DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. 92–28; Notice 8]

RIN 2127–AG07

Federal Motor Vehicle Safety Standards; Head Impact Protection

AGENCY: National Highway Traffic Safety Administration (NHTSA), DOT.

ACTION: Notice of Proposed Rulemaking.

SUMMARY: This document proposes to amend the upper interior impact requirements of Standard No. 201, Occupant Protection in Interior Impact, to permit, but not require, the introduction of dynamic head protection systems currently being developed by vehicle manufacturers to provide added lateral crash protection. Target points in those areas of the upper interior occupied by these dynamic systems would be allowed, with the systems undeployed, to meet slightly reduced requirements. To ensure that these dynamic systems would enhance safety, the proposal would add procedures and performance requirements for testing the systems, while deployed, through in-vehicle component tests or a combination of such in-vehicle tests and vehicle crash testing.

DATES: *Comment closing date:* Comments on this notice must be received by NHTSA no later than October 27, 1997.

ADDRESSES: Any comments should refer to the docket and notice number of this notice and be submitted (preferably in 10 copies) to: Administrator, National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, DC 20590.

FOR FURTHER INFORMATION CONTACT: The following persons at the National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, DC 20590:

For non-legal issues: Dr. William Fan, Office of Crashworthiness Standards, NPS–11, telephone (202) 366–4922, facsimile (202) 366–4329, electronic mail ''bfan@nhtsa.dot.gov''.

For legal issues: Otto Matheke, Office of the Chief Counsel, NCC–20, telephone (202) 366–5253, facsimile (202) 366–3820, electronic mail ''omatheke@nhtsa.dot.gov''.

SUPPLEMENTARY INFORMATION:

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I. The Safety Problem

In an August 18, 1995 final rule (60 FR 43041) adding requirements for upper interior impact protection to Standard No. 201, ''Occupant Protection in Interior Impact,'' NHTSA estimated that even with air bags installed in all cars and LTVs, head impacts with the pillars, roof side rails, windshield header, and rear header would result in 1,591 annual passenger car occupant fatalities and 575 annual LTV occupant fatalities. The agency also stated that it believed such head impacts also result in nearly 13,600 moderate to critical (but non-fatal) passenger car occupant injuries (MAIS 2 or greater), and more than 5,200 serious LTV occupant injuries. (The AIS or Abbreviated Injury Scale is used to rank injuries by level of severity. An AIS 1 injury is a minor one, while an AIS 6 injury is one that is currently untreatable and fatal. The Maximum Abbreviated Injury Scale or MAIS is the maximum injury per occupant.)

Manufacturers may choose the means that they use to meet the requirements of the August 18, 1995 final rule. One method of compliance is through the installation of static energy absorbing materials like padding, which will reduce the number and severity of these injuries. In that final rule, the agency estimated that the new requirements would prevent 675 to 768 AIS 2–5 head injuries and 873 to 1,045 fatalities. The development of dynamic head protection systems offers the potential for additional injury reduction.

II. Background

A. August 1995 Final Rule on Upper Interior Impact Protection

The August 1995 final rule issued by the National Highway Traffic Safety Administration (NHTSA) amended Standard No. 201 to require passenger cars, and trucks, buses, and multipurpose passenger vehicles (collectively, passenger cars and LTVs) with a gross vehicle weight rating (GVWR) of 10,000 pounds or less, to provide protection when an occupant's head strikes upper interior components, including pillars, side rails, headers, and the roof, during a crash. This final rule, which requires compliance beginning on September 1, 1998, significantly expands the scope of Standard 201. Previously, the standard applied only to the portion of the vehicle interior in front of the front seat occupants. The amendments added procedures and performance requirements for a new in-vehicle component test.

B. Petitions for Reconsideration

The agency received nine timely petitions for reconsideration of the final rule. The issues raised by the petitions can be divided into five categories—(1) application of the new requirements to dynamic head protection systems, (2) influence of systems variables, (3) lead time and phase-in, (4) exclusion of certain vehicles, and (5) test procedure.

Insofar as the petitions addressed the last four categories of issues, NHTSA responded by issuing amendments to the August 18, 1995 final rule in a notice dated April 7, 1997 (62 FR 16718). In the April 7, 1997 notice, NHTSA modified the final rule to exclude certain vehicles from the requirements of Standard 201, changed the phase-in requirements by providing manufacturers with the option of complying with an additional schedule for meeting the requirements of the standard and amended other sections of the standard to address concerns about test procedures.

