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SURFACE VEHICLE INFORMATION REPORT

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(R) Guidelines for Evaluating Out-of-Position Vehicle Occupant Interactions with Deploying Frontal Airbags

Foreword—In the mid 1980's, vehicle manufacturers began to develop and install frontal airbags in their vehicles to meet the requirements of Federal Motor Vehicle Safety Standard for Occupant Crash Protection, FMVSS 208. Since considerable amount of energy is generated by the deploying airbag, there was concern that if an occupant was in the path of the deploying airbag, he could be severely injured by the interaction. In order to design airbag systems to mitigate the injury potential of such interactions, the vehicle manufacturers and their airbag suppliers developed tests to measure the interactions. In 1988, a Task Force was created by the SAE Human Biomechanics and Simulation Standards Committee to summarize the various test procedures that were being used in an SAE Information Report. The first Task Group meeting was April 29, 1988 and the document was completed on March 17, 1989. The SAE Information Report J1980—Guidelines for Evaluating Out-of-Position Vehicle Occupant Interactions with Deploying Airbags was issued on November 26, 1990.

Since both European and Asian vehicle manufacturers were beginning to develop airbags for their vehicles, the International Standards Organization formed a working group (ISO/TC22/SC10/WG3) to review SAE J1980 and develop a set of Out-of-Position (OOP) test procedures which had international agreement. The first meeting of ISO/TC22/SC10/WG3 was September 27, 1989. The technical report, ISO/TR10982—Road Vehicles—Test Procedures for Evaluating Out-of-Position Vehicle Occupant Interactions with Deploying Air Bags was issued on March 15, 1998.

As the volume of airbag equipped cars on the road increased, so did the number of deployment accidents increase. Fatalities of occupants who were in the path of the deploying airbag also began to appear in deployment accident studies of the early 90's.

On August 23, 1996, the American Automobile Manufacturers Association, (AAMA) filed a petition requesting that the National Highway Traffic Safety Administration (NHTSA) take two actions to address the Out-of-Position (OOP) fatality concerns. First, they requested immediate deletion of the 30 mph rigid barrier test requirement of FMVSS 208 so that airbag inflators could be depowered which would reduce the severity of airbag forces on OOP occupants. Second, they requested that OOP tests similar to those of ISO/TR 10982 be added to the requirements of FMVSS 208 to limit, by regulation, the airbag OOP forces. On March 19, 1997, NHTSA changed the 30 mph rigid barrier test requirement for unbelted occupants to a less severe, generic 30 mph sled test which would allow the manufacturers to use depowered inflators. On May 20, 2000, NHTSA added OOP tests and limits to FMVSS 208 to regulate the airbag OOP deployment interactions.

SAE J1980 has been revised and reissued because it is a more comprehensive set of possible OOP test conditions than either ISO/TR 10982 or FMVSS 208. It is also a historic document since it represents the initial coordinate effort by the domestic automobile industry to address the OOP occupant injury concerns.

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1. ***Scope—***An airbag generates a considerable amount of kinetic energy during its inflation process. As a result substantial forces can be developed between the deploying airbag and the out-of-position occupant. Accident data and laboratory test results have indicated a potential for head, neck, chest, abdominal, and leg injuries from these forces. This suggests that mitigating such forces should be considered in the design of airbag restraint systems.

This document outlines a comprehensive set of test guidelines that can be used for investigating the interactions that occur between the deploying airbag and the occupant who is near the module at the time of deployment. Static and dynamic tests to investigate driver and passenger systems are given. Static tests may be used to sort designs on a comparative basis. Designs that make it through the static sorting procedure may be subjected to the appropriate dynamic tests. On a specific vehicle model, engineering judgment based upon prior experience in airbag testing may make it unnecessary to conduct the tests identified by the document or may indicate that different tests should be conducted.

Mild severity and moderate severity crash pulses are described in Section 5. These pulses are not vehicle-specific, but represent a general acceleration-time history that approximates what occurs with a large variety of vehicles. The mild severity crash pulse is near the threshold of many airbag deployments and represents a high-frequency accident event. Since small children are more likely than adults to be out of position due to preimpact braking, this pulse can be used for the child tests. Since preimpact braking has much less of an effect on adults, the moderate severity crash pulse can be used for adult testing. The described pulses or other vehicle specific pulses may be used.

No performance limits are specified in this document. References 2.1.4 2 and 16 gives interpretations of dummy responses relative to human injury potential.

2. ***References***

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

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J211—Instrumentation for Impact Tests
SAE J1733—Sign Convention for Vehicle Crash Testing
SAE J2189—Guidelines for Evaluating Child Restraint System Interactions with Deploying Airbags

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO/TR10982—Road vehicles—Test procedures for evaluating out-of-position vehicle occupant interactions with deploying air bags
ISO/TR 12349-1—Road vehicles—Adult dummies for restraint system testing
ISO/TR 12349-2—Road vehicles—Child dummies for restraint system testing
ISO/TR 14645—Road vehicles—Test procedures for evaluating child restraint system interactions with deploying airbags
ISO/TR 6487—Road vehicles—Measurement techniques in impact tests—Instrumentation

ISO/TR 14933—Road vehicles—Test procedures for evaluating occupant interactions with deploying side air bags

