



SIMPLIFIED METHOD FOR SIMULATING GLANCING BLOW IMPACTS—SAE J136

SAE Information Report

Report of Body Engineering Committee approved December 1969.

1. Scope—The purpose of the information report is to present an interim test method whereby glancing blow impact testing can be simulated utilizing existing pendulum type equipment. Tests are conducted normal to a test specimen at a reduced velocity which produces results approximating those obtained from a glancing blow impact.

The report also documents the investigation upon which the test method is based.

2. Discussion—During collision, passengers may contact the vehicle interior in a variety of directions of impact. Most test equipment in general use today simulates occupant impact only normal to the surface of the component under test. Such normal-direction testing is realistic for components such as instrument panels and seatbacks. Other components, such as pillars, roof rails, consoles, etc., may require an impact direction which would result in a glancing blow. Existing equipment, constrained to motion about a fixed axis in a single plane, cannot be used for glancing blow impacts since the compressive and side loads which would occur can adversely influence equipment repeatability and may damage the test equipment.

To allow the use of existing equipment, an investigation was conducted to determine if the deceleration levels obtained from glancing impacts could be approximated by normal direction impacts at a reduced velocity. Paragraph 3 of this report presents an interim test method derived from this investigation. The Appendix A documents the investigation.

Background and rationale for the report are contained in Appendix B.

3. Interim Test Method

3.1 Glancing blow impacts may be simulated by conducting impacts normal to the test sample, but at a reduced velocity. The reduced velocity is established as follows:

3.1.1 Using the vehicle package drawing and appropriate standards and test procedures, establish the true angle relationship, ϕ , between the specified glancing blow direction line and an impact test line constructed perpendicular to the component at the impact point to be tested. (See Fig. 1.)

3.1.2 Calculate the test velocity for the normal-direction impact as:

$$V_N = V \cos \phi \quad (1)$$

Where:

V_N = reduced test velocity for the normal-direction impact

V = desired glancing blow velocity

ϕ = angle determined in paragraph 3.1.1

3.2 Conduct the impact test using the reduced test velocity V_N , and the impact test direction normal to the component.

APPENDIX A

1. Purpose—This appendix documents the test procedures, results, and conclusions of an investigation to determine the correlation between glancing impacts and impacts normal to the surface of the components being evaluated.

2. Procedures—Tests were conducted using an unguided, 15 lb, 6.5 in. diameter metal sphere. The metal sphere was instrumented to measure acceleration in three mutually perpendicular directions. Impact tests were performed on test samples of two designs at various impact velocities and angles.

3. Results

3.1 Unguided Ball Drop Tests—Figs. 2 and 3 show curves of resultant deceleration versus impact velocity for various impact angles. The decelerations are the vector summation of the three mutually perpendicular accelerations. The information from Figs. 2 and 3 was processed to compare impact velocities for normal and glancing impacts.