Since the first category of issues, dynamic head protection systems, was outside the scope of the rulemaking that led to the August 18 final rule, the agency considered it not a proper

subject for a petition for reconsideration. Therefore, the agency announced that it was treating the requests relating to these issues as petitions for rulemaking, and was granting those petitions.

C. March 7, 1996 ANPRM on Dynamic Head Protection Systems

On March 7, 1996, NHTSA published an advance notice of proposed rulemaking (ANPRM) to assist the agency in evaluating the issues raised by dynamic head protection systems (61 FR 9136). In the ANPRM, the agency noted that the only existing accommodation in Standard 201 of vehicles equipped with dynamic restraint systems is a provision concerning vehicles with frontal automatic protection systems meeting S5.1 of Standard No. 208, ''Occupant Crash Protection.'' The head impact area on instrument panels need only meet the performance requirements of Standard 201 when impacted at a relative velocity of 19 kilometers per hour (km/h) (12 mph) rather than the 24 km/h (15 mph) requirement imposed on vehicles not meeting S5.1 of Standard 208. This exception to the 24 km/h (15 mph) requirement is premised on the agency's belief that the tests contained in Standard 208 for dynamic systems provided adequate assurance that these systems perform well enough to protect occupants in the event of a crash.

However, the dynamic systems described in the petitions for reconsideration are intended to supplement other dynamic restraints and protect the heads of occupants in side impacts and rollovers. They are not used to comply with the frontal protection requirements of S5.1 of Standard 208. Neither Standard 208 nor any other Standard contained comparable requirements for side impact protection systems intended to provide head protection to occupants. Thus, there was no readily available way of providing for the testing of these systems or providing adequate assurance that they would yield sufficient safety benefits to justify a similar reduction in the relative impact velocity of 24 km/h (15 mph) afforded for vehicles with dynamic systems providing protection in frontal impacts.

The agency noted that two categories of dynamic systems were then under consideration by manufacturers—dynamically deployed padding and dynamically deployed air bags or other inflatable devices. NHTSA stated that both of these systems potentially provided greater protection to occupants than design features likely to be used in meeting the requirements contained in the August 18, 1995 final rule. Accordingly, the agency suggested the possibility of developing test procedures to assure that the protection afforded by the systems is a suitable substitute for the protection provided by that final rule. The ANPRM suggested that dynamically deployed padding and dynamically deployed inflatable devices be subjected to different tests. In the case of dynamically deployed padding, the agency suggested that existing targets specified in the final rule protected by the dynamic system be impacted at 19 km/h (12 mph) prior to the deployment of the padding and then be impacted at 32 km/h (20 mph) with the padding deployed. This test would accommodate the limitations of dynamic padding systems in their undeployed state while providing assurance that deployed padding provided additional protection to occupants. In the case of inflatable devices, the ANPRM discussed the possibility that the agency might propose subjecting vehicles equipped with these systems to 19 kilometer per hour (12 mph) impacts at all points covered by the inflatable device with the device in its undeployed state. The performance of the device as deployed would be tested in a side impact test into a fixed rigid pole at 30 km/h (18.6 miles per hour) or a side impact with a moving deformable barrier at 50 km/h (31 miles per hour). The ANPRM also requested responses to 17 questions relating to the design, performance, evaluation and testing of dynamic head protection systems.