2.1.3 CODE OF FEDERAL REGULATIONS (CFR)—Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

49 CFR, Part 571.208—Occupant Crash Protection (FMVSS 208)
49 CFR Part 572—Anthropomorphic Test Dummies

2.1.4 OTHER PUBLICATIONS

1. Special Crash Investigation Reports, National Center for Statistics and Analysis, NHTSA.
2. "Proposal for Dummy Response Limits for FMVSS 208 Compliance Testing," Attachment C, AAMA S98-13, Docket No. NHTSA 98 - 4405, Notice I, December 1998.
3. Mertz, H. J., Parasad, P., and Irwin, A. L., "Injury Risk Curves for Children and Adults in Frontal and Rear Collisions," SAE 973318, Forty-First Stapp Conference, November 1997.
4. Mertz, H. J. and Prasad, P., "Improved Neck Injuury Risk Curves for Tension and Extension Moment Measurements of Crash Dummies," SAE 2000-01-SC05, Forty-Fourth Stapp Conference, November 2000.
5. Patrick, L. M. and Nyquist, G. W., "Airbag Effects on Out-of-Position Child," 2nd International Conference on Passive Restraints, SAE 720442, May 22–25, 1972.
6. Aldman, B., Anderson, A., and Saxmark, O., "Possible Effects of Airbag Inflation on a Standing Child," Proceedings of the 18th Conference of the American Association for Automotive Medicine, September 12–14, 1974.
7. Montalvo, F., Bryant, R. W, and Mertz, H. J., "Possible Positions and Postures of Unrestrained Front-Seat Children at Instant of Collision," Ninth International Technical Conference on Experimental Safety Vehicles, November 1–4, 1982. Also available as SAE 826045.
8. Stalnaker, R. L., Klusmeyer, L. F., Peel, H. H., White, C. D., Smith, G. R., and Mertz, H. J., "Unrestrained Front Seat Child Surrogate Trajectories Produced by Hard Braking," 26th Stapp Car Crash Conference, SAE 821165, October 20–21, 1982.
9. Mertz, H. J., Driscoll, G. D., Lenox, J. B., Nyquist, G. W., and Weber, D. A., "Responses of Animals Exposed to Development of Various Passenger Inflatable Restraint System Concepts for a Variety of Collision Severities and Animal Positions," Ninth International Technical Conference on Experimental Safety Vehicles, November 1–4, 1982. Also available as SAE 826047.
10. Wolanin, M. J., Mertz, H. J., Nyznyk, R. S., and Vincent, J. H., "Description and Basis of a Three Year Old Child Dummy for Evaluating Passenger Inflatable Restraint Concepts," Ninth International Technical Conference on Experimental Safety Vehicles, November 1–4, 1982. Also available as SAE 826040.
11. Mertz, H. J. and Weber, D. A., "Interpretations of the Impact Responses of a Three Year Old Child Dummy Relative to Child Injury Potential," Ninth International Technical Conference on Experimental Safety Vehicles, November 1–4, 1982. Also available as SAE 826048.
12. Prasad, P. and Daniel, R. P., "A Biomechanical Analysis of Head, Neck and Torso Injuries to Child Surrogates Due to Sudden Torso Acceleration," 28th Stapp Car Crash Conference, SAE 841656, November 6–7, 1982.
13. Mertz, H. J., "Restraint Performance of the 1973–76 GM Air Cushion Restraint System," SAE 880400, Automatic Occupant Protection Systems, SP-736, February 1988.
14. Horsch, J. D. and Culver, C. C., "A Study of Driver Interactions with an Inflating Air Cushion," 23rd Stapp Car Crash Conference, SAE 791029, October 17–19, 1979.
15. Mertz, H. J., Irwin, A. L., Melvin, J. W., Stalnaker, R. L., and Beebe, M. S., "Size, Weight and Biomechanical impact Response Requirements for Adult Size Small Female and Large Male Dummies," SAE 890756, March 1989.
16. Mertz, H. J., "Anthropomorphic Test Devices," Accidental Injury—Biomechanics and Prevention, Springer-Verlag, New York, NY 1993.

3. ***Test Dummies and Measurements—***Dummies of the Hybrid III family are recommended for OOP testing of frontal air bags. The family consists of 3 sizes of adult and 3 sizes of child dummies. The adult dummies are a large male dummy, a mid-size male dummy, and a small female dummy. The latter two dummies are specified in subparts E and O of the Code of Federal Regulations, Part 572—Anthromorphic Test Devices. The large male dummy will be incorporated into Part 572 shortly. The child dummies consist of 3-, 6- and 10-year-old dummies. The 3- and 6-year-old dummies are specified in subparts P and N, respectively. The 10-year-old is a new dummy that is currently being developed by the SAE for OOP testing to fill the size void between the 6-year-old and small adult female dummies.

The following measurements should be made when doing OOP testing with either the adult or child dummies.

Head triaxial acceleration (3 channels)
Upper neck forces and moments (6 channels)
Lower neck forces and moments (6 channels)
Thoracic spine triaxial acceleration (3 channels)
Sternal accelerations (Ax) (2 channels)
Sternal compression (1 channel)

For inflatable knee restrains, the full spectrual of the tibia and femur load and displacement transducer channels should be recorded when the adult dummies are used.

All measurements should be recorded and filtered according to the latest version of SAE J211. These measurements should be continuous functions of time so that various injury criteria such as found in Reference 2.1.4.2 may be derived.

4. ***Test Temperature—***Normally, testing should be conducted within a temperature range of 20.6 to 22.2 °C (69 to 72 °F). If it is desired to investigate performance outside this temperature range, the temperature of the dummy should still be maintained within the above range.

