# Transport Canada

## Child Occupant Protection Research
## &
## Considerations for Future Regulations

**Suzanne Tylko**
**Chief of Crashworthiness Research**

3rd Informal Child Restraint System Meeting May 13, 2008

# Areas of Study

FRONTAL PROTECTION IN-VEHICLE CRASH TESTS & SLED

1. Rear facing infant seats:
   - Attachment method
   - Influence of front seat contact
   - Influence of carry handle position
2. Forward facing CRS for small to large child:
   - Attachment method:
     - top tether
     - belt + tether
     - Belt + tether + LATCH
   - LATCH dynamic load measurements

# Areas of Study

FRONTAL PROTECTION IN-VEHICLE CRASH TESTS & SLED

3. Booster seats:

- Attachment method:
- Vehicle – booster seat interface

# Areas of Study

SIDE PROTECTION IN-VEHICLE CRASH TESTS & SLED

1. Rear facing infant seats:
   - Attachment method
   - Interaction with intruding door of car-to-car
   - Interaction with other passengers
2. Forward facing CRS for small to large child:
   - Attachment method
   - Interaction with intruding door of car-to-car
   - Interaction with other passengers

# Areas of Study

SIDE PROTECTION IN-VEHICLE CRASH TESTS & SLED

3. Booster seats:
   - Attachment method
   - Interaction with intruding door of car-to-car
   - Interaction with other passengers

# CRS for Big Kids

**Background**

- Harmonize child restraint regulations
- Increase weight limit to 30 kg

**What do we tell parents?**

- Determine optimal attachments

**Do we need to change the requirements?**

- Evaluate existing regulatory requirements.

# Test Matrix

- Full Frontal Rigid Barrier tests 40, 48, 56 km/h
- Sub-compact and cross-over vehicles
- Hybrid III 6-year-old & 10-year-old
- CRS labelled to 22 – 36 kg
- Top tether used for all seats

# Parameters to Consider

**Vehicle**

- Lower anchorage strength;
- Upper tether anchorage location;
- Seat back strength and configuration
- Seat cushion stiffness, geometry and friction;
- Seat belt geometry and webbing stiffness

