



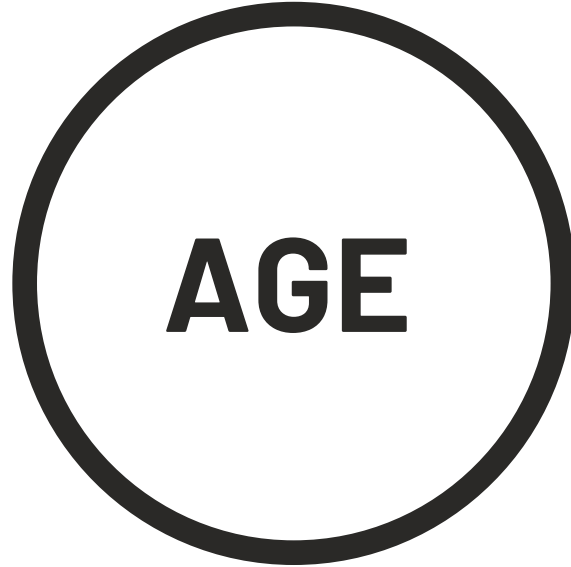
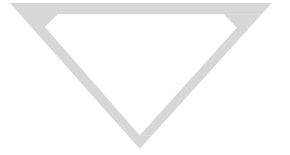
Car Position

DO NOT use the booster seat if your child's head is less than 5 in (12.7 cm) below the roof of the car. Consult your vehicle manual for proper seatbelt usage.

5" Minimum Headroom Requirement in Booster Mode

May 6, 2022

Background: 50 State Car Seat Usage Max Requirements



8+ Years Old

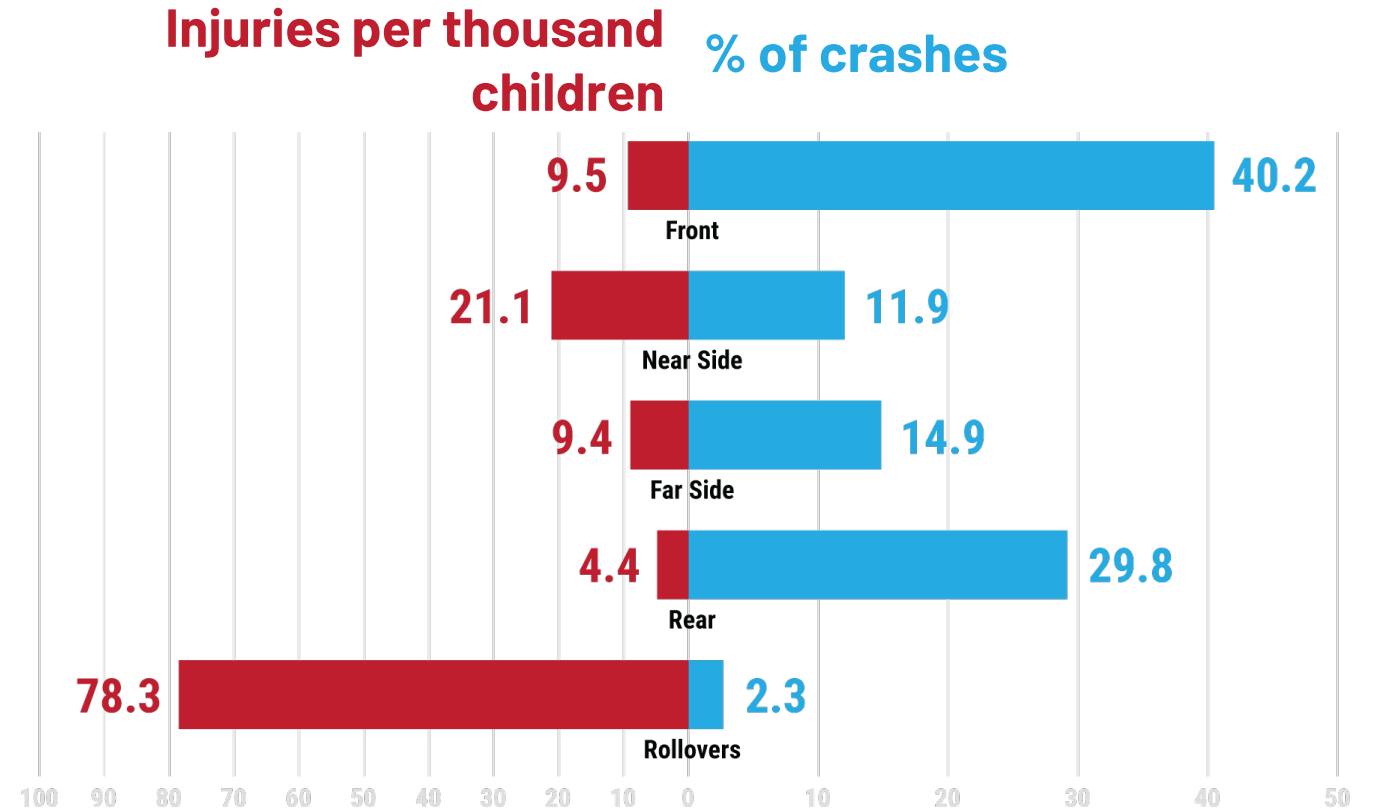


80+ Lbs.



