CLEPA
European Association of Automotive Suppliers

Side impact protection in non-integral CRS – First feedback on 440 mm

52nd Meeting of the UN Informal Group on Child Restraint Systems

18-06-15

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ISO BOOSTER VOLUME DEVELOPED IN CLOSE COLLABORATION BETWEEN OICA AND CLEPA

List of Interactions

10 **worst-case** vehicles selected by OICA (assessed during BASt workshop)
3 vehicles no interaction issues found

Vehicle	Attachment	Position	Issue	Comment
Audi A1	ISO Belt	Outer Outer	No Latch C-Pillar	
Ford Fiesta	Belt	Middle	Buckling	
Mitsubishi Space Star	ISO	Outer	C-Pillar	1 of 2 Fixtures
Suzuki SX4	Belt	Middle	Buckling	Waiting on vehicle availability (rare car)
Vauxhall Adam	ISO	Outer	C-Pillar	1 of 2 Fixtures
Vauxhall Zafira	Belt/ISO	Outer	Door	
Porsche Panamera	ISO	Front Outer	No Latch	Waiting on vehicle availability (rare car)

7 | britax BOB römer

Summary of Interaction Investigation

5 vehicles assessed further
- 1 vehicle: the fixture fitted with no interactions – no action required
- 1 vehicle: the fixture did not fit in middle position – position not suitable
- 3 vehicles: had minor interaction – modifications proposed

Vehicle	Attachment	Position	Issue	Comment
Audi A1	ISO Belt	Outer Outer	No Latch C-Pillar	Propose modification
Ford Fiesta	Belt	Middle	Buckling	Position not suitable
Mitsubishi Space Star	ISO	Outer	C-Pillar	Propose modification
Vauxhall Adam	ISO	Outer	C-Pillar	Fixture fits
Vauxhall Zafira	Belt/ISO	Outer	Door	Propose modification

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Source: CRS-47-03e, Britax

- Assessment volume adapted following two joint CLEPA-OICA workshops and further assessment by Britax
- Volume fits outboard seating position of cars

CRS MANUFACTURERS ARE BEING ASKED TO REDUCE WIDTH OF BOOSTER ASSESSMENT VOLUME

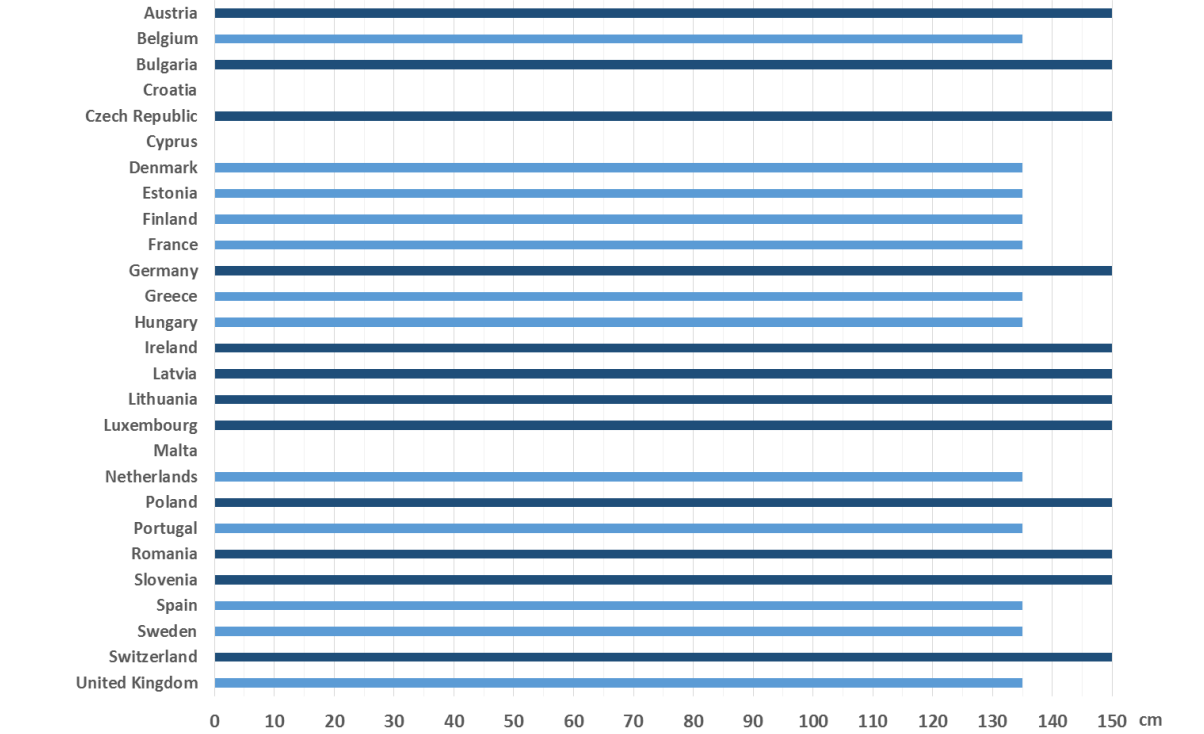
Source: CRS-50-04e, European Commission

- Extend i-Size seating position to 135 cm
- Justification is to ensure three (max. size) CRS will fit in “larger family cars”
  - Euro NCAP incentive to include three i-Size positions

CAR MANUFACTURERS ARE BEING ASKED TO ALIGN SEAT BELT AND ISOFIX ANCHORAGES

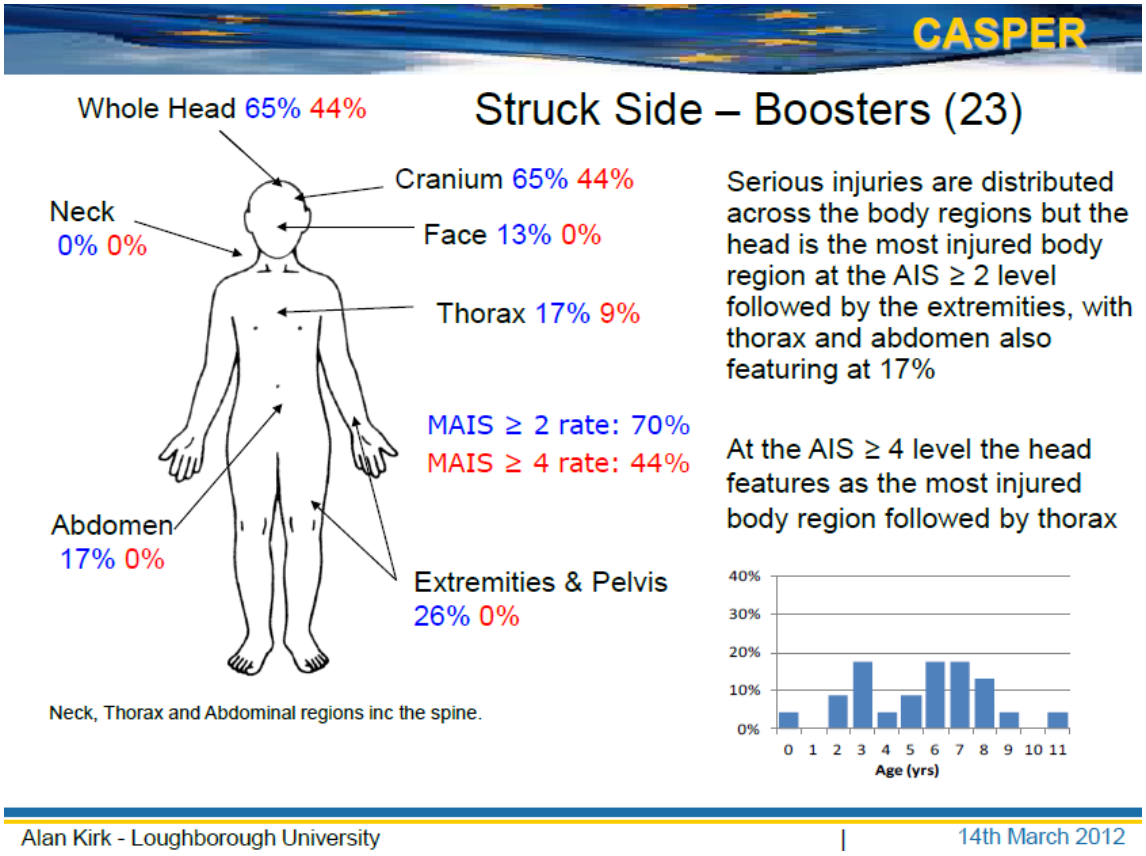
- Requires significant change to current vehicles

We welcome 135 cm limit in R129, but booster seats accommodate larger children than integral CRS and some states adopt 150 cm



- EU seat belt wearing legislation specifies CRS use to 150 cm
  - Many member states choose not to take the 135 cm exemption

HEAD IS THE PRIORITY BUT BOOSTER SEATS MUST PROVIDE PROTECTION TO OTHER BODY REGIONS



Source: Kirk 2012, COVER – CASPER & EPOCH Final Workshop

- Regulatory thresholds are applied to the head only, but CRS manufacturers aim to protect all body regions

OVERVIEW OF CLEPA INVESTIGATION

		Q3		Q6		Q10	
		440 mm	520 mm	440 mm	520 mm	440 mm	520 mm
R129	Dynamic	✓	✓	✓	✓	✓	✓
	Simulations	✓	✓	✓	✓		
Consumer Test	Dynamic	✓	✓	✓	✓		
	Simulations	✓	✓	✓	✓		

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Implications of 440 mm and effect of CRS width in R129 test environment
- Simulation and testing

