Effects of Q1.5 chin-thorax contact in measuring upper neck forces

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INDUSTRIALES
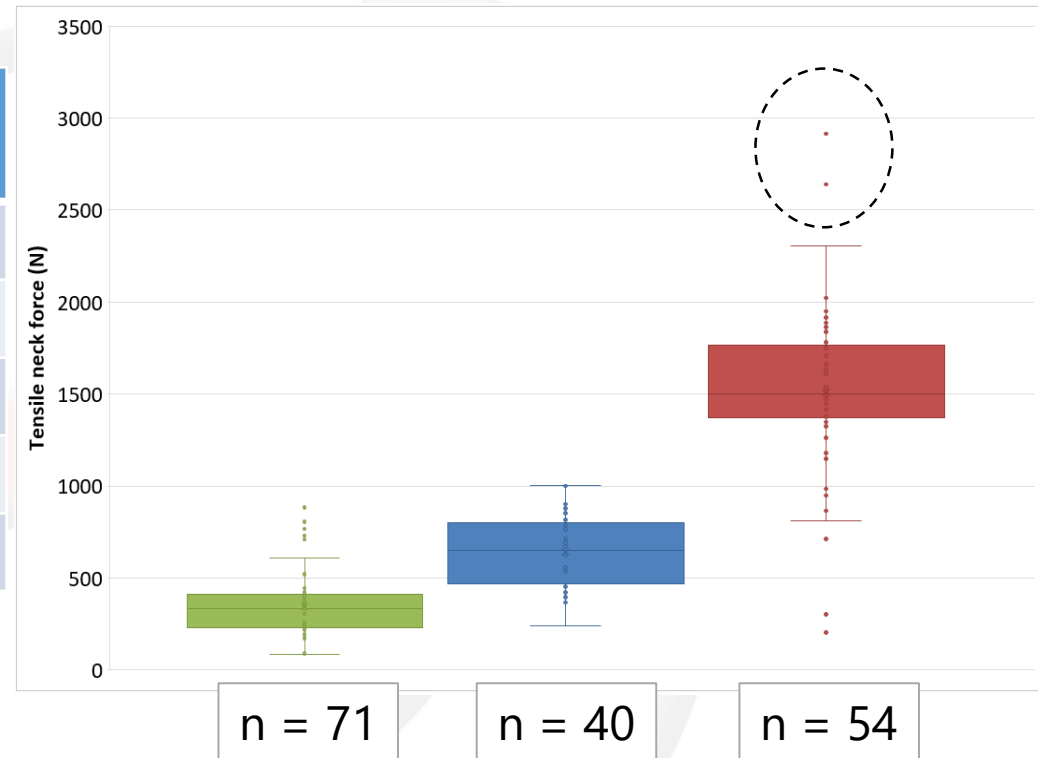ETSII | UPM

INSIA

LSP

CLEPA proposal based in registered values

Dummy	95th %ile	Mean + (2*SD)	Limit proposal
Q0	720	670	**[700] N**
Q1	905	1018	**[950] N**
Q1.5	2,122	2,443	**[2,300] N**
With upper outliers removed*:			
Q1.5	1,931	2,261	**[2,000] N**

n = 71   n = 40   n = 54

- Chin to thorax contact is included in the measured upper neck forces.

- Large increment between Q1 and Q1.5 for tensile force limit, not supported by a change in neck resistance during 6 months.

