Transport Canada
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INF GR/DL/6/3

Transport Canada testing in support of the global technical regulation on Door Locks and Door Retention Components

Presentation to NHTSA Team Members

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Standards and Regulations
Road Safety and Motor Vehicle Regulation

January 27, 2004

OUTLINE

- Inertia Testing
- Latch Testing
- Combination Testing

INERTIA TESTING

Procedure

- 3 tests total as per gtr procedure:
  - 1 full vehicle test
  - 2 door-on-sled tests with 3 doors / test
- Hinged doors only
- Previously used in TC compliance programs
- Directions relative to
  VEHICLE axes, not LATCH / STRIKER axes

Vehicles

- 1 full vehicle test

'00 Toyota Camry

- 2 door-on-sled tests with 3 doors / test

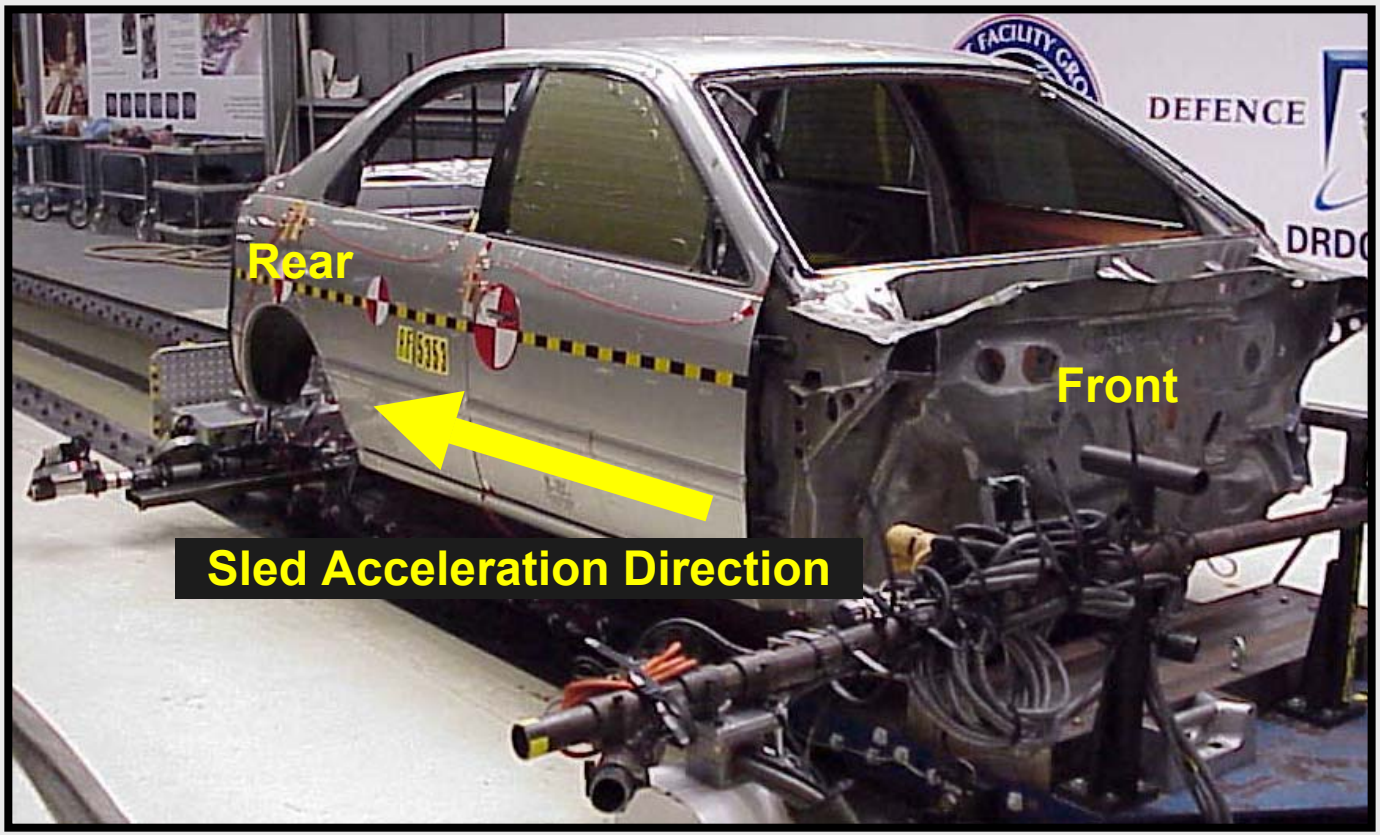
'98 Toyota Camry

'03 Chevrolet TrailBlazer

'02 Ford Focus

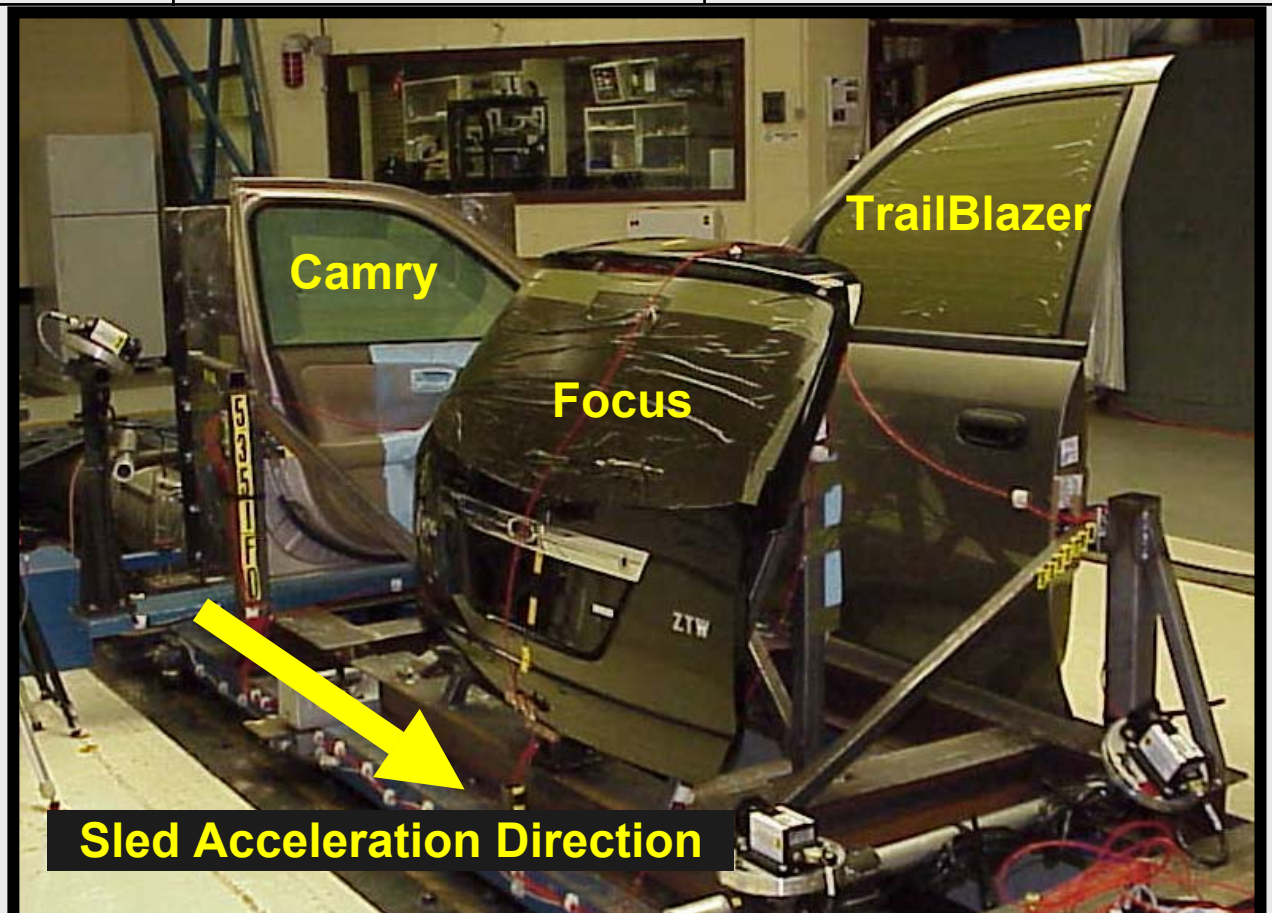
Test #1 - Full Vehicle Test

Vehicle	Door	Direction
Camry	All doors	Longitudinal Frontal



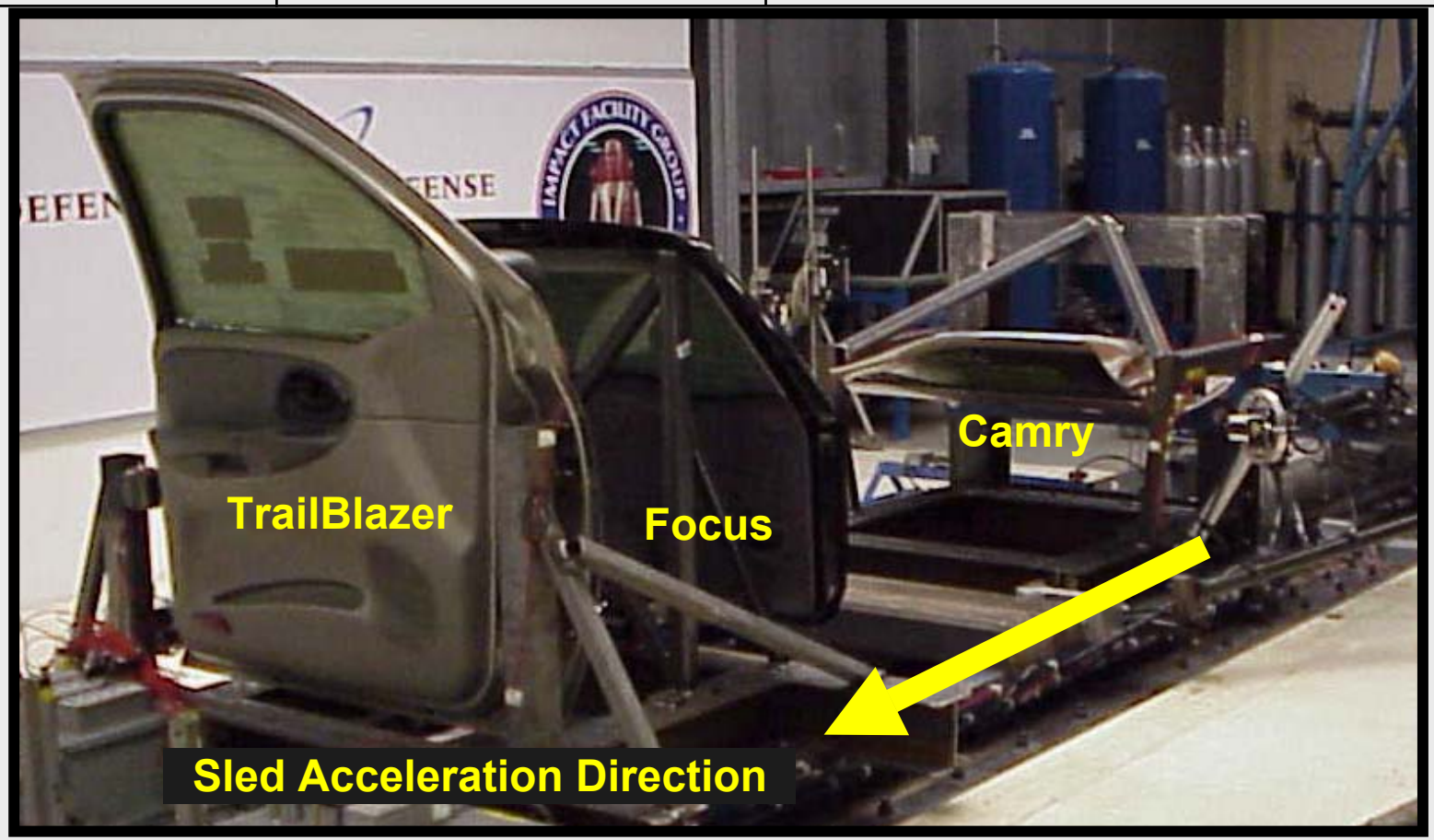
Test #2 - Door-on-Sled Test A

Vehicle	Door	Direction
TrailBlazer	Driver	Longitudinal Frontal
Focus	Hatchback	Lateral
Camry	Front Passenger	Lateral (Door Opening)

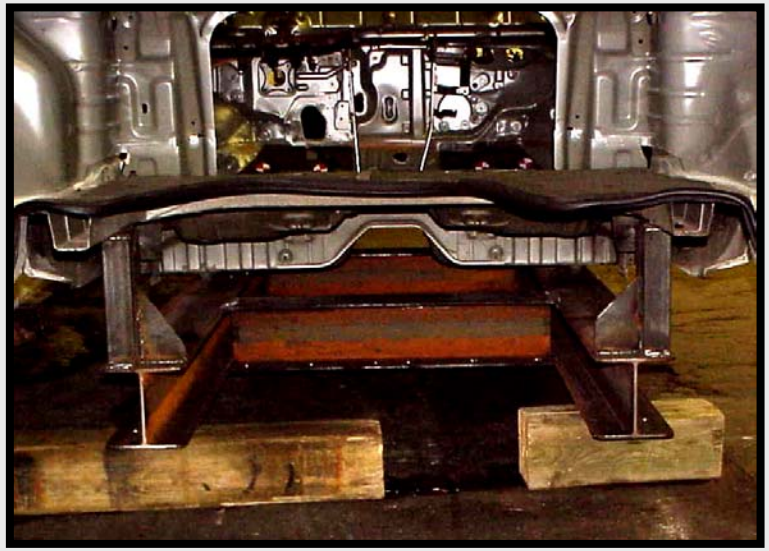


Test #3 - Door-on-Sled Test B

Vehicle	Door	Direction
TrailBlazer	Driver	Lateral (Door Opening)
Focus	Hatchback	Rear (Door Opening)
Camry	Front Passenger	Rollover (Towards Ground)



