



Rear Impact Sled Testing Summary

BioRID II vs. Hybrid III
and
FMVSS 202a vs. Modified Annex 9 Pulse
with OEM seats

*GTR 7 Head Restraints
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- What?
 - Compare the responses of the BioRID II(g) with those of the Hybrid III when subjected to FMVSS 202a and Modified Annex 9 rear impact pulses using OEM vehicle seats.
- Why?
 - To evaluate the relationship between FMVSS202a with the current direction of the Draft GTR7 Head Restraint standard
- How?
 - Utilize the side-by-side VRTC rear impact buck fitted with OEM vehicle seats while mounted on the TRC HYGE sled.
 - Vary the seat/head restraint from a “good” configuration to a “poor” configuration by varying the head restraint backset

<i>Test Matrix</i>										
Test No	Pulse	Seat Position		Head Restraint Condition		Test No	Pulse	Seat Position		Head Restraint Condition
		Left	Right					Left	Right	
1	FMVSS202a	BioRID	HIII	OEM		5	Mod A9	BioRID	HIII	OEM
2	FMVSS202a	BioRID	HIII	OEM + 40mm		6	Mod A9	BioRID	HIII	OEM + 40mm
3	FMVSS202a	BioRID	HIII	OEM		7	Mod A9	BioRID	HIII	OEM + 40mm
4	FMVSS202a	BioRID	HIII	OEM + 40mm		8	Mod A9	BioRID	HIII	OEM

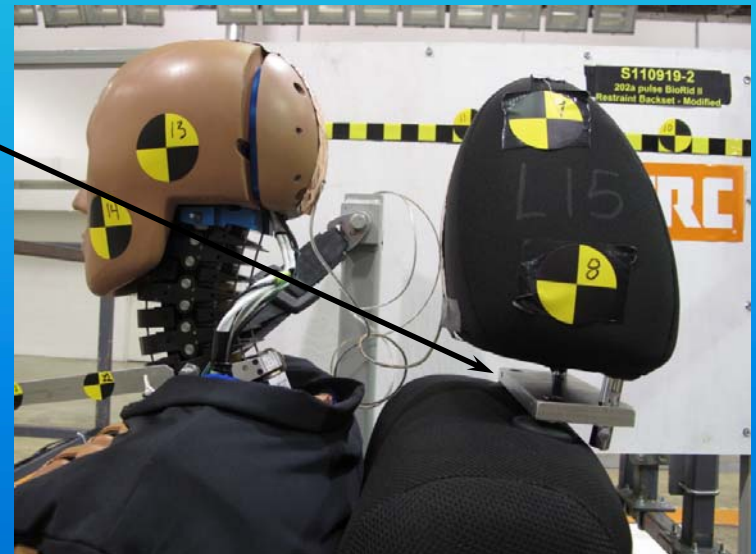
- ATDs
 - BioRID II(g) and Hybrid III 50th percentile
- Sled Buck
 - Standard VRTC rear impact buck
 - Side-by-side seating configuration – BioRID left; HIII right
 - Mirror image belt configurations
 - Two high speed video cameras per seat position



