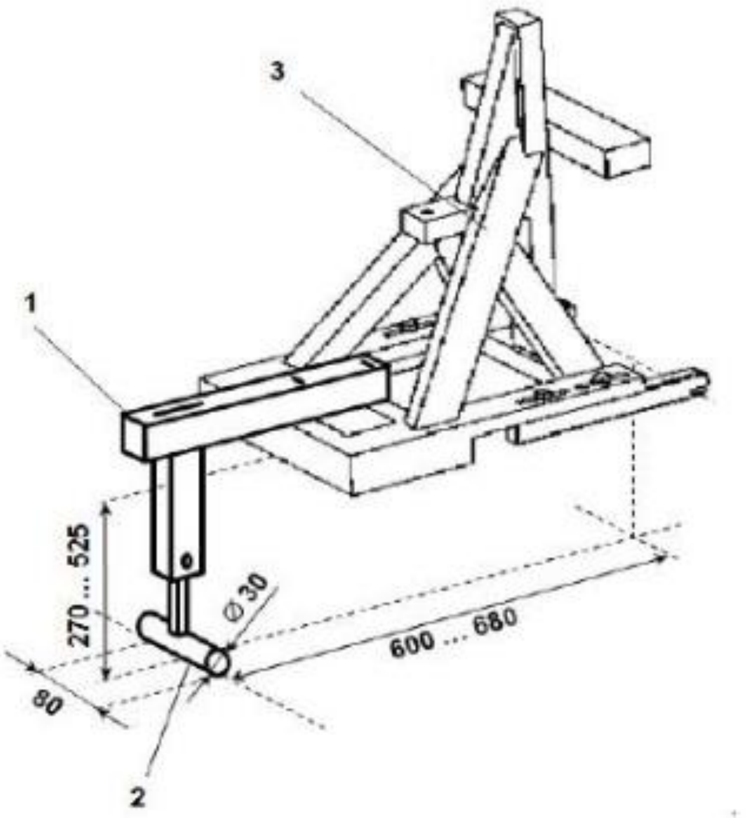
CRS support legs: Background and facts

UN CRS Ad-hoc Group

Paris, 29th June 2022

UN R145 DOESN'T SPECIFY A MINIMUM VEHICLE FLOOR STRENGTH PRECISELY

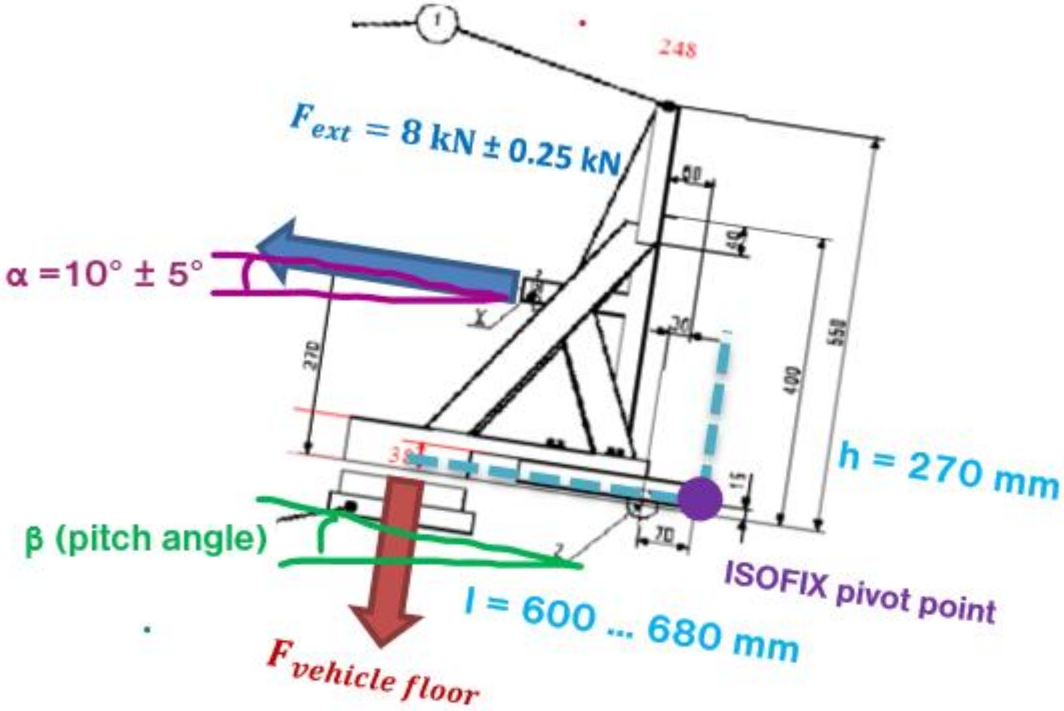


UN R145 Static Force Application Device (SFAD)