Preparation of Full Vehicle Buck

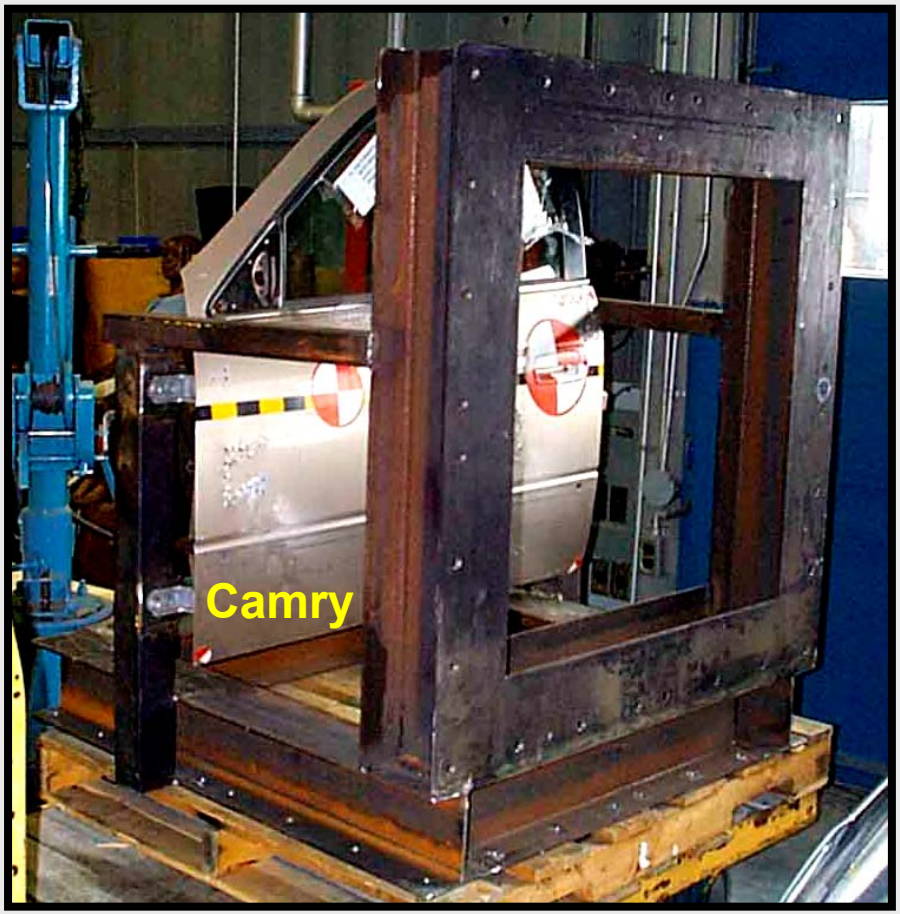


Preparation of Doors-on-Sled

Orthogonal View

Side View

Preparation of Doors-on-Sled

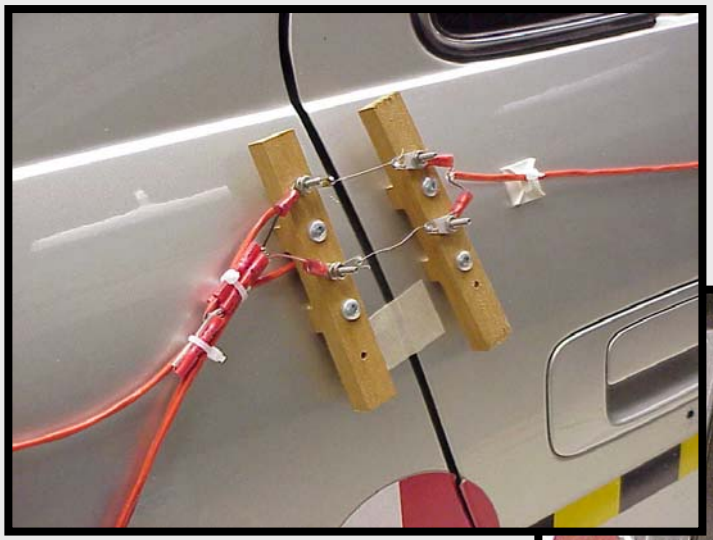


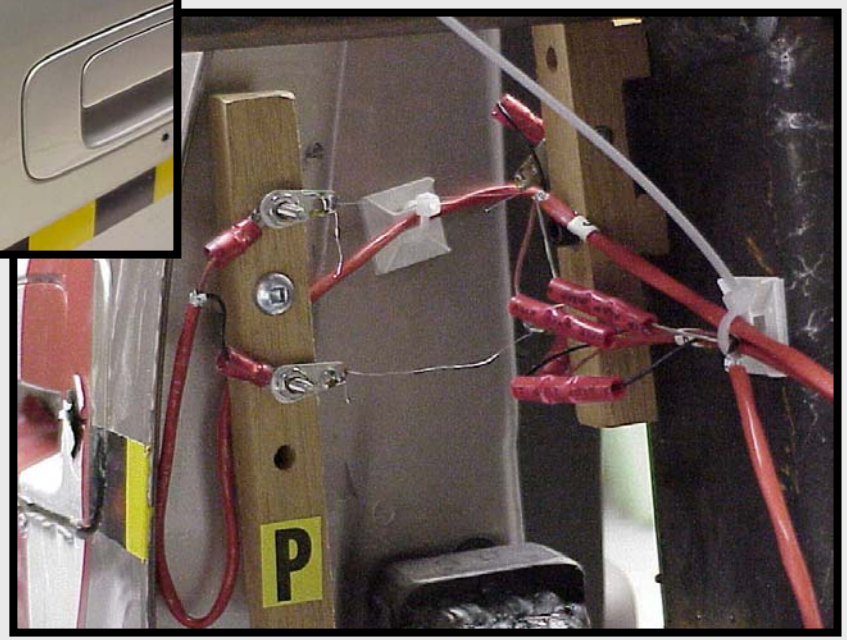
Orthogonal View

Rotated View

Measuring Door Opening

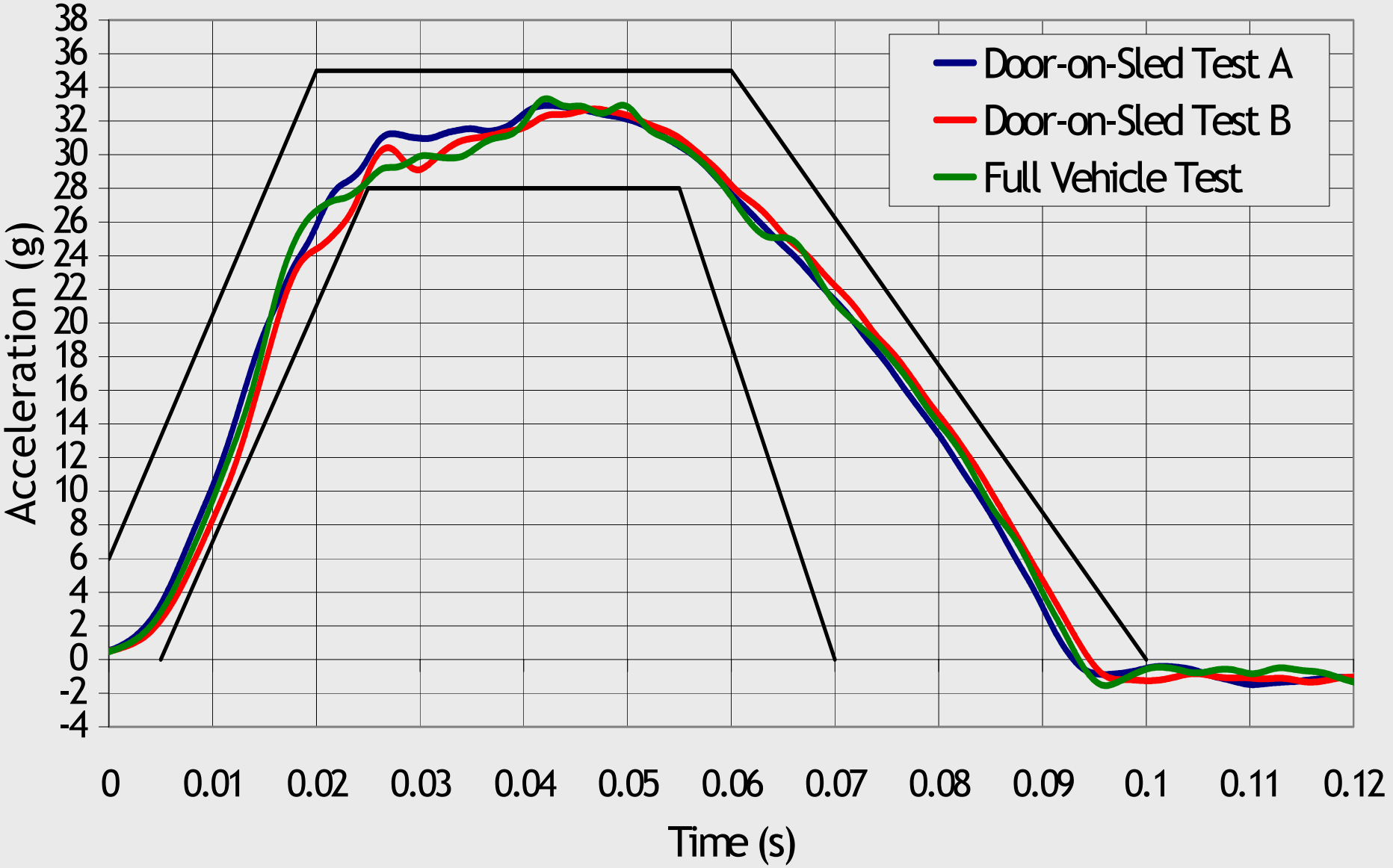
- 1 high-speed camera / door
- Low-resistance tape on full-vehicle doors





- Wires to determine primary + secondary latching

Results - Sled Pulse



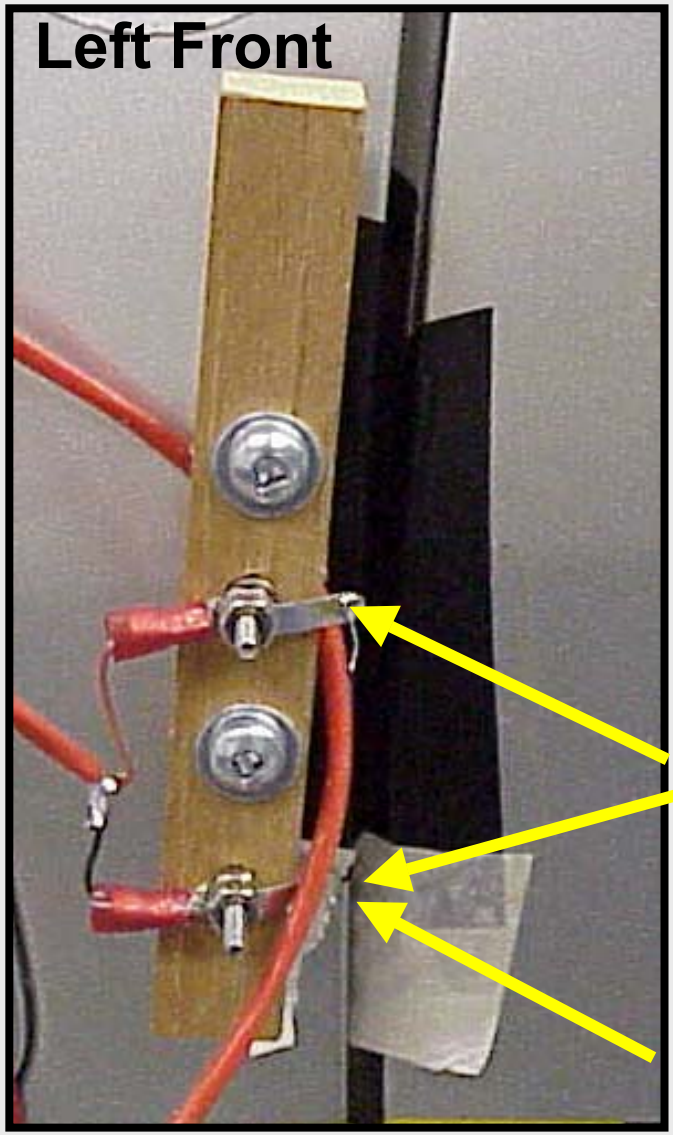
Results #1 - Full Vehicle Test

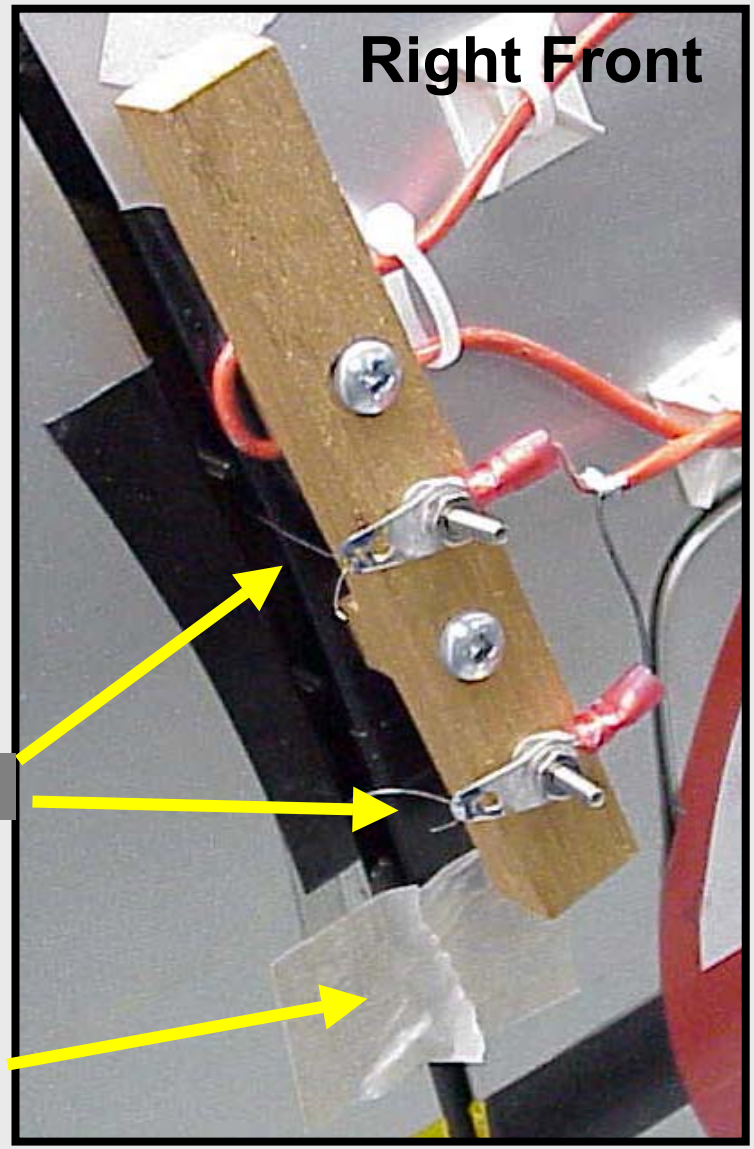
Vehicle	Door	Direction	Secondary Remained Latched	Primary Remained Latched	Notes
Camry	LF	Long. Frontal	√	√	
	LR	Long. Frontal	√	√	*
	RF	Long. Frontal	√	√	
	RR	Long. Frontal	√	√	*

