

Test Device Head Contact Duration Analysis

A technically equivalent version of SAE J2052 is included in ISO Technical Report 12351.

Foreword—A technique has been established for determining head impact contact duration called the "Force Difference Method." This technique allows calculation of Head Injury Criterion (HIC) only during head contact.

1. Scope—This methodology can be used for all calculations of HIC, with all test devices having an upper neck triaxial load cell mounted rigidly to the head, and head triaxial accelerometers.

1.1 Purpose—The purpose of this SAE Information Report is to describe a computer-adaptable technique for determining head engagement and disengagement times for use in the calculation of the HIC without reliance on contact switches or photography.

1.2 Rationale—The difference between linear head inertial forces as measured head accelerations (a_x , a_y , a_z) and measured upper neck forces (F_x , F_y , F_z) is used as an indication of externally applied loads to the head as occurs during contact. The duration of contact can thus be determined without the use of other sensors and used for HIC calculations.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J211-1 MAR95—Instrumentation for Impact Test

2.1.2 FEDERAL PUBLICATION—Available from the Superintendent of Documents, U. S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

FMVSS 49: 571-208—Occupant Crash Protection, revised as of April, 1997

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2.1.3 ISO PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ISO Technical Report 12351—Determination of head contact and duration in impact tests—ISO/TC22/SC12/WG3N355

3. Definitions

3.1 **HIC**—The HIC is one of the "injury criteria" prescribed by S6 of the Federal Motor Vehicle Safety Standard (FMVSS) 208. It is the maximum value calculable from the head c.g. resultant acceleration-time profile in accordance with Equation 1:

$$\text{HIC} = \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a \cdot dt \right]^{2.5} (t_2 - t_1) \quad (\text{Eq. 1})$$

where:

a is the resultant acceleration expressed as multiples of G (the acceleration of gravity), and t_1 and t_2 are any two points in time during the crash.

NOTE—Although a HIC window of 36 milliseconds maximum was subsequently mandated by NHTSA, it is not utilized with this document.

3.2 **Contact HIC**—HIC values calculated only during the periods of each head contact.

3.3 **t_e , t_d** —The head engagement and disengagement times, t_e and t_d respectively, are determined by the method given in Section 5. These are the starting and ending times, i.e., the windows for the iterative HIC calculations for each head contact.

NOTE—The maximum contact HIC for each t_e , t_d interval will have associated with it times t_1 , t_2 which may be equal to, or less than the t_e , t_d interval.

3.4 **Accelerometers (a_x , a_y , a_z)**—The triaxial accelerometer(s) in the head of the test device will be referred to as an accelerometer, omitting the triaxial classification as defined in SAE J211-1; $+a_x$ is forward, $+a_y$ is to the right, and $+a_z$ is downward. These orientations are shown in Figure 1.

3.5 **Load Cell**—The triaxial force load cell (attached rigidly to the base of the skull portion of the test device to which the neck is attached) will be referred to as a load cell, omitting the triaxial and upper neck classification. Load cells with additional outputs can also be used.

3.6 **Head Mass (M)**—The mass of the head including the masses of the head accelerometers and mounting brackets and the mass of the load cell above the gage plane.

NOTE—Caution should be exercised to minimize the effect of elements external to the neck, such as neck skins or wires, which might carry load or modify the head mass.

3.7 **Inertial Head Forces (Ma_x , Ma_y , Ma_z)**—The inertial head forces are calculated from the triaxial accelerometers which are inside the head of the test device. The accelerations are multiplied by the M of the test device to determine the inertial head forces. The directions of these inertial forces are the same as the directions of their corresponding acceleration vectors.