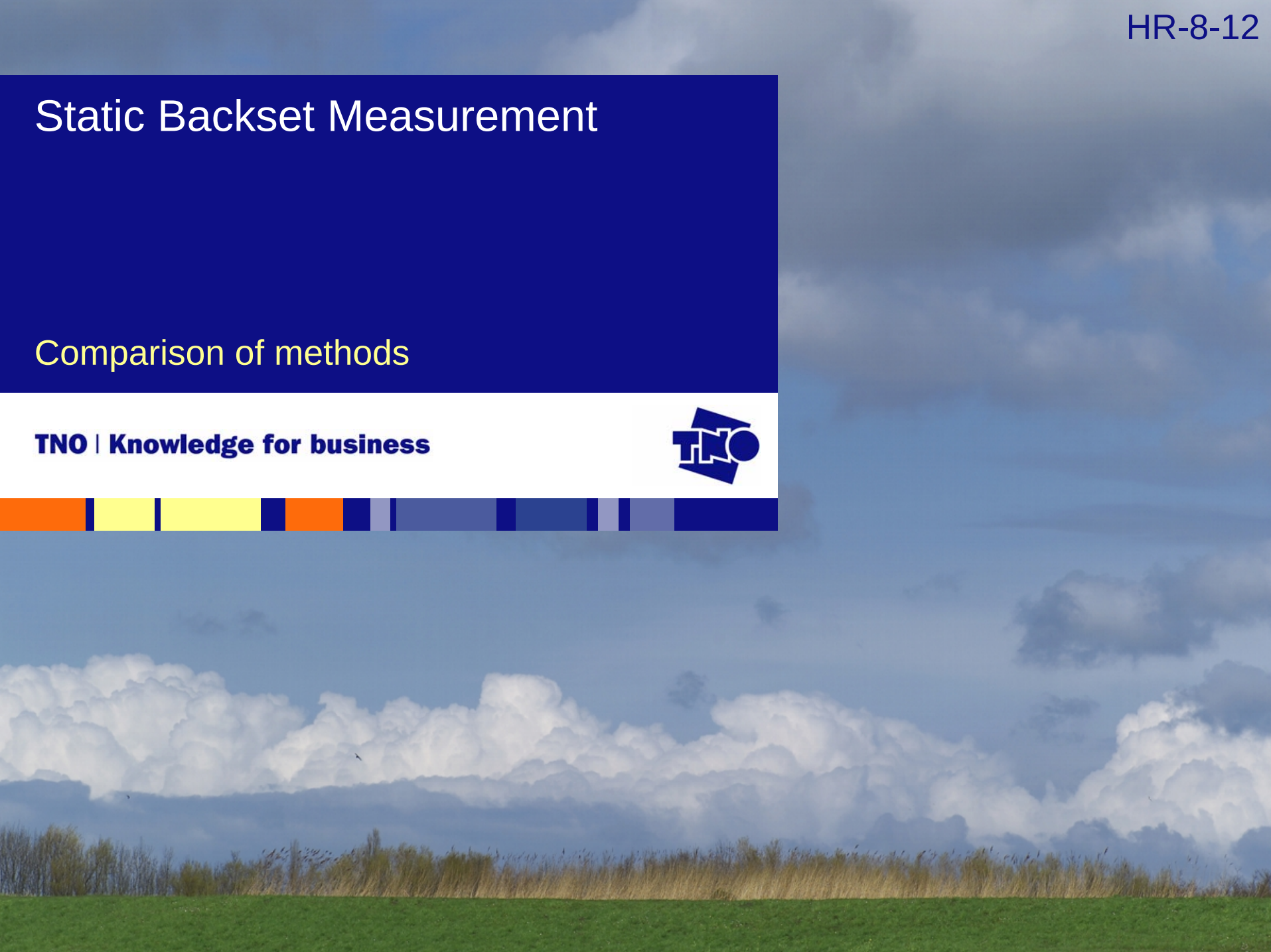
Static Backset Measurement

Comparison of methods

TNO | Knowledge for business



Aims

- Comparison of static backset measurement of head restraints
- Evaluate EuroNCAP protocol
- Evaluate UTAC alternative
- Recommendations for a method

