

EPOCH-COVER-CASPER Workshop

EPOCH Project Q10 dummy Development Status Review Biofidelity Performance Validation



Munich, 29th and 30th November 2010

Kees Waagmeester
Humanetics - Europe

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 218744.

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Introduction

List of Content

- 1 Requirements definition
- 2 Design realisation and dummy manufacturing
- 3 Performance tuning and validation process
- 4 Dimension and Mass compliance
- 5 Performance compliance Head, Neck, Thorax, Abdomen and Lumber Spine



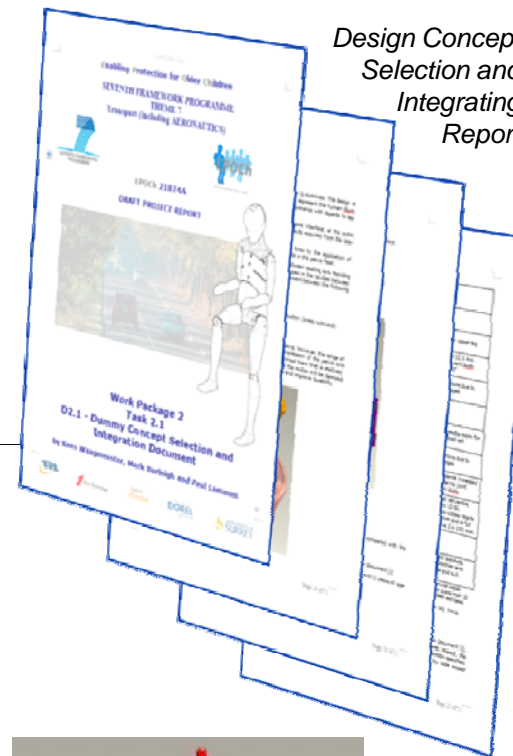
Definition of Q10 requirement in EPOCH

- Definition of requirements in first half 2009
 - Highlights of Q10 dummy requirements:
 - Size of the dummy based on CANDAT data for 10.5 years old children
 - Biofidelity scaled with anthropometry and stiffness data
 - Biofidelity compliance to be similar to other Q-dummies to allow injury criteria scaling
- EPOCH Requirements review meeting April 27+28, 2009
- Dissemination of dummy requirements to stakeholder groups:
 - Stakeholder meeting in Paris, June 10, 2009
 - GRSP Informal Group on CRS and EEVC WG12 in June and July 2010
 - Conference Protection of Children in Cars in Munich, December 2009
- EPOCH Design Brief confirmation meeting July 01, 2009
 - Final Design Brief submitted September 17, 2009

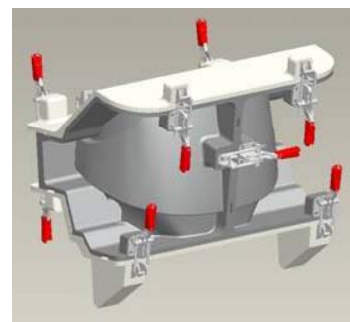


Q10 Design realisation and dummy manufacturing

- Design frozen January 14, 2010
- Drawings completed February 05, 2010
- EPOCH design justification review April 22, 2010
- Tooling design and manufacturing
- Dummy prototype production
- Final assembly September 14, 2010
- Display on Kind und Jugend Fair September 16-19, 2010



Design Concept Selection and Integrating Report



Abdomen mold tooling



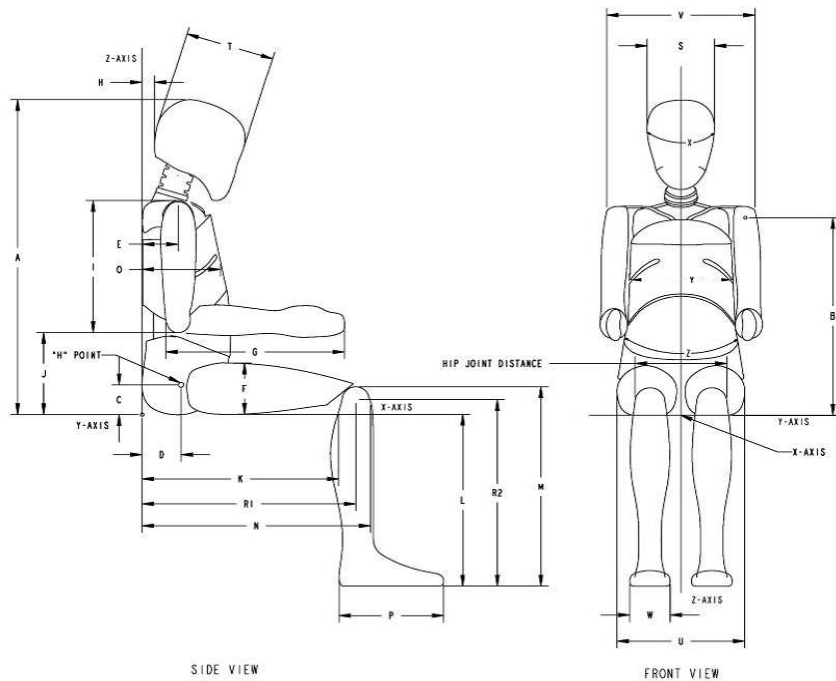
Q10 Performance tuning and validation process

