Side Impact Upgrade Research Update

R&D Public Meeting

July 2002

National Highway Traffic Safety Administration

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Outline

- Background
- ES-2 testing research update
- Side impact pole test procedure development
- SIDIIs planned testing
- MDB upgrade research update

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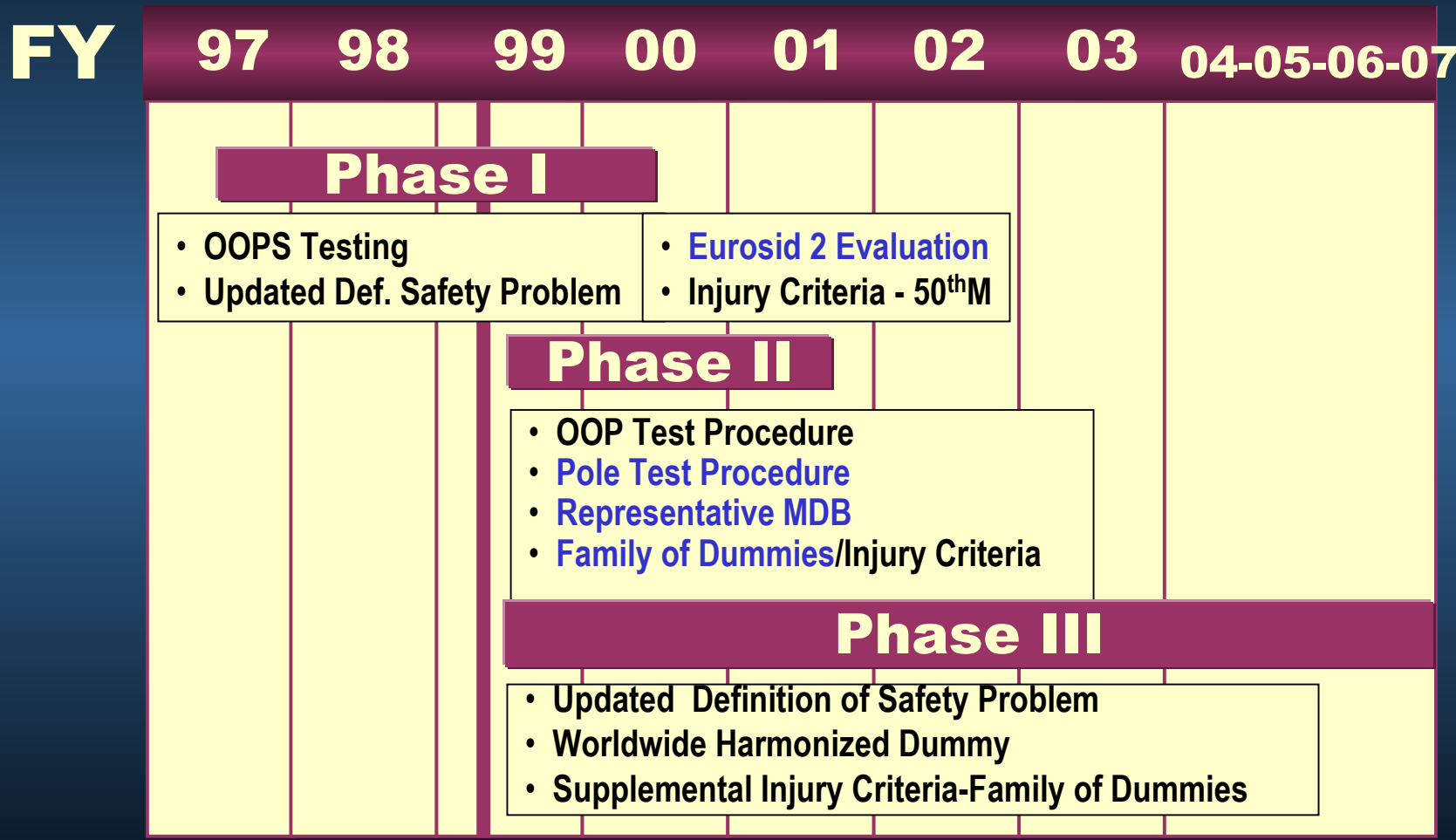
Additional Research

- http://www-nrd.nhtsa.dot.gov/departments/nrd-01/presentations/sae.html
  - Performance Requirements and Injury Criteria for Side Impact: a Research Update
  - Side Impact Dummy Biofidelity
  - SIDIIs Dummy Durability
  - ES-2 Crash Test Performance
- http://www-nrd.nhtsa.dot.gov/departments/nrd-01/presentations/IIHS_TWGmtg.html
  - Evaluation of Injury Risk from Side Impact Air Bags

1999 Report to Congress "Status of NHTSA Plan for Side Impact Regulation Harmonization and Upgrade"



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Crash Environment Population

1990-2000 NASS/CDS

- **People**
  - Near side occupants
  - Seated in first two rows
  - Not completely ejected
- **Vehicles**
  - Light passenger vehicle
  - Towed from the scene
  - Inspected by NASS
- **Damage**
  - Primary damage to the side
  - No rollover
  - No top damage
  - No front, rear, or undercarriage damage past extent zone 2

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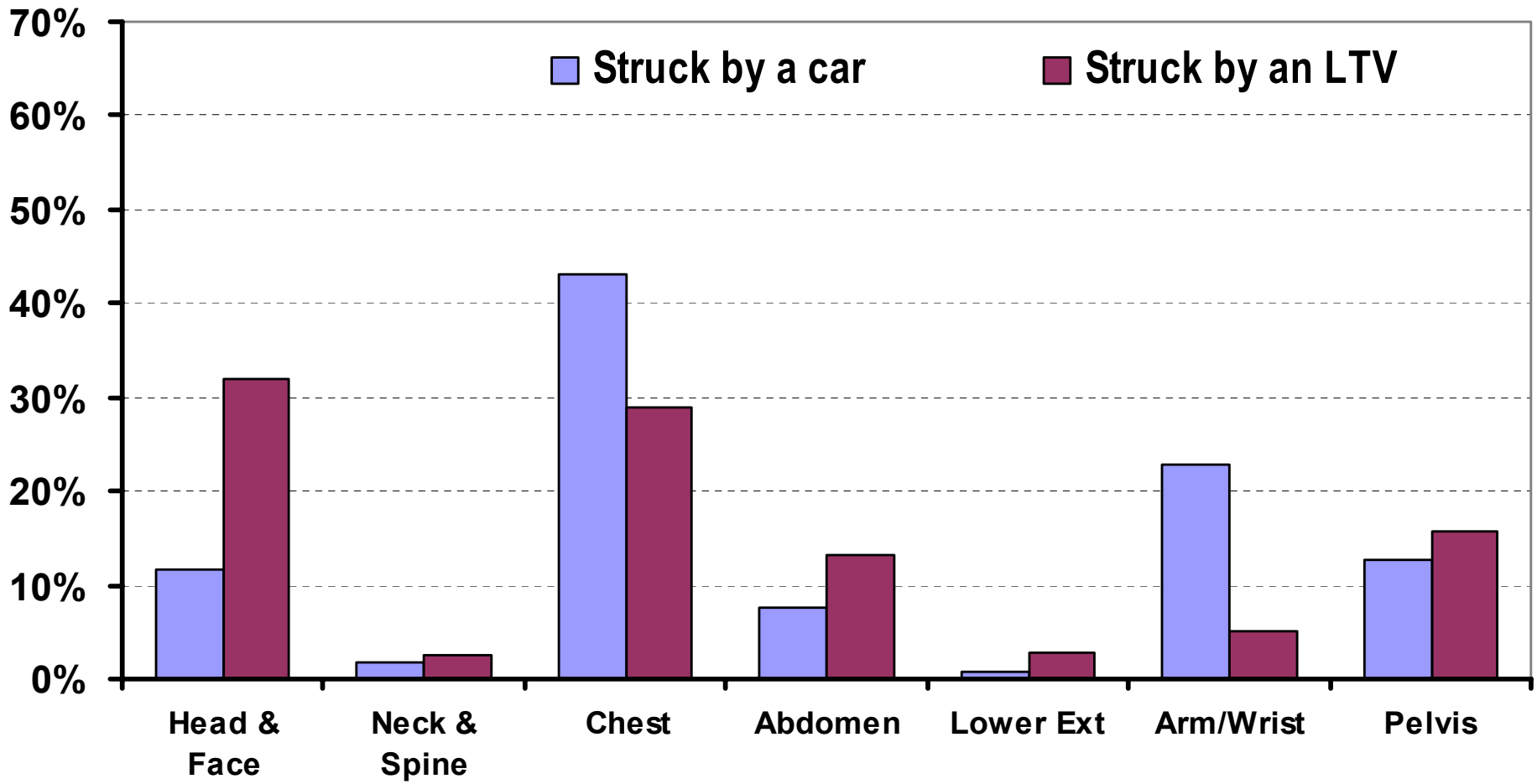
Vehicle to Vehicle -AIS 3+ Injury

Near Side Belted Occupant by Body Region

Model Year 95-2000 (Weighted NASS/CDS 95-99)