# Parameters to Consider

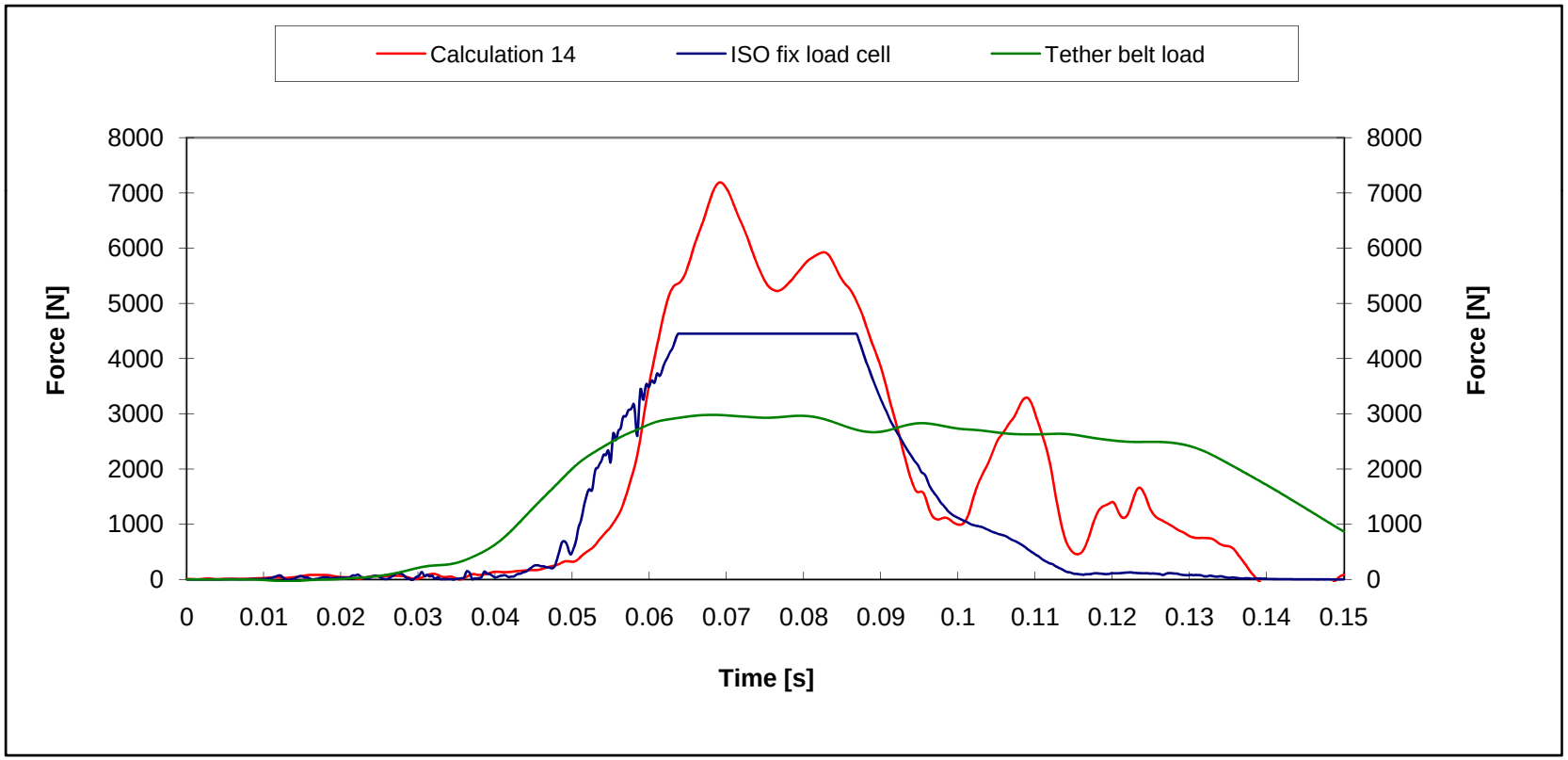
**Child Seat**

- Lower anchorage belt geometry
- Tether attachment location
- Seat strength
- Lower anchorage belt stiffness