57+ Inches

Background: Injuries by Point of Impact



Background: ECE R129 European CRS Size and Performance Requirements



- Boundary boxes that limit size of CRS
- Rollover test method and performance requirement:
 - Mass equal to 4x test dummy weight added while inverted
 - Maximum excursion when inverted after weight removed is 300 mm (11.8 inches)
- Forward facing and booster head excursion limitation above test bench of 840 mm (33 inches)
 - Q10 ATD in booster mode exempted from requirement

NOTE: European vehicles are typically smaller than U.S. vehicle and therefore have less 2nd row headroom available

Background: ECE R129 European CRS Size and Performance Requirements

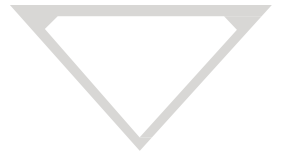


- Boundary boxes that limit size of CRS
- Rollover test method and performance requirement:
 - Mass equal to 4x test dummy weight added while inverted
 - Maximum excursion when inverted after weight removed is 300 mm (11.8 inches)
- Forward facing and booster head excursion limitation above test bench of 840 mm (33 inches)
 - Q10 ATD in booster mode exempted from requirement

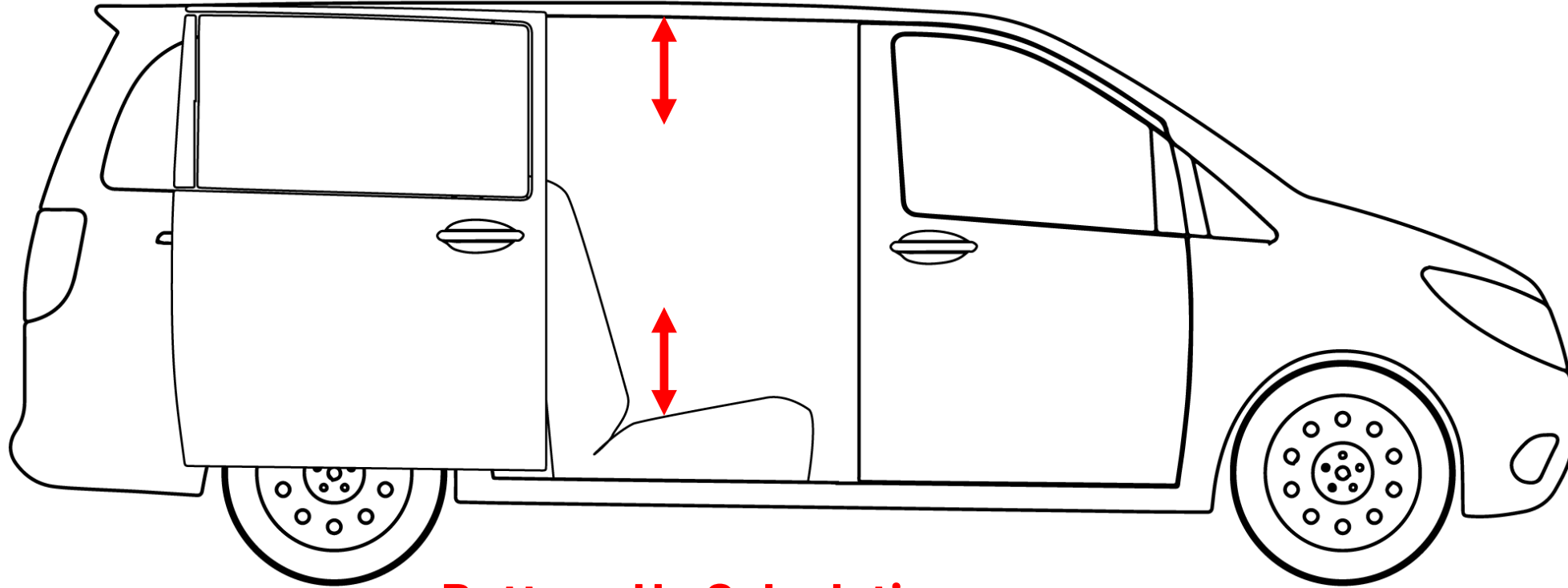
Minimum Headroom?

NOTE: European vehicles are typically smaller than U.S. vehicle and therefore have less 2nd row headroom available

Which is a better way to ensure sufficient headroom remains available?