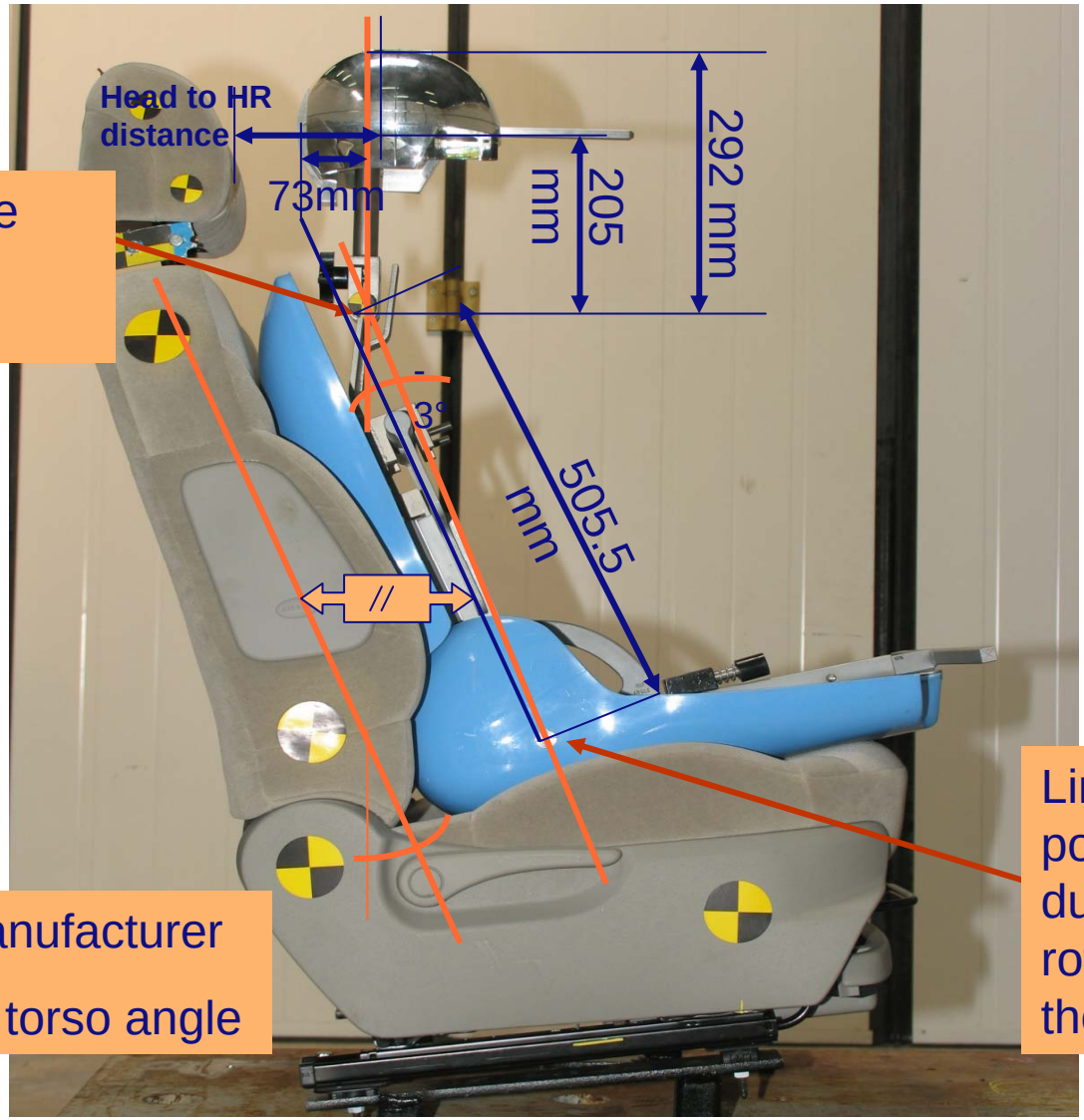
Methods

Measure backset using five methods

- Proposed EuroNCAP protocol using
  - H-point SAE Manikin (OSCAR)
  - Head Restraint Measuring Device (HRMD)
  - No preload to head restraint
- Proposed EEVC WG20 procedure
  - Similar to EuroNCAP, but with 10 N preload to backset probe
- Alternative proposal from UTAC (not used in the end)
  - Explained in next pages
- 3D FARO measurement without HRMD
  - Like UTAC, but seat loaded with SAE manikin
- 3D FARO measurement without HRMD, without SAE manikin
  - Like UTAC without preload
  - Like UTAC with 10 N preload to backset probe