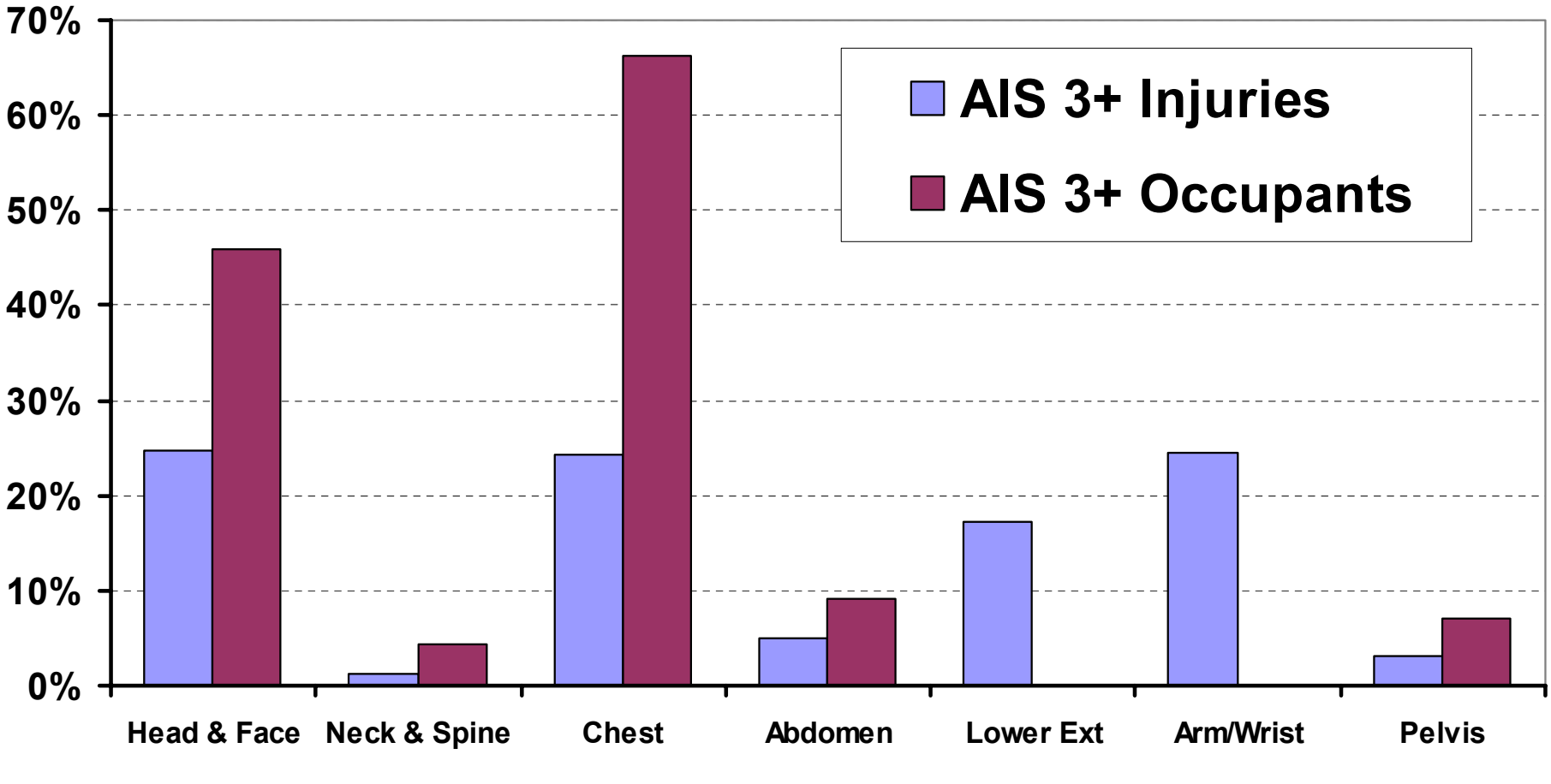
N_{PC}= 81 , weighted= 5,653

N_{LT}= 191, weighted= 9,918

Narrow Object Impacts

Near Side Belted Occupants by Body Region

Model Year 95-2000 (Weighted NASS/CDS 95-99)



N_{NO}= 118, weighted=5,722

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ES-2 R&D Testing Update

- **Crash tests* (27 completed)**
  - High severity/upgrade 214 MDB tests
  - 201P and forward oblique pole side impact
  - NCAP side impact
- **Mechanical performance component tests**
  - Pendulum and rib drop tests
  - Seat back pressure maps
- **Biofidelity tests (total of 19 sled & 10 impactor)**
  - Head/neck/shoulder sled tests
  - Shoulder/thorax/pelvis impactor tests
  - Additional abdominal offset sled tests

* Since ESV 6/01

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Research Oblique Pole Tests

Side Impact Pole Test Procedure Development			
VEHICLE	BAG	Condition	DUMMY
2001 Saturn	none	201P	SIDH3/ES-2
2001 Saturn	none	Oblique	SIDH3/ES-2
2001 Saturn	curtain only	201P	SIDH3/ES-2
2001 Saturn	curtain only	Oblique	ES-2
1999 Maxima	none	201P	SIDH3/ES-2
1999 Maxima	none	Oblique	ES-2
1999 Maxima	head/thorax combo	201P	SIDH3/ES-2
1999 Maxima	head/thorax combo	Oblique	ES-2

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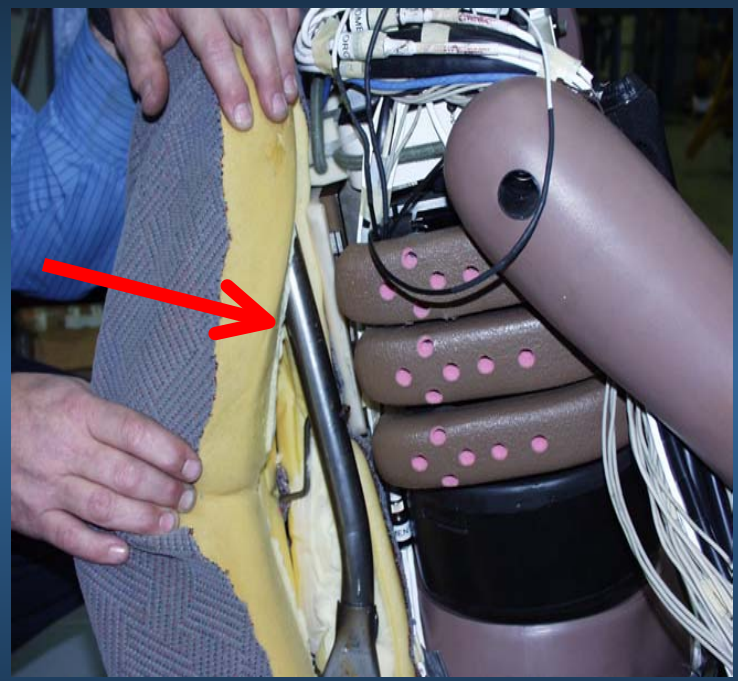
ES-2 Testing Findings

- Rib binding is gone
- Dummy is durable
- Back plate/seat interaction is an issue
  - Possible solutions
    - Placing a limit on back plate loads
    - Retrofit internal dummy fix
    - Use of protective shield as part of seating procedure

