

VRTC Rear Impact Sled Testing Status

BioRID II vs. Hybrid III
and
FMVSS 202a vs. ENCAP-Annex 9

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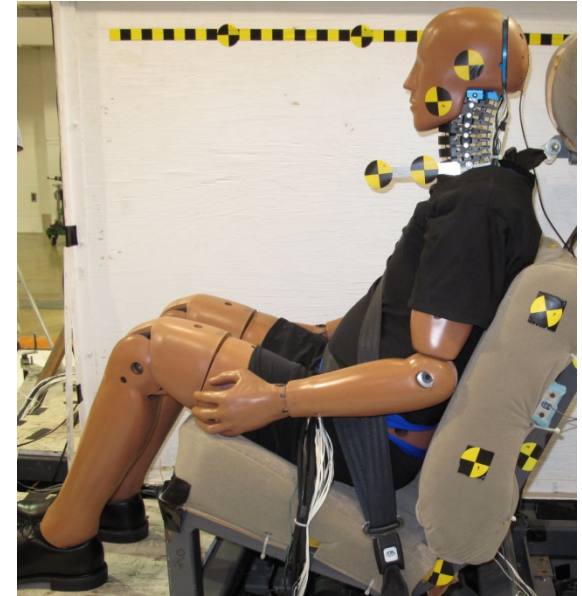
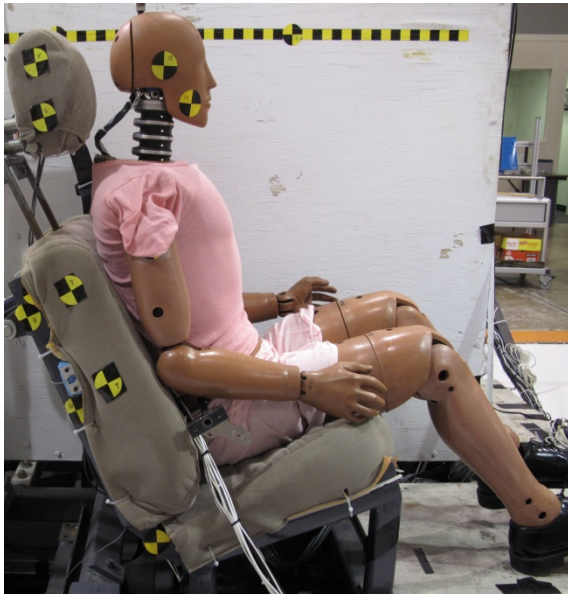
- Objective
 - Compare the responses of the BioRID II (g) with those of the Hybrid III when subjected to FMVSS 202a and ENCAP-A9 pulses
- Methods
 - Utilize the side-by-side VRTC rear impact research buck on the TRC HYGE sled.
 - Vary seat configuration from “perceived” good to poor by varying head restraint backset.
- Results
 - BioRID II – Good discrimination with A9 pulse and ENCAP evaluation criteria
 - Hybrid III – Head/T1 angle correlates with backset ; little discrimination with other 202 or A9 parameters
 - Results affected by mass and rigidity of research buck seat/head restraints
- Follow-up Activities
 - Additional sled tests planned utilizing “good-rated” OEM seat design (March/April)

Test Methods –

ATDs

Rear Impact Sled Testing

- BioRID II 50th
 - Fully certified by Humanetics (Denton) prior to test
 - Configured to change level “G”