- Performance tuning iterations in September and October 2010
 - Several iteration steps were made to get compliance
 - Concentrating of frontal performance (side impact to be done later outside EPOCH)
- EPOCH team agreed on the performance tuning results November 09, 2010
- Two Q10 prototype dummies under EPOCH evaluation sled testing since November 15, 2010



Dimensional compliance

Requiements compared to actual design
(hardware not yet measured)



Description	Req.m't	Tol.	Actual	Dev'n
Sitting Height	748	±7	734	-14
Sitting H (via T1)	748	±7	748	0
Shoulder Height	473	±5	473	0
Standing Height	1443	±9	1441	-2
Standing H (via T1)	1443	±9	1455	+12
Shoulder breadth	270	±2	271	+1
Hip breadth	270	±2	271	+1

- Conclusion: Dimensions of the design are justified
 - Final hardware to be measured in detail later
 - Internal pelvis anthropometry and range of motions to be validated



Mass compliance

Requirements compared to actual

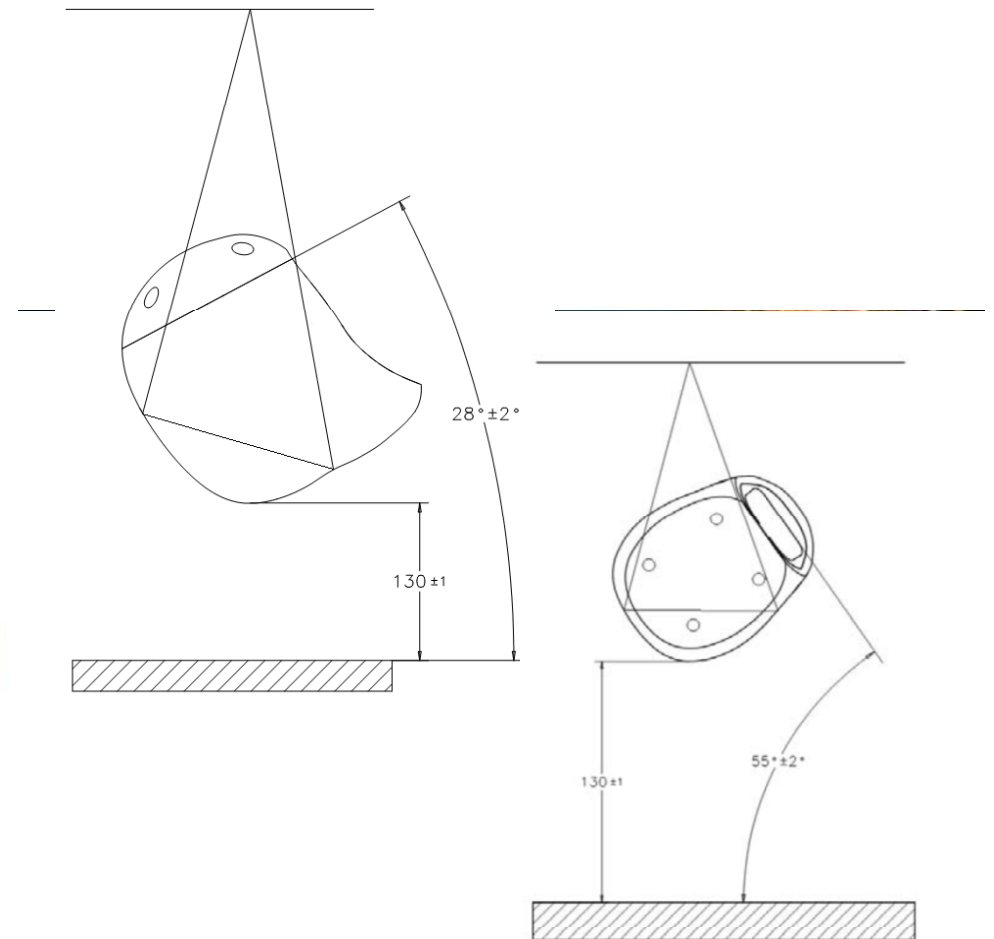
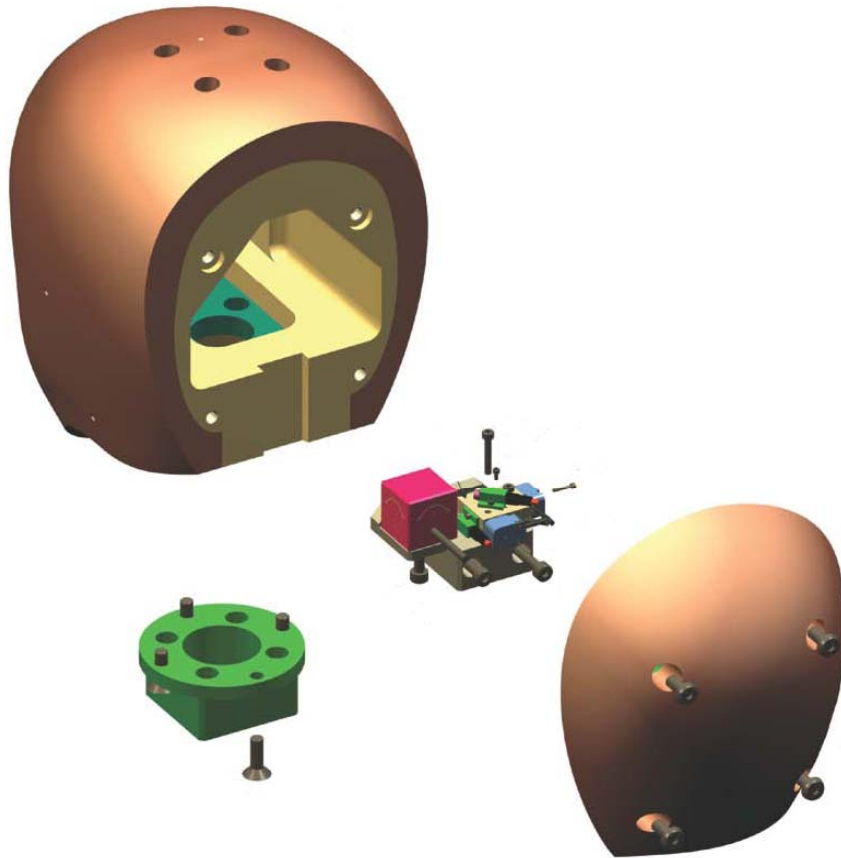
Description	Requirement	Tolerance	Actual	Deviation
Head	3.59	0.10	3.59	0.00
Neck	0.60	0.05	0.63	0.03
Upper torso	5.15	0.15	5.14	-0.01
Lower torso (incl. 0.98 kg ballast)	9.70	0.30	9.02	-0.68
Torso total	14.85	0.50	14.15	-0.70
Upper arm (each)	1.09	0.05	1.05	-0.05
Lower arm and hand (each)	0.9	0.05	0.83	-0.07
Upper leg (each)	3.71	0.10	3.70	-0.01
Lower leg and foot (each)	2.53	0.10	2.44	-0.09
Total	35.5	0.60	34.41	-1.09

