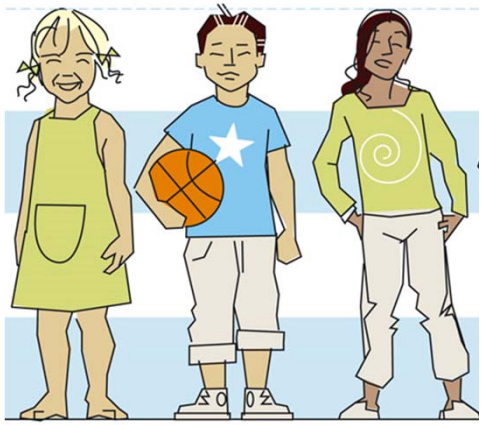
Informal document **GRSP-55-35**
(55th GRSP, 19 - 23 May 2013,
agenda item 18)

Child safety with respect to vehicle protection and booster seats

- a proposal for a CRF for children > 4yo

The balance of booster and vehicle protection - age group 4-12y



Main safety related aspects:

- Size and proportions
- Pelvic development

<u>All crash situations:</u>

- ➢ Booster to help provide good fit of vehicle safety belt;
  - Lap belt for avoidance of submarining
  - Shoulder belt for torso retention and head impact protection

<u>Side impacts:</u>

- ➢ Raise in height for better interaction with vehicle side structure, including Inflatable Curtain

Note: The mechanisms of head injuries in side impacts are similar for adults and children

Real world child safety

There is always a car to help protect the child in a child restraint when traveling!
- Consumer ratings are driving the developments of rear seat protection of all new vehicles.

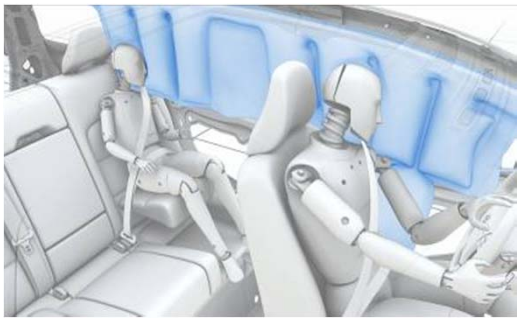
- Children aged 4 and more benefit from the vehicle safety systems, given they are raised in position using high back boosters.
- Add-on child restraints need to be balanced to the in-vehicle safety design.
- The primary effect of the backrest part of the high-back booster is to help position the child, when needed, in relation to the in-vehicle occupant protection.

➢ From a real world safety perspective it is **not** optimal for **all** children to use high back boosters

Protection principles

As for adults, children gain protection by having a **tight connection** to the vehicle.

As for an adult, a child's head will be **protected by the vehicle side structure**, incl. Inflatable Curtain.



For belt position and lateral support, **comfort covers** can be used.

Soft cover for built-in booster cushion

Real world safety wrt to child safety

The optimal child restraint depends of the child's size and behavior, the vehicle used and the purpose (and duration) of the trip.

Hence, **it is important that child seat regulation provides possibility to support optimal real world protection;**

- High back boosters for the smallest children only, >4yo
- Acknowledge booster cushions as good protection and the primary choice for the largest children.

Alternative for booster regulation- taking real world safety into account

- Children **>6yo**, side impact test not included + geometrical compatibility evaluation using a “CRF booster cushion”
- Children **≤6yo**, side impact test included + geometrical compatibility evaluation using a “CRF 120cm”.

There is a need for a “CRF 120cm”.

“CRF booster cushion” is being developed by ISO wg1.

