

# Pedestrian Safety GTR Head and Leg Impact Testing

41<sup>st</sup> Session of GRSP  
May 2007

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# Purpose of US Testing

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- ★ Understand impact of draft GTR in terms of benefits in the US and costs for the current US fleet.
- ★ Understand the effect of shape on feasibility
- ★ Gather data to determine feasibility of extending draft GTR to cover all US light vehicles fleet (4500 kg), or whether draft GTR should only apply to vehicles of 3500 kg or 2500 kg.
- ★ Gather data for both the head and leg requirements in draft GTR.

# Head Test Overview

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## ★ Purpose:

- Provide data on current level of head protection for GTR benefits estimate
- Focus on larger vehicles in US fleet
- Focus on vehicles with a range of front end shapes, based on bonnet leading edge location.

## ★ Methods:

- Head impacts per GTR procedures (35 km/h)
- 8 Hard/Soft/Typical points
- Estimated 1/3 relaxation zone to identify probable “passing” points/vehicles.
  - $\leq 1700$  HIC in relaxation zone (1/3 test zone)
  - $\leq 1000$  HIC everywhere else

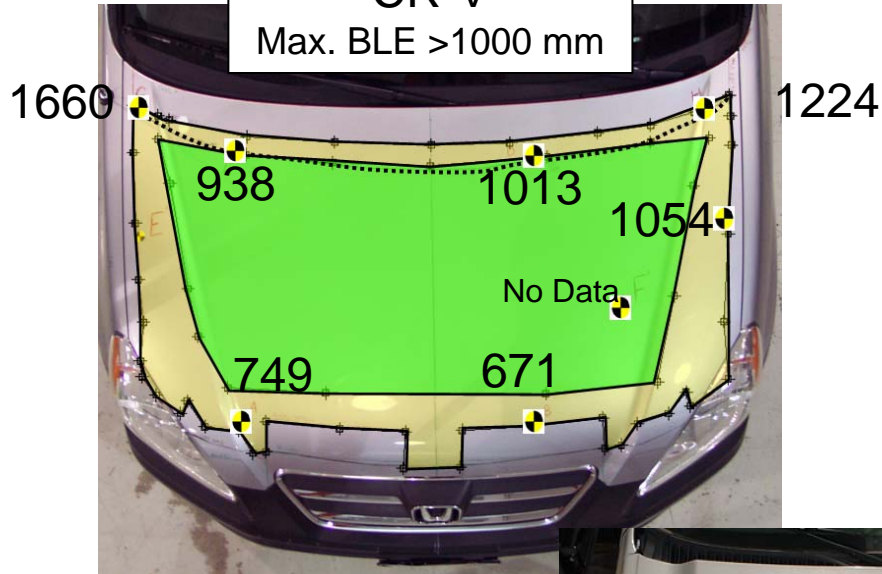
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Test vehicles	GVM (kg)	Bonnet	
		Leading Edge WAD (mm)* (Min)	(Max)
2002 Jeep Wrangler	2019	916	1111
2005 Honda CR-V	2020	880	1014
2006 Volkswagen Passat	2020	840	880
2006 Toyota Tacoma	2063	992	1026
2003 Toyota 4Runner	2063	1030	1091
1999 Dodge Dakota	2200	895	995
2003 Ford Crown Victoria	2632	804	848
2006 Dodge Durango	2903	1088	1240
2003 Hummer H2	3901	1172	1196
2003 Ford E350	4127	1162	1188
2005 Chevrolet Silverado	4173	1210	1265