D. Comments on the ANPRM

The agency received a total of ten comments on the ANPRM. Five automobile manufacturers (Ford, Volvo, BMW, VW, and Mercedes), one restraint system supplier (Autoliv), three safety organizations (Automotive Occupant Restraint Council (AORC), Insurance Institute for Highway Safety (IIHS), and Advocates for Highway and Auto Safety (AHAS)), and one manufacturers' association (American Automobile Manufacturers Association (AAMA), submitted comments in response to the ANPRM. The comments received from Volvo and Ford indicated that these commenters did not support the adoption of mandatory full scale crash tests for dynamic systems. Ford indicated its belief that existing tests incorporated in Standards 201 and 214 were adequate for measuring the performance of dynamic systems. Additional testing, in Ford's view, would be redundant and unduly burdensome. Volvo contended that full scale crash testing would impose a greater testing burden on cars arguably equipped with safer systems and questioned the fairness of this burden. Volvo also objected to full scale testing as such testing, if restricted to one test configuration, would not be useful in evaluating head impacts that may occur throughout the vehicle. The use of a single test configuration, Volvo argued, would also lead to the development of systems geared to provide optimum protection in specific areas of a vehicle rather than throughout the interior of the car. Volvo and Autoliv recommended the combination of a 19 km/h (12 mph) FMH impact test prior to system deployment and a 24 km/h (15 mph) FMH impact test with the system fully deployed. Autoliv indicated that dynamic systems would deploy in crashes resulting in head speeds above 19 km/h (12 mph) and that the protection these systems provide would be adequate at 24 km/h (15 mph). Autoliv further submitted that the systems would offer significant collateral benefits such as ejection mitigation, protection against intrusion and protection against impacts with windows. Volvo indicated that a 24 km/h (15 mph) impact was appropriate as it was similar to the requirements for other head injury mitigating measures. Mercedes and Volkswagen indicated that dynamic systems be tested only at a 24 km/h (15 mph) impact speed. In Volkswagen's view, testing at this speed in conjunction with a requirement that the dynamic system stay inflated for a time period sufficient to assure protection against subsequent crash induced impacts would be sufficient to ensure that the systems provided adequate protection. Mercedes supported the use of a single 24 km/h (15 mph) impact into a deployed system as there would be no loss of benefits compared to static systems and greater collateral benefits in the form of ejection mitigation and protection from impacts with wider areas of the interior. However, BMW supported the 19 km/h (12 mph) FMH impact tests in combination with a 29 km/h (18 mph) side crash test into a fixed, rigid pole. Of the comments received from associations and safety organizations, those from the AAMA indicated that AAMA did not favor a mandatory full scale test requirement. AAMA indicated its belief that testing conducted pursuant to Standard 214 was sufficient to evaluate the ability of a vehicle to protect occupants in a side impact. AORC, IIHS and AHAS did not oppose the use of full scale crash testing, but raised concerns about reducing the existing requirements of Standard 201 to accommodate dynamic systems. The

comments received by NHTSA are summarized below.

BMW indicated that the agency should specify multiple test procedures for gauging compliance with Standard 201 in order to give manufacturers flexibility to offer a variety of head protection systems in their product lines. The company also suggested that dynamic systems be tested in the undeployed condition with 19 kilometer per hour (12 mph) FMH impacts into the A-pillar, certain points on the B-pillar and roof rails. In conjunction with FMH testing at 19 km/h (12 mph), BMW supported testing of dynamic systems with a full scale side impact test consisting of a 29 km/h (18 mph) side impact into a fixed pole using a EuroSid dummy. BMW provided test data generated from its development of the Inflatable Tubular System (ITS) indicating that the suggested pole test generated, in the absence of countermeasures, HIC scores above 2000. Based on its testing, BMW stated that such a dynamic test would establish the performance of dynamic systems and assure that these systems offered sufficient safety benefits to justify use of lower impact speeds when testing them in their undeployed condition.

BMW's suggested test specifies that all targets on the A/B-pillars (except BP4) and side rails (including SR3 on the rear side rail) be tested with a FMH impact of 19 km/h (12 mph) in conjunction with the full scale pole test. BMW indicated that its system would provide head protection for all of these points except for SR3. BMW indicated that SR3 should be tested at 19 km/h (12 mph) even though it is not protected by the ITS as it believed that padding thickness along the side rails should remain constant. In regard to the remaining points that would be protected by ITS, BMW indicated that limitations imposed by dynamic systems forbid padding the entire side rail to meet the existing 24 km/h (15 mph) requirement.

Ford indicated its belief that the existing requirements of Standard 201 and Standard No. 214 ''Side Impact Protection'', already provide a means of evaluating the performance of advanced dynamic systems and, therefore, any additional tests are not necessary. However, Ford would not object to the ANPRM's suggestion for adjusting the FMH impact speed from 24 km/h (15 mph) to 19 km/h (12 mph) for vehicles that provide a lap-shoulder belt and a side impact head (or head/chest) supplemental air bag for each front outboard occupant.

Mercedes indicated its support for revisions to Standard 201 to accommodate dynamic systems. The company indicated its belief that inflatable dynamic systems presented the best means to meet the requirements of the Standard with existing technology. Mercedes further stated that it was developing such a system and recommended a test procedure with a 24 km/h (15 mph) FMH impact into a fully deployed system for those targets protected by the inflatable device. The comments submitted by Mercedes also stated that dynamic systems should be tested to ensure that they are fully deployed within 30 ms after triggering. Mercedes indicated that the design it was considering offered superior protection against hazards other than impacts with the interior points specified in Standard 201. Because of this superior performance, Mercedes contended that revisions to the standard requiring a 24 km/h (15 mph) FMH impact into a deployed dynamic device are more than sufficient to ensure that the goals of Standard 201 are achieved.

