



INTERNATIONAL ORGANIZATION OF MOTOR VEHICLE MANUFACTURERS

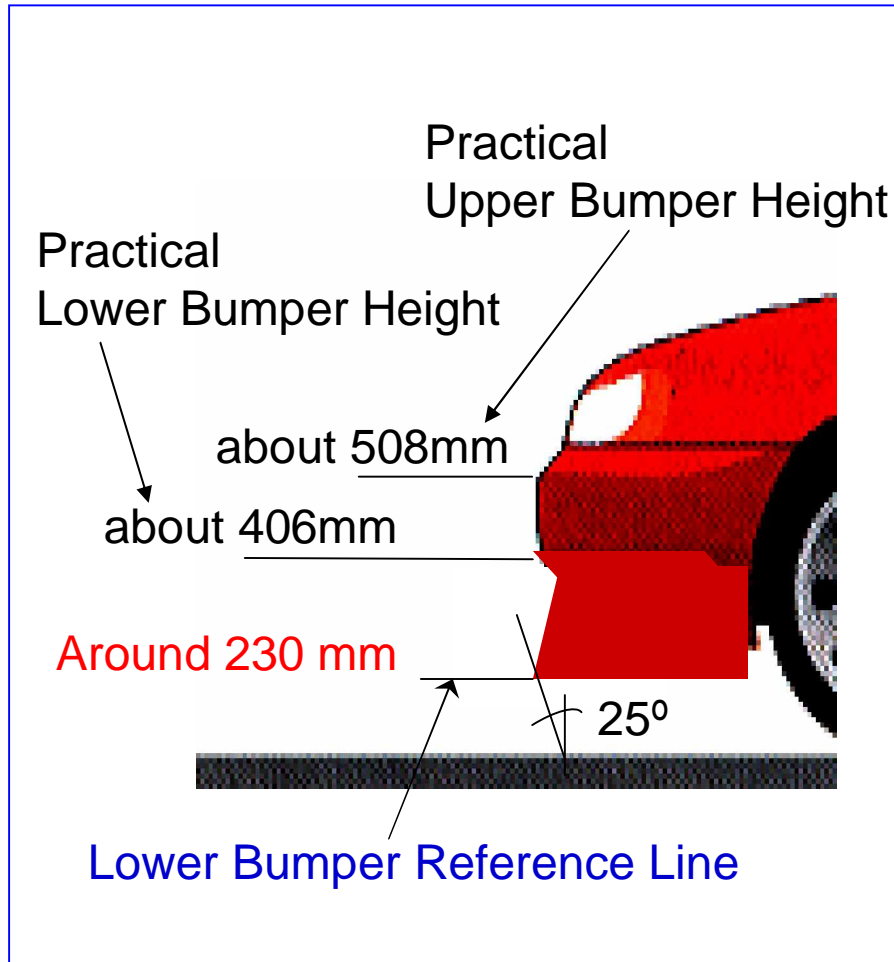
# Lower/Upper Bumper Reference Line

Data on existing vehicles

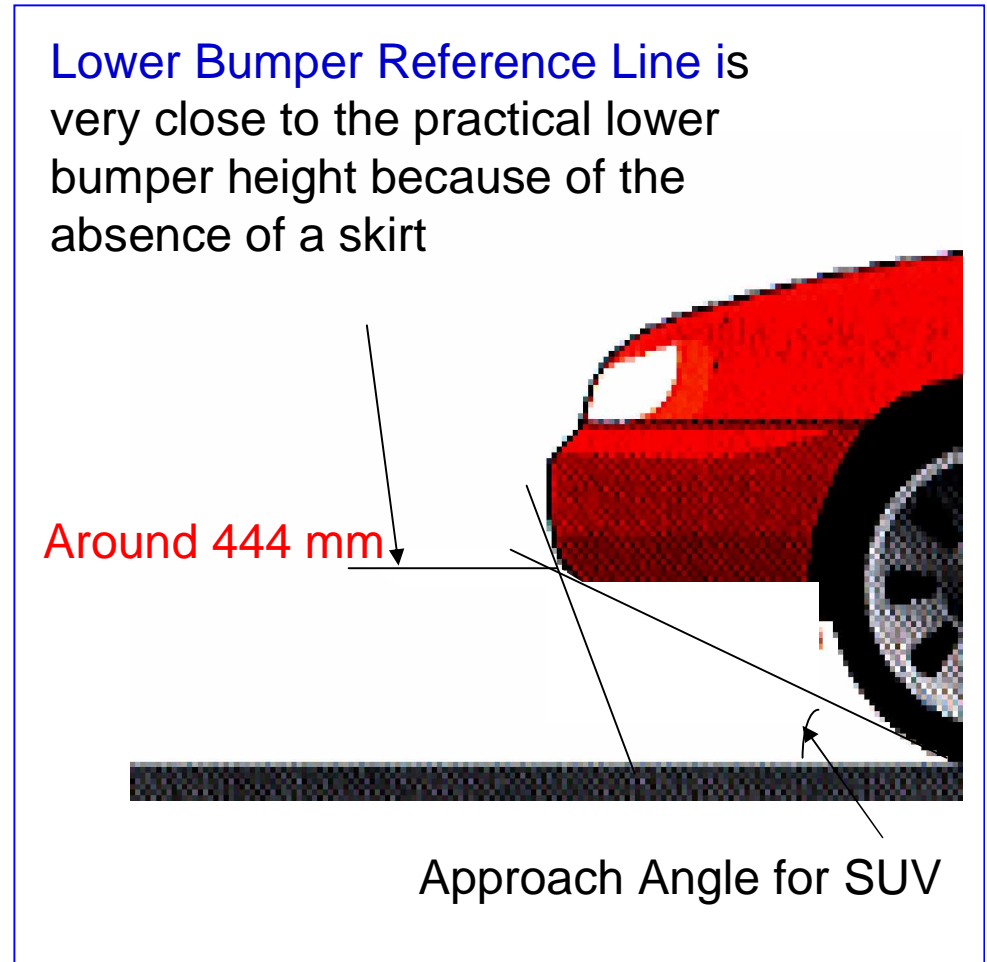


# Introduction

Typical Passenger Car



Typical SUV





| Car | Type       | LBRL<br>(mm) | UBRL<br>(mm) |
|-----|------------|--------------|--------------|
| 1   | Sport      | 210          | n.a.         |
| 2   | Sport      | 210          | n.a.         |
| 3   | SUV        | 466          | n.a.         |
| 4   | Large SUV  | 497          | 730          |
| 5   | Large SUV  | 485          | 712          |
| 6   | Large SUV  | 440          | 618          |
| 7   | Medium SUV | 420          | 685          |