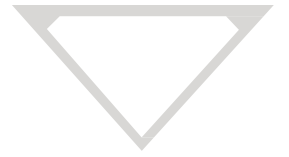


**Top-Down Calculation:
Headroom Required**

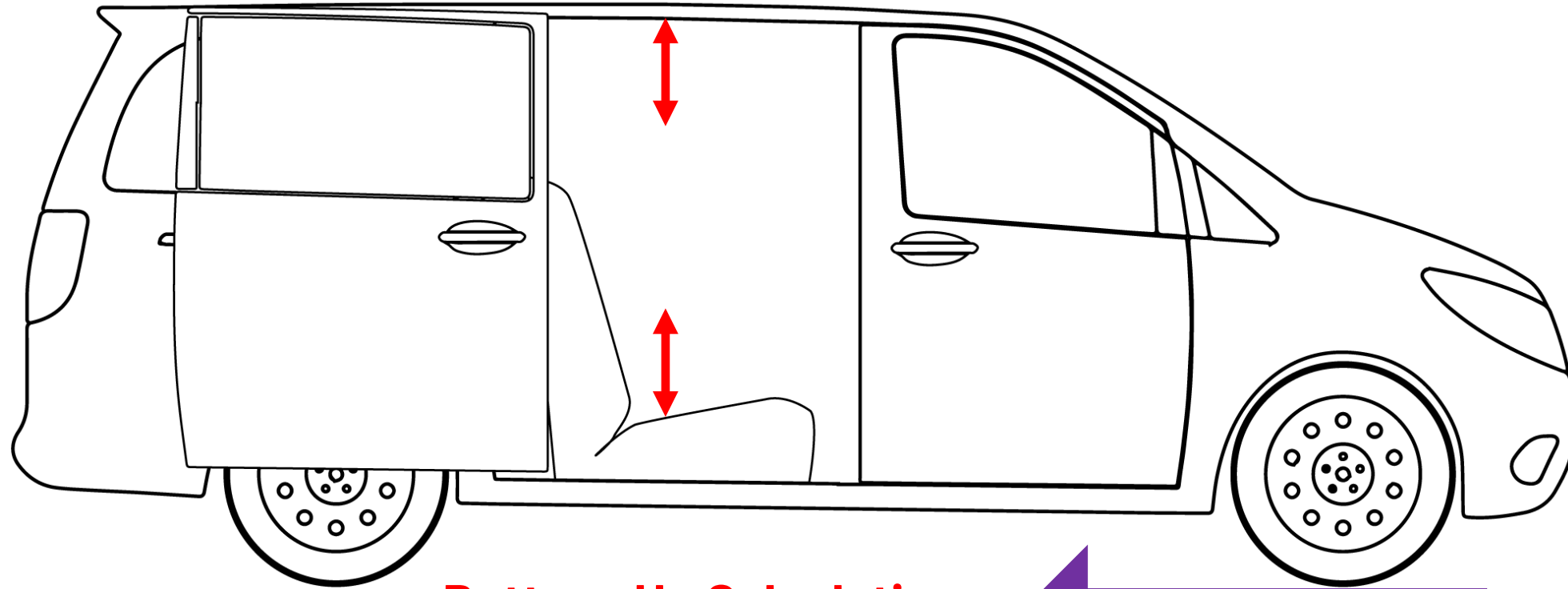


**Bottom-Up Calculation:
Headroom Available**

Which is a better way to ensure sufficient headroom remains available?



**Top-Down Calculation:
Headroom Required**



**Bottom-Up Calculation:
Headroom Available**

ECE R129

Reference: Adult Frontal Crash Test ATD's



H3 5th% Female

- 108 lbs.



**Seated height:
31.0 inches**

H3 95th% Male

- 223.1 lbs.