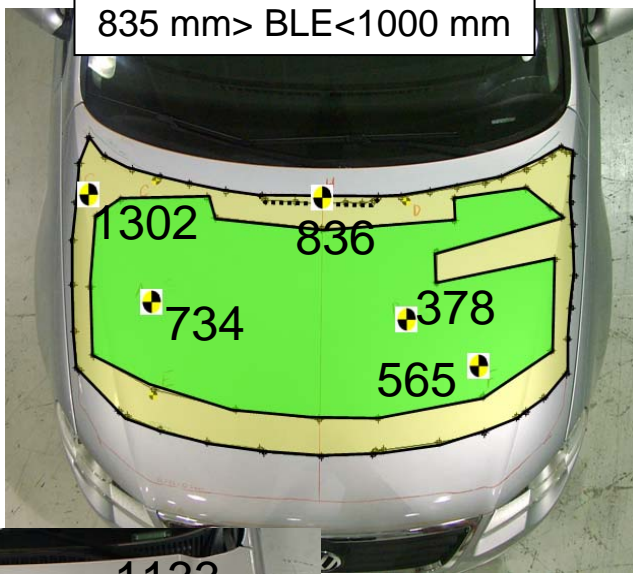
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# Vehicles with No Failures

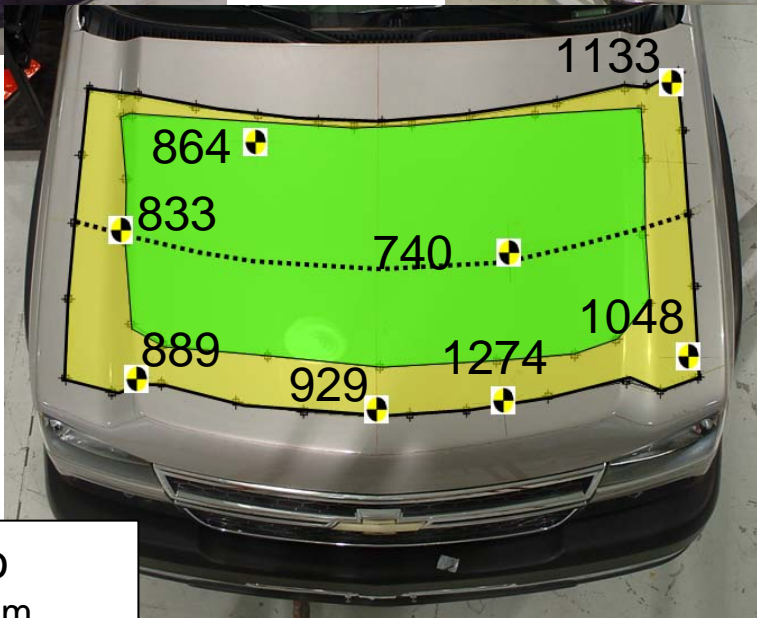
CR-V  