- Higher limits that in a biomechanics basics development.
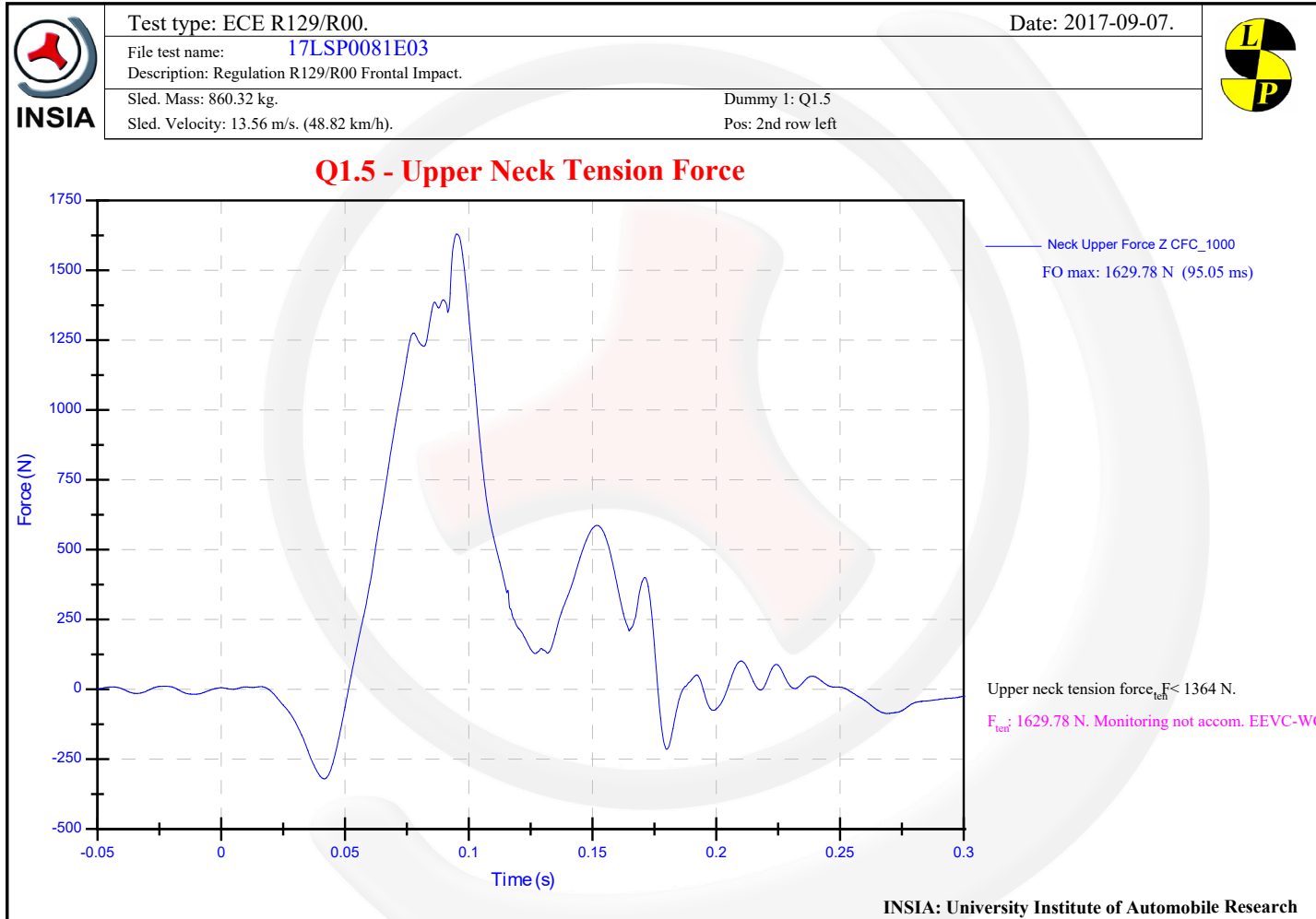