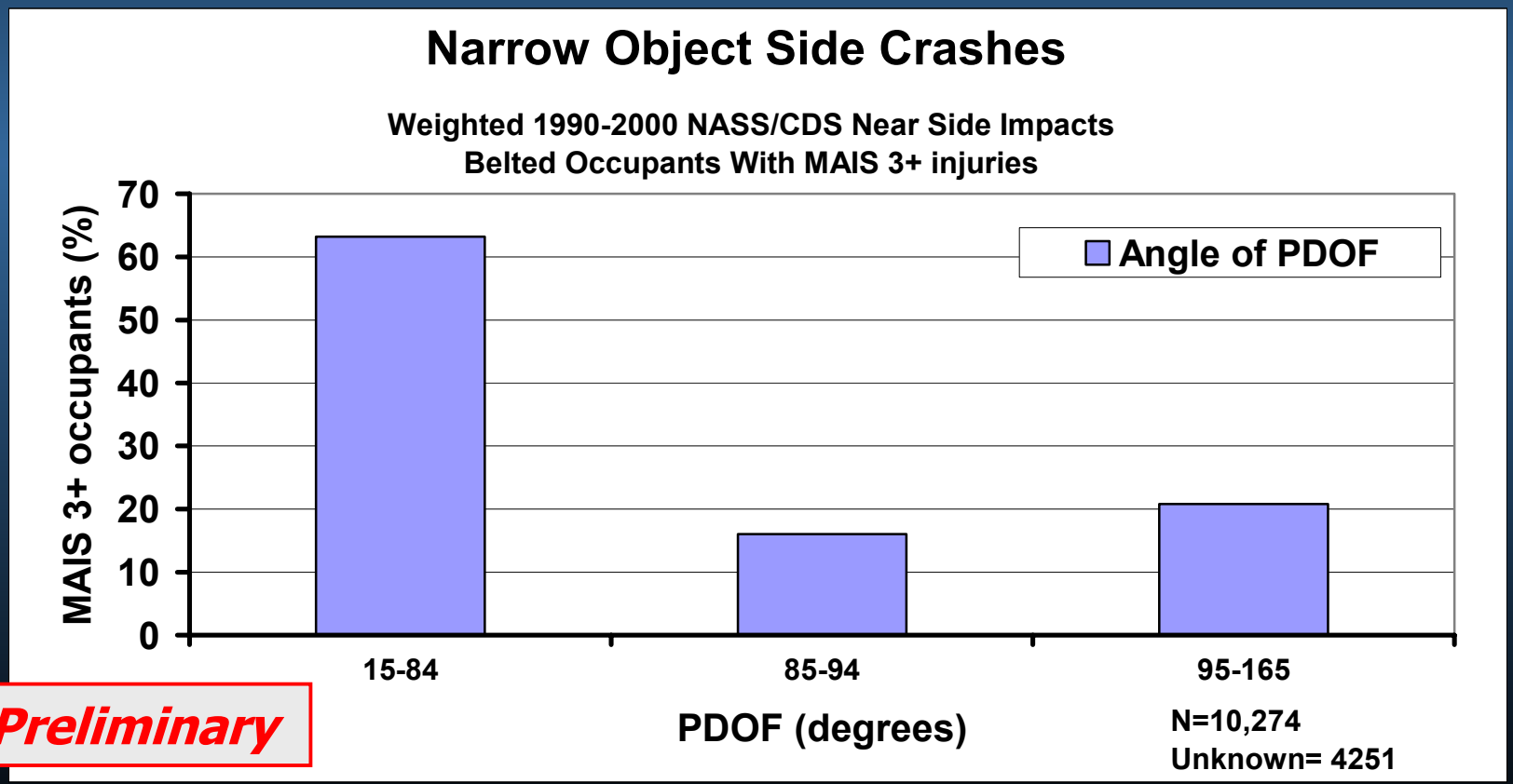


- ES-2 demonstrated ability to detect usefulness of head protection
- ES-2 exceeded thoracic and abdominal injury threshold in some vehicles (SID did not)

Research Pole Test Development:

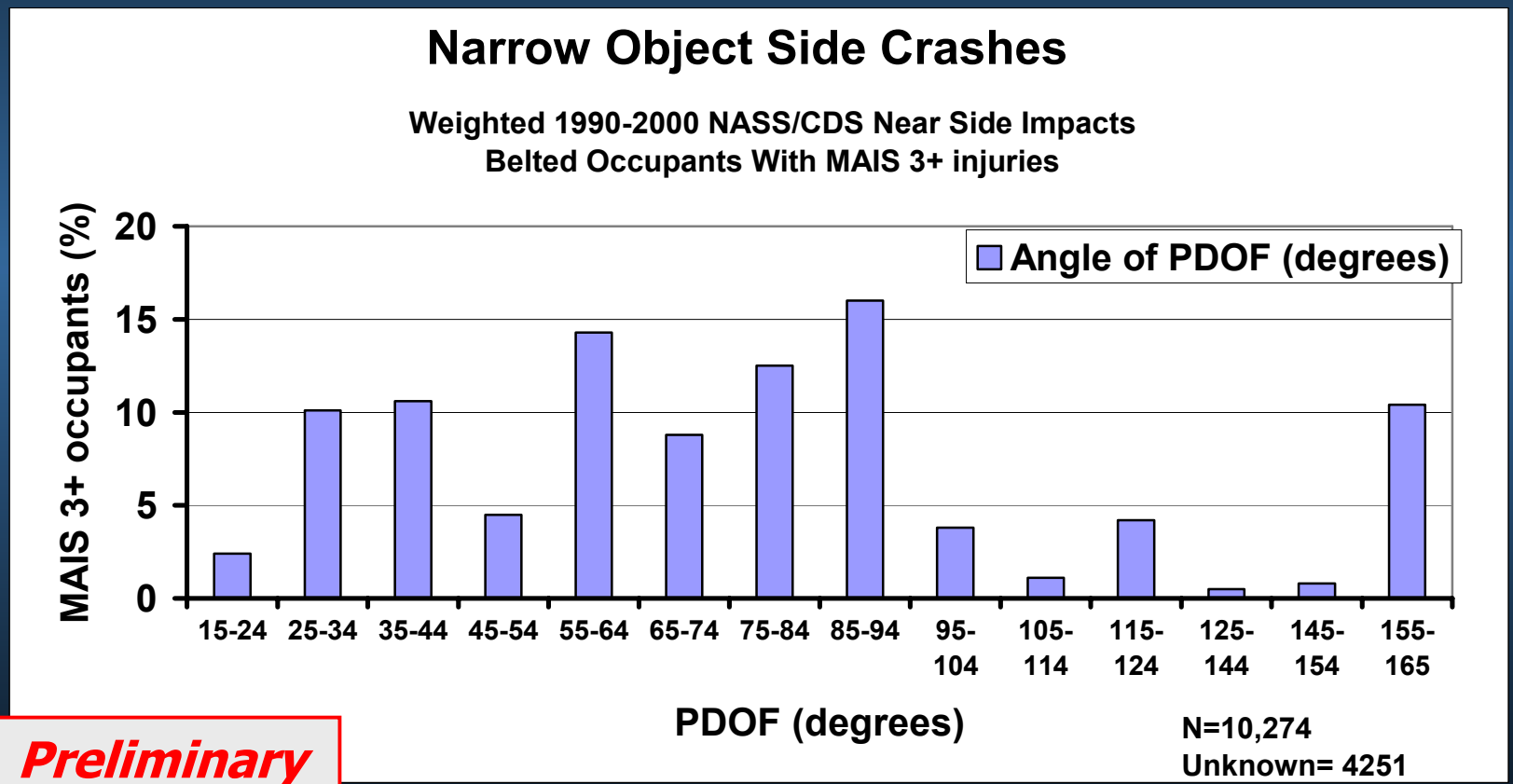
Principle Direction of Force (PDOF) in Narrow Object Side Crashes

- Frontal oblique are 66%
- 90º degree are 16%
- Rear oblique are 21%



Research Pole Test Development:

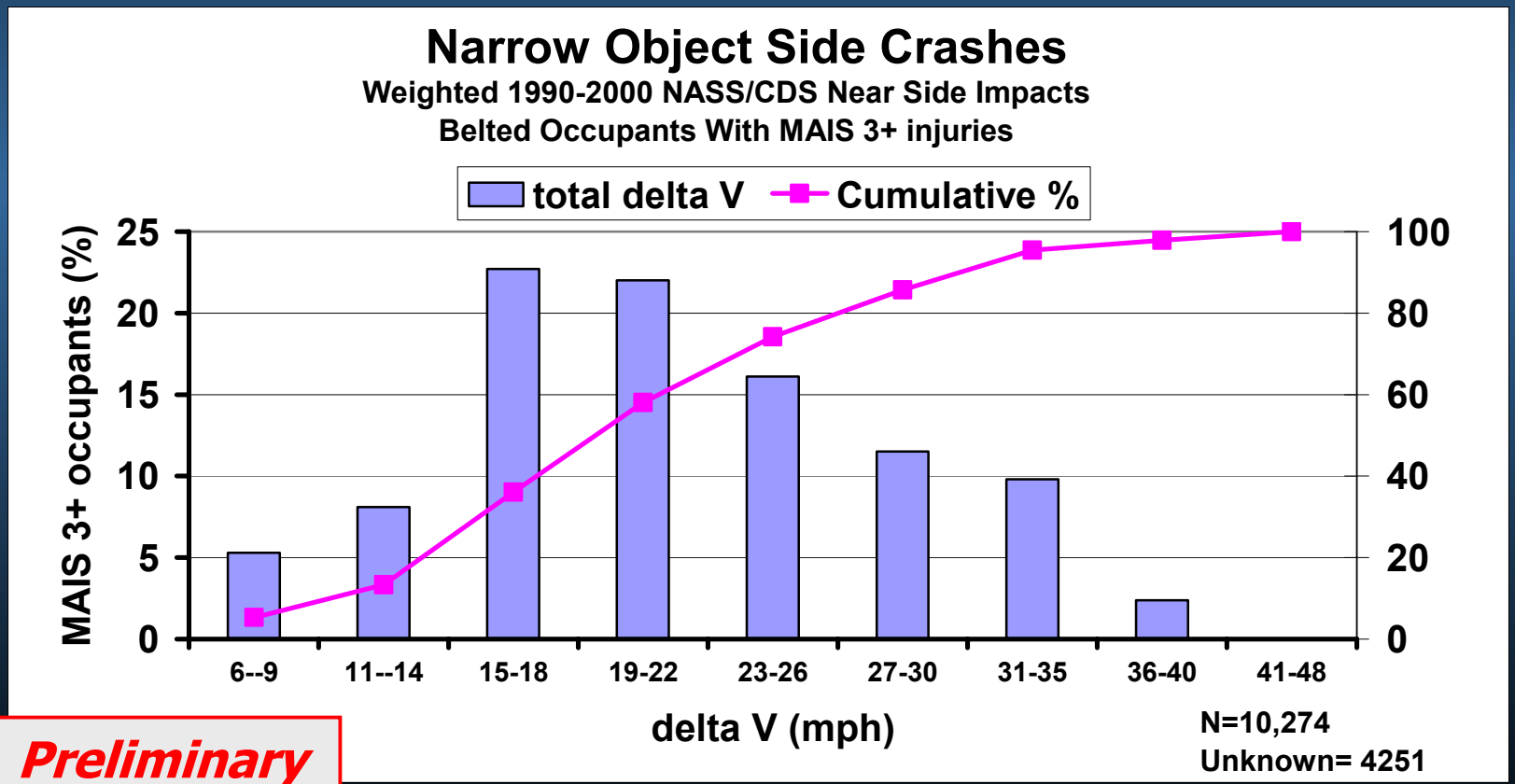
Principle Direction of Force (PDOF) in Narrow Object Side Crashes