- Conclusion: some adjustments required:
 - Lower torso needs significant extra mass (requires design effort)
 - Fine tuning of extremities



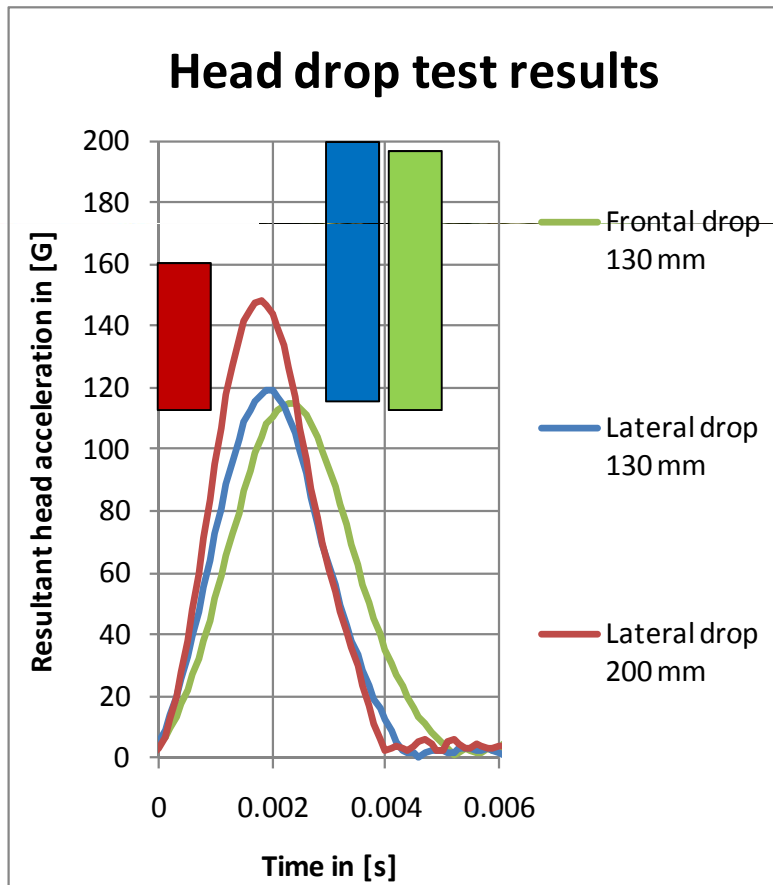
Head impact performance validation

Head design and Drop test setup



Head impact performance validation

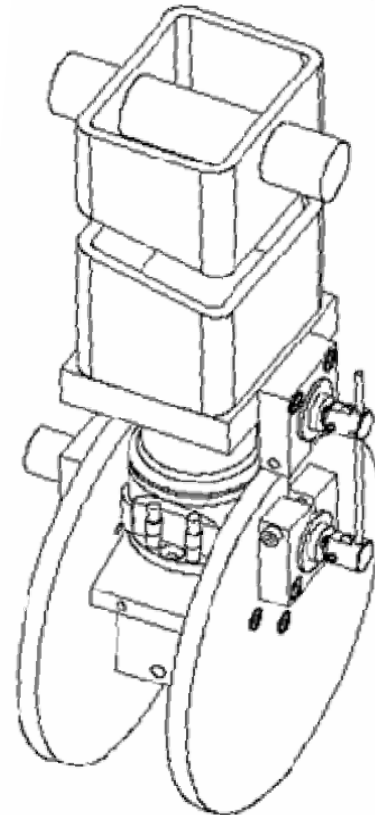
Drop test results compared with requirements



- Three drop test requirement corridors
 - Frontal 130 mm (EEVC)
 - Lateral 130 mm (EEVC)
 - Lateral 200 mm (ISO)
- Actual performance in 3rd tuning step:
 - Frontal 130 mm: 115.4 G**
Compliant, very low corridor
 - Lateral 130 mm: 119.0 G**
Compliant, very low corridor
 - Lateral 200 mm: 154.8 G**
Compliant, high in corridor
- Conclusions / discussion:
 - Further stiffness increase desired
 - Is simultaneous compliance with EEVC (low) and ISO (high) desired?

Neck bending performance validation

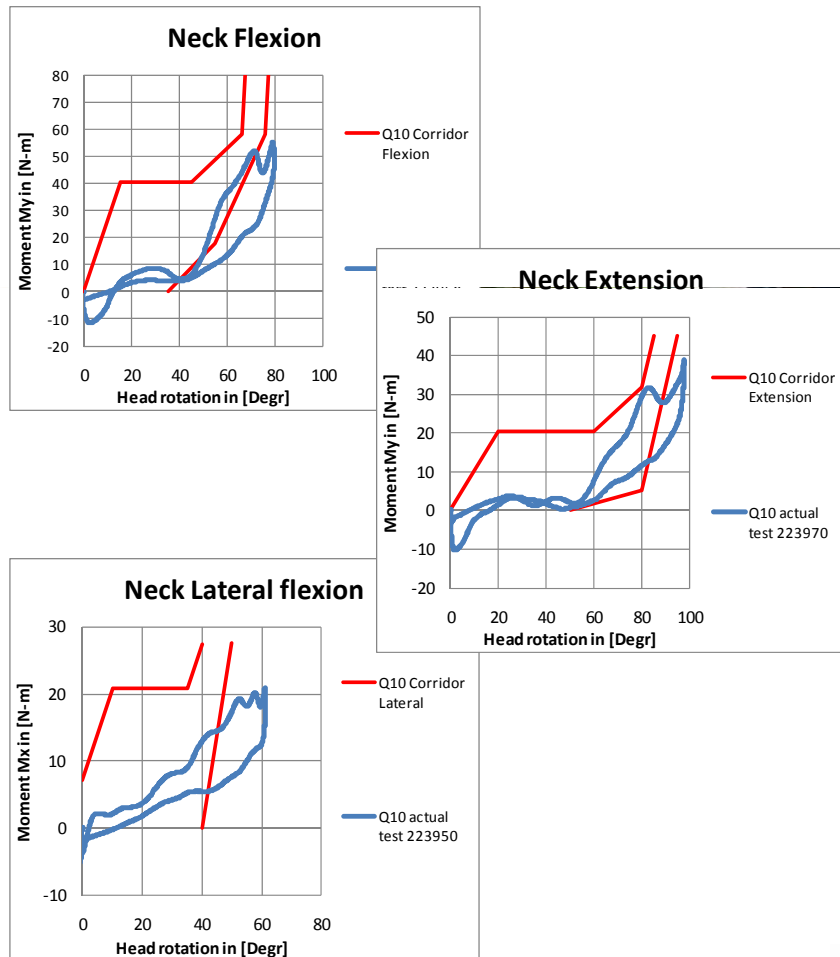
Neck design and neck pendulum test setup