# Dynamic LATCH Load Measurements

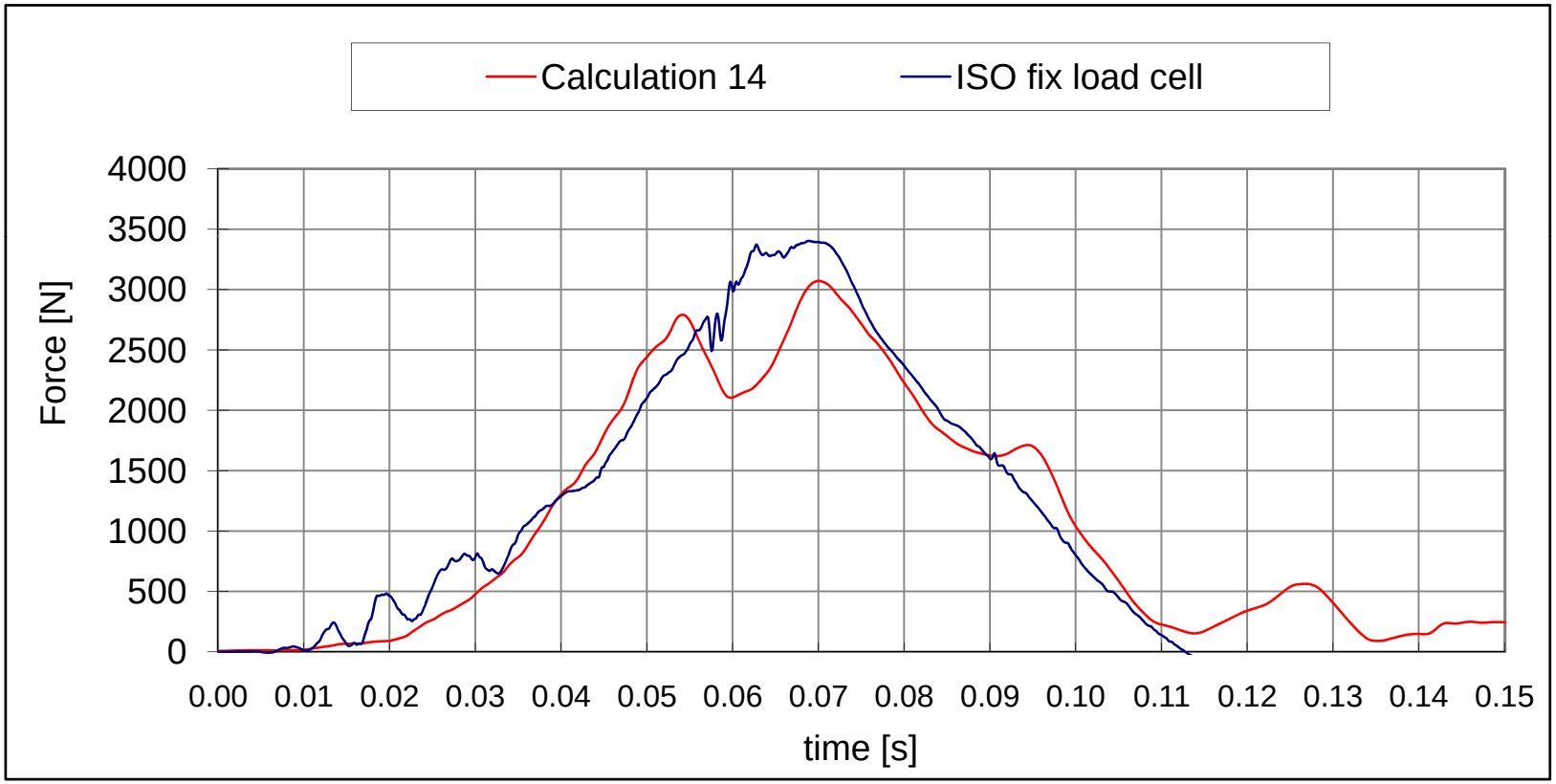
6 yr old + child seat = 32.5 kg

Measured load 4452 N (sat) Calculated load 7190 N

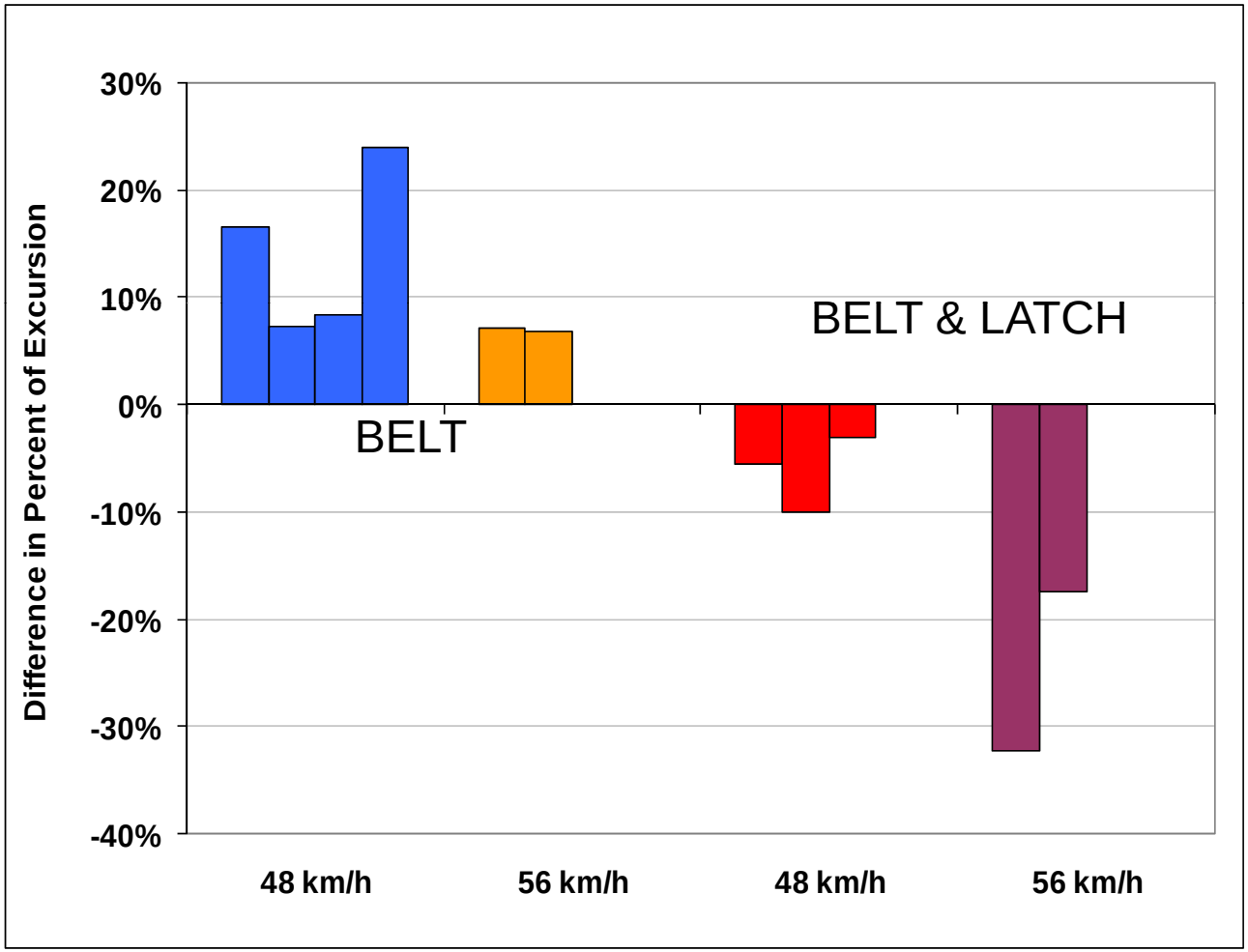


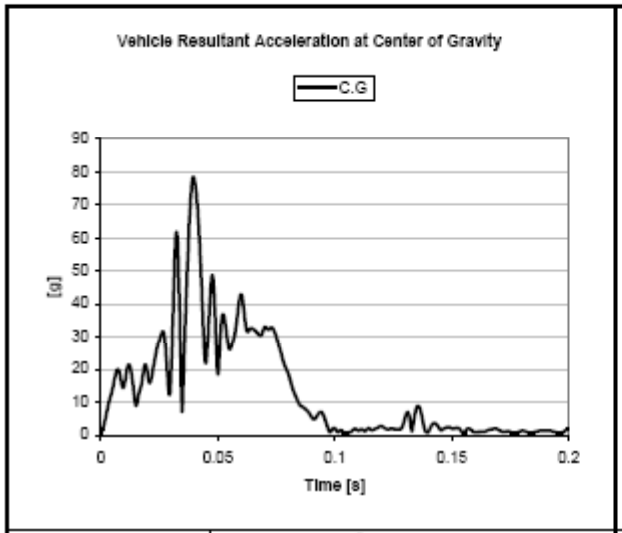
12 month + infant seat = 15.3 kg

Measured load 3445 N  Calculated load 3286 N

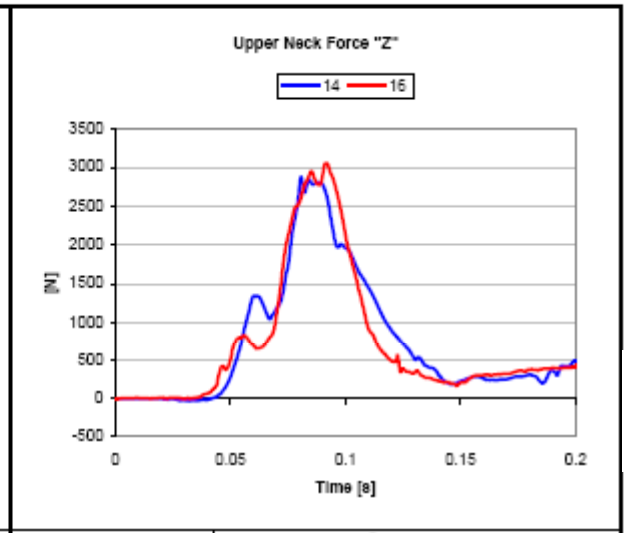