Max. BLE >1000 mm



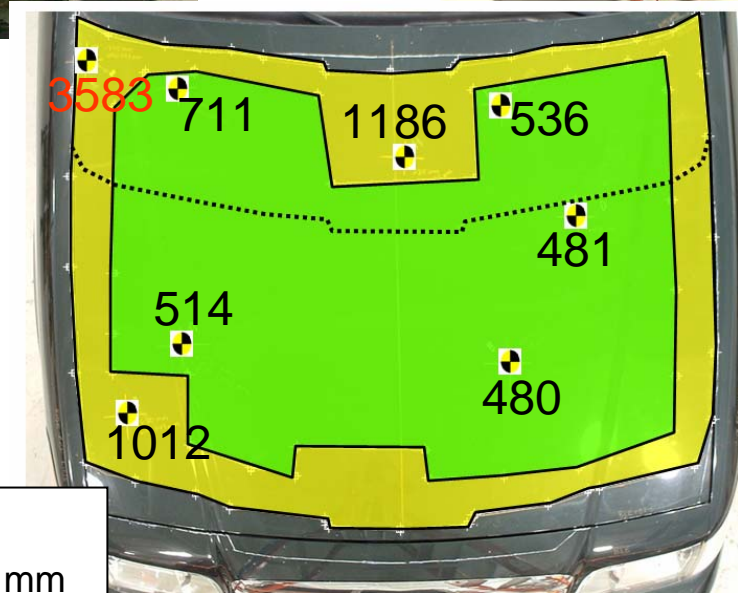
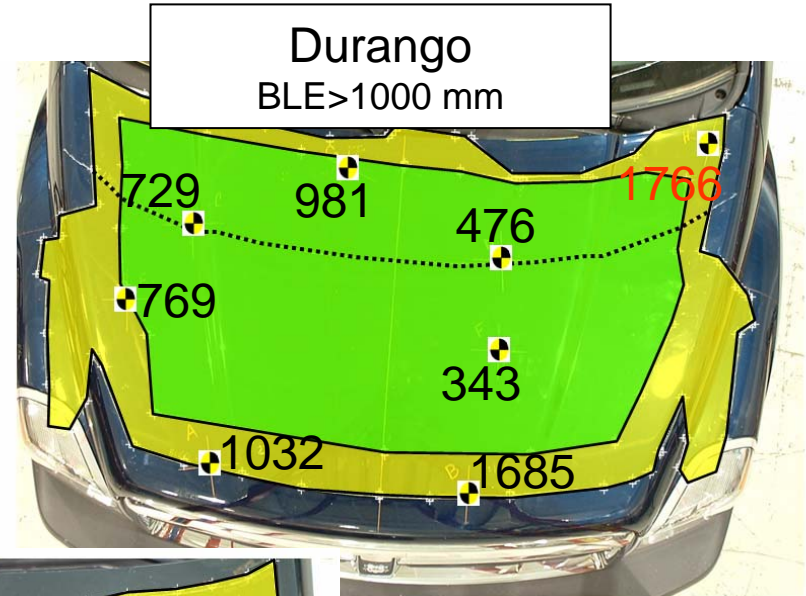
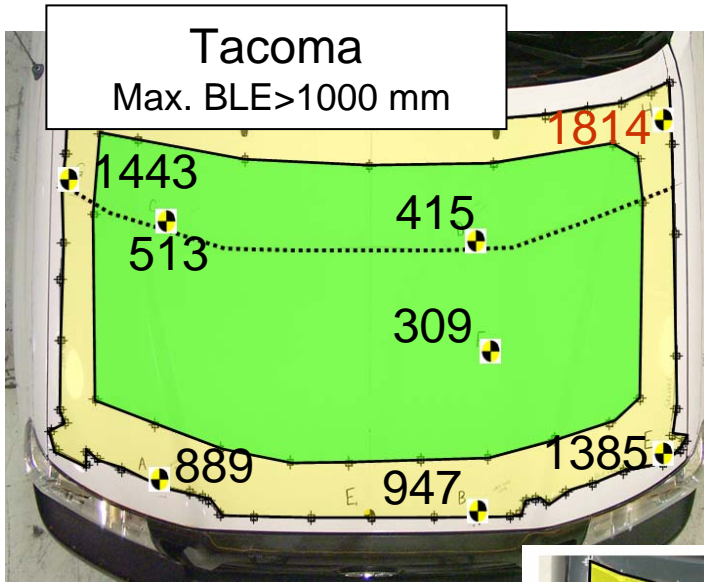
Passat  
835 mm > BLE < 1000 mm