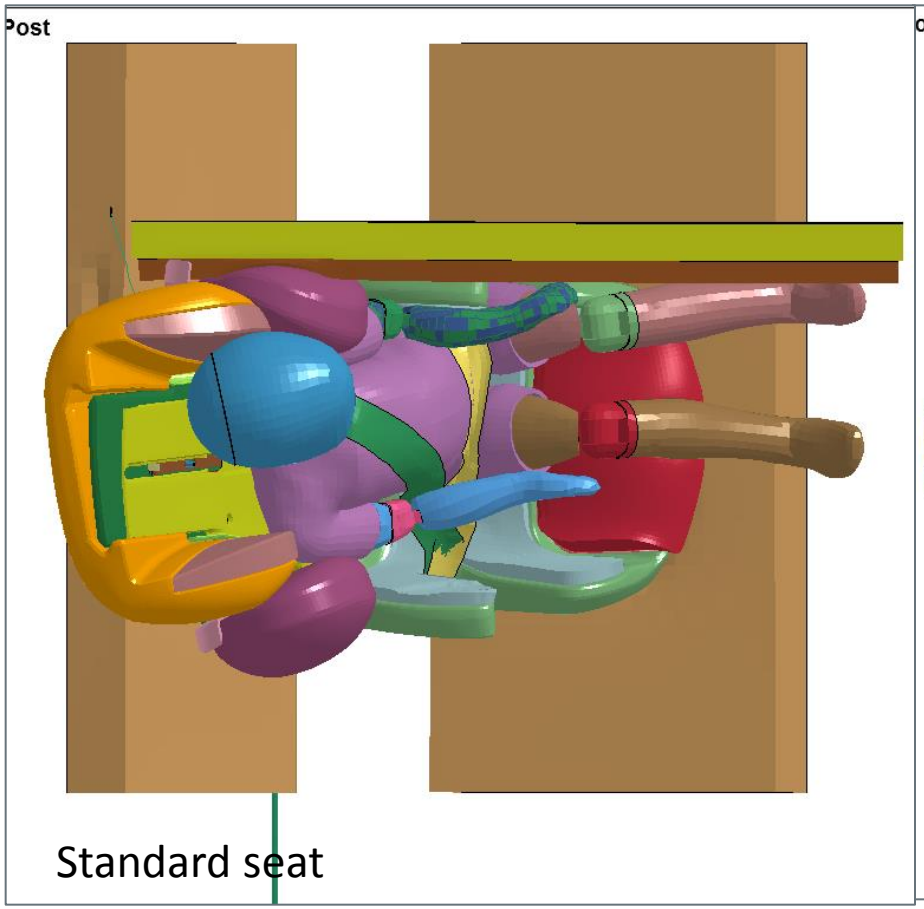
KIDDY NUMERICAL SIMULATION

Results R129 side impact Q3

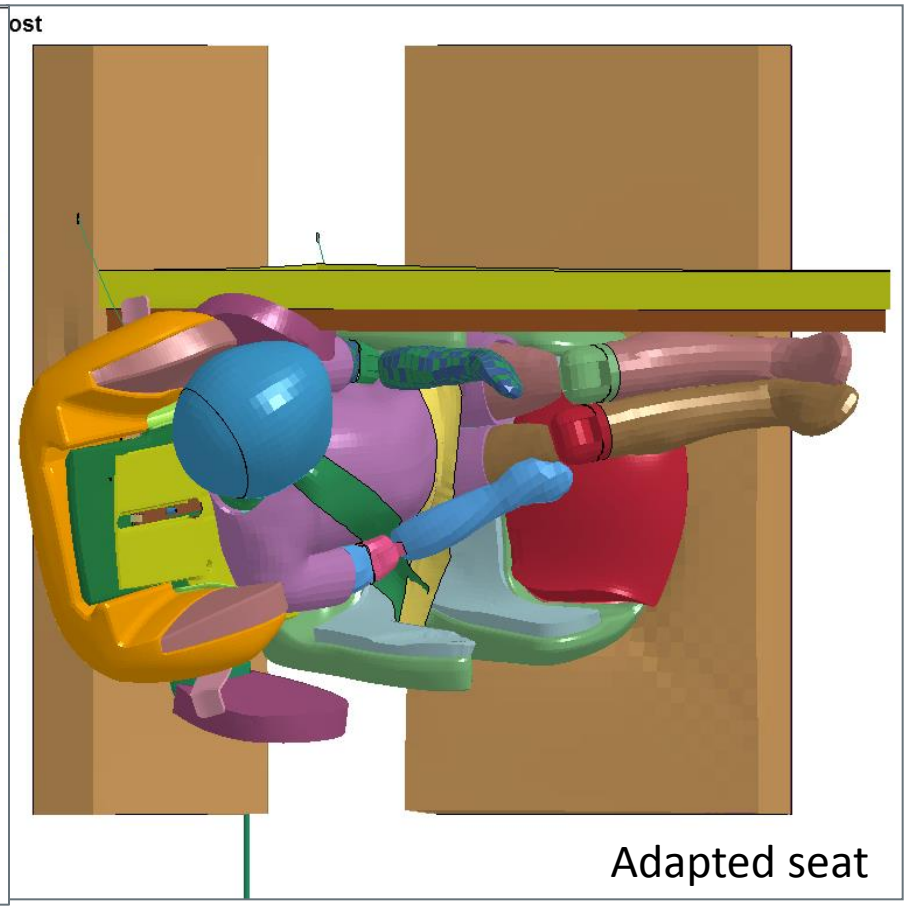
	HIC	Head Acceleration (g)	Chest Acceleration (g)	Upper Neck force (N)	Upper Neck Moment (Nm)
R129 threshold	174%	129%			
Q3 Standard seat	100%	100%	100%	100%	100%
Q3 Adapted seat	88%	124%	179%	100%	106%

KIDDY NUMERICAL SIMULATION

Results R129 side impact Q3



Standard seat



Adapted seat

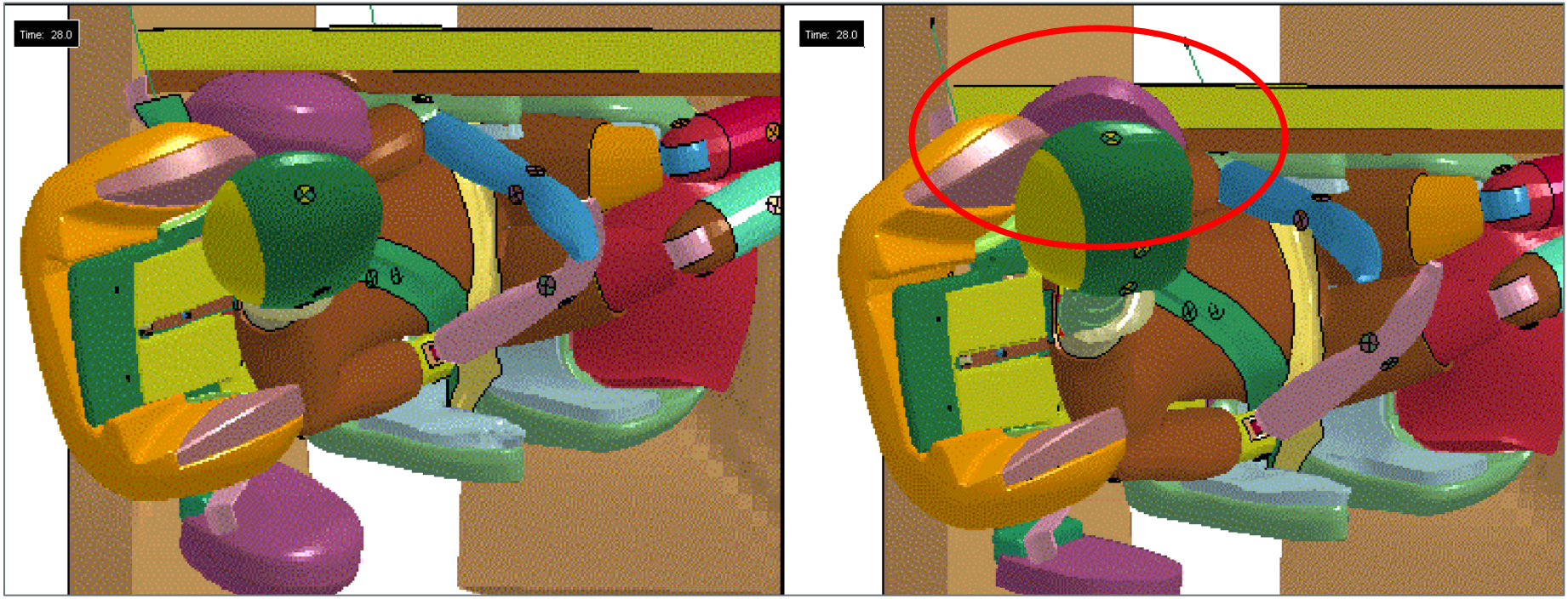
KIDDY NUMERICAL SIMULATION

Results R129 side impact Q6

	HIC	Head Acceleration (g)	Chest Acceleration (g)	Upper Neck force (N)	Upper Neck Moment (Nm)
R129 threshold	254%	133%			
Q6 Standard seat	100%	100%	100%	100%	100%
Q6 Adapted seat	107%	107%	144%	115%	132%

KIDDY NUMERICAL SIMULATION

Results R129 side impact Q6



Standard seat

Adapted seat

OVERVIEW OF CYBEX PROTOTYPES

520 mm

473 mm

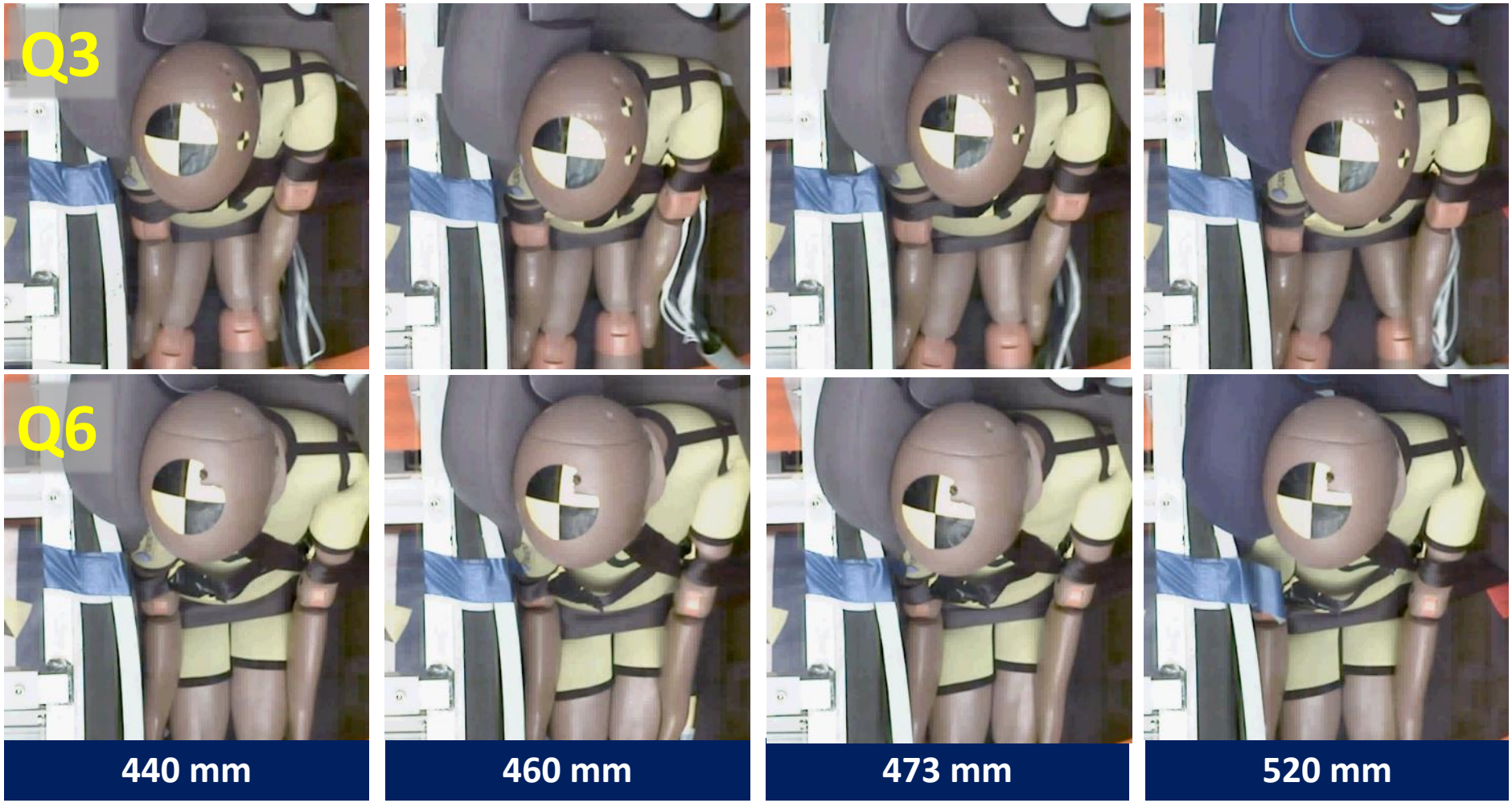
460 mm

440 mm

- Internal dimensions – 95th percentile 135 cm
- Prototypes differ in shoulder / chest side wings only
  - Head wings / padding consistent across prototypes
- R129 side impact tests with Q3 and Q6