Research Pole Test Development:

Total Delta V in Narrow Object Side Crashes

- 64% of seriously injured occupants in crashes of delta Vs > 18 mph
- 49% of seriously injured occupants in crashes of delta Vs > 20 mph



Preliminary

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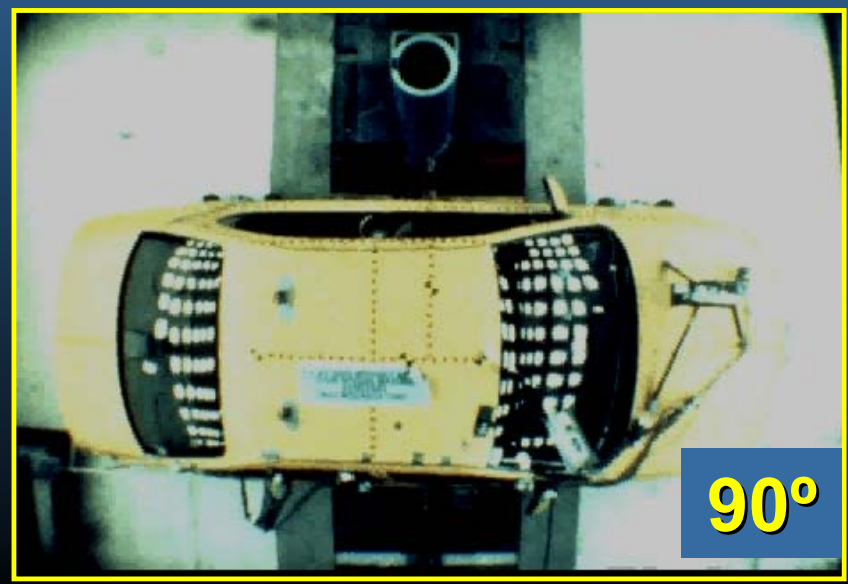
Research Pole Test Crash Conditions

- 20 mph: median total delta-v for seriously injured occupants (MAIS3+) in narrow objects side crashes
- 75º anticlockwise (Optional 201P is 90º)

Preliminary



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Side Impact Pole Test Conditions

	Optional 201P	Oblique Pole Test
Angle	vehicle positioned 90º counterclockwise relative to line of motion	vehicle positioned 75º counterclockwise relative to line of motion
Alignment	centerline of 10”/254mm pole aligned with driver dummy head CG	centerline of 10”/254mm pole aligned with driver dummy head CG
Impact Speed	18 mph(29 km/h)	20 mph(32.2 km/h)

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Research Oblique Pole Tests

Side Impact Pole Test Procedure Development			
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1999 Maxima	none	201P	SIDH3/ES-2
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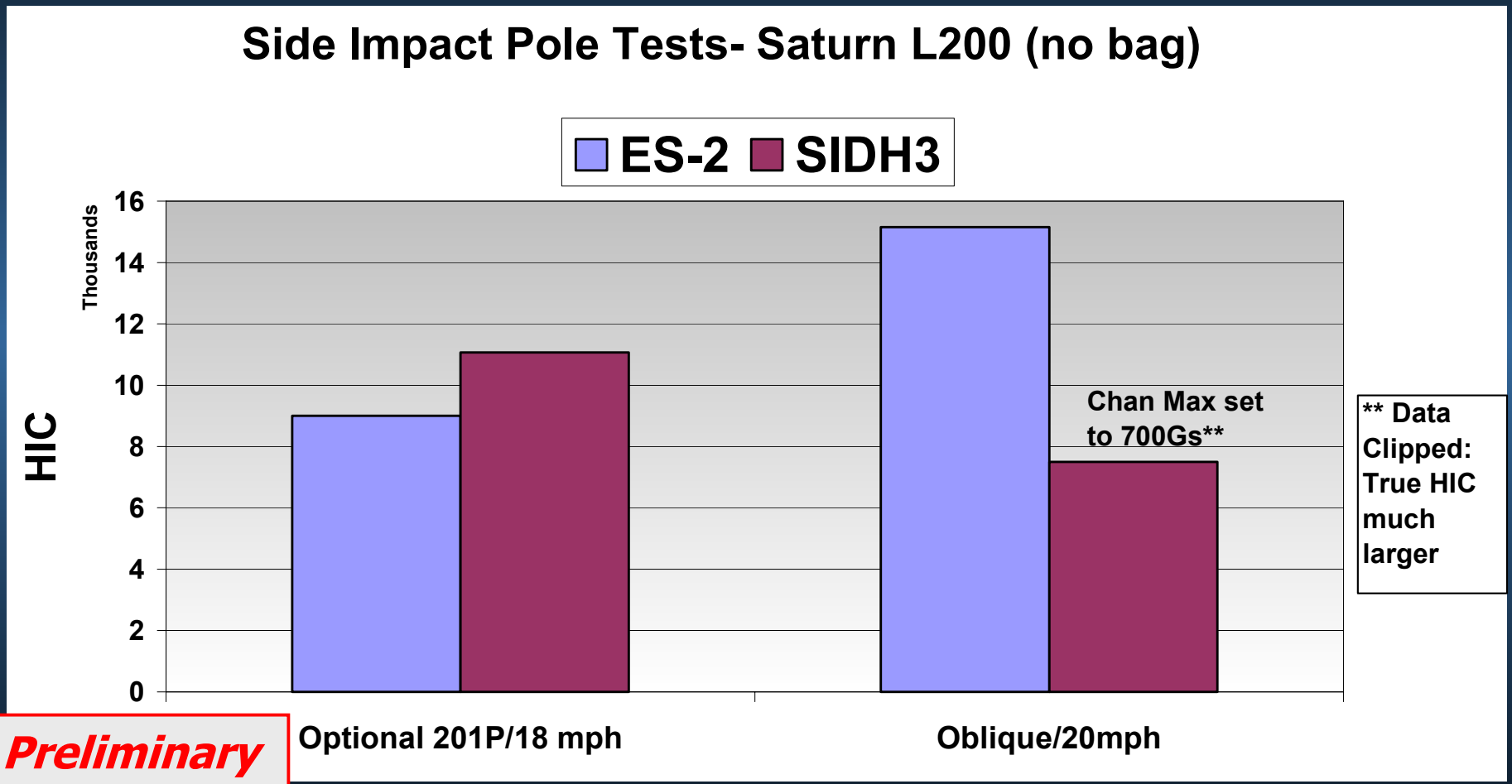
1999 Maxima	head/thorax combo	201P	SIDH3/ES-2
1999 Maxima	head/thorax combo	Oblique	ES-2