Starting point

95 %-ile child of stature 120cm

Shoulder width: 33.3cm

Pelvis width: 29.1cm

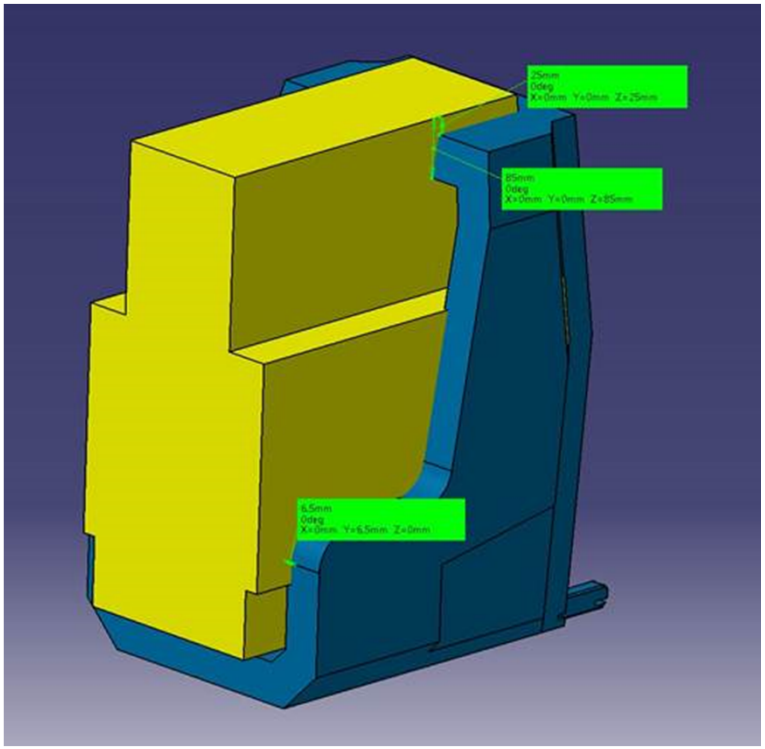
Sitting height: 68.0cm

Booster cushion height 8.0 cm and side structure thickness of approx. 5.0 cm

=> has to be further investigated.

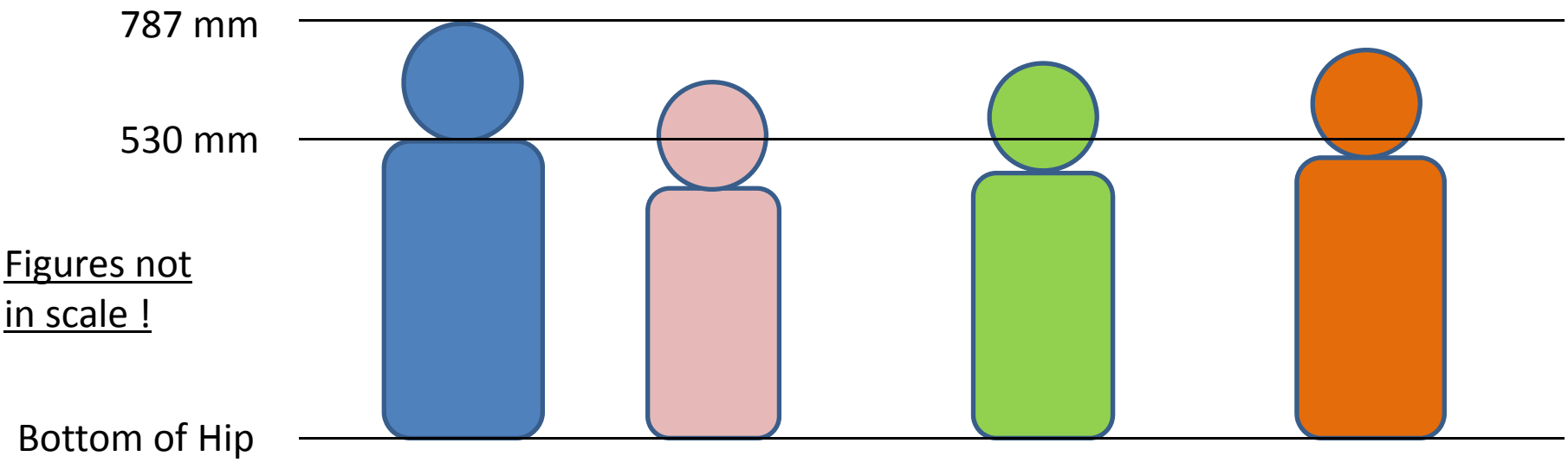
The **CRF in FMVSS225** is close to required size, requiring minor adjustments.

