

Status and Remarks on
USSID and SIDHIII Model
EUROSID-1
ES-2 and ES-2re Model

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Content

- Development methodology
- USSID and SIDHIII
- Recent work
- Future work
- Eurosid-1 and ES-2
- Recent work
- Future work
- ES-2re

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FAT/DYNAmore SID Models

- FAT (German Research Organization of the Automotive Industry)
- models developed during the past 9 years by Dynamore



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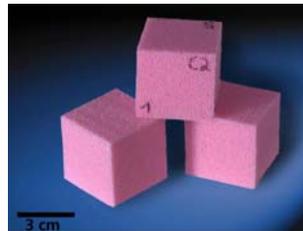
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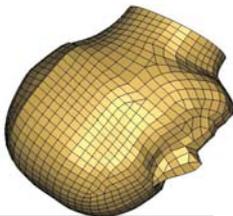
Material tests

- static and dynamic tension
- static and dynamic compression
- shear tests
-



Component tests

- drop tests
- pendulum tests
- impact tests
-



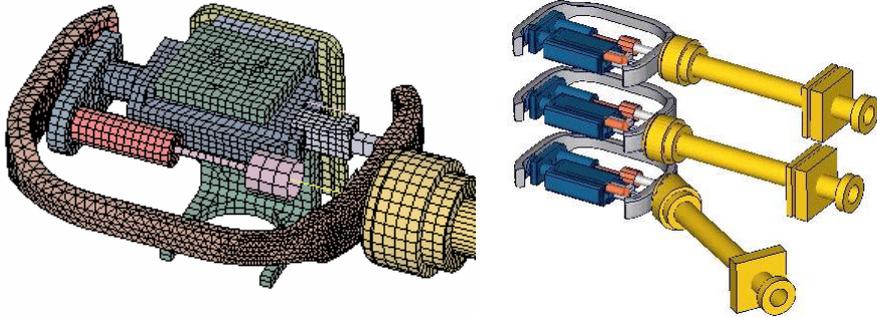
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Example Component test: Rib module



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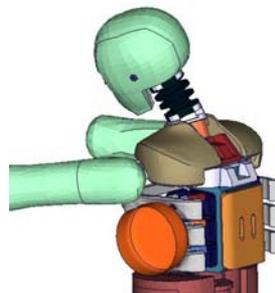
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Pendulum test on assembled model

- different impact locations
- different impactor speeds



Sled tests on assembled model

- rigid barriers
- impacting speed 4 to 9 m/s
- plane, oblique and shaped barriers
-

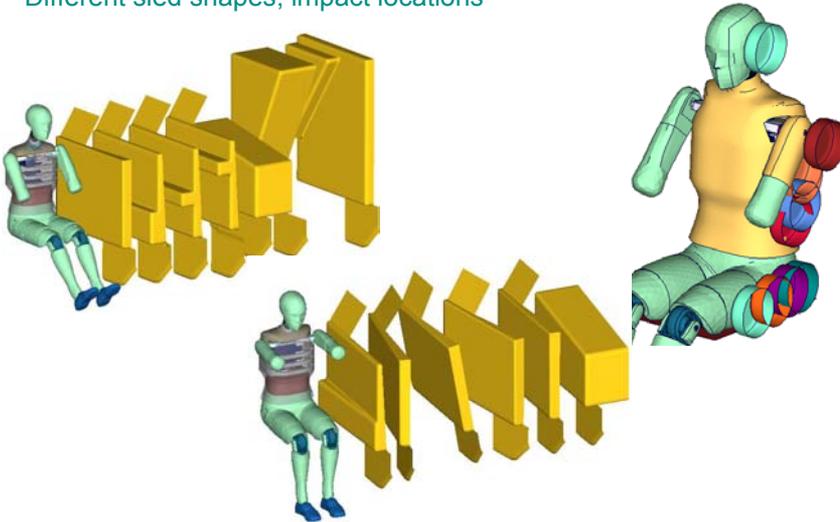
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Different sled shapes, impact locations