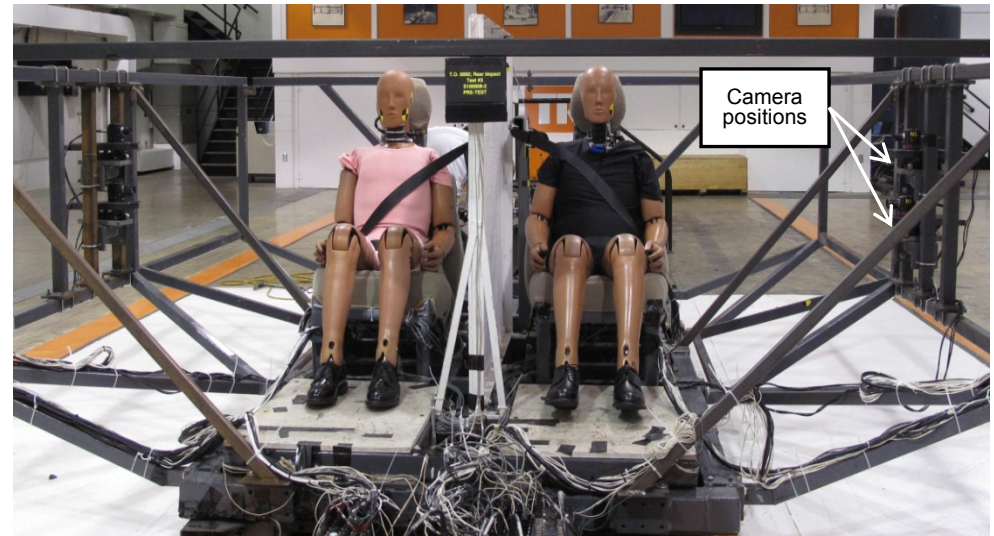
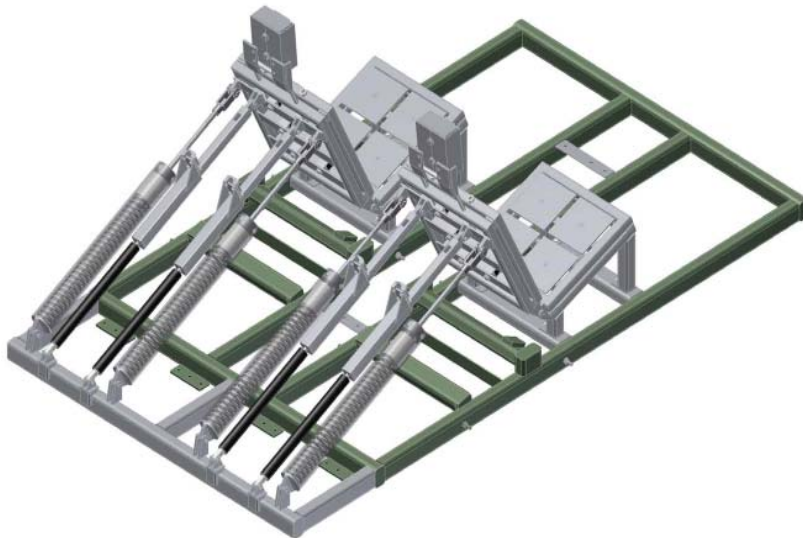
- Hybrid III 50th
 - Pre-test certified head and neck

Test Methods -

Buck and Seat Setup

Rear Impact Sled Testing

- Experimental rear impact test buck
 - Repeatabile/reusable test environment
 - 1999 Toyota Camry seat configuration/geometry
 - Realistic seat back rotation response
 - Side-by-side configuration (mirror image belt configurations)

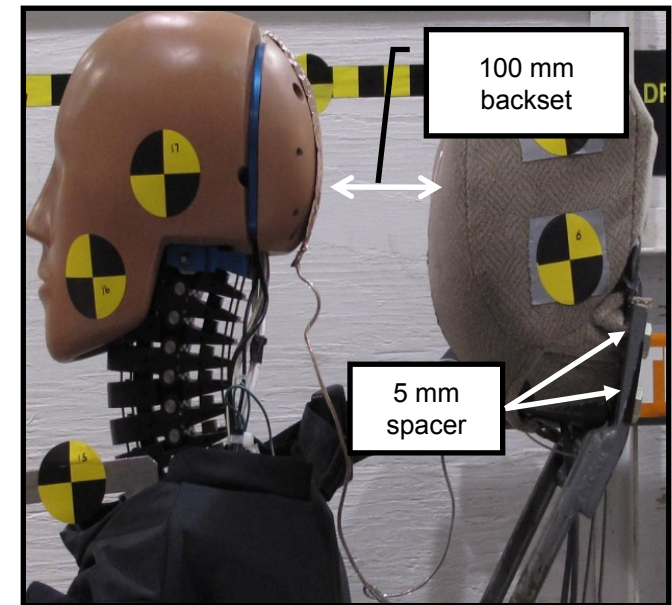


Test Methods -

Buck and Seat Setup (cont.)