UTAC proposal: replace HRMD with 2 link bar

rotation point of the HRMD to align it horizontally

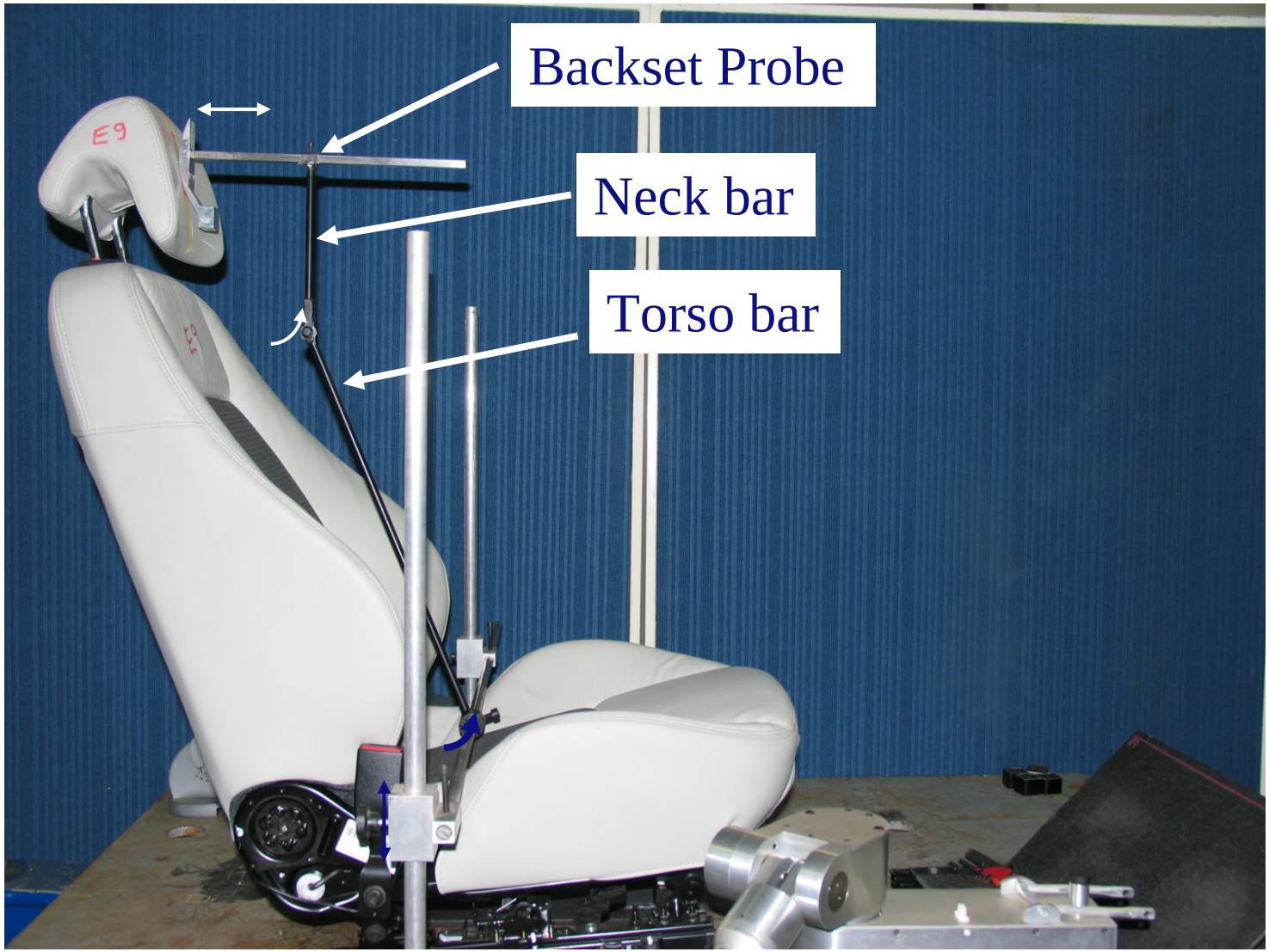


Car manufacturer

design torso angle

Line through H-point of the dummy and rotation point of the HRMD

UTAC proposal, simplified tool



UTAC proposal made even more simple

- Use SAE manikin to determine H-point (or start from R-point in the car) and seat back angle
- Measure H-point on 2 sides of manikin with 3D FARO arm
- Determine:
  - Probe height which is needed for backset measurement
  - Virtual location of the back of the HRMD head
  - Using mathematical equations + manikin and HRMD dimensions
- Adjust the probe to calculated height

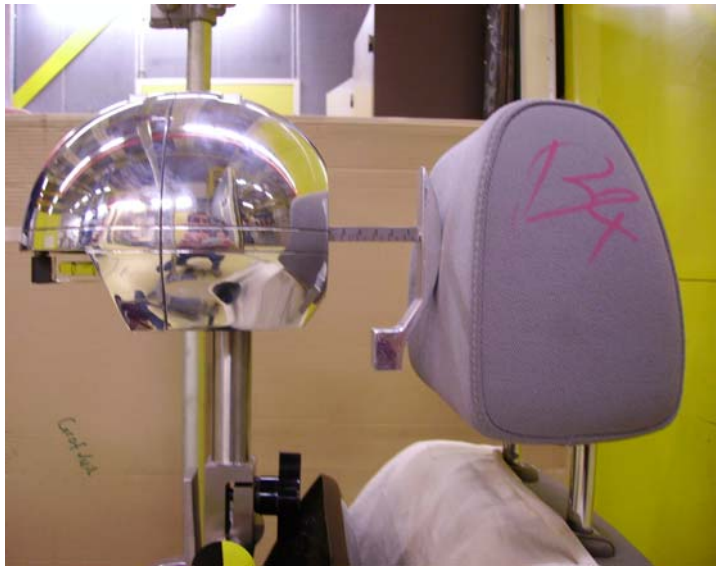
- Push probe against the head restraint (3 methods evaluated)
  - With SAE manikin in the seat, without probe preload
  - Without SAE manikin, without probe preload
  - Without SAE manikin, with 10 N probe preload
- Measure backset with 3D FARO arm

Comments to UTAC proposal

- Method should work fine, but the values found were different from those proposed by UTAC
  - Average distance from H-point to HRMD rotation point was 505.9 mm (TNO) instead of 505.5 mm (UTAC)
  - Average angle difference between seat back angle and line through H-point and HRMD rotation point was -1.9 deg (TNO) instead of -3 deg (UTAC)
  - Ending up with backset differences of 13 -15 mm
- Of course these values are related to combined SAE machine and HRMD!
- Standardising the analytical values solves these problems and does not interfere with any combinations of these tools!

