

Rear Impact Protection A Canadian View



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Objectives

- Review of US regulation
- Canadian research
- Canadian regulatory proposal
- Cost/Benefit summary
- Proof of concept

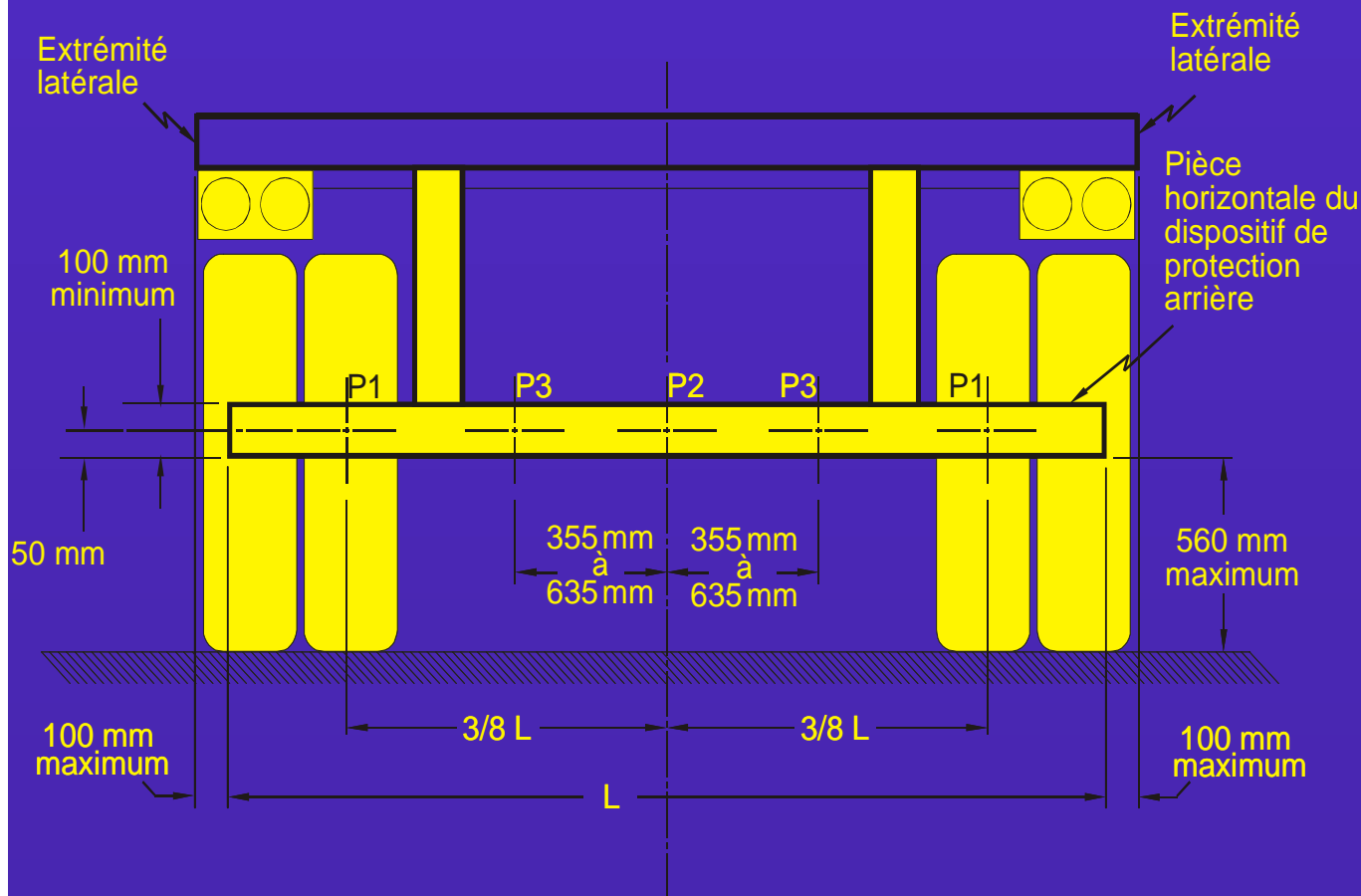


Background

- ◌ FHWA - BMCS guard 1953
- ◌ ECE Regulation 58, published in 1989
- ◌ NHTSA final rule issued in 1996 - effective Jan 1998
- ◌ Canadian provinces Ontario and Quebec - rear underride requirements for 53 ft trailers

Typical NHTSA Guard

(rearview of trailer)



