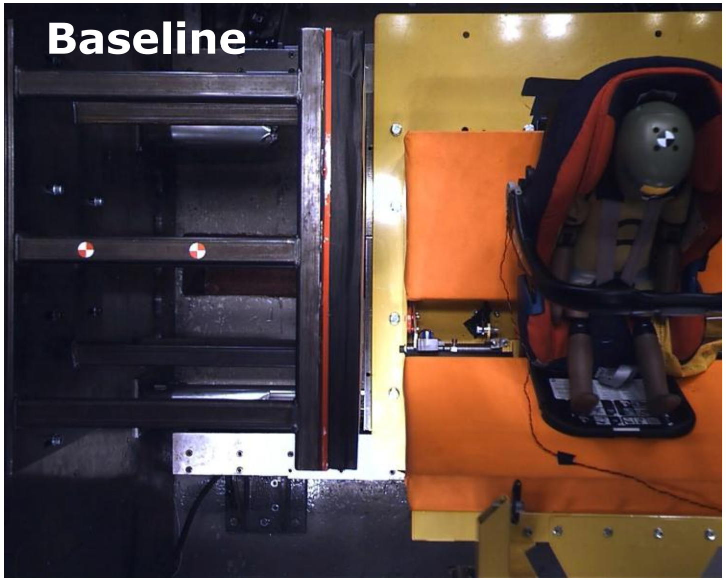
Child restraint system – TRL modifications