Proposed as a starting point.



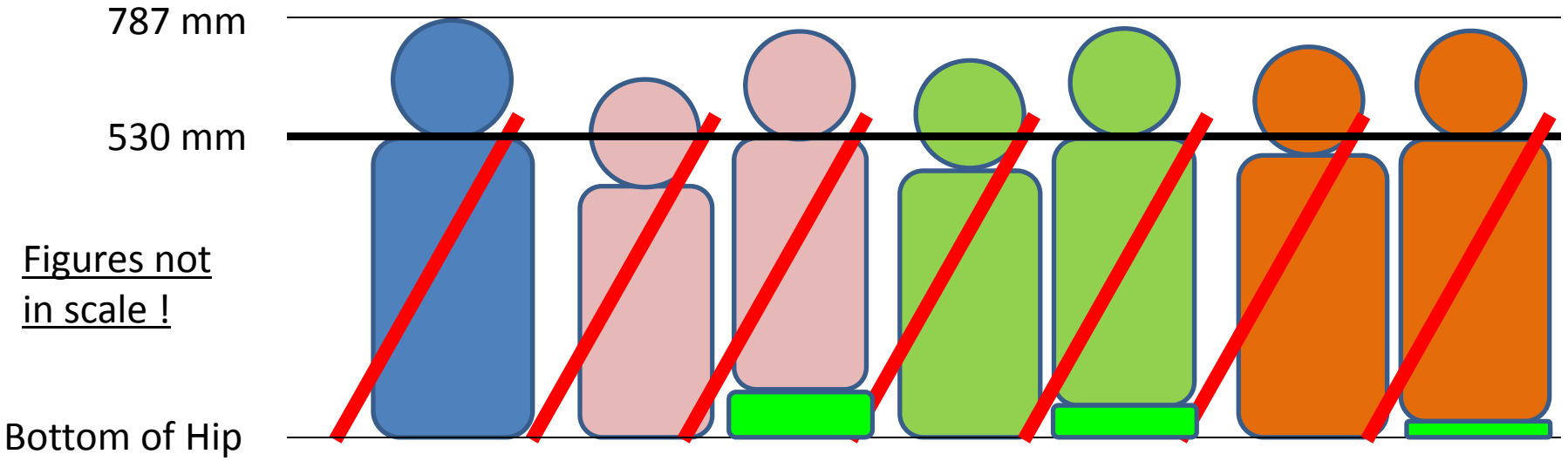
Booster cushion height – further investigation

UN-R129 Phase 2
Concept of Child Safety with Booster Cushion



Size Range	AF05	125cm		130cm		135cm	
		5%ile	50%ile	5%ile	50%ile	5%ile	50%ile
Shoulder height in Sitting	530 mm	385 mm	411 mm	400 mm	427 mm	415 mm	445 mm
Difference of shoulder height in sitting against AF05	-	145 mm	119 mm	130 mm	103 mm	115 mm	85 mm
Sitting height	787 mm	630 mm	660 mm	645 mm	680 mm	670 mm	700 mm
Difference of sitting height against AF05	-	157 mm	127mm	142 mm	107 mm	117 mm	87 mm

UN-R129 Phase 2
Concept of Child Safety with Booster Cushion
(1) Frontal Impact
As the seat belt path is important for frontal impact, necessary booster cushion height can be calculated as shown below:



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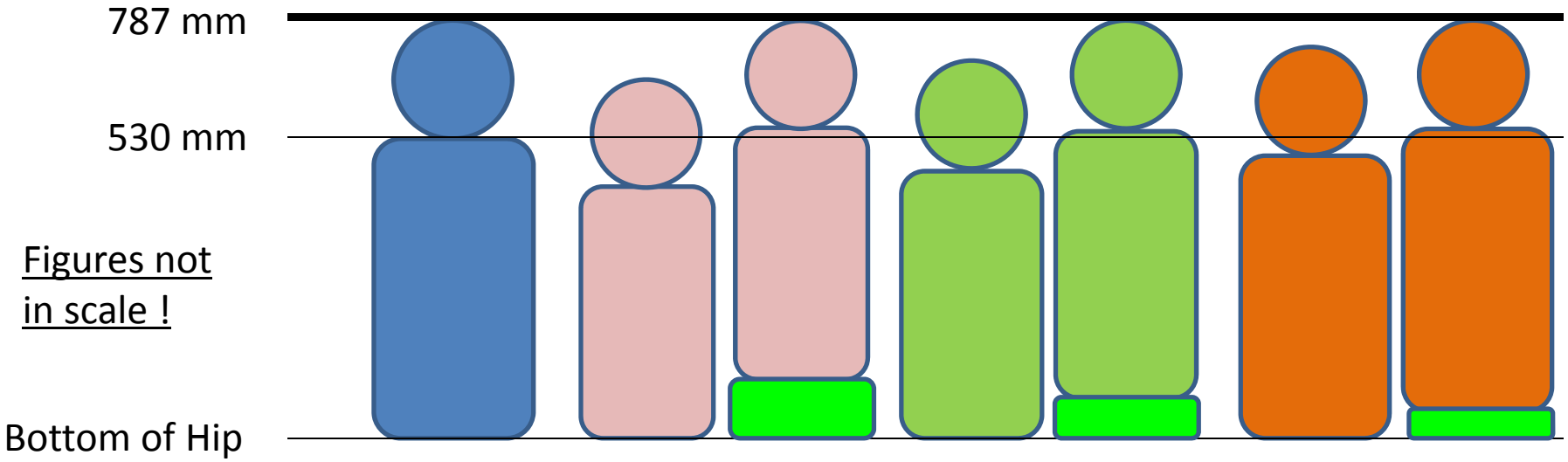
UN-R129 Phase 2
Concept of Child Safety with Booster Cushion
(2) Side Impact

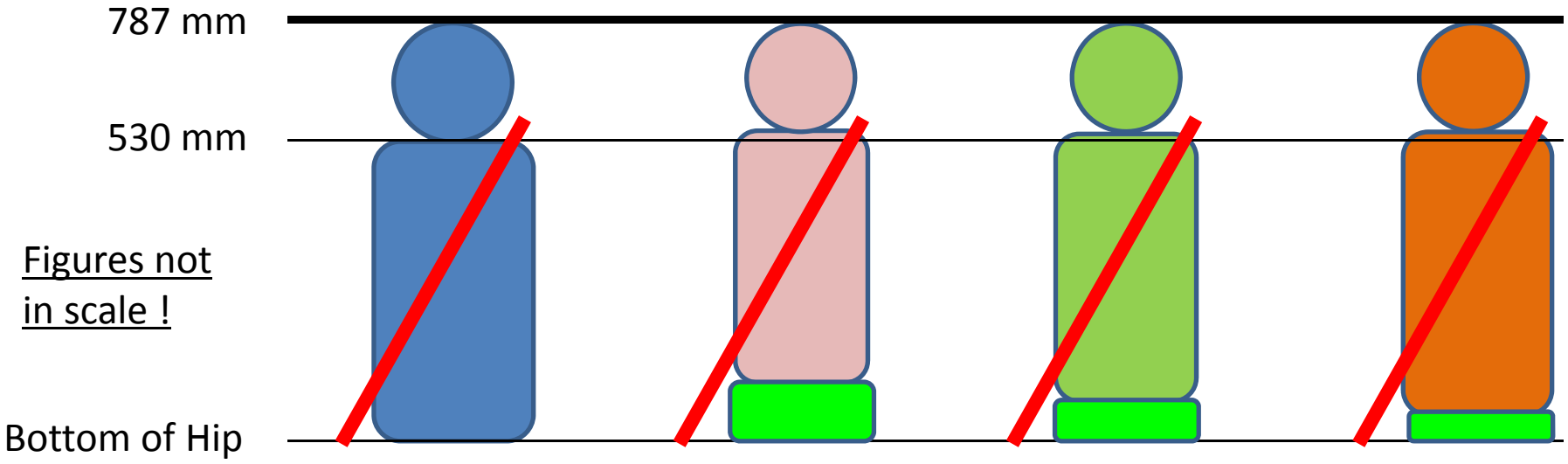
As the head position is important for side impact, necessary booster cushion height can be calculated as shown below:



Size Range	AF05	125cm		130cm		135cm	
		5%ile	50%ile	5%ile	50%ile	5%ile	50%ile
Sitting height	787 mm	630 mm	660 mm	645 mm	680 mm	670 mm	700 mm
Difference of sitting height against AF05	-	157 mm	127mm	142 mm	107 mm	117 mm	87 mm

UN-R129 Phase 2
Concept of Child Safety with Booster Cushion
(3) Summary and Proposal

To cover the safety of children sitting in booster cushion in both frontal impact and side impact, the necessary cushion height whichever is greater between the two, which is for side impact, should be a requirement for universal booster cushion



Size Range	AF05	125cm		130cm		135cm	
		5%ile	50%ile	5%ile	50%ile	5%ile	50%ile
Necessary cushion height for frontal impact	-	145 mm	119 mm	130 mm	103 mm	115 mm	85 mm
Necessary cushion height for side impact	-	**157 mm**	**127mm**	**142 mm**	**107 mm**	**117 mm**	**87 mm**

Booster cushion height – further investigation

Need to define appropriate heights of the belt positioning boosters

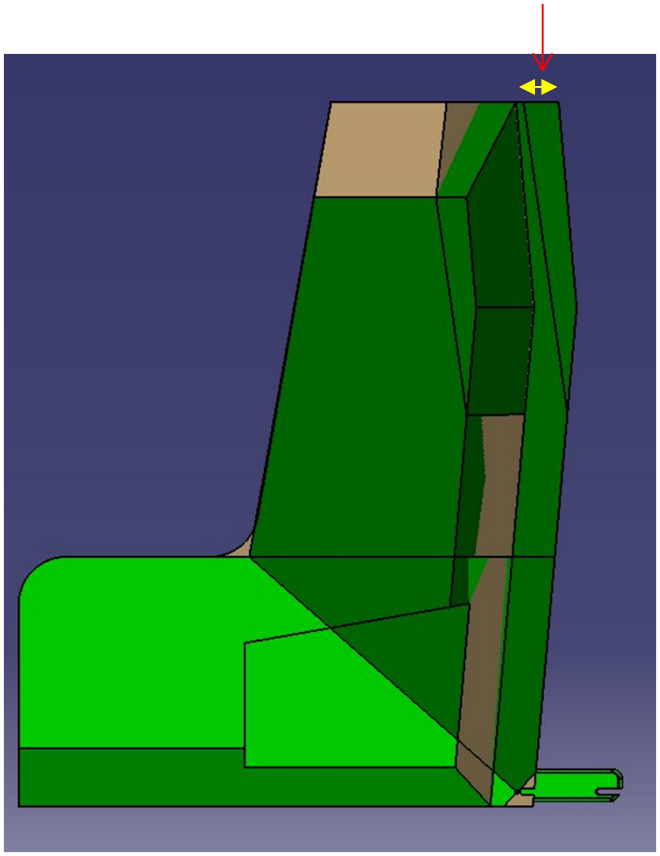
Could be achieved by correlating the vehicle H-point with the Cr-point in UN Reg.129 test bench.

A possible method could be to install the 5 %-ile female dummy in the UN Reg. 129 test bench and measure the relationship between the dummy's hip point and the Cr-point in the test bench

