Multipoint chest deflection measurement with RibEye in the Hybrid III

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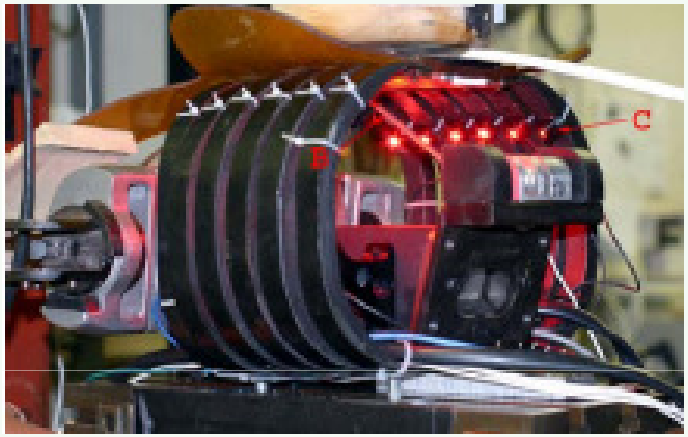
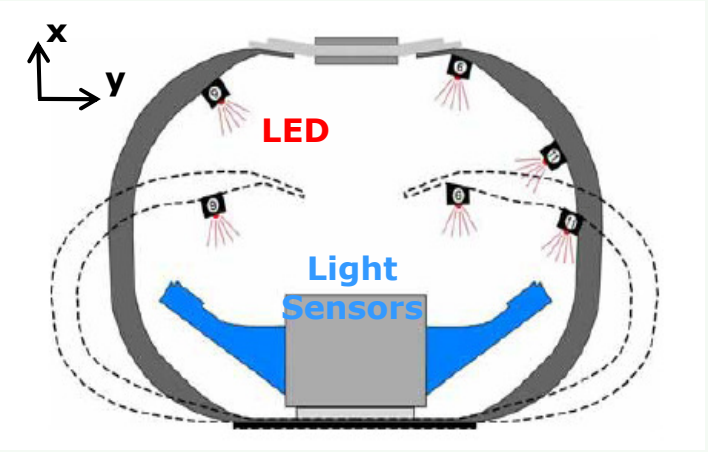
Bundesanstalt für Straßenwesen
(Federal Highway Research Institute)

Basic Information on the RibEye System

- Optical measurement device based on incident angle of light on optical sensors triangulation
- Possible to use in parallel to standard uniaxial chest potentiometer
- 2-axial system with 12 measurement points capable of measuring X- and Y-axis deflection using 2 light sensors
- Available for Hybrid III 50%, Hybrid III 5%





Motivation to use multipoint chest deflection measurement in Hybrid III

Some known limitations exist with the current test tool Hybrid III

- Maximum chest deflection measured by standard chest potentiometer in HIII can be influenced by seat belt routing
- Injury risk due to different load distribution on chest can not be assessed by current single point measurement

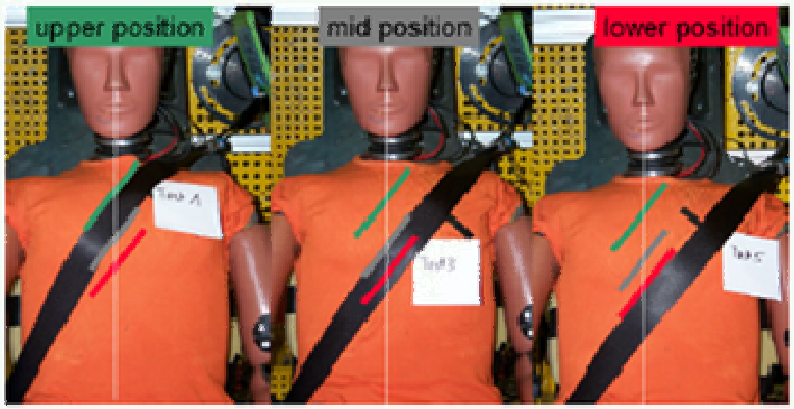
The THOR dummy will most probably address these limitations. However, depending on the status and availability of THOR, Hybrid III with multipoint chest deflection measurement could be an intermediate solution to these problems