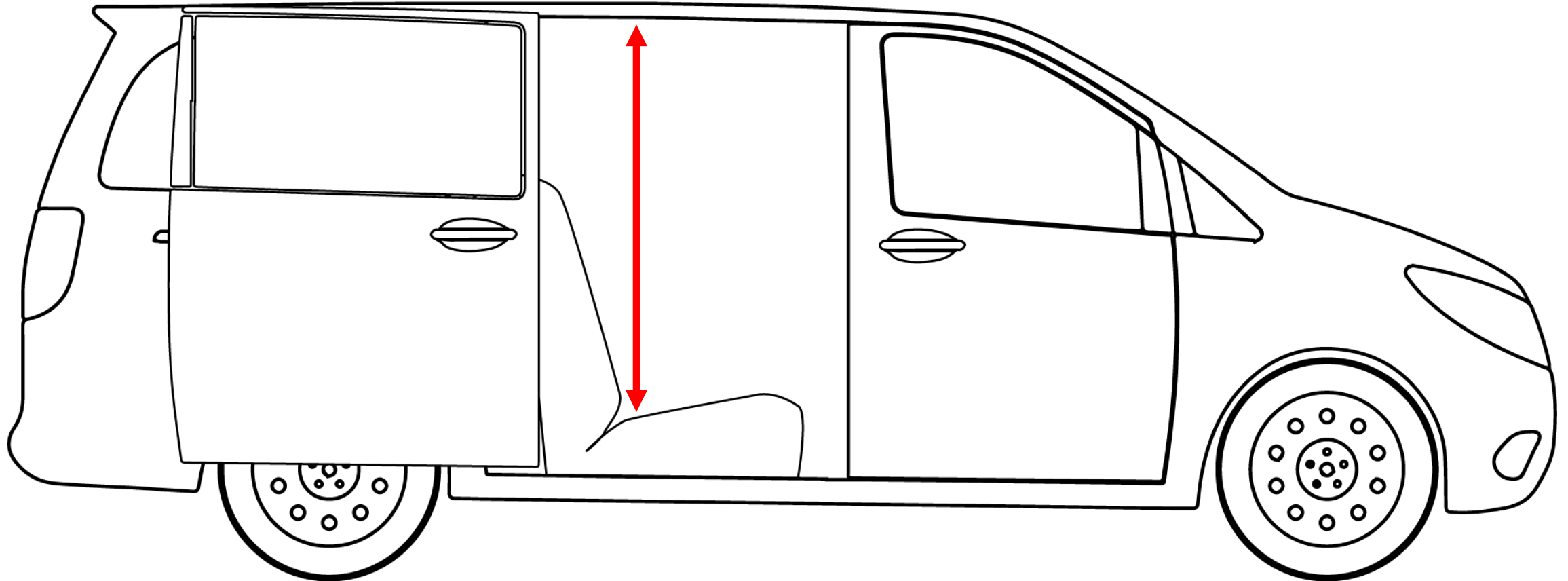


**Seated height:
36.2 inches**

Headroom Available in U.S. Vehicles



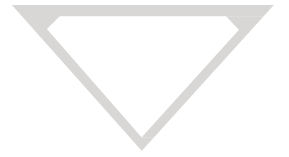
2nd Row Vehicle Headroom Ranges From 34.9 to 43.1 Inches



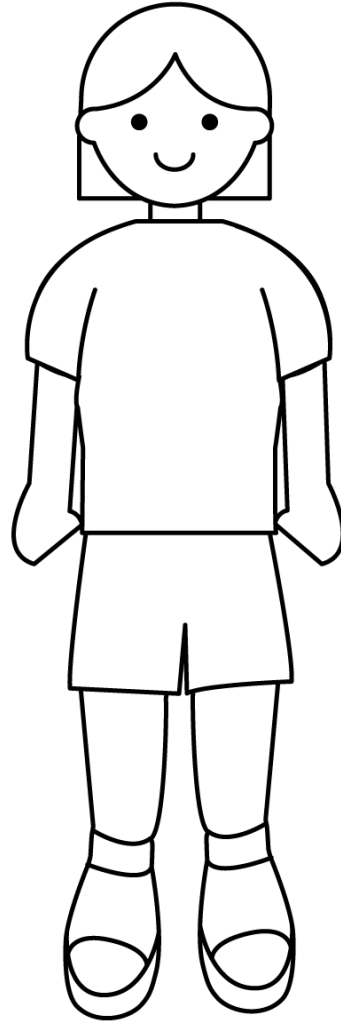
Average 2nd Row Vehicle Headroom: 38.8 Inches