Rear Impact Sled Testing

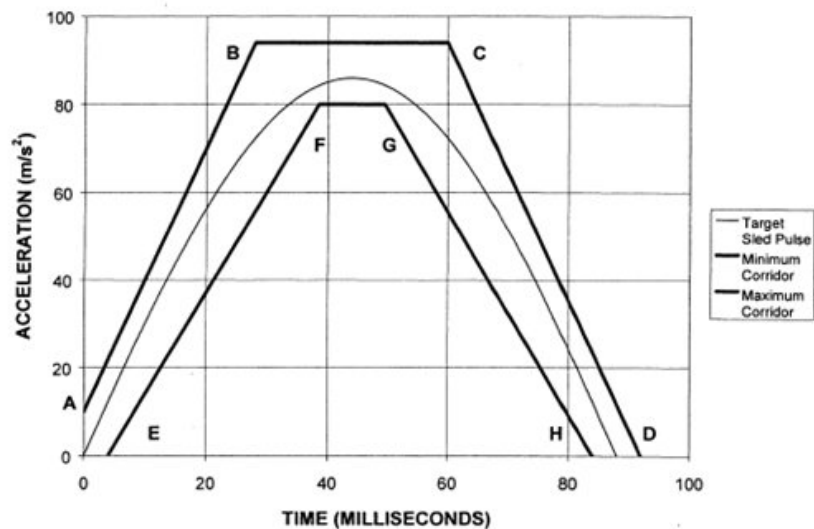
- Head restraint designed to produce varying degrees of backset
 - 25, 50, 75 and 100 mm
 - Good* → *Poor*
- Seats “Oscar’d” at beginning of each pulse sequence
 - Establish seat H-pt
 - Check for seat cushion compression
- Camera positions:
 - Full view and upper torso close-up
 - 1000 fps