# Excursion Calculations Relative to LATCH

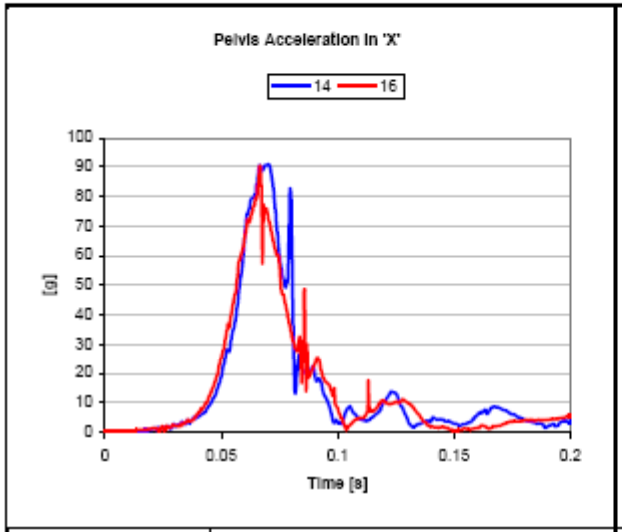




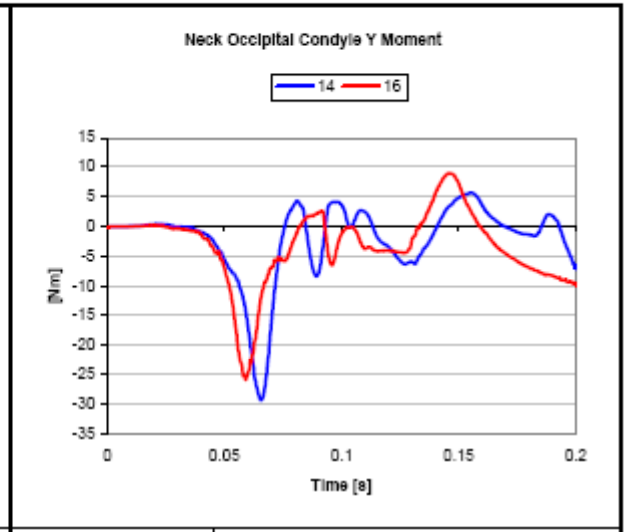

| | | |
|---|---|---|
| Max Acceleration | 78.35 [g] @ | 0.0396 [s] |




| | | |
|---|---|---|
| Max Neck Force 14 | 2875.81 [N] @ | 0.0807 [s] |
| Max Neck Force 16 | 3056.66 [N] @ | 0.0917 [s] |




