R129 NECK LIMITS: EFFECT OF CHIN-TO-CHEST CONTACT AND POTENTIAL SOLUTIONS

Submitted by the experts from CLEPA

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CHIN-TO-CHEST CONTACT OCCURS IN FF CRS IN FRONT IMPACT AND RF CRS IN REAR IMPACT

Chin-to-chest contact increases tensile neck force, potentially beyond the purely inertial peak.
MOST TESTS EXAMINED WITHIN CLEPA SHOW SOME INFLUENCE OF CHIN-TO-CHEST CONTACT

Q1.5 FF Integral harness – R129 Front impact
Q0 RF Integral harness – R129 Rear impact

Chin-to-chest contact typically aligned with peak neck force in RF CRS in rear impact – **harder to distinguish effects** reliably
If a large part of the sample was affected, our limit values would be skewed upwards – as would subsequent measurements.

Mitigating chin-to-chest contact may be prioritised over inertial neck loading.
INSIA PROPOSED A METHOD TO CALCULATE INERTIAL NECK FORCE (HEAD MASS*VRT. HEAD ACCELERATION)

Q1.5 FF Integral harness – R129 Front impact

Can the method guarantee that neck force would not be higher if contact had not occurred (or if nature/timing of contact was different)?

To compute only inertial forces

\[ F_{Z|M} = \frac{M}{H + \frac{1}{2}LC} \cdot A_Z \]

- \( F_{Z|M} \): Neck force for Injury Ass.
- \( M \): Head and LC part mass
- \( A_Z \): Head Z acceleration

\[ M = 2.2 \, 2.18 \, kg \]

\[ F_{Z(N)} = 2.2 \cdot A_Z \cdot 9.80665 \]
Q1.5 FF Integral harness – R129 Front impact

What would happen if there had been no contact, or the timing was different?
INSIA METHOD CAN PREDICT PRE-CONTACT NECK FORCE MEASUREMENT

What would happen if there had been no contact, or the timing was different?
EFFECT OF CHIN-TO-CHEST CONTACT

Experiments

Standard head

Adapted head

Vs.

Adapted head created by Cellbond (currently Q3 and Q6 only)
EFFECT OF CHIN-TO-CHEST CONTACT

Front impact: Q3 in FF Integral Harness CRS

All methods give the same result (i.e. standard head ignoring contact phase, adapted head or INSIA method)
Rapid drop-off in INSIA calculated inertial force seems unrealistic and suggests contact itself can influence vertical head acceleration (and hence this calculated force).
EFFECT OF CHIN-TO-CHEST CONTACT

Front impact: Q3 in Booster Seat B

Broad peak duration in INSIA method seems unrealistic and may be masking true inertial force had contact not occurred (as suggested by adapted head with lesser contact)
Marginal contact with standard head (i.e. <500 N), reduced to negligible level with adapted head. INSIA method predicts inertial force reasonably well.
**INSIA METHOD CAN LEAD TO STRANGE RESULTS WHEN NO CHIN-TO-CHEST CONTACT OCCURS**

The calculated inertia force can be higher than the measured force – Technical Services would need to determine if/when the method is appropriate.
CONCLUSION
Using measured force vs. calculated inertial force

• Chin-to-chest contact likely skewed type-approval monitoring analysis of measured neck tension force
  – Limit values and subsequent measurements likely to be skewed upwards

• INSIA’s calculated inertial force method would reduce limit values and measurements; but
  – Neck force is not really measured (only vert. head acceleration)
  – It doesn’t work very well when contact occurs at the same time as peak inertial loading (especially RF CRS in rear impact)
  – Chin-to-chest contact may reduce the calculated inertial force – dummy chin-to-contact would be incentivised by regulation
PROPOSAL

For discussion with Contracting Parties

• Adopt neck tension force limits in R129 based on measured type-approval monitoring data as proposed in GRSP-68-05
  – No reanalysis of data required
  – Simple for technical services

• Investigate Q-Series chin adaptation as per Cellbond prototypes
  – Neck force limits could be revised down if dummy changes

• Limits are validated values based on CRS performance in current R129 test conditions
  – Changing the test conditions would necessitate new analyses and limits
Further reading


Another rapid drop-off in INSIA method force
EFFECT OF CHIN-TO-CHEST CONTACT

Q6 in Booster Seat B