Volkswagen recommended that dynamic systems be tested only in the deployed mode through a 24 km/h (15 mph) FMH impact. Volkswagen also indicated its belief that system deployment should be tested through use of a rollover simulation identical to that contained in S5.3 of Standard 208 and a lateral or side impact as specified in S6.3 of Standard 301. In its comments, Volkswagen stated that to protect occupants adequately, a dynamic system should remain inflated for a period of time sufficient to represent foreseeable crash events. Testing in this manner, according to Volkswagen, would eliminate the need to test those areas protected by a dynamic system at a lower impact speed with the system undeployed. In Volkswagen's view, if a dynamic system remains deployed for a sufficient period of time to protect occupants against foreseeable impacts and a combination of rollover and lateral/side impact tests provide assurances that the system will deploy, testing in an undeployed mode is not required. In addition, Volkswagen indicated that if a dynamic system is tested through a 24 km/h (15 mph) FMH impact alone, testing at higher impact speeds is not necessary as the inflated dynamic system would then meet the performance criteria established for Standard 201 in the August 18, 1995 final rule.

Volvo's comments indicated the company's belief that dynamic systems would be used to provide occupant protection beyond the levels specified in Standard 201. In Volvo's view, these systems would require unyielding components in areas covered by Standard 201, making the dynamic systems and the existing requirements incompatible. To accommodate dynamic systems, Volvo suggested that dynamic systems be subject to a 19 km/h (12 mph) FMH impact test for affected targets with the system inactivated, a 24 km/h (15 mph) FMH impact test into the activated system and a 24 km/h (15 mph) FMH impact test for all targets not protected by the system. Volvo stated its opposition to full scale dynamic testing for compliance with Standard 201. In Volvo's view, the use of one specific test configuration would place undue emphasis on those areas likely to be involved in that single test rather than the wide number of targets specified in the standard. Volvo believes that adopting a single full scale dynamic test would provide an unfair advantage to vehicles with dynamic systems in that they would only be tested in one crash mode.

Autoliv stated that dynamic systems would offer benefits that could not be evaluated by the existing tests contained in Standard 201. However, Autoliv commented that the FMH test is a sufficient means for assessing the performance of dynamic systems and supported a test procedure in which a 19 km/h (12 mph) FMH impact is conducted against those points covered by an undeployed system with a 24 km/h (15 mph) FMH impact against a deployed system. Autoliv stated that such a test procedure should be sufficient to meet the goals of Standard 201 and that other testing at higher impact speeds would not necessarily gauge the safety benefits of dynamic systems in the variety of crash modes in which the systems would offer safety benefits.

AAMA indicated that it believed that the existing Standard 201 requirements were adequate to gauge the performance of dynamic systems and opposed additional full scale testing. AAMA believes that such testing would be burdensome and would not produce any safety benefits particularly in light of its view that, in conjunction with Standard No. 214, ''Side Impact Protection,'' Standard 201 provided for adequate protection of occupants in side impacts without the requirement of further tests. Proper testing of dynamic systems, in AAMA's view, could be accomplished through a 24 km/h (15 mph) FMH impact into a deployed system. AAMA also stated that testing at impact speeds above 24 km/h (15 mph) would be unjustified and stated its position that the challenges involved in designing

components to meet the 24 km/h (15 mph) FMH impact test are formidable.

AORC also indicated that the agency should consider the existing requirements of Standard 214 and the side impact benefits that will result from that standard when contemplating changes to Standard 201. Due to its belief that dynamic designs intended to accommodate Standard 214 would result in additional occupant head protection, AORC indicated that it did not believe additional full scale testing was required. Instead, AORC supports testing dynamic head protection systems as follows: for those points protected when the system is deployed, the points would be impacted by the FMH at 19 km/h (12 mph) with the system undeployed; and for those points unprotected when the system is deployed, the points would be impacted by the FMH at 24 km/h (15 mph). In the event that NHTSA adopted full scale tests, AORC stated that it would seem reasonable that the MDB height should be raised to address head protection problems if a side impact test with the barrier was employed. However, due to the severity of the pole test proposed in the ANPRM, AORC did not consider that the side-to-pole crash test is an appropriate tool for evaluating compliance of FMVSS No. 201.