* Tape broke on ALL doors, even though none opened
* Wires broke on rear doors, even though none opened

Results #1 - Full Vehicle Test

Results #1 - Full Vehicle Test

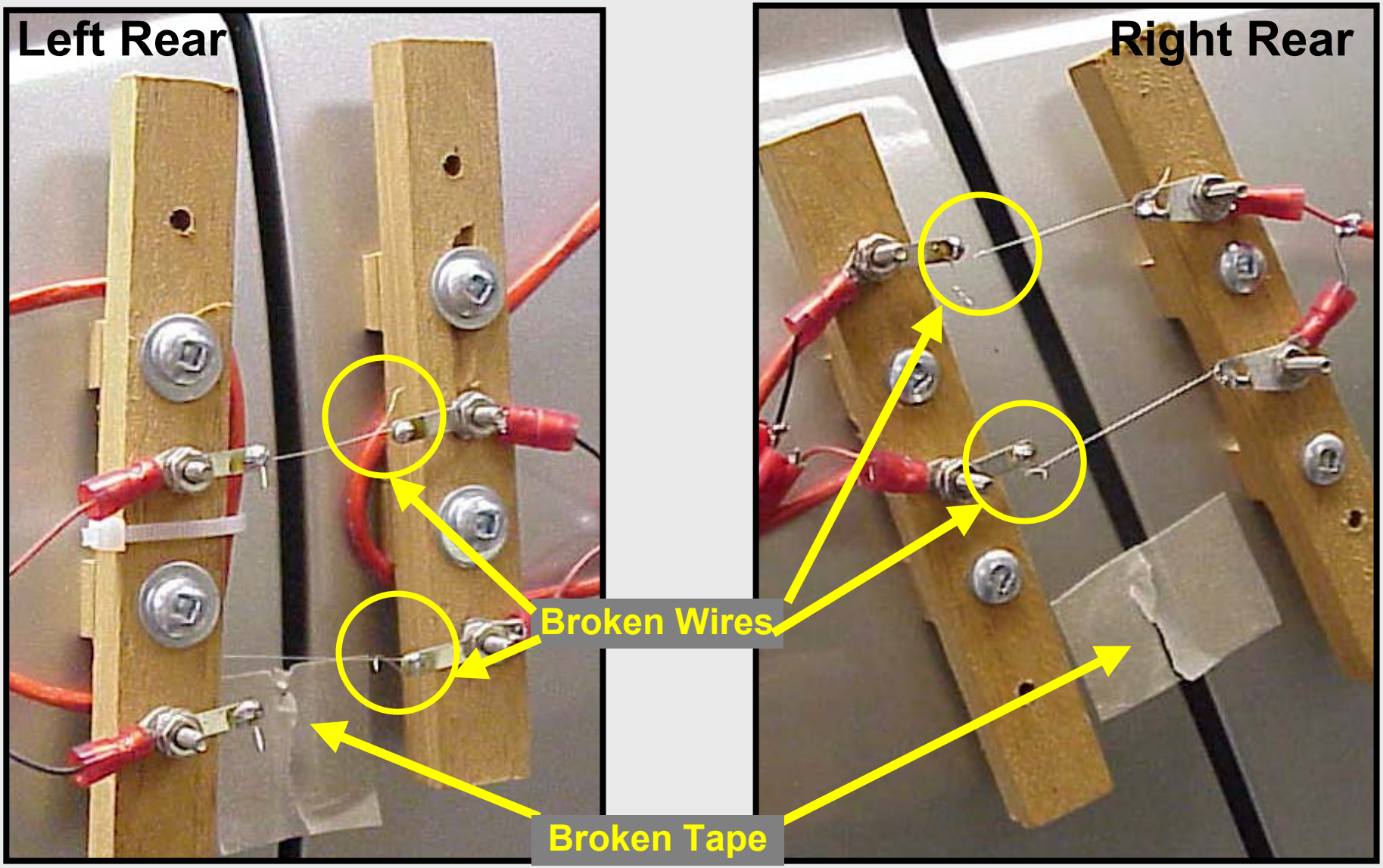




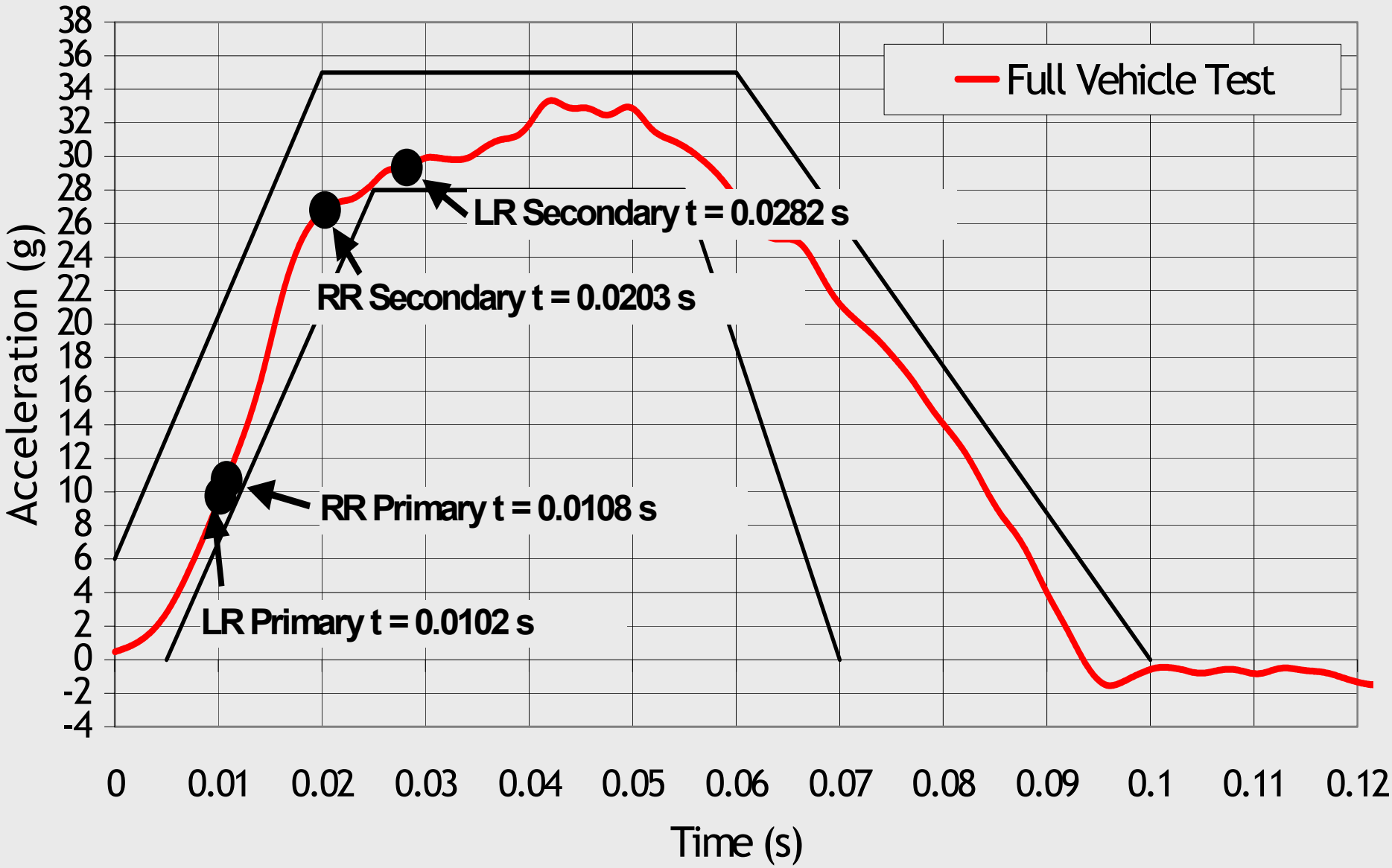
Wires Intact

Broken Tape

Results #1 - Full Vehicle Test



Results - Wire Breaking



Results #1 - Full Vehicle Test

Post-test:

- 250 N load application: no door openings √
- Door opening, closing: all doors OK √
- Latch + striker inspection: no damage √
- Very little deformation of frame post-test √

Results #2 - Door-on-Sled Test A

Vehicle	Door	Direction	Secondary Remained Latched	Primary Remained Latched	Notes
TrailBlazer	Driver	Longitudinal Frontal	√	√	
Focus	Hatchback	Lateral	√	√	
Camry	Front Passenger	Lateral (Door Opening)	√	X	*

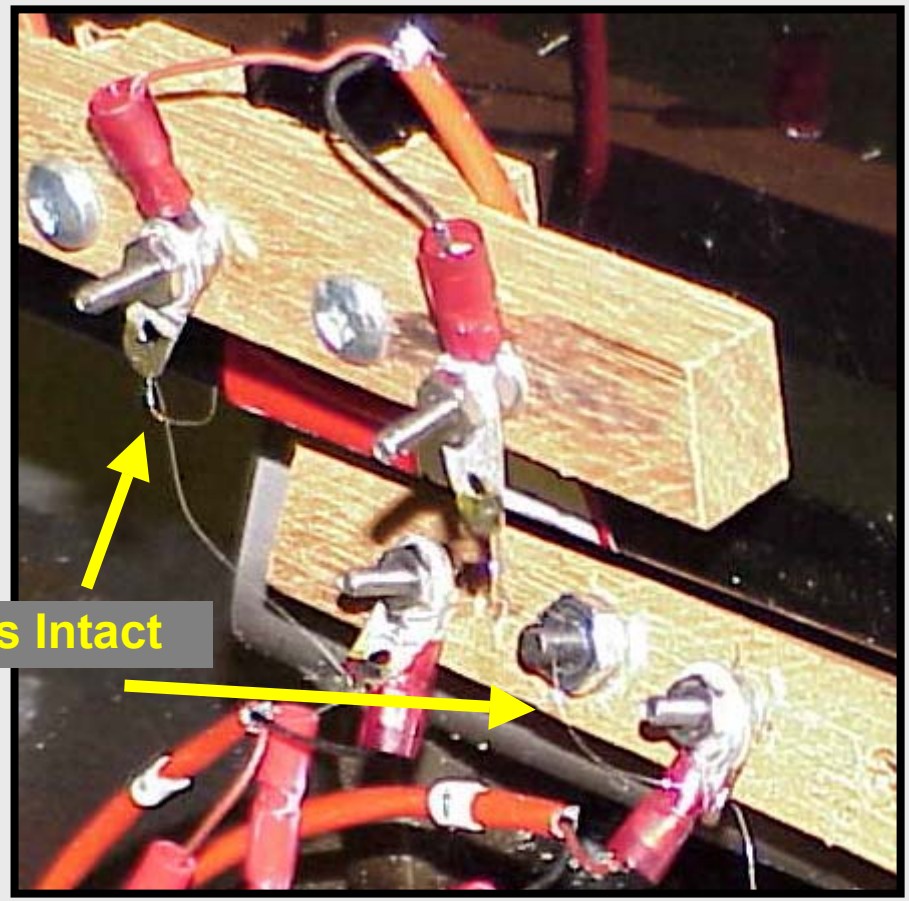
* Camry likely went to secondary latch, then rebounded into primary latch
* Camry door difficult to open and re-close post-test