*Top 20 Best-Selling 2021 Vehicles

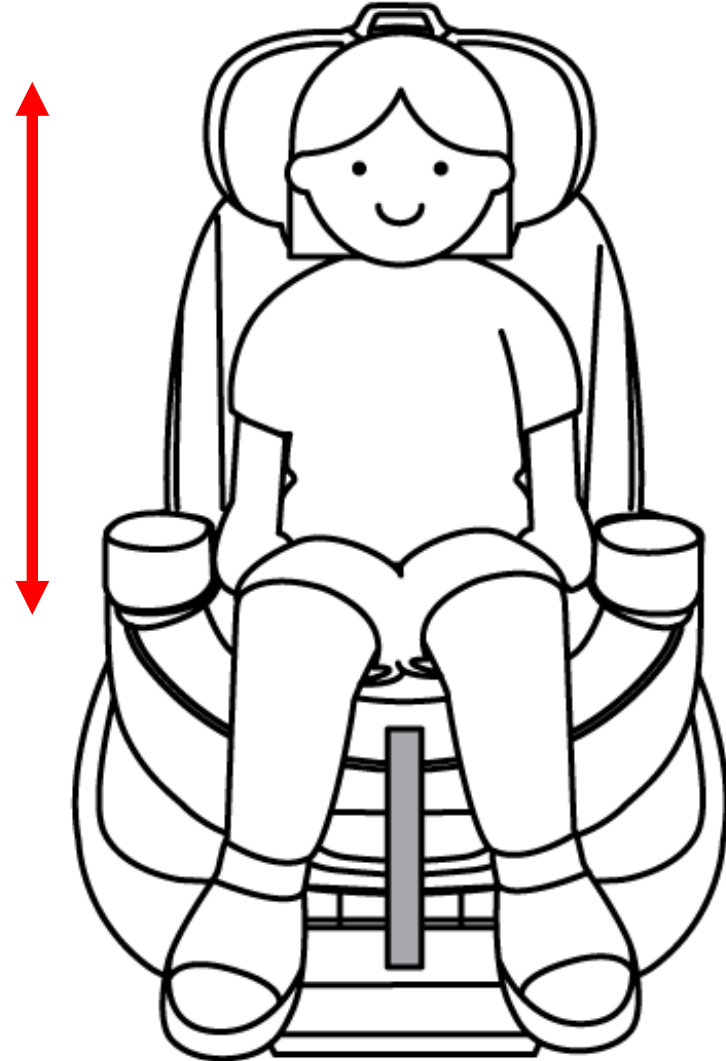
Estimated 95th% 8 YO Child



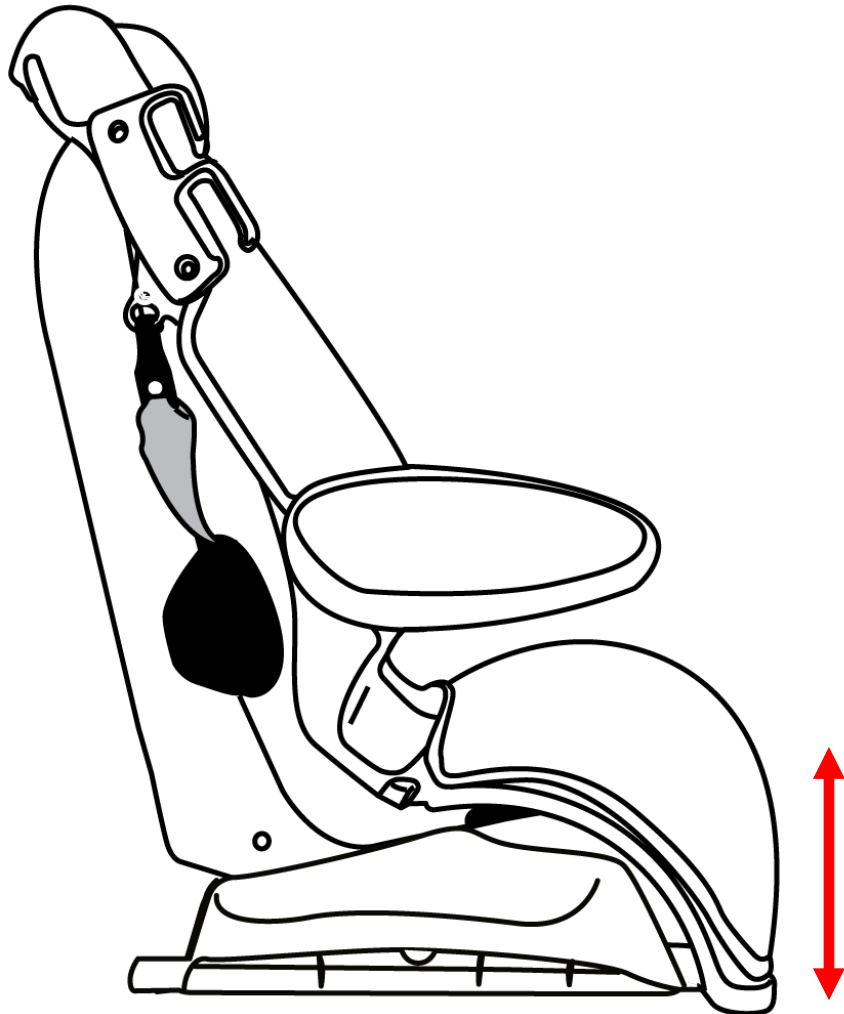
- 57" tall
- 102 lbs.