| 8   | Medium SUV | 458          | 648          |
| 9   | Small SUV  | 391          | 669          |
| 10  | Small SUV  | 500          | 608          |
| 11  | Small SUV  | 340          | 633          |
| 12  | Large MPV  | 274          | 570          |

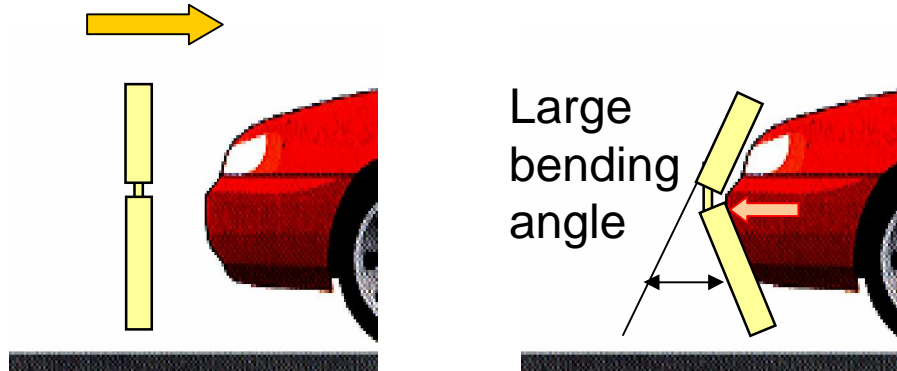
| Car | Type         | LBRL<br>(mm) | UBRL<br>(mm) |
|-----|--------------|--------------|--------------|
| 13  | Large Family | 235          | 469          |
| 14  | Large Family | 228          | 487          |
| 15  | Large Family | 237          | 586          |
| 16  | Small Family | 236          | 522          |
| 17  | Small Family | 224          | 493          |
| 18  | Mini         | 225          | 514          |
| 19  | Mini         | 214          | 509          |

