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Technical Bulletin

Hybrid III Low Speed Thorax Certification Test & Potentiometer Calibration

Version 1.1

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TB 005

Title	Hybrid III chest certification
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Related Documents	Euro NCAP Frontal Test Protocol
Status	Information
Application Date	Immediate, applicable to all vehicles published from and including November 2009.

Hybrid III low speed thorax certification test

Background
Since approximately 2002 Euro NCAP has been aware of Hybrid III dummy variability in the chest region. Data supplied by the Euro NCAP test laboratories was reviewed and the following findings were made:

- Dummy characteristics under low speed test conditions are different to normal speed calibration test conditions.
- Dummy response is not linear with respect to impact velocity.
- Dummies that tend to be stiffer in normal calibration tests are not necessarily stiff at lower impact speeds.
- Variation of chest deflection seems to be significantly higher at low speed impacts.
- The influence of temperature is high.
- Chest deflection is dependant on impact energy and not only impact speed.
- The chest deflection is sensitive to the seat belt position.
- Dummy certification procedure does not reflect crash test loading conditions.
- The chest deflection potentiometer has an inherent non-linearity in its output.

In order to more tightly control the variability of the thorax response the Euro NCAP TWG agreed to the following change regarding Hybrid III dummy certification:

The Hybrid III dummy should meet both the low speed thorax test as prescribed by SAE J2779, as well as the full certification test detailed in CFR572 for future Euro NCAP testing.

Additionally, chest deflection data from both vehicle tests and certification tests shall be post processed in accordance with SAE J2517, see below.

Chest potentiometer calibration and Polynomial post processing

In order to address the inherent non-linearity of the Hybrid III chest potentiometer, the Euro NCAP Technical Working Group also agreed that the dummies should meet the chest potentiometer data processing procedure prescribed by SAE J2517.

For the non-linear potentiometer calibration to be effective, polynomial post processing of the chest potentiometer data is also required. The linear sensitivity obtained from the measured voltage data must not be used to calculate chest deflection.

Summary of calibration procedure
A third order regression shall be performed through the calibration data based on the following calibration points (se Figure 1):

0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 68mm

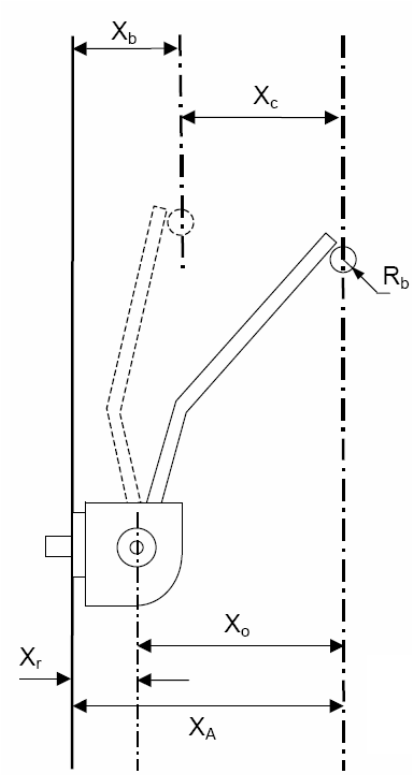

FIGURE 1 – CALIBRATION FIXTURE
SIDE VIEW

Relate the sensor output readings S (mV/V) to the displacement values D (mm) as follows:

$$D = AS^3 + BS^2 + CS + M$$

D = A*S^3 + B*S^2 + C*S + M

Where:

D = the actual displacement in mm
S = sensor output
A, B, C, and M = the calibration coefficients

Determine values for A, B, C, and M from the regression analyses and apply calibration coefficients to convert test data from (mV) to the required units (mm)

Use of the Calibration Coefficients

The potentiometer assembly should be re-installed in the dummy without any mechanical adjustment of the potentiometer. Prior to a crash test, the original zero offset level must be preserved by either not zeroing the potentiometer (by signal conditioning or post-processing) or the amount that was zeroed must be added during post processing. During the test the absolute voltage output time history should be recorded. This voltage signal is then converted to engineering units by:

1. Convert voltage signal to mV/V at the sensor. This is the sensor reading S.

2. Convert the sensor reading S to displacement D by using the equation

D = A*S^3 + B*S^2 + C*S + M
Where D is the displacement relative to the thorax design position in mm,
S is the sensor output reading in mV/V
A, B, C, and M are the calibration coefficients.

3. Subtract the offset in the displacement D at time zero (T_0) from the displacement time history to get a zeroed deflection Dz. Dz is the deflection of the sternum relative to the spine box during the crash test.

Implementation date

Application date for ALL aspects of the TB – **immediate, all results published from and including November 2009 will comply with this procedure.**