**Seated height:
28.7 inches**



Child Restraint Base Thickness

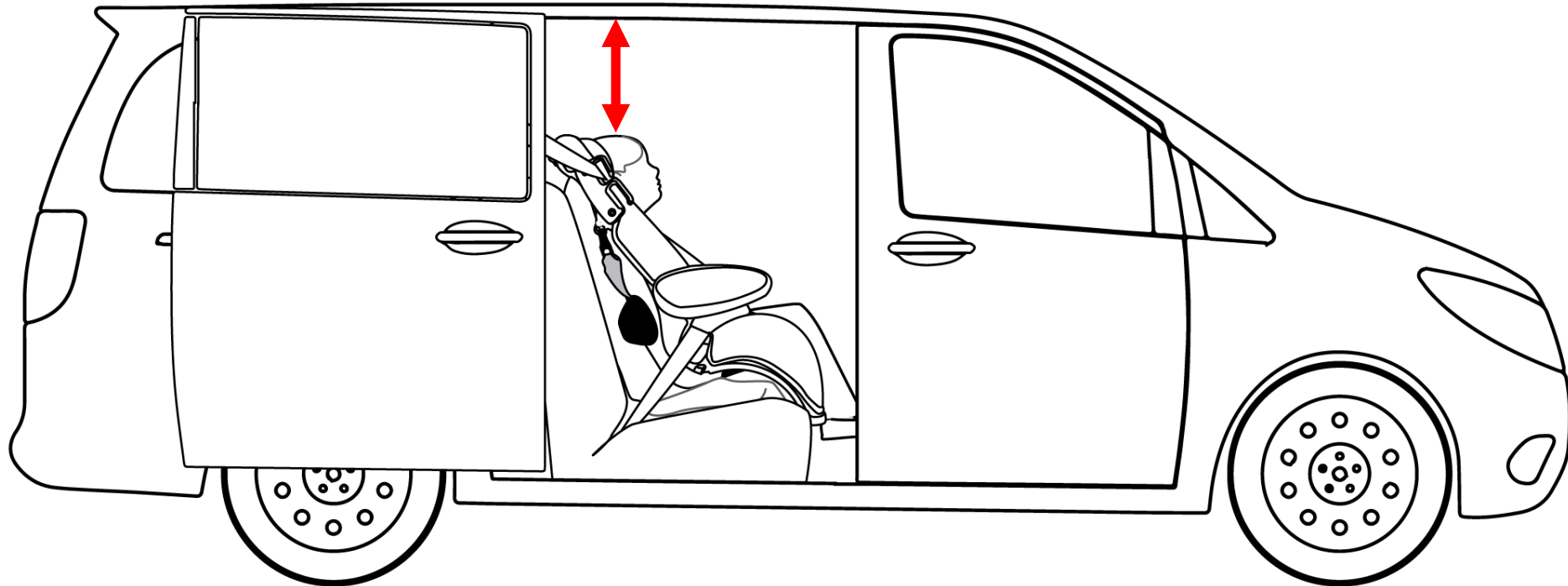


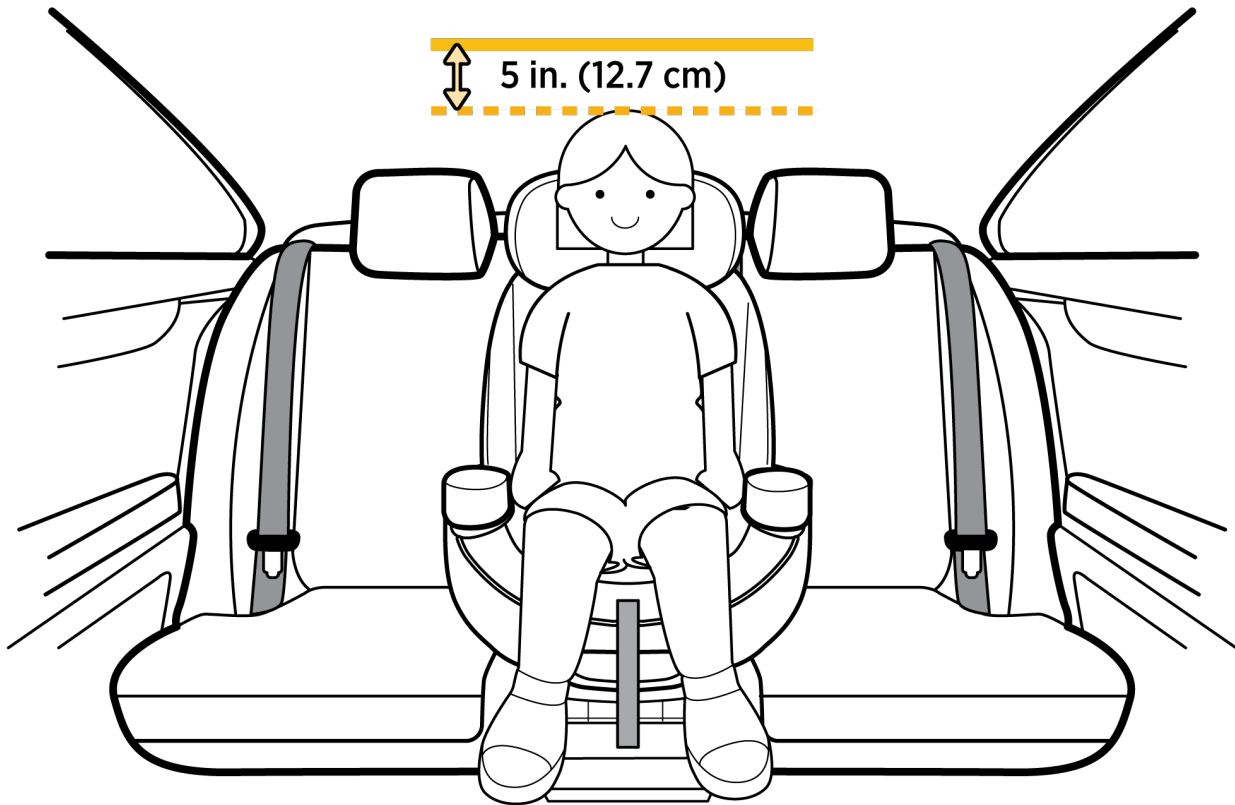
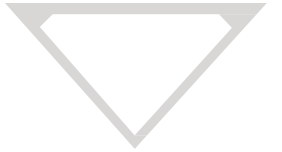
**Booster Child Restraint Base Thickness:
Up to 5 inches**