➤ 50 kN P1 & P2

➤ 100 kN at P3

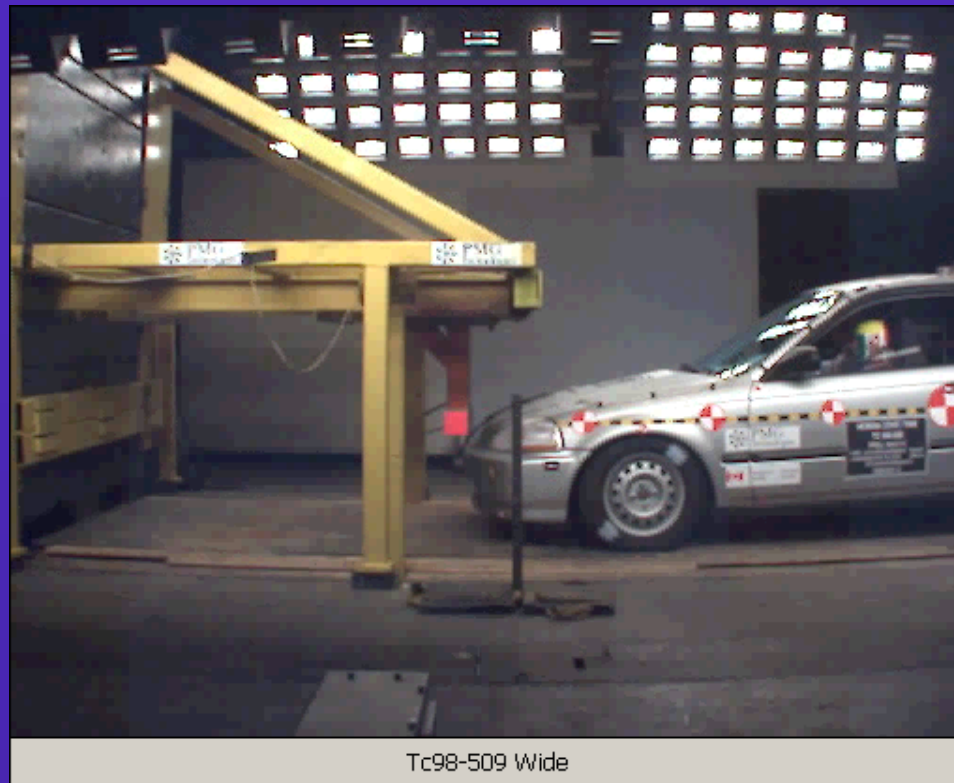
➤ 5,650 J energy
absorption



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Typical NHTSA Guard



Tc98-509 Wide



Typical NHTSA Guard

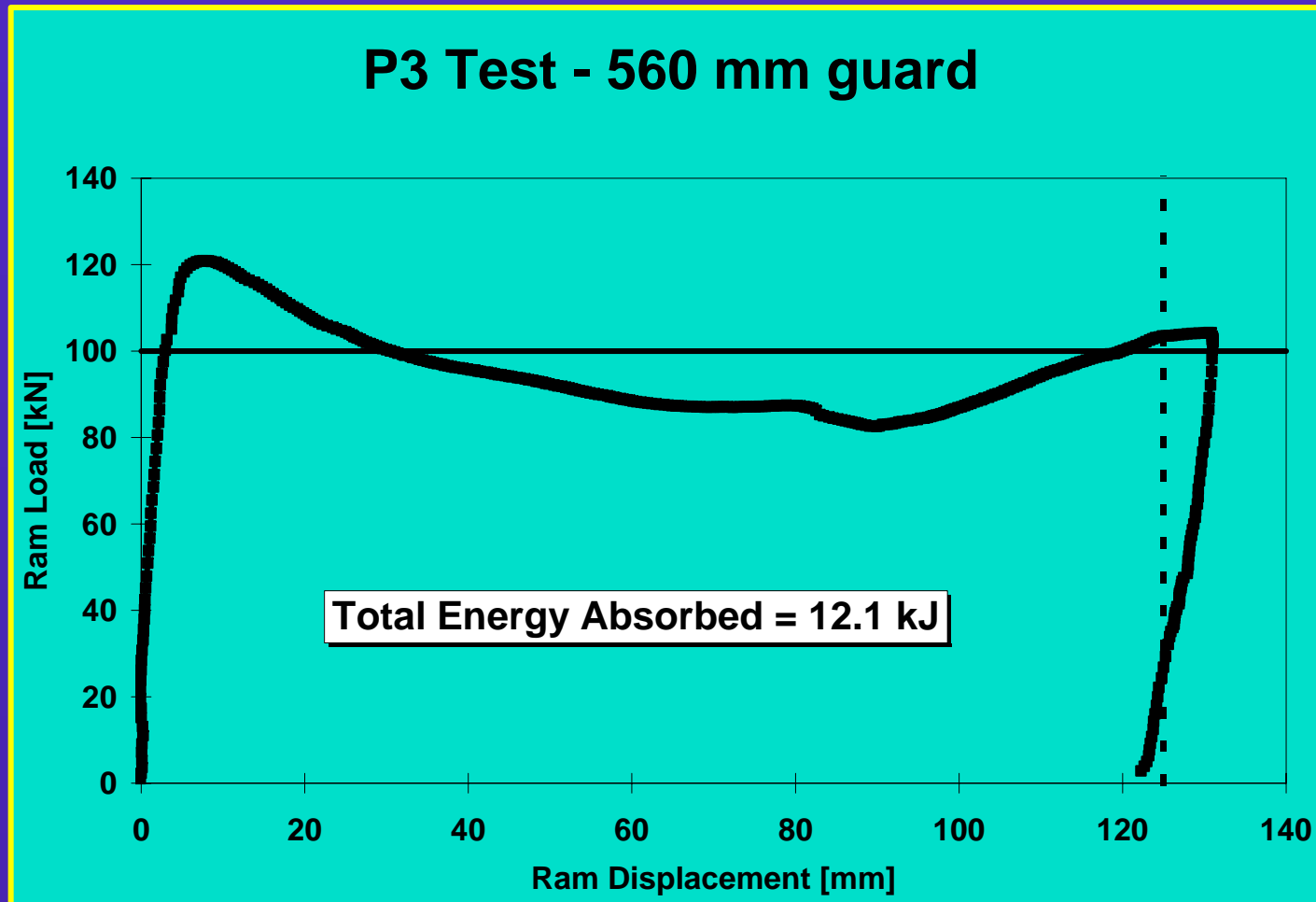


Tc98-509 Closeup





560 mm guard Compliance Test @ P3



Compact Vehicle Collision



Rear Underride Research

- ◌ Started in 1997 stationary guard project
- ◌ Deformable guard research project
 - » 3 vehicle sizes (minivan, compact and sub-compact)
 - » 2 ground clearances (480 and 560 mm)
 - » 3 impact speeds (48, 56 and 65 km/h)
 - » 3 guard “designs”
 - » 3 impact tests with dummies
 - » 350 kN proof-of-concept test with dummies





Solid Guard Test Programme

What did we learn?

- Incidence of serious or fatal injuries could be reduced significantly if guards were much stiffer and somewhat lower