Comparison of ES-2 and SIDH3 in Pole Tests



Comparison of ES-2 and SIDH3 in Pole Tests

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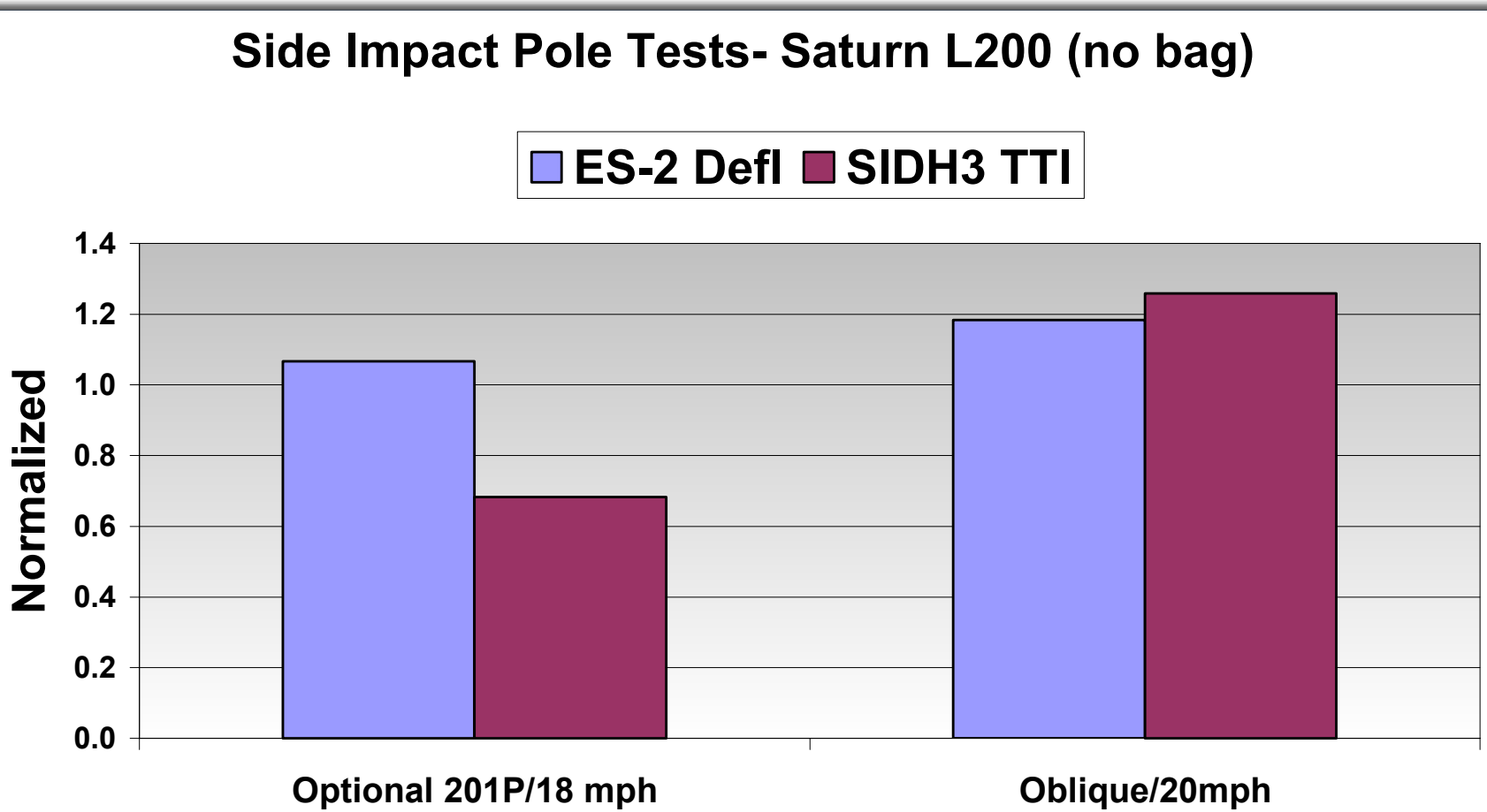

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EU/214 Criteria Limits
TTI=85/90
Defl=42 mm

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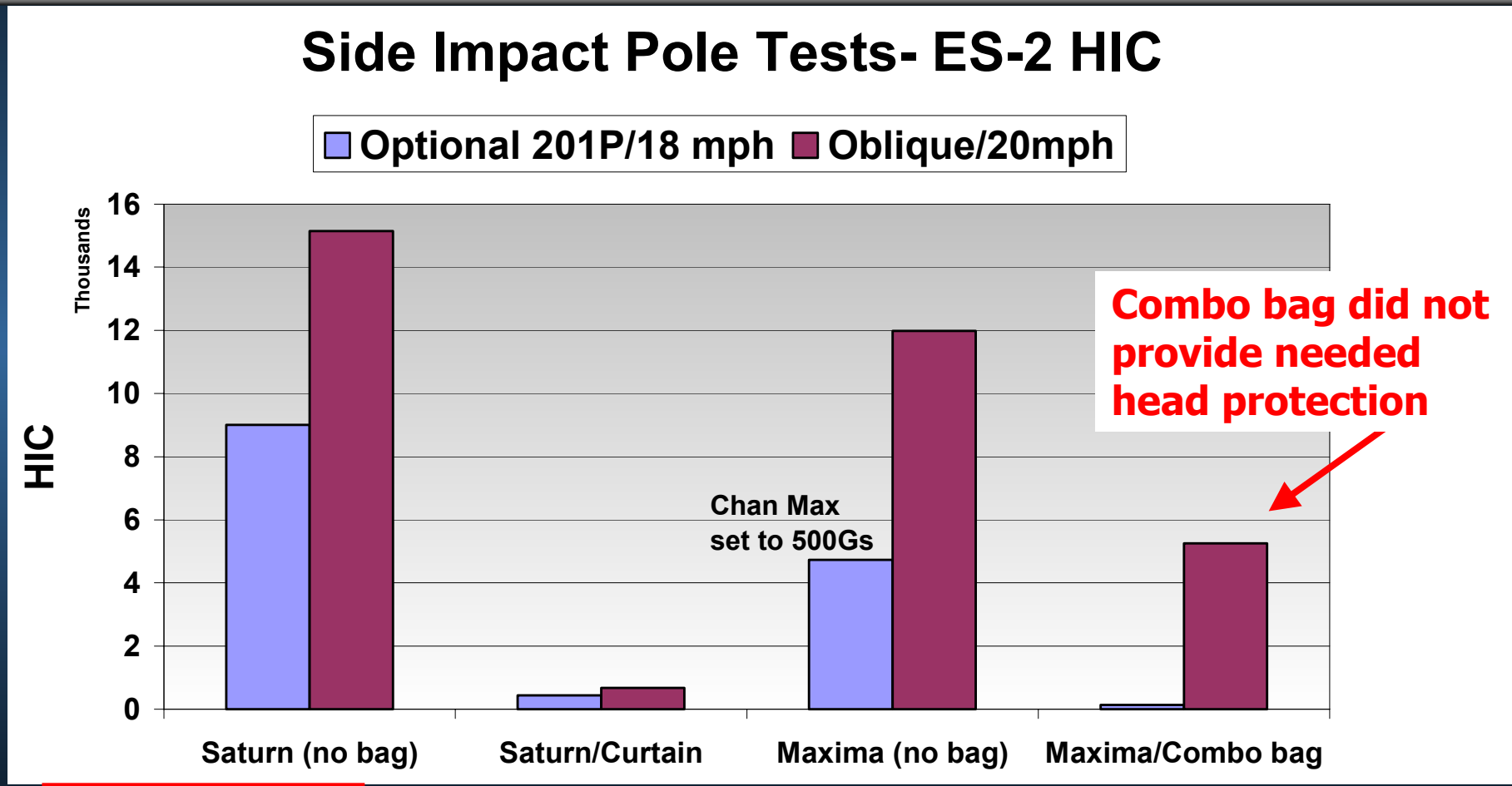
ES-2 in Pole Tests



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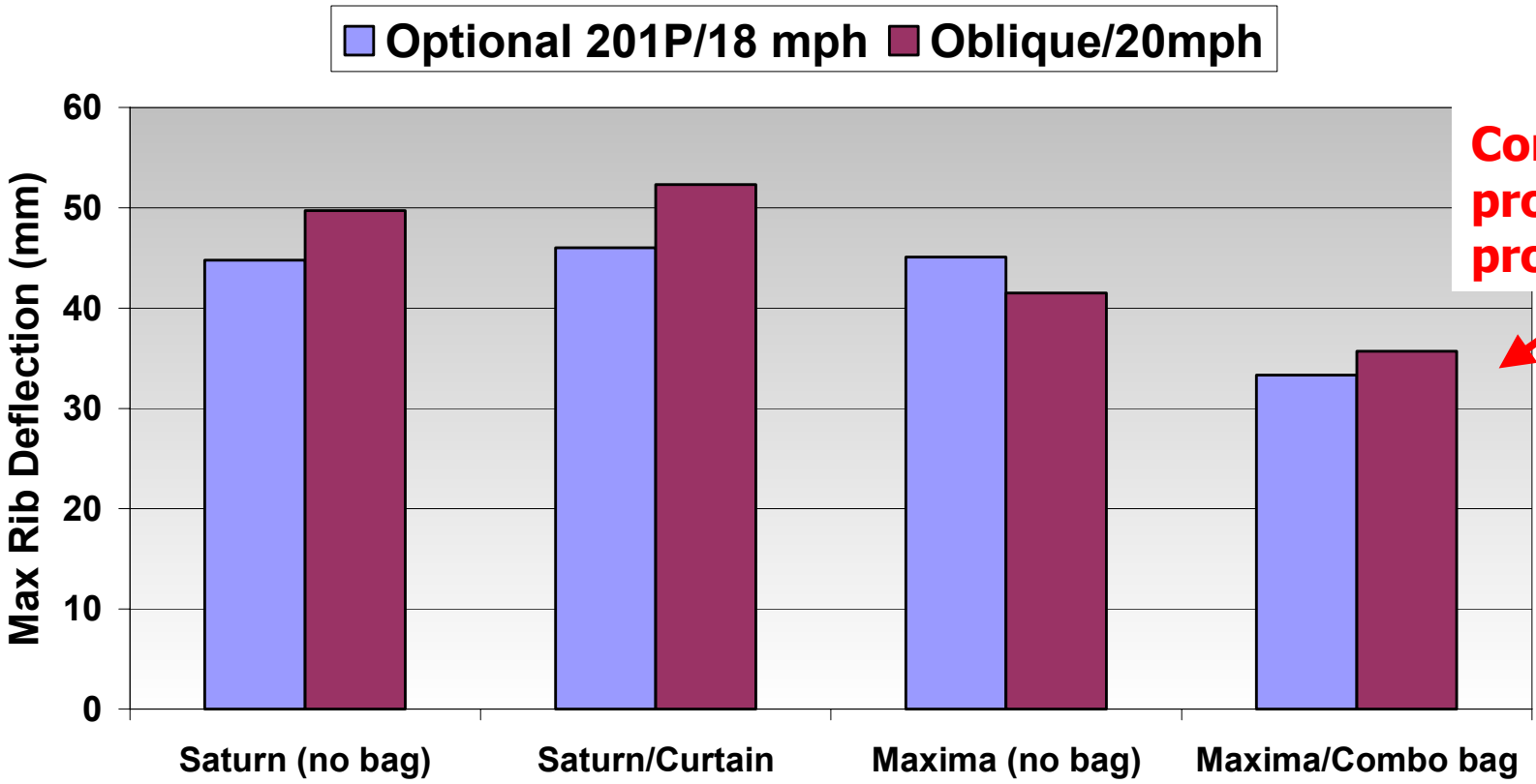
ES-2 in Pole Tests