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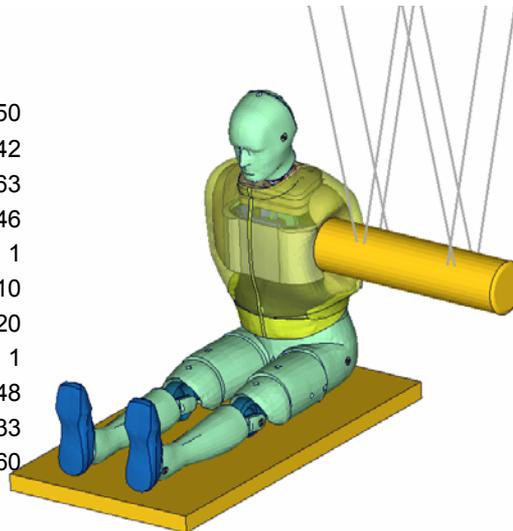
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USSID v4.7

■ nodes :	61150
■ solids :	96042
■ shells :	45363
■ beams :	46
■ discrete elements :	1
■ accelerometers :	10
■ time history nodes :	20
■ time history beams :	1
■ materials :	48
■ sections :	33
■ parts :	160



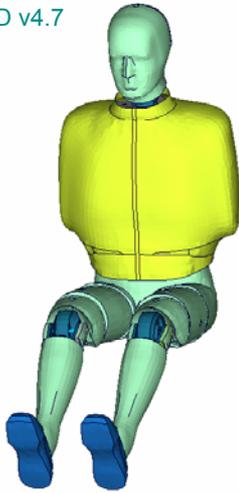
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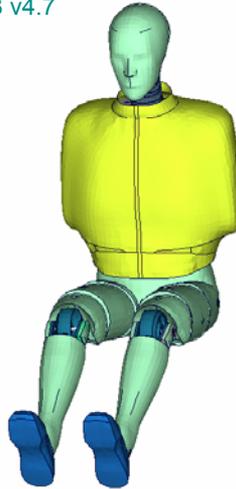
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USSID v4.7



SID-H3 v4.7



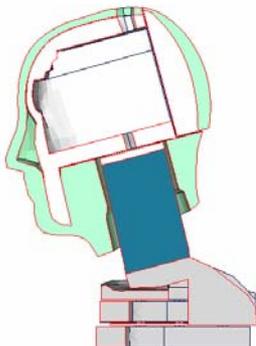
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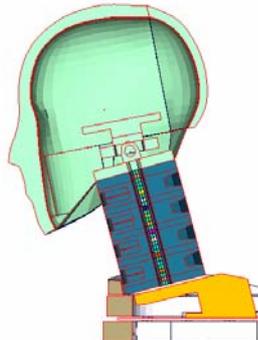
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USSID v4.7



SID-H3 v4.7



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Recent Enhancements in USSID and SIDHIII

Material tests from drop towers used to re-model the arm and pelvis foam and the rib wrap foam.

- static compression tests (30x30x30 mm specimen)
- dynamic compression tests
 - Strain rates 10, 20, 50, 100, 200 1/s
 - 50 and 90% volumetric strain
- static tension tests
- dynamic tension tests
 - Strain rates 10, 20, 100, 200 1/s



(Rib wrap foam tested with less strain rates)

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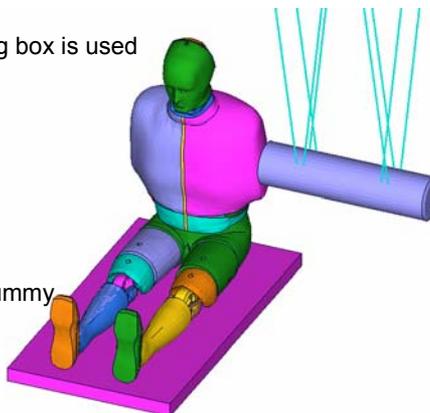
Modifications due to Pendulum Test on Thorax

- new arm foam material model
- new material tests for rib wrap foam
- validated material of the anti bottoming box is used