Bottom-Up Calculation: Available Headroom



$$\begin{aligned} &(\text{Headspace} - (\text{Seated Height} + \text{Booster Base})) = \text{Available Headroom} \\ &(\quad 34.9'' - (28.7'' + 5'')) = \text{Worst: } \underline{1.2 \text{ inches}} \\ &(\quad 38.8'' - (28.7'' + 5'')) = \text{Average: } \underline{5.1 \text{ inches}} \\ &(\quad 43.1'' - (28.7'' + 5'')) = \text{Best: } \underline{9.4 \text{ inches}} \end{aligned}$$





How Dorel arrived at 5 inches

- Top-Down Calculation: Headroom Required
 - ✓ Evaluation of NHTSA vehicle roof crush data
 - ✓ Determination of additional excursion due to rollover crash

Dorel Internal Inversion Test Study

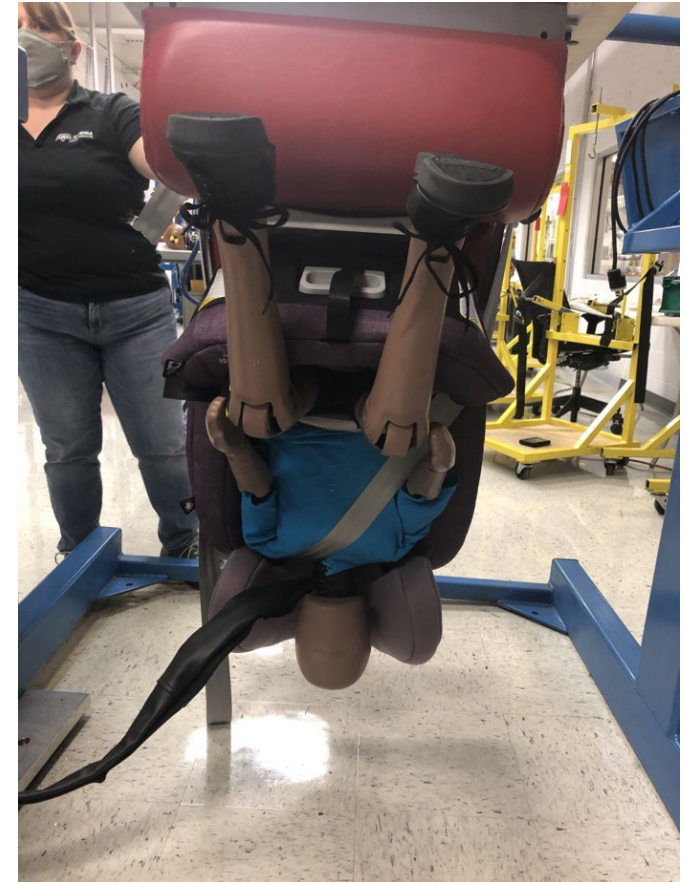
- Added lap/shoulder belt anchors to FMVSS 213 FAA Inversion Test Fixture
- Inverted H3-6YO and H3-10YO ATD's to determine additional excursion away from seat bight when upright
- Averaged the additional excursion values from the 6YO and 10YO ATD's to estimate excursion amount for an 8-year-old:
3.05 inches