IIHS indicated that its preeminent concern was that Standard 201 be amended to accommodate dynamic systems as soon as possible in order that the safety benefits of the systems be made available to the public. IIHS agreed with the suggestions set forth in the ANPRM and further cautioned the agency to consider all instances where compliance with Standard 201 could preclude the availability of the benefits offered by dynamic systems. In particular, IIHS stated that some dynamic systems may have difficulty meeting the requirements of Standard 201 at certain impact points both before and after deployment. In the view of IIHS, the inability to meet these criteria at these impact points should not stand as a barrier to their development and use due to the dramatic increase in protection such systems will offer in a variety of crash modes.

AHAS stated that it believed that dynamic systems offered great potential increases in occupant protection. However, in AHAS's view, the purported benefits of such systems should be gauged by testing at higher impact speeds. Accordingly, AHAS suggested that for dynamic systems appropriate target points should be tested for compliance at an impact speed of 32 km/h (20 mph). AHAS expressed concern that lowering impact speeds or excluding certain areas from testing when dynamic systems are employed could seriously erode the overall benefits offered by Standard 201. AHAS stated that the agency should establish separate but complementary standards for dynamic systems that would require them to meet the existing requirements of Standard 201 in the undeployed mode and greater requirements in the case of a deployed system. AHAS believes that such testing would avoid potential pitfalls in accepting lower impact speeds as a means of accommodating dynamic systems.

III. Analysis of Comments

The agency's review of the comments submitted by manufacturers and other interested groups revealed several areas of concern. AAMA, AORC, Ford and Volvo all voiced an opposition to the use of mandatory full scale crash tests. AHAS indicated its opposition to the abandonment or revision of existing Free Motion Headform (FMH) impact testing of vehicles that are equipped with a dynamic system. AAMA, AORC, Volvo, VW, Mercedes and Autoliv all argued that any proposed test specifying FMH impacts above 24 km/h (15 mph) would be impracticable, while AHAS stated that FMH impacts into deployed systems should be conducted at 32 km/h (20 mph). BMW supported the use of a full scale test with a 29 km/h (18 mph) side impact into a fixed pole. Volvo stated that such a full scale test would not adequately assess the performance of dynamic systems because of the limited area of impact.

AAMA indicated that any additional mandated full scale testing beyond FMVSS No. 214 would be unwarranted and unproductive since the existing tests specified in Standard 214 were sufficient to gauge performance in a side impact. AAMA's comments also stated that additional mandatory tests were unnecessary as its member companies did not consider dynamic head protection systems to be incompatible with the August 18, 1995 final rule. Ford commented that the present requirements of FMVSS Nos. 201 and 214 already provide a means of evaluating the performance of dynamic systems and, therefore, additional tests are not necessary. Volvo would not support the inclusion of any full scale dynamic tests because a specific test configuration will be of limited use in evaluating head impacts that occur in a wide range of vehicle upper interior. AORC supported the continuous review and refinement of FMVSS No. 214 combined with the use of SID dummy with the Hybrid III head/neck system as a means of measuring head injury potential.

The March 7, 1996 ANPRM sought comment on two alternatives to the upper interior impact protection requirements established in the August 1995 final rule. The first alternative, which the ANPRM indicated would be applicable to dynamically deployed padding, consisted of a 19 km/h (12 mph) FMH test prior to the deployment of the dynamic system and a 32 km/h (20 mph) FMH test after the deployment of the device. The second alternative, which the ANPRM indicated was intended for use in evaluating dynamically deployed air bags, consisted of a 19 km/h (12 mph) FMH test prior to the system deployment and a full scale side crash test employing either a 30 km/h (18.6 mph) rigid pole or a 50 km/h (31 mph) moving barrier test. In suggesting these alternatives, NHTSA intended that a manufacturer would have three choices, compliance with the requirements established in August 1995 or with one of the two alternatives. No consideration was given to the possibility of subjecting all vehicles, regardless of the presence or absence of dynamic side impact systems, to additional mandatory testing.