6.2.4.5. (UN R145.00. Cor.1)

The **horizontal excursion** (after pre-load) of point X of the SFAD during application of the 8 kN ± 0.25 kN force shall be limited to 125 mm and **permanent deformation including partial rupture or breakage** of any ISOFIX low anchorage and the **vehicle floor contact surface**, or surrounding area **shall not constitute failure** if the required force is sustained for the specified time.

ENGINEERING CALCULATIONS CAN ESTIMATE FLOOR LOADING IN THE R145 TEST



$$F_{vehicle\ floor} = \frac{h}{l} \times F_{ext} \times (\cos(\alpha - \beta) - \sin(\alpha - \beta)) = \frac{270\ \text{mm}}{600\ \text{to}\ 680\ \text{mm}} \times 8\ kN$$

assuming $\alpha \approx \beta$

$$\approx \mathbf{3.2\ to\ 3.6\ kN}$$

UN R145 REQUIREMENTS WERE DERIVED FROM CRS DYNAMIC TESTS PRESENTED TO UN IWG

CLEPA European Association of Automotive Suppliers

DOREL Europe

Test description

- R44 bench equipped with :
  - Lower isofix anchorages loads sensors
    - Load given in this document are calculated in the centre of the 6 mm diameter anchorage
  - Support Leg load sensor
- Tests performed
  - Seat A : Gr0+ with Support leg R44 / P1,5
  - Seat B : Gr1 with Support leg R44 / P3
  - Seat A : Gr0+ with Support leg Euroncap / Q1,5
  - Seat B : Gr1 with Support leg Euroncap / Q3

