PSI-01-10

US Side Impact Pole Test

Federal Motor Vehicle Safety Standard No. 214

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National Highway Traffic Safety Administration

Bonn, Germany – November 16-18, 2010

Purpose of Rulemaking

- **To protect front seat occupants in a vehicle-to-pole test**
  - Simulates a vehicle crashing sideways in a narrow fixed object, like a utility pole or tree
- **Assures head and improved chest protection in side crashes for a wide range of occupant sizes and over a broad range of seating positions.**
  - Encourages the use of new technologies, such as curtain airbags
  - Also reduces fatalities and injuries in vehicle-to-vehicle side impact crashes and partial ejections through side windows.

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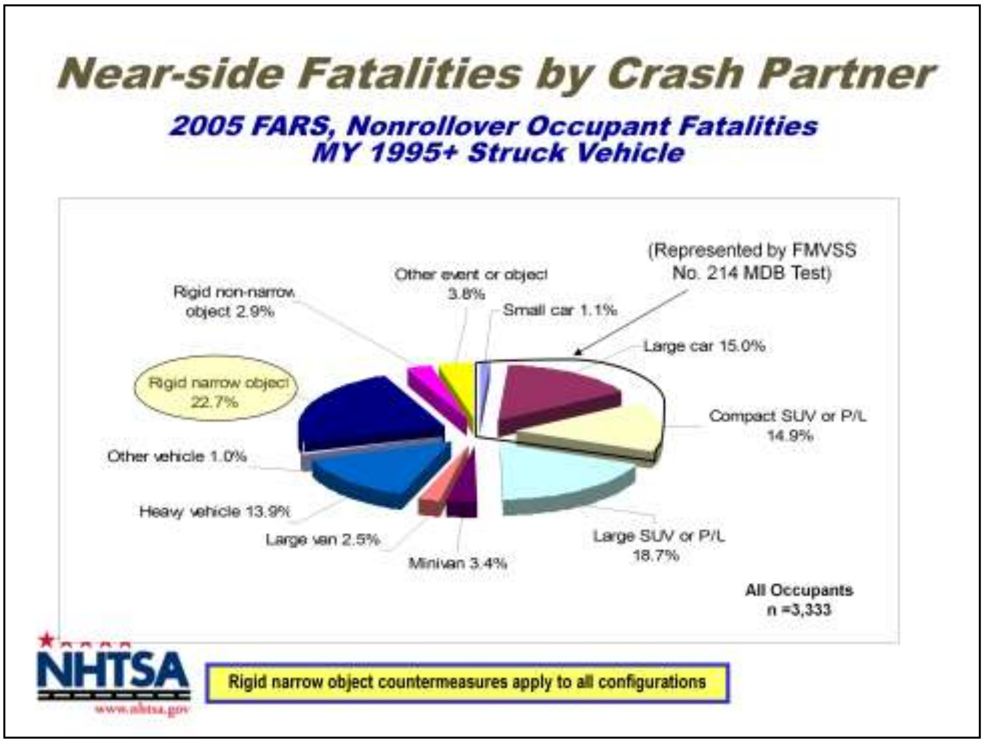

•An analysis of FARS data shows that of side impact fatalities, 23% are caused by impacts with a narrow rigid pole.

Real World Crash Injury Data
(Basis for US Rulemaking)