Side Impact Pole Tests- ES-2 Rib Deflection



Combo bag provided chest protection

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Note: 42 mm is current European limit

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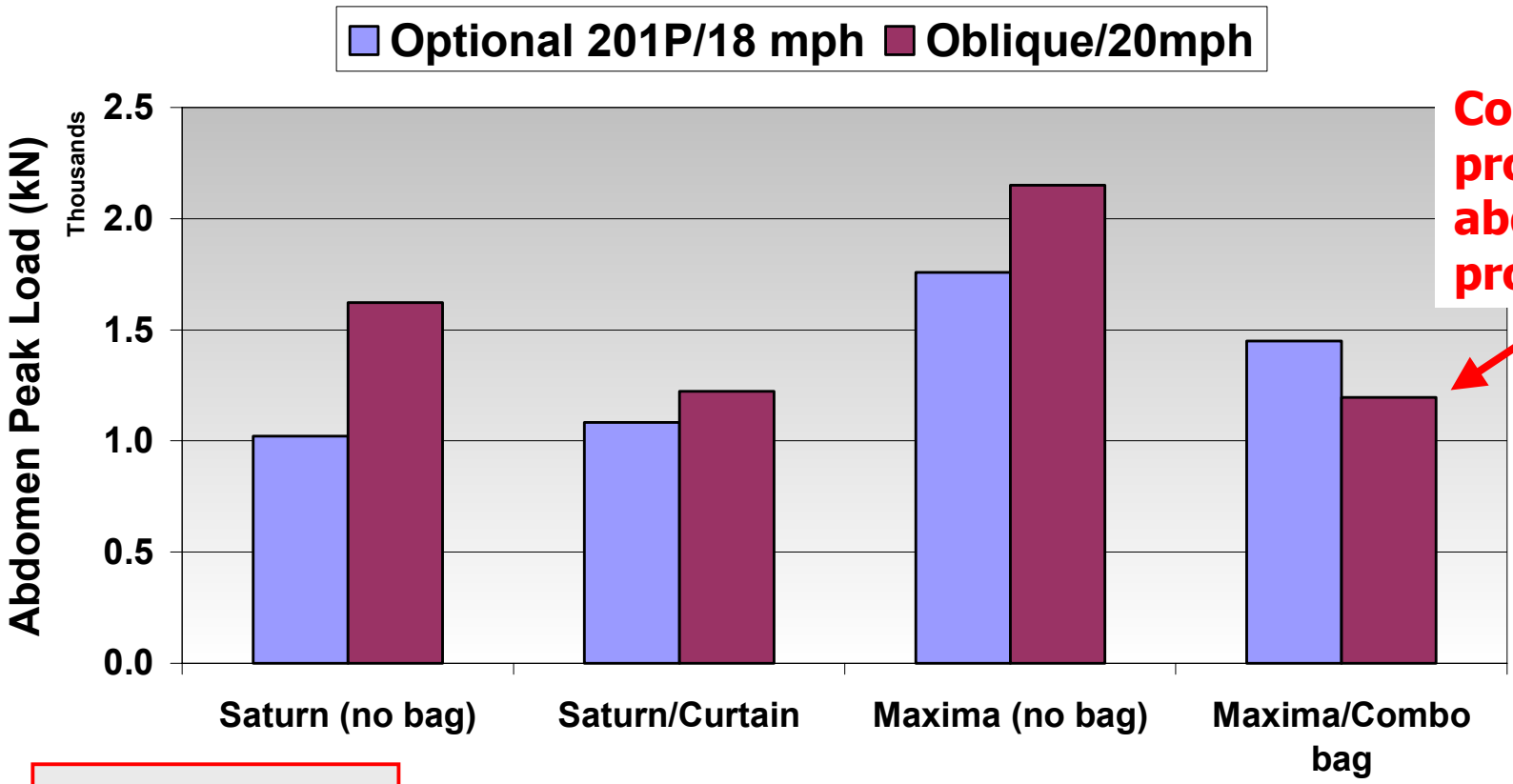
ES-2 in Pole Tests

Side Impact Pole Tests- ES-2 Abdomen Loads



Combo bag provided abdominal protection

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Note: 2.5 kN is current European limit

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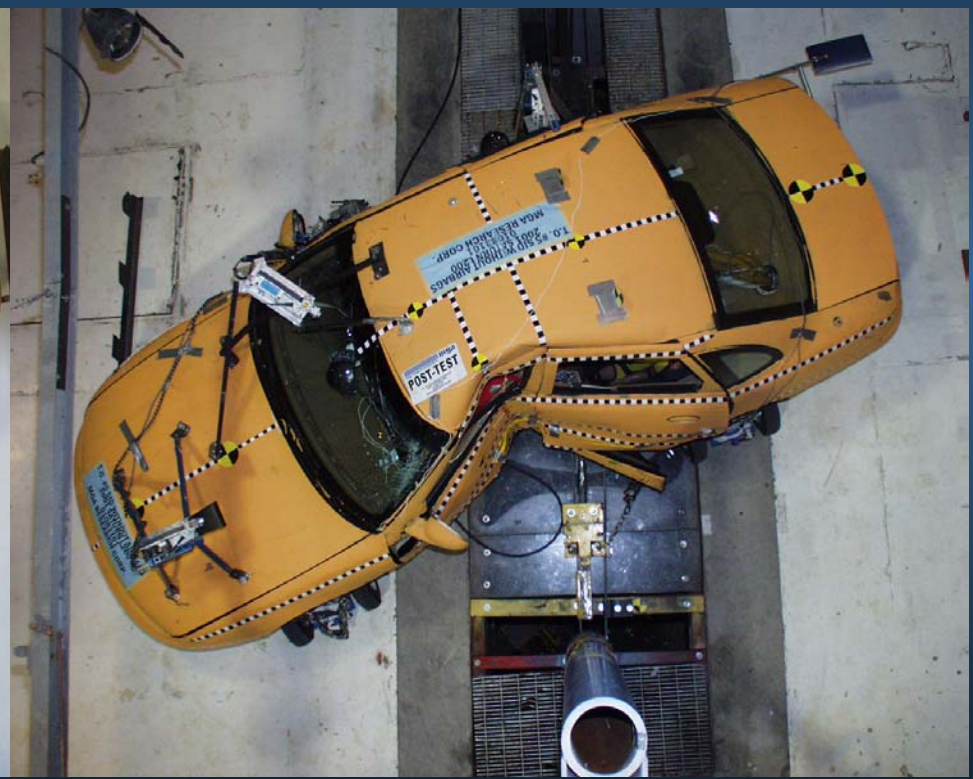
Post-Test Crush