Deformable Guard Test Programme



Deformable Guards

560 & 480 mm Guards



560 mm guard



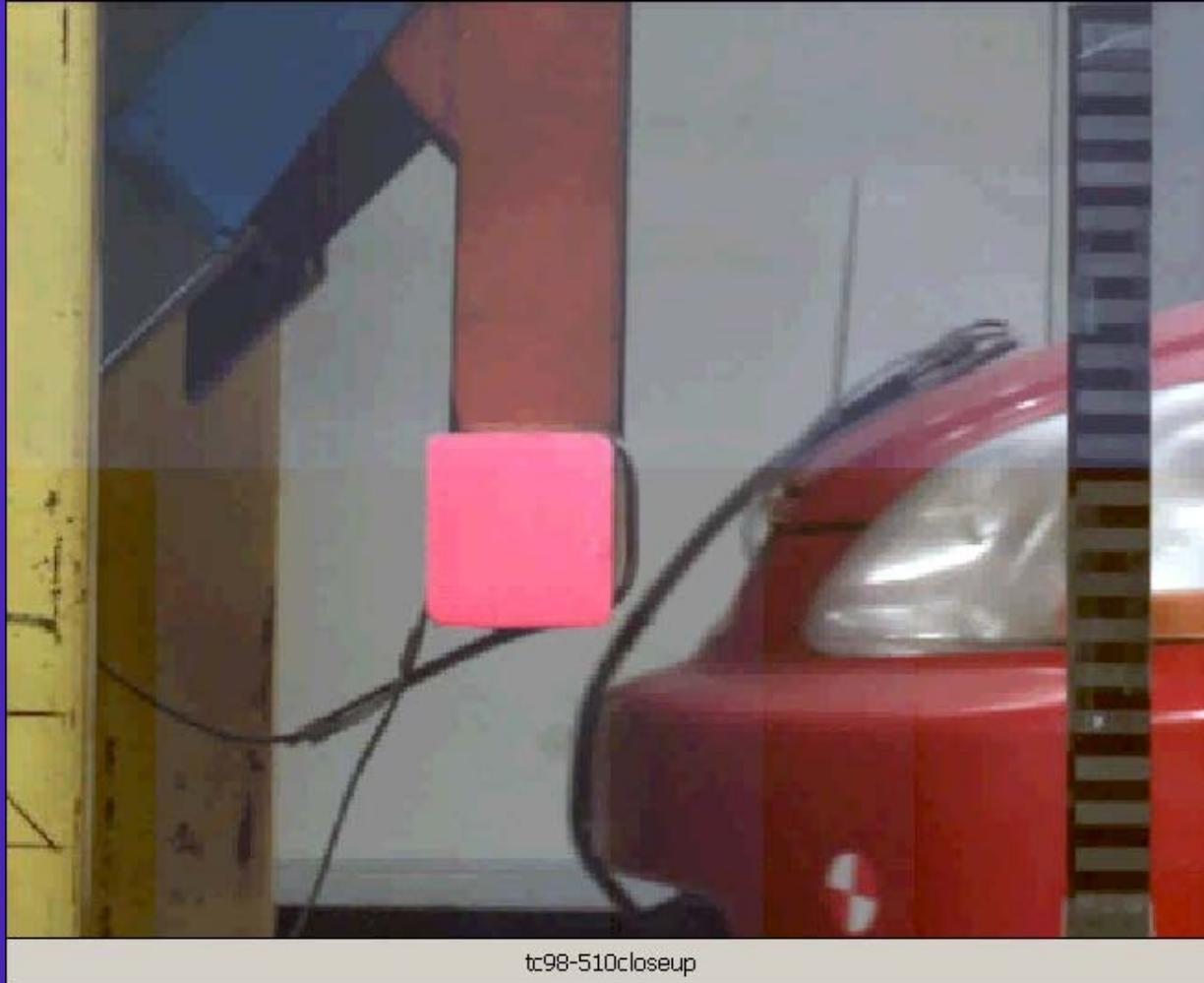
480 mm guard



56 km/h, 480 mm w/stopper



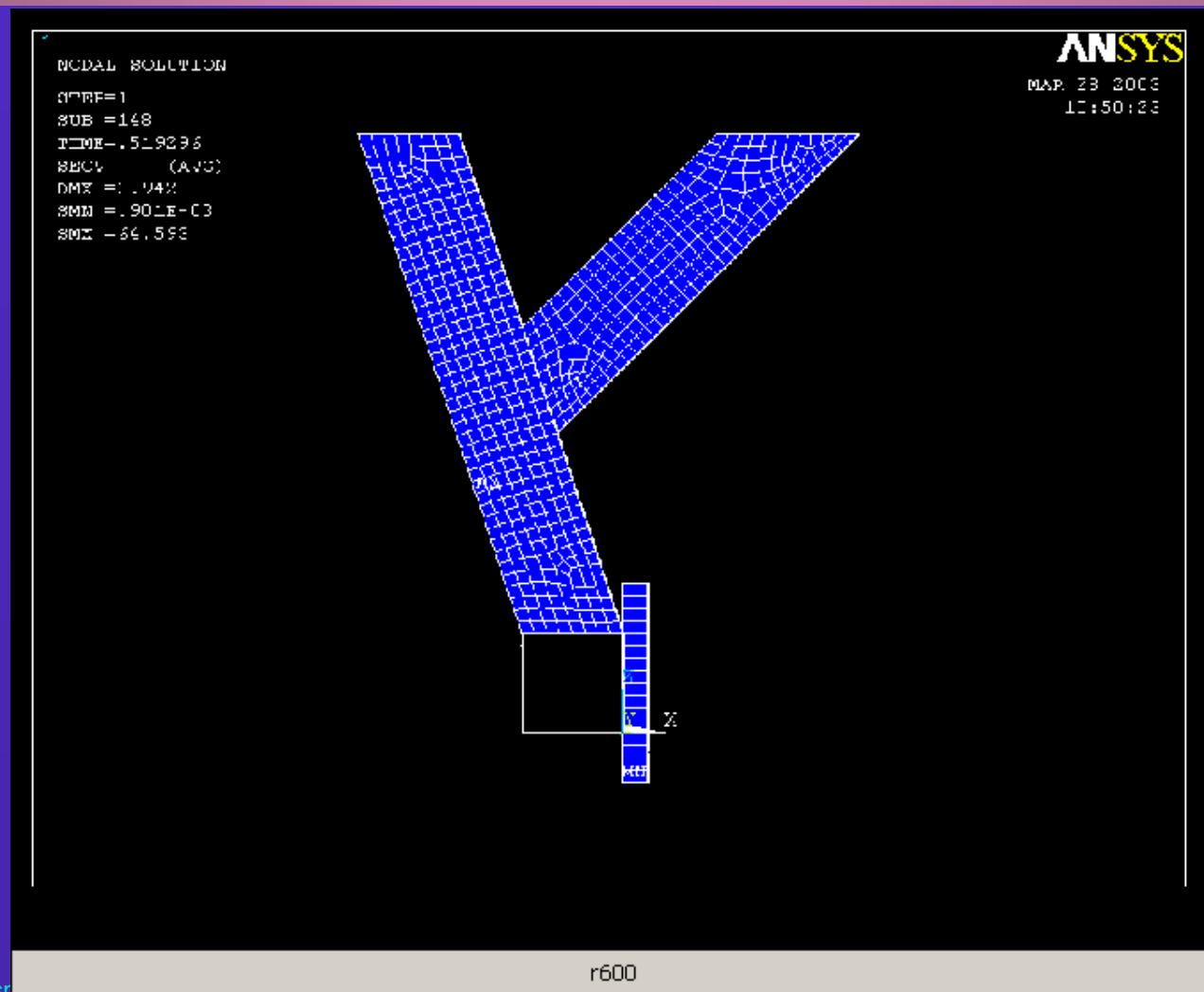
480 mm guard with Stopper



560 mm Slanted Guard

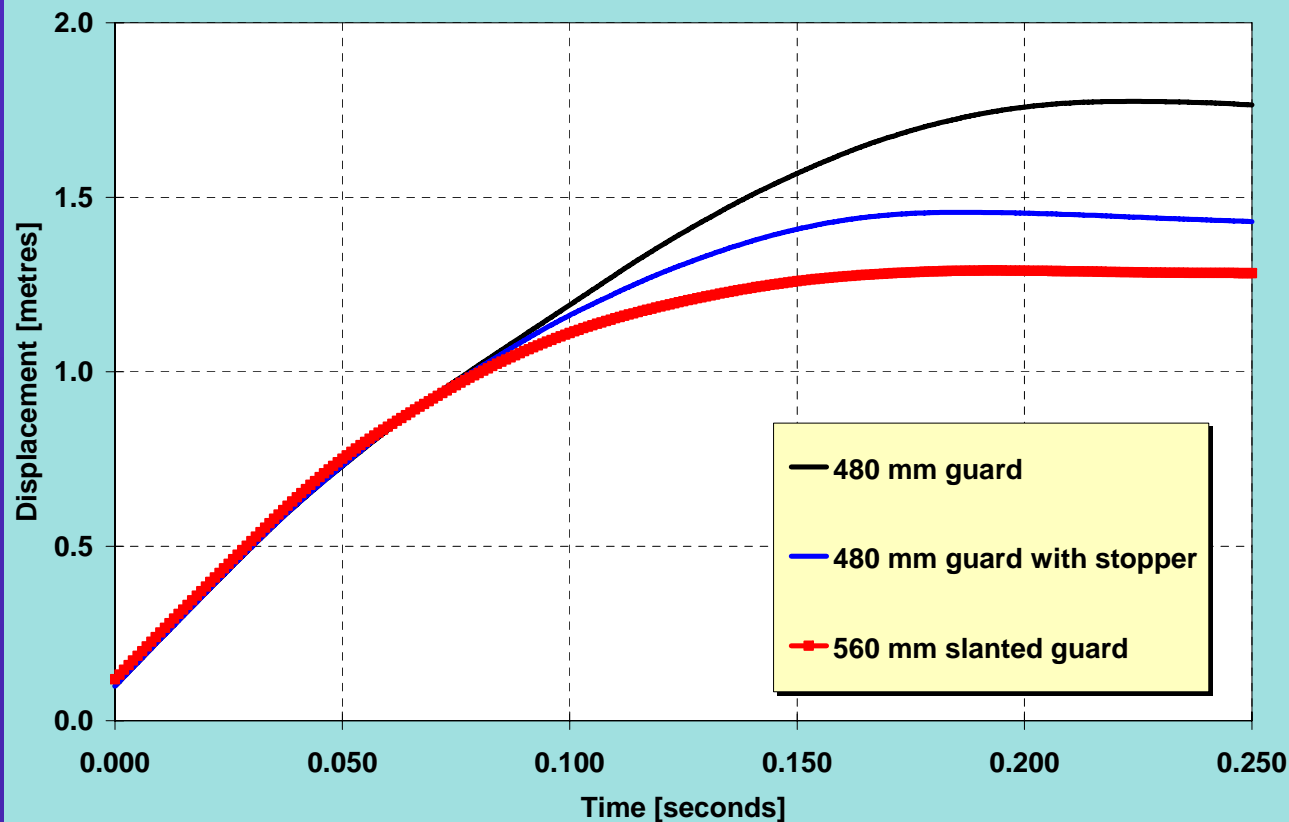


FEA – Slanted Guard Design



Deformable Guard Test Programme

Passenger Compartment Displacement