- For the static measurements presented here, the height of the probe as measured with HRMD was taken for valid comparison

Test rigs: HRMD and Portal
Measurements done with FARO

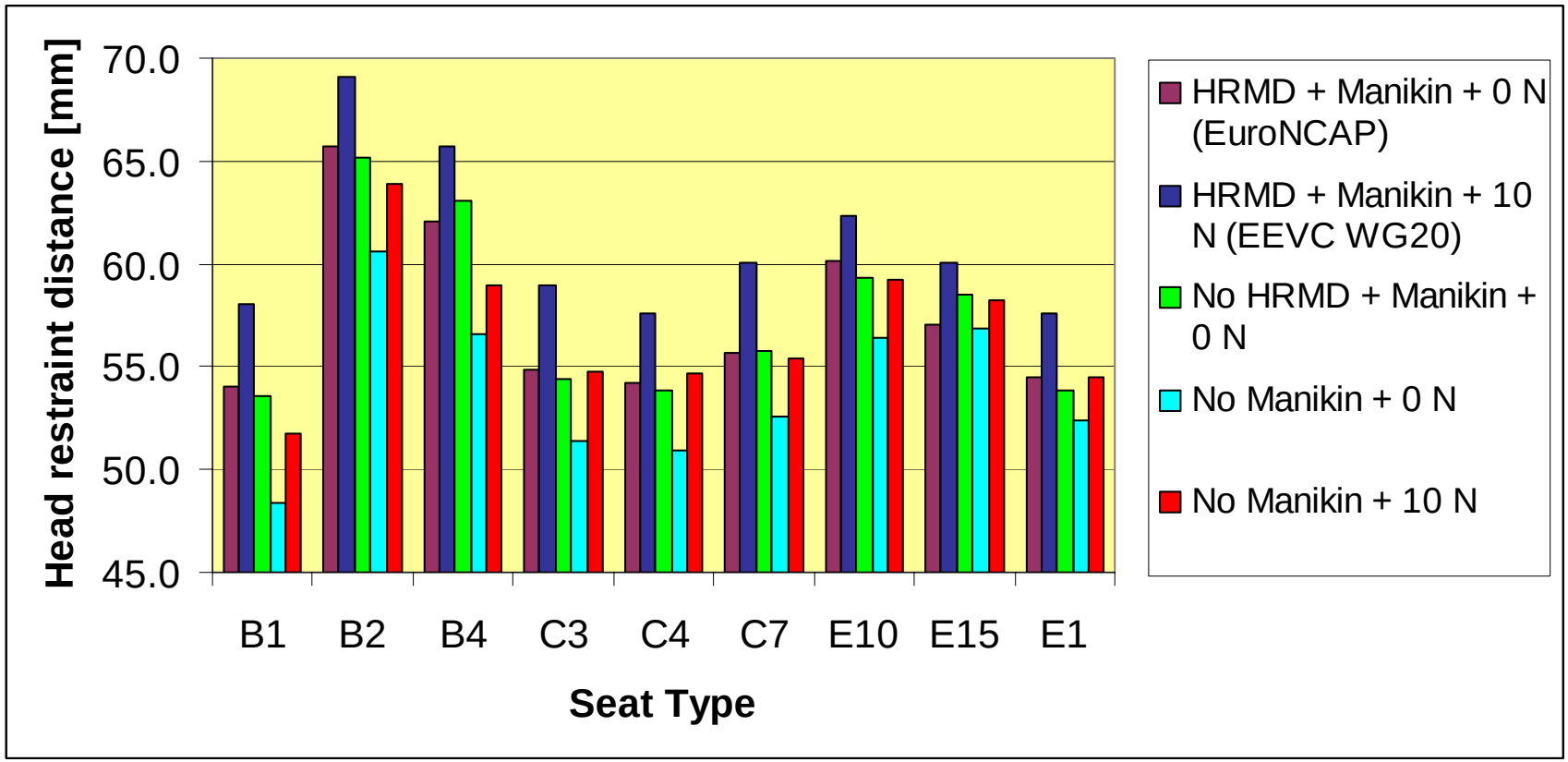


- Regular measurement
- With SAE manikin and HRMD
  - Without preload (EuroNCAP)
  - With preload of 10 N (EEVC)