5. ***Generic Sled Pulse—***Mild severity and moderate severity crash pulses are defined as follows. The out-of-position child may be exposed to a pulse similar to the mild severity crash pulse since collisions of similar severity occur most often, and preimpact braking will cause the child to be out of position more often that the collision dynamics.

5.1 Mild Severity Crash Pulse—This pulse is a half sine type with a 6.7 G nominal acceleration, a 25 km/h (16mph) velocity change, and a 150 ms pulse duration. Typical acceleration-time and velocity-time curves, and nominal acceleration are shown in Figures 1 and 2.

5.2 Moderate Severity Crash Pulse—This pulse is a half sine type with a 12 G nominal acceleration, a 29 km/h (18 mph) velocity change and a 110 ms pulse duration. Typical acceleration-time and velocity-time curves, and nominal acceleration are shown in Figures 3 and 4.

6. ***Static Tests for Driver Airbag Systems—***Two types of driver system static tests are described: one to investigate only the airbag module and the other to investigate the combination of the airbag module and steering system.

6.1 Airbag Module Evaluations

6.1.1 TEST SET-UP—Attach the airbag module to the appropriate steering wheel. Mount the steering wheel with the plane of its rim horizontal, to a rigid fixture with a load cell inserted between the wheel and the fixture. Adjust the height of the fixture so the cover of the module will contact the head/chest of the selected kneeling and bent forward adult dummy when the general anterior surface of the chest is horizontal.