Average SUV: 444 mm

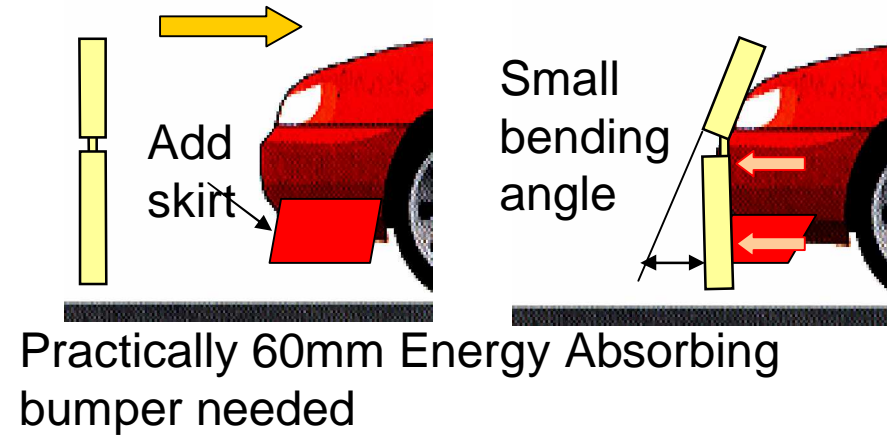
Average other: 230 mm

# Counter measures for Lower Leg Requirements

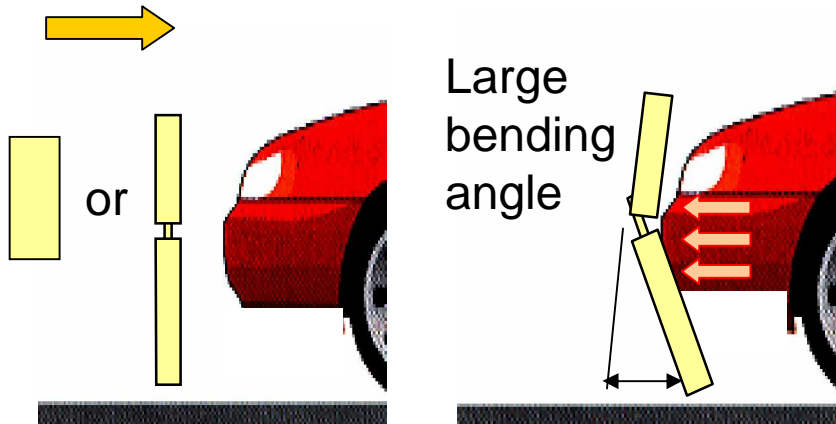
Typical Current Passenger Car



Improved car



Typical SUV



High bumper test requirement

@ Max. Load 7.5KN

@Max. Bending Moment 510Nm

Practically 120mm Energy Absorbing bumper needed



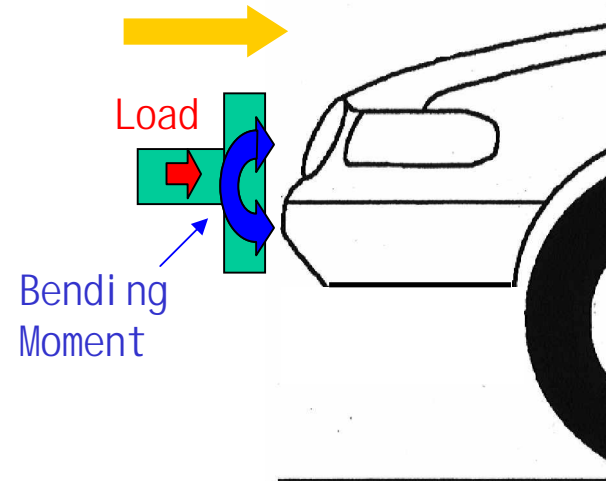
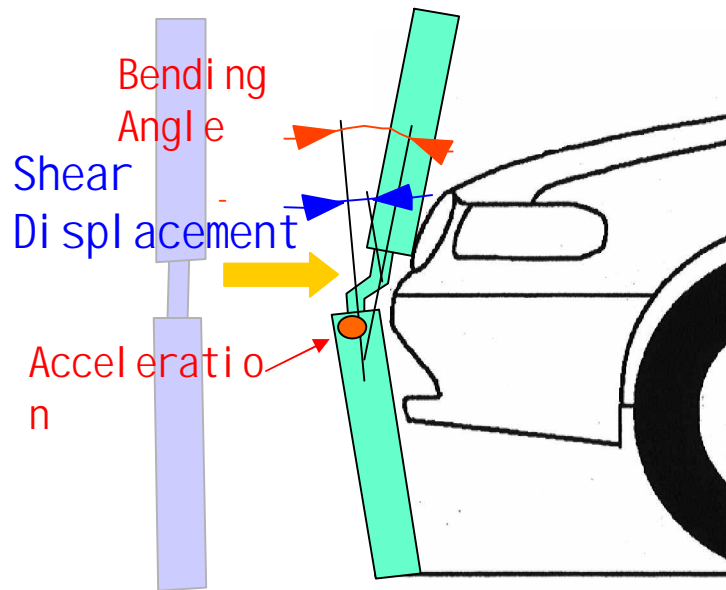
Typical passenger cars can meet the angle requirement, because they can have lower load path at the skirt. However, SUV cannot have such lower load path and have difficulties to meet the angle requirement.



# Conclusions

- SUV, because of their basic design, cannot include a lower load path for the lower leg test
- SUV therefore need the option of the upper leg bumper test
- Typical Lower Bumper Reference Line for SUV start at 340 mm up to 500 mm
- In order to cover a representative portion of existing SUV's, such option (lower or upper leg to bumper test) should therefore be possible for LBRL between around 400 and 500 mm

# LEGFORM IMPACT TEST & HIGH BUMPER IMPACT TEST



# Comparison of Both Tests

## High Bumper Test Results (Upper Leg Impactor)

Red = Over

Blue = Meet

|                         |          | Bumper Length | Load     | Bending moment |
|-------------------------|----------|---------------|----------|----------------|
| Production SUV          | Model A  | 55mm          | 13.11 kN | 965.0 Nm       |
|                         | Model B  | 90mm          | 9.18 kN  | 654.5 Nm       |
| Modified Bumper         | Model B' | 105mm         | 6.32 kN  | 391.6 Nm       |
| Criteria (draft Phase2) |          |               | 7.5 kN   | 510 Nm         |