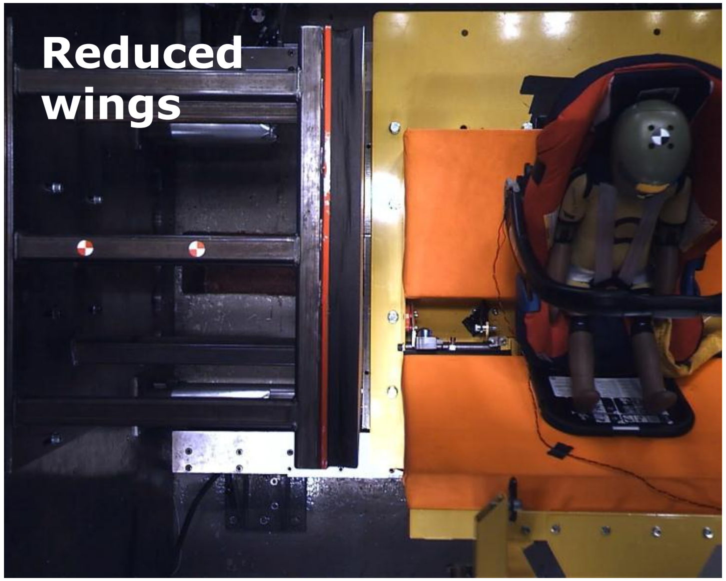


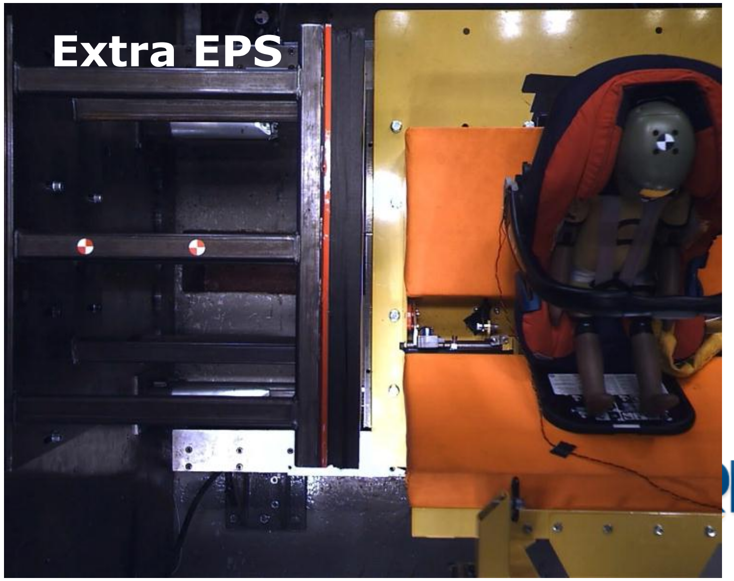


Q3 in FF ISOFIX integral CRS

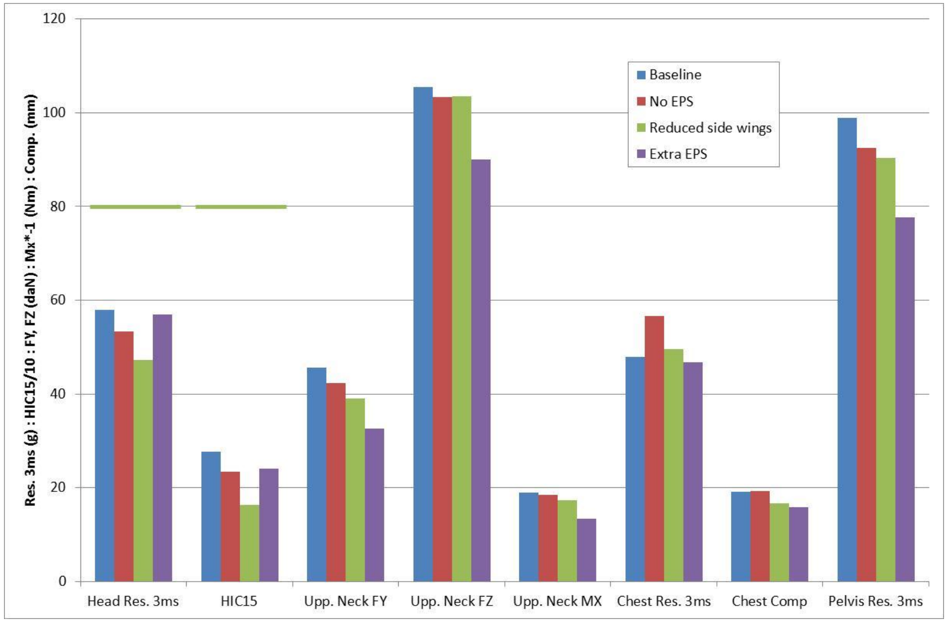
Q1.5 in RF ISOFIX integral CRS



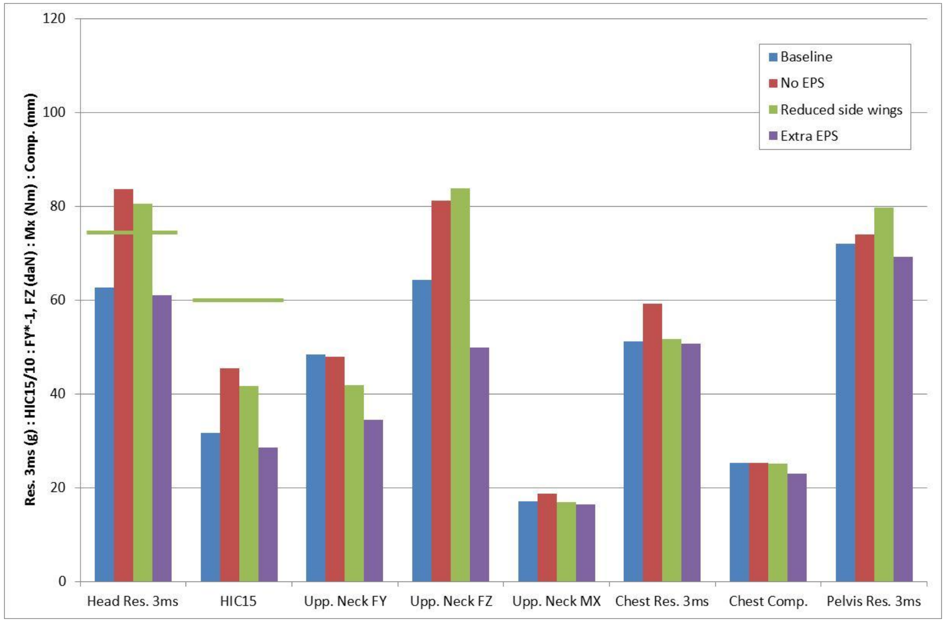




Principal dummy measurements



Q3 in FF ISOFIX integral CRS



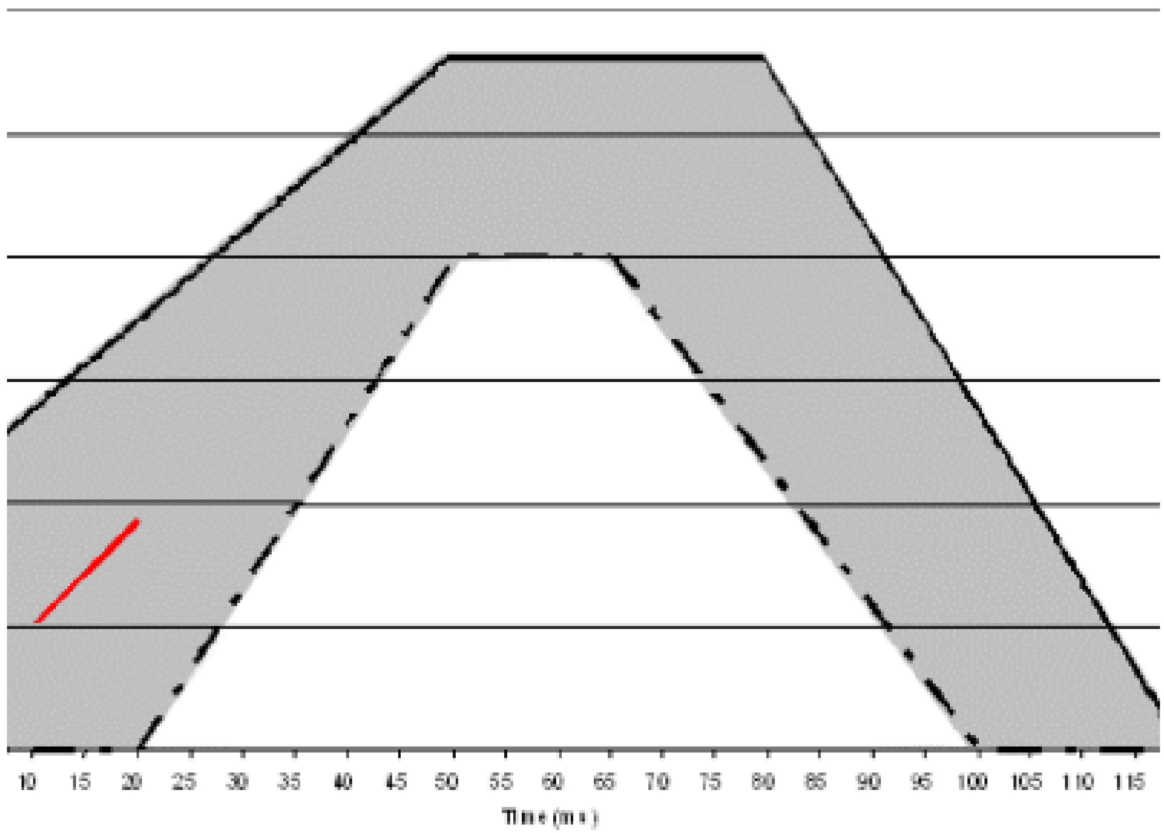
Q1.5 in RF ISOFIX integral CRS

Summary

- Dummy measurements displayed some trends consistent with changes to baseline CRS
  - Results repeatable in body regions not affected by changes

- Head contained with minimal side structure on CRS
  - FF and RF CRS with reduced wings met minimum depth requirement (80 mm, for RF CRS)
  - Will test procedure encourage desirable features for head containment?