Results #2 - Door-on-Sled Test A

Results #2 - Door-on-Sled Test A

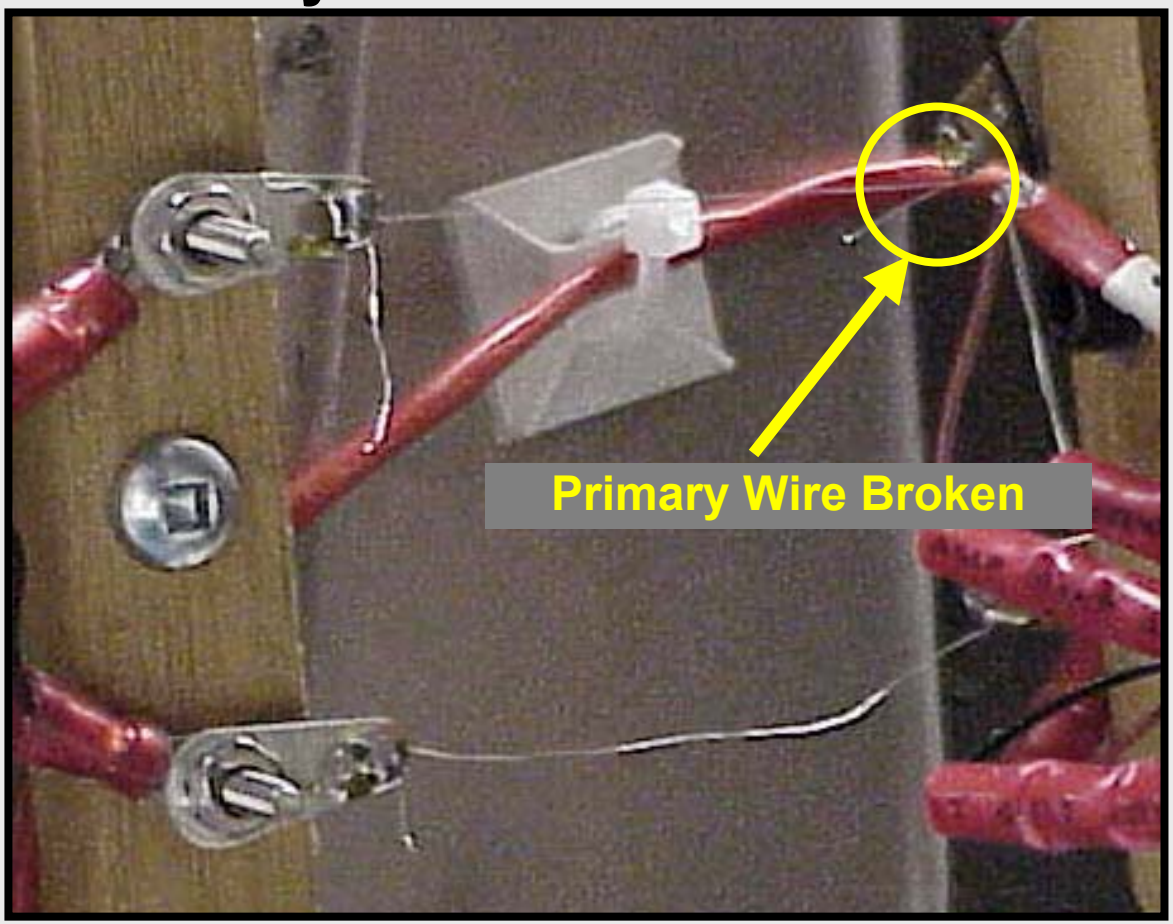
TrailBlazer

Focus

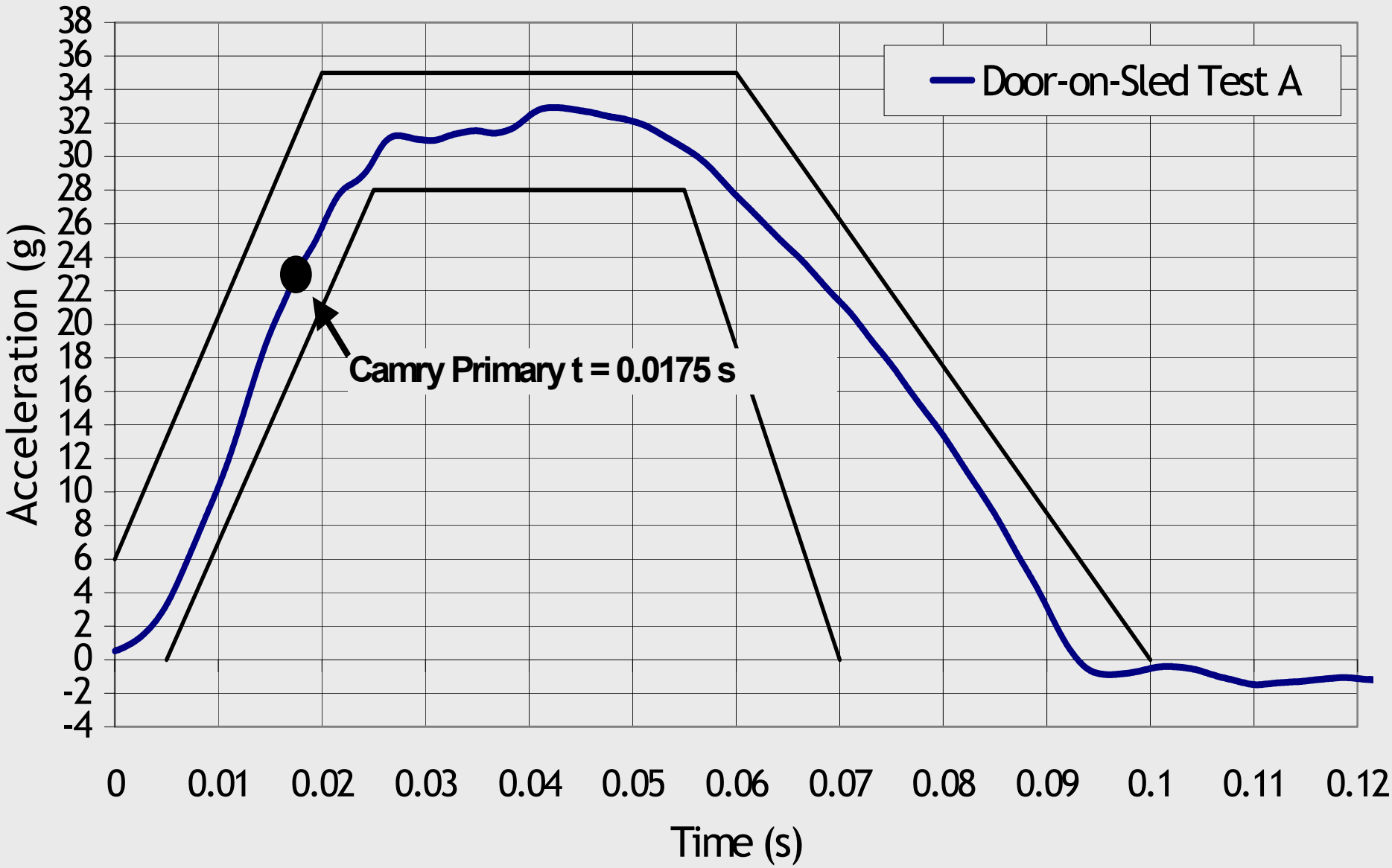


Results #2 - Door-on-Sled Test A

Camry



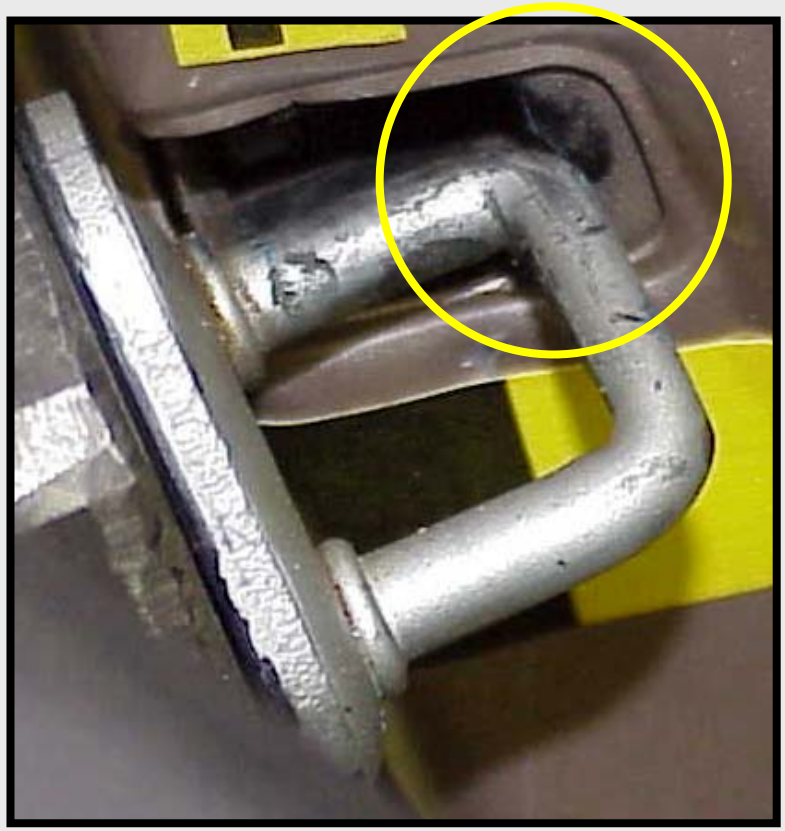
Results - Wire Breaking



Results #2 - Door-on-Sled Test A

Post-test:

- 250 N load application: no door openings √
- Door opening, closing: all doors OK except Camry X
- Latch + striker inspection: minor damage to Camry latch X



Results #3 - Door-on-Sled Test B

Vehicle	Door	Direction	Secondary Remained Latched	Primary Remained Latched	Notes
TrailBlazer	Driver	Lateral (Door Opening)	√	X	*
Focus	Hatchback	Rear (Door Opening)	√	?	* *
Camry	Front Passenger	Rollover (Towards Ground)	√	√	

* TrailBlazer likely went to secondary latch, then rebounded into primary latch

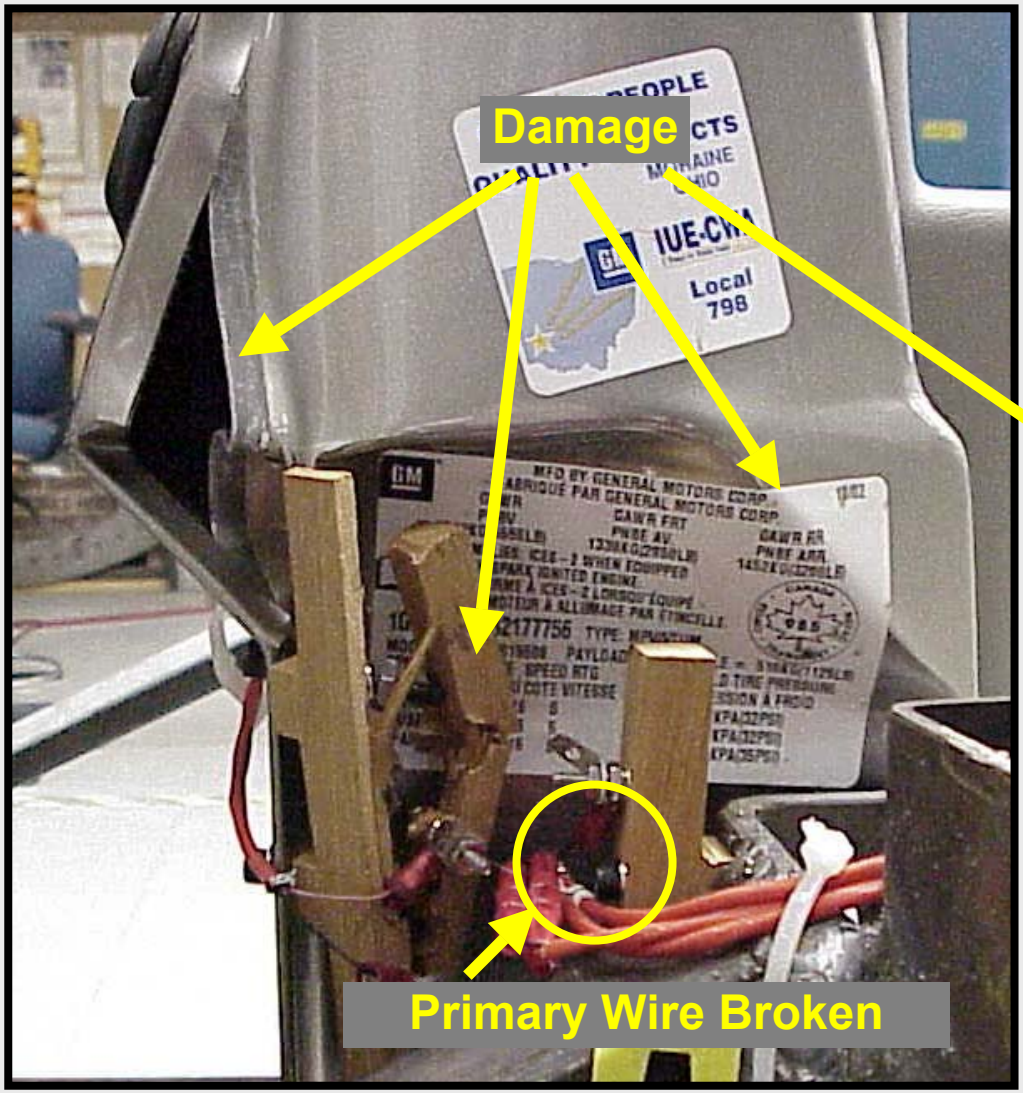
* TrailBlazer door completely jammed, much deformation

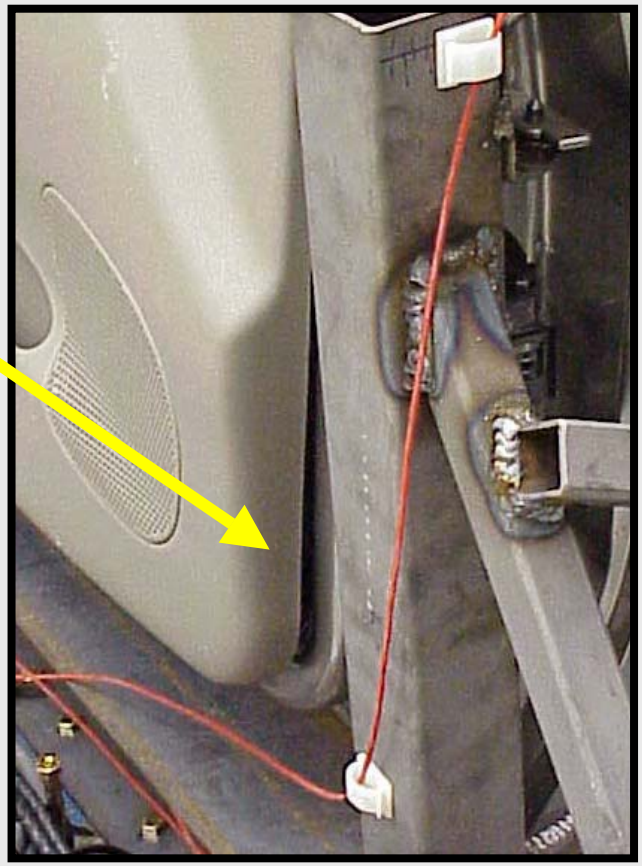
** Difficult to tell whether Focus went to secondary latch