In response to concerns raised by AAMA and Ford that additional crash testing would be redundant in light of the existing tests specified in Standard 214, the agency notes that while FMVSS No. 214's dynamic side crash test is excellent for evaluating the reduction of chest injury potential, it is not appropriate for assessing the head injury potential of upper interior components because the dummy's head would not, except for some rare cases, strike any vehicle interior components. In view of this, NHTSA disagrees with AAMA's and Ford's contention that FMVSS No. 214's dynamic side impact test requirements are adequate to evaluate the head protection offered by a dynamically deployed system.

Similarly, the agency also rejects AORC's suggestion that FMVSS No. 214 be upgraded to include head injury criterion. NHTSA believes that extensive modifications of FMVSS No. 214 would be required to incorporate the head injury criterion into the standard. Time constraints preclude an upgrade of Standard 214 at this time. Moreover, the agency believes that unless substantial changes were made to Standard 214, including modification of the MDB to ensure impact with the dummies' heads, the standard's test procedures are not appropriate for evaluating dummy HIC and occupant head protection. However, for reasons

explained below, the agency agrees with AORC's suggestion that the SID dummy with the Hybrid III head/neck is appropriate for assessing the protection provided by dynamically deployed systems in lateral impacts. Accordingly, NHTSA has developed a new test dummy combining the head and neck of the Hybrid III with the SID torso. The agency is preparing an NPRM to amend Part 572 to add a new subpart—subpart M—which will contain the specifications for this new dummy.

AHAS strongly opposed a complete exclusion of vehicles equipped with a dynamic system and an exclusion of targets arguably protected by dynamic systems. The agency notes that it did not propose either of these alternatives in the ANPRM and agrees that exclusion of vehicles equipped with a dynamic system from Standard 201 is not an acceptable option. However, the agency does not agree with AHAS's suggestion that dynamic systems be tested through a 32 km/h (20 mph) FMH impact into a deployed system. As noted below, the agency tentatively concludes that a 29 km/h (18 mph) FMH impact test would provide adequate protection to occupants.

NHTSA also does not agree with those commenters who indicated that testing of deployed systems be limited to FMH impacts of 24 km/h (15 mph). NHTSA believes that dynamic systems are not likely to deploy in all crash modes nor to achieve a 100 percent deployment rate in one crash mode. If FMH impact speeds were limited to 24 km/h (15 mph) into a deployed system and 19 km/h (12 mph) into an undeployed system, a vehicle equipped with a dynamic system would offer 24 km/h (15 mph) head protection in certain crashes and 19 km/h (12 mph) head protection in other crashes, depending on the sensor design. In comparison with vehicles with traditional countermeasures providing 24 km/h (15 mph) head protection in all crash scenarios, vehicles with advanced dynamic systems would not provide 24 km/h (15 mph) head protection in all the same scenarios. The result would be a net reduction in safety. This would defeat the purpose of amending Standard 201 to facilitate the efforts of manufacturers to install advanced dynamic systems.

The March 7, 1996 ANPRM suggested two full scale crash tests for evaluating head protection by dynamic systems: (1) a 30 km/h (18.6 mph) side crash test into a fixed, rigid pole of 254 millimeters (10 inches) in diameter (in combination with 19 km/h (12 mph) FMH tests prior to system deployment) and (2) a 50 km/h (31 mph) side impact test using the International Standard Organization (ISO) 10997 MDB fitted with a rigid surface (in combination with 19 km/h (12 mph) FMH tests prior to system deployment). AAMA and its member companies, apparently mistakenly believing that the ANPRM contemplated that full scale testing would be mandatory for all vehicles, opposed the use of either test and stated that no other full scale tests should be employed. Volvo also did not support inclusion of full scale dynamic tests in amended Standard 201. BMW supported alternative tests using a 19 km/h (12 mph) FMH impact into an undeployed system with certain points exempted in combination with a 29 km/h (18 mph) side impact into a fixed, rigid pole 254 millimeters (10 inches) in diameter. A EuroSid dummy or a SID dummy with a Hybrid III head and neck could be used in this test, with an upper limit of a HIC less than or equal to 1000. Under the test suggested by BMW, system deployment would be tested at a FMVSS No. 214 equivalent barrier speed of 24 km/h (15 mph).

As noted above, NHTSA believes that AAMA and its member companies misunderstood the intent of the test procedures discussed in the ANPRM. The two alternative tests outlined in the ANPRM were intended to be optional not mandatory. In demonstrating FMVSS No. 201 compliance for vehicles equipped with a dynamically deployed inflatable device, a manufacturer could choose, at its own option, to comply with either the standard 24 km/h (15 mph) FMH impact tests or with one of the two alternative tests outlined in the ANPRM.