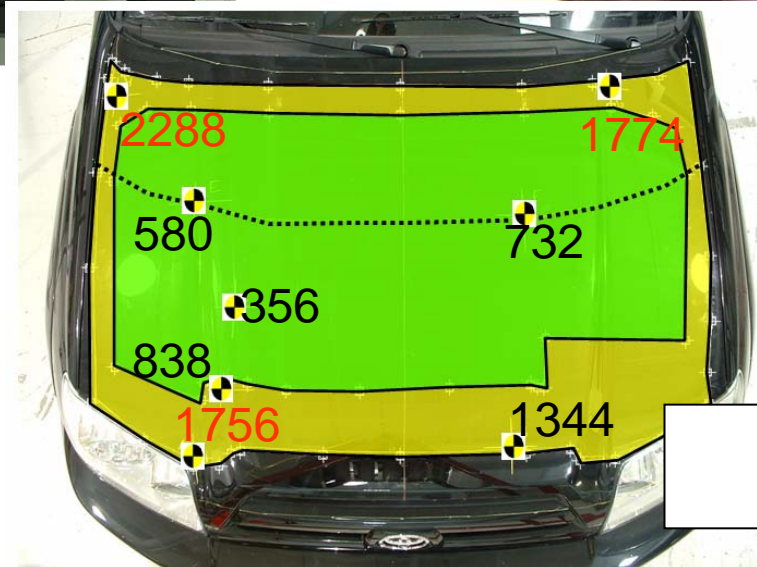
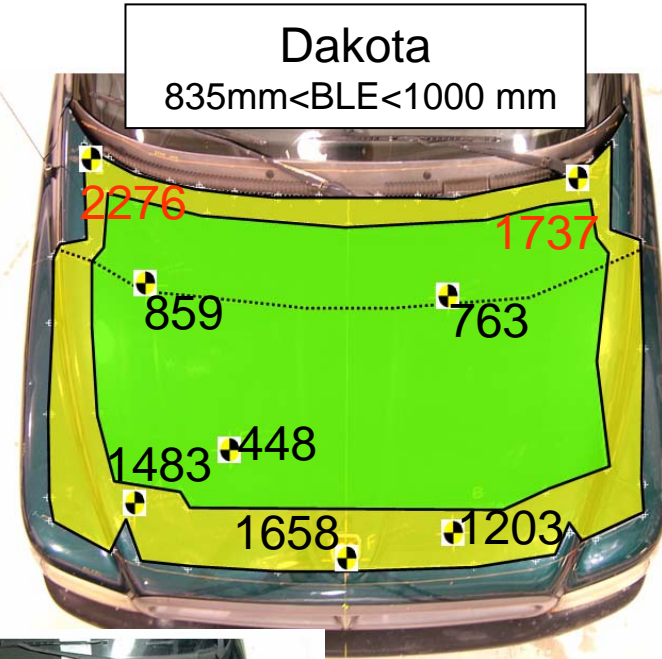
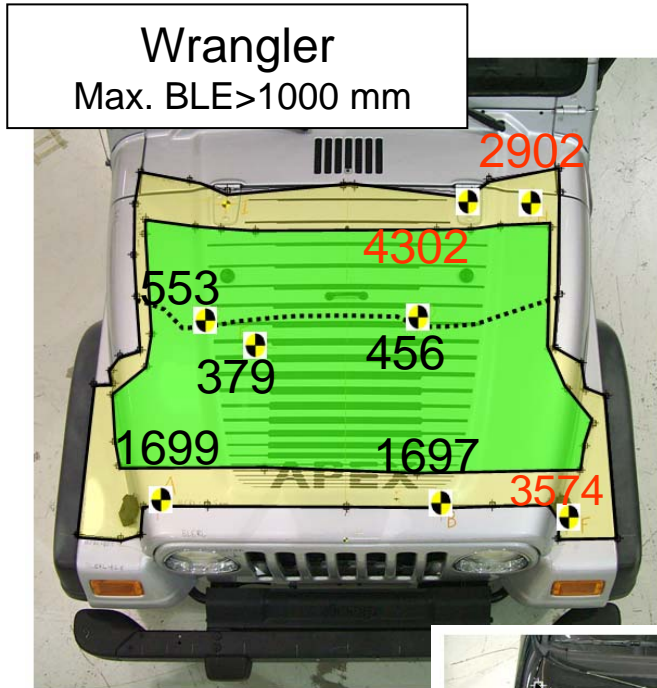
Silverado  
BLE > 1000 mm