Results #3 - Door-on-Sled Test B

Results #3 - Door-on-Sled Test B

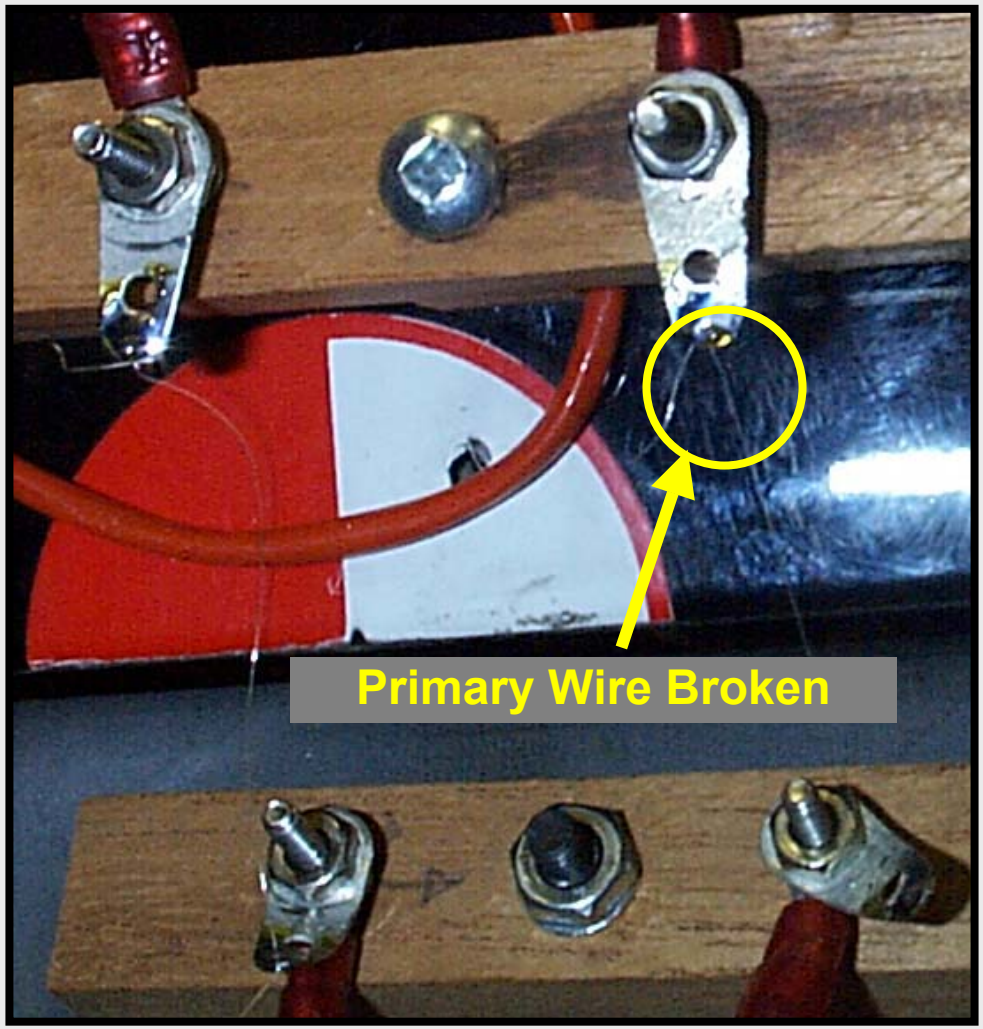
TrailBlazer





Results #3 - Door-on-Sled Test B

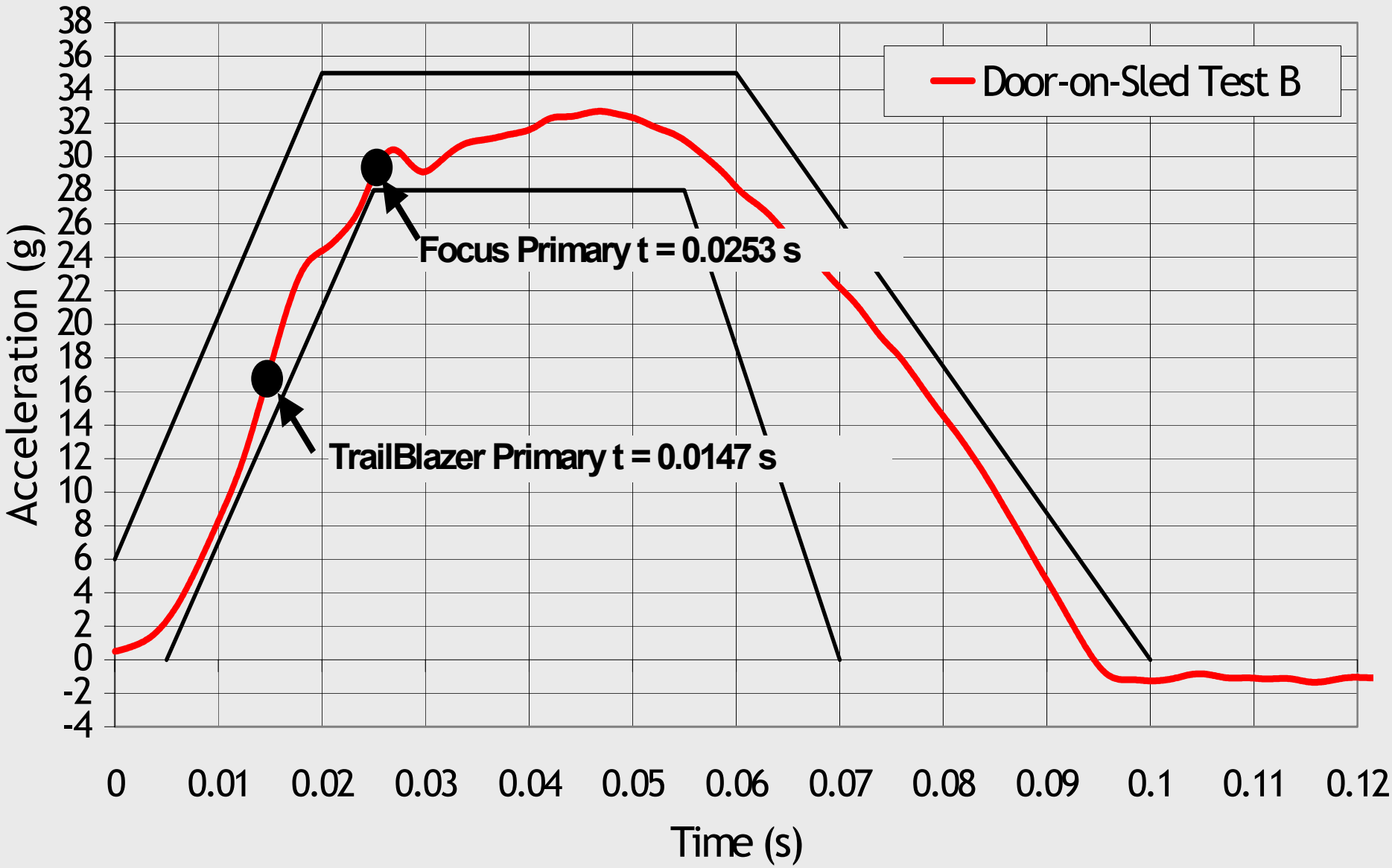
Focus



Results #3 - Door-on-Sled Test B

Camry

Results - Wire Breaking



Results #3 - Door-on-Sled Test B

Post-test:

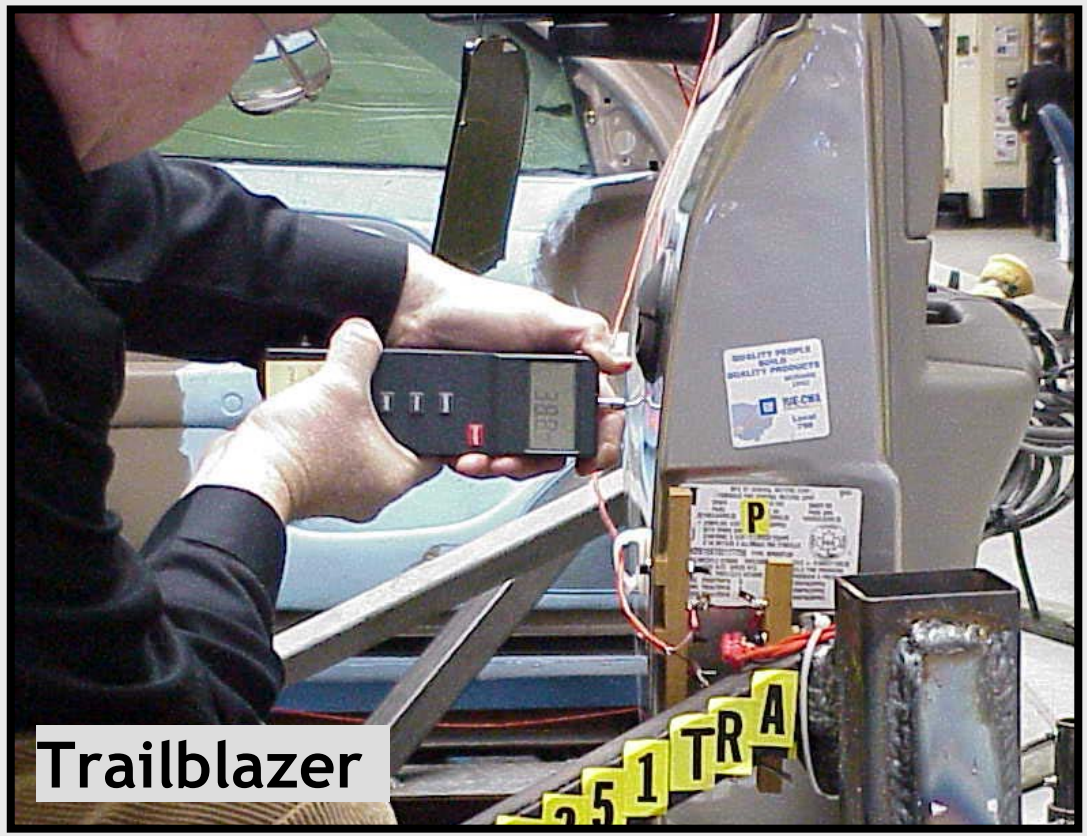
- 250 N load application: no door openings √
- Door opening, closing: all doors OK except TrailBlazer X
- Latch + striker inspection: major damage to Trailblazer door X

Post-test Procedure

- Side hinged doors:

  -must drill hole without damaging internal linkages

  -handle "center" needs better definition

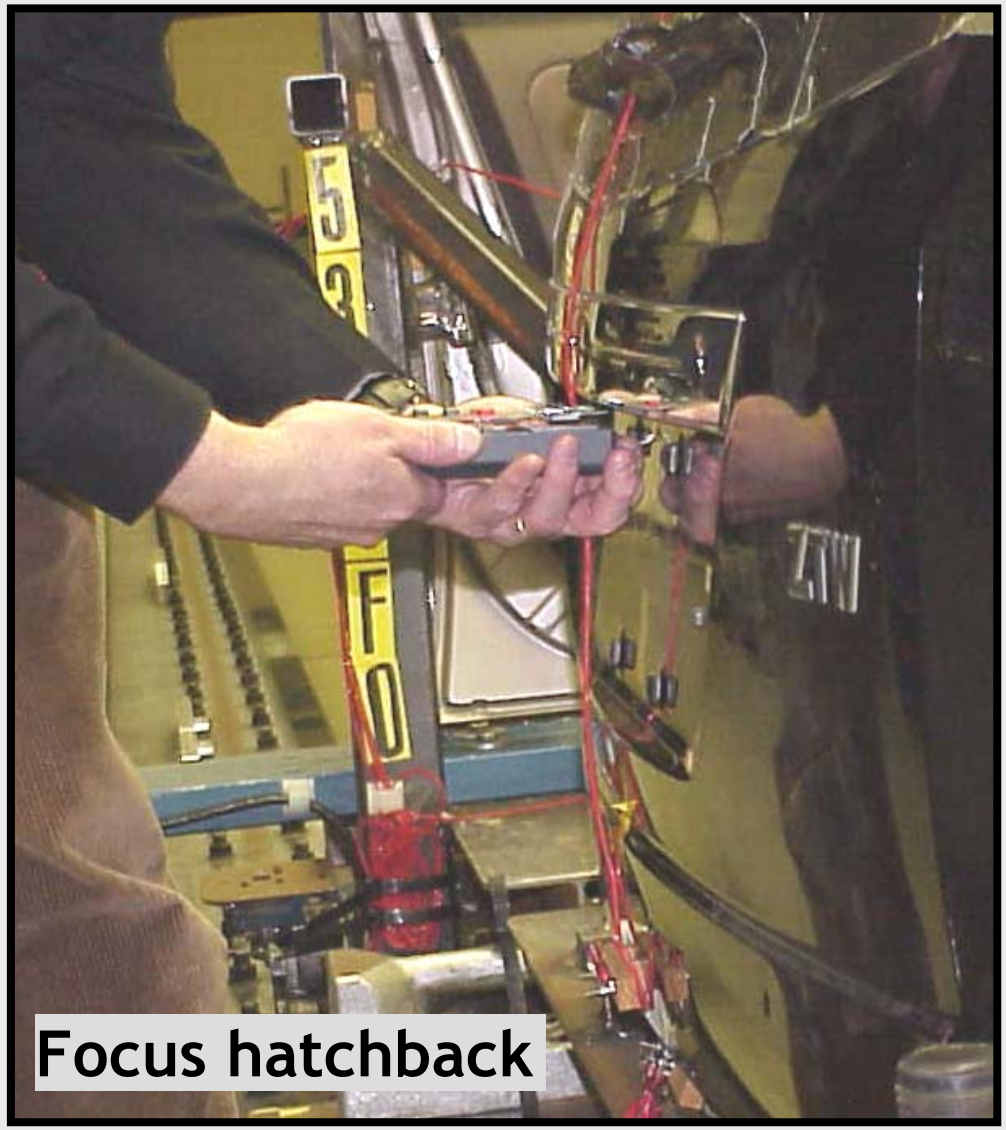


Post-test Procedure

- Rear hatchbacks:

  -What to do about doors without handles?

  -e.g. Opens with key, from inside only



Focus hatchback

Conclusions - Results

- Failures = 0 /10 tests
- Doors opening to secondary latched position =

  (2 or 3) / 3 lateral or door opening direction

  0 / 6 longitudinal direction

  0 / 1 rollover direction

- Worst case = lateral or door opening direction
- More deformation than expected

Conclusions - Procedure

- Tests feasible, more realistic than calculation
- Sled pulse initially difficult
- Monitoring door opening:
  - video absolutely necessary
  - tape method gives false results
  - wire method has potential

Conclusions - Cost Breakdown

- High cost for limited # of doors tested:

$25,000 CAD for vehicle + door-on-sled prep.

- $6,900 CAD for full vehicle prep.
- $6,000 CAD x 3 doors = $18,000 for door-on-sled prep.

