

$$\begin{aligned}x' &= \gamma(x - vt), & x &= \gamma(x' + vt') \\t' &= \gamma\left(t - \frac{xv}{c^2}\right), & t &= \gamma\left(t' + \frac{x'v}{c^2}\right), & v' &= \frac{v_2 - v_1}{1 - \frac{v_1 v_2}{c^2}} \\ \gamma &= \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}, & p'_x &= \gamma\left(p_x - \frac{vW}{c^2}\right), & W' &= \gamma(W - vp_x) \\ x &= x' \frac{(\gamma - 1)(\vec{x} \cdot \vec{v})}{v^2} - \gamma vt', & t' &= \gamma\left(t - \frac{\vec{x} \cdot \vec{v}}{c^2}\right), & u(r, t) &= C_1 \frac{f(r - vt)}{r} + C_2 \frac{g(r + vt)}{r} \\ u(r, t) &= \frac{\hat{u}}{\sqrt{r}} \cos(k(r \pm vt)), & \vec{E} &= \frac{Q}{4\pi\epsilon_0 r^2} \frac{(1 - B^2)^{3/2}}{(1 - B^2 \sin^2(\theta))^{3/2}} \\ \vec{E}' &= \gamma(\vec{E} + \vec{v} \times \vec{B}), & \vec{B}' &= \gamma\left(\vec{B} - \frac{\vec{v} \times \vec{E}}{c^2}\right)\end{aligned}$$



Rebound UN-R16

Definition of rebound phase in UN-R16 dynamic test

Bauke ter Steeg

Rebound R16 dynamic test

Background

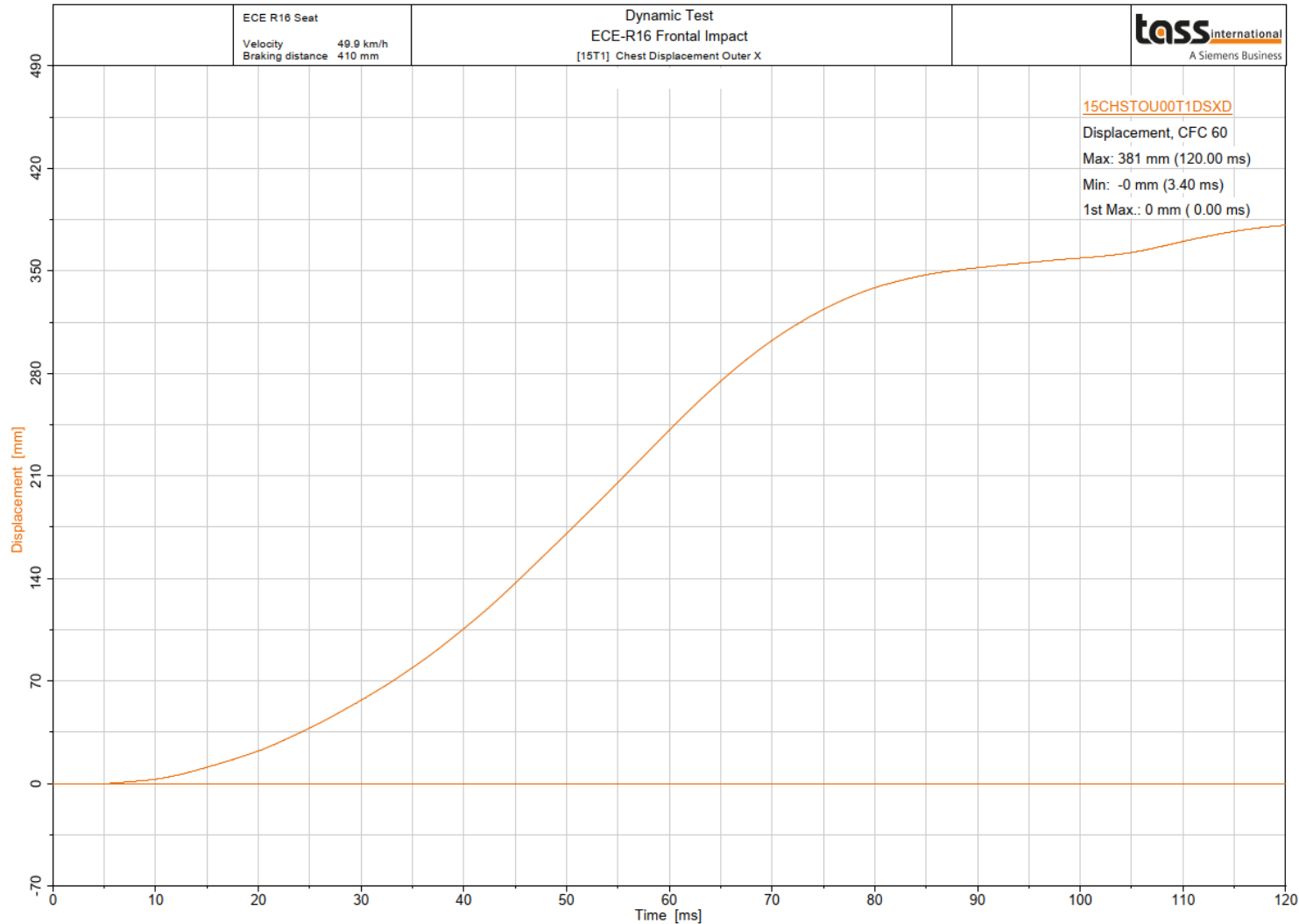
R16 dynamic test with seat belt equipped with load limiter shows:

- Increased level of chest displacement
- Chest displacement continues to rise after impact (at low-speed)

UN-R16 does not describe the max. duration of the dynamic test

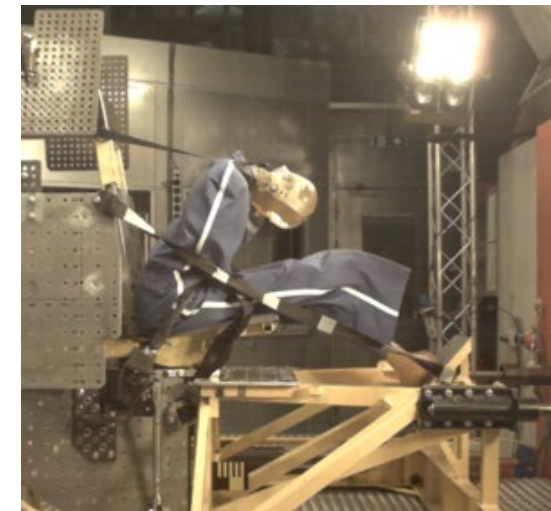


Rebound R16 dynamic test



Plot of chest displacement during dynamic test seat belt with load limiter

Chest displacement continues to rise after the actual test phase due to dummy is 'hanging in the seat belt'



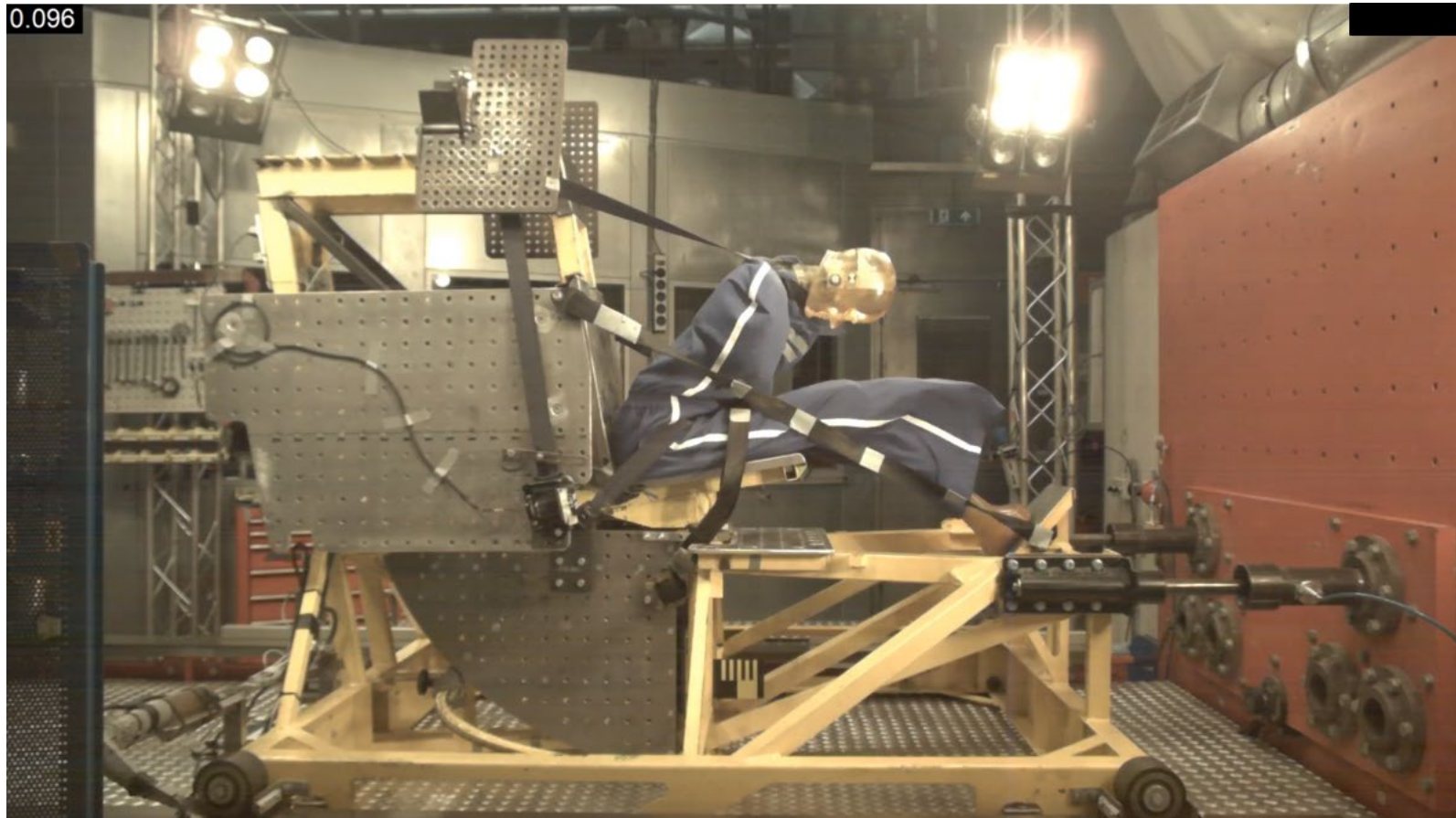
Rebound R16 dynamic test



This may result in excessive chest displacement which is **not the result of the dynamic test itself** but due to low-speed movement of the upper body occurring during the rebound phase.