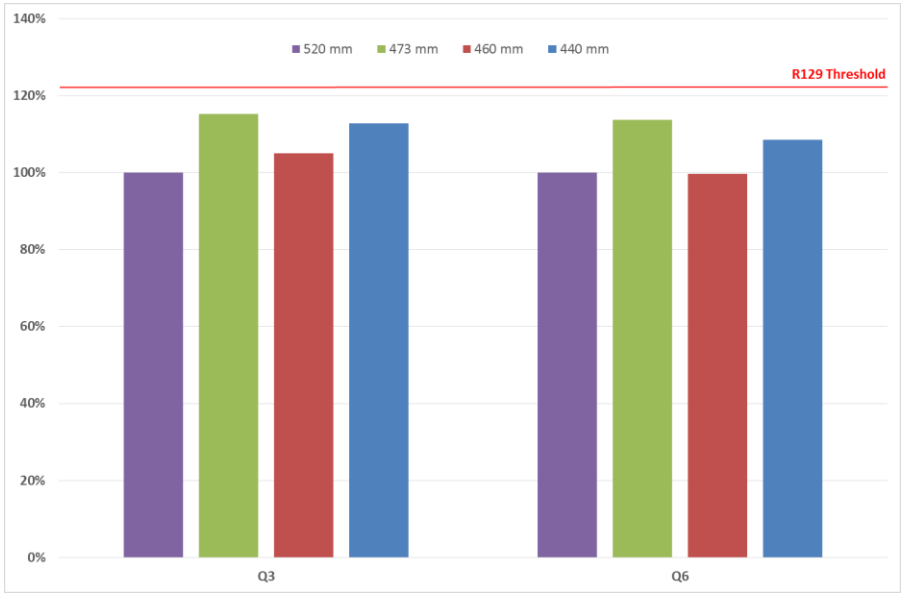
R129 PERFORMANCE REQUIREMENTS ACHIEVED WITH 440 MM – HEAD SPECIFIED ONLY

HEAD CONTAINMENT ACHIEVED WITH 400 MM, BUT HEAD IS CLOSER TO PANEL



R129 Head requirements can be met but enhanced protection offered by larger booster

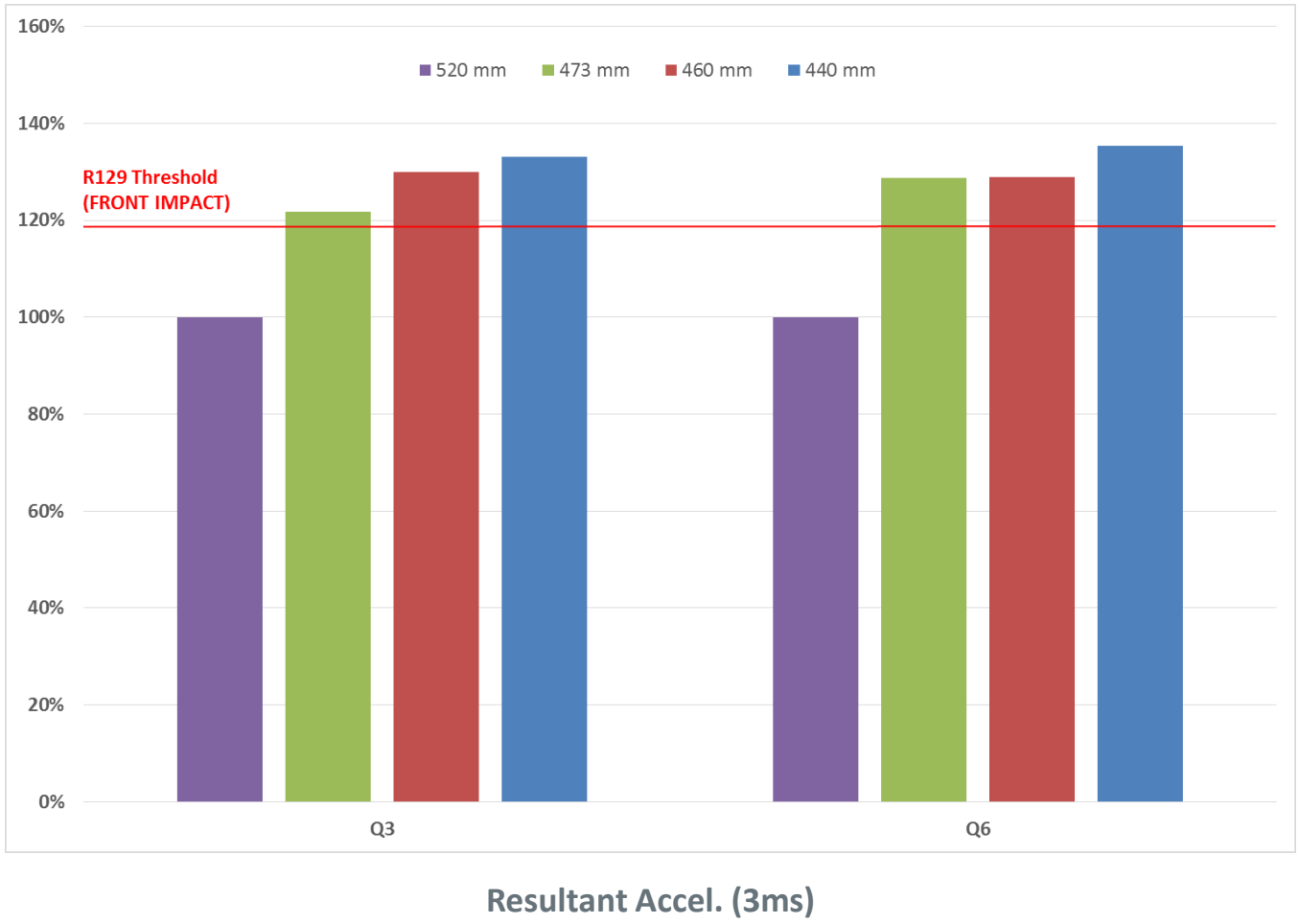
HPC(15)



Resultant Accel. (3ms)

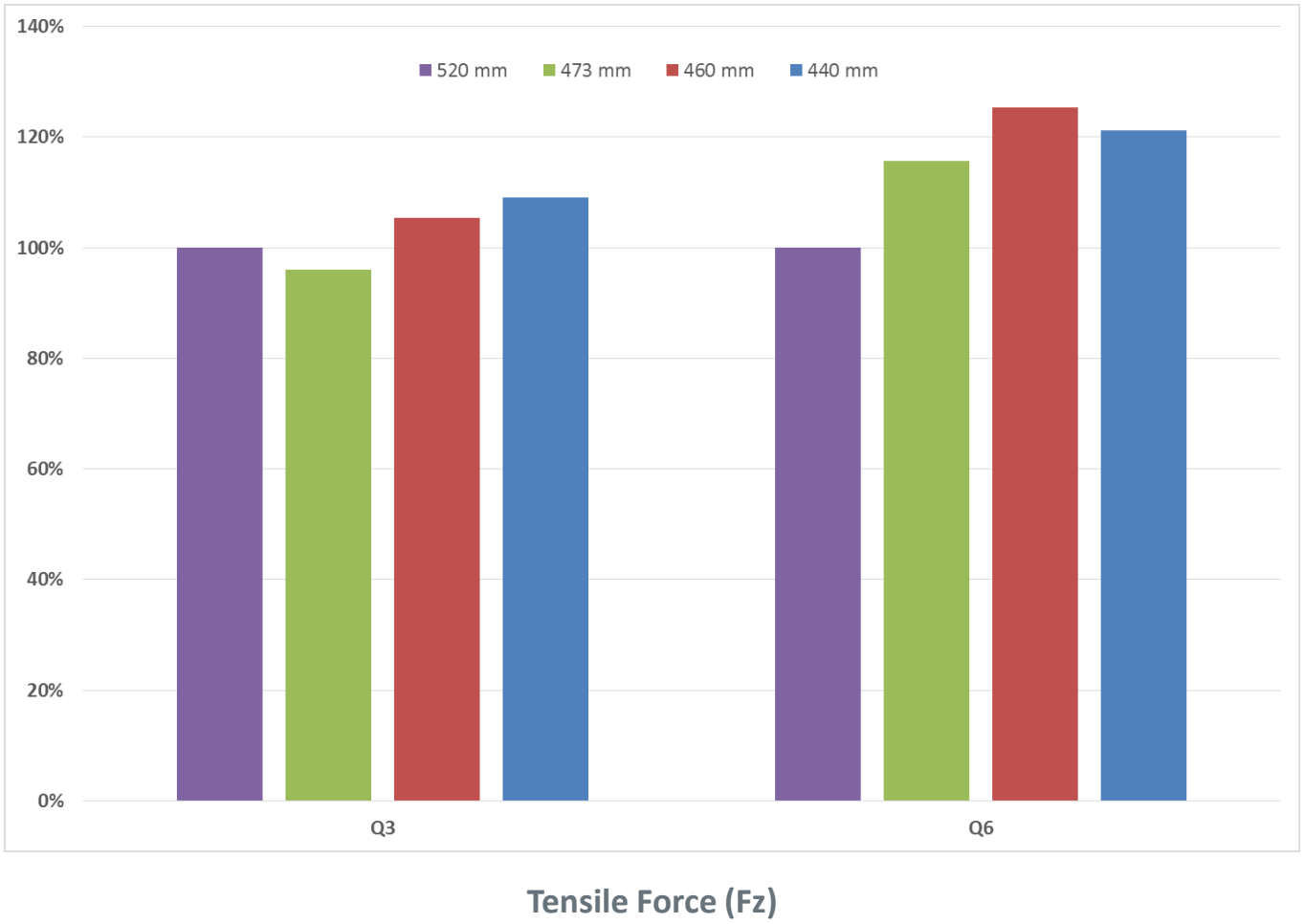
- Shoulder / chest wing width influences head protection
- Step improvement in performance offered by 520 mm

