Independent Transport
Research, Consultancy & Testing

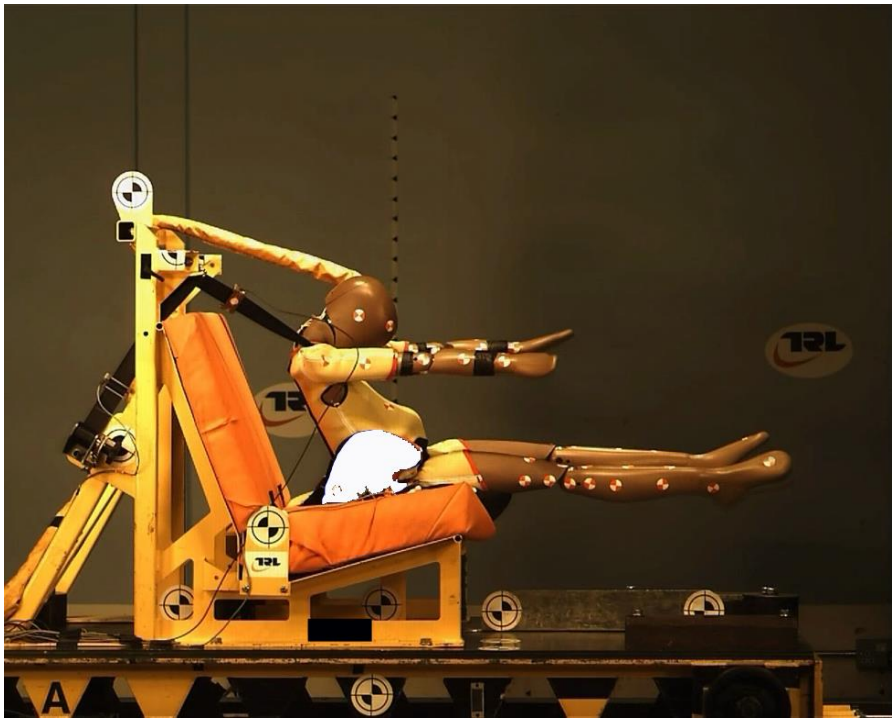
Creating the future of transport

EC child safety project – summary of abdomen results

Prepared by Jolyon Carroll and Mark Pitcher – 27th October 2015

Dummy behaviour

R129 status 2014 - Submarining



Lack thereof

- Difficult to generate submarining with Q-Series dummies in R129 conditions
- Sensors available, but belt does not load them during a test
- Dummy accessories for the Q3 and Q10 did not solve the issue
- Need a soultion
  - Should test conditions be varied?
    - Bench (foam, angle)
    - Anchorages
    - Pulse
  - Alterative pelvis insert
- Need to show that R129 is at least as discerning of this behaviour as R44

Q10

Remember:

- P10 on test bench
- No submarining
- Pelvis well restrained

- CRS-52-07 (DOREL)
- Normal Q10 with conventional hip shields
- No submarining
- Forward movement of pelvis restricted by lap belt

- Q10 with silicon insert from Dorel
- Submarining
- Much larger forward movement of pelvis

Q10

Submarining on the test bench

Testing

- Investigated with different input conditions:
  - R129 conditions
  - UMTRI installation method
  - R129+ pulse - higher severity pulse (TRL report; Hynd et al., 2010)
- With/without poor lab belt guidance CRS
- Used Q10 with:
  - DOREL pelvis insert
  - New Humanetics abdomen
  - 50mm abdominal sensors

Q10

Submarining on the test bench

Test	CRS	Abdomen Sensors	Pelvis Insert	Submarine	Belt in Abdomen	Pressure		
						L	R	Av.
R129	No	Y	Y	**Y**	**Y**	**2.01**	**1.43**	**1.67**
	Poor	Y	Y	**Y**	**Y**	**1.32**	**1.40**	**1.32**
	Good	Y	Y	N	N	0.55	1.15	0.81
	Good	Y	Y	N	N	0.58	**1.21**	0.85
UMTRI	Poor	Y	Y	**Y**	**Y**	**2.41**	**1.31**	**1.84**
R129+	Poor	Y	Y	**Y**	**Y**	**1.94**	**1.32**	**1.63**
UMTRI & R129+	Poor	Y	Y	**Y**	**Y**	**2.62**	**1.44**	**1.99**
	Good	Y	Y	N	N	0.60	1.06	0.83

Proposed limit: 1.2 bar

Q10

Submarining on the test bench

Summary

- Using DOREL insert gives:
  - Submarining without CRS & the belt loads abdomen
  - Submarining with poor CRS
  - No submarining or abdomen loading with good CRS
- When dummy does submarine, sensors measure >1.2 bar
- However some good CRS may still measure >1.2 bar (one one side) due to shoulder belt loading