Standard Part 572 neck pendulum with standard Q-dummy headform

Neck bending performance validation

Neck pendulum test results compared with requirements

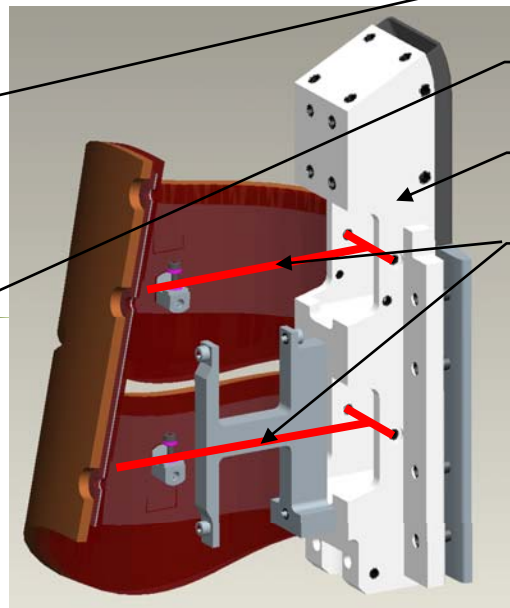
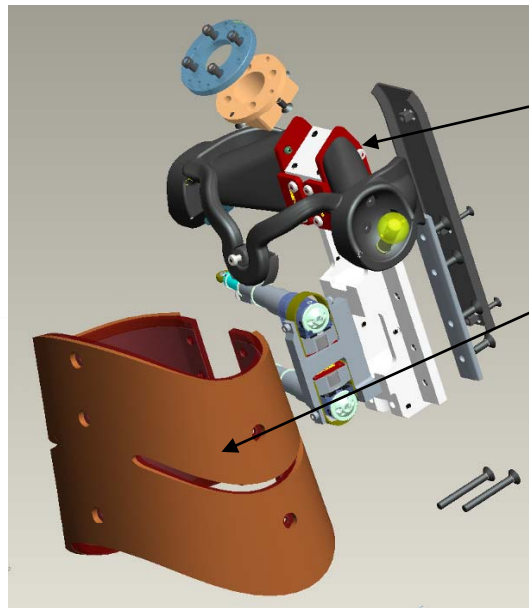


- Three bending versus angle corridors (scaled from adult corridors)
- Actual performance in 3rd tuning step:
 - Flexion: Loading curve just in corridor
 - Extension: Loading curve well in corridor
 - Lateral flexion: Low in corridor (less severe test desired)
- Conclusions:
 - Neck compliant for Flexion, Extension and Lateral flexion
 - Tunable with cable tension

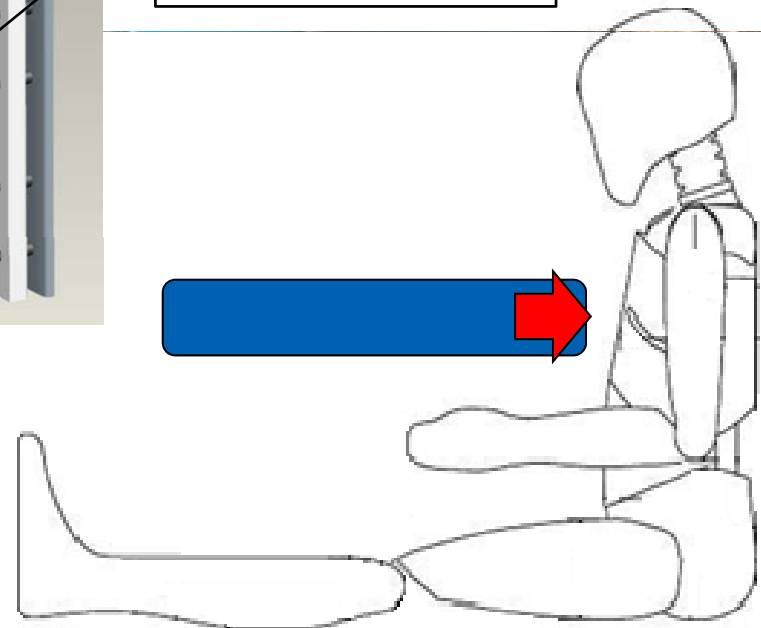


Thorax impact performance validation

Thorax design and pendulum test setup



- Shoulder and Clavicle
- Rib Cage
- Thoracic spine
- IR-TRACC location (frontal)



Full body pendulum test:
Dummy sitting on telfon sheets
Impactor mass 8.76 kg
Impacts at 4.3 and 6.7 m/s
Location mid between IR-TRACC's