CHEST PROTECTION IS SEVERELY COMPROMISED WHEN BOOSTER WIDTH IS REDUCED



- Step improvement in performance offered by 520 mm

NECK PROTECTION IS ALSO COMPROMISED WHEN BOOSTER WIDTH IS REDUCED



- Step improvement in performance offered by 520 mm

Test Matrix - Britax

R129 side impact test method

CRS Version	Q3	Q6	Q10
500mm wide Booster	Lab 1 & Lab 2	Lab 2	Lab 1
460mm wide Booster	Lab 1 & Lab 2	Lab 2	Lab 1
440mm wide Booster	Lab 1 & Lab 2	Lab 2	Lab 1

Modified Kidfix XP - Width of backrest varied

Testing Results Summary

General Trends seen from reducing the width of the booster seat:

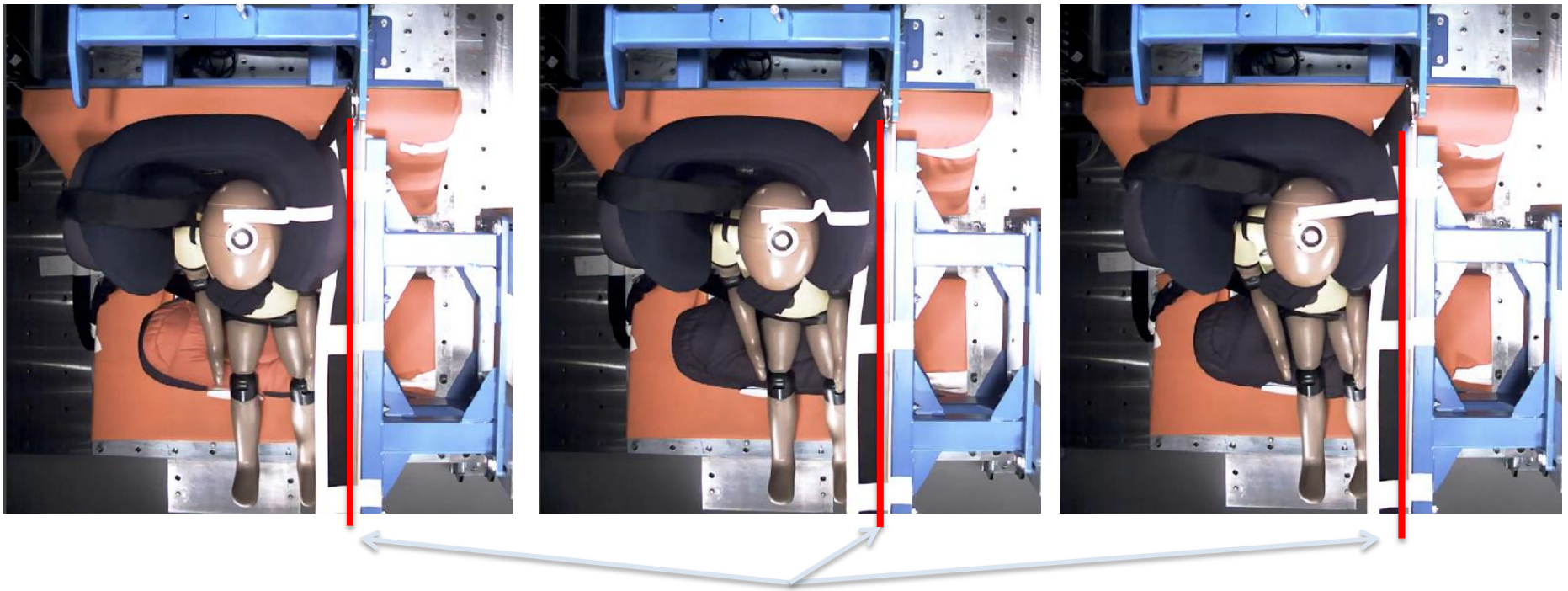
Body Region	Q3	Q6	Q10
Head Movement	↑	↑	↑
Head Resultant (3ms)	≈	↓	↑
HPC15	≈	↓	↑
Neck Fz	↑	↑	≈ ↑
Neck Mx	↑	↑	↓

≈	=	Similar
↓	=	Reduction
↑	=	Increase

Q3 Kinematics

Excursion increases as booster width decreases

Standard	460mm	440mm



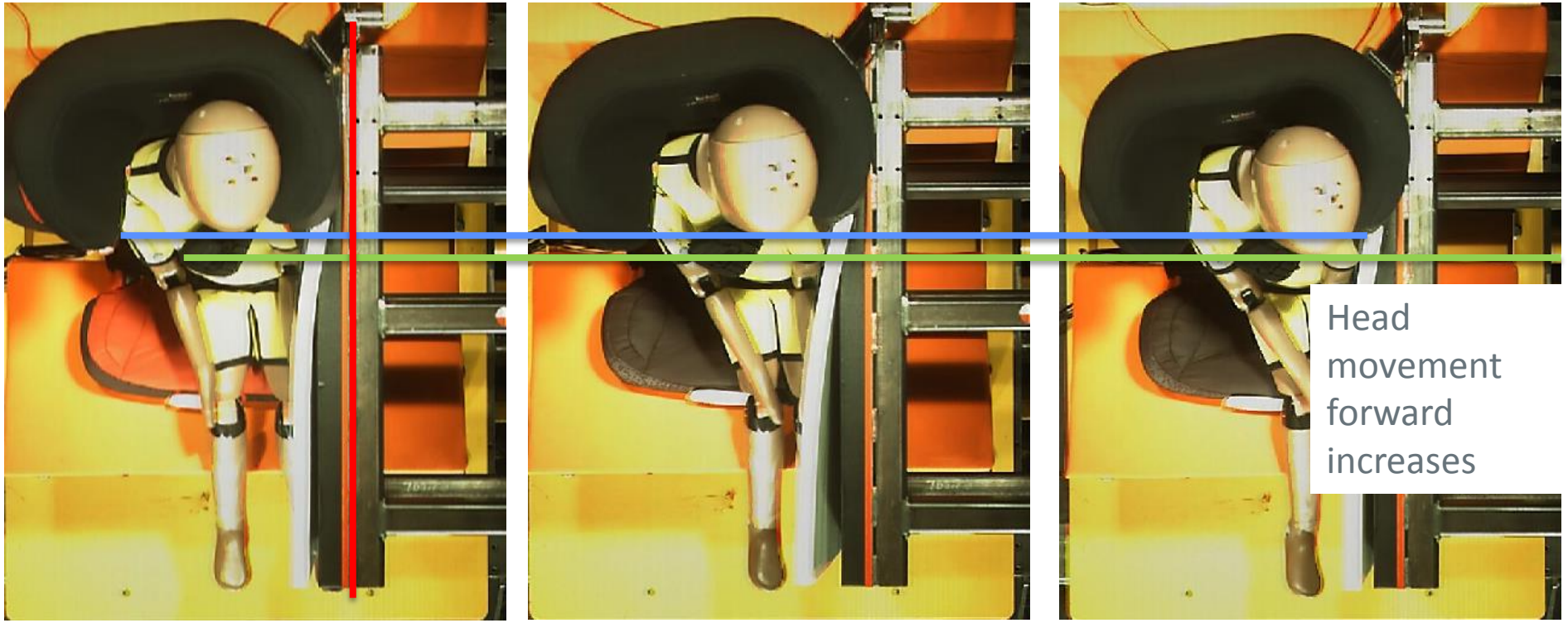
Distance to containment plane:

123mm	**113mm**	**98mm**
@ 45 ms	@ 46 ms	@ 49 ms

Q6 Kinematics

Excursion and head roll increases as booster width decreases

Standard | 460mm | 440mm



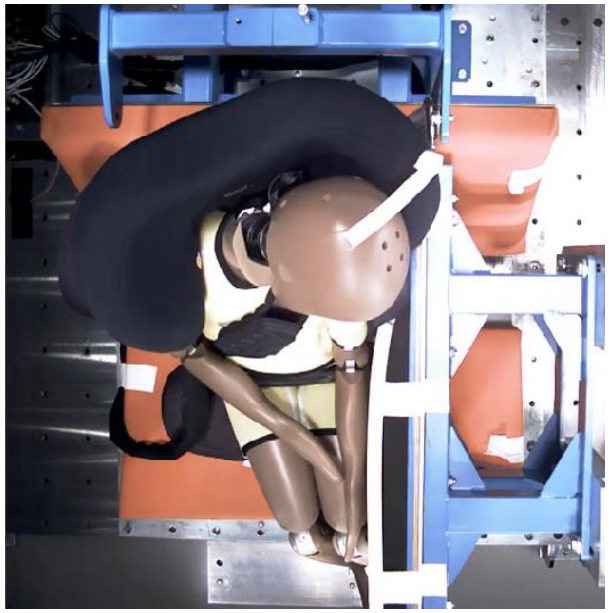
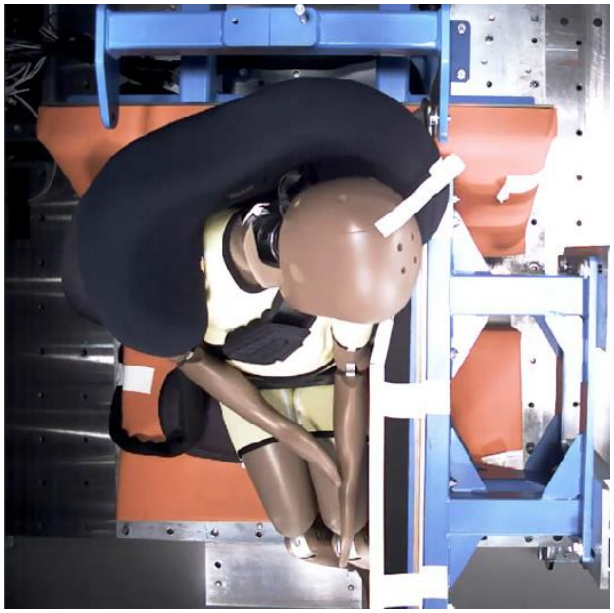
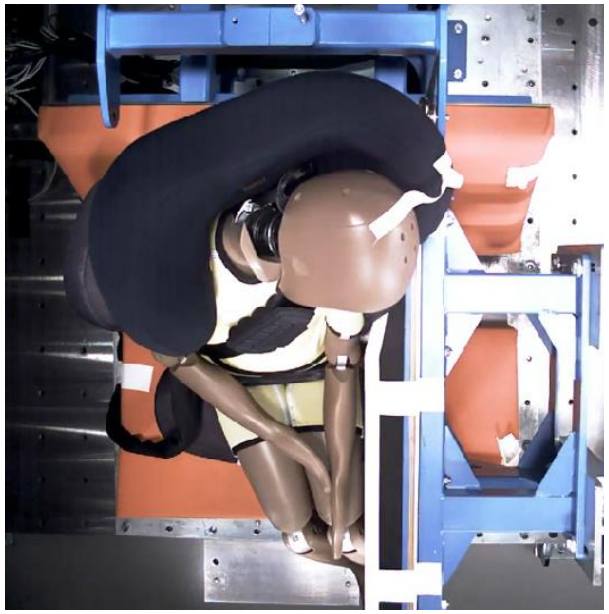
Head movement forward increases