Honda Civic - 48 km/h

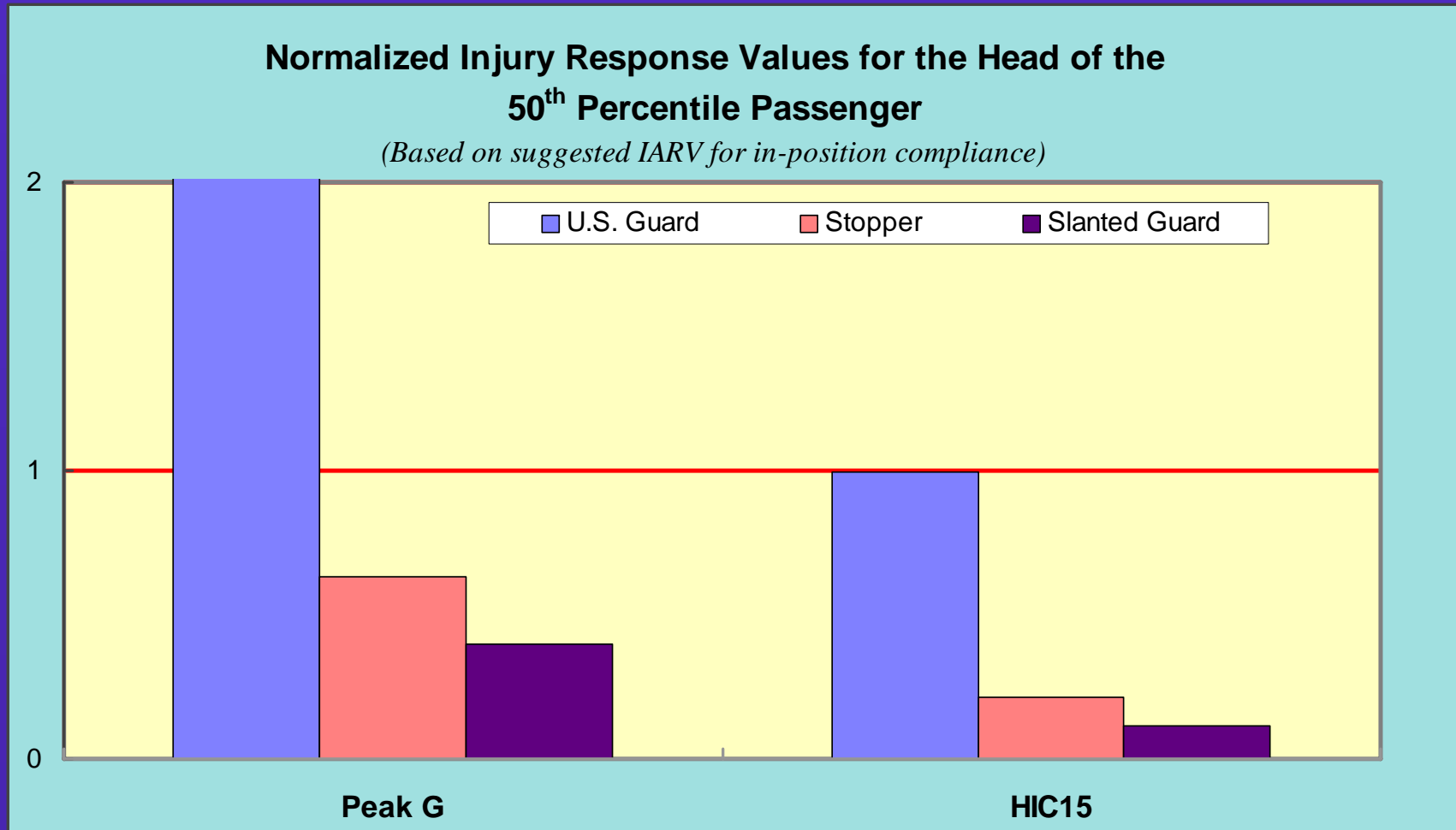


Deformable Guard Test Programme Summary

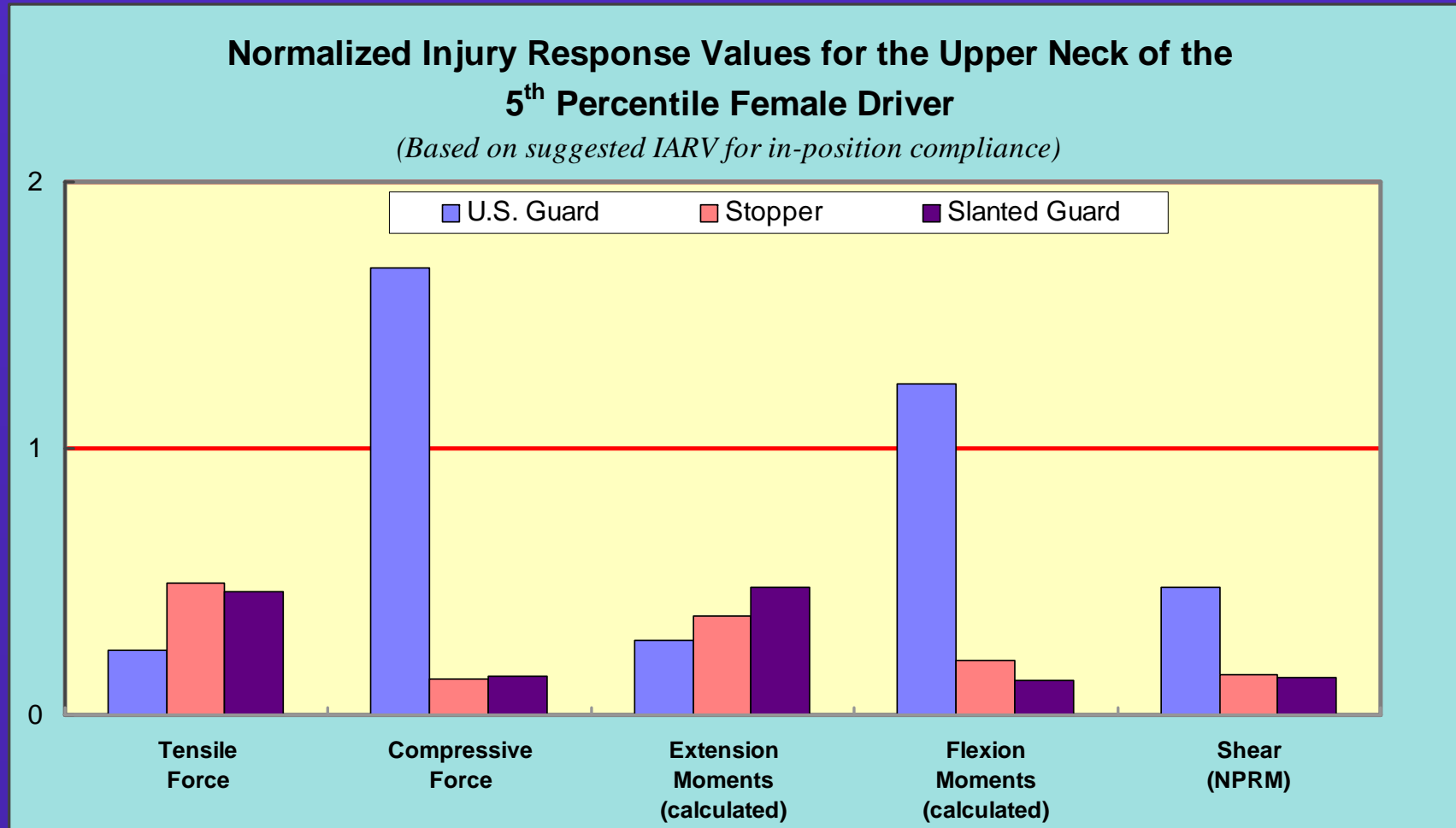
Vehicle ID	Speed [km/h]	Guard	Displacement [metres]	Max Force [kN]
Cavalier	48	560 mm	2.0	166
Cavalier	48	480 mm	1.4	227
Cavalier	65	480 mm	2.2	236
Cavalier	65	Stopper	1.4	400
Civic	48	480 mm	1.8	180
Civic	48	Stopper	1.4	214
Civic	48	Slanted	1.3	308
Civic	56	560 mm	2.4	176
Civic	56	Stopper	1.6	265
Windstar	48	560 mm	1.4	287



Analysis -- Dummy Response



Analysis -- Dummy Response



Deformable Guard Test Programme Conclusions

- ⌚ A guard meeting the minimum requirement of the US FMVSS 223 did not adequately protect occupants in a 1998 Cavalier and Civic EVEN AT 48 km/h
- ⌚ A guard that could withstand a uniform load of 300 kN adequately protected occupants in compact vehicles at 48 km/h