2001 FARS
1997-2001 NASS

	Injury Occurrence	
	Serious	Fatal
Head	13%	40%
Chest	59%	38%

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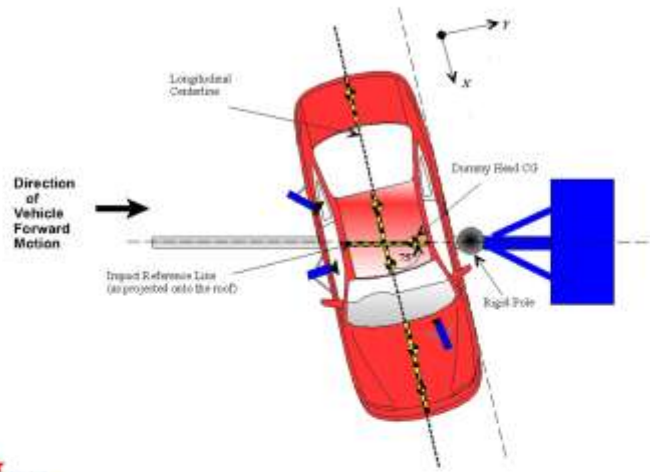
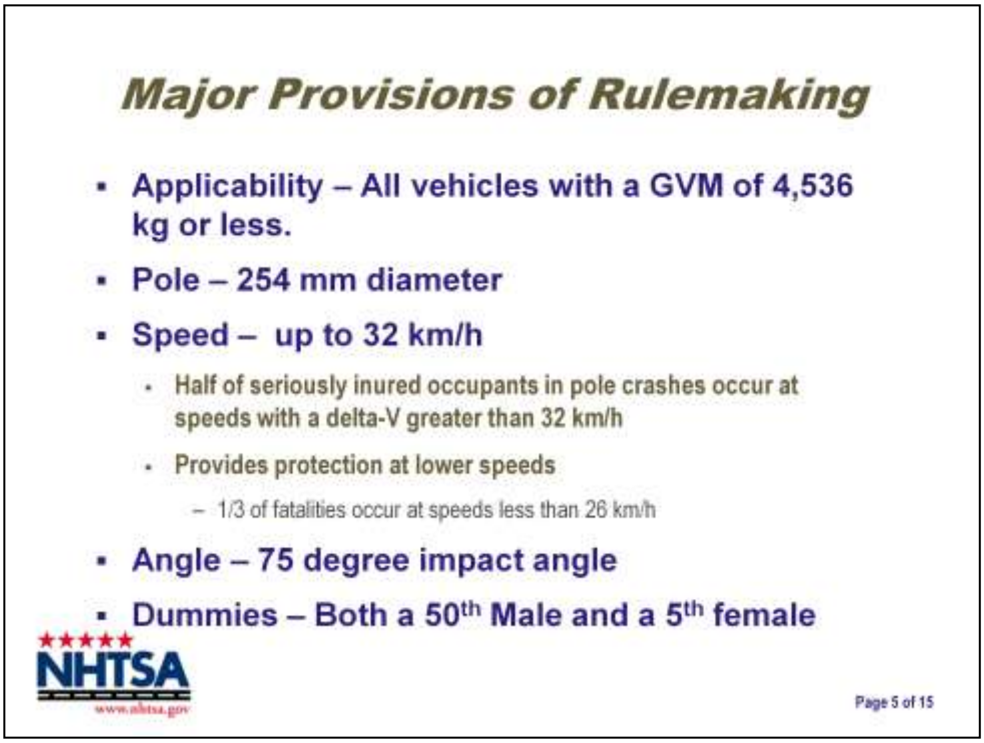
•In the data, 40% of the total fatalities are caused by head/face injuries, 38% by chest injuries and 8% by abdominal injuries.

•In contrast, for the non-fatal AIS 3-5 target population, chest injuries are the predominant maximum injury source accounting for 59 percent, head/face injuries account for 13 percent.

Oblique Pole Test





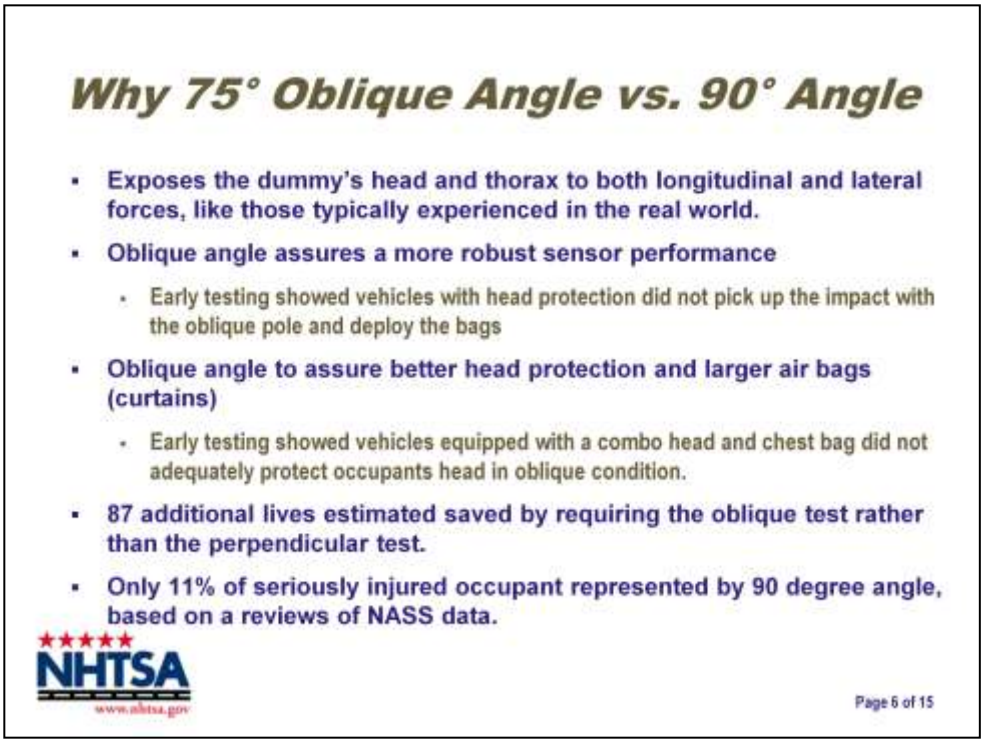
The intent of the rulemaking was to establish a comprehensive side impact test that requires a systems approach to improve protection for the head, thorax, abdominal, and pelvic areas and to help retain the occupant in the safe environment of the vehicle interior. This test was not designed to duplicate the FMVSS 201 perpendicular pole test.

Applicability – NHTSA provided more lead time for vehicles greater than 3,855 kg because they had never been regulated to any dynamic side impact test.

Pole – The diameter of the pole is the same as the prior FMVSS 201 perpendicular pole test. This size is representative of poles struck in the US. It is based on data provided by the Federal Highway Administration that noted there are 80 million timber utility poles in the roadside environment which have a common 254 mm diameter.