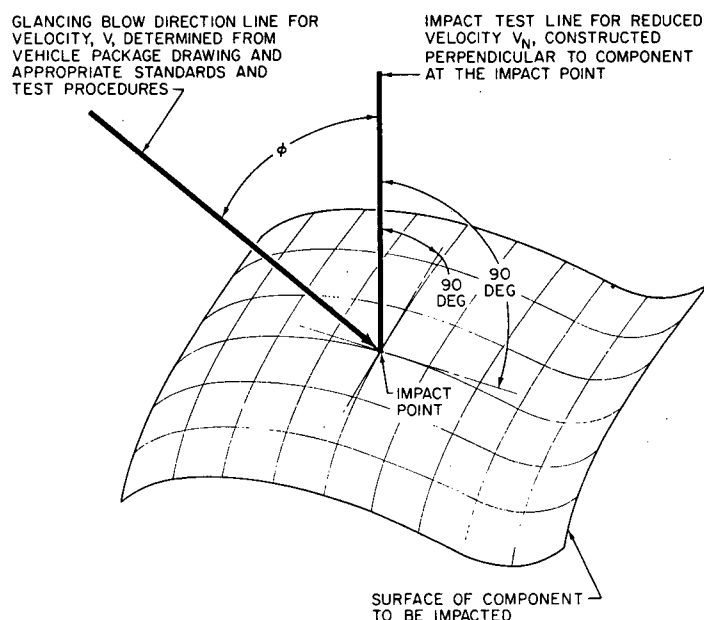


FIG. 1—DEFINITION OF ϕ , THE TRUE ANGLE BETWEEN THE GLANCING BLOW DIRECTION VELOCITY AND THE IMPACT TEST VELOCITY

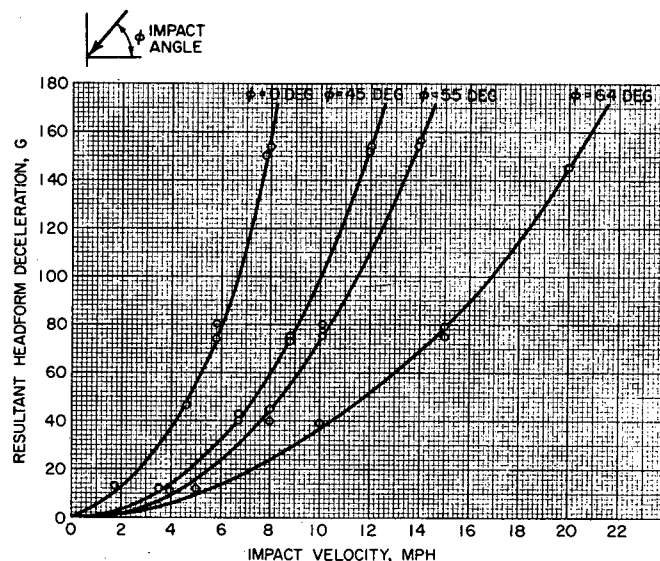


FIG. 2—RESULTANT HEADFORM DECELERATION VERSUS IMPACT VELOCITY FOR VARIOUS IMPACT ANGLES

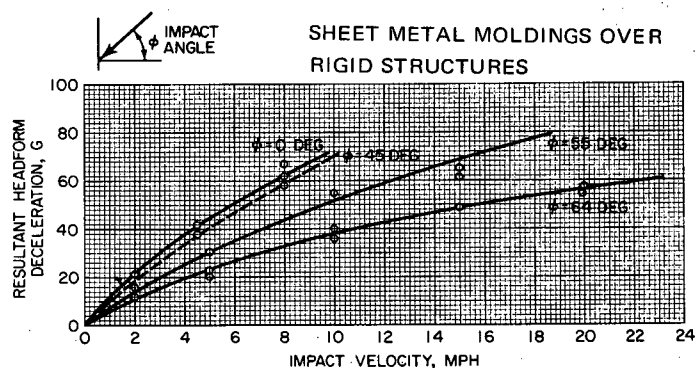


FIG. 3—RESULTANT HEADFORM DECELERATION VERSUS IMPACT VELOCITY FOR VARIOUS IMPACT ANGLES

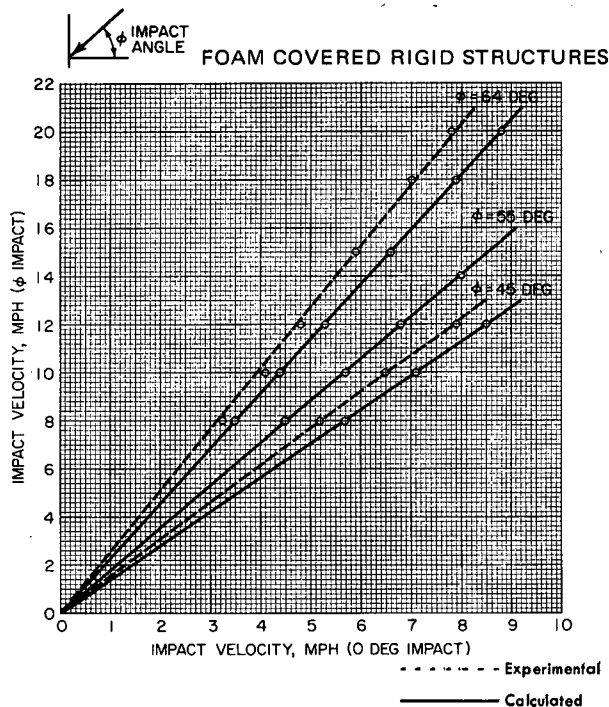


FIG. 4—CALCULATED AND EXPERIMENTAL IMPACT VELOCITY BASED ON CONSTANT HEADFORM DECELERATION

Figs. 4 and 5 were generated by cross plotting the normal-direction impact test velocity versus the glancing impact test velocity for constant values of deceleration. Also shown are lines calculated for the Eq. 1.

3.2 Errors—Use of this procedure may result in a significant error in the resultant headform deceleration. Fig. 7, a regression analysis of the data presented in Figs. 2 and 3, is included to indicate the possible error in using this method.

4. Conclusions—The results obtained from normal-direction tests conducted at a reduced velocity approximate test results obtained from actual glancing blow tests.