The effect of chin to thorax contact
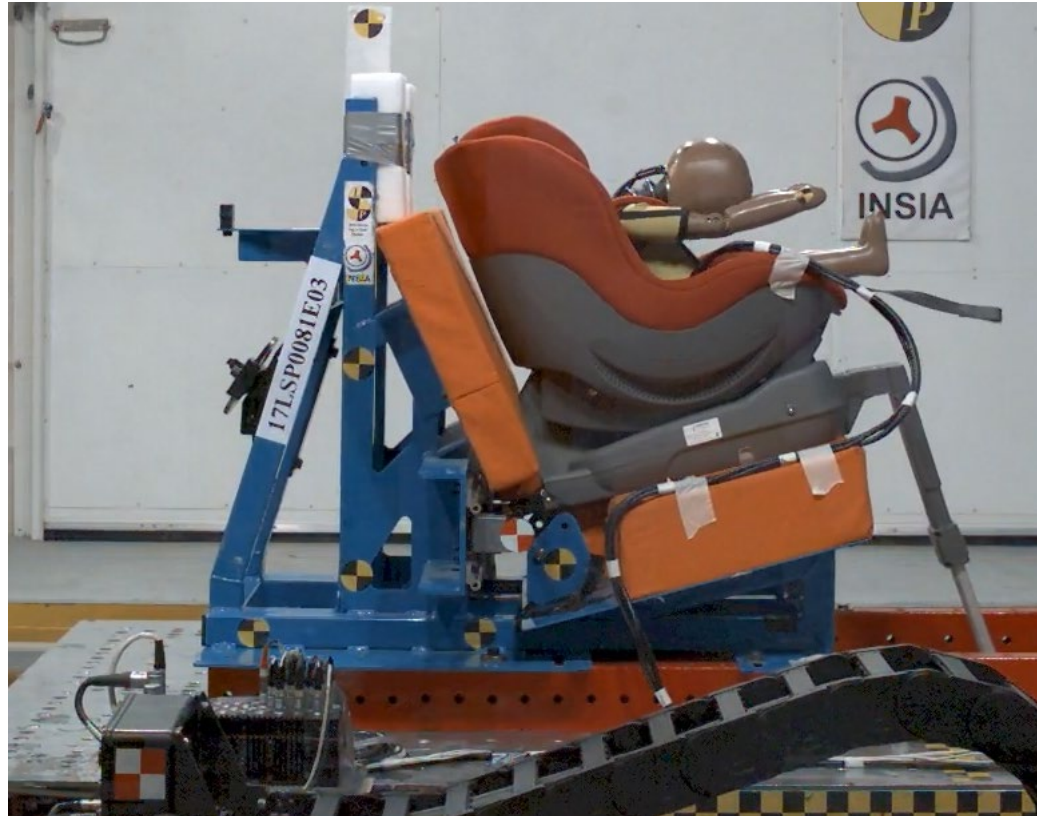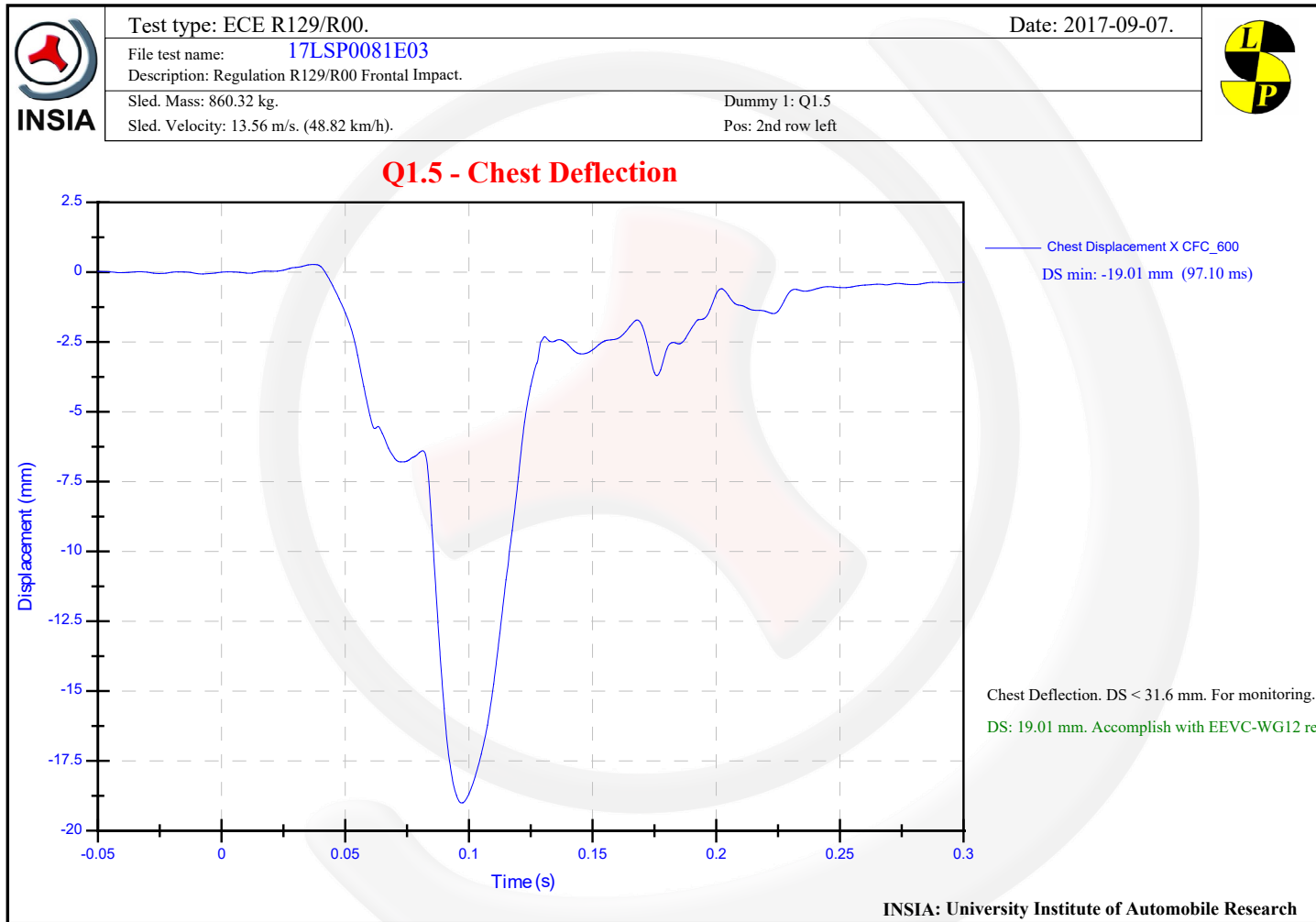