Models are in Calibration Corridor

Tests Provided by OEMs

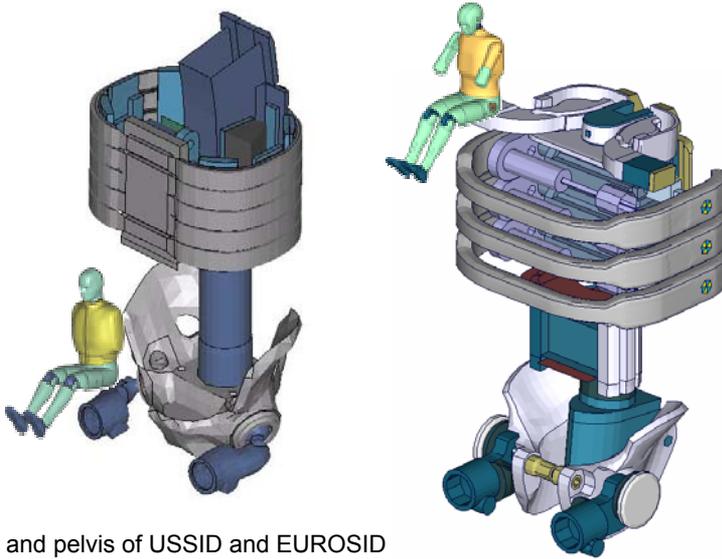
- impact test for bottoming out box
- impact test on thorax
- impact tests on partially assembled dummy



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Thorax and pelvis of USSID and EUROSID

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EUROSID v3.5

■ nodes :	53248
■ solids :	99754
■ shells :	45410
■ beams :	93
■ discrete elements :	21
■ accelerometers :	11
■ time history nodes :	20
■ time history beams :	7
■ materials :	79
■ sections :	50
■ parts :	180



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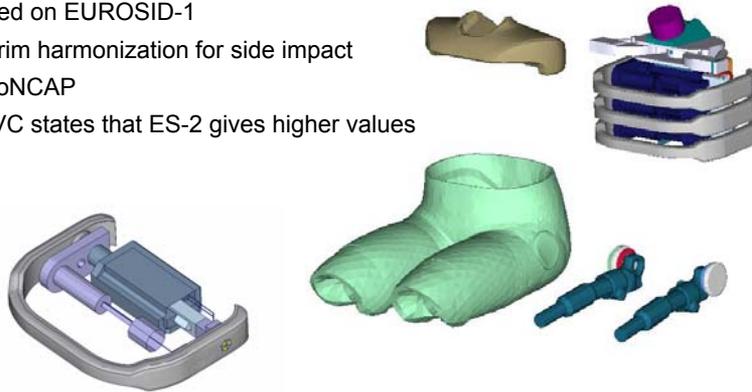
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ES-2 Dummy

- based on EUROSID-1
- interim harmonization for side impact
- EuroNCAP
- EEVC states that ES-2 gives higher values



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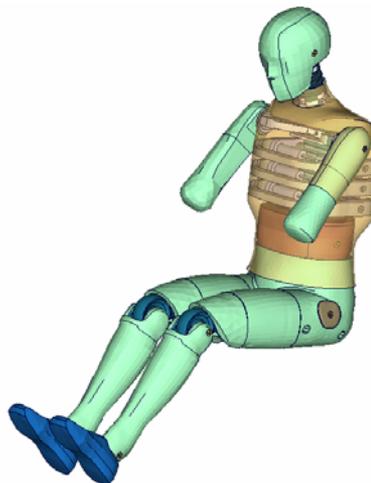
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ES-2 v3.3

▪ nodes :	85051
▪ solids :	135361
▪ shells :	69192
▪ beams :	510
▪ discrete elements :	12
▪ accelerometers :	8
▪ time history nodes :	23
▪ time history beams :	10
▪ materials :	113
▪ sections :	133
▪ parts :	210



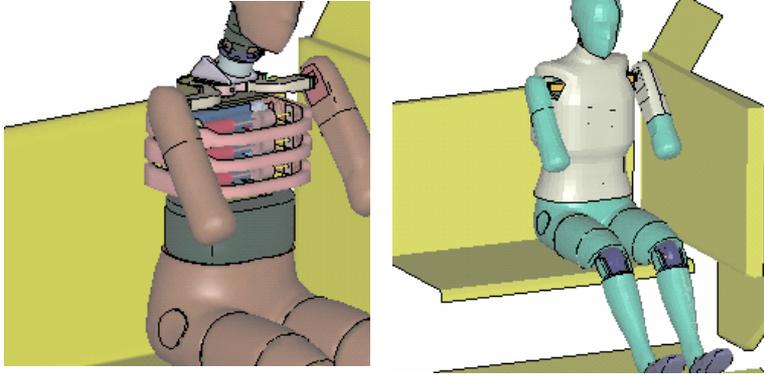
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Results of ES-2 in Sled Test