Deformable Guard Test Programme Design Results

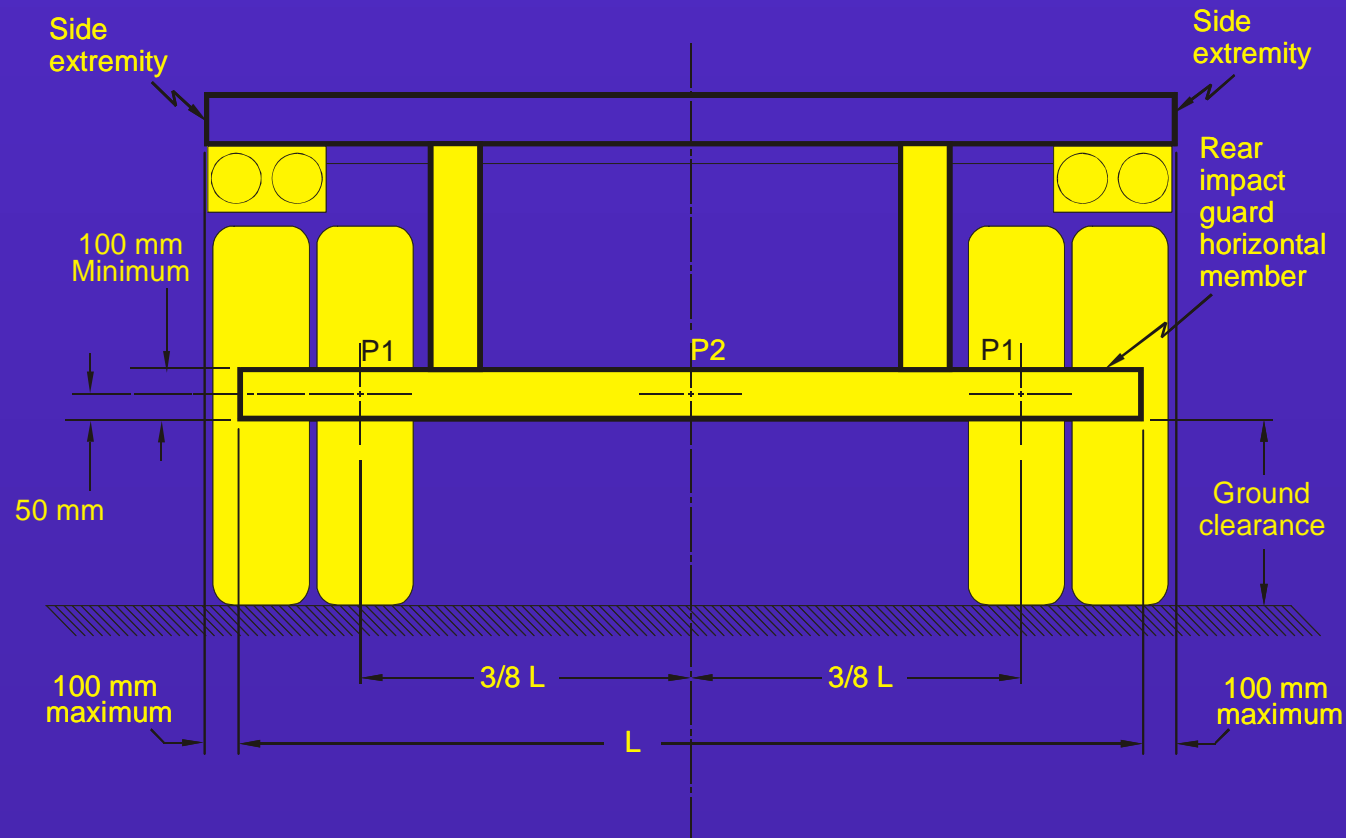
- Full-width uniform test to better simulate interaction between colliding vehicle & guard
- Minimum 350 kN resistance to handle sub-compact vehicles at 56 km/h
- Minimum energy absorption requirement of 20 KJ
- Same P1 and P2 load tests as the U.S. to ensure lower structural member strength
- 560 mm clearance requirement measured after testing

Deformable Guard Test Programme



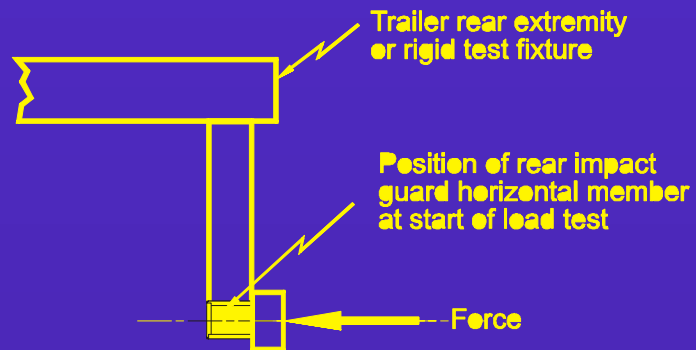
Canadian Guard

(rearview of trailer)