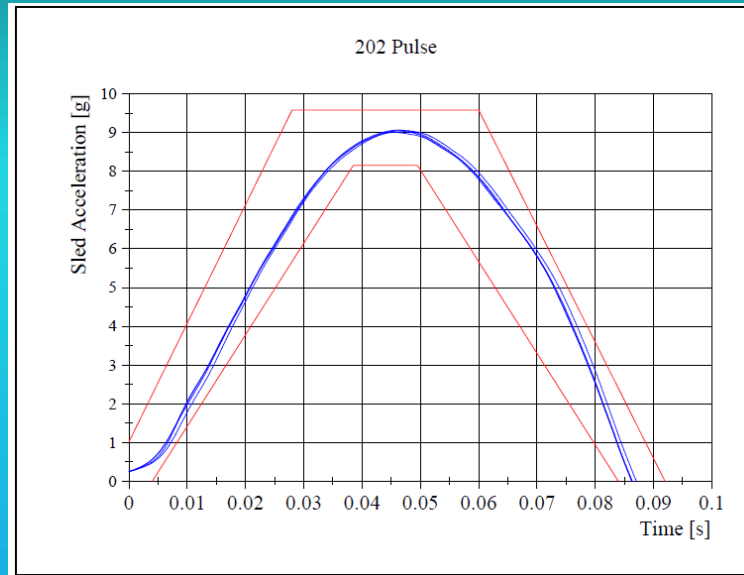
- Close-up
- Wide-angle



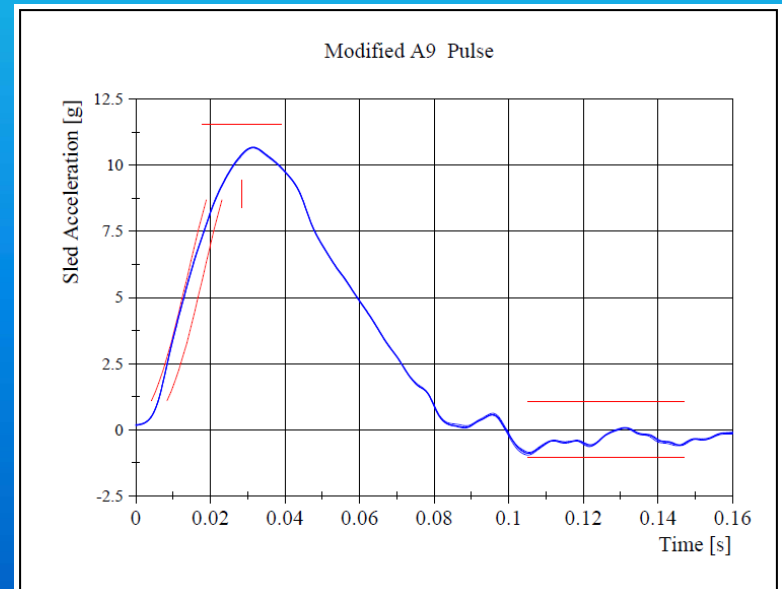
- Seats procured from OEM Tier I supplier
- Compact 2010 passenger car
 - Seat rated “Good” by IIHS – 2011/12 M.Y.
 - Seat rated “Good” by ENCAP – 2009 M.Y.
- Head restraint tested with two backset conditions
 - OEM design
 - 40 mm rearward translated
- All seats “Oscar’d” prior to testing
 - Seats set at full down height
 - Full upward pan tilt
 - 25° seat back torso angle
 - Seat H-pt used to position ATDs per FMVSS202a HIII and BioRID specs



- FMVSS 202a



- Modified Annex 9



Primary evaluation criteria:

FMVSS 202a

- Head-to-T1 angle
 - $< 12^\circ$ extension
- HIC₁₅
 - < 500

Euro NCAP

- NIC [f (relative head-T1 acceleration and velocity)]
 - $11 - 24 \text{ m}^2/\text{s}^2$
- Nkm [f (UPNK Fx and My)]
 - $.15 - .55$
- Head rebound velocity
 - $3.2 - 4.8 \text{ m/s}$
- Upper neck shear, Fx
 - $30 - 190 \text{ N}$
- Upper neck tension, Fz
 - $360 - 750 \text{ N}$
- T1 acceleration
 - $9.3 - 13.1 \text{ g}$
- Time to head restraint contact
 - $57 - 82 \text{ msec}$

Trends: good/bad seat FMVSS202a criteria

	HIII	BioRID II
202a	<ul style="list-style-type: none"> •Head-T1 rot. ↑ pass/fail •HIC₁₅ ↑ pass/pass < 70 	<ul style="list-style-type: none"> •Head-T1 rot. ↔ pass/pass •HIC₁₅ ↑ pass/pass < 100
Mod Annex 9	<ul style="list-style-type: none"> •Head-T1 rot. ↑ pass/fail •HIC₁₅ ↑ pass/pass < 70 	<ul style="list-style-type: none"> •Head-T1 rot. ↔ pass/pass •HIC₁₅ ↑ pass/pass < 100

Trends: good/bad seat ENCAP criteria

	HIII	BioRID II
202a	<ul style="list-style-type: none"> •NIC ↑ pass/fail* •NKM ↑ pass/pass •Reb. Vel. ↑ pass/pass •UpperFx ↑ pass/fail •UpperFz ↑ pass/pass •T1x accel ↔ fail/fail •Tcontact ↑ pass/fail 	<ul style="list-style-type: none"> •NIC ↑ pass/fail* •NKM ↑ pass/fail •Reb. Vel. ↑ fail/fail* •UpperFx ↑ pass/fail •UpperFz ↑ fail/fail* •T1x accel ↔ fail*/fail* •Tcontact ↑ pass/fail
Mod Annex 9	<ul style="list-style-type: none"> •NIC ↑ pass/fail* •NKM ↑ pass/pass •Reb. Vel. ↑ pass/pass •UpperFx ↑ pass/fail •UpperFz ↑ pass/pass •T1x accel ↔ fail/fail •Tcontact ↑ pass/pass 	<ul style="list-style-type: none"> •NIC ↑ pass/fail* •NKM ↑ pass/fail •Reb. Vel. ↑ fail/fail •UpperFx ↑ pass/fail* •UpperFz ↑ fail/fail* •T1x accel ↑ fail*/fail* •Tcontact ↑ pass/fail

* Exceeds CL value



- *Observations*

- BioRID does not perform well with FMVSS202a criteria
- HIII does perform well with FMVSS202a criteria
- BioRID appears to function better with ENCAP criteria (albeit our pulse & seating not exactly ENCAP)
- HIII does not discriminate as well as BioRID II with ENCAP criteria
- T1x acceleration is a poor criterion for both dummies
- BioRID is more biofidelic than the HIII (ref: Moorehouse/Kang, Brussels, 2011)



Thank you

Head Time to Contact						
Pulse	Backset (mm)	ATD	Initial contact (msec)	Avg. Initial contact (msec)	Total time of contact (msec)	Avg.Total time of contact (msec)
202a						
	OEM	BioRID	74.6/73.1	73.8	74.6/73.0	73.8
		HIII	75.6/73.5	74.6	77.6/80.1	78.8
	+ 40	BioRID	86.6/88.3	87.4	71.2/73.0	72.1
		HIII	86.4/87.8	87.1	63.2/64.1	63.6
Mod. A9						
	OEM	BioRID	68.6/65.8	67.2	67.2/69.7	68.4
		HIII	65.8/65.8	65.8	82.2/79.0	80.6
	+ 40	BioRID	82.8/83.0	82.9	67.8/65.4	66.6
		HIII	79.4/81.5	80.5	64.5/63.4	64.0