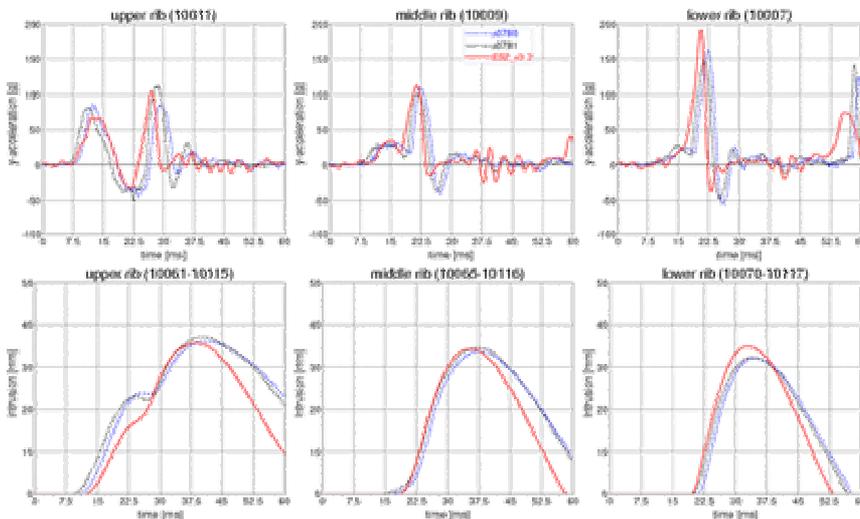
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Plane Barrier - 40° Arm, 6 m/s



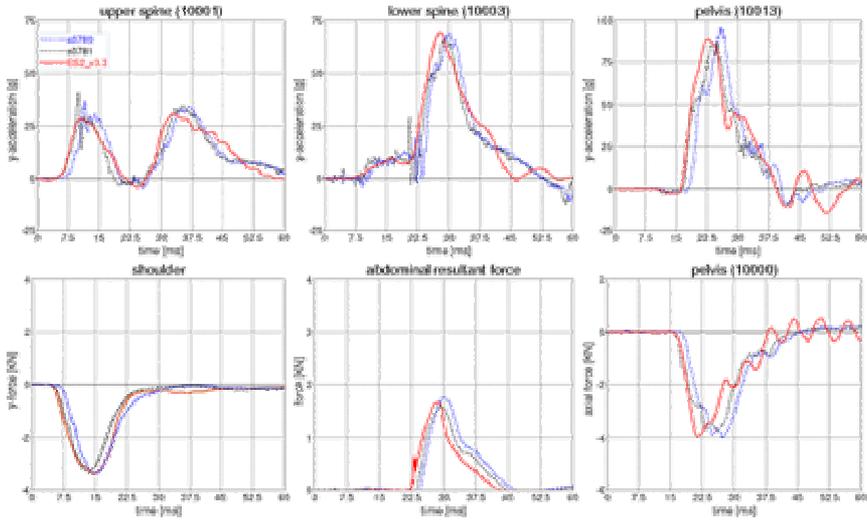
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Plane Barrier - 40° Arm, 6 m/s



