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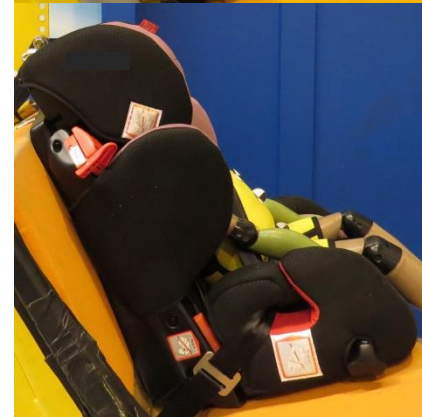
Recommendations for setting dummy injury thresholds for Regulation 129 Phase 2 regarding chest & abdomen loading

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Child Safety Informal Working Group, April 2016



Background

- Work has been conducted on behalf of the European Commission to investigate and validate proposals for Phase 2 of Regulation 129
- Phase 2 - “non-integral” child restraint systems, where a child is positioned on a child seat, but essentially wearing the vehicle seat belt
- Key injury mechanisms for non-integral seats are:
 - Head contact
 - Chest loading
 - Abdomen loading
- Head accelerations & excursions measured as in Phase 1
- Abdomen and chest limits proposed but not validated in R129 test environment



Abdomen Loading – Objective

Propose solutions that improve the capacity of UN Regulation 129 to differentiate between non-integral child restraint systems

Abdomen Tools

- Validate a solution for preventing penetration of the lap part of the seat belt into the gap between the legs and the pelvis (and its implications for the assessment of abdomen injury protection)

Injury Thresholds

- Validate proposed injury criterion:
 - Q10 – 1.2 bar
 - Q6 – 1.2 bar
 - Q3 – 1.2 bar



Abdomen Loading – Tool Recommendations

Hip Liner

- **Q-Series dummies should be used with Humanetics hip liners to prevent belt entrapment**
 - Q6 hip liner exists & was validated



- Q3/Q10 in development (validation still required)

Abdomen Sensors

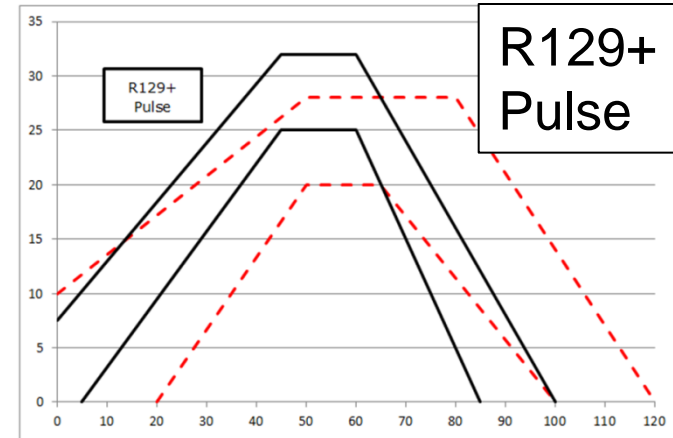
- **Q-series dummies should be used with Humanetics abdomens with moulded slots for APTS**
 - Q10 used 50mm APTS
 - Q3/Q6 used 40mm APTS



Abdomen Loading – Test Condition Recommendation

Test conditions had an influence on submarining:

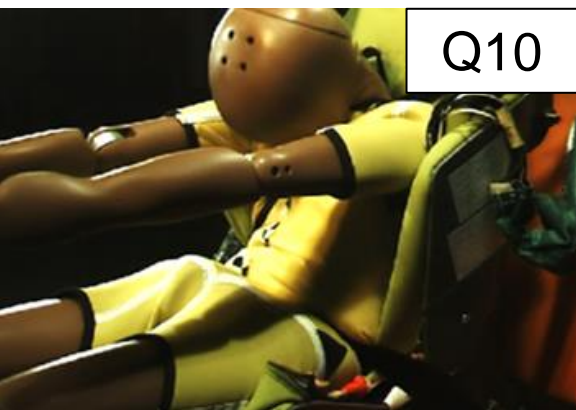
UMTRI seating procedure:
 Dummy initially slouched &
 Belt tension $\approx 15\text{N}$



Test Condition	Q10 Submarines	Q6 Submarines	Q3 Submarines
R129	Y	Y	N
R129+ Pulse	Y	Y	N
UMTRI seating	Y	Y	N
R129+ Pulse & UMTRI	Y	Y	Y