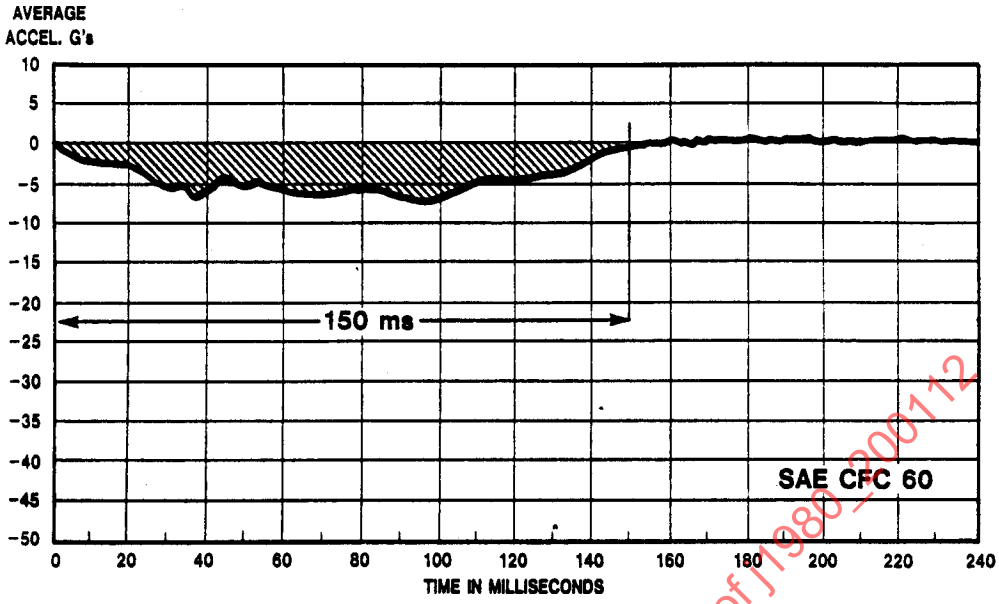

FIGURE 1—GENERIC HYGE SLED PULSE FOR A MILD CRASH SEVERITY

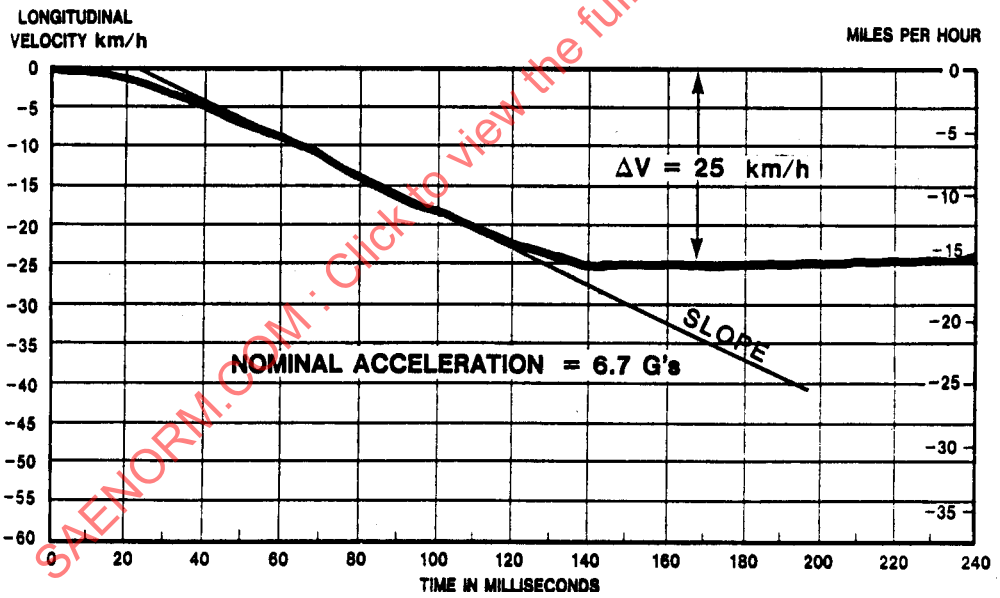

FIGURE 2—VELOCITY-TIME HISTORY OF THE GENERIC MILD CRASH SEVERITY SLED PULSE

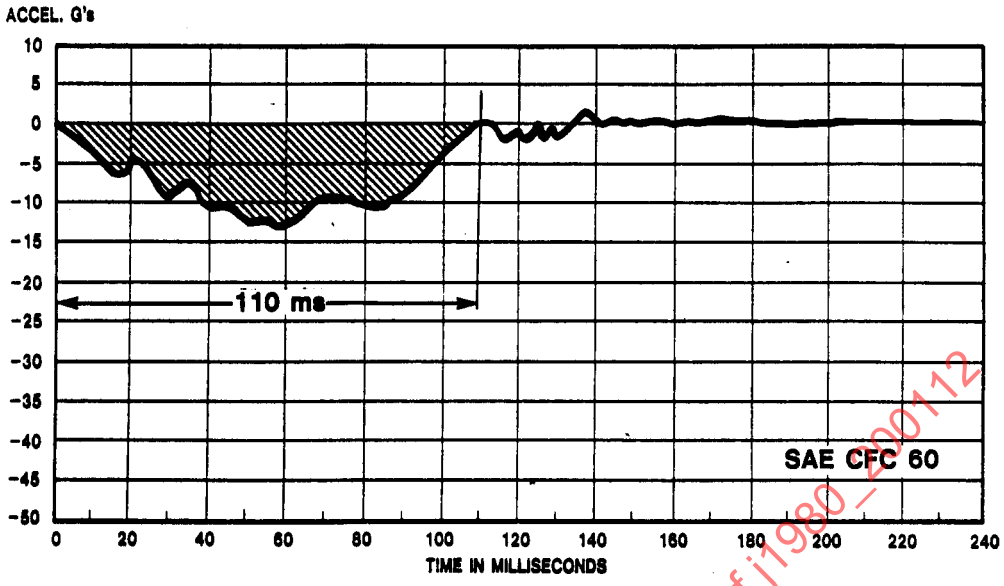

FIGURE 3—GENERIC HYGE SLED PULSE FOR A MODERATE CRASH SEVERITY

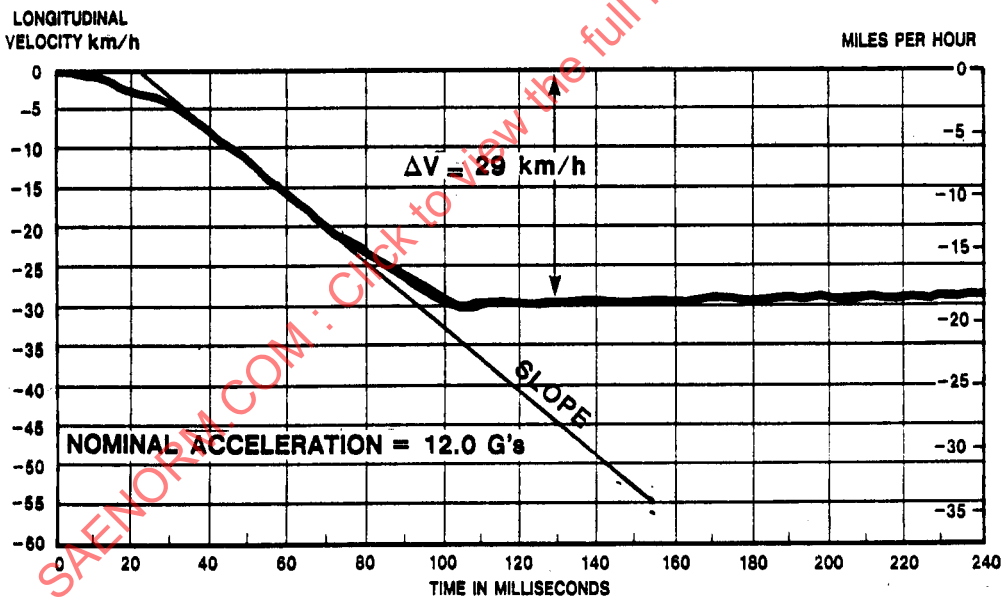

FIGURE 4—VELOCITY-TIME HISTORY OF THE GENERIC MODERATE CRASH SEVERITY SLED PULSE

6.1.2 DUMMY POSITIONS—Three dummy positions are described. Each position will provide data to investigate different types of interactions. No priority is assigned to any of these interactions. Any of the three adult size dummies described in Section 3 can be used. Additional tests may be conducted to determine the dummy positions that produce maximum involvement with the deploying airbag.

6.1.2.1 *Chest on Module*—This position is intended to investigate one of the possible chest-bag-cover interactions as the bag is being forced out of its container while being constrained by the dummy's chest. For this position the center of the dummy's sternum is aligned and squared with the module, with the whole weight of the dummy's chest resting against the wheel-module system. The dummy's chin should be outside the periphery of the rim to maximize the weight on the module.

Dummy responses of interest are chest measurements. Other responses could include neck and lower spine measurements.

6.1.2.2 *Forehead on Module*—This position is intended to investigate one of the possible head-bag-cover interactions as the bag is being forced out of its container while being constrained by the dummy's head. For this position the dummy's forehead is placed in the center of the module with the head weight bearing against the module.

Dummy responses of interest are head and neck measurements. Other responses could include chest measurements.

6.1.2.3 *Chin on Upper Rim*—This position is intended to investigate one of the possible neck loadings caused by the deployment. For this position the dummy's chin is placed against the upper rim and the chest is allowed to rest on the module. The total chest-head weight should bear against the module-wheel assembly.