Distance to containment plane:

Standard	460mm	440mm
88mm @ 45 ms	**67mm** @ 48 ms	**52mm** @ 51 ms

Q10 Kinematics

Excursion increases as booster width decreases

Standard	460mm	440mm
		

Distance to containment plane:

0mm	**-18mm**	**-23mm**
@ 65 ms	@ 68 ms (Containment plane crossed)	@ 70 ms (Containment plane crossed)

Summary – Implications of 440 mm and effect of booster width in R129 environment

1. 440mm Booster:
   a. Q3 – Passed R129 side impact requirements
   b. Q6 – Passed R129 side impact requirements
   c. Q10 – **Failed** R129 side impact requirements (Head not contained)

2. Q10 head not contained by any narrower booster seats

3. CRS performance degradation observed in other body regions
   a. Neck and chest loadings increased for Q3, Q6

4. Dummy kinematic affected differently by backrest width reduction:
   a. Q3 – Consistent kinematics, slight increase in neck bending
   b. Q6 – Head movement around the head pad and towards the door increases
   c. Q10 – Containment problems

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Implications of 440 mm and effect of CRS width in consumer test environment
- Simulation and testing

INTRODUCTION

Child Restraint System offers protection for children in cars fulfilling :

- Performance criteria in selected configurations representing car accidents
- Compatibility rules to be sure that the CRS fits properly in cars (universality)

CRS must be homologate according R44 or R129 to be sold in the Market.

Consumer Ratings distinguish products on the markets. CRS must reach a good or a very good rating to be a commercial success.

CONSUMER TESTS ARE AN IMPORTANT DESIGN CONSTRAINT – POOR PERFORMANCE CAN LEAD TO NEGATIVE PUBLICITY AND PRODUCT WITHDRAWALS

Which? advice: Don't Buy ...

/s/2015/05/which-advice-dont-buy -car-seat-404405

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Which? advice: Don't Buy car seat

Belted base fails our frontal crash tests

28 May 2015

Which? is advising parents who own the child car seat – and are using it with the base belted-in, forward-facing – to replace it. This seat was downgraded to our lowest test score of 0% following a failure in one of our key crash tests.

The seat is sold as a package with a base included. The base can be fixed to your car by using Isofix connectors, or by using the car's adult seat belt.

If you have this car seat and are using it in a forward-facing, Group 1 mode, with the base attached to your car using the seat belt (and your car does not have Isofix connectors), our advice is to replace this car seat as soon as possible, following poor frontal-crash test results in this mode.

Group 1 forward-facing, belted base: the seat of the tips forward from the base during the crash

crash test results

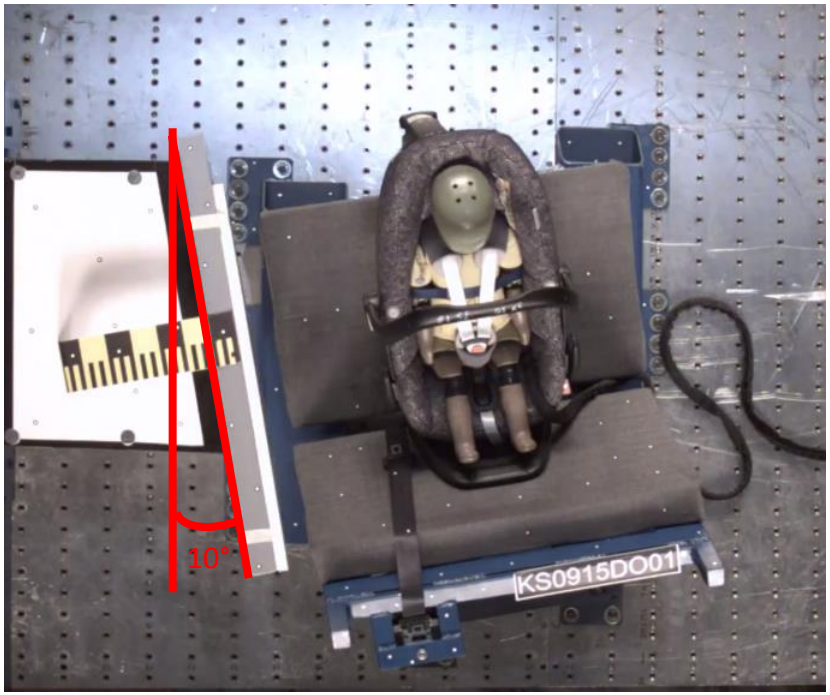
The is an affordable, extended, rear-facing child car seat. It costs around £180 and the fact that it can be used rearward-facing up until 18kg, or your child is around four years of age, means many parents may be tempted to buy this car seat to keep their children rearward-facing for longer.

This child car seat has passed the official regulatory tests required by ECE R44/04 to be sold as suitable for children from birth up to 18kg (around four years old). But in our own, more demanding, crash tests it scored 0% overall for safety – the lowest test score possible. Our crash tests are conducted at higher speeds and forces than the current R44.04 UK standards require.

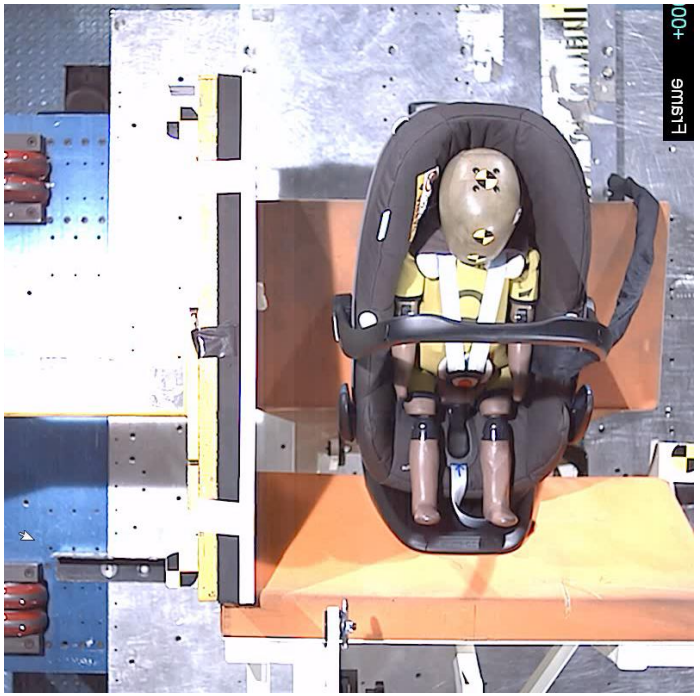
COMPARISON ETC/R129 SIDE IMPACT

Overall Setup

ETC 2015



R129



COMPARISON ETC/R129 SIDE IMPACT

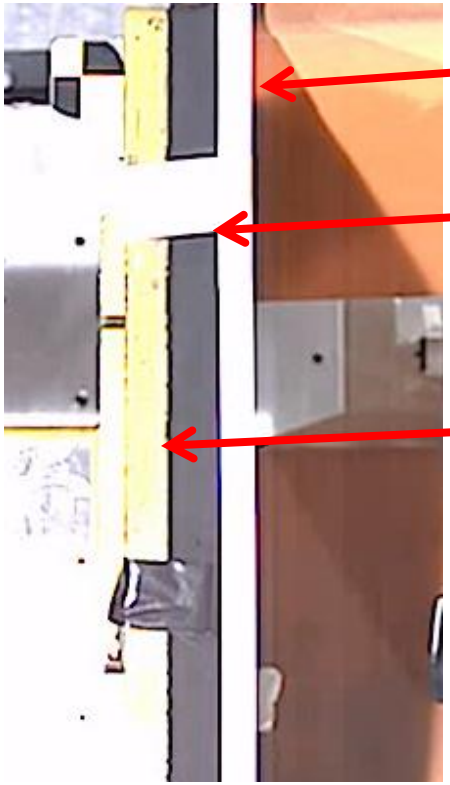
Less padding in intruding door to represent door panel

ETC 2015

Styrodur panel
(20 mm)

Rigid Structure

R129



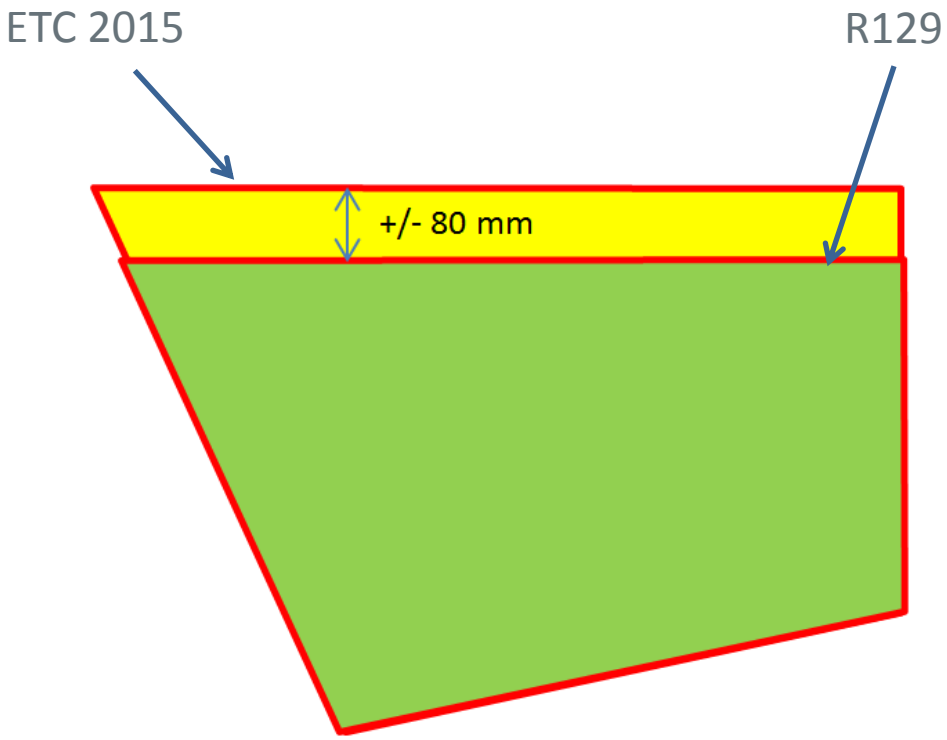
Styrodur panel
(20 mm)