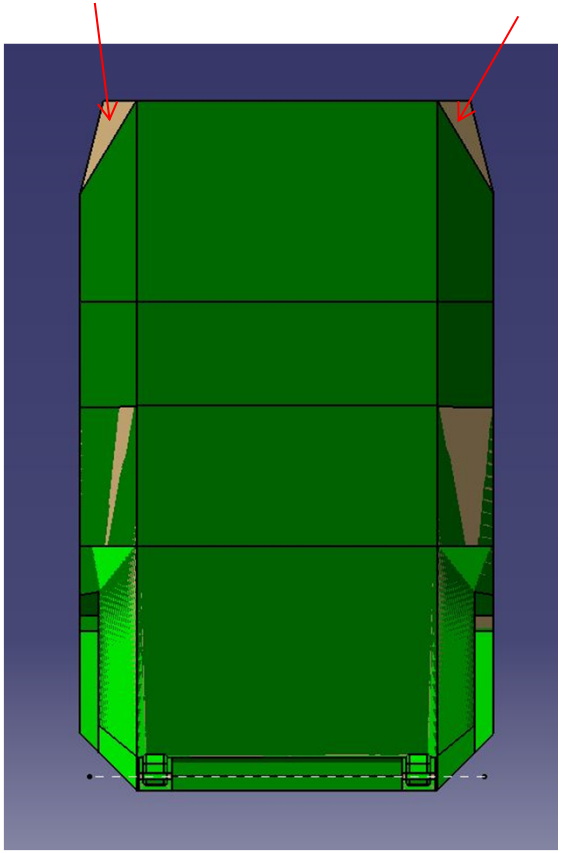
Annex – CRF comparison

Proposed design of a ”CRF 120” (green) - compared to ”CRF FMVSS 225” (grey)