Dummy responses of interest are the neck and chest measurements. Other responses might include head measurements.

6.2 Airbag Module and Steering System Evaluations

6.2.1 TEST SET-UP—Mount the steering wheel, airbag module, and steering column to an open structure or body buck by the normal column mounting means, so the mounting is at least as rigid as the actual vehicle mounting. The column should be mounted at the design column angle, and the column/wheel should be adjusted to its nominal design tilt position unless otherwise specified. If the windshield is expected to play any part in the deployment, then it or a mockup must be included. Any on-vehicle hardware that might restrict column axial movement during inflation should be included. The steering wheel may be in any desired rotated position (i.e., straight ahead, rotated 90 degrees, 180 degrees, etc.).

6.2.2 DUMMY POSITIONS—Place the test device on any suitable seating surface so the chest, neck, or head is in the desired location in relation to the airbag. One or two layers of paper tape may be used to retain the dummy in the desired location. No priority is assigned to any of these interactions. Any of the three adult size dummies described in Section 3 may be used. The following are some possible dummy positions. It may be impossible to perform certain tests because of vehicle geometry. Additional tests may be conducted to determine the dummy positions that produce maximum involvement with the deploying airbag.

6.2.2.1 *Forehead on Module*—This position is intended to investigate one of the possible head-bag-cover interactions when the forehead is against the module as in 6.1.2.2. Center the dummy's forehead (25 mm above the head center-of-gravity) on the module, with the torso angle essentially parallel to the angle of the steering wheel rim in side view.

Dummy responses of interest are head and neck measurements. Other responses might include chest measurements.

6.2.2.2 *Slumped Driver*—This position is intended to investigate one of the possible interactions between the deploying airbag and a driver slumped against the steering wheel. Adjust the seat to the accommodation position per FMVSS 208 for the size of dummy being used. Seat the dummy and then rotate it forward about the hips and lumbar spine, maintaining the H-point position, until the head contacts the steering wheel/module assembly.

Dummy responses of interest are head and neck measurements. Other responses might include chest measurements.

6.2.2.3 *Chin on Top of Module*—This position is intended to investigate one of the possible neck and head loadings during the inflation event. Place the head of the dummy as far forward as permitted by the steering wheel rim, and center the chin laterally on the top edge of the module. Align the torso so the torso angle is parallel to the plane of the wheel in side view.

Dummy responses of interest are head and neck measurements. Other responses might include chest measurements.

6.2.2.4 *Chest on Module*—This position is intended to investigate one of the possible chest-bag-cover interactions when the bag is constrained during breakout by the chest. Center the sternum on the module in both the vertical and lateral planes, with the chest against the module and/or the plane of the rim. The chest may have to be moved up slightly to get the chin over the top of the rim so the chest can be against the module.

Dummy responses of interest are neck and chest measurements. Other responses might include head measurements.

6.2.2.5 *Chin on Upper Rim*—This position is intended to investigate one of the possible neck loadings as the head is pushed upwards and rearward by the inflating bag. For this position the dummy's chin is placed against the upper rim and its chest is allowed to lie on the rim-module.

Dummy responses of interest are neck and chest measurements. Other responses might include head measurements.

6.2.2.6 *Normally Seated Small Female*—This position is intended to investigate one of the possible interactions between the deploying bag and a small driver whose normal driving position is closet to the airbag module. Adjust the seat as prescribed in FMVSS 208. The seat back is to be tilted to the full up driving position. If the column or wheel tilts greater than ±2 degrees, it is recommended that the test be conducted at nominal column angle and at the two extremes of column tilt. If the column telescopes, the test should be conducted with the telescope feature full rearward.

Dummy responses of interest are head, neck, and chest measurements.

***7. Dynamic Tests for Driver Airbag Systems*—**Two types of dynamic tests are described in this section; 1) prepositioned out-of-position driver tests and 2) acceleration-induced out-of-position driver tests. No priority is assigned to any of these interactions.

7.1 Test Set-Up—Mount the steering wheel, airbag module, and steering column to an open structure or body buck by the normal column mounting means, so the mounting is at least as rigid as the actual vehicle mounting. The column should be mounted at the design column angle. If practicable, use the actual instrument panel. If not, knee bolsters with performance characteristics near those expected in production should be mocked into the buck at package location. If the windshield is expected to play any part in the deployment, then it or a mockup must be included. Any on-vehicle hardware that might restrict column axial movement during inflation should be included. This buck should be mounted to any suitable sled or other test mechanism that produces the desired acceleration-time pulse.

7.2 Prepositioned Driver Tests—Place the test device on any suitable seating surface so the chest and head are in the desired locations in relation to the airbag. One or two layers of paper tape may be used to retain the dummy in the desired location. Six dummy positions that can be investigated are described in 6.2.2. Any of the three adult dummies described in Section 3 can be used except for the test described in 6.2.2.6. For these dynamic tests the dummy is prepositioned in the desired location and the sled is subjected to the desired crash pulse described in Section 5. The airbag can be deployed at any desired time during the simulated collision event.

7.3 Acceleration-Induced Out-of-Position Driver Tests—The object of these tests is to investigate possible interactions between the deploying airbag and the part of the dummy of interest when the dummy is seated in its normal driving position and allowed to move forward as a result of sled acceleration. The airbag is deployed (in different tests) at various times during the sled pulse to determine the maximum bag interaction with the dummy. Any of the three adult dummies defined in Section 3 can be used. The crash pulses defined in Section 5 can be used for these tests.