75º oblique pole test: 20 mph

Optional 201P test: 18 mph



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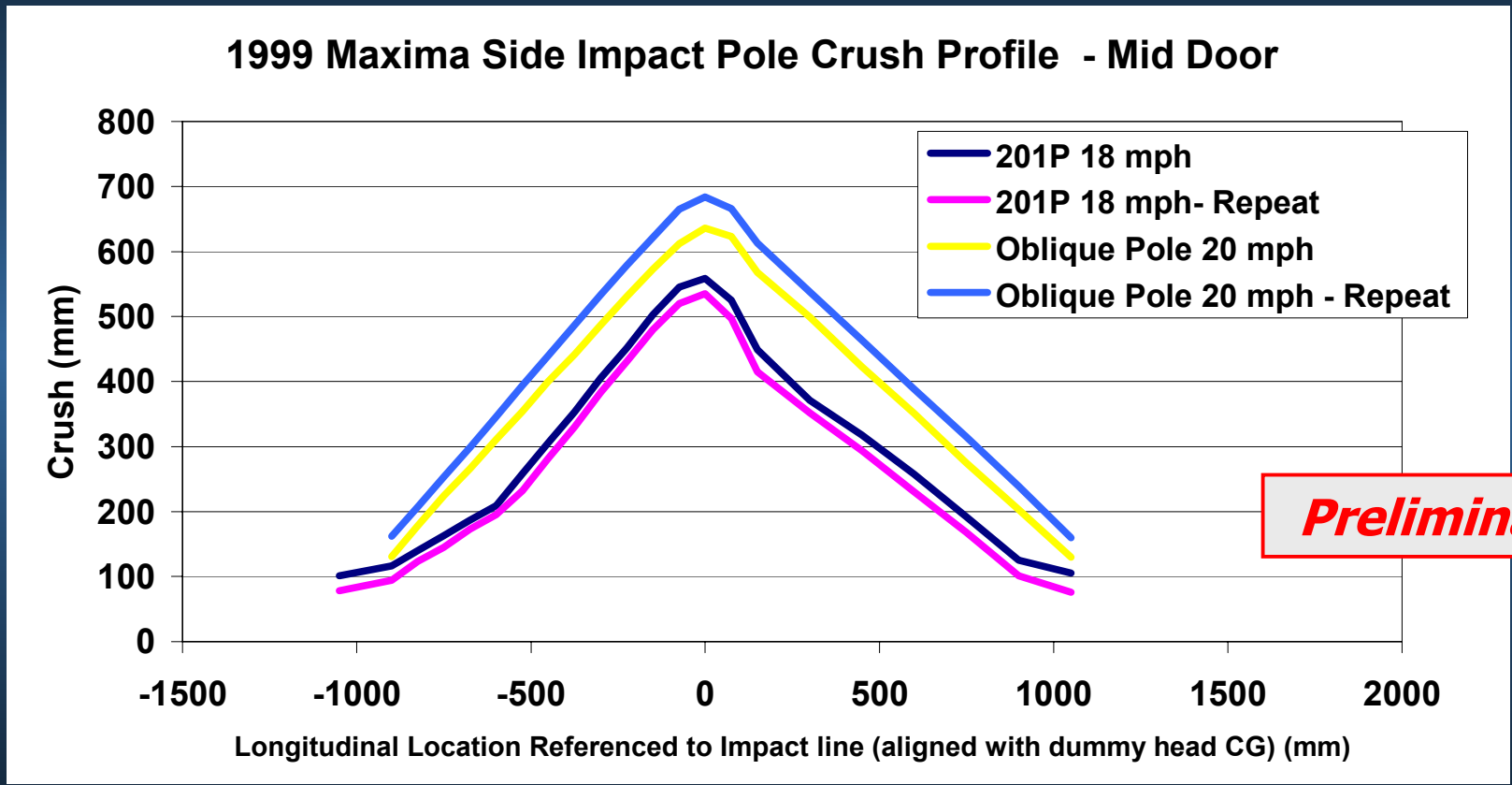
Maxima Crush Profile



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Observations: Oblique Test procedure

- Representative of narrow object crash environment
- Repeatable
- Seating procedure defined
- 15% more energy in the lateral direction relative to Optional 201P test due to increase in speed from 18 to 20 mph
- More post test lateral crush than Optional 201P (about 4-5” or 10-13 cm)

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Observations: Oblique Pole Test Results

- **In Saturn (no bag) test:**
  - Both SIDH3 and ES-2 measured high chest loads
  - Both dummies found to withstand the crush loads well
- **Maxima with combination thorax/head side protection bag did not provide needed head protection in oblique pole test**
- **Saturn with curtain head air bag provided head protection in oblique pole test**
- **ES-2 measured high chest loads in both Optional 201P and oblique pole test**
- **ES-2 measured increased abdominal loads relative to Optional 201P**
- **ES-2 did not measure any high back plate loads in the oblique pole tests**

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Planned Pole Tests

Side Impact Oblique Pole Tests		
VEHICLE	BAG	DUMMY
Dummy & Test Procedure Repeatability		
1999 Maxima	none	ES-2
1999 Maxima	none	ES-2
Dummy & Restraint System Performance		
1999 Volvo S80	curtain plus thorax	SIDH3/ES-2/SIDIIs
2000 Saab	head/thorax combo	SIDH3/ES-2/SIDIIs
2002 Explorer	curtain only	SIDH3/ES-2/SIDIIs

FMVSS 201P Side Pole Tests		
VEHICLE	BAG	DUMMY
Dummy & Restraint System Performance		
1999 Volvo S80	curtain plus thorax	SIDIIs
2000 Saab	head/thorax combo	SIDIIs
2002 Explorer	curtain only	SIDIIs

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Additional SIDIIs Tests

Side NCAP SIDIIs Performance Tests			
VEHICLE	SIZE/CLASS	BAG	DUMMY
2001 Focus	compact PC	none	SIDIIs
2003 Corolla	light PC	none	SIDIIs
2001 LeSabre	heavy PC	thorax	SIDIIs
2002 Odyssey	van	thorax	SIDIIs

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MDB Upgrade Research Update

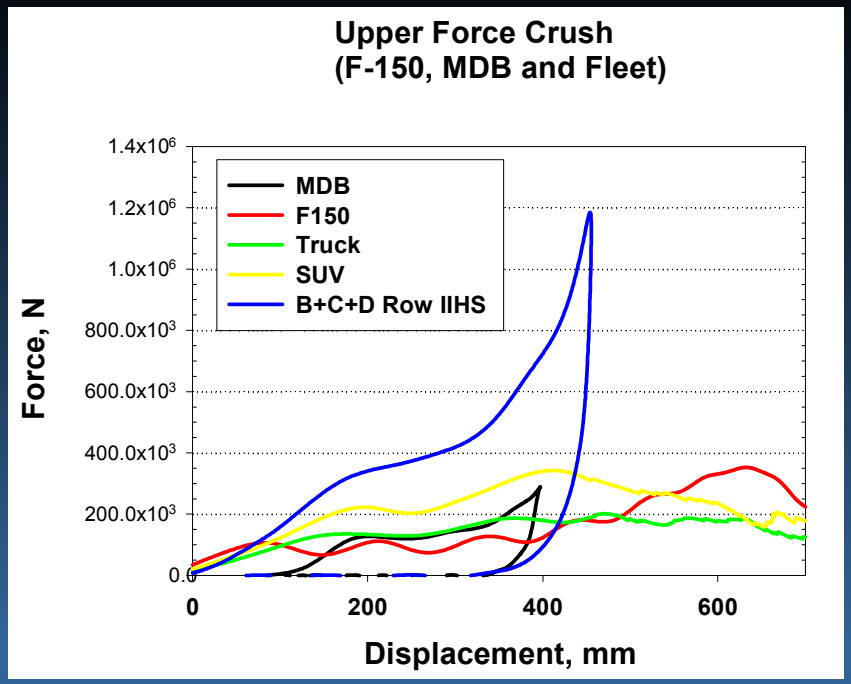
FMVSS 214 Upgrade - High Severity/Barrier Development Tests

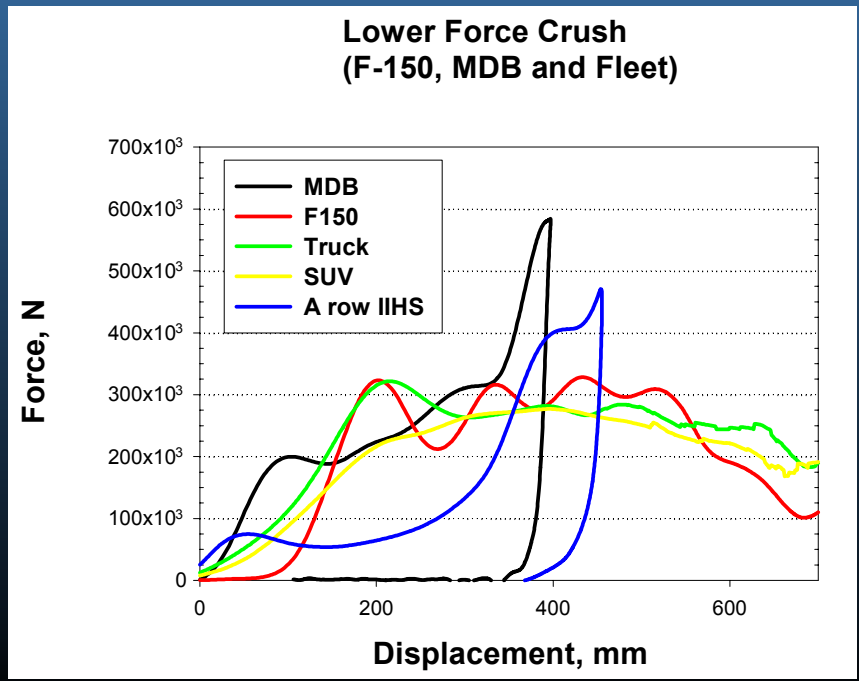
VEHICLE	BAG	IMPACTOR	DUMMY	TEST CONDITION
1999 Prizm	none	IIHS MDB/F150	ES-2	214 speed/angle
1999 Cadillac Deville	none	IIHS MDB/F150	ES-2	214 speed/angle
1999 Maxima	none	IIHS MDB	ES-2	214 speed/angle
1999 Cadillac Deville	none	IIHS MDB/F150	ES-2	Side NCAP