$20,000 CAD for sled testing

- $6,600 per test x 3 tests

Conclusions - Procedure

Full Vehicle	vs	Door-on-Sled
+ Interaction with door trim		- Not testing door system
- Need many cameras		- Costly preparation
		- Need expert machinist
		- Difficult from compliance pt. of view

Conclusions - Procedure

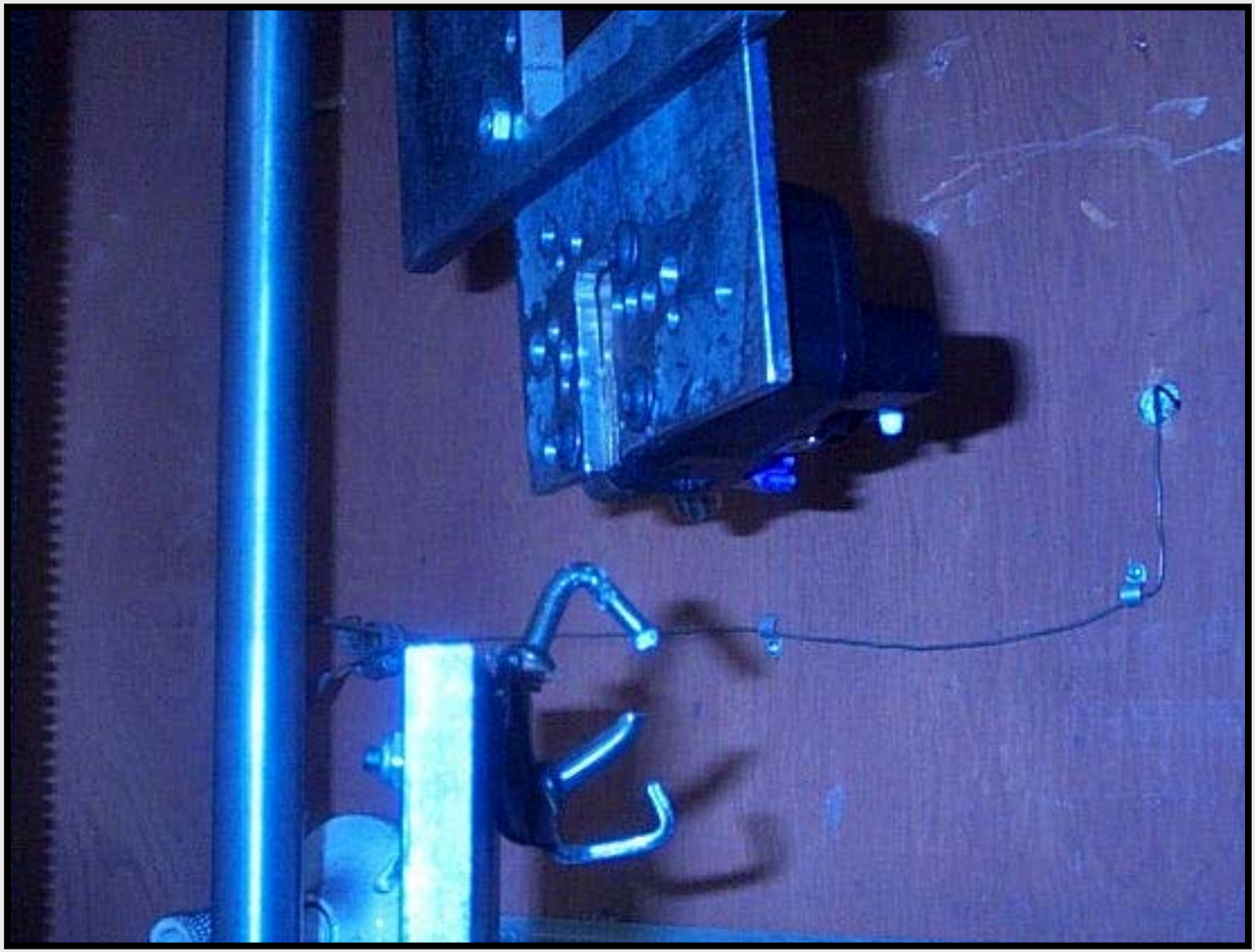
TC can provide input into more detailed + improved procedure, e.g.:

- Detailed drawings of bucks for full vehicle + door-on-sled tests
- Wire method
- Post-test procedure

Conclusions - Canada's thoughts

- Limited information regarding inertia openings in the field
- Full-vehicle more realistic than door-in-frame
- Tests expensive for information obtained
- Ideally, would like to do reconstructions of real-world inertia openings

LATCH TESTING



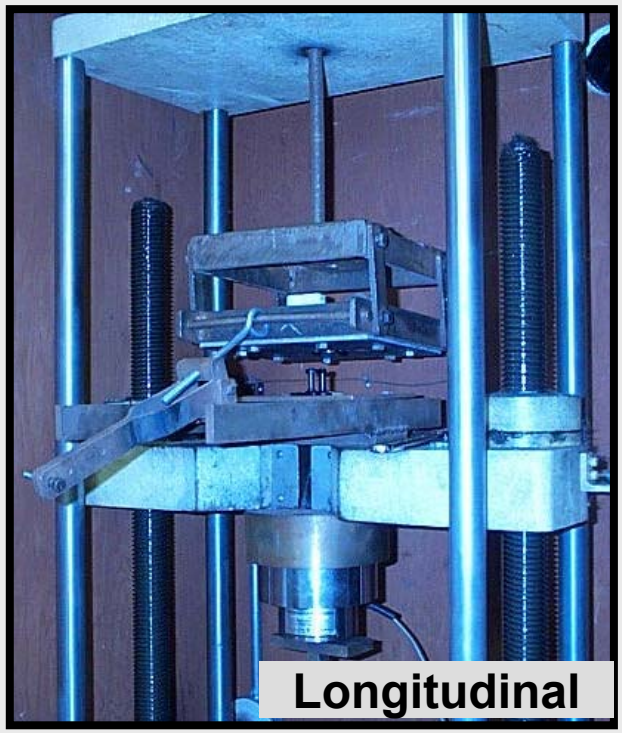
Objective

- What is max. load that latches can sustain?
- Perspective on loads required by gtr tests
- Selected latches

Procedure

As per CMVSS / FMVSS 206 procedure (SAE J839):

- Longitudinal, transverse directions
- Primary latch only (not secondary)



Specimens

- 2003 MY vehicles
- Power locks
- High volume sales vehicles:

  passenger car — minivan

  SUV — pickup truck

  (U.S. sales figures as of Oct 2003, Source: Automotive News)
- Latches, strikers, hardware:

  bought new from dealerships

Results - Overview

Dir.	CMVSS / FMVSS
Long.	11,000 N *2473 lb.*
Trans.	8,900 N *2000 lb.*

#	Vehicle	Latch	Dir.	Maximum Load
1	Ford F-150 	Driver	Long. Trans.	21,128 N *4750 lb.* 19,669 N *4422 lb.*
2	Toyota Camry 	Front Pass.	Long. Trans.	26,292 N *5911 lb.* 24,899 N *5598 lb.*
3	Dodge Caravan 	Driver	Long. Trans.	29,948 N *6733 lb.* 17,143 N *3854 lb.*
4	Chevrolet Trail Blazer 	Driver	Long. Trans.	42,981 N *9663 lb.* 16,693 N *3753 lb.*

Results - Ford F-150

Longitudinal

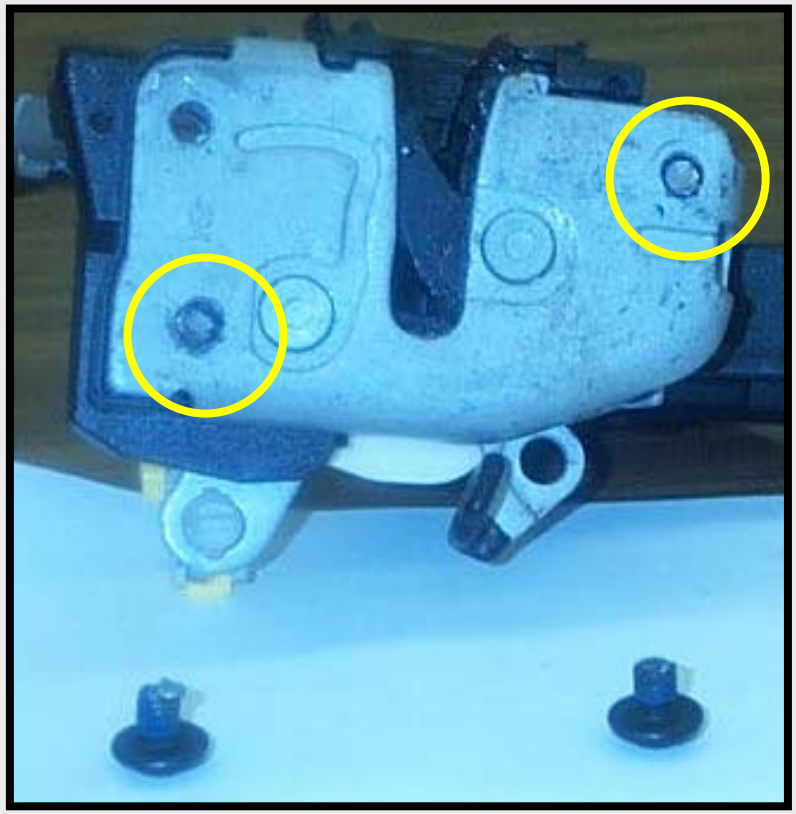
Failure = 21,128 N (*4750 lb.*)

Mode = striker bolts stripped

Transverse

Failure = 19,669 N (*4422 lb.*)

Mode = 2 latch bolts failed

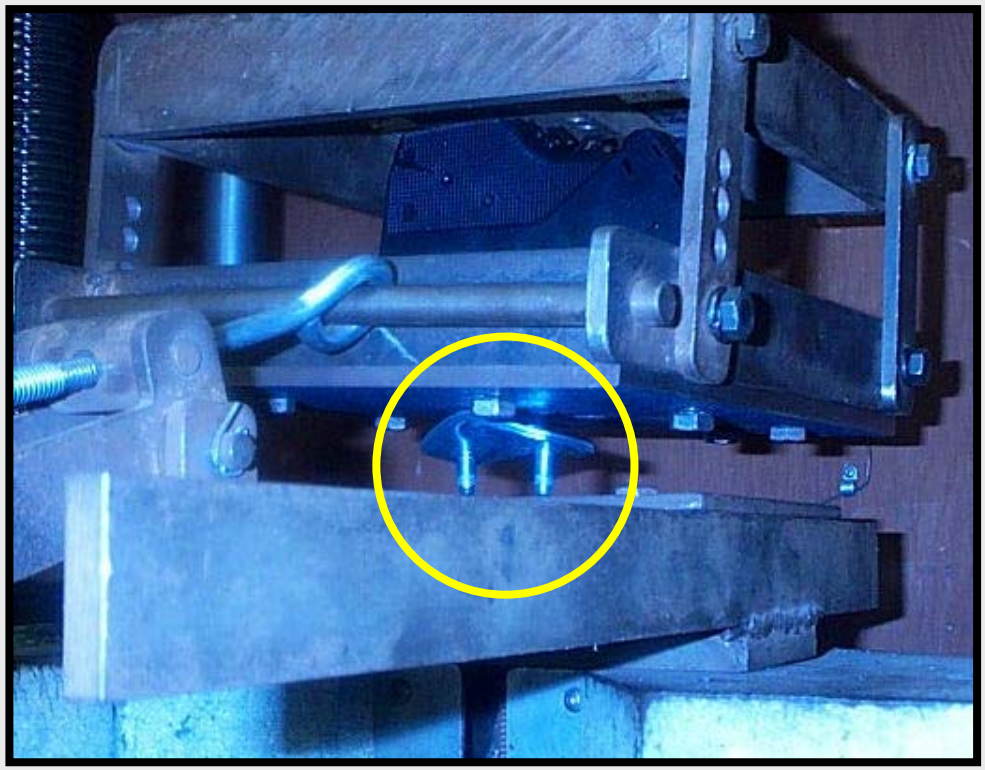


Results - Toyota Camry

Longitudinal

Failure = 26,292 N (*5911 lb.*)

Mode = striker bolts stripped



Transverse

Failure = 24,899 N (*5598 lb.*)

Mode = striker failed at base

Results - Dodge Caravan

Longitudinal

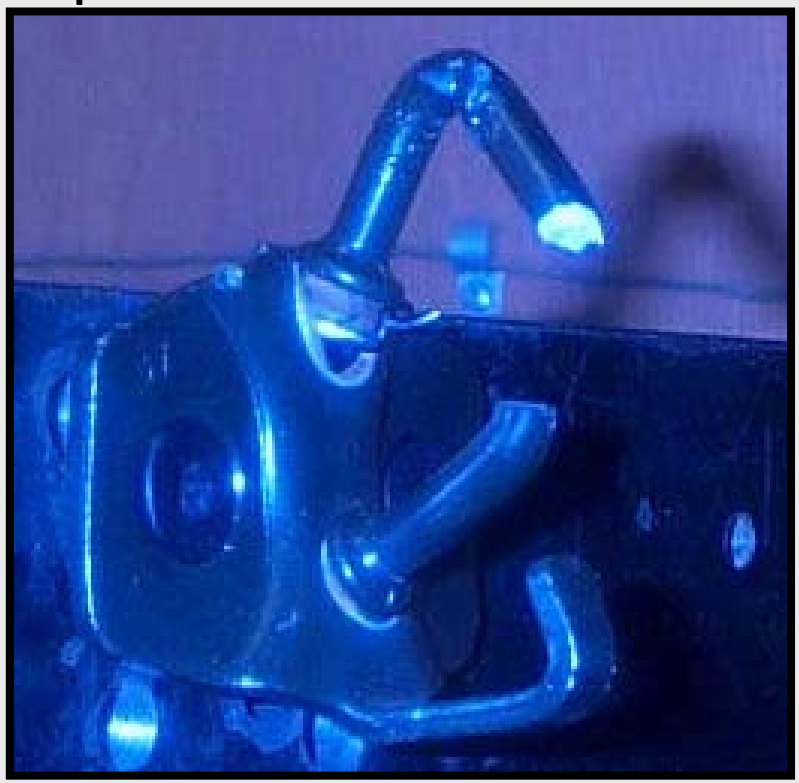
Failure = 29,948 N (*6733 lb.*)

Mode = striker failed at top

Transverse

Failure = 17,143 N (*3854 lb.*)

Mode = striker failed in 2 places



Results - Chevy TrailBlazer

Longitudinal

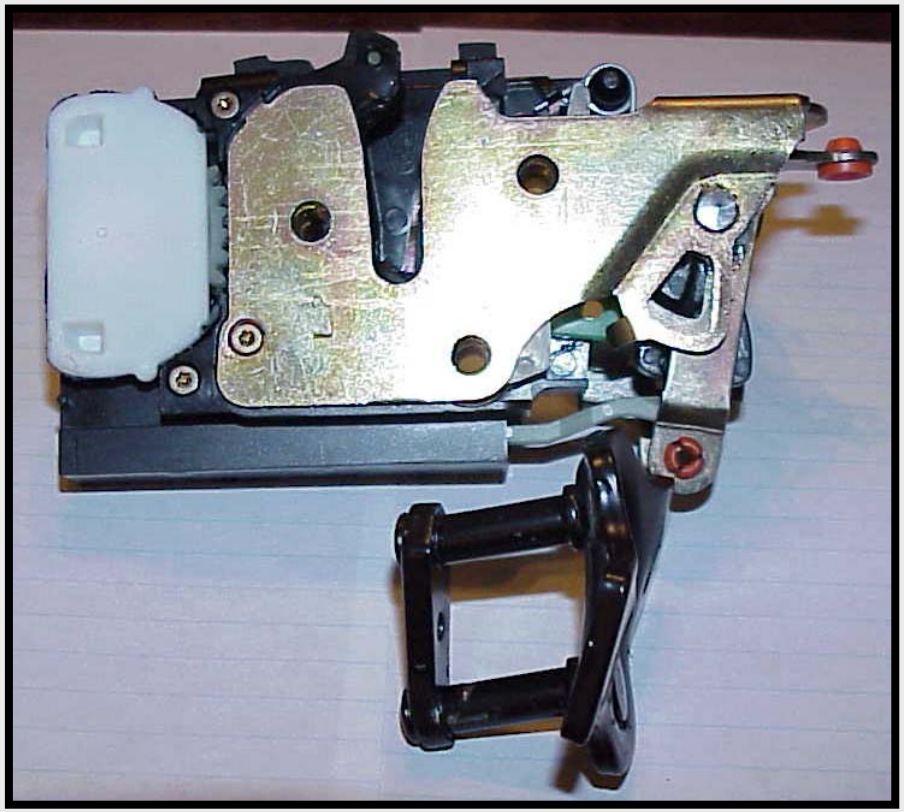
Failure = 42,981 N (*9663 lb.*)