100 ms view

- Higher Fz tensile force is registered.

- Higher thorax deformation is measured.

- High variability in the tests that this issue happens.

- Difficulties to control when it happens.

The effect of chin to thorax contact

Test type: ECE R129/R00.	Date: 2017-09-07.

File test name: 17LSP0081E03
Description: Regulation R129/R00 Frontal Impact.

Sled. Mass: 860.32 kg.	Dummy 1: Q1.5
Sled. Velocity: 13.56 m/s. (48.82 km/h).	Pos: 2nd row left

Q1.5 - Upper Neck Tension Force

Neck Upper Force Z CFC_1000

FO max: 1629.78 N (95.05 ms)

Upper neck tension force F_{ten}< 1364 N.

F_{ten}: 1629.78 N. Monitoring not accom. EEVC-WG

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Higher Fz tensile force is registered

The effect of chin to thorax contact

Test type: ECE R129/R00.	Date: 2017-09-07.
File test name: 17LSP0081E03	
Description: Regulation R129/R00 Frontal Impact.	
Sled. Mass: 860.32 kg.	Dummy 1: Q1.5
Sled. Velocity: 13.56 m/s. (48.82 km/h).	Pos: 2nd row left

Q1.5 - Chest Deflection

Chest Displacement X CFC_600

DS min: -19.01 mm (97.10 ms)

Chest Deflection. DS < 31.6 mm. For monitoring.

DS: 19.01 mm. Accomplish with EEVC-WG12 re

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Higher thorax deformation is measured