- UN R16 does not describe the max. duration of the dynamic test.

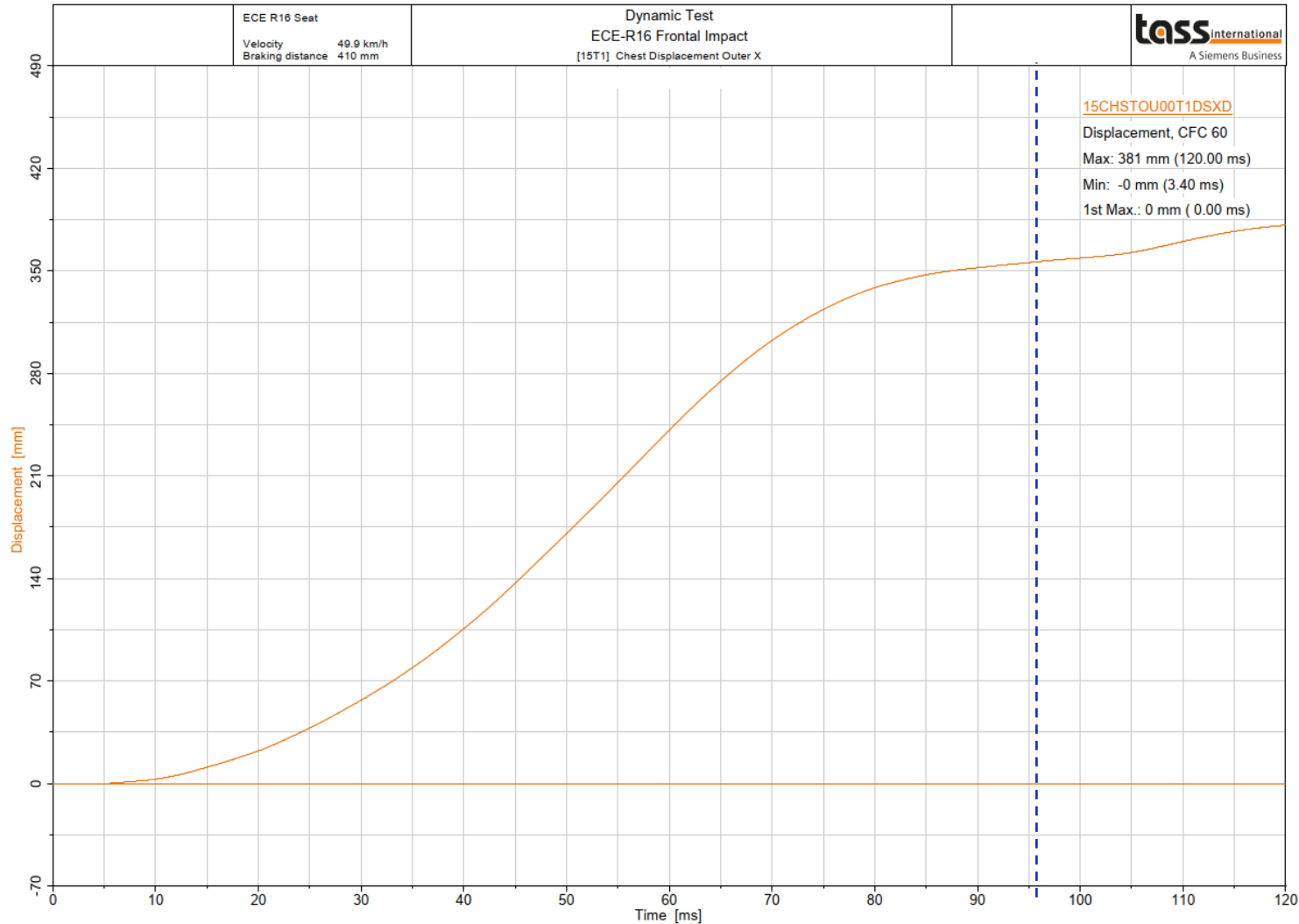
Rebound R16 dynamic test



Proposal:

- Define the judgement phase up to the point where the **manikin contacts the seat back during its backward movement** after impact
- This is at 96ms in this example, derived from contact sensors on seatback

Rebound R16 dynamic test



Proposal:

- Define the judgement phase up to the point where the **manikin contacts the seat back during its backward movement** after impact
- This is at 96ms in this example, derived from contact sensors on seatback:
- Test ends at 96ms