Extended backrest rearward

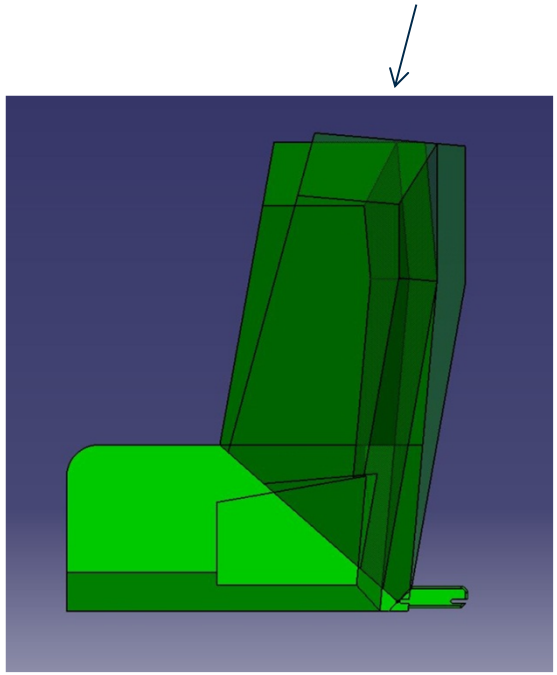


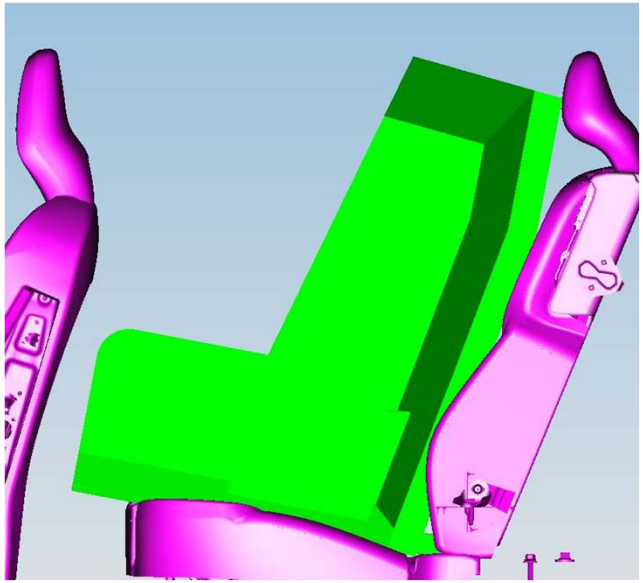
Corner more angled

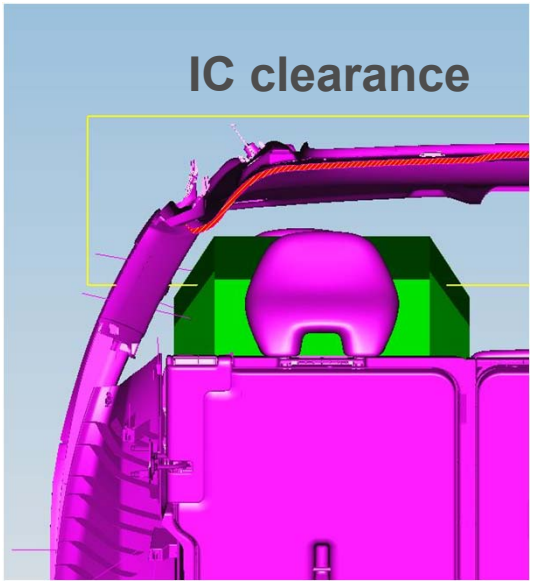


”CRF 120” positioned in Volvo V40 rear seat

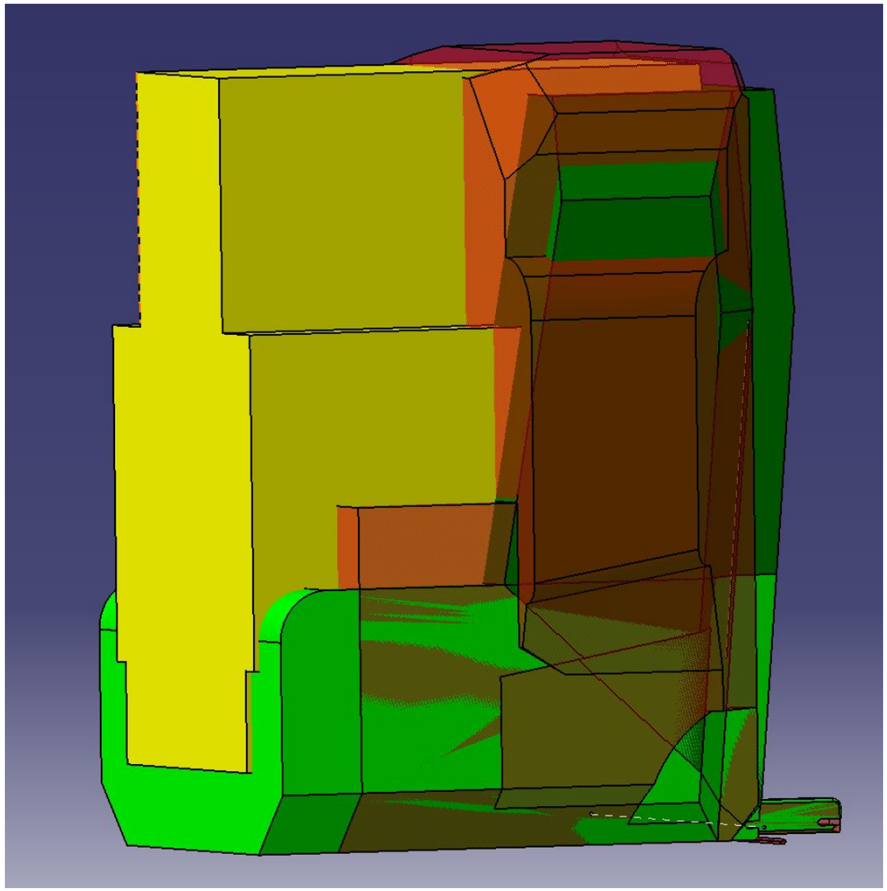
The adjustable backrest adjusted 5°rearward to adjust towards back rest and head restraint in Volvo V40 rear seat.