Polychloroprene
panel
(35 mm)

Rigid Stucture

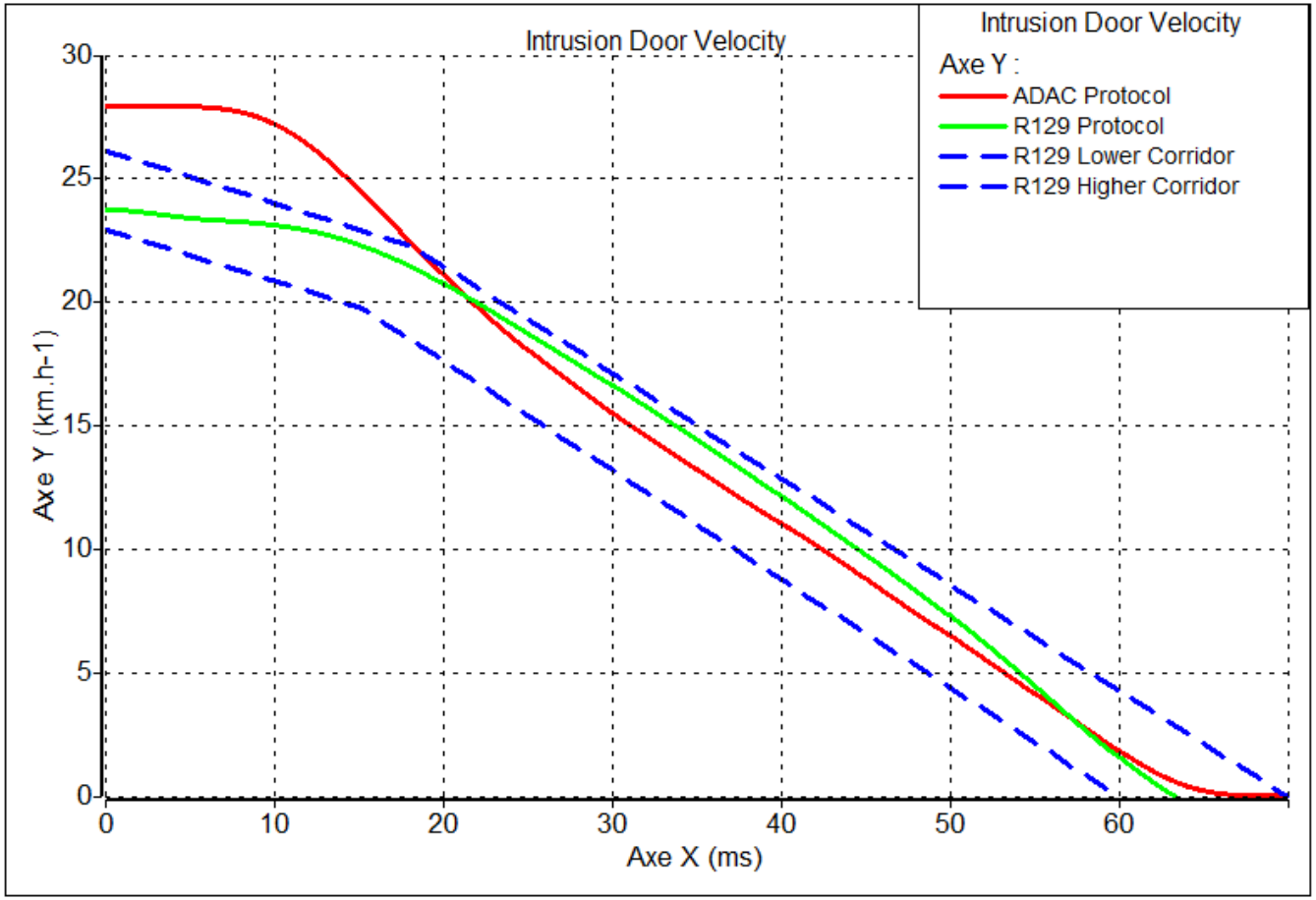
COMPARISON ETC/R129 SIDE IMPACT

Higher Door



COMPARISON ETC/R129 SIDE IMPACT

Higher Intrusion speed



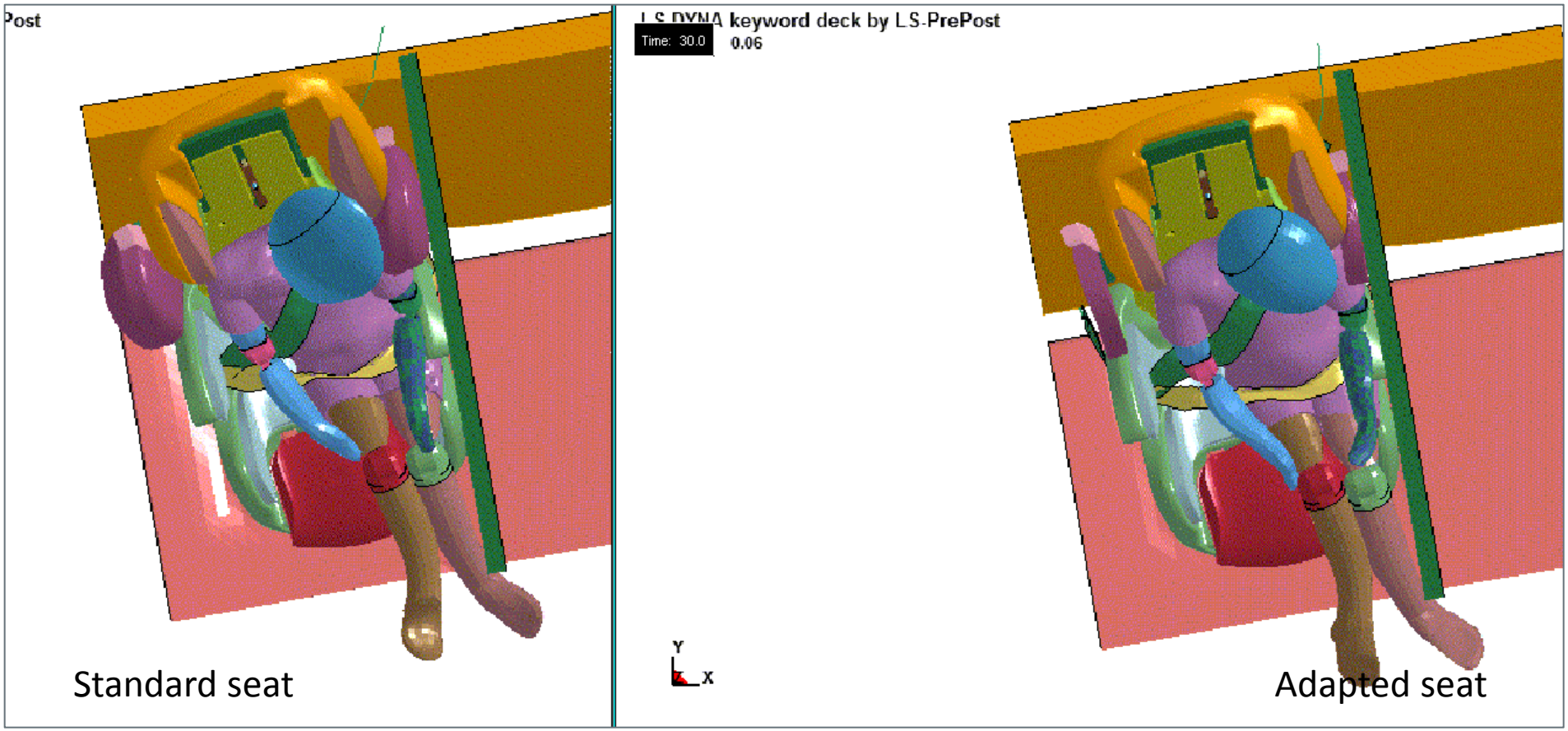
KIDDY NUMERICAL SIMULATION

Results ETC-2015 side impact Q3

	HIC	Head Acceleration (g)	Chest Acceleration (g)	Upper Neck force (N)	Upper Neck Moment (Nm)
Q3 Standard seat	100%	100%	100%	100%	100%
Q3 Adapted seat	111%	168%	196%	84%	118%