| | | |
|---|---|---|
| Max Pelvis 14 | 90.75 [N] @ | 0.0701 [s] |
| Max Pelvis 16 | 90.27 [N] @ | 0.0668 [s] |




| | | |
|---|---|---|
| Max Moment 14 | 5.62 [N] @ | 0.1553 [s] |
| Max Moment 14 | -29.36 [N] @ | 0.0657 [s] |
| Max Moment 16 | 8.91 [N] @ | 0.1464 [s] |
| Max Moment 16 | -25.91 [N] @ | 0.0592 [s] |

# LATCH vs BELT + LATCH

| | |
|---|---|
| Dummy | :Hybrid III 6 Year Old |
| Vehicle Velocity | :56 [km/h] |
| Vehicle Type | :Nissan Sentra |
| Vehicle mass | :1282 [kg] |

**Restraints Systems**

| | |
|---|---|
| 14 | Britax Regen (Harness+Latch+Tether+Belt) |
| 16 | Britax Regen (Harness+Latch+Tether) |

## Delta V @ 52 ms

34 km/h

07-210

# Considerations for Future Regulations

1. Worst case for harness

   CRS is rigidly fixed to bench

2. Worst case for excursion

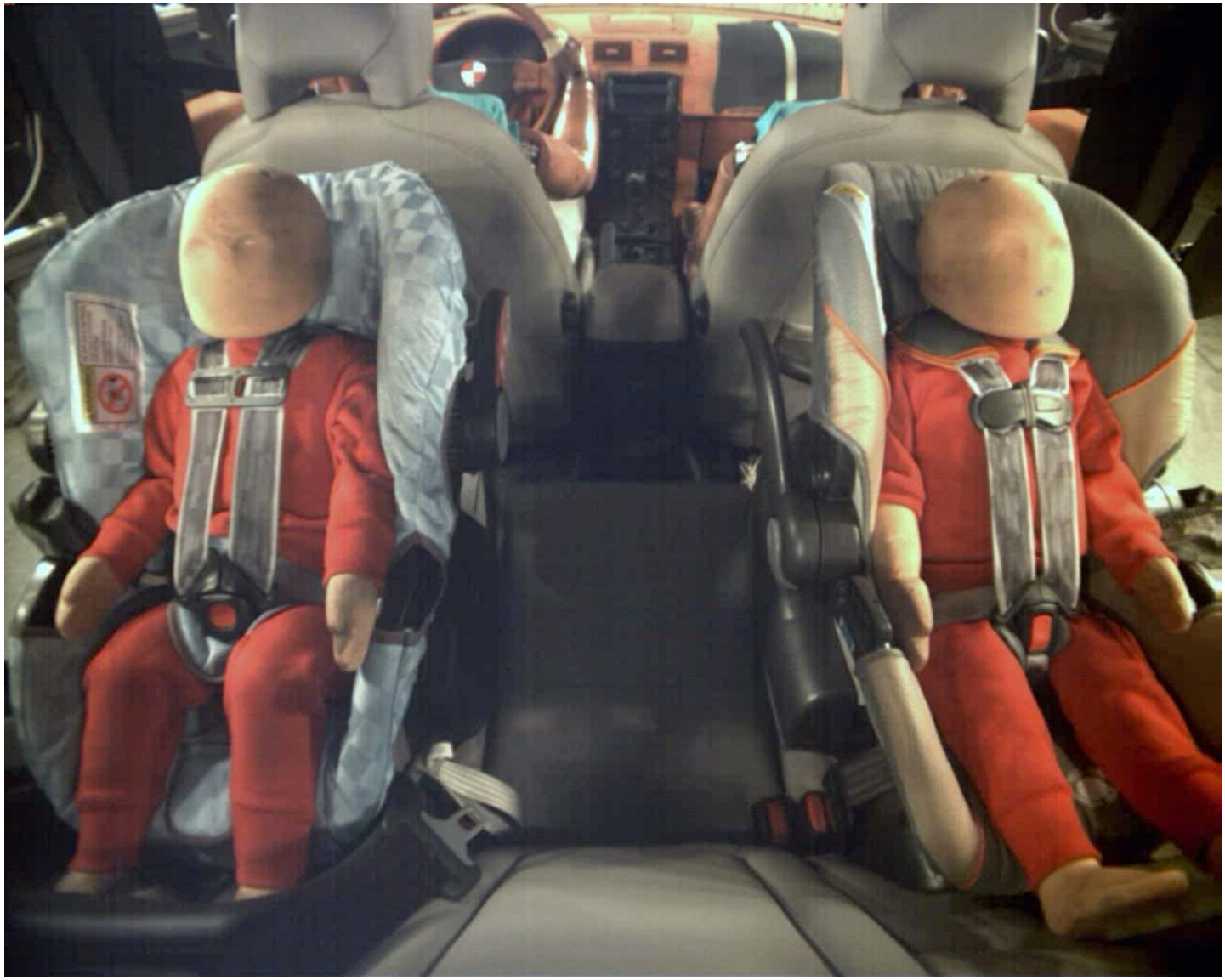
   Belt + LATCH

3. Sled pulse

# Infant Seats ….

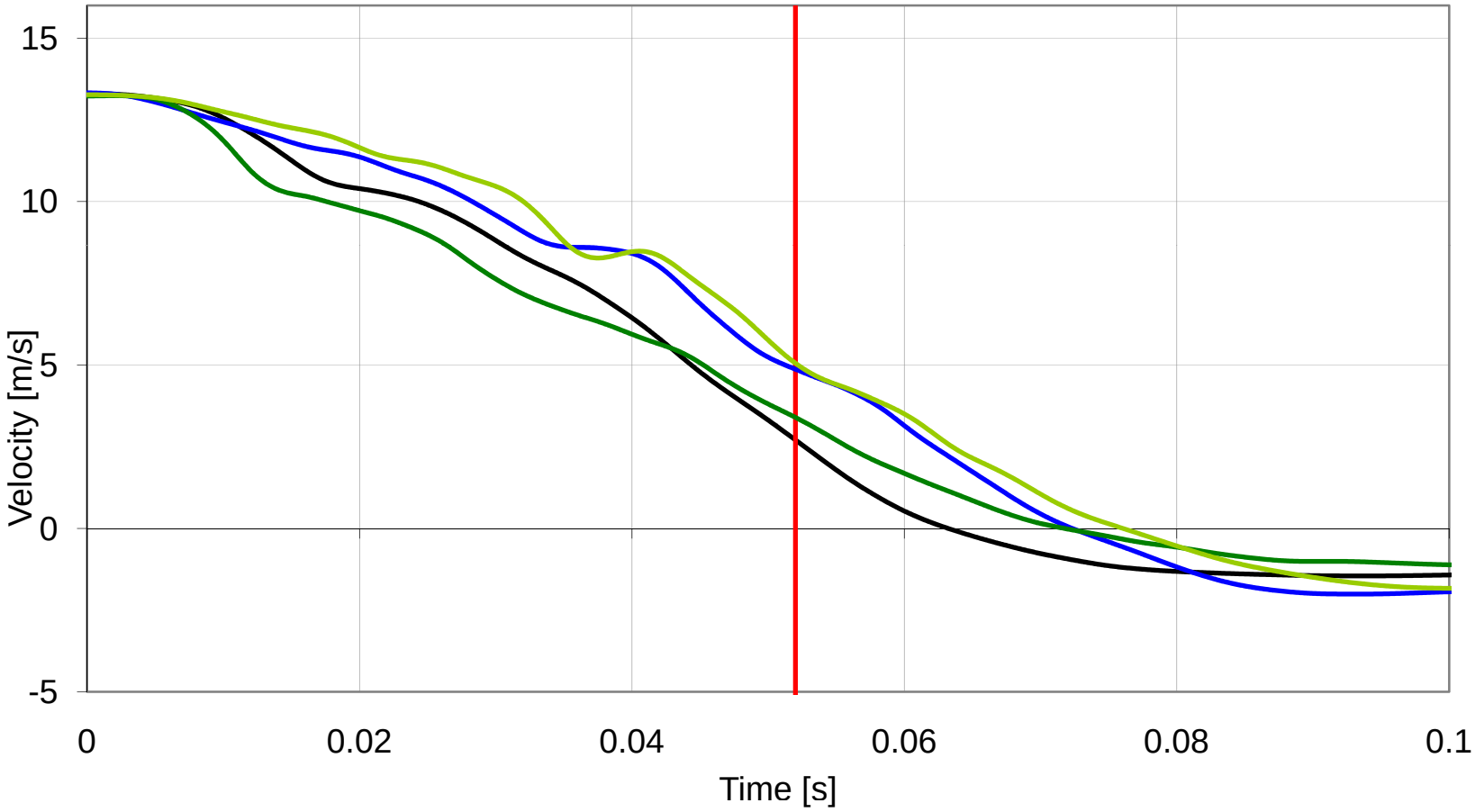
# Test Matrix

- Full Frontal Rigid Barrier tests 48, 56 km/h;
- Offset deformable barrier test 40km/h;
- Side impact SUV to car crashes;
- 12 month-old;
- Infant seats labelled to 22 lbs