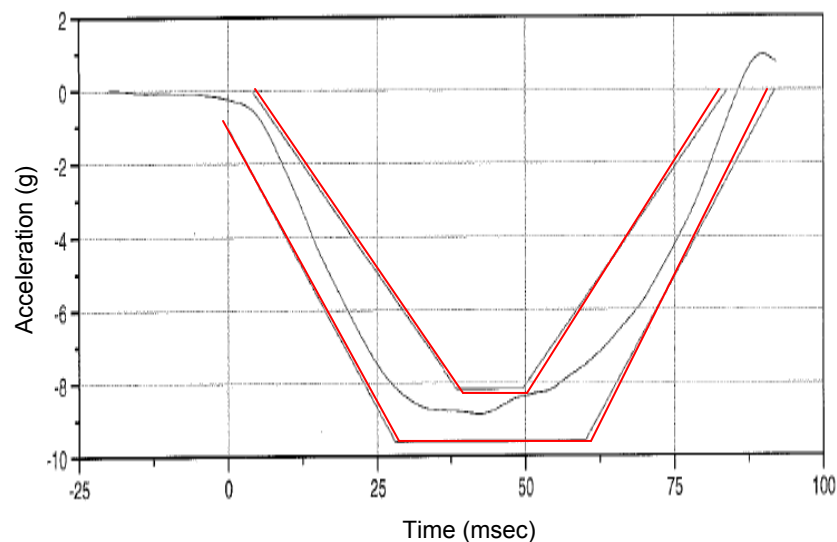
Test Methods - Sled Pulse

Rear Impact Sled Testing

- FMVSS 202a



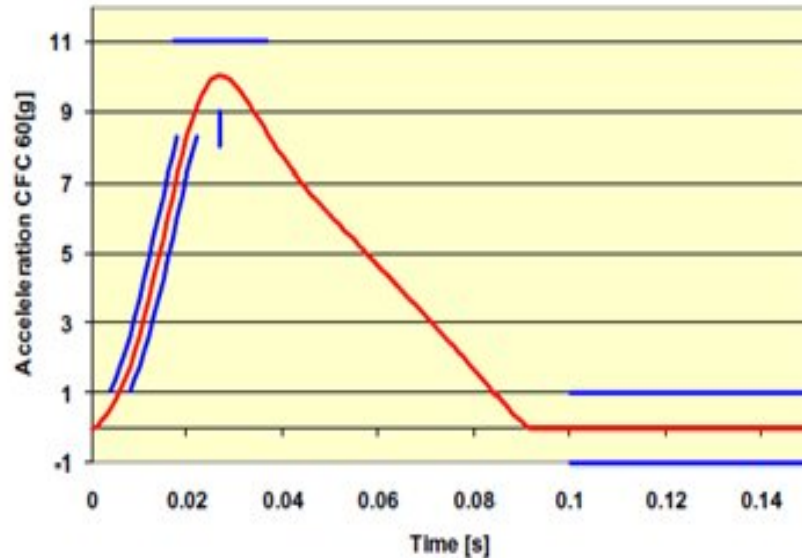
Actual Pulse



Test Methods - Sled Pulse (cont.)

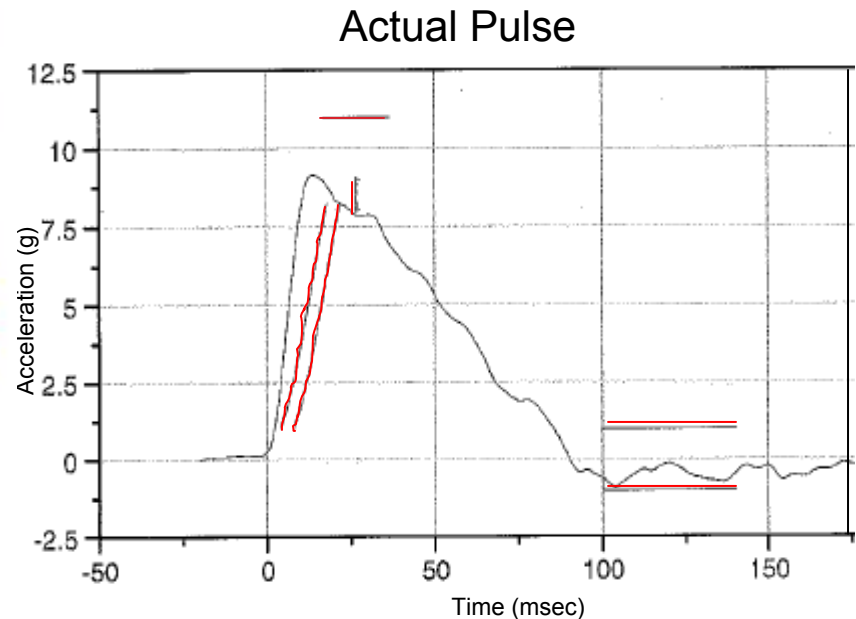
Rear Impact Sled Testing

- ENCAP – Annex 9



- Issues

- Evaluated several existing pins
- Best option onset too fast
- 4-5 weeks -\$5K for new pin



- **BioRID II**
 - 26 channels
 - Accels – head, T1, T8, lumbar, pelvis
 - Load – skull cap, upper & lower neck, lumbar
 - Moment - upper & lower neck, lumbar
 - ARS – head, T1, pelvis
- **HIII**
 - 18 channels
 - Accels – head, T1, pelvis
 - Load – upper & lower neck, lumbar
 - Moment - upper & lower neck, lumbar
 - ARS – head, T1, pelvis
- **Sled**
 - 25 channels
 - Acceleration
 - Head contact
 - Seat pan and seat back load cells, accels, and ARS