Conclusion: R129+ & UMTRI - All 3 dummies submarined

Abdomen Loading – Injury Criterion Recommendations



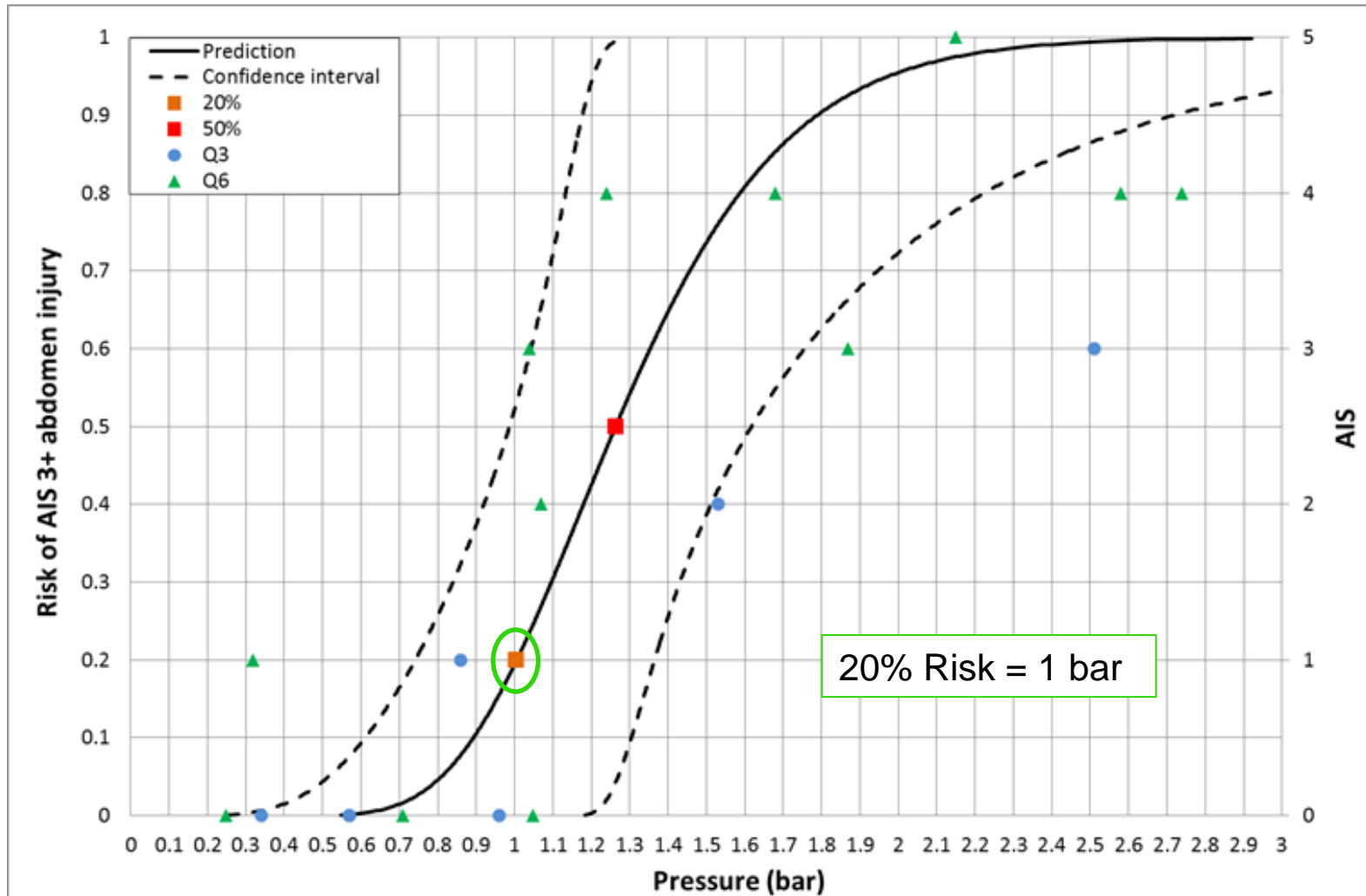
Submarining was observed with various pressure measurements:

Dummy	Q10	Q6	Q3
Minimum pressure (bar) measured when submarining occurs (Left / Right)	1.32 / 1.40	0.93 / 0.93	1.06 / 0.95

Recommendation: Q10 – 1.2 bar
 Q3/Q6 – submarining can occur & sensors measure less than 1.2 bar
 Recommend lower limit to 1 bar