Close to 80%

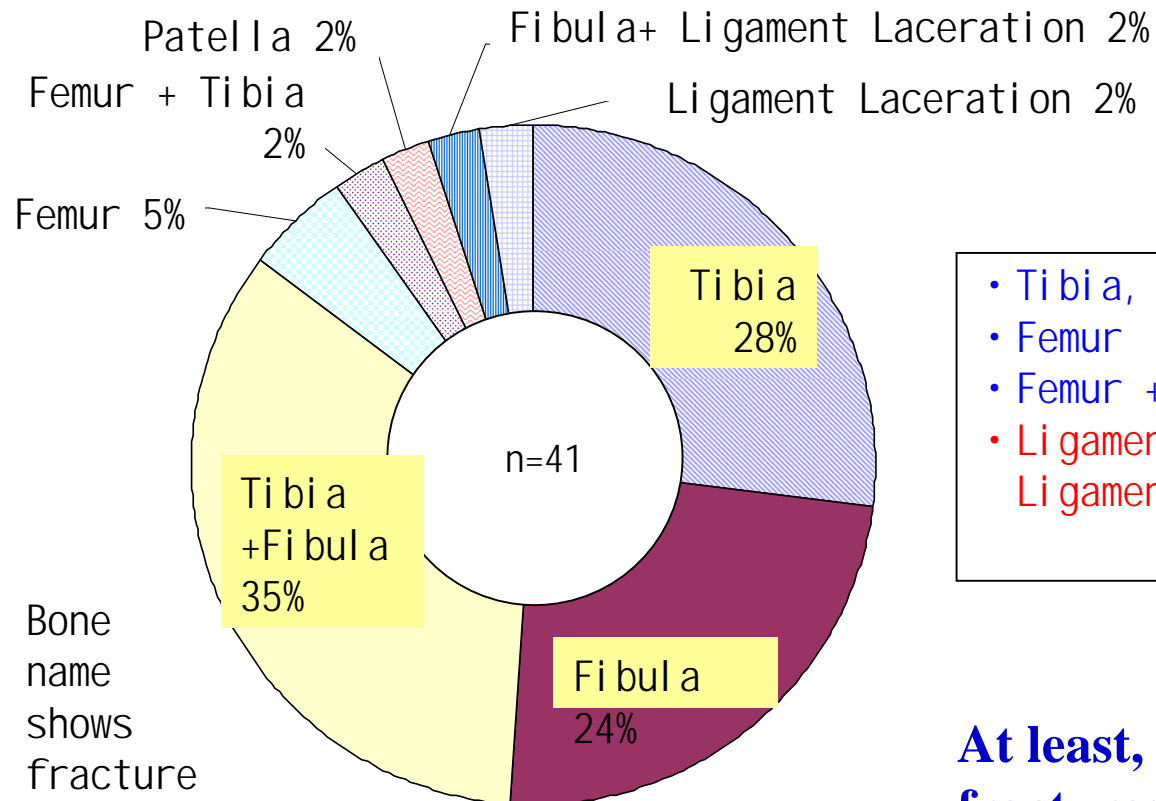
## TRL Leg Form Impactor Test Results

|                         |          | Bumper Length | Bending Angle | Shear disp. | Acceleration |
|-------------------------|----------|---------------|---------------|-------------|--------------|
| Production              | Model A  | 55mm          | 32.5deg.      | No Data     | 226.6G       |
|                         | Model B  | 90mm          | 33.5deg.      | 7.2mm       | 199.9G       |
| Modified Bumper         | Model B' | 105mm         | 30.9deg.      | 4.4mm       | 155.7G       |
| Criteria (draft Phase2) |          |               | 19deg.        | 6mm         | 170G         |

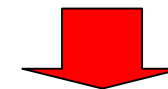
Counter measure for high bumper test could not largely reduce the bending angle, but reduce acceleration and shear displacement up to the required level by LFI test.

# Leg Injury Distribution

JAPAN



- Tibia, Fibula, Tibia + Fibula 87%
- Femur 5%
- Femur + Tibia 2%
- Ligament Laceration, Ligament Laceration + Fibula 4%



**At least, tibia, fibula or femur fractures which share large part of AIS2+ leg injuries could be expected to be reduced by the high bumper test application.**

Distribution of AIS 2+ Leg Injuries

by ITARDA report issued 2005

117 pedestrian accidents in 1993-2003,  
bonnet type passenger car



# Conclusions

- @ The lower leg to bumper test is not feasible for high bumper vehicles.
- @ High bumper vehicles need to have energy absorbing bumpers in order to meet the upper leg to bumper test.
- @ Energy absorbing bumpers will reduce real world leg injuries as also seen in the lower leg acceleration criterion.

END