- Crash tests with IIHS MDB and F150 at FMVSS 214 and side NCAP speeds
- Load path analysis of striking vehicle from frontal NCAP load wall tests
- Geometry

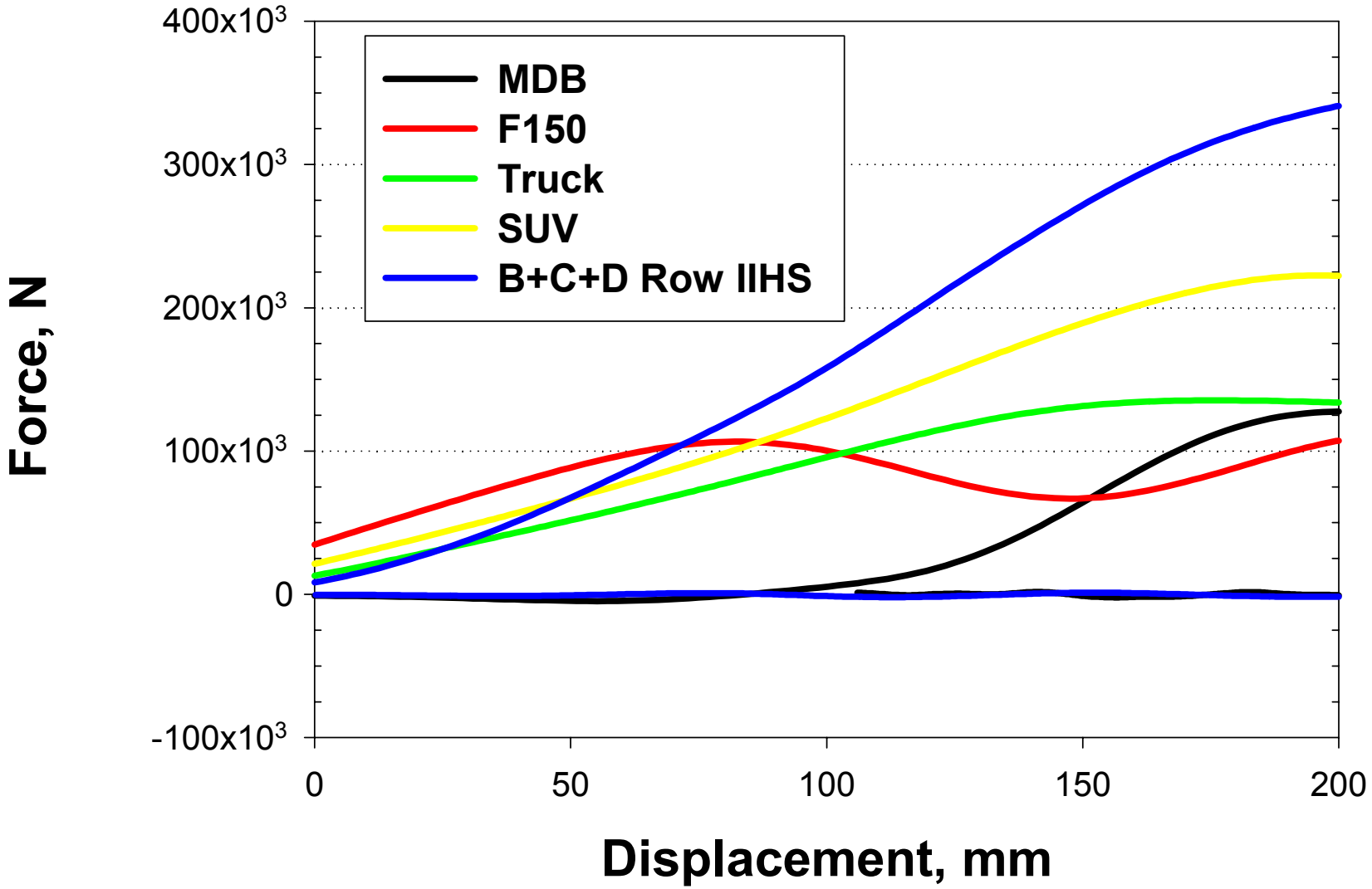
MDB Upgrade Research Findings

- Based on frontal NCAP load wall tests (averages up to MY 2000), the IIHS stiffness distribution is not representative of pickups or SUVs. It has a high average height of force.
- The F150 is a soft pickup relative to its class.

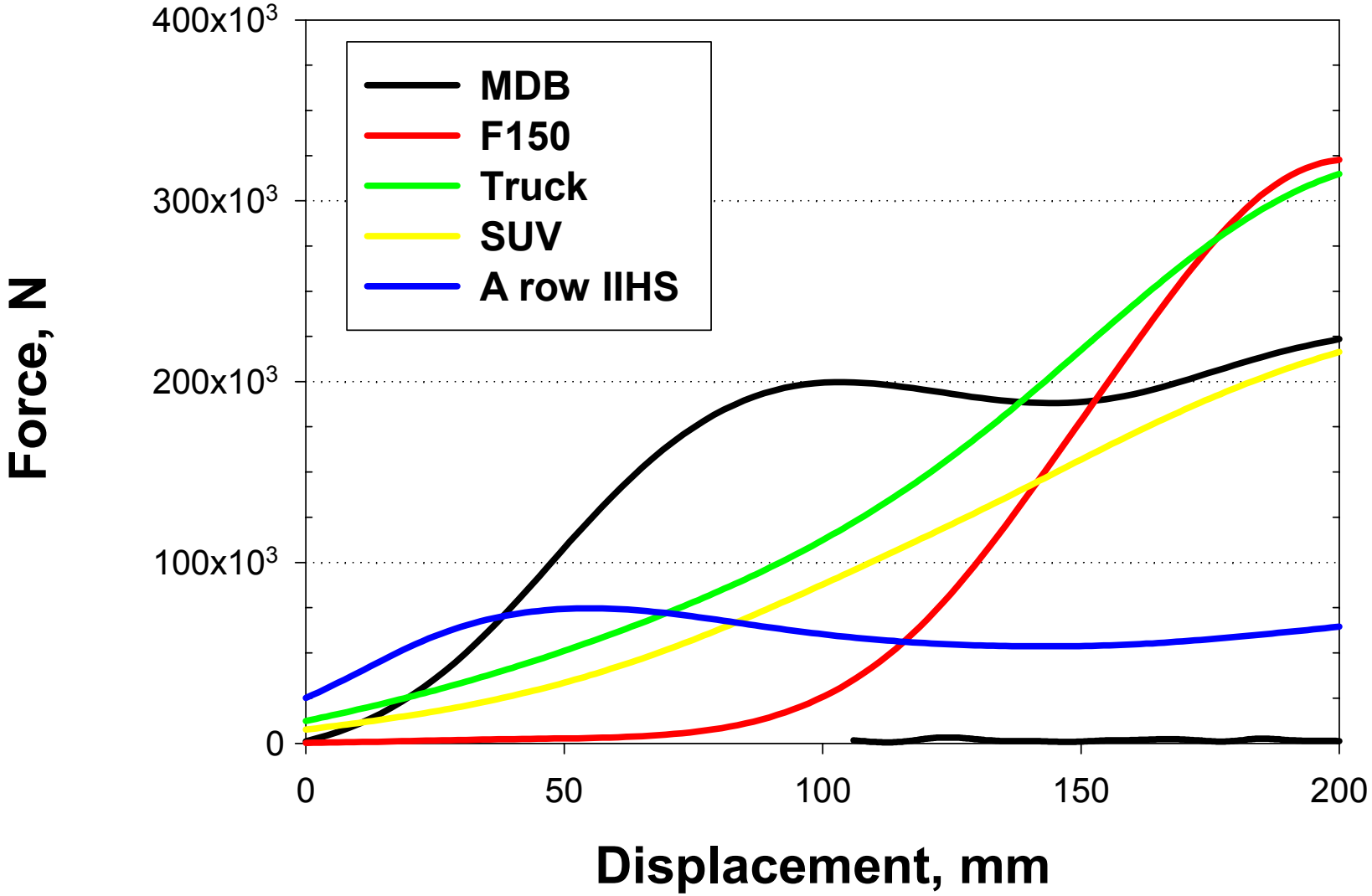




Upper Force Crush
(F-150, MDB and Fleet)



Lower Force Crush
(F-150, MDB and Fleet)



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Research Findings: MDB Test Results

- **Dummy responses indicate that the IIHS MDB is stiffer than the F150**
  - Head, abdomen and pelvic dummy responses were higher for the IIHS MDB tests
  - Chest dummy responses were similar for both the IIHS MDB and F150 tests
- **Door contact velocities for the IIHS MDB were over 25 mph compared with about 18 mph for the FMVSS 214 MDB**
- **IIHS MDB and F150 tests resulted in similar exterior crush profiles for the vehicles tested**
- **Geometry needs to be considered**

Responses

Profiles

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Thank You!