CLEPA European Association of Automotive Suppliers

DOREL Europe

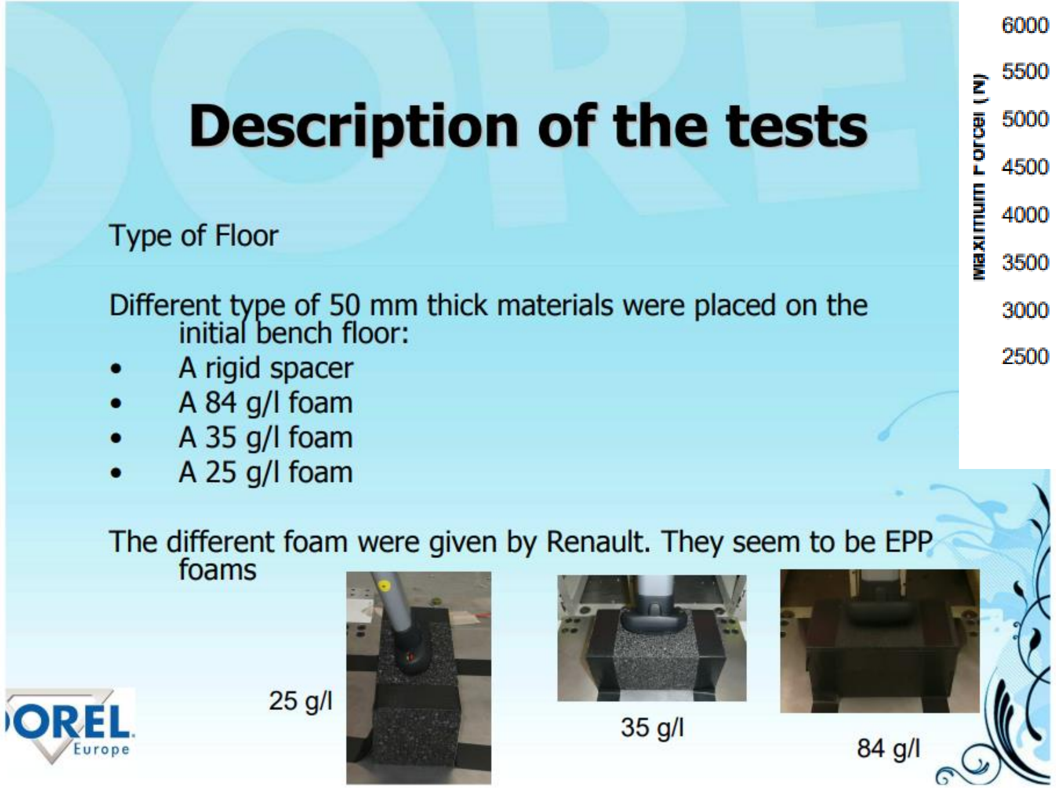
Results- Synthesis

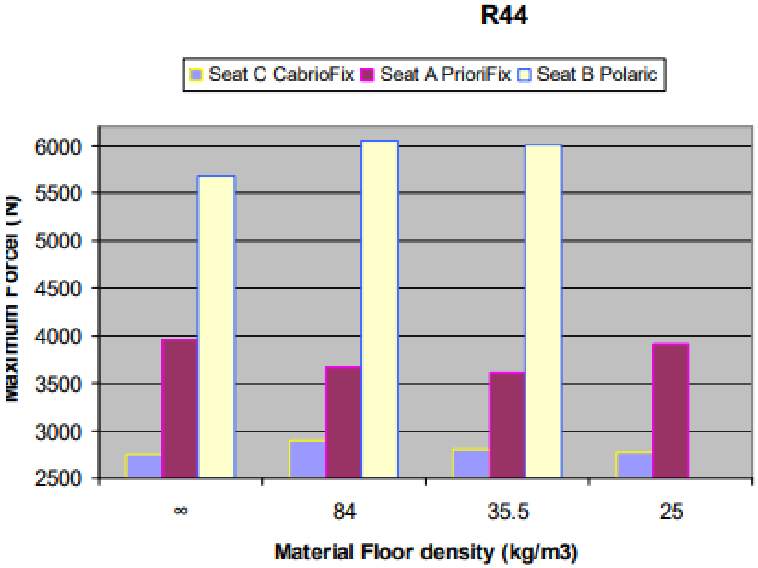
Pulse	Seat	Anti-rotation	Dummy	Lower Isofix anchorage				SL/TT
				X	Y	Z	Res	
R44	C	TT	P3	2383	126	640	**2418**	**3870**
R44	C	/	P3	3370	233	825	**3468**	/
R44	A	SL	P1,5	2668	/	1005	**2847**	**3699**
R44	B	SL	P3	2549	/	1969	**3221**	**4065**
Euroncap	A	SL	Q1,5	2911	/	851	**2968**	**3119**
Euroncap	B	SL	Q3	3465	/	1822	**3761**	**4622**

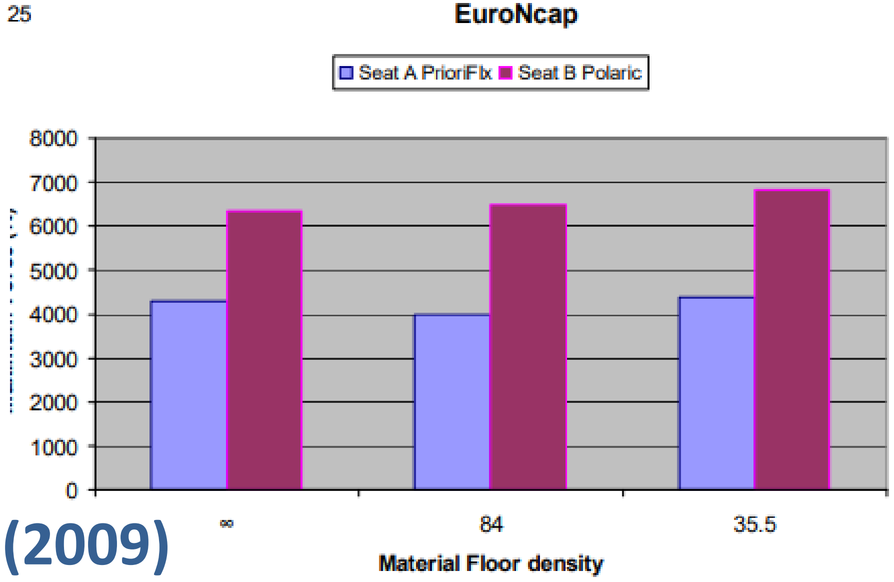
Force measured in N

UN IWG Document CRS-07-03 (2008)