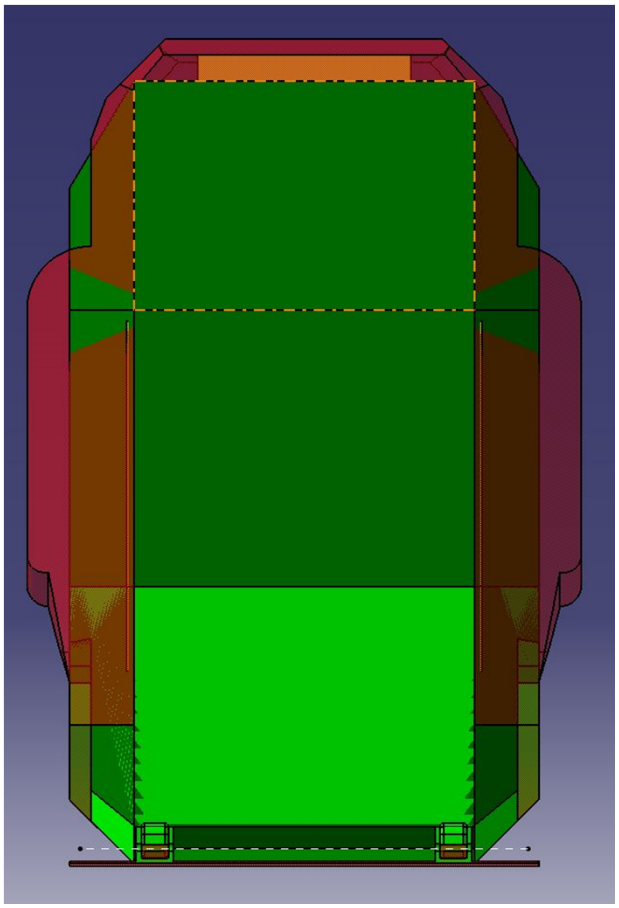


Comparison
“CRF 120” (blue) to
“ISO CRF135” (wg1 N1068) (red)



The yellow area represent the dimensions for the 95 %-ile child of stature 120cm

Comparison
“CRF 120” (Green) to
“ISO CRF135” (wg1 N1068) (red)



Comparison
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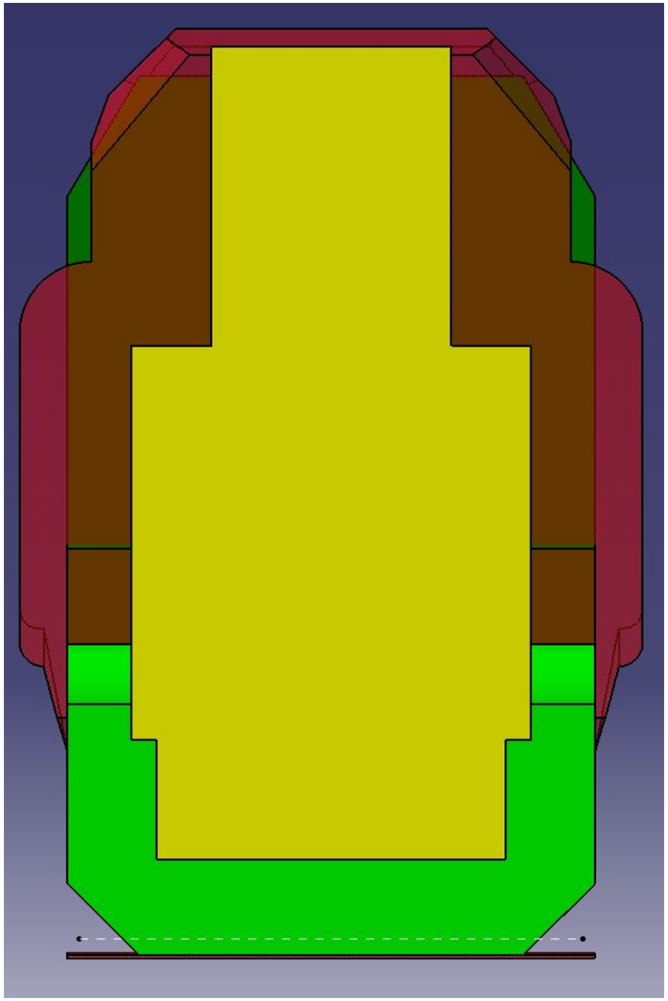
“ISO CRF135” (wg1 N1068) (red)



CAD files

CRF120
2014-05-12.stp

CRF120
!014-05-12.CATPar