KIDDY NUMERICAL SIMULATION

Results ETC-2015 side impact Q3



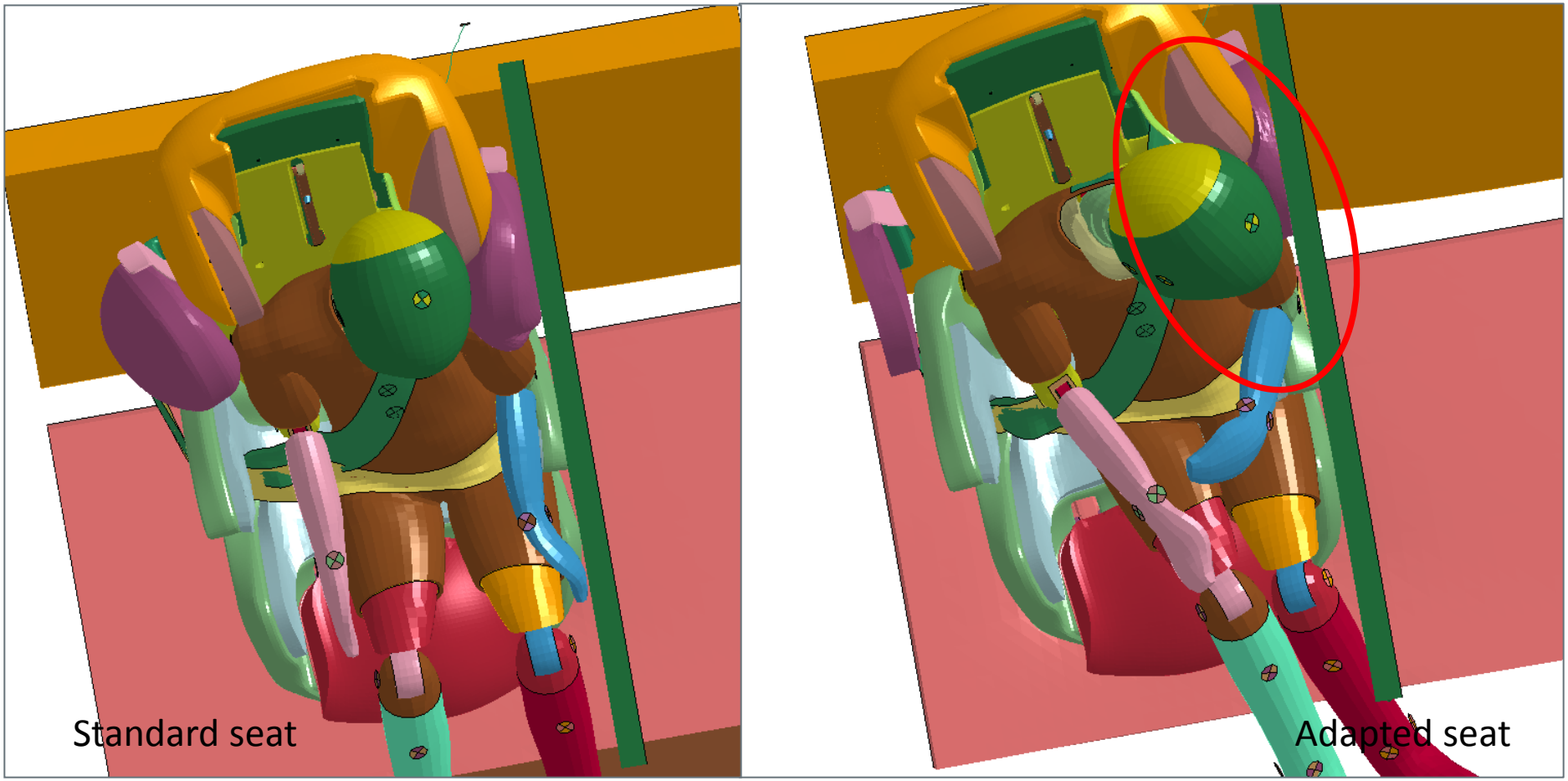
KIDDY NUMERICAL SIMULATION

Results R129 side impact Q6

	HIC	Head Acceleration (g)	Chest Acceleration (g)	Upper Neck force (N)	Upper Neck Moment (Nm)
Q6 Standard seat	100%	100%	100%	100%	100%
Q6 Adapted seat	153%	158%	225%	157%	120%

KIDDY NUMERICAL SIMULATION

Results R129 side impact Q6



COMPARISON ETC/R129 SIDE IMPACT – DOREL TESTING

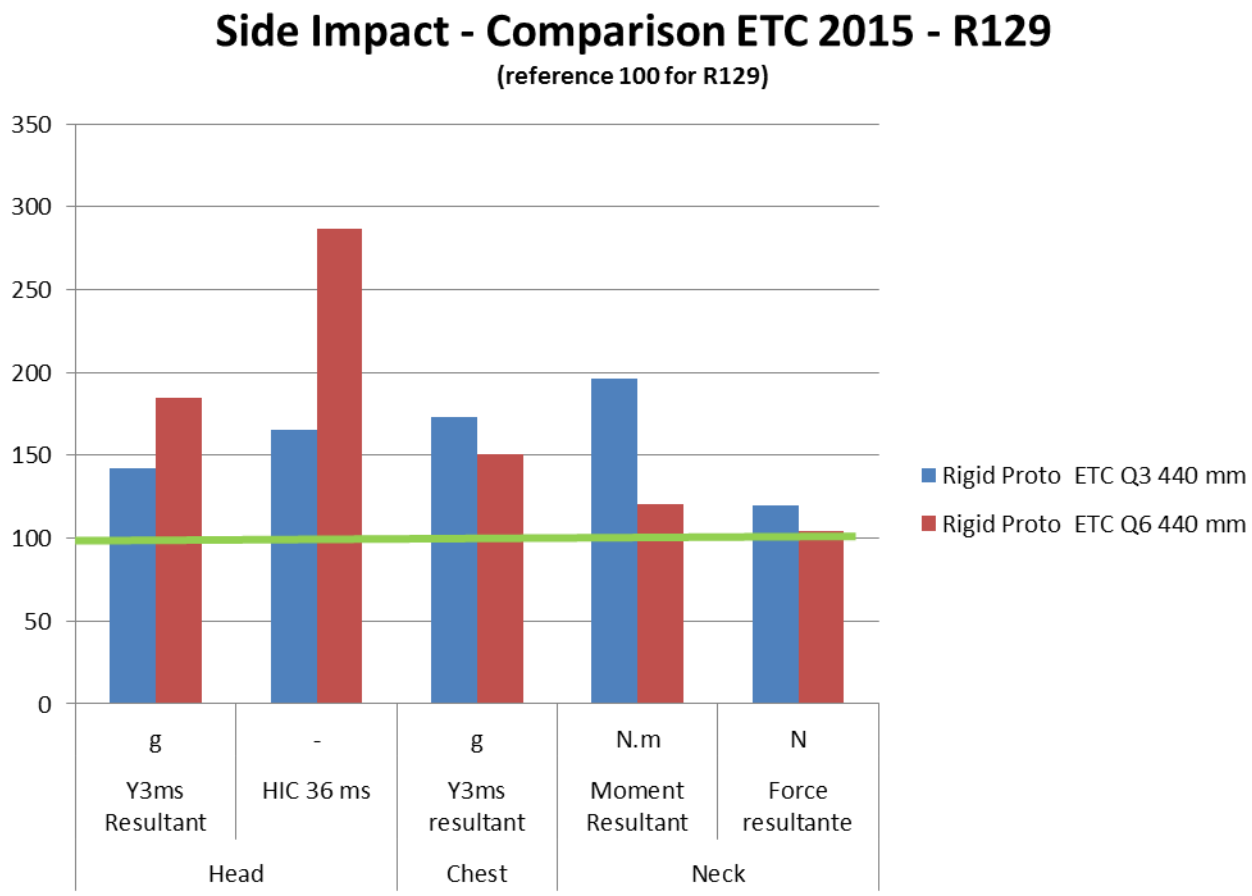
Tests with 440 mm wide prototype

Q3

Q6

Comparison ETC/R129 side impact – Dorel testing

Tests with 440 mm wide prototype – Comparison with ETC side impact criteria



Severity Increase
59 % for Q3
69 % for Q6

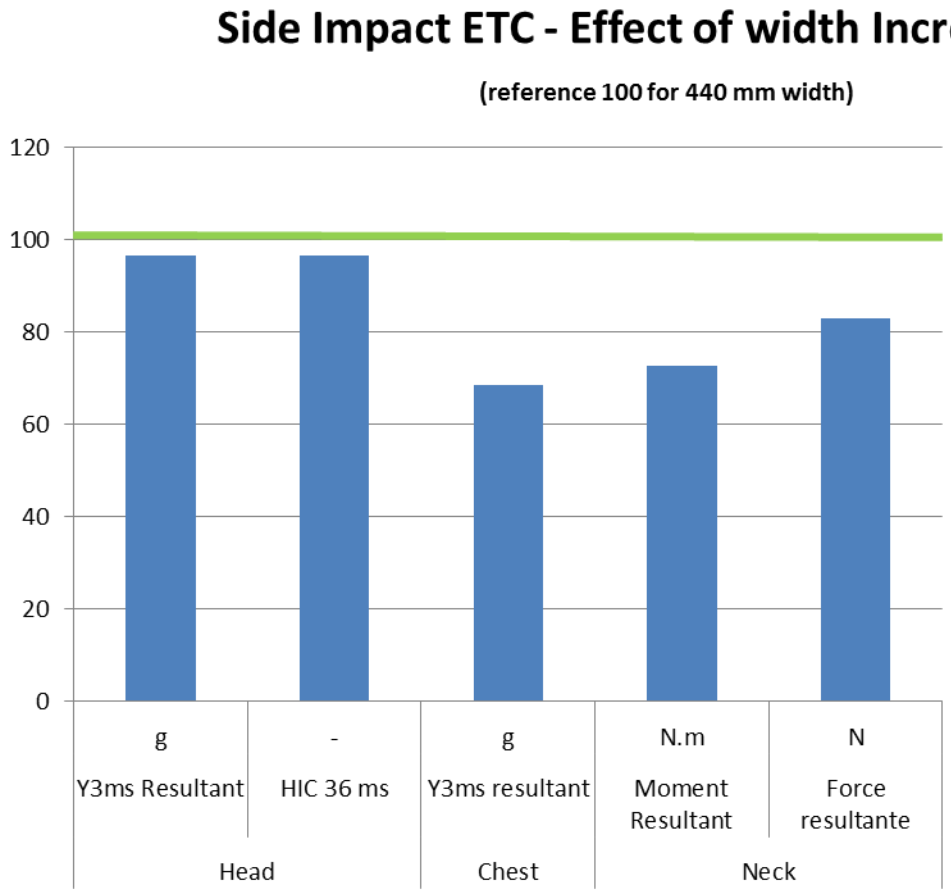
COMPARISON ETC/R129 SIDE IMPACT – DOREL TESTING

ETC Side impact – Influence of product width with Q3

440 mm

500 mm

Comparison ETC/R129 side impact – Dorel testing



Improvement
17 % with 500 mm

Important improvement for chest and neck

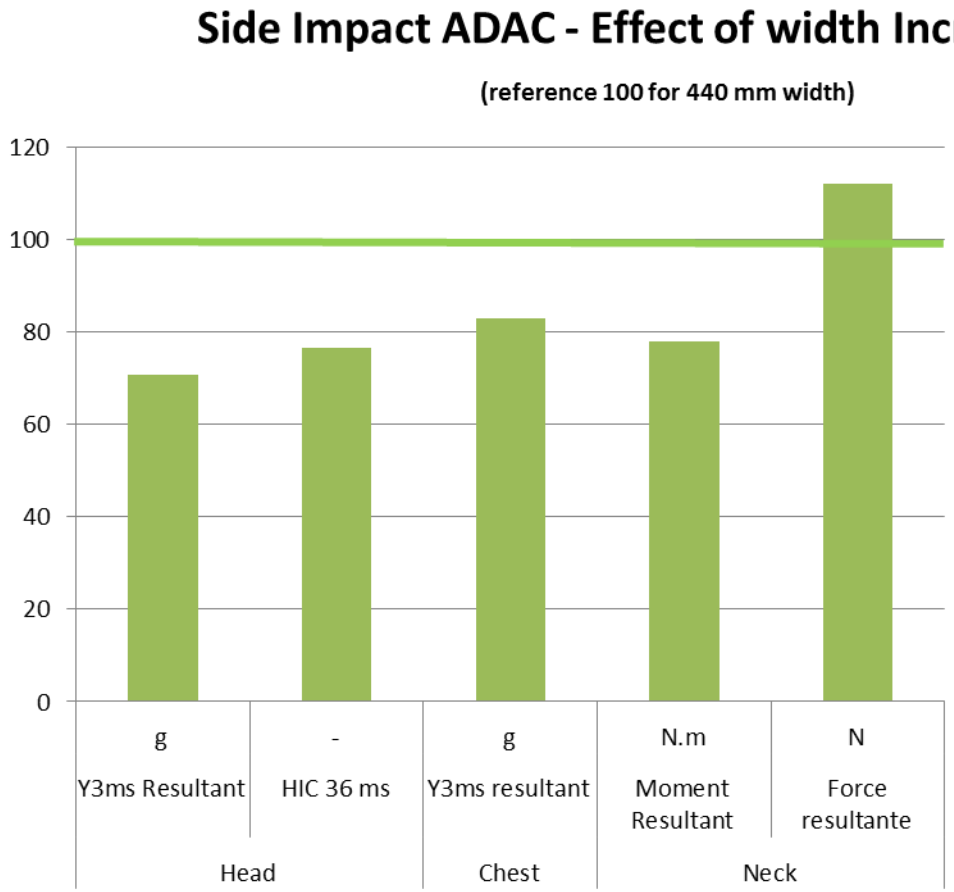
Comparison ETC/R129 side impact – Dorel testing