APPENDIX B—BACKGROUND AND RATIONALE

Certain interior components in the passenger compartment usually produce glancing blows when struck by an occupant's head during a collision. Among these might be windshield pillars, windshield headers, roof side rails, consoles, and similar components. For some time, the Passenger Compartment Energy Absorption Subcommittee has been struggling with writing an impact test procedure for glancing blows.

One of the major problems is the inability of current test equipment to tolerate oblique hits. Almost all impact machines in use incorporate a rigid pendulum to guide the headform. Glancing impacts would most likely damage the pendulum arm or its bearings. Also, the glancing action would produce a wedging effect that cannot be properly evaluated by the deceleration measurements now taken.

In the search for a way to test components involved with glancing

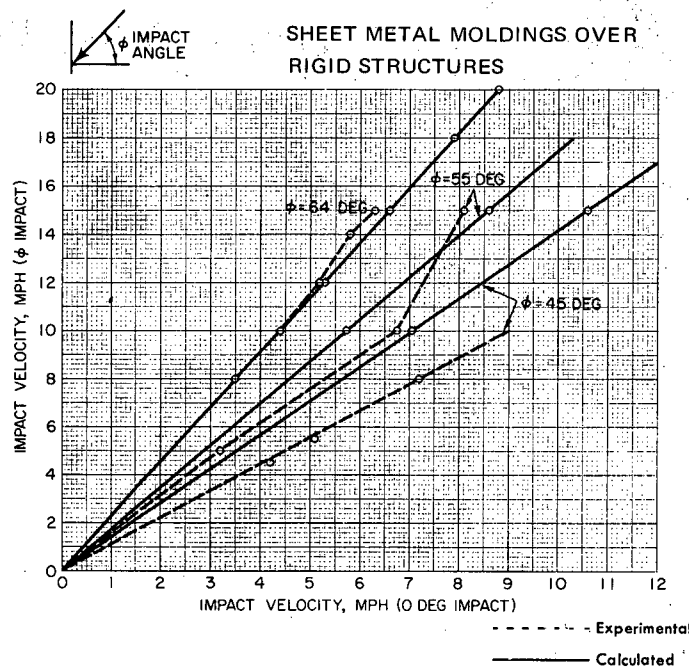


FIG. 5—CALCULATED AND EXPERIMENTAL IMPACT VELOCITY BASED ON CONSTANT HEADFORM DECELERATION

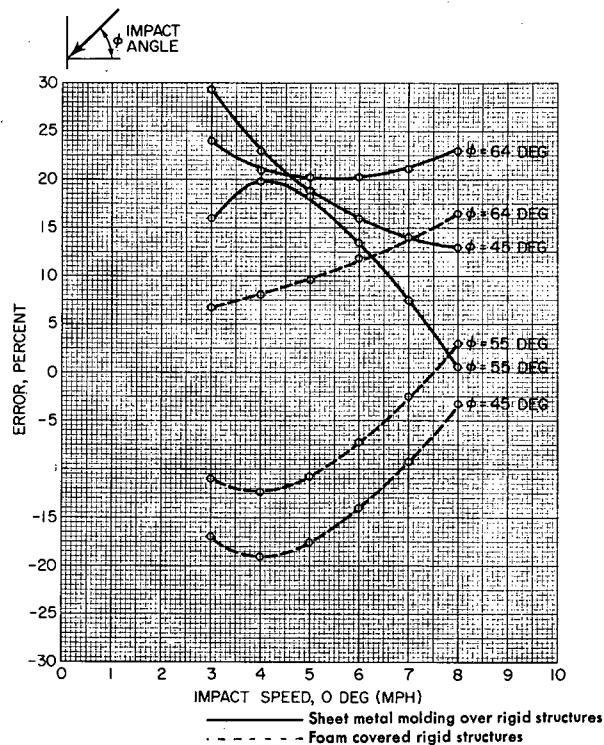


FIG. 6—ERROR BETWEEN ANGLE IMPACT AND ZERO DEG IMPACT VERSUS IMPACT VELOCITY

blows, the idea of simulating an oblique impact with a reduced-velocity perpendicular hit was conceived. A series of tests were conducted to work out a test method.

This information report describes the method and the investigation behind it. This method is not intended to be the final answer to glancing impacts. However, it may be a good interim tool that will allow existing equipment to be used in the study of various passenger compartment items. Notice that this document is *not* a recommended practice. It is simply an information report. It is being submitted for publication so that wider experience can be obtained through further testing.

The subcommittee realized that further impact machine develop-