Upper neck force balance with chin to thorax contact

Forces acting over head
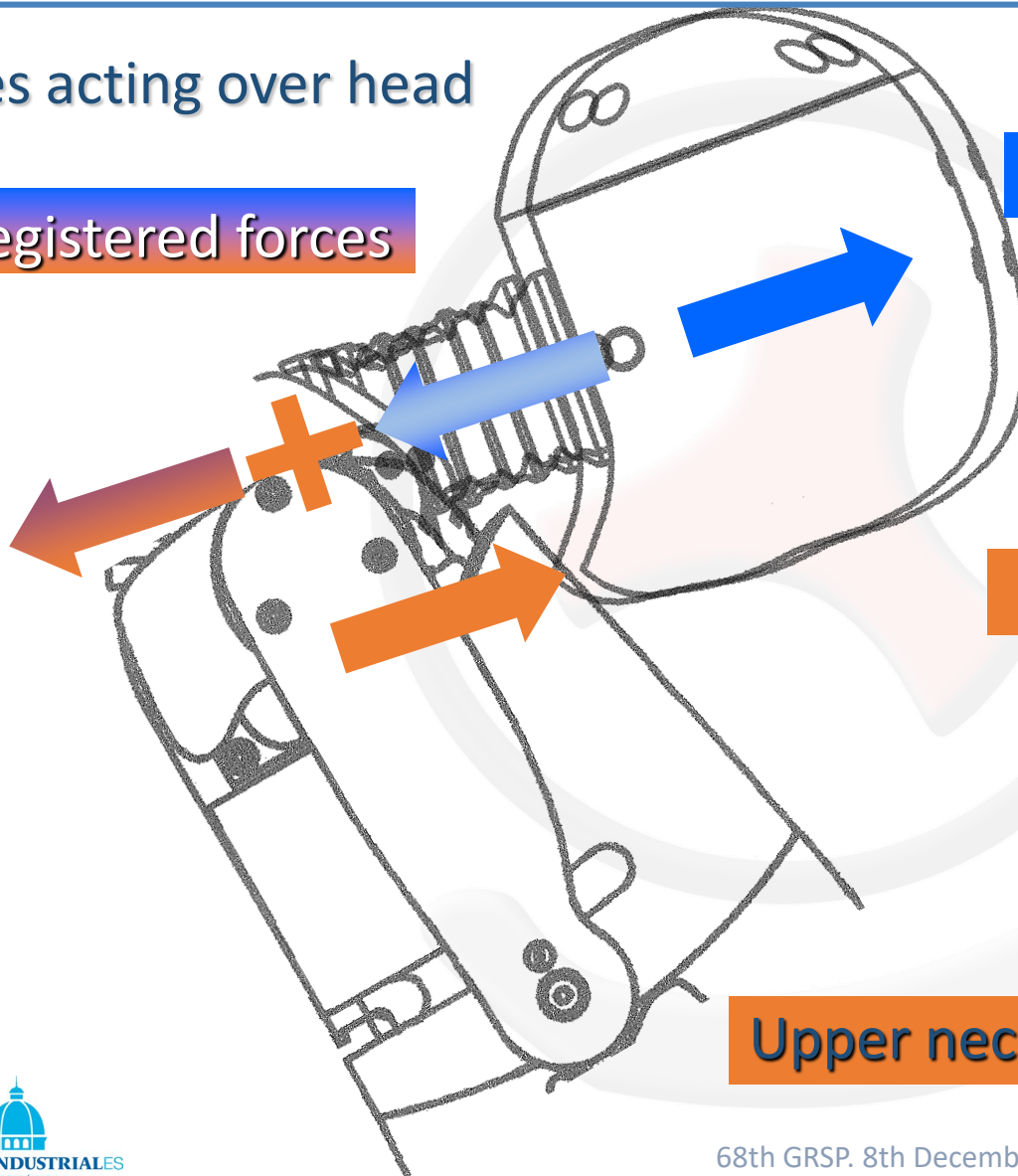
LC registered forces

Inertial forces acceleration

No chin contact

Contact forces

Chin to thorax contact

Upper neck LC register higher force

How compensate chin to thorax contact?