Mode = striker failed in 2 places

Transverse

Failure = 16,693 N (*3753 lb.*)

Mode = latch opened



Summary - Maximum Loads

Dir.	CMVSS / FMVSS
Long.	11,000 N
Trans.	8,900 N

- Longitudinal loads

  1.9x - 3.9x limit

  21,128 N - 42,981 N

- Transverse loads

  1.9x - 2.8x limit

  16,693 N - 24,899 N

Summary - Failure Modes

- Longitudinal Failure Modes:

  4 / 4 related to striker

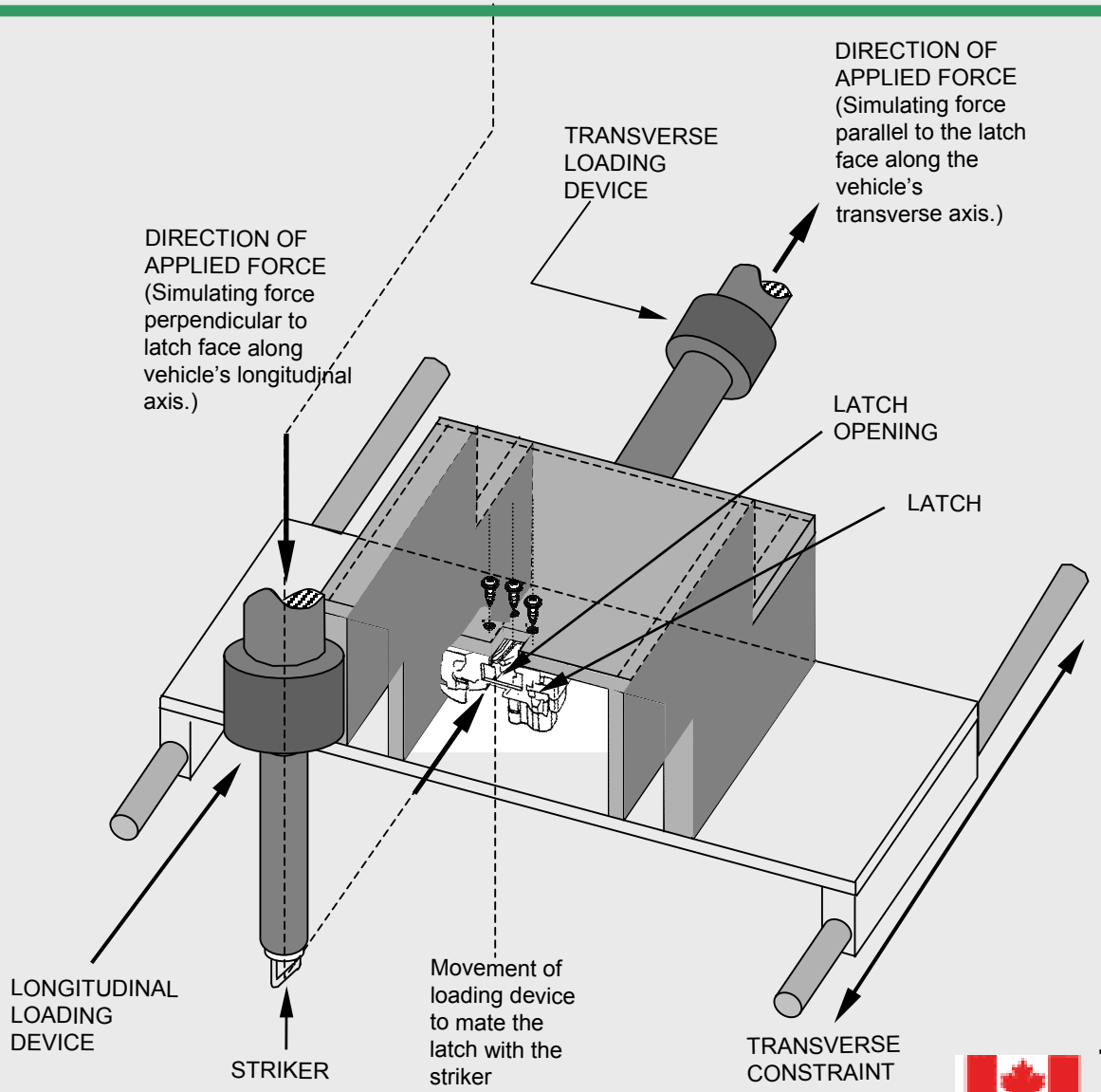
- Transverse Failure Modes:

  2 / 4 related to striker

  1 / 4 related to latch bolts

  1 / 4 related to latch opening

COMBINATION TESTING



Objective

- Evaluate test procedure, suggest improvements
- Obtain results for 4 latches
- Compare results to latch testing program results

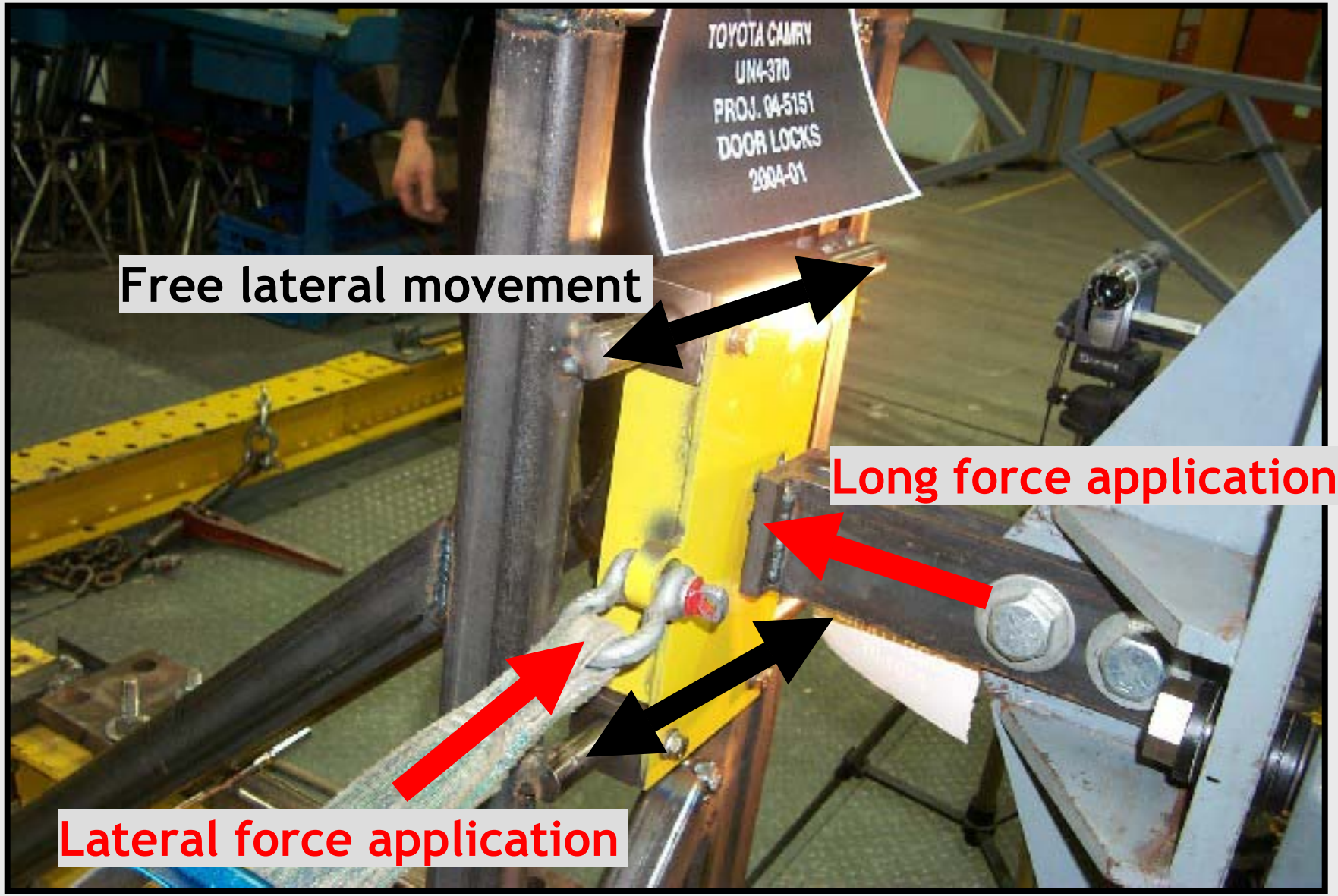
Procedure

- 4 tests total:
  2 tests as per gtr procedure in long. COMPRESSION
  2 tests in longitudinal TENSION
- Directions relative to
  LATCH / STRIKER axes, not VEHICLE axes
- Force application rate:
  - Longitudinal as per gtr (1.0 cm/min)
  - Lateral 0 - 6,650 N in 10 s (unspecified in gtr)

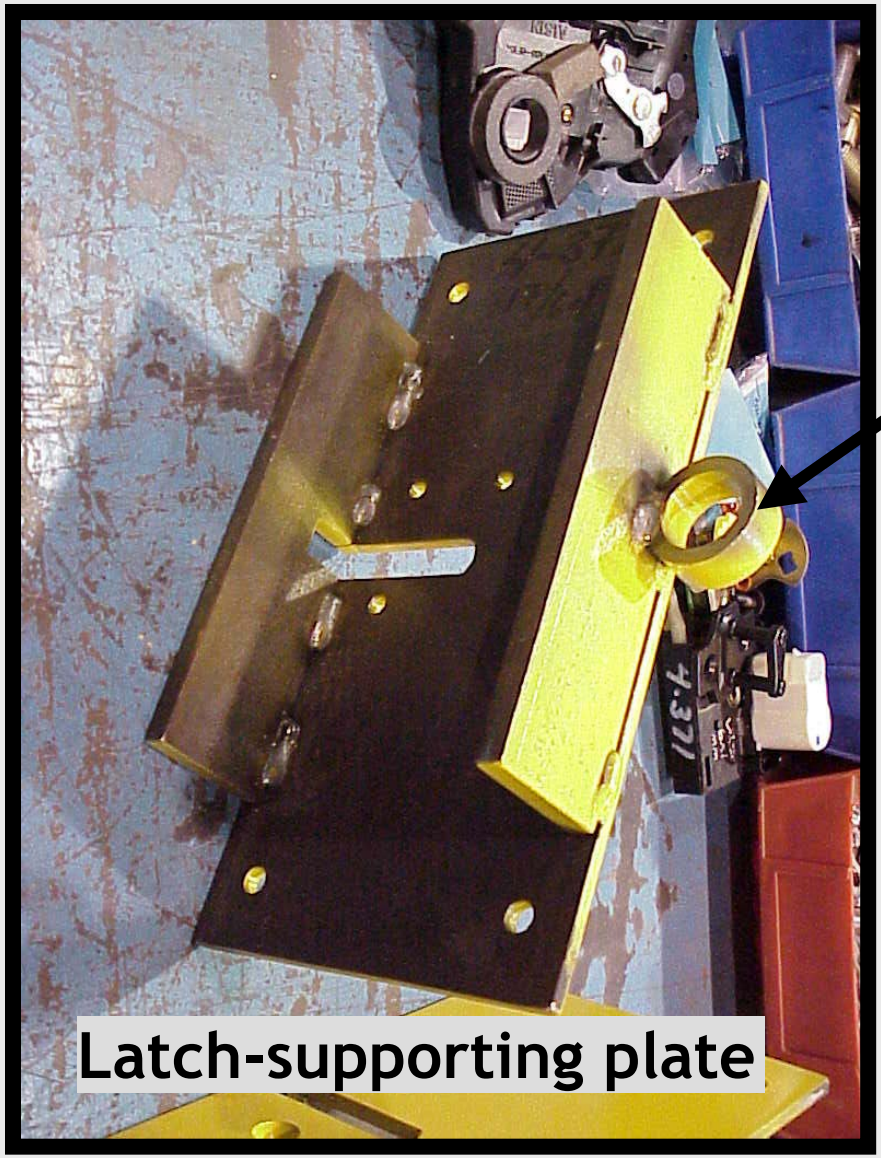
Test Matrix

#	Vehicle	Latch	Longitudinal Force	
			Direction	Load
1	Ford F-150 	Driver	Compression	16,000 N
2	Toyota Camry 	Front Pass.	Compression	16,000 N
3	Dodge Caravan 	Driver	Tension	16,000 N
4	Chevrolet Trail Blazer 	Driver	Tension	16,000 N