Recommendations

- Use R129 conditions
  - Average Left & Right Pressure

  or
  - Increase threshold to 1.3 bar

Or

- UMTRI method

Q6

DOREL's pelvis insert concept:

- CRS-50-10e Dorel results with silicon insert
- Impressive new ability for Q6 to submarine

- Tested with and without hip shields
- Suggestion that the Dorel insert negates the need for shields

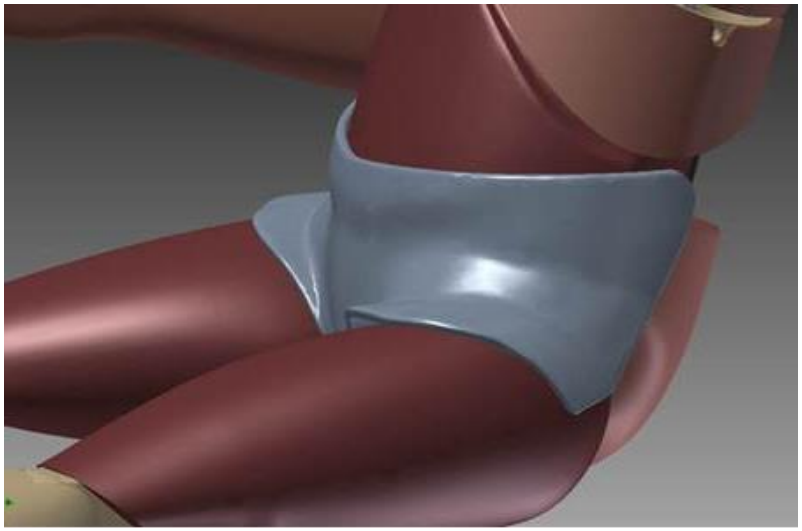
Test configuration	With booster cushion	Abdominal pressure (max in bar)	Submarining
Normal Q6	No	0.61	No
Q6 with Silicone insert from DOREL	No	1.21	Yes
Q6 with plastic insert from HUMANETICS	No	0.83	No
Q6 with silicone Insert from DOREL & plastic insert from HUMANETICS	No	1.64	Yes

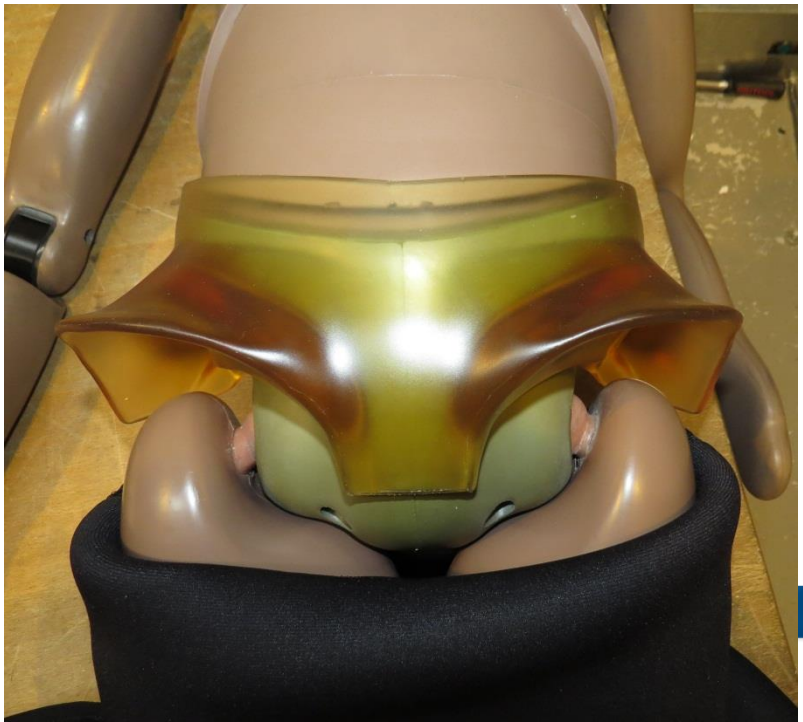
Q6

Evaluation of pelvis insert concept:

Testing

- Following work at Dorel
- Humanetics created a hip liner concept
- Prototype hip liners made available for testing at TRL
- Used Q6 with
  - New abdomen
  - New 40mm abdominal sensors
- Very similar performance between Dorel and Humanetics version of insert
- But… No submarining detected by sensors 0.7-0.9 bar recorded





Q6

Further investigation with Q6:

Testing

- Investigated testing with different input conditions:
  - R129 conditions
  - UMTRI installation method
  - R129+ pulse - higher severity pulse (TRL report; Hynd et al., 2010)
- With/without poor lab belt guidance CRS
- Used Q6 with:
  - New Humanetics hip liner
  - New Humanetics abdomen
  - New 40mm abdominal sensors