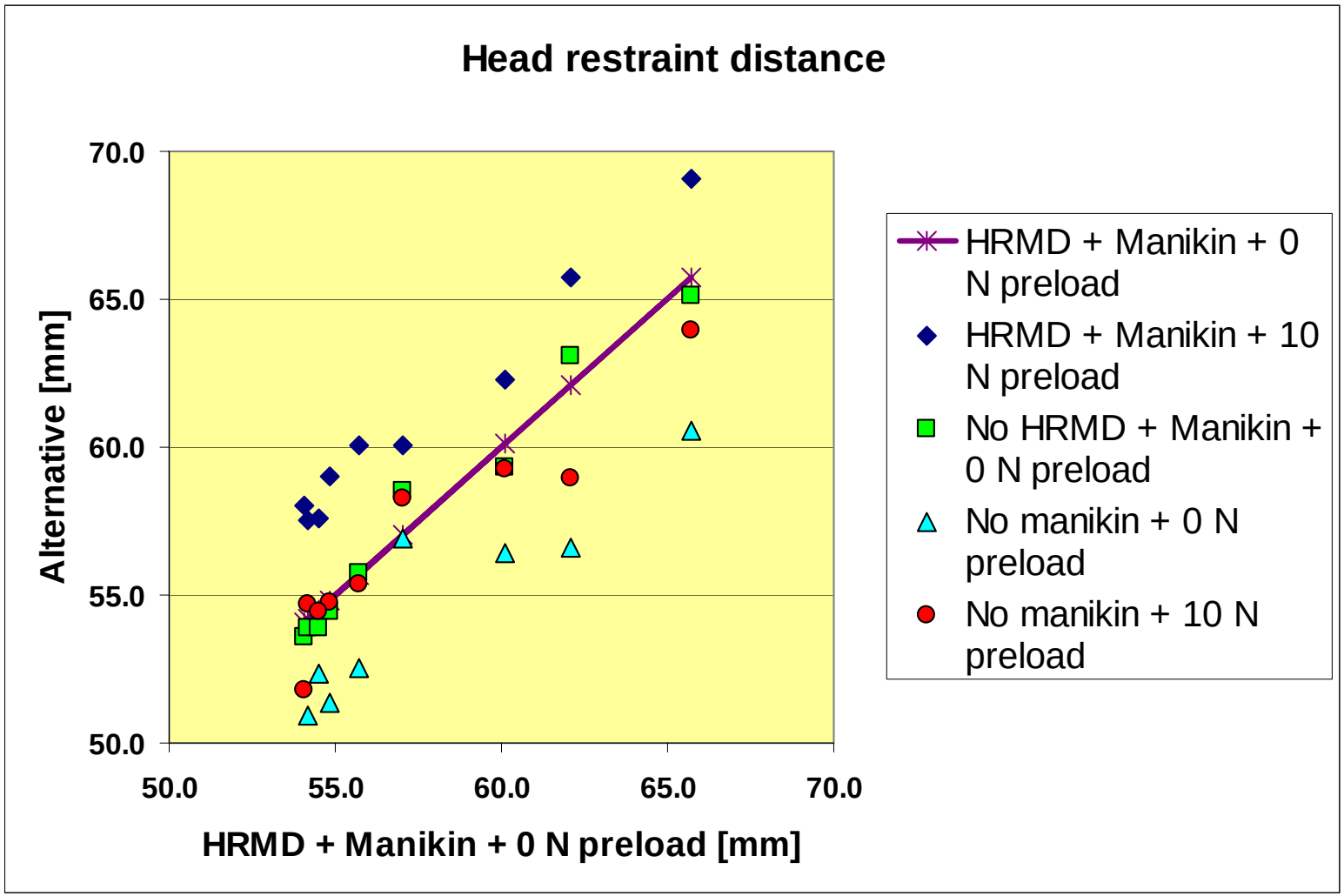
- Portal measurement @ height of HRMD
- With SAE manikin loading seat
- Without manikin
  - Without preload (UTAC)
  - With preload 10 N for comparison

Comparison of methods

- Largest difference is between seats of one type, not method used



Comparison with EuroNCAP method (1)