To compute only inertial forces

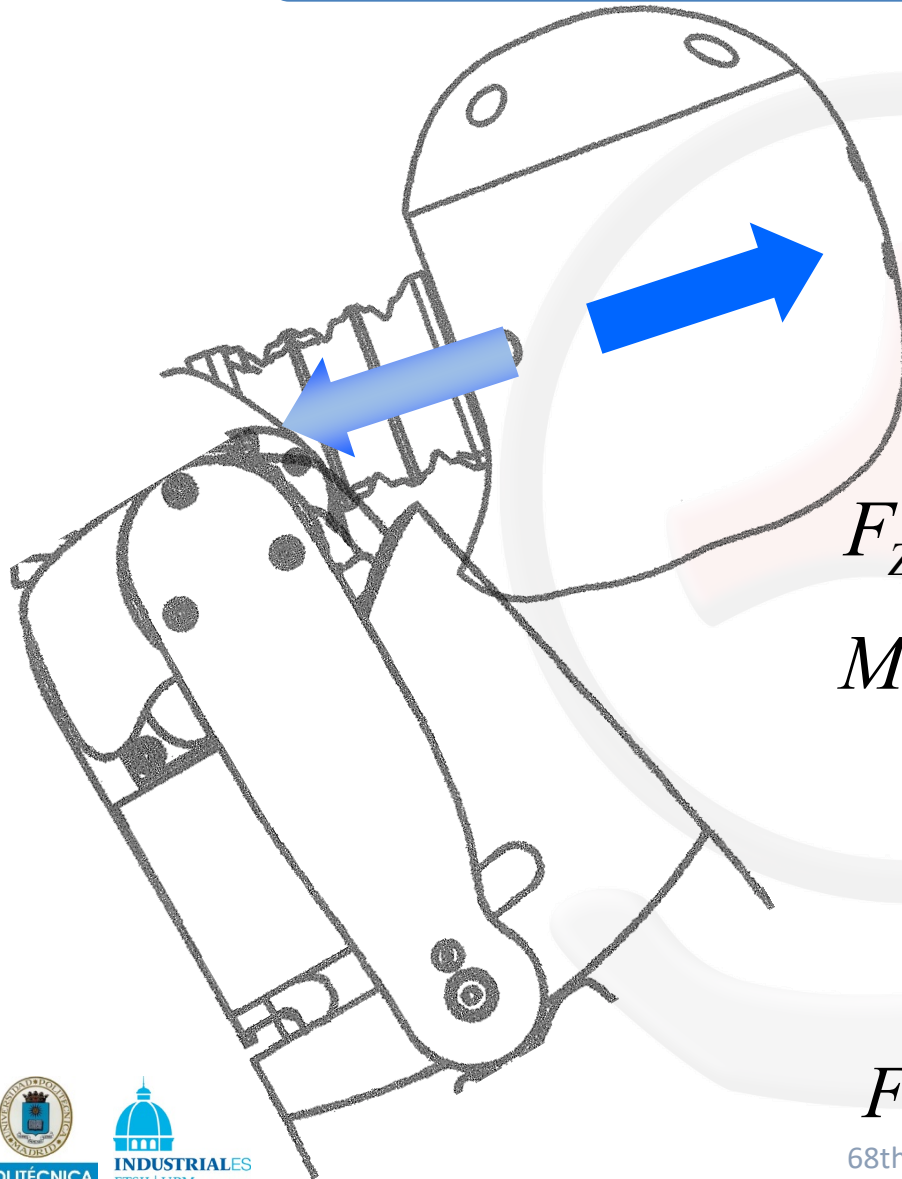$$F_Z\big|_{IA} = M_{H+\frac{1}{2}\cdot LC} \cdot A_Z$$