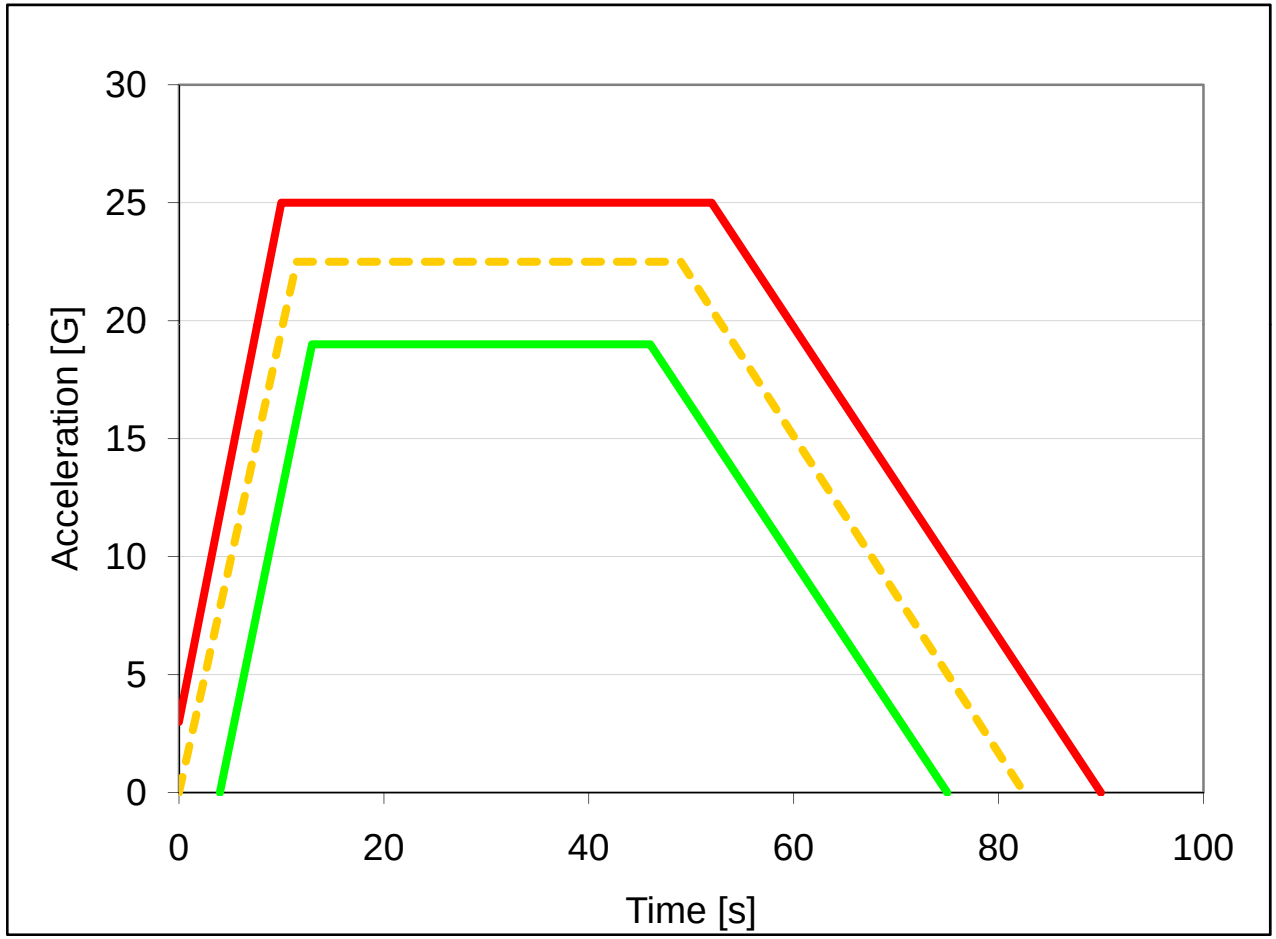



SD08-003_4

# Delta V Calculated from Ax at C.G of Vehicle



# FMVSS 213 CORRIDORS AND CORRESPONDING Δv




Delta V

58.8 km/h

47.7 km/h

34.9 km/h

# Considerations for Future Regulations

- Energy
- Dynamic orientation of the seat on seat cushion
- Infant seat must remain horizontal/ level to ground

# School- aged Child

- Belt migration with seatbelt only
- Shoulder roll-out on booster seats
- High neck loads associated with proximity of the torso belt to the neck;
- Chest response is unreliable due to belt position with respect to deflection instrumentation.