Test Methods –

Test Matrix

Rear Impact Sled Testing

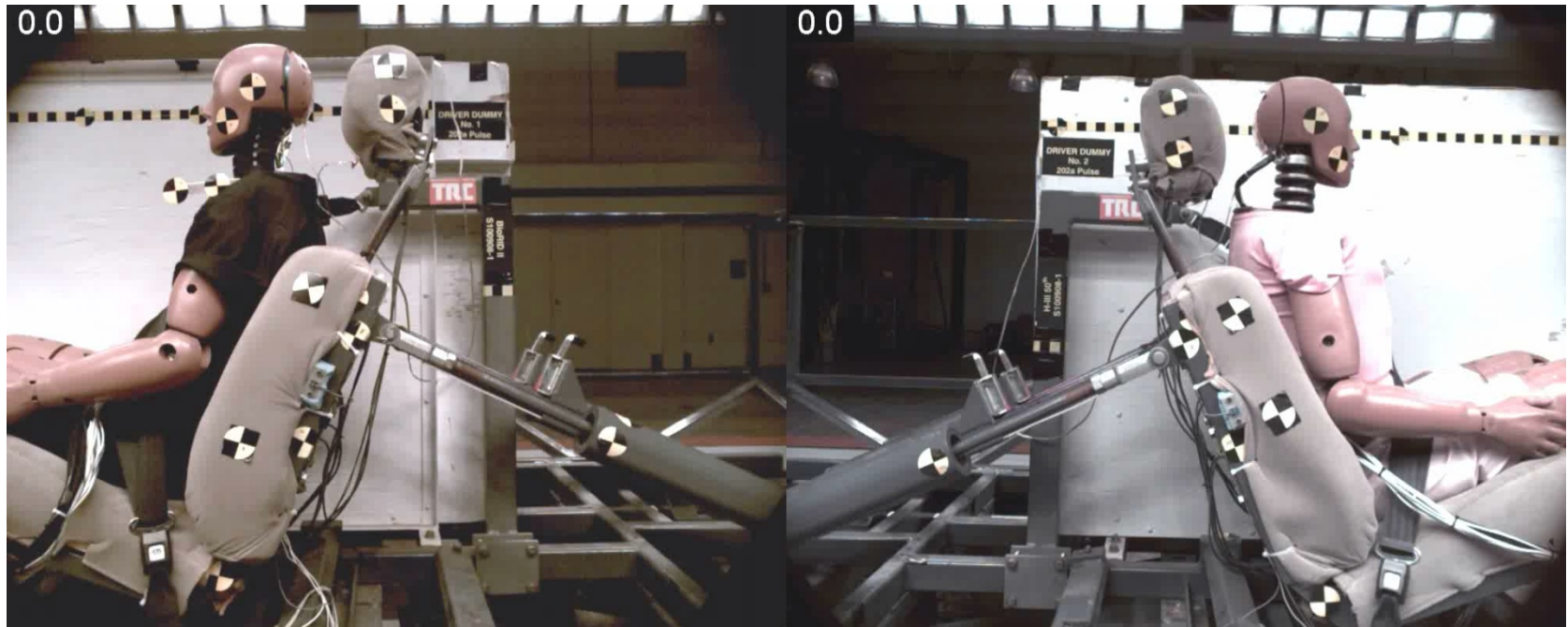
- Pulses segregated to minimize pin changes
- Backsets randomized
- Dummies assigned seating position

Test number	Pulse	Backset (mm)	H3 50th	BioRID
1	202a	75	Right	Left
2	202a	100	Right	Left
3	202a	75	Right	Left
4	202a	25	Right	Left
5	202a	50	Right	Left
6	202a	100	Right	Left
7	202a	25	Right	Left
8	202a	50	Right	Left
9	Annex 9	50	Right	Left
10	Annex 9	75	Right	Left
11	Annex 9	100	Right	Left
12	Annex 9	25	Right	Left
13	Annex 9	100	Right	Left
14	Annex 9	75	Right	Left
15	Annex 9	50	Right	Left
16	Annex 9	25	Right	Left