7.3.1 NORMALLY SEATED DRIVER WITH NORMAL STEERING WHEEL POSITION (UNBELTED)—Adjust the seat and steering wheel for the nominal driving position for the dummy size selected. Place the dummy in its nominal driving posture. Do not use any belt restraints. Subject the sled to the desired pulse crash and allow the dummy to translate forward toward the steering wheel. Deploy the system at various times (in different tests) during the pulse to determine maximum dummy interaction with the deploying bag.

Dummy responses of interest are head, neck, and chest measurements. Other responses might include femur, knee, and tibia measurements.

7.3.2 NORMALLY SEATED DRIVER WITH NORMAL STEERING WHEEL POSITION (BELTED)—This test is the same as 7.3.1 except that all available belts are used.

Dummy responses of interest are head, neck, and chest measurements. Other responses might include femur and knee measurements.

7.3.3 CHEST INTERACTION TEST (UNBELTED)—The purpose of this test is to investigate one of the possible interactions between the deploying airbag and the chest. Position the dummy in its nominal seated position and adjust the steering wheel system so the dummy's chest will contact the center of the airbag module and its chin will pass over the top of the rim. Subject the sled to the desired pulse and allow the dummy to translate forward. Deploy the airbag at various times (in different tests) during the pulse when the chest is near or in contact with the module.

Dummy responses of interest are neck and chest measurements. Other responses might include head and femur measurements.

8. Static and Dynamic Tests for Passenger Airbag Systems, Using Child Dummy—The location of the passenger module on the instrument panel is an important consideration in choosing the child position and posture to be investigated. Three generic instrument panel locations of the passenger module are used; low, mid, and top. The low position denotes a rearward deploying module location in the area of the instrument panel normally used for knee bolsters. The midposition denotes a rearward deploying module location above the knee bolster area. The top position denotes an airbag system that deploys through the top surface of the instrument panel area. For any combination of module location and child position to be investigated, tests may have to be conducted to determine the child dummy positions that produce maximum involvement with the deploying airbag.

8.1 Test Set-Up—Mount the instrument panel or panel mockup and the airbag module to an open structure or body buck by the normal mounting means or by a similar mounting means so the mounting is at least as rigid as the actual vehicle mounting. If the windshield is expected to play any part in the deployment, then it or a mockup must be included. Any on-vehicle hardware that might restrict or deflect the deployment should be included. For dynamic tests, this buck should be mounted to any suitable sled or other test mechanism that produces the desired acceleration pulse.

8.2 Child Dummy Test Positions—Montalvo, et al [Reference 7] reported that 34% of unrestrained front seat children in airbag deployment collisions would be near the instrument panel at the time of deployment. These children would either be initially near the instrument panel immediately before the collision or be propelled toward it by preimpact braking and/or collision forces. They categorized the possible positions into 13 "Z"-positions. Seven of these "Z" -positions (Z-1, -2, -4, -5, -6, -7, -12) involve children who are facing forward, five (Z-8, -9, -10, -11, -13) involve sideways facing children, and one (Z-3) involves a rearward facing child.

Mertz, et al [Reference 9] have shown that forward facing and sideways facing animals experienced similar injury types and severities when exposed to similar airbag deployments. They concluded that it was only necessary to expose forward facing surrogates in various child positions to assess the injury potential associated with deploying the airbag when the child is near the instrument panel. For this reason, the side and rear facing positions have been grouped with their corresponding forward facing positions, which result in the following seven primary child dummy test positions (see Figures 5 to 11). In all positions, the arms of the dummy should be positioned not to interfere with the cushion's interaction with the body region of interest. Note the arm position in the figures. The figures should be taken as a general guide which may not be applicable for all packages. In all cases, the dummy is centered in plan view on the module.

8.2.1 CHILD POSITION NUMBER 1—(See Figure 5.)

This child position is the Z-4 position (or its side facing, Z-13, equivalent) described in Reference 7. The child dummy may be seated on the front edge of the seat or stood on the floor. In either case, its chin should be above the top surface of the instrument panel and its thoracic spine should be vertical. The dummy's vertical height can be raised to obtain a worst case condition.

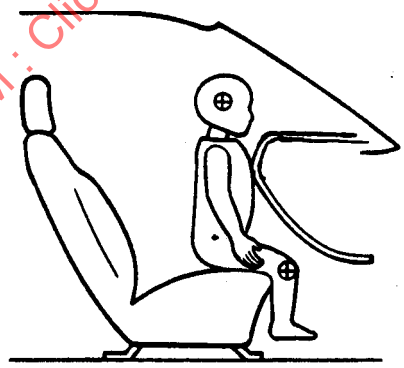

FIGURE 5—CHILD POSITION NUMBER 1

8.2.2 CHILD POSITION NUMBER 2—(See Figure 6.)

This child position is the Z-12 position (or its side facing, Z-10, equivalent) described in Reference 7. Place the child dummy in a kneeling position on the seat. Lean its torso forward and adjust the seat so its chin is against the top surface of the instrument panel.

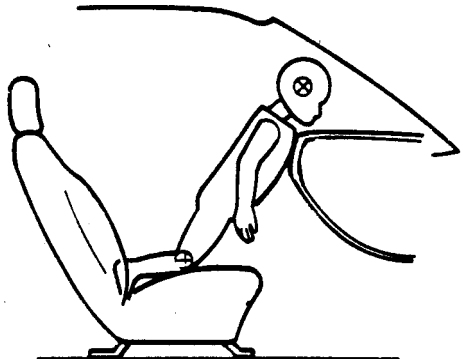

FIGURE 6—CHILD POSITION NUMBER 2

8.2.3 CHILD POSITION NUMBER 3—(See Figure 7.)

This child position is the Z-1 position (or its side facing, Z-8, equivalent) described in Reference 7. Place the child dummy so its head is against the midface of the instrument panel and its buttocks on the seat.