Motivation to use multipoint chest deflection measurement in Hybrid III

- Peak deflection measured by chest potentiometer is significantly reduced for high belt routing

Belt Path Sensitivity

Result of dynamic tests: lowest chest deflection for upper pos. belt path

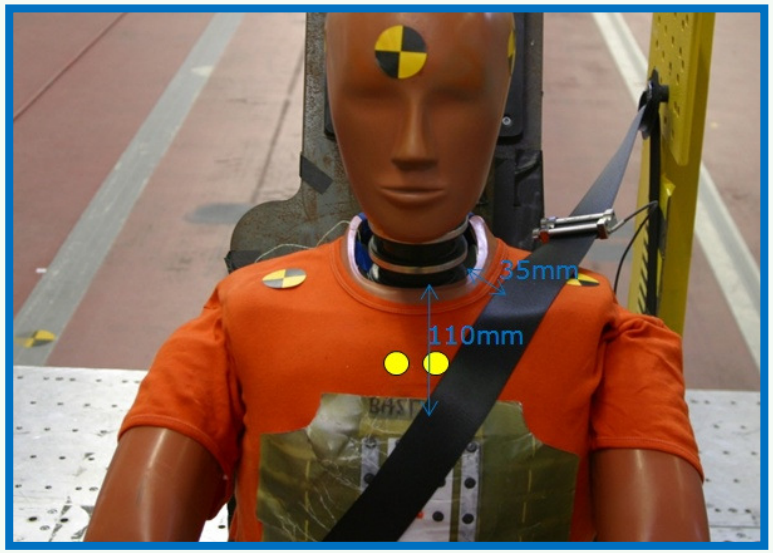


Chest deflection:

upper pos.:	21 mm
mid pos. :	36 mm
lower pos.:	39 mm

Source: Zellmer 2010

Investigation of sensitivity to belt routing with RibEye

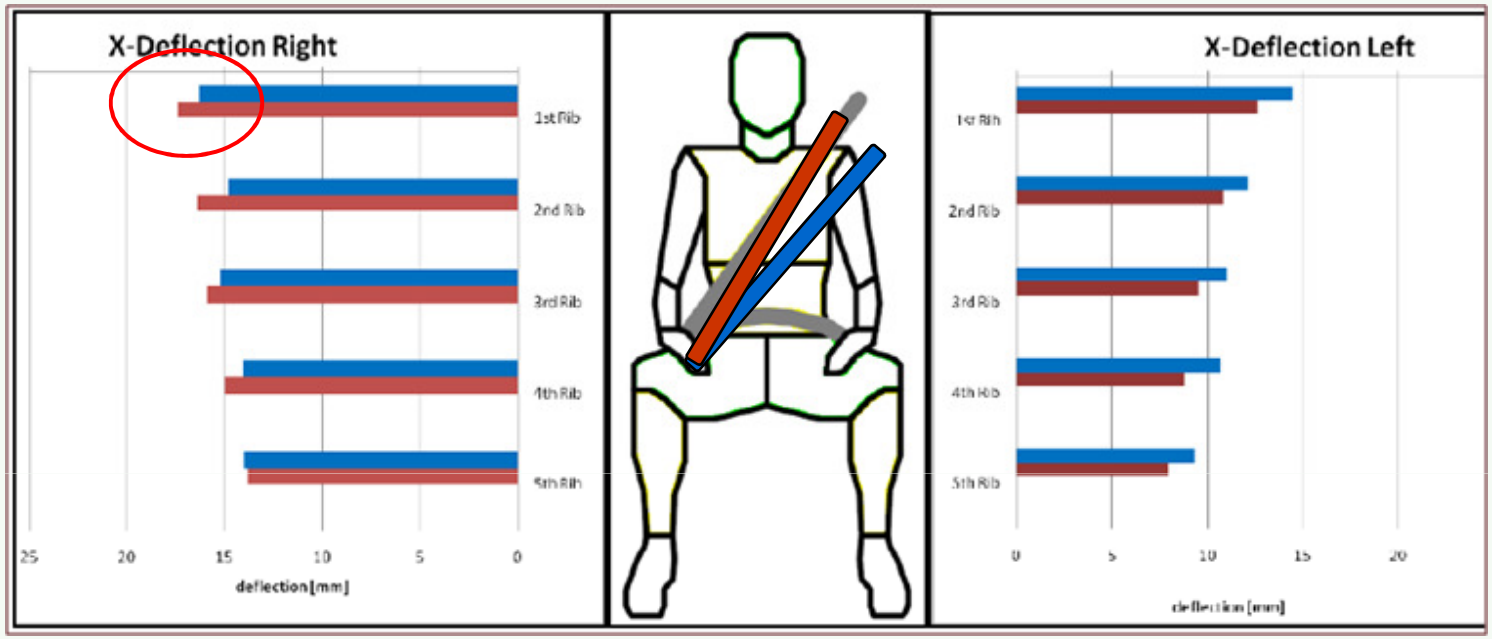


Low belt routing

High belt routing

- Sled tests with belt-only configuration
- Compare high versus low belt routing

Investigation of sensitivity to belt routing with RibEye

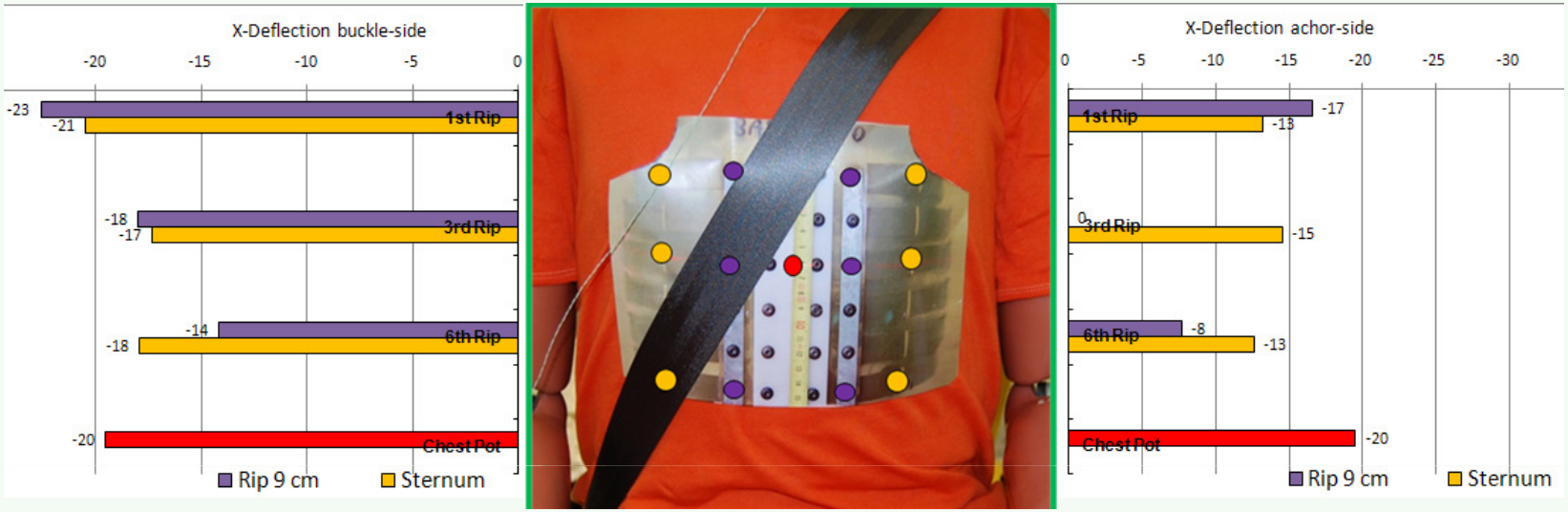


→ **Maximum deflection measured by RibEye increases for higher belt path**

<u>Further observations in this test series:</u>

- For all sled tests at BASt peak RibEye deflection was observed at 1st right rib
- Significant difference between left and right as well as 1st and 6th rib (indication of asymmetric load distribution)

Maximum rib deflection detected by RibEye in Euro NCAP tests



Rib deflection for passenger in 64 km/h ODB Euro NCAP test

→ In most Euro NCAP tests maximum peak deflections measured by RibEye are equal or higher (10 to 15%) than chest potentiometer deflections (depending on belt routing)

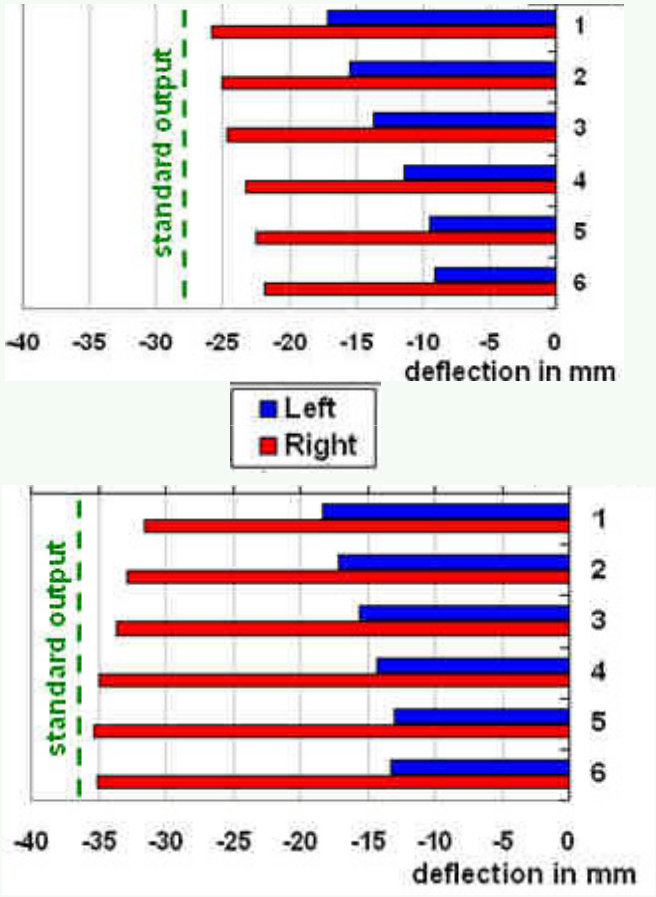
→ RibEye peak deflection can show the actual maximum chest deflection!

Results of other studies with RibEye

- Tests presented by Eickhoff et al., ESV 2011
- Belt only sled test series with HIII with RibEye (different belt geometry/ buckle position)
- Maximum deflection was observed at 1st rib level (see upper figure) or at 6th rib (see lower figure) depending on belt system geometry!

→ RibEye data can indicate **load distribution between left and right** half of chest as well as **upper and lower part**

→ RibEye can show the location of actual maximum peak rib deflection (at 1st or 6th rib level)



Conclusion

- Multipoint measurement with RibEye can be used to always **detect the actual maximum chest deflection** independent of belt routing!
- The maximum of RibEye peak value or chest potentiometer could be used with current (or reduced) injury limits as first step
- Possibility of RibEye to show **asymmetric deflection** has been shown
- Biomechanical injury criteria (based on asymmetry / load distribution) have potential, but will need more time and effort

Thank you for your attention!

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