Abdomen Loading – Injury Criterion Recommendations

- Risk of AIS 3+ abdomen injury, created from Beillas (2012a) data



Abdomen Loading – Recommendations for R129

- Dummy tools:
 - Q-series dummies should be used with Humanetics hip liners to prevent belt entrapment:
 - Q3 and Q10 versions need to be made 'production-ready' by Humanetics
 - Q-series dummies should be used with Humanetics abdomens with moulded slots for APTS
- Test conditions:
 - Use R129+ pulse & UMTRI installation method
 - (allows all 3 dummies to submarine)
- Abdomen loading thresholds:
 - Q10 use 1.2 bar
 - Q3/Q6 revise threshold to 1 bar



Chest loading – Objective

Propose solutions that improve the capacity of UN Regulation 129 to differentiate between non-integral child restraint systems

Situation

- Validate a solution for preventing movement of the diagonal part of the seat belt towards the neck (and its implications for the assessment of chest injury protection)



Injury Thresholds

- Validate proposed injury criterion:
 - Q10 – 56 mm
 - Q6 – 56 mm
 - Q3 – 40 mm
- Investigate setting threshold for clavicle sensor



Chest Loading – Q10 Recommendation

Q10

- Seat belt remains on the shoulder of dummy (no slippage)
- Dummy is able to detect poor belt path as one sensor is severely loaded
- Q10 is able to measure at least 56 mm deflection
- Proposed limit of 56 mm appears appropriate

Conclusion: Adopt 56 mm chest deflection limit



Chest Loading – Q3/Q6 Recommendation

Q3/Q6

- Seat belt slips towards neck
- Chest deflection sensor reaches physical limit before 40 or 56 mm (respectively for Q3/Q6)
- Clavicle sensor detects upper ribcage loading but also reaches physical limit

Conclusion: Q3/Q6 limits not appropriate

Improvements to dummy design are required to improve seat belt interaction



Chest loading – Short Term Recommendation

Torso static belt path assessment based on IIHS method

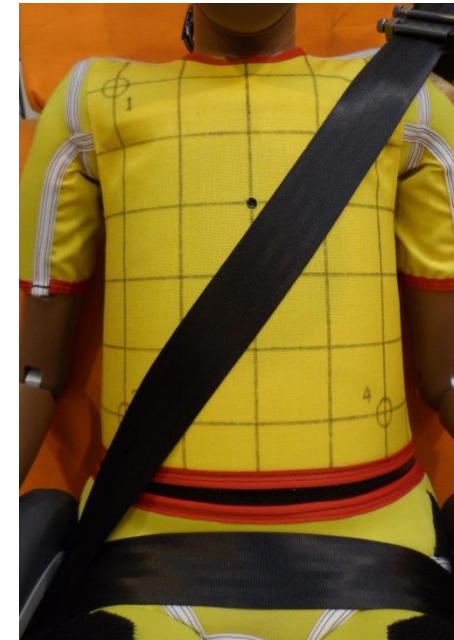
Use for Q3, Q6 & Q10



Too close to neck



Ok



Too wide



Chest loading – Recommendations for R129

- Dummy & instrumentation:
 - Q3/Q6 seat belt slips towards neck
 - Chest or Clavicle deflection bottoms out before limit can be reached
- Chest loading thresholds:
 - Q10 use 56 mm
 - Q3/Q6 threshold will need validating once dummy design is revised
- Torso static belt path assessment should be conducted in short term to ensure poor belt routing is avoided



Summary - Recommendations

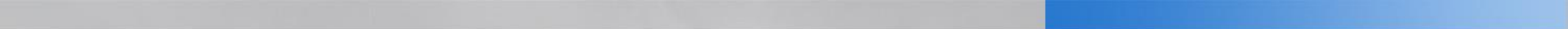
For evaluating non-integral CRSs in R129

Abdomen Loading

- Use Q-Series dummies with hip liner
 - Q3 & Q10 inserts – Expected 2016
- UMTRI installation method should be used
 - More realistic seating position
 - Better differentiation in detecting abdomen loading
- R129+ pulse should be used
- 1.2 bar limit seems only applicable for Q10
- For Q3 & Q6 limit should be revised to 20% risk of injury (1 bar)

Chest Loading

- Q10 limit seems reasonable
- Q3 & Q6 thresholds, not realistic
- Ideally Q3 & Q6 need redesign to avoid belt slippage and allow robust assessment of chest injury risk
- In short term a static belt path assessment could be a solution to ensure poor belt routing is avoided



Do You Have Any Questions?

Thank you

Recommendations for setting dummy injury thresholds for Regulation 129 Phase 2

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