Thorax impact performance validation

Pendulum test results compared with requirements

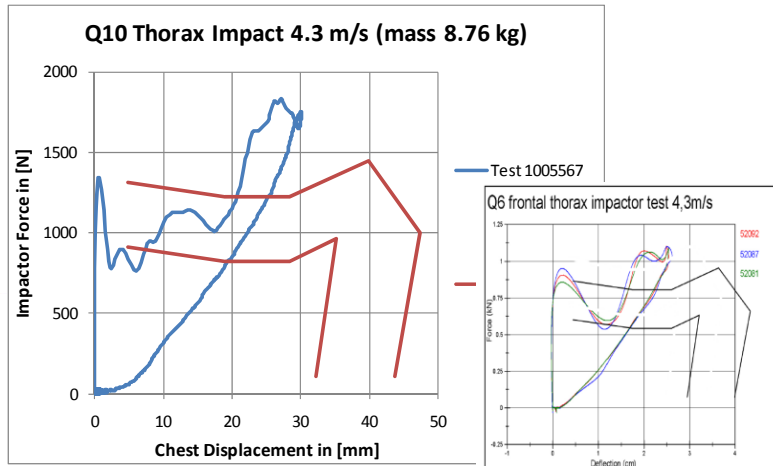


Figure 32: Q6 frontal thorax impactor test result - Test speed 4.3 m/s

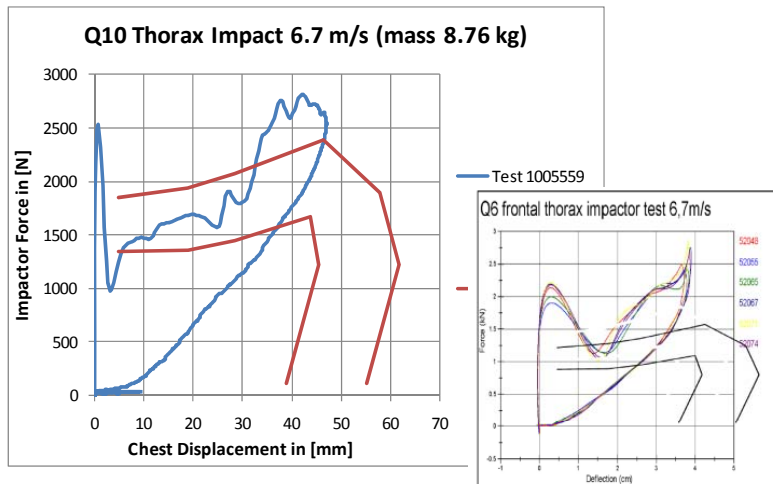


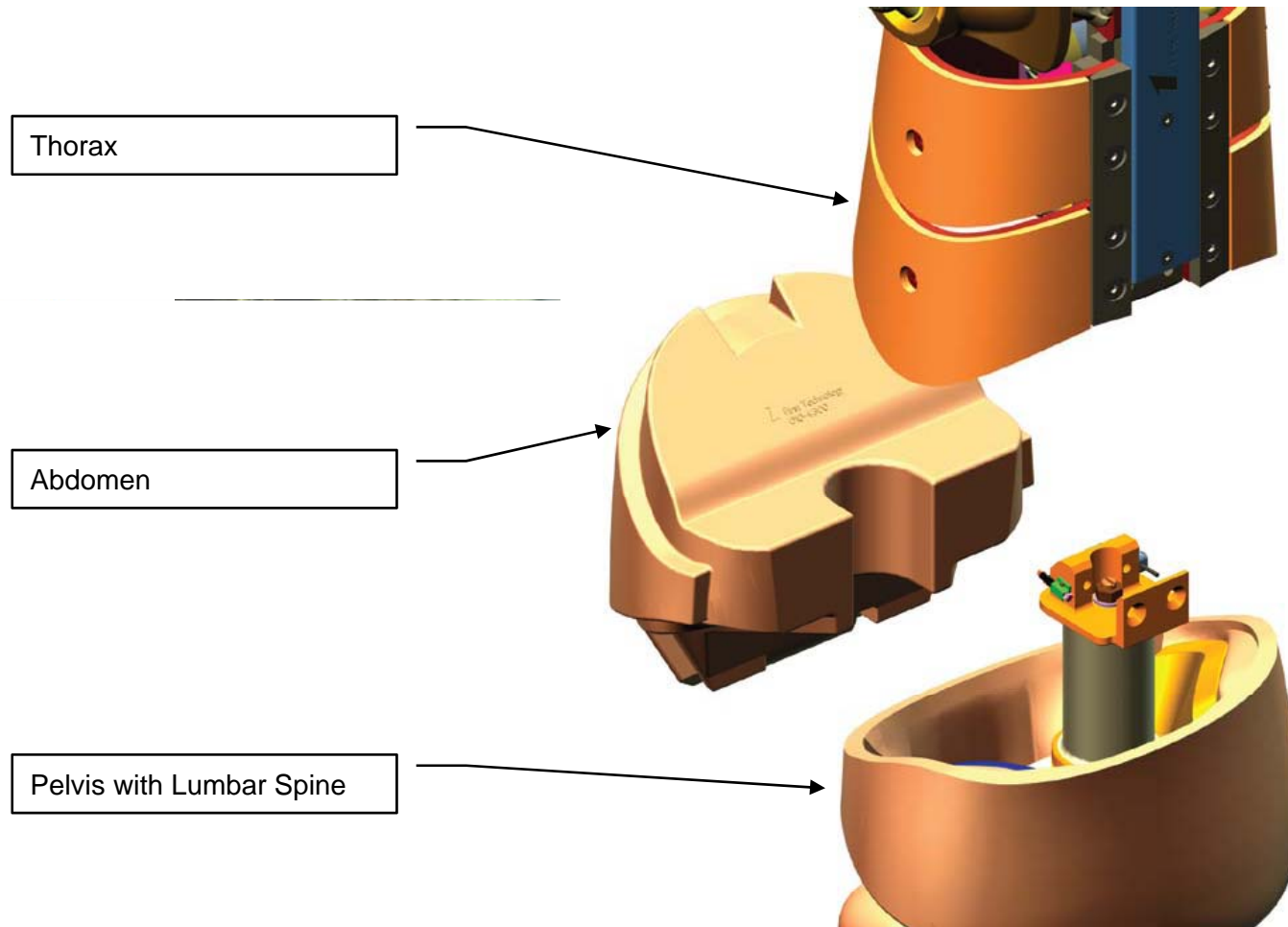
Figure 33: Q6 frontal thorax impactor test result - Test speed 6.7 m/s