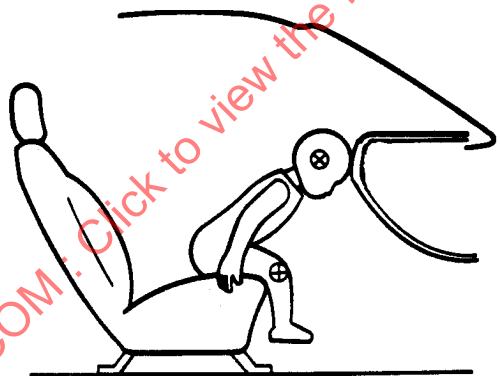

FIGURE 7—CHILD POSITION NUMBER 3

8.2.4 CHILD POSITION NUMBER 4—(See Figure 8.)

This child position is the Z-7 position described in Reference 7. Place the child dummy in either a kneeling or sitting position on the floor. The thoracic spine should be vertical and the head should be against the face of the instrument panel.

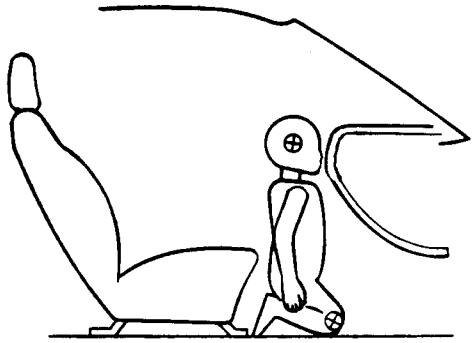

FIGURE 8—CHILD POSITION NUMBER 4

8.2.5 CHILD POSITION NUMBER 5—(See Figure 9.)

This child position is the Z-6 position (or its side facing, Z-11, and rear facing, Z-3, equivalent) described in Reference 7. Place the child dummy so its head is against the midpanel surface and the body wrapped around the panel, with the torso against the lower instrument panel surface. Foam blocks and/or paper tape may be used to hold the dummy in position.

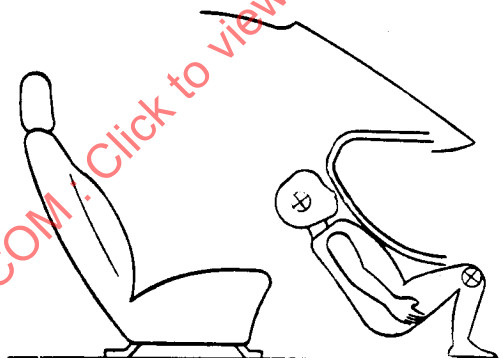

FIGURE 9—CHILD POSITION NUMBER 5

8.2.6 CHILD POSITION NUMBER 6—(See Figure 10.)

This child position is the Z-5 position described in Reference 7. Place the child dummy so its head is against the upper pad edge and the body wrapped around the panel, with lower legs bent back. This is a higher head position than in child position number 5. Foam blocks and/or paper tape may be used to hold the dummy in position.

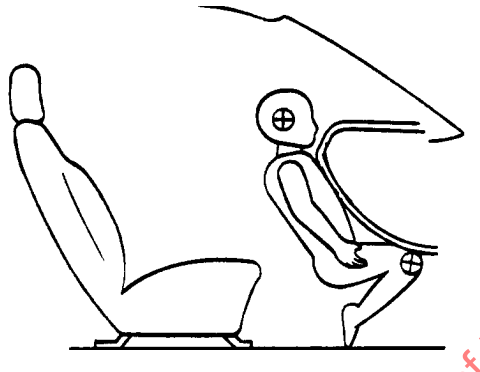

FIGURE 10—CHILD POSITION NUMBER 6

8.2.7 CHILD POSITION NUMBER 7—(See Figure 11.)

This child position is the Z-2 position (or its side facing, Z-9, equivalent) described in Reference 7. Place the child dummy so its head is against the lower face of the instrument panel (knee restraint area), and its buttocks on the seat.

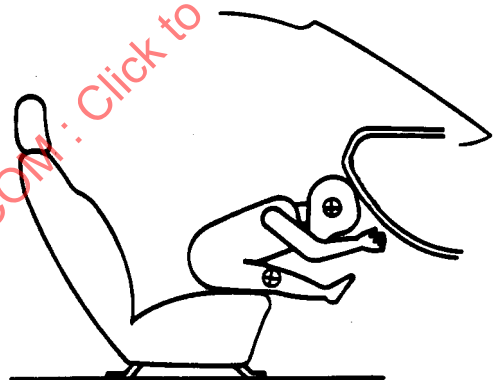

FIGURE 11—CHILD POSITION NUMBER 7

8.3 Child Dummy Static Tests for Passenger Airbag Systems—The choice of child dummy position to be used will be dependent on the instrument panel location of the passenger airbag system. It may be impossible to perform certain tests because of vehicle geometry. Table 1 gives possible child dummy positions for low, mid, and top mounted passenger airbag modules. Dummy response measurements of primary importance are listed for each applicable combination.