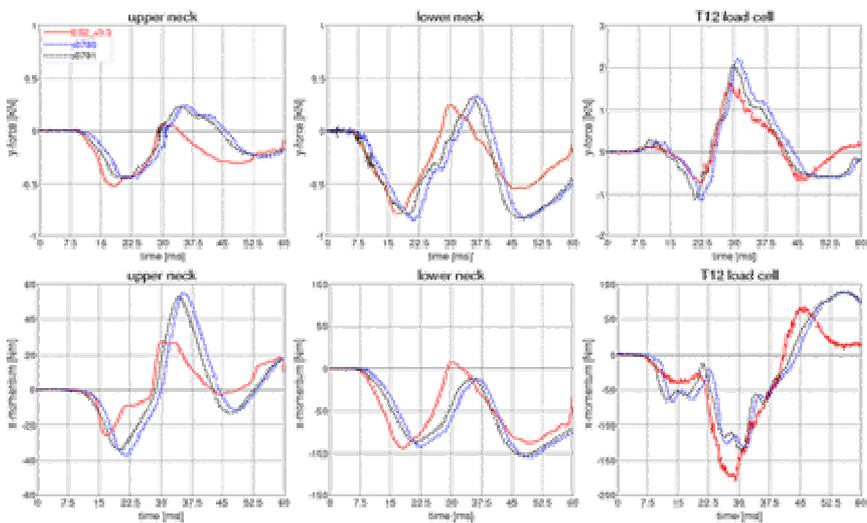
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Plane Barrier - 40° Arm, 6 m/s



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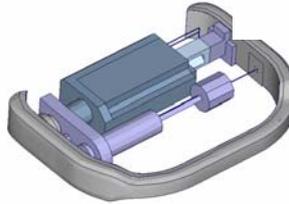
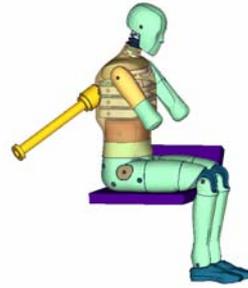
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Enhancements in Recent Version

- re-meshed rib steel
- rib foam and skin are re-meshed
- all rigid parts switched to deformable in the rib steel
- contact for inner rib skin changed to a constrained formulation
- the piston is modeled more detailed
- better correlation in calibration tests
- stability enhanced



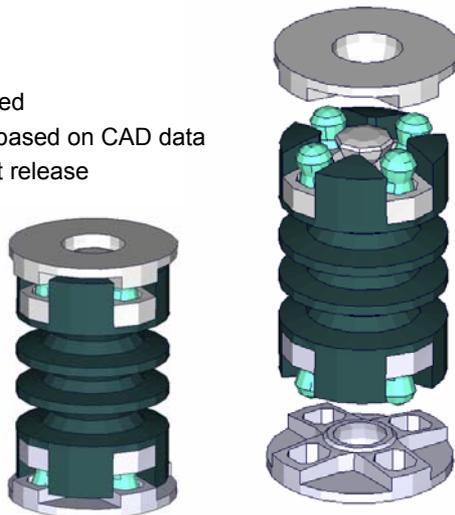
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Future Work on ES-2 Model

- neck model will be more refined
- small geometric adaptations based on CAD data
- shoes will be modeled in next release



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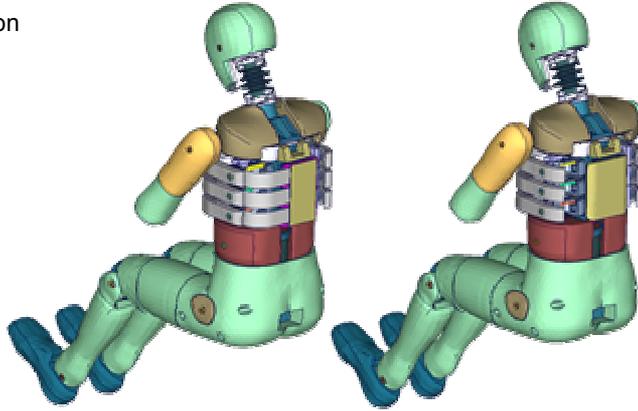
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FMVSS 214 (upcoming): ES-2re Dummy

Very few differences:

- rib extension
- back plate



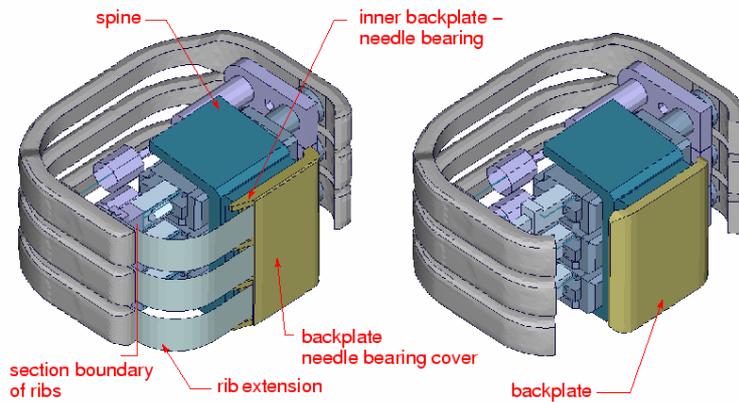
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Differences between ES-2re and ES-2



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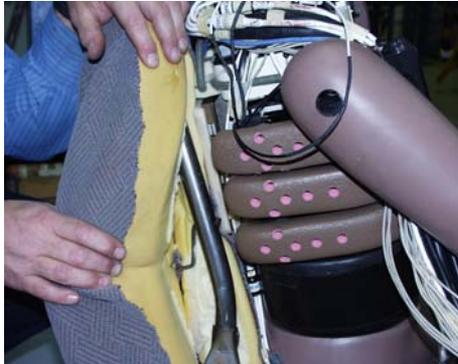
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One Justification for ES-2re

NHTSA Testing:
Seat frame can catch
ES-2 back plate

Vehicle XXX:
– Back plate $F_y > 8\text{kN}$



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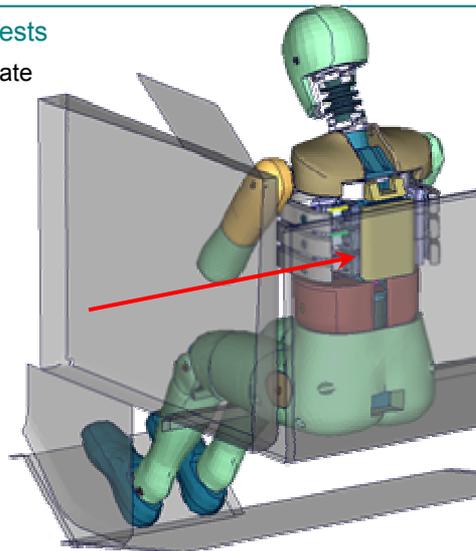
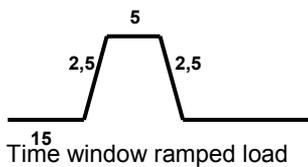
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Considerations in Simple Sled Tests

ES-2 with additional force at back plate

Load details:

Max force: 1 kN or 5 kN.



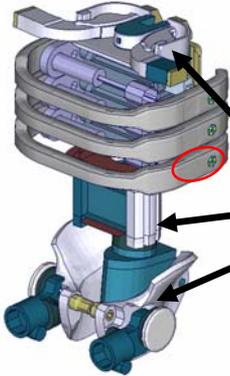
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Results



	No artificial back plate load	Back plate load high (5kN)	Back plate load low (< 1kN)
Max T1 accl. [g]	20	55	25
Max. T12 accl. [g]	30	34	28
Max Pelvis accl. [g]	52	52	52
Upper rib intrusion [mm]	17	8	12
Middle rib intrusion [mm]	18	10	14
Lower rib intrusion [mm]	21	13	18

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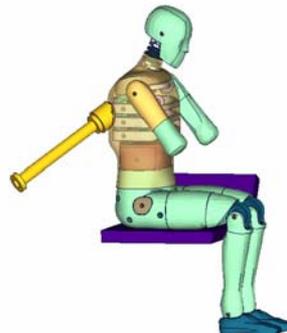
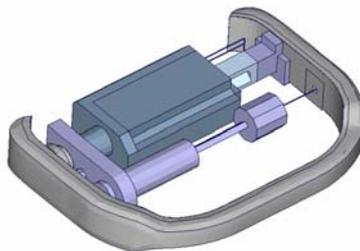
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Enhancements in Recent Version

- same modifications as ES-2
- incorporation of further tests planned
- passes almost all calibration tests



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Conclusion

- models of USSID, EUROSID and ES-2 are available
- modifications as ES-2re and SIDHIII are available
- the models show a good correlation is tests
- the models will be updated frequently

Thank you !