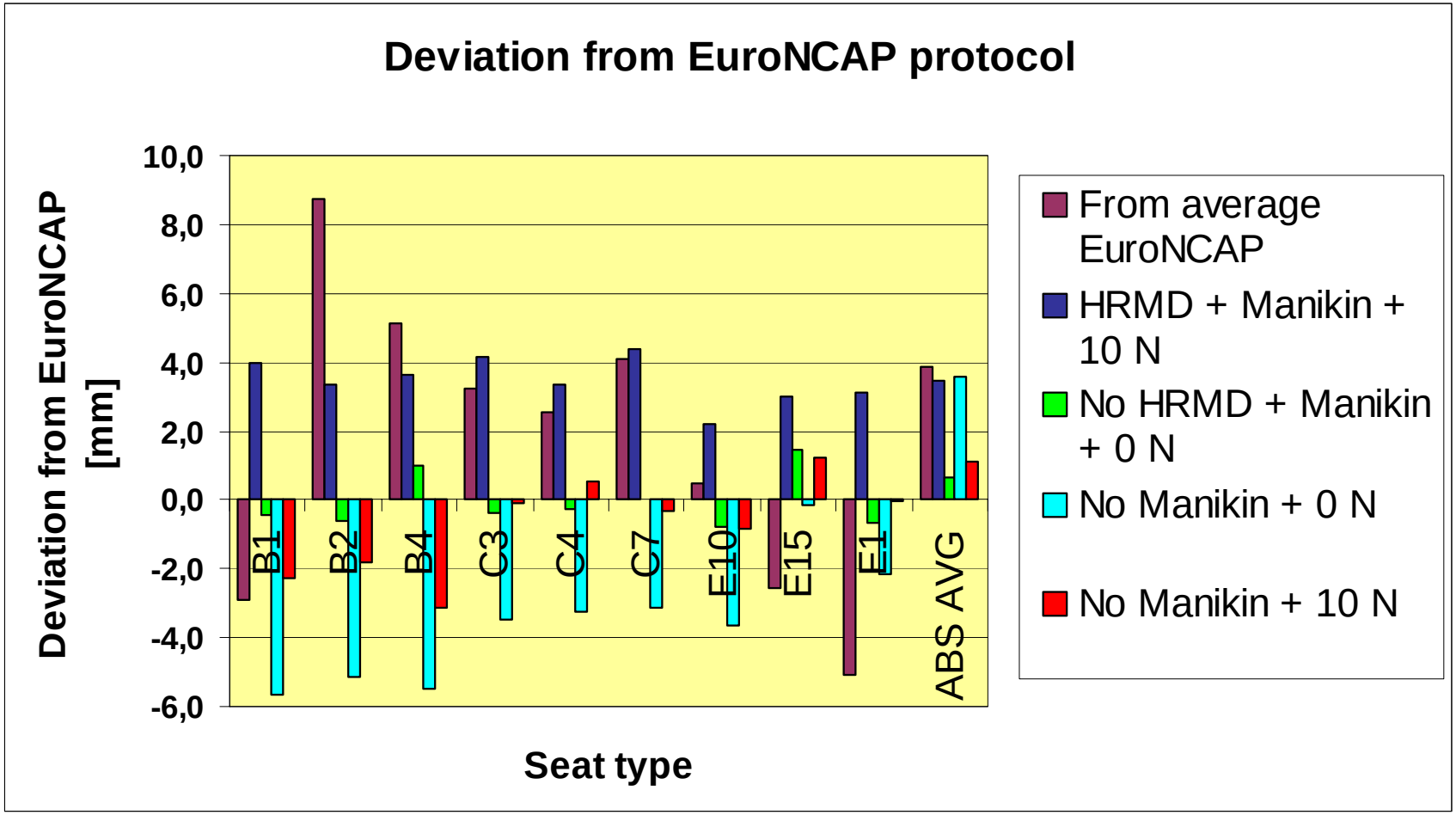


Comparison with EuroNCAP method (2)

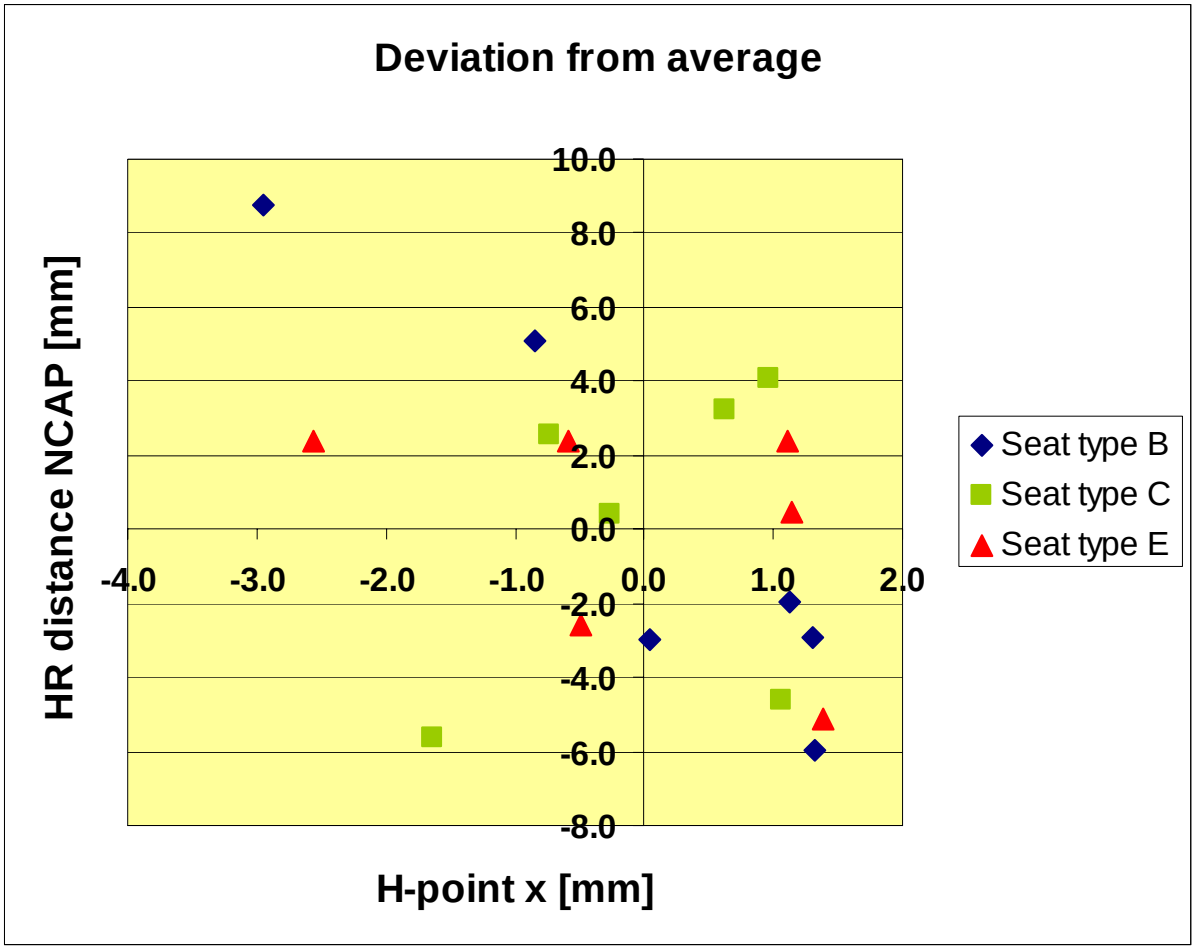
- Applying 10 N preload is used to prevent very soft head restraints. This always increases the head restraint distance measurement by average 3.5 mm.
- Not using the HRMD, but with the SAE manikin in the seat decreases the head restraint distance by average 0.1 mm (average absolute deviation is 0.6 mm). Not significant!
- Not loading the seat with a manikin decreases the head restraint distance by average 3.6 mm
- Applying a 10N preload with an unloaded seat causes a decrease of 0.7 mm with respect to the EuroNCAP measurement