# Vehicles with a Failing Impact in Estimated Relaxation Zone



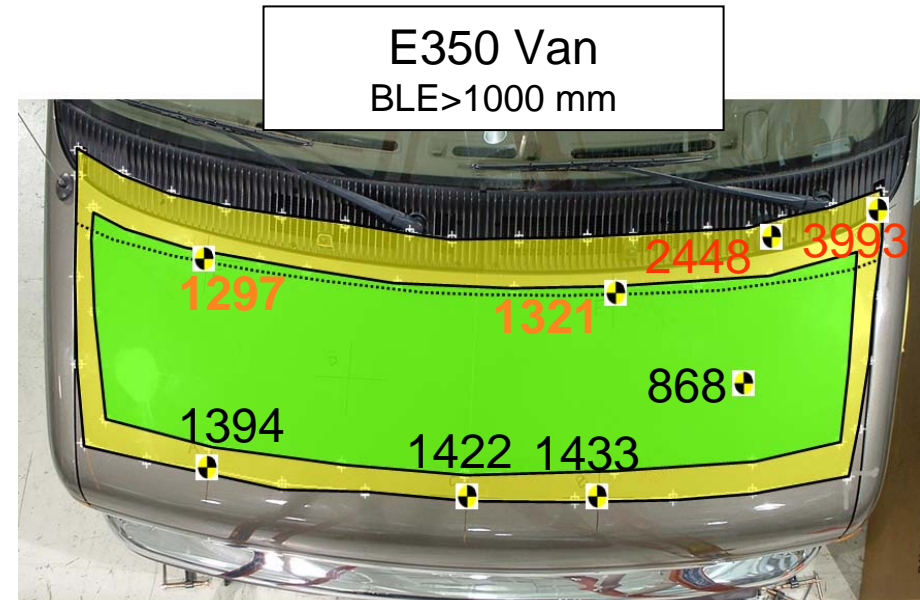
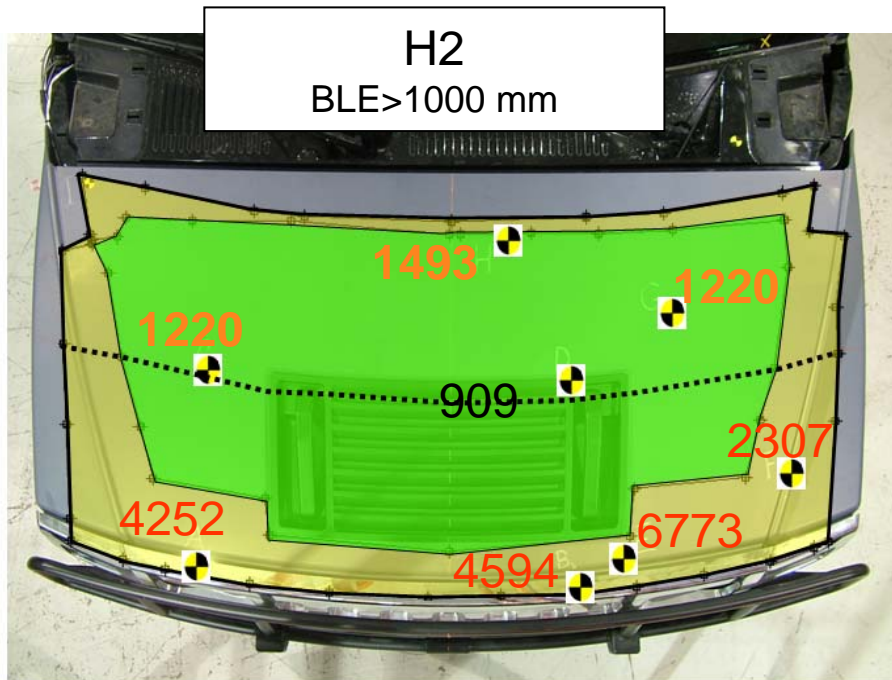
# Multiple Failing Impacts in Estimated Relaxation Zone



4Runner  
BLE > 1000 mm

# Vehicles with Multiple Failing Impacts in Relaxation Zone *and* outside of Relaxation Zone

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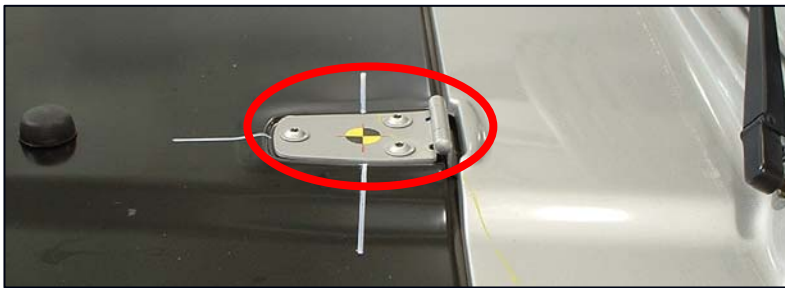