Typical Test –

202a Pulse, 75 mm Backset

Rear Impact Sled Testing



- FMVSS 202a
 - Head-to-T1 angle
*(less than 12°
extension)*
 - HIC₁₅
(Less than 500)
- ENCAP (Whiplash assessment)
 - Upper Neck Shear, Fx
 - Upper Neck Tension, Fz
 - T1 Acceleration
 - NIC [*f*(relative head-T1 accel & vel)]
 - Nkm [*f*(UPNK Fx & My)]
 - Time to Head Restraint First Contact
 - Rebound velocity

Results – Evaluation Criteria (cont.)

Rear Impact Sled Testing

Analysis: EuroNCAP

High, Low and Capping limits – medium pulse

Euro NCAP Criteria	Units	Medium Severity		
		HPL	LPL	CL
NIC	m ² /s ²	11,00	24,00	27,00
Nkm	-	0,15	0,55	0,69
Rebound velocity	m/s	3,20	4,80	5,20
Upper Neck Shear Fx	N	30,00	190,00	290,00
Upper Neck Tension Fz	N	360,00	750,00	900,00
T1 acceleration	g	9,30	13,10	15,55
Time to head restraint first contact	ms	57,00	82,00	92,00

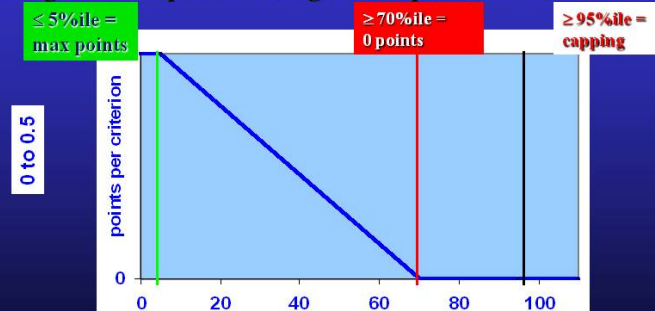
ENCAP method of rating seat performance for whiplash protection



Slides from B. Donnelly presentation at GTR meeting Sept., 2010.

Analysis: EuroNCAP

Sliding scale for point scoring of seat performance criteria



Six criteria * 0.5 points max. each = 3 points max.



Results –

Data Observations

HIII

BioRID

202a

Backset ↑

→ Head to T1 angle ↑

→ HIC ↔

• Time to contact: HIII < BioRID

Backset ↑

→ Head to T1 angle < 0
(no extension)

→ HIC < 400

Annex 9

Backset ↑

→ Head to T1 angle ↑

→ A9 Eval Criteria ↔

• Time to contact: HIII < BioRID

Backset ↑

→ T1XG, T1ZG,
HIC, HDXG, NIC } ↑

• Highest sensitivity
combination

Conclusions –

Rear Impact Sled Testing

- BioRID does not appear to display meaningful discrimination with respect to 202a assessment criteria
 - Head-to-T1 angle
 - HIC
- HIII better in 202a with this seat configuration
 - Shows expected discrimination wrt Head-to-T1 rotation
 - No discrimination shown wrt HIC
- Choice of buck appears to have affected the results
 - Head restraint too hard
 - Seat pan and seat back may be too stiff (inadequate suspension)

New Test Plan –

Rear Impact Sled Testing

1. New Side-by-side Buck with OEM seats
 - 2011 Chevy Cruze driver seats
 - Rated “Good” in ENCAP and IIHS rear impact assessments
 - Devise backset adjustability to produce “Good” and “Poor”
2. Fabricate new A9 HYGE gun metering pin
 - Designed specifically for new buck
 - Goal is to achieve better compliance with A9 corridors
3. Proposed Matrix – eight tests (two repeats of each condition)

Test No	Pulse	Backset	Hill	BioRID
1	202a	Good	Right	Left
2	↓	Poor	↓	↓
3		Good		
4	Poor			
5	A9	Good		
6	↓	Poor	↓	↓
7		Good		
8	Poor			

Thank you