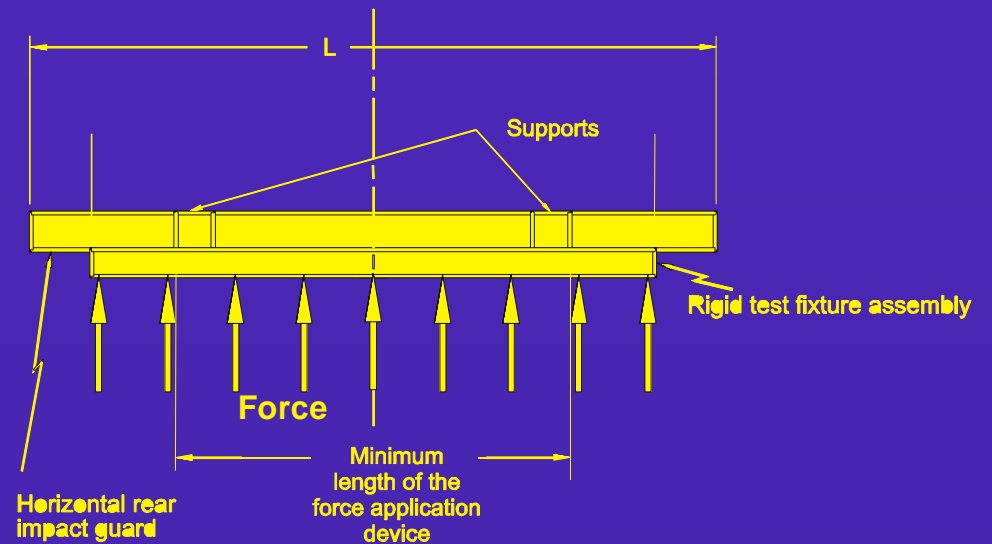


Uniform Load Application

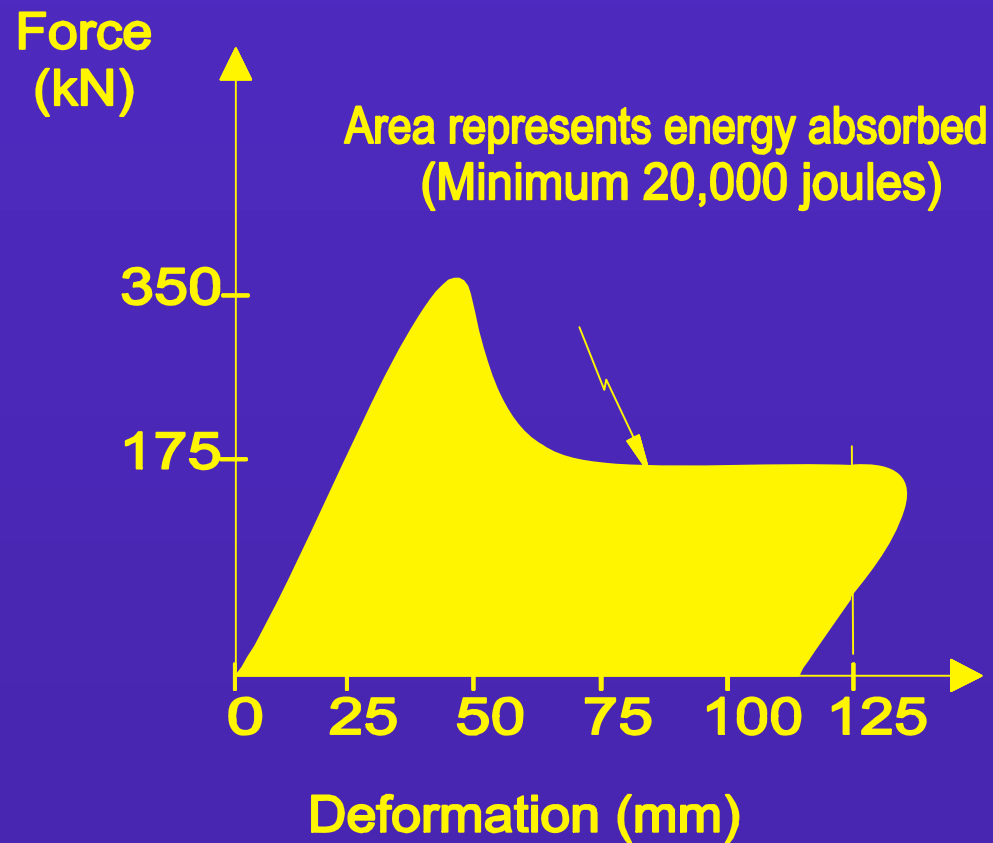
SIDE VIEW



TOP VIEW

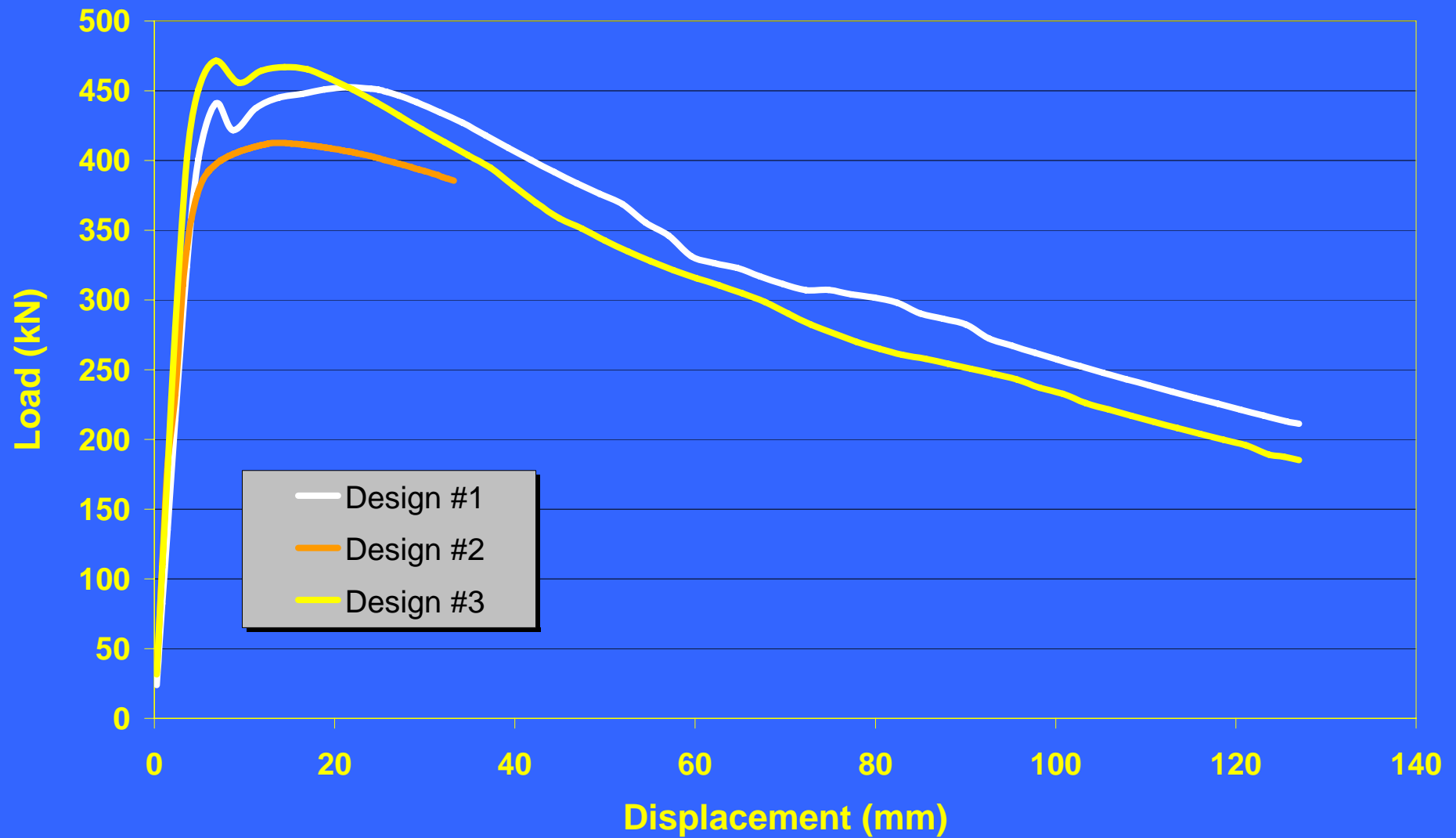


Uniform Test Load Force Deflection Curve

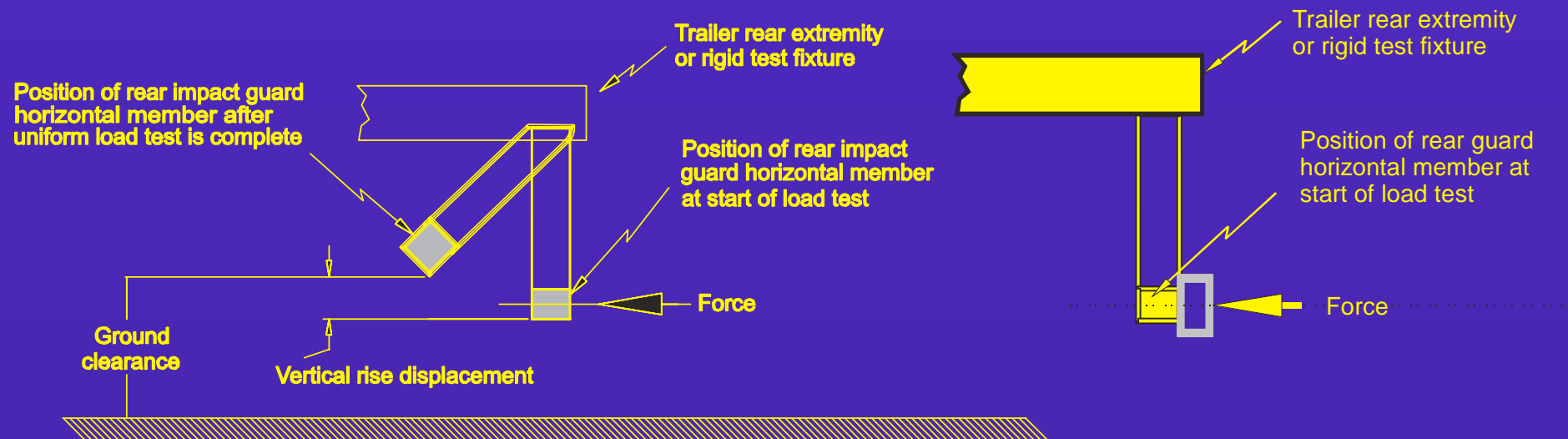


FEA

CMVSS 223 Compliant Rear Impact Protection



Ground Clearance Requirement



Summary of U.S. & Canadian Guard Requirements

	U.S. FMVSS 223/224	CANADIAN CMVSS 223
Guard height	560 mm (before testing)	560 mm (after testing)
Strength requirements	50 kN at P1 50 kN at P2 100 kN at P3	50 kN at P1 50 kN at P2 350 kN uniform load test
Energy Absorption	5,650 Joules	20,000 Joules



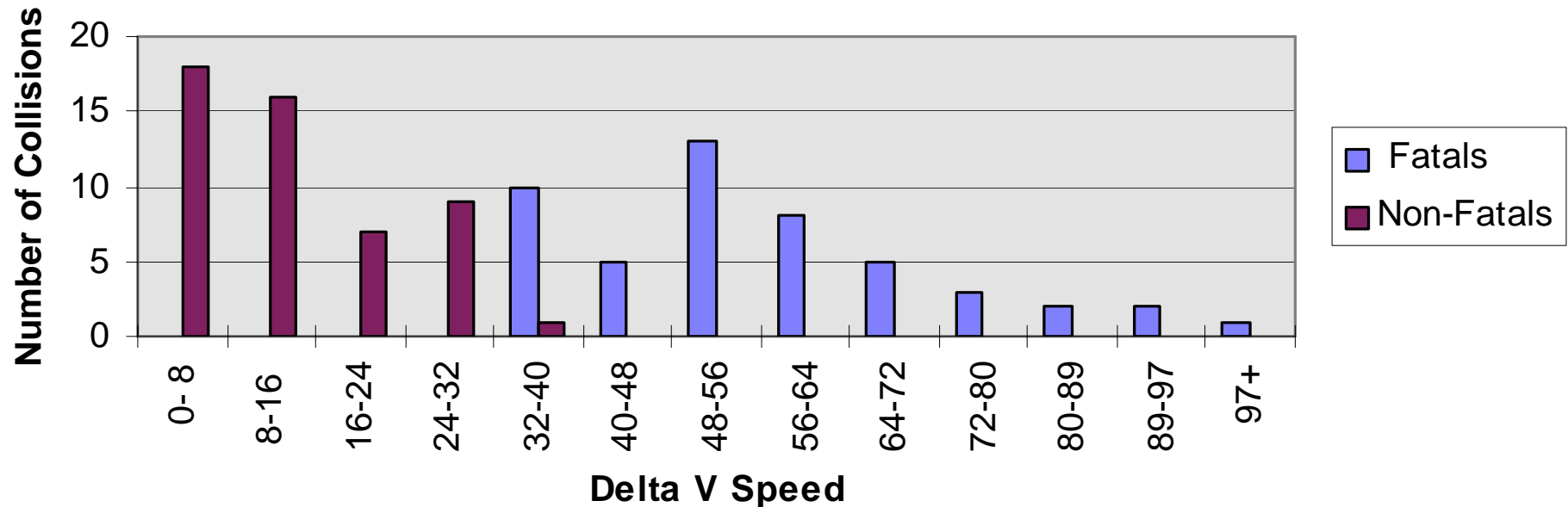
Rear Impact Fatalities Vs Underride Vs PCI

From the 1995 fatal truck study

- 23 fatalities in rear trailer impacts
- Underride occurred in 60% of the cases where details known
- Passenger compartment intrusion (PCI) occurred in 40% of the cases where details known

Why A Stronger Guard?

Collision Severity vs Delta V Speed kph



Why an After Test Height Requirement?

Sub-Compact Vehicles Over-represented

- ◌ NHTSA - sub-compacts represented 12% of underride fatalities - 2.4% of noted 1993 sales
- ◌ Sub-compacts - 11% of Canadian fleet
- ◌ Compacts - 25% of the Canadian fleet
- ◌ 1995 truck fatality study
 - ▢ 22% of occupant fatalities in sub-compact vehicles, thus 2X over representation in this study