TABLE 1—CHILD DUMMY PRIMARY MEASUREMENTS FOR VARIOUS COMBINATIONS OF DUMMY POSITIONS AND PASSENGER MODULE LOCATIONS

Dummy Position	Passenger Module Location Low	Passenger Module Location Mid	Passenger Module Location Top
1	Neck	Chest, Neck	Head, Neck
2	Neck	Chest, Neck	Head, Neck
3	Head, Neck	Head, Neck	N.A.
4	Chest, Head, Neck	Head, Neck, Chest	N.A.
5	Chest, Abdomen, Neck	Head, Neck	N.A.
6	Abdomen, Chest, Neck	Head, Neck, Chest	N.A.
7	Head, Neck	N.A.	N.A.

N.A. indicates dummy position not applicable to module location.

8.4 Child Dummy Dynamic Tests for Passenger Airbag Systems

8.4.1 UNRESTRAINED CHILD DUMMY OUT-OF-POSITION TESTS—The child dummy positions described in 8.2 and 8.3 can be investigated by dynamic testing. For these tests the fixture is mounted to a suitable crash sled. The dummy is placed in the desired position and the sled is subjected to the desired crash pulse described in Section 5. The airbag is deployed at any desired time during the simulated collision event.

8.4.2 LAP BELTED CHILD DUMMY OUT-OF-POSITION TEST, DELAYED DEPLOYMENT—Place the child dummy in the full forward seated position, restrained by the lap belt only. When the sled is accelerated the torso and head of the dummy will pitch forward. Deploy the airbag at various times (in different tests) to determine maximum head-neck involvement with the deploying bag.

9. Static and Dynamic Tests for Passenger Airbag Systems, Using Adult Dummies—The location of the passenger module on the instrument panel is an important consideration in choosing the adult position and posture to be investigated. Three generic instrument panel locations of the passenger module are used; low, mid, and top. The low position denotes a rearward deploying module location in the area of the instrument panel normally used for knee bolsters. The midposition denotes a rearward deploying module location above the knee bolster area. The top position denotes an airbag system that deploys through the top surface of the instrument panel area. For any combination of module location and adult position to be investigated, tests may have to be conducted to determine the adult dummy positions that produce maximum involvement with the deploying airbag.

9.1 Test Set-Up—Mount the instrument panel or panel mockup and the airbag module to an open structure or body buck by the normal mounting means or by a similar mounting means, so the mounting is at least as rigid as the actual vehicle mounting. If practicable, use the actual instrument panel. If not, knee bolsters with performance characteristics near those expected in production should be mocked into the buck at package location. If the windshield is expected to play any part in the deployment, then it or a mockup must be included. Any on-vehicle hardware that might restrict or deflect the deployment should be included. For dynamic tests this buck should be mounted to any suitable sled or other test mechanism that produces the desired acceleration pulse.

9.2 Adult Dummy Positions Near Instrument Panel—The six adult dummy positions described can be produced in collisions by a number of factors such as preimpact braking and/or collision forces (see Figures 12 to 17. It may be impossible to perform certain tests because of vehicle geometry. Any of the adult dummies described in Section 3 can be used with the exception of adult position numbers 3 and 6. Only the small female dummy will fit in these positions. One or two layers of paper tape can be used to hold the dummy in the desired position. Blocks can be placed under the buttocks to maintain desired height. In all tests the dummy will be centered on the module in plan view.

9.2.1 ADULT POSITION NUMBER 1—(See Figure 12.)

This position simulates a slumped person whose head is resting against the upper rear edge of the instrument panel, but the knees are rearward of the panel surface. It also simulates a lap belted person who has pitched forward due to braking and/or collision forces. The head can be closer to the windshield when investigating a top mounted module.

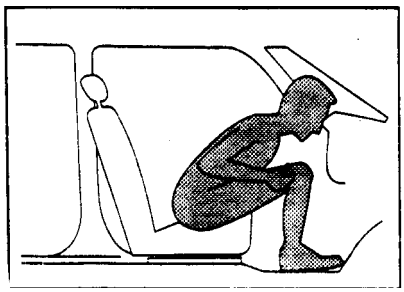

FIGURE 12—ADULT POSITION NUMBER 1

9.2.2 ADULT POSITION NUMBER 2—(See Figure 13.)

This position investigates an unrestrained person who has slid forward so the knees are in contact with the lower instrument panel and the head-torso is against the upper panel and/or windshield.

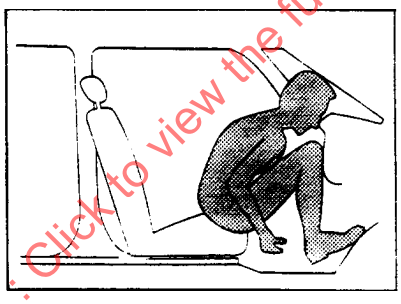

FIGURE 13—ADULT POSITION NUMBER 2

9.2.3 ADULT POSITION NUMBER 3—(See Figure 14.)

This position investigates a normally seated but small adult. Seat the small female dummy with the seat in the 5th percentile accommodation position per FMVSS 208, and with the seat back tilted to its full up driving position.

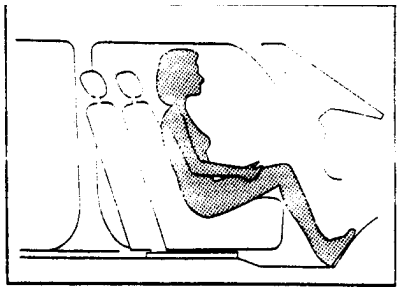

FIGURE 14—ADULT POSITION NUMBER 3