ETC Side impact – Influence of product width with Q6

440 mm

500 mm

COMPARISON ETC/R129 SIDE IMPACT – DOREL TESTING



Improvement
16 % with 500 mm

Important improvement for head and chest

SUMMARY - IMPLICATIONS OF 440 MM AND EFFECT OF BOOSTER WIDTH IN CONSUMER TEST ENVIRONMENT

- ETC and Regulation side impact differ substantially :
  - Less door padding
  - More important intrusion speed
- ETC is much more severe compared to Reg 129.
- Increased product width offers possibility to reach better results.
- ETC seems to favor performance results in side impact when GRSP would like to favor car compatibility. These 2 requirements may be contradictory.
- Unintended consequences:
  - CRS manufacturers may be unable to produce i-Size boosters that achieve reasonable performance in consumer tests
  - CRS manufacturers may produce specific to vehicle boosters only, with potentially better ratings compared to i-Size universal products
  - Few i-Size boosters may come to the market

OVERALL SUMMARY

- R129 performance thresholds can be met with 440 mm with Q3 and Q6
- R129 performance thresholds cannot be met with 440 mm with Q10
- Reducing width of CRS leads to significant performance degradation in non-regulated body regions
- Acceptable consumer test performance cannot be achieved with 440 mm for all dummy sizes
  - CRS manufacturers reluctant to bring products to the market with such a risk
  - This may limit the penetration of i-Size booster seats

Avenues for further investigation - Internal dimensions

INTRODUCTION

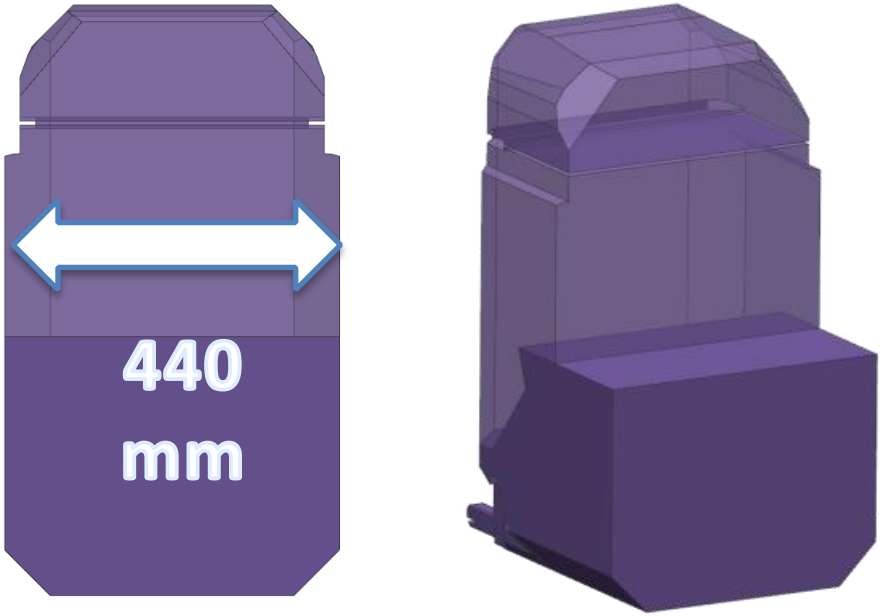
In order to be sure that ECRS accept children of a certain stature, 95th centile dimensions are checked in the ECRS.

This requirement is very demanding for the higher stature :

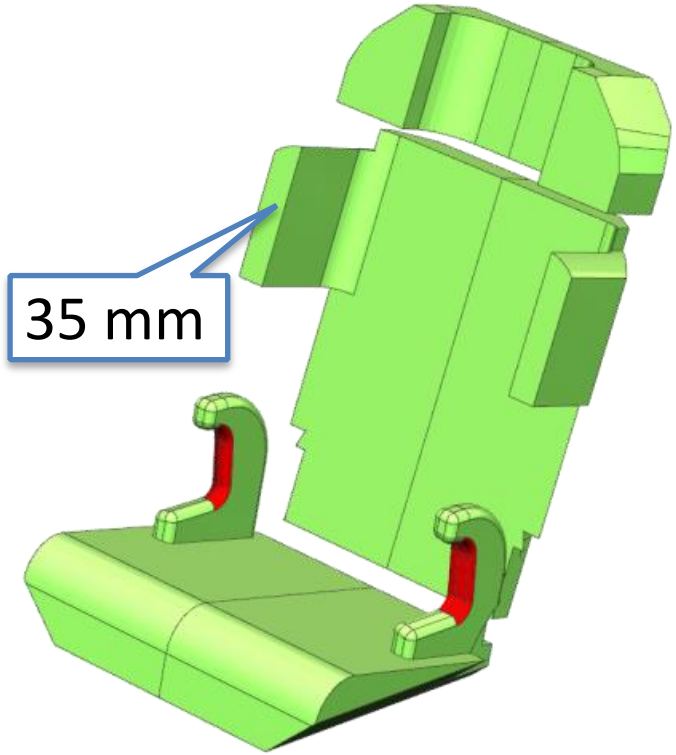
	HIII 5th	Q6	Q10	135 cm 95th	150 95th
Hip Breadth (mm)	307	200	270	330	379
Shoulder Breadth (mm)	358	259	338	369	415

INTRODUCTION

Since design space is also limited by ISO envelope, available lateral space to offer side protection is very limited.

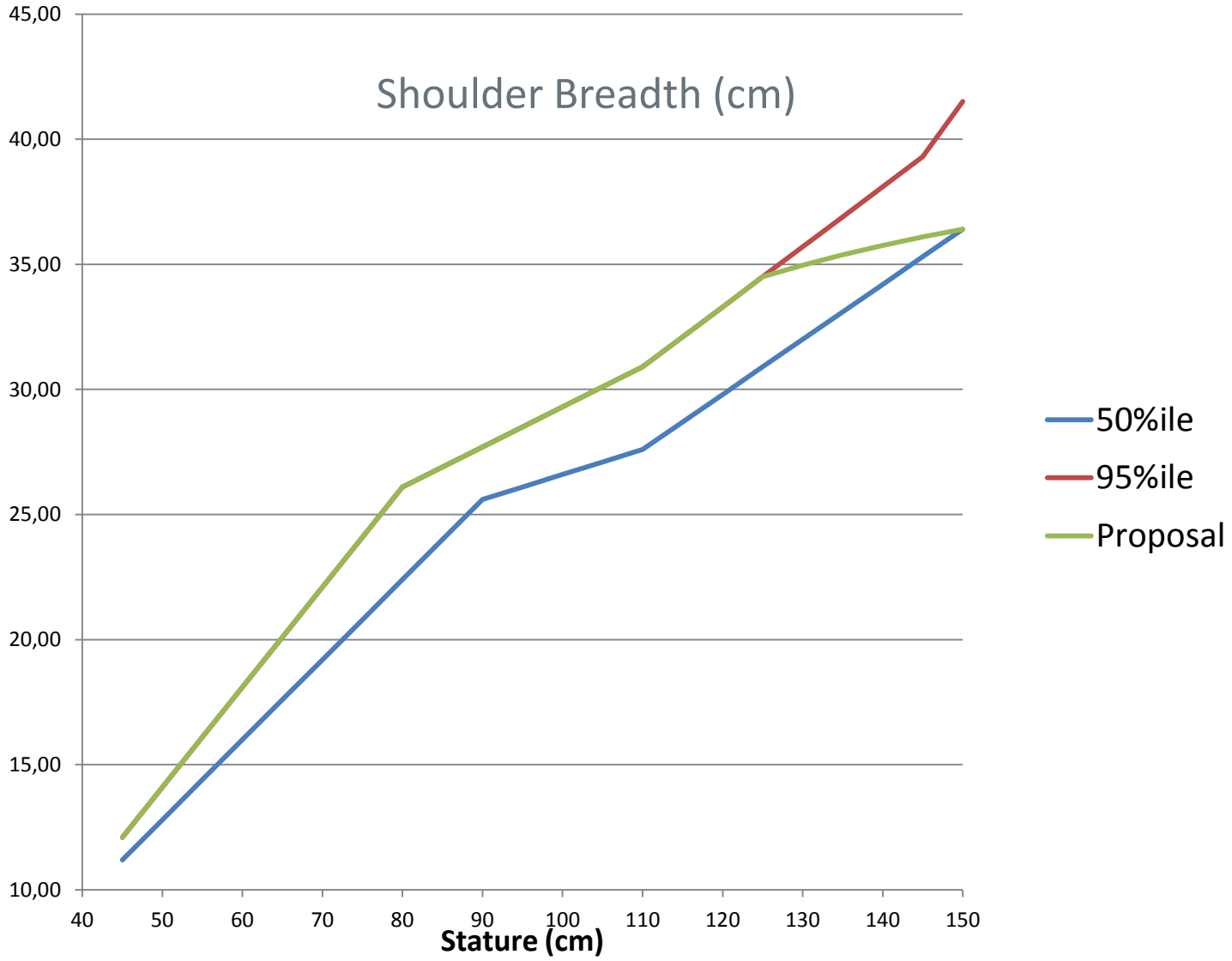


440 mm booster envelope



Available volume for 135 cm size in 440 mm envelope

POSSIBLE CONCEPT



AVENUES FOR FURTHER INVESTIGATION – F4 DEPTH

F4 DEPTH MODIFICATION REQUEST

Why ?

More cushion depth needed for the comfort of older children :

More lateral protection needed with side wing

Concept
Align F4 fixture depth with F2X

F4 DEPTH MODIFICATION REQUEST