Q6

Further investigation with Q6 test matrix:

Test	CRS	Abdomen Sensors	Hip liner	Submarine	Belt in Abdomen	Pressure	
						L	R
R129	N	Y	Y	N	**Y**	0.83	0.89
	Poor	Y	Y	**Y**	**Y**	0.93	0.93
UMTRI	N	Y	Y	N	**Y**	1.09	**1.22**
	Poor	Y	Y	**Y**	**Y**	**1.21**	1.18
R129+ Pulse	N	Y	Y	N	**Y**	1.12	1.17
	Poor	Y	Y	**Y**	**Y**	1.16	1.13
UMTRI & R129+	Poor	Y	Y	**Y**	**Y**	**1.81**	**1.39**
	Good	Y	Y	N	N	0.32	0.32

Proposed limit: 1.2 bar

Q6

Submarining on the test bench

Summary

- Using Humanetics insert gives
  - No submarining without CRS, but the belt loads abdomen
  - Submarining with poor CRS
  - No submarining or abdomen loading with good CRS
- When dummy does submarine, sensors measure <1.2 bar
- Exception UMTRI installation (slouched & slacker belts ≈15N) measured ≈ >1.2 bar with/without CRS
- More severe pulse & UMTRI procedure pressures >1.2 bar

Recommendations

- Q6 threshold too high (using R129 conditions)
  - Propose: 0.8 bar limit

Or

- Adopt UMTRI method

Q6

Submarining on the test bench – 0.8 bar limit applied

Test	CRS	Abdomen Sensors	Pelvis Insert	Submarine	Belt in Abdomen	Pressure	
						L	R
R129	N	Y	Y	N	**Y**	0.83	0.89
	Poor	Y	Y	**Y**	**Y**	0.93	0.93
UMTRI	N	Y	Y	N	**Y**	1.09	1.22
	Poor	Y	Y	**Y**	**Y**	1.21	1.18
R129+ Pulse	N	Y	Y	N	**Y**	1.12	1.17
	Poor	Y	Y	**Y**	**Y**	1.16	1.13
UMTRI & R129+	Poor	Y	Y	**Y**	**Y**	1.81	1.39
	Good	Y	Y	N	N	0.32	0.32

Q3

Submarining on the test bench

Testing

- Investigated testing with different input conditions:
  - R129 conditions
  - UMTRI installation method
  - R129+ pulse - higher severity pulse (TRL report; Hynd et al., 2010)
- With/without poor lab belt guidance CRS
- Used Q3 with:
  - DOREL pelvis insert
  - New Humanetics abdomen
  - 40mm abdominal sensors

Q3 – Test Results

Submarining on the test bench

Test	CRS	Abdomen Sensors	Pelvis Insert	Submarine	Belt in Abdomen	Pressure	
						L	R
R129	Poor	Y	Y	N	**Y**	0.39	0.47
UMTRI	Poor	Y	Y	N	**Y**	0.51	0.56
R129+ Pulse	Poor	Y	Y	N	**Y**	0.56	0.58
UMTRI & R129+	Poor	Y	Y	**Y**	**Y**	1.06	0.95
	Good	Y	Y	N	N	0.22	0.41

Proposed limit: 1.2 bar

Q3

Submarining on the test bench

Summary

- Using DOREL insert means:
  - Abdomen loading in poor CRS
  - Submarining with poor CRS using UMTRI & R129+ pulse
  - No submarining or abdomen loading with good CRS
- When dummy did submarine, sensors measure <1.2 bar
  - 1 bar measured when submarining seen
  - 0.39-0.58 measured when belt loads abdomen without submarining

Recommendations

- Production version of insert required
- Limits needs to be reduced:

  Either:
  - R129 conditions use 0.4 bar

  Or
  - UMTRI and R129+ use 0.9 bar

Summary

Submarining on the test bench

Ideal response

- Q-Series dummies are used with the inserts
  - Q3 and Q10 versions are made 'production-ready' by Humanetics
- To consider using 1.2 bar limit with the Q6
  - R129 adopts UMTRI positioning procedure
- To instigate submarining with the Q3
  - R129 also adopts a more severe frontal pulse
- There is a review of the 1.2 bar pressure limit for use in R129
  - Consider effective limits based on our single tests only ->

Condition	Q3	Q6	Q10
R129	0.4	0.8	1.3
R129 UMTRI only	0.5(?)	1.2	1.3
R129+ pulse	0.5(?)	1.1(?)	1.3(?)
Pulse and UMTRI	0.9	1.2	1.2

Do You Have Any Questions?

Thank you

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