  - We don’t know whether head would have been contained in real vehicle

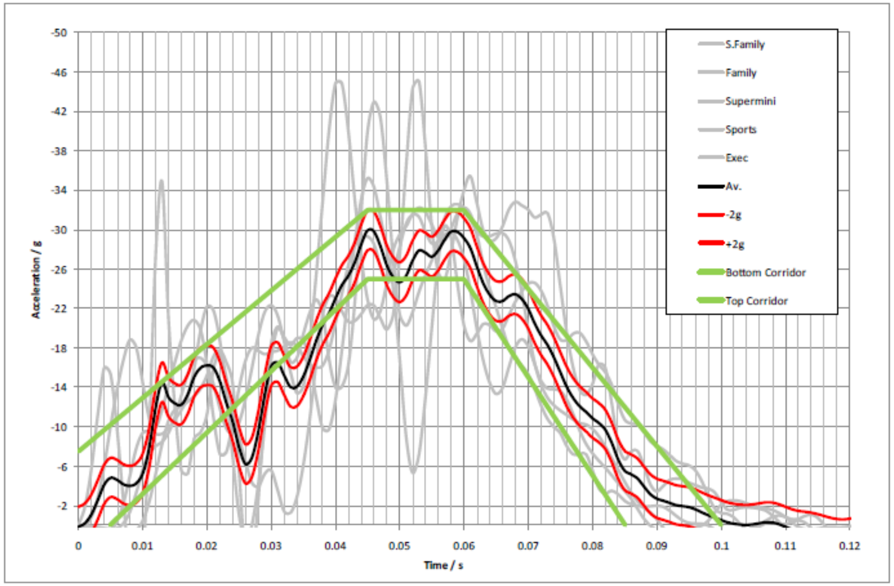


Investigation of the front impact pulse

Background

- Vehicle stiffness has increased since UN Regulation 44
  - Is the pulse representative of modern cars?
- Previous comparisons made with 40% offset tests only
  - Test of vehicle structure

    (lower deceleration than full-width test)
- A full-width test pulse is more appropriate for testing restraint systems



NHTSA data cars vs. full-width barrier (50 km/h) (source: Hynd *et al.*, 2010)

Hynd, M., Pitcher, M., Hynd, D., Robinson, R. and Carroll, J. A. (2010). An*alysis for the development of legislation on child occupant protection* (Client Project Report 821).

Objectives

- Investigate the acceleration pulse characteristics of a typical vehicle
- Compare typical vehicle pulse characteristics with front impact corridor in new UN Regulation

- Is the sled pulse consistent with a typical vehicle in a full-width collision?
- What are the implications of any differences?
- How do the ISOFIX anchorages behave?

Full-scale front impact experiment

Overview

- Moving car to moving car
  - 50 km/h
  - Full-width
- Identical cars – superminis (worst-case)

Car	Seating position	Dummy	Child restraint
Alfa Romeo MiTo #1	Rear left	Q3	ISOFIX non-integral
	Rear right	Q3	ISOFIX integral
Alfa Romeo MiTo #2	Rear left	Q6	ISOFIX non-integral
	Rear right	Q6	Non-integral