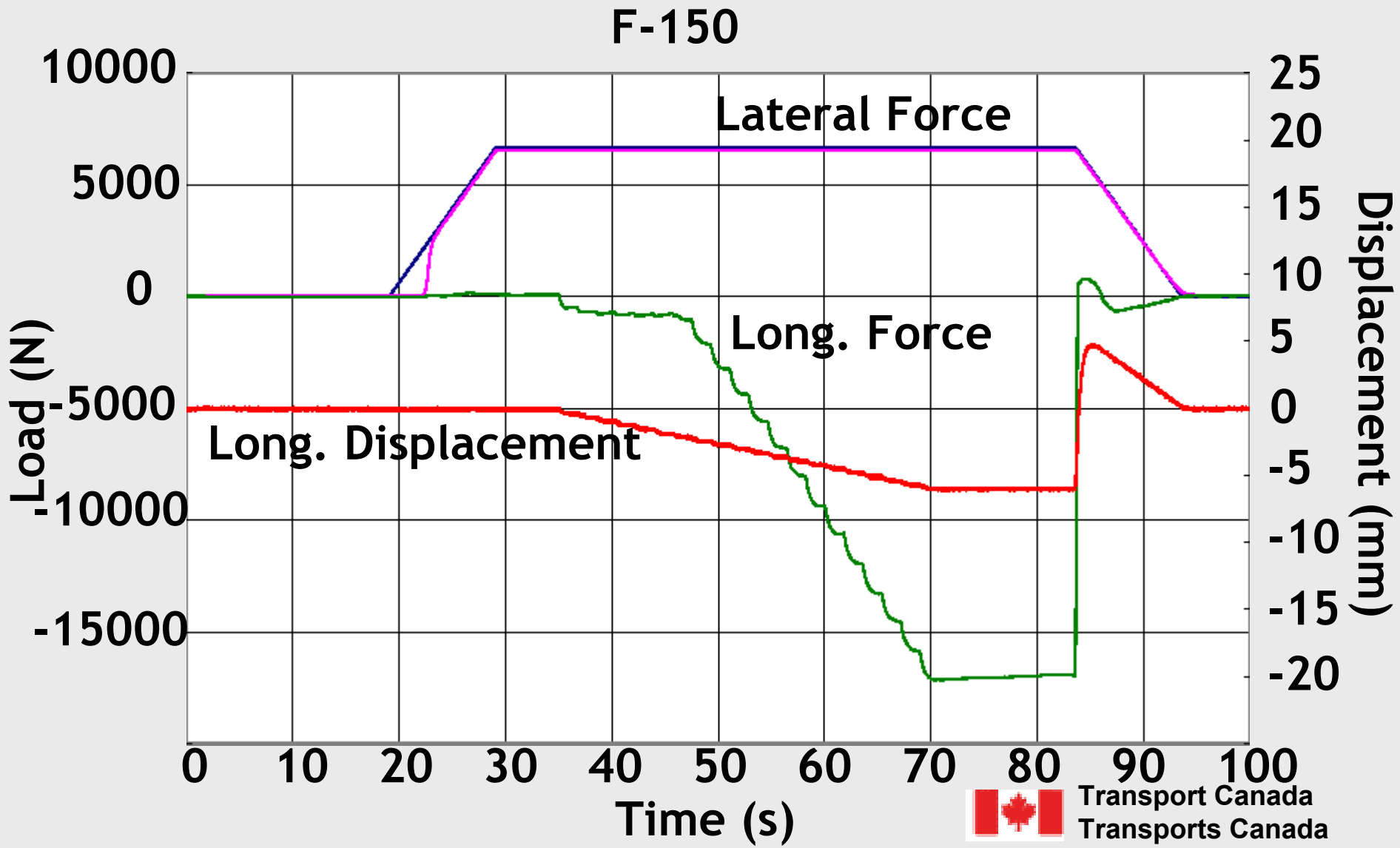
Test Setup


TOYOTA CAMRY
UN4-370
PROJ. 04-5151
DOOR LOCKS
2004-01
Free lateral movement
Long force application
Lateral force application

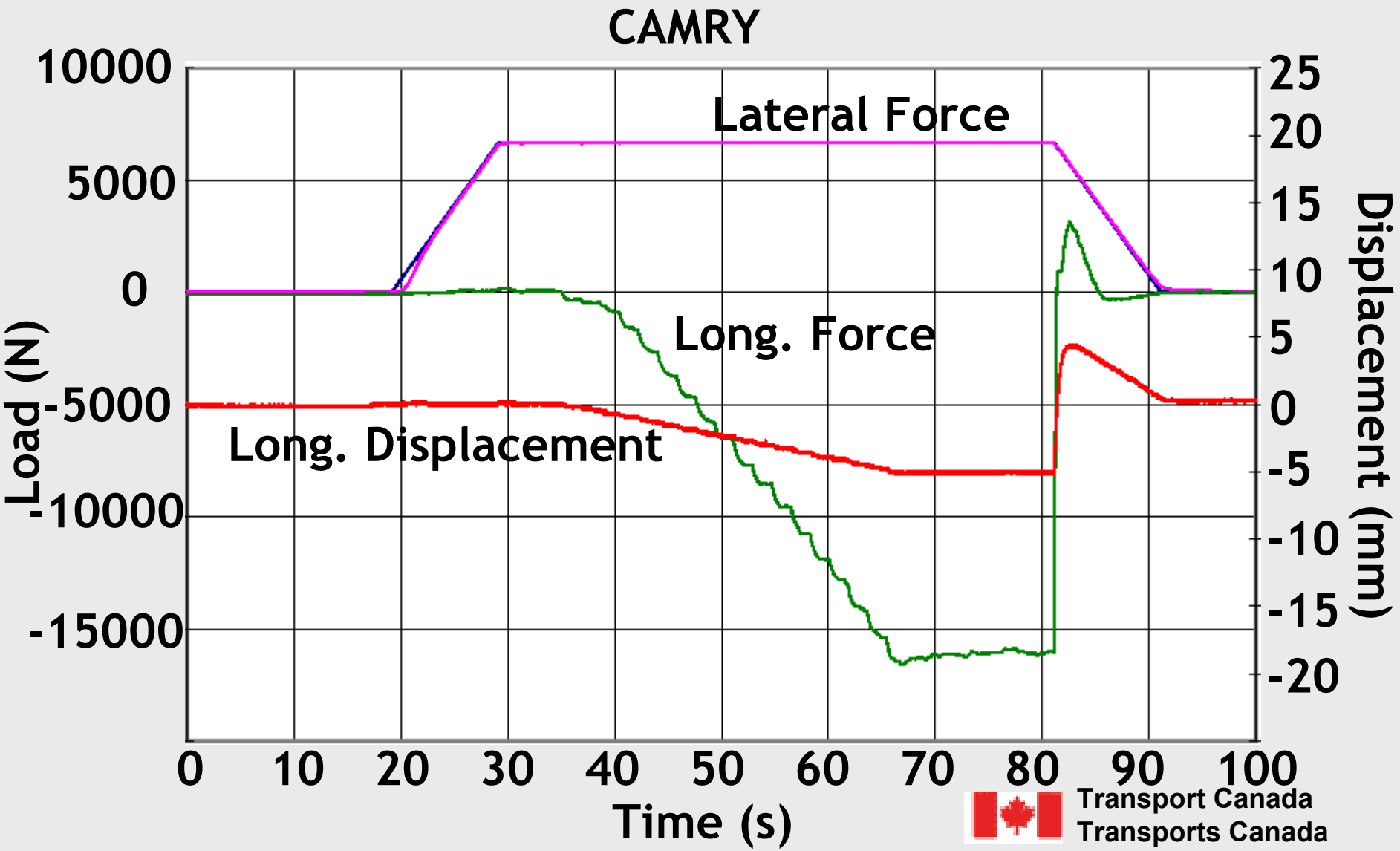
Test Setup



Results - Long. Compression



Results - Long. Compression



Results - Long. Compression

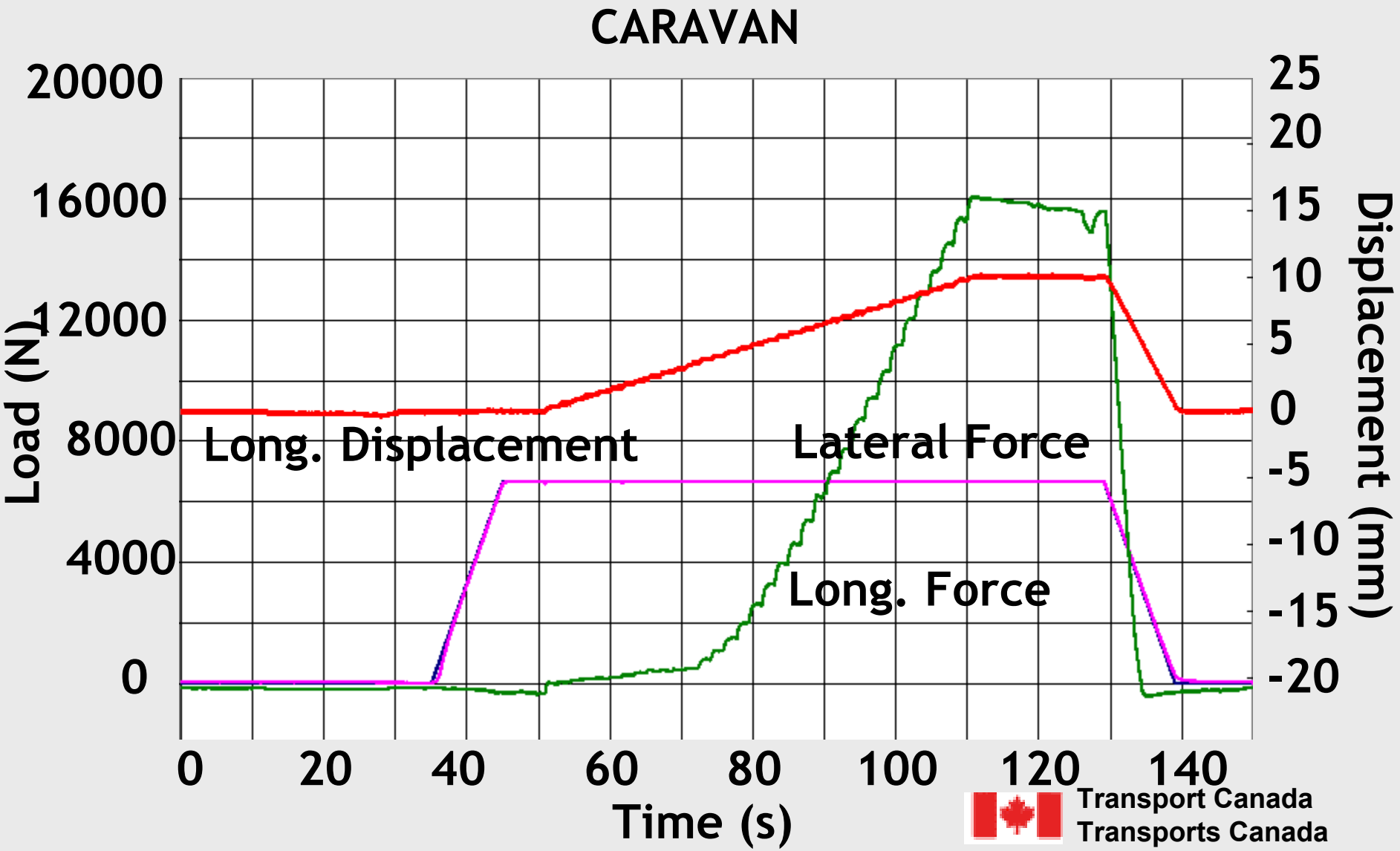
e.g. CAMRY

Results - Long. Compression

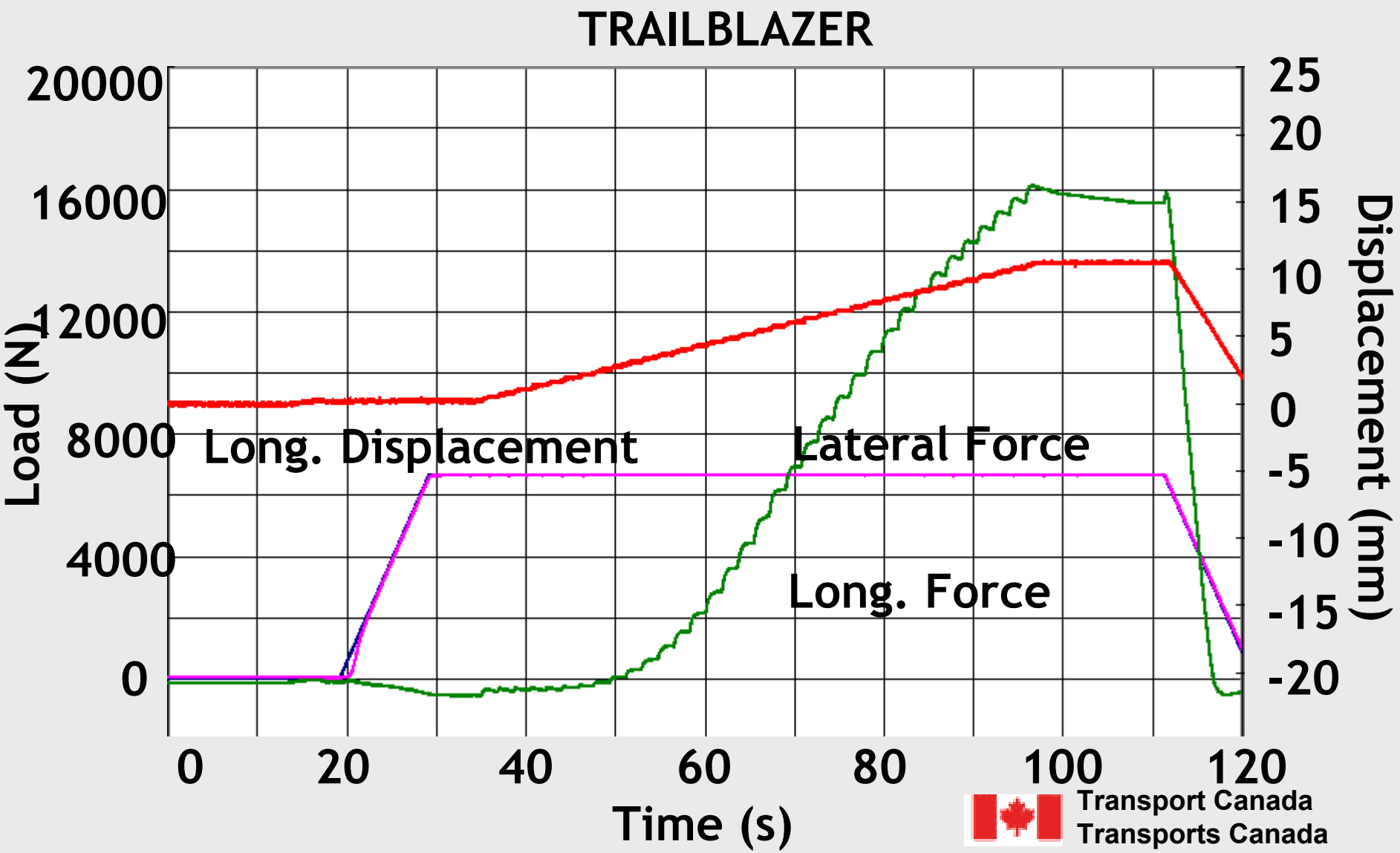
- Interference between striker plate and latch-supporting plate

- Tests results insignificant

Results - Long. Compression



Results - Long. Compression



Results - Long. Tension

- No failures
- No damage to any parts

Results - Long. Tension

e.g. TRAILBLAZER

Conclusions

- Tests are feasible (both compression + tension)
- Challenging simultaneous force application
- TC can provide:
  - detailed drawings of test setup + latch support plates
  - input into more detailed + improved procedure

Conclusions

- TC does not recommend the longitudinal compression test using the current test procedure:

  not testing latch performance, testing fixture

- Difficult to simulate offset frontal crash forces using only latch

- Longitudinal tension test has potential, BUT:
  - research needed into lateral + longitudinal forces during actual offset collisions
  - is this realistic of UNSTRUCK side?