# On Seat FFRB Test at 56km/h

# Booster Seat FFRB Test at 40km/h

# ISO- Booster Seat FFRB  at 48 km/h

# Conventional Booster Seat FFRB at 48 km/h

# Considerations for Future Regulations

1. Realistic representation of child position

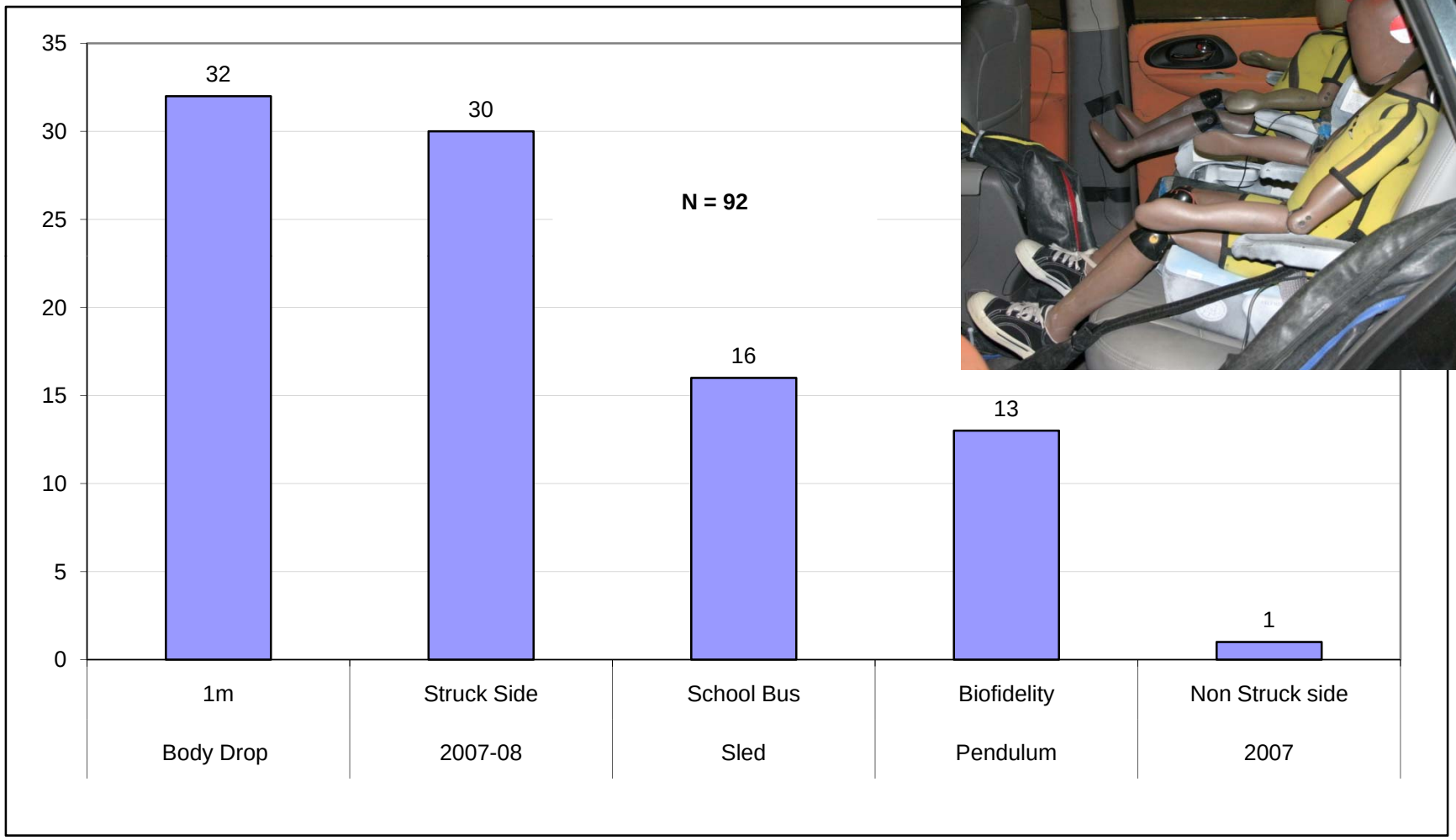
   slouching

2. Worst case for excursion

   adjustable seatbelt anchorage locations

3. Sled pulse

# Q3s Evaluation




# Car-to-car Strike – CRS

# Car-to-car Strike – CRS

# SUV-to-car Strike – Infant seat

# Considerations for Future Regulations

1. Realistic representation of intrusion, based on car-to-car side impact crash
2. Worst case for excursion

   Include far-side occupant
3. Sled pulse