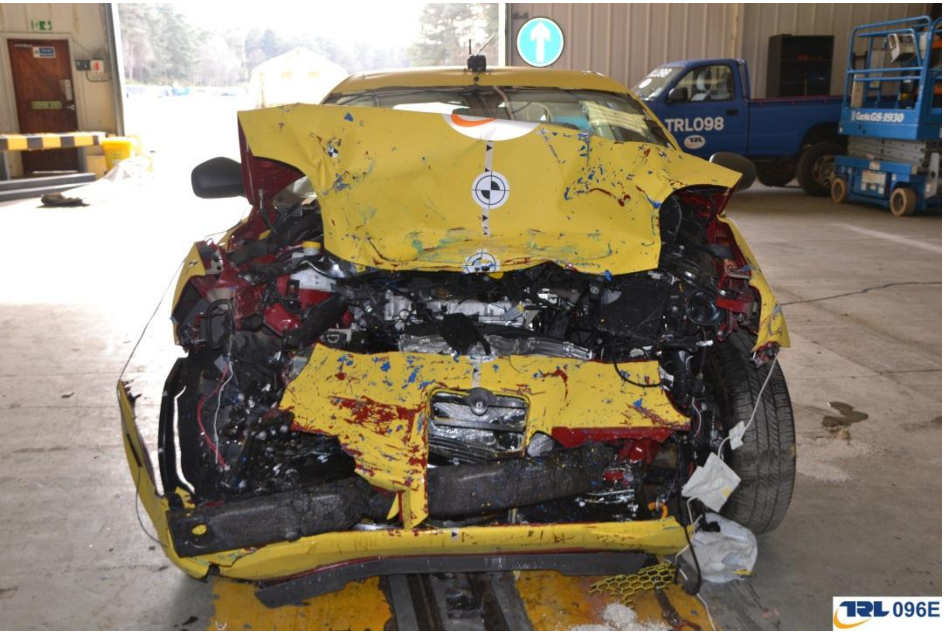
Full-scale front impact experiment

Full-scale front impact experiment

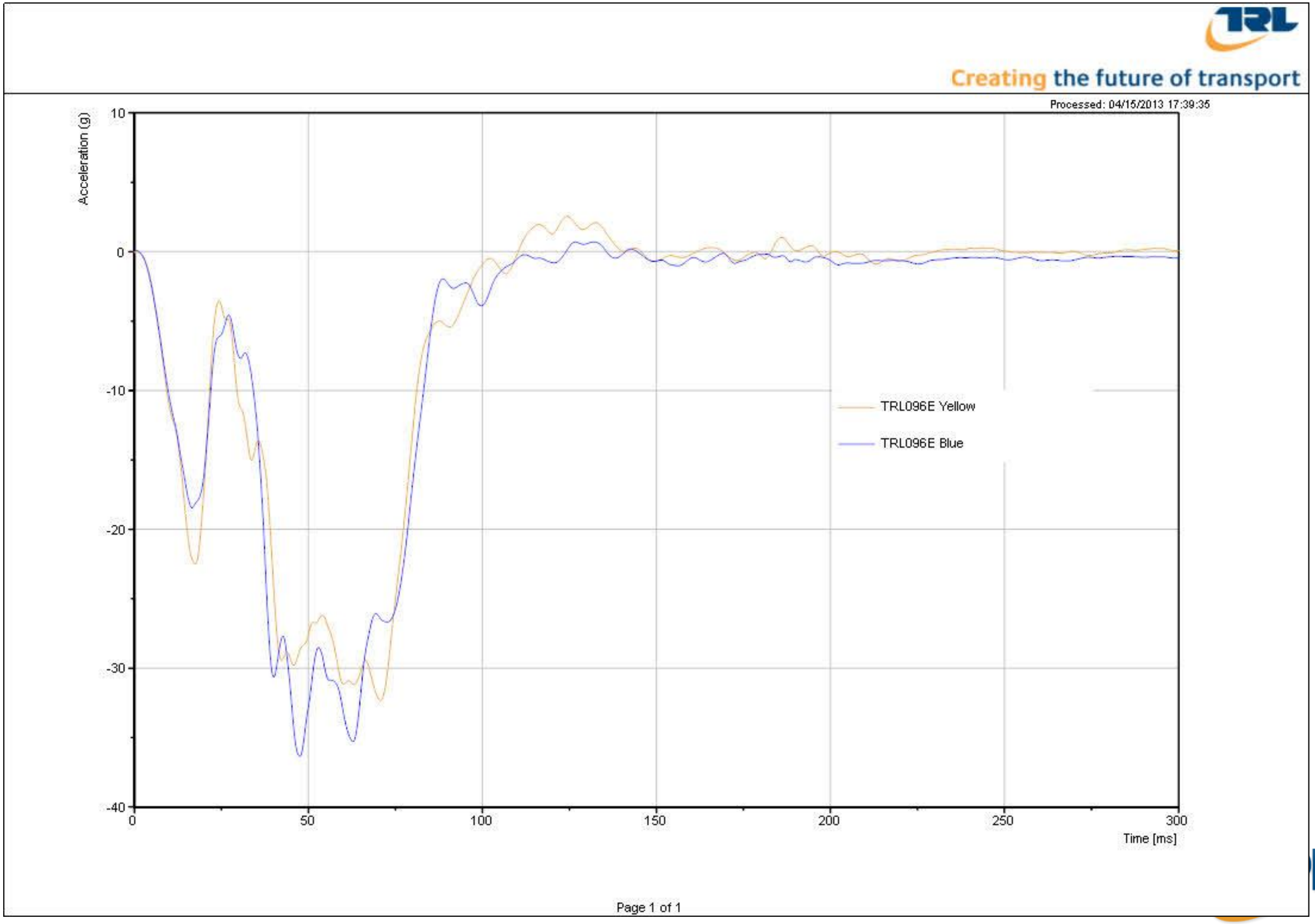
Full-scale front impact experiment

Full-scale front impact experiment

Full-scale front impact experiment



Vehicle deceleration



Full-scale front impact experiment

ISOFIX anchorage deformation – ISOFIX integral CRS

Any Questions?

Thank you

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