- Two force versus deflection requirement corridors (at 4.27 and 6.71 m/s)
 - Compliance as other Q-dummies acceptable (ref. EEVC WG12 DOC 514)
 - Q-dummies made stiffer to prevent bottoming out at severe impacts
- Actual performance with softer clavicle:
 - 4.3 m/s: Compliance as Q6
 - 6.7 m/s: Slightly better than Q6
- Conclusions:
 - Compliance as Q6 (and other Q-dummies)
 - Clavical and shoulder stiffness interacts with ribcage performance: Stiffness reduction to be studied.



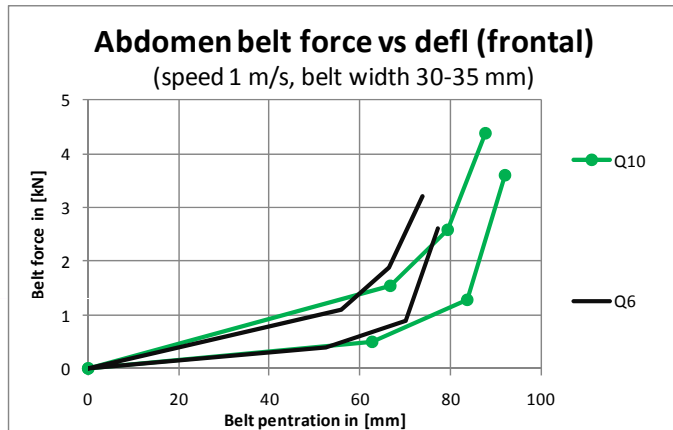
Abdomen stiffness validation

Abdomen design and integration



Abdomen stiffness validation

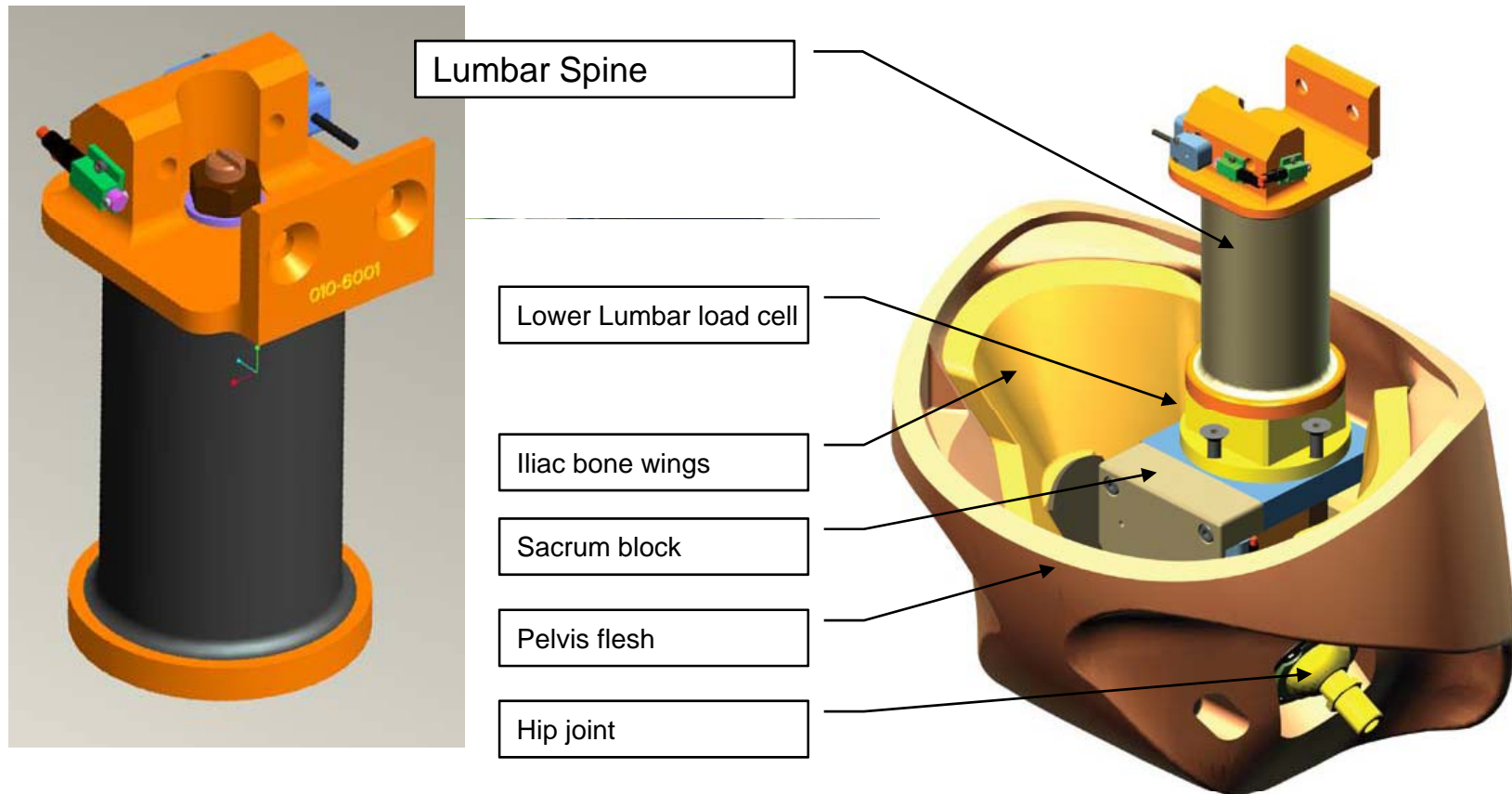
Flat plate intrusion test results compared with Q6 results