FURTHER TESTS WERE DONE WITH DIFFERENT FLOOR PROPERTIES

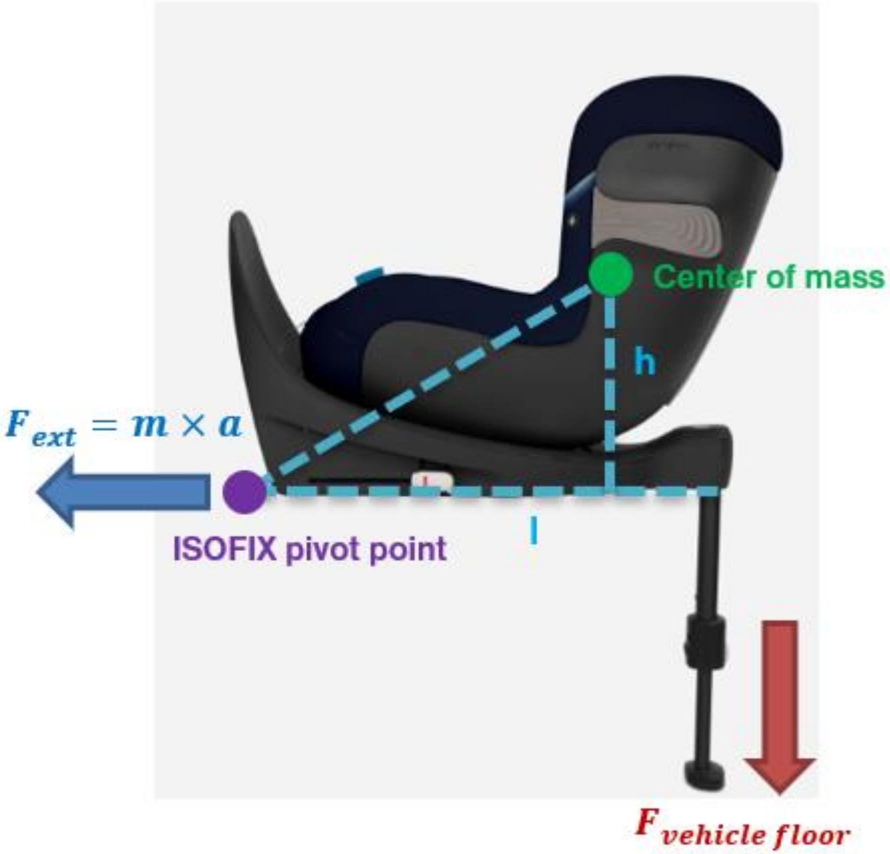






UN IWG Document CRS-13-05 (2009)

WHAT INFLUENCES THE FORCES GENERATED BY THE SUPPORT LEG?



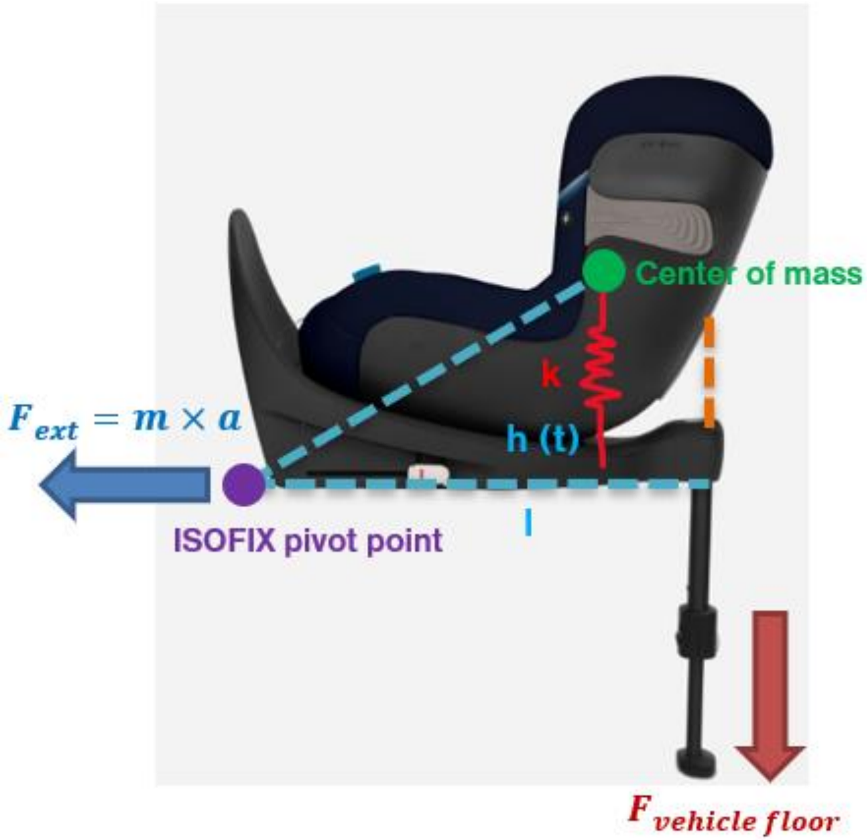
- **Assumption:** Rigid system without slack, support leg perpendicular to floor and horizontal test bench
- Then, the force on the vehicle floor can be estimated to be:

$$F_{vehicle\ floor} = \frac{h}{l} \times m \times a$$

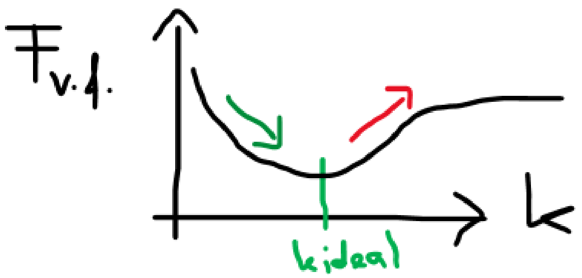
Where: h is height of center of mass over horizontal plane through ISOFIX pivot point
l is distance between support leg and pivot point
m is CRS mass
a is sled acceleration

- R129 provides upper limits for l, m and a but does not regulate h (the only upper bound is the height of the envelope)
- **Variation in the force on the vehicle floor is inevitable in real CRS products**

WHAT EFFECT WILL INCREASING THE SUPPORT LEG VOLUME HAVE?



- **Assumption 2:** A spring with spring constant k accounts for flexibility between seat and base
  - h(t), becomes a function of time and the simple static estimation for the force on the floor is no longer valid
- Extending the support leg height to directly support the seat will lead to a stiffer response with higher k.
- Whether this increases or decreases $F_{vehicle\ floor}$ is not certain
- This is because there is a finite k_{ideal} that minimizes $F_{vehicle\ floor}$ for a given F_{ext}.
  - If the extended support leg brings k closer to k_{ideal}, $F_{vehicle\ floor}$ decreases, otherwise it increases



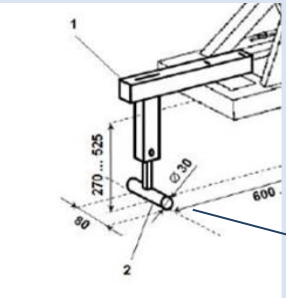
SUMMARY

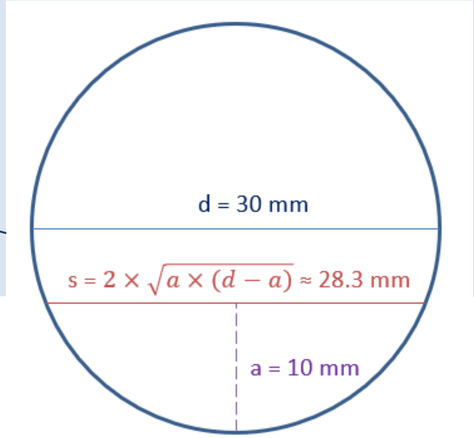
- R145 specifies a static 8 kN ‘pull test’ – vehicle floor failure is allowed
  - R145 static test generates floor forces of 3.2 to 3.6 kN
  - CRS dynamic tests generated floor forces of 4 to 6 kN - **regulators were aware of this when setting the R145 requirements**
- Not all CRS design factors that influence floor forces are regulated – product diversity is inevitable, but hasn’t led to real-world problems
- Increasing the support leg height (or allowing support legs on boosters) could increase or decrease the floor loading depending on other CRS design factors

Annex 5 (UN R45.00. Cor.1)

Notes to SFAD (Figure 3)

3. The support leg foot shall consist of a cylinder, having a width of 80 mm, a diameter of 30 mm and on both side faces rounded edges with a 2.5mm radius.





Contact Area
$= \text{s} \times 80\ \text{mm} \approx \boldsymbol{2263\ mm^2}$

6.3.5.3. (UN R129.03. Supp.6)

Support-leg foot dimensions

The dimensions of the support-leg foot shall meet the following requirements:

a) Minimum support-leg contact surface shall be **2,500 mm^2**, measured as a projected surface 10 mm above the lower edge of the support-leg foot (see Figure 3(d));

b) Minimum outside dimensions shall be 30 mm in the X’ and Y’ directions, with maximum dimensions being limited by the support-leg foot assessment volume;

c) Minimum radius of the edges of the support-leg foot shall be 3.2 mm.