Speed –

Angle – discussed in next slide



Oblique test would enhance safety because it is more representative of real-world side impact pole crashes than the 90-degree test.

Frontal Oblique crashes with a principle direction of force of 74 to 84 degrees account for the highest percentage of seriously injured near side occupants in narrow impact crashes.

However, the crash data shows that the principle direction of force distribution encompasses a wide range of approach angles, where the mean is a 60 degree impact angle, but a steeper angle was not chosen because there were repeatability problems with the test procedure.

Why Use the 5th Percentile Female

- **35% of all serious and fatal injuries to near-side occupants in side impact crashes occur to occupants 5' 4" or less.***
- **Differences in body region distribution of serious injuries**
  - Smaller occupants have a higher proportion of head, abdominal, and pelvic injuries
  - Smaller occupants have a lesser proportion of chest injuries
- **Ensures protection over a range of seating positions**
- **Additional 78 lives estimated saved by use of 5th female**

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*Based on 19977-2001 NASS CDS data (value is 25% for 2002-2004 data)

Using both dummies will better represent the at-risk population.

In this test of a Toyota Sienna, the 50th percentile male dummy had good head protection, recording a HIC of 667, but the 5th female was not as well protected by the airbag system and showed a high probability of a head and pelvis injury, with a HIC of 2019 and a pelvic force of 4670 N.

Other examples:

The Nissan Maxima met the perpendicular pole test with a HIC of 130, but in the oblique test, the head of the ES-2 dummy rotated off of the combination head and thorax bag and hit the pole, resulting in a HIC of 5,254.

Both the Ford Explorer and Toyota Camry meet the requirements of the perpendicular pole test, but when tested obliquely with the 5th female, the airbags failed to deploy – resulting in HICs of 13,125 and 8,706 respectively.

(For Reference) Injury Criteria

SID-IIsD	ES-2re
HIC36: 1000	HIC36: 1000
Lower Spine: 82g	Rib Def: 44 mm
Pelvis Force: 5100N	Lower Spine: 82g
Thorax def (M): 38 mm	Abdominal Force: 2500N
Abdominal def (M): 45 mm	Pelvis Force: 6000N

Technical Feasibility

- **Seat –mounted head/thorax bags, designed for the 90-degree test, will need to be redesigned**
  - The air pocket would need to extend further forward toward the A-pillar
  - Need a more robust inflation system and larger size
- **Side air curtains would need less redesign**
  - Extend them closer to the A-pillar to protect the small female dummy
- **Some vehicles in the U.S. already meet the new requirement.**

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Incremental Costs

- **New systems**
  - Wide head/torso combo bag w/ 2 sensors ~ $126/vehicle
  - Wide window curtain + torso bag w/ 2 sensors ~ $243/vehicle
  - Wide window curtain + torso bag w/ 4 sensors ~ $280/vehicle
- **Vehicles with Side Air Bags**
  - In 2005, over 40% have head and/or torso inflatable protection systems
  - In 2011, manufacturers project 89% head and 73% torso air bags
  - Added sensors and/or wider bags required to meet requirements
- **Average incremental cost ~ $25-66/vehicle, with MY 2011 fleet**

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*Target Population**
(NASS CDS, 12 –25 mph)

- Fatalities: 2,311
- AIS 3-5 Injuries: 5,891

* Excludes Rollover Crashes

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*Incremental Benefits**
(Lives & Injuries Saved)

- **About 80% of benefits are from head injuries**

	Fatalities saved	AIS 3-5 injuries prevented
Combination head/torso air bag w/ 2 sensors	266	352
Window curtain + torso air bag w/ 2 sensors	311	361
Window curtain + torso air bag w/ 4 sensors	311	371

*Benefit estimates are based on 100% ESC

*Based on projected air bag sales in MY 2011

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Cost Effectiveness Estimates

Costs (2004 dollars)	Benefits	Cost per ELS
$429M – 1.1B	266-311 fatalities 352-371 injuries	$1.6* – 4.6 M†

* - 3% discount; head/torso combo bag
† - 7% discount; window curtains + torso bag w/ 4 sensors

The most likely scenario is window curtains and separate thorax bags with 2 sensors, the cost per equivalent life saved is $1.8 to $2.3 million.

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References

- Federal Register Notices (http://www.gpoaccess.gov/fr/index.html)
  - Notice of Proposed Rulemaking: 69 FR 27993
  - Final Rule: 72 FR 51957
  - Response to Comments on Final Rule: 73 FR 32483
- NHTSA Side Impact Research: Motivation For Upgraded Test Procedures, R. Samaha and D. Elliott, 18ESV492
- FMVSS 214 Pole Tests w/ SID-IIsD and ES2-re (http://www-nrd.nhtsa.dot.gov/database/aspx/vehdb/querytesttable.aspx)
  - Test #s: 5436, 5317, 5443, 5408, 5457, 5472, 5444, 4859, 5458, 5407, 5438, 5300, 5459, 5405, 5421, 5439, 5417,5296,5437,5406,5470, 5416

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Thank You

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