# Solutions in Challenging Areas: Hinge

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Jeep Wrangler – HIC 4302



Ford E350 – HIC 3993



VW Passat – HIC 1302



Low-profile  
deformable hinge

# Solutions in Problem Areas: Cowl

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Ford E350 – HIC 2448



Dodge Durango – HIC 981



# Preliminary Head Impact Benefits & Costs

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## ★ Preliminary benefits from Head Impact Test

- Up to 2500 kg: 4-5 lives may be saved
- 2500-3500 kg range: 49-74 lives may be saved
- 3500-4500 kg range: 8-13 lives may be saved

## ★ Preliminary costs per lives saved

(millions of US \$2006)

- Up to 2500 kg: 24.1 - 34.0
- 2500-3500 kg range: 2.9 – 4.3
- 3500-4500 kg range: 1.8 - 3.0

# Head Testing Observations

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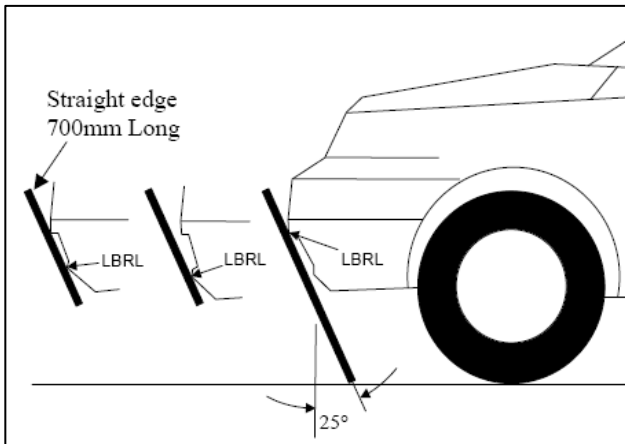
- ★ No apparent reason to limit scope of GTR below 4500 kg.
  - The heaviest vehicle in our test program currently meets all head impact requirements in the draft GTR, while the lightest vehicle in the test program requires some redesign .
  - Technical consensus is that the vehicle shape, NOT the mass, is the most important.
- ★ The test procedure is feasible and the requirements are cost beneficial for all vehicles up to 4500 kg.
- ★ Few vehicles will require major re-design, but most vehicles will require some re-design. Adequate lead time must be provided to make these changes.
- ★ Effective countermeasures exist for challenges identified:
  - For all problem areas at least one vehicle performed well.

# Lower Leg Test Overview

- ★ Testing 13 vehicles for compliance with the draft GTR lower leg requirements.
  - Will also analyze data from 5 previously tested vehicles, discussed in ESV paper 05-194.
- ★ Purpose
  - Provide data on current level of leg protection for the GTR benefits estimate
  - Focus on larger vehicles in US fleet
- ★ Methods
  - Lower Leg impacts per GTR procedures using the TRL legform (40 km/h)
  - 5 points per vehicle tested
- ★ Testing completed for discussion at June WP.29 session.

# Lower Leg Impact Testing

	2002 Mazda Miata	2005 Chev Silver- ado	2005 Honda CRV	2006 Toyota Tacoma	2003 Toyota 4- Runner	2002 Jeep Wrangler	1997 Ford Expedi- tion	2006 VW Passat	2006 Toyota Sienna	1999 Ford Explorer	1999 Dodge Dakota	2006 Dodge Durango	2003 Ford E350 Van
LBRL Min. Height (mm)	200	420	410	378	460	451	482	219	TBD	418	342	405	348
LBRL Max. Height (mm)	218	505	415	378	469	481	502	230	TBD	540	342	452	408



**GTR Test Rules**

- LBRL < 425 mm**      lower leg test required
- 425 mm ≤ LBRL < 500 mm**      manufacturer's choice of lower or upper leg test
- LBRL ≥ 500 mm**      upper leg test required