- Belt load intrusion test to be done later.
(35 mm belt 1.0 m/s, See picture of corridor)
Stiffnesses Q10 and Q6 equivalent up to 70 mm intrusion with a wide corridor.
- Actual performance compared with Q6 abdomen with standard certification test:
 - Q6 Depth 98 mm
Certification intrusion 6 to 10 mm
Relative to depth: 6.1 to 10.2%
 - Q10 Depth 108 mm (mass 1.254 kg)
2nd tuning step: intrusion 11.5 mm
Relative to depth 10.6%
- Conclusions:
 - Q10 softer than Q6 to obtain realistic submarining
 - Q10 stiffness as Q3 abdomen

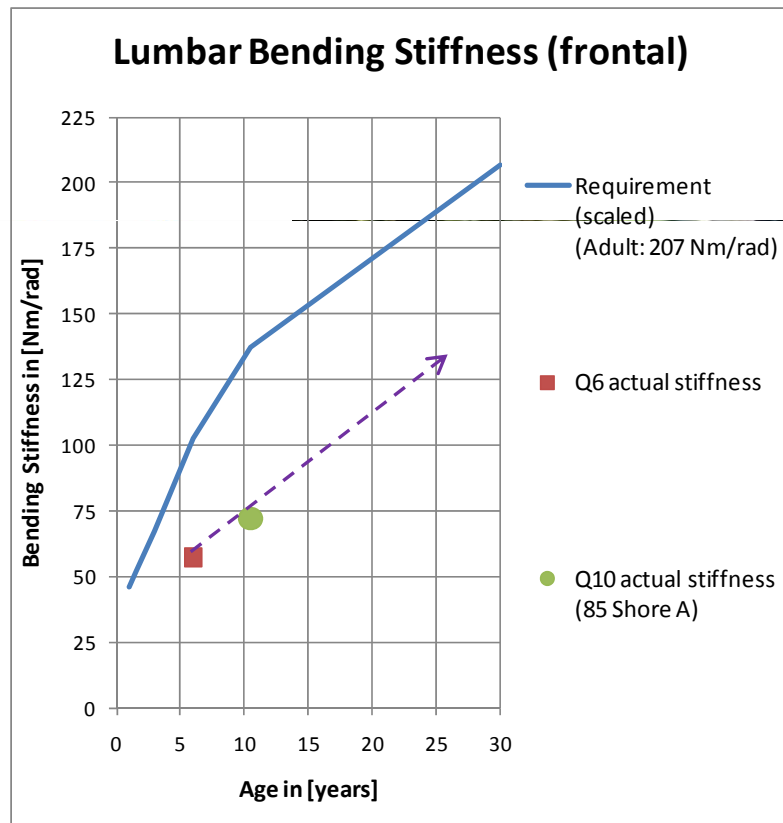
Lumbar Spine stiffness validation

Lumbar Spine design and integration



Lumbar Spine stiffness validation

Dynamic (neck pendulum) and Static stiffness tests



- Requirement scaled: Adult: 207 Nm/rad.
 - Q6: Scaled requirement: 102.8 Nm/rad
Modified requirement: 62.1 Nm/rad
 - Q10: Scaled requirement: 137.1 Nm/rad
- Actual performance
 - Dynamic and Static tests are equivalent
 - Q6 : Diameter 44 mm
Stiffness 57.3 Nm/rad (56% of scaled)
 - Q10: Diameter 48 mm
Stiffness 72.0 Nm/rad (53% of scaled)
- Conclusions:
 - Rubber 85 Shore A, stiffer not desired
 - Soft Lumbar Spine to obtain realistic submarining



Q10 dummy ready ...



For more information

Email:

EPOCh@trl.co.uk

www.epochfp7.org



Enabling Protection for Older Children

... to face evaluation testing