$F_Z\big|_{IA}$: Neck force for Injury Ass.
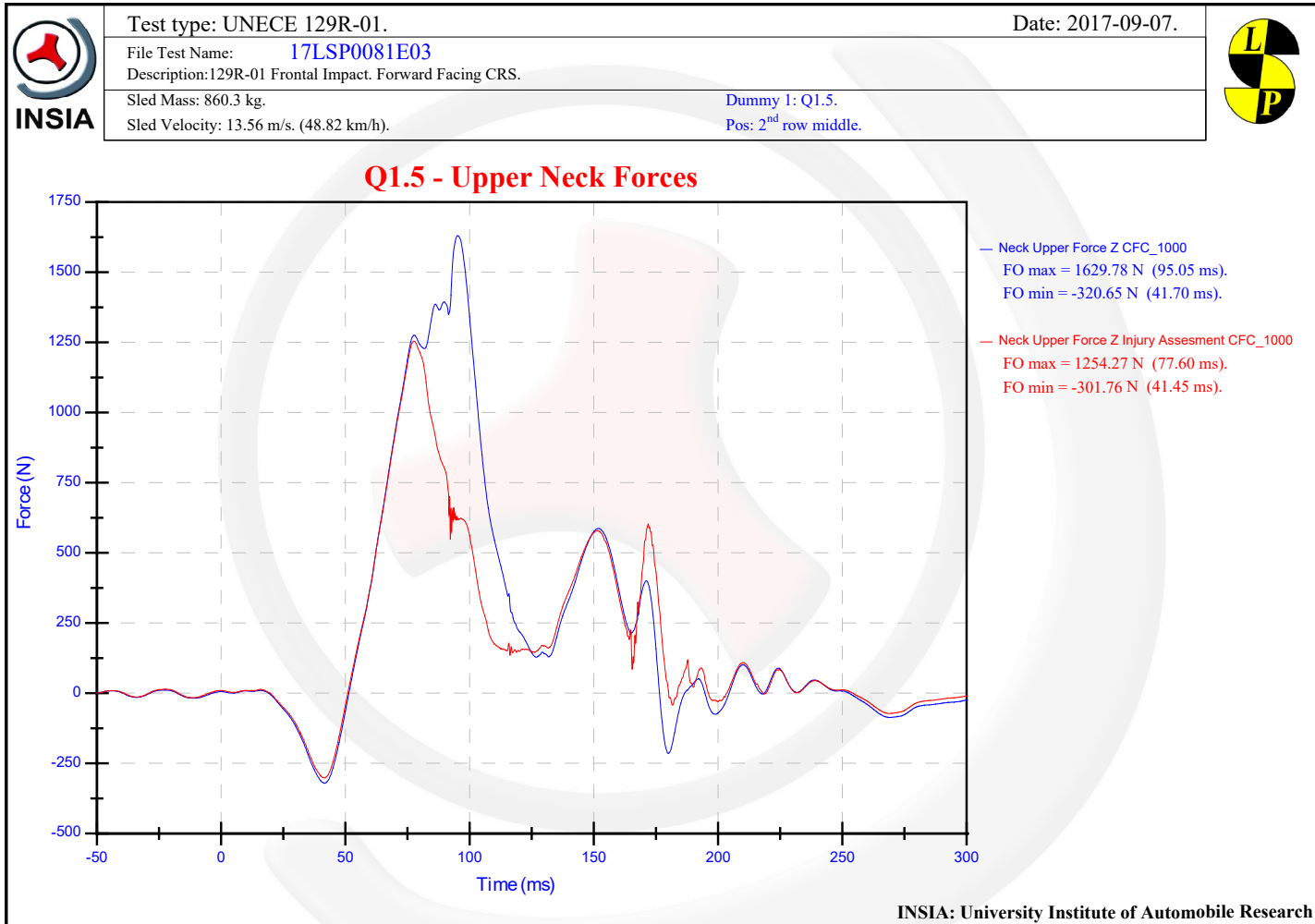
$M_{H+\frac{1}{2}\cdot LC}$: Head and LC part mass

A_Z : Head Z acceleration

$M_{H+\frac{1}{2}\cdot LC} = 2.2 \div 2.18\,\text{kg}$

$F_Z(N) = 2.2 \cdot A_Z(g) \cdot 9.80665$

Example of the process

Test type: UNECE 129R-01.   Date: 2017-09-07.

File Test Name: 17LSP0081E03
Description: 129R-01 Frontal Impact. Forward Facing CRS.

Sled Mass: 860.3 kg.   Dummy 1: Q1.5.
Sled Velocity: 13.56 m/s. (48.82 km/h).   Pos: 2nd row middle.

Q1.5 - Upper Neck Forces

— Neck Upper Force Z CFC_1000
  FO max = 1629.78 N (95.05 ms).
  FO min = -320.65 N (41.70 ms).

— Neck Upper Force Z Injury Assesment CFC_1000
  FO max = 1254.27 N (77.60 ms).
  FO min = -301.76 N (41.45 ms).

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Fz with chin contact 1,629.8 N.

Fz without chin contact 1,254.3 N.

Next steps

To reprocess the 54 cases presented by CLEPA.

To recalculate again the Q1.5 Fz limit.

To include Fz proposed Injury Assessment in R129.

This IA process for the upper neck tensile force may

be extended to other Q dummies sizes.

Many thanks for your attention!