- The error within one seat type (3 seats) is 3.8 mm on average
- This means that all deviations are within the range of measurements of one seat type

Comparison with EuroNCAP method (3)

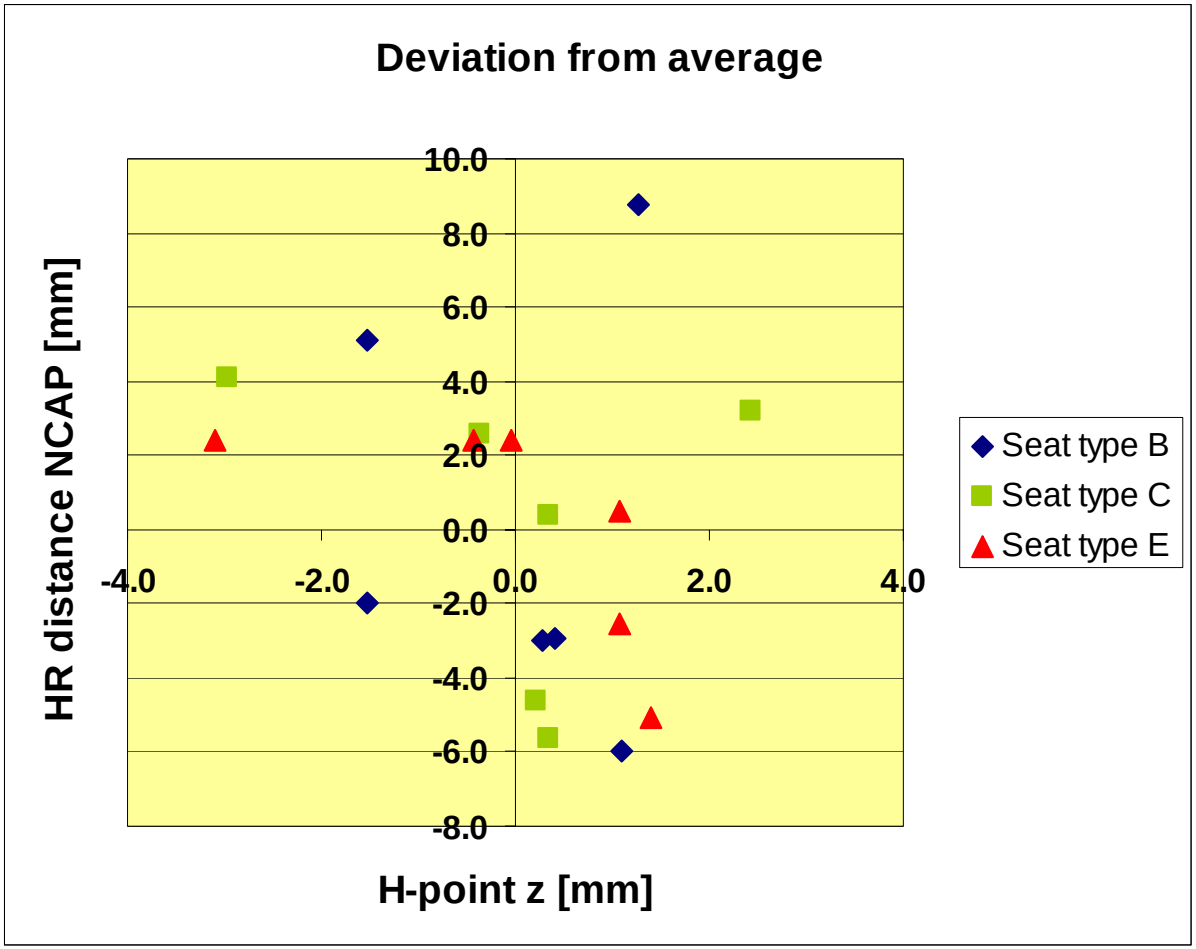


Causes of head restraint distance variations: H-point x location



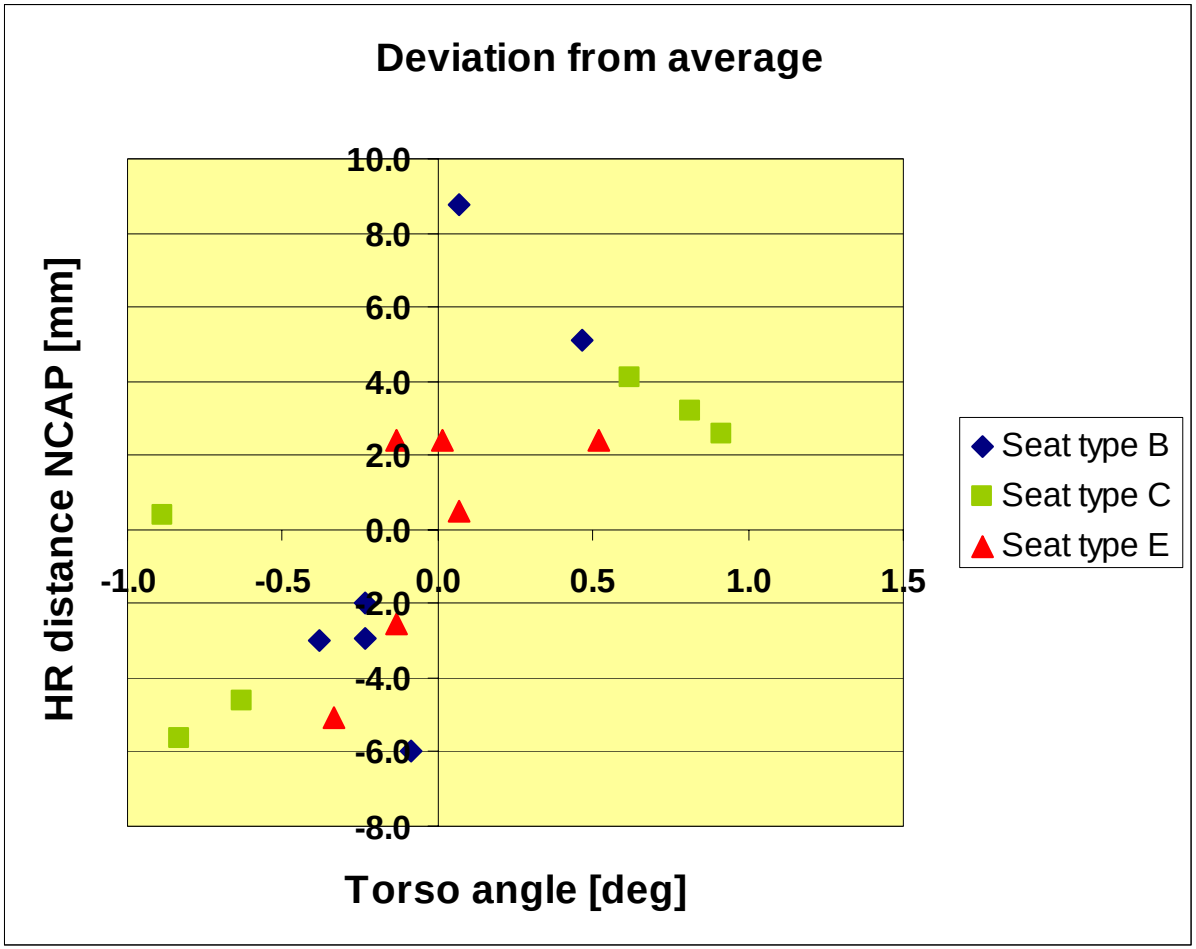
- Seat C and E: no influence of H-point x with HR distance
- Seat B: Increasing H-point x ~ decreasing HR distance

Causes of head restraint distance variations: H-point z location



- Seat B and C: no influence of H-point z with HR distance
- Seat E: Increasing H-point z ~ decreasing HR distance

Causes of head restraint distance variations: Torso angle



- Seat B, C and E: Increasing angle ~ increasing HR distance

Main results summary

- The deviation caused by the seat (of one type) and SAE positioning (reproducibility) is larger than the deviation caused by a change of measurement method.
- Head restraint distance varies with
  - Seat back angle
  - H-point location
- This relation is not similar for all seat types.
- Small differences in H-point location (within specs) may result in large changes of the head restraint distance
  - Example Seat B: H-point location ranges from -3 to +2 mm, but HR distance -6 to +9 mm

Conclusions

- Measurement method is not mainly determining head restraint distance
- SAE manikin positioning has large influence on head restraint distance
- Need for more tight requirement on SAE manikin positioning or use more straightforward point in car, like R-point

- No preference for any method with regard to current results
- UTAC method is more straightforward, not more accurate
- UTAC method cannot be varied easily for different occupant sizes

- Preference for simple (analytical) method