H3-10YO ATD



3.54 inches

H3-6YO ATD

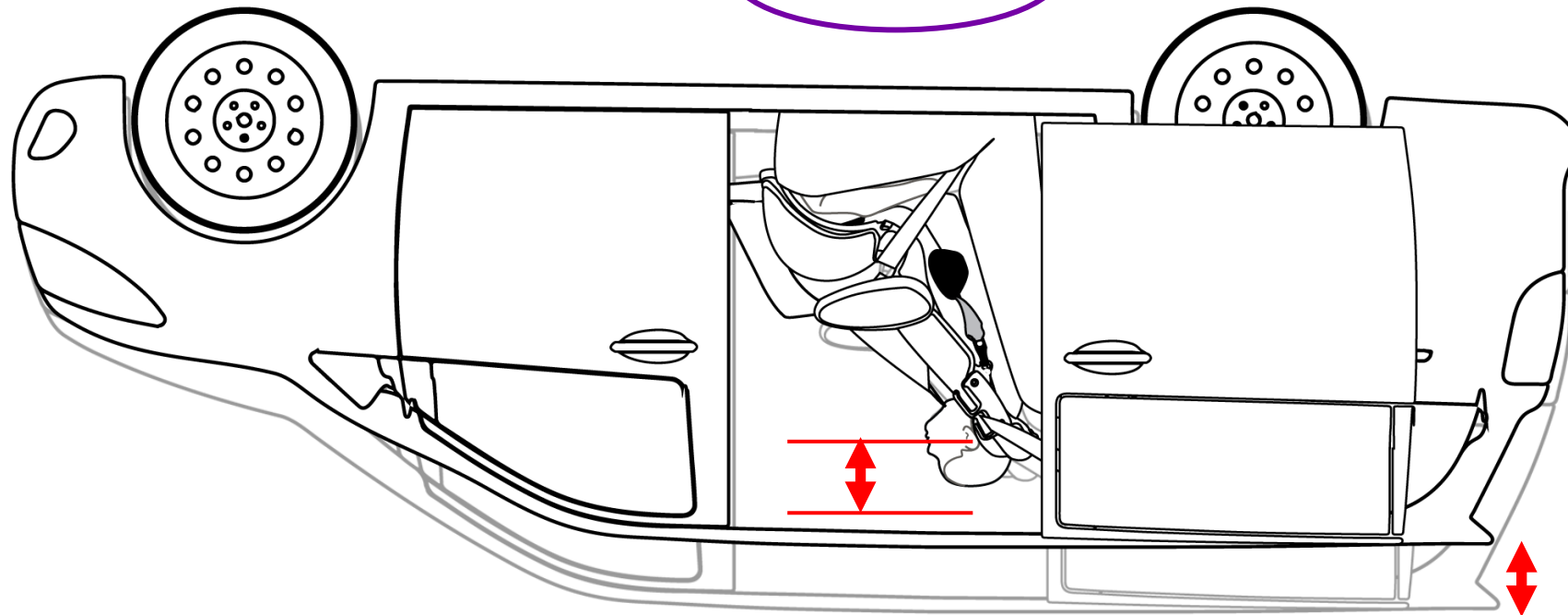
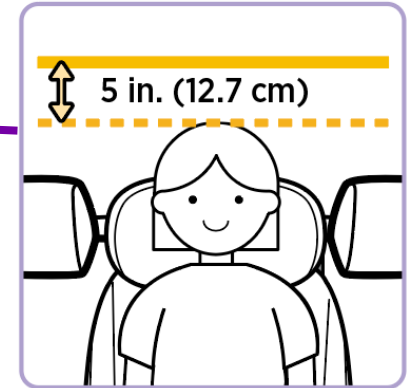


2.55 inches

Top-Down Calculation: Headroom Required

Roof Crush + 8 YO Excursion = Headroom Required

$$1.86'' + 3.05'' = \text{4.91 inches}$$



**Estimated Additional Excursion of
8 YO Child: 3.05 inches**

*Dorel Internal Inversion Study

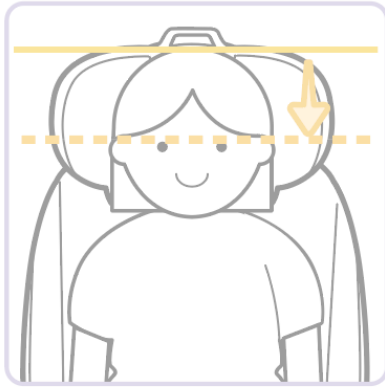
**Average Vehicle
Roof Crush: 1.86 inches**

*NHTSA 2002 Vehicle data coupled with
2012 roof crush improvement requirements

Minimum Headroom Requirement in Manuals

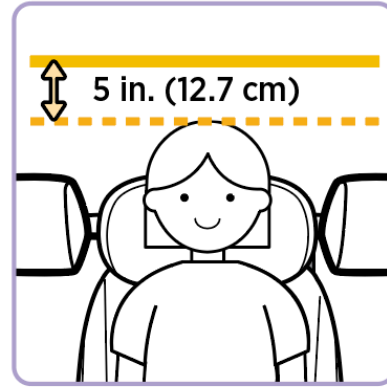


Booster Seat Child Fit



Head Position

The tops of your child's ears should **never be above** the top of the booster seat's headrest.



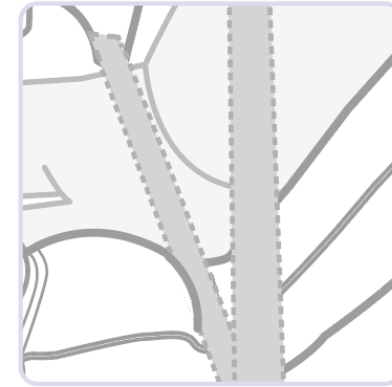
Car Position

DO NOT use the booster seat if your child's head is less than 5 in (12.7 cm) below the roof of the car. Consult your vehicle manual for proper seatbelt usage.



Shoulder Belt Position

The shoulder belt should lay snugly across the center of your child's shoulder and across their chest.



Lap Belt Position

The lap belt should lay snugly across your child's hips; **not on their stomach.**

Thank You!



QUESTIONS?