 - ▢ 26% of occupant fatalities in compact vehicles

Injury Estimates

From TRAID

- » Est. 300 injuries/yr in rear truck impacts
- » From the 1995 fatal truck study Underride occurred in 64% of the cases where details known - 192 Injuries/yr.
- » Passenger compartment intrusion (PCI) occurred in 42% of the cases where details known - 126 injuries/yr.



Cost Benefit Comparison (millions)

	Guard Cost	Minimum Benefits	Maximum Benefits
Option 1	\$3.0	\$0.96	\$2.39
Option 2	\$3.1	\$1.49	\$3.73
Option 3	\$3.6	\$4.80	\$7.66



Canadian Guard Vs. U.S./ECE Guard

\$30 Cost Differential



Canadian guard



NHTSA guard



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Regulation Phased-In

- ⌚ Allow time for industry to prepare for the Canadian specific requirements and the NHTSA to consider upgrading their regulation
- ⌚ Proposed that regulation effective 1 year after publication in the Canada Gazette
- ⌚ During phase 1 – two year period following registration
 - either NHTSA Guard or Canadian Guard allowed
- ⌚ Phase 2 – three years after publication - Canadian Guard only (Sept 1, 2007)

Industry Built Trailer

Rear Impact 56 k/hr Honda Civic



TC98-511wide900frames



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Industry Built Trailer

Rear Impact 56 k/hr Honda Civic



Should Passenger Car Underride Protection be our Next Project?