Volvo opposed inclusion of any full scale crash tests. It argued that a specific test configuration would be of limited use in evaluating head impacts that occur in a wide range of vehicle interiors. While the agency acknowledges that employing the rigid pole test by itself would leave many areas of the vehicle untested at the higher impact speed, NHTSA has conducted a safety benefit analysis and concluded that a dynamic system that complies with the ANPRM proposed 29 km/h (18 mph) side-to-pole test would further reduce head injuries beyond the level attained by designs solely meeting the requirements of the August 18, 1995 final rule. NHTSA believes it is appropriate to propose the 29 km/h (18 mph) side-to-pole test allowing flexibility in the test procedure so that manufacturers may install, as they wish, an advanced head protection system in their vehicles.

NHTSA concurs in BMW's suggestion that a test involving a 29 km/h (18 mph) side impact of a moving vehicle into a rigid pole is appropriate for measuring the performance of certain dynamic systems. The pole test is relatively severe and, in the absence of countermeasures, results in HIC scores well above 1000. The test is also well suited to evaluate those systems that, because of the manner in which they deploy, would not be in a position to attenuate impacts occurring through the use of the FMH but would still provide protection to the heads of occupants in crashes.

However, the agency believes that the combination of SID with Hybrid III head/neck is a better dummy test device than the EuroSid dummy because of its higher biofidelity rating. The Hybrid III head and neck are used in the BioSID dummy, whose biofidelity was compared with the Eurosid and the SID by two GM researchers (Mertz and Irwin) in 1990. Using an ISO scale for determining biofidelity, these researchers determined that the biofidelity for the Hybrid III head was within the numeric range equivalent to ''good'' and the neck was ''fair.'' The EuroSid head and neck were found to have scored lower and were rated as ''marginal.''

IV. Proposed Test Procedure

After considering the comments on the ANPRM and other available information, NHTSA has decided to propose amendments to Standard 201's test procedure to allow manufacturers greater flexibility in offering dynamic systems to provide interior impact protection. Given the characteristics of these systems, which include the use of relatively stiff and hard components in areas including target points specified in the test procedure contained in the August 18, 1995 final rule, the agency has decided to propose modifications to the Standard and its test procedures so that manufacturers may, at their option, choose one of three test procedures to demonstrate compliance with this Standard. The first option, hereinafter referred to as option 1, which may be most suitable for vehicles without dynamic systems or systems that deploy from seat backs or door panels, is to perform FMH impacts at 24 km/h (15 mph) at all test points and target angles now specified in the August 1995 final rule. The second and third options, hereinafter referred to as options 2 and 3, respectively, are intended to accommodate dynamically deployed systems by employing FMH testing at a reduced impact speed at those points located directly over a stowed dynamic system and its inflation and attachment hardware. However, to ensure that these

systems offer safety benefits in the deployed mode commensurate with the reduced protection provided in the undeployed mode, both options specify testing of the deployed system at impact speeds above 24 km/h (15 mph).

Based on information contained in the comments received in response to the ANPRM and other data, NHTSA has tentatively concluded that padding and other passive countermeasures required to meet the existing Standard 201 requirements are incompatible with dynamic systems. Such dynamic systems are likely to employ either air bags, inflatable padding or other designs that remain covered inside the trim of B-Pillars, side rails or other structures until activated by a crash. Once activated, the systems will be inflated either by compressed gas or a pyrotechnic device and must deploy rapidly without interference from padding or other soft structures. These devices may also require relatively stiff components in their anchorages and inflation systems and may be relatively inflexible as stored. As such, the characteristics of these devices make compliance with the existing Standard 201 requirements difficult.

The impact of padding on air bag deployments was previously considered by NHTSA in a prior rulemaking in which the head impact protection requirements for instrument panels were amended to reduce the impact speed of test headforms from 24 km/h (15 mph) to 19 km/h (12 mph) in air bag equipped cars. In the July 18, 1990 Notice of Proposed Rulemaking proposing this change, (55 FR 29238), the agency noted that optimal deployment of top mounted air bag systems required that the air bag should not be located more than one inch below the top of the instrument panel while compliance with the 24 km/h (15 mph) head impact test mandated the use of energy absorbing material that was approximately two inches thick (55 FR 29239). In order to encourage the greater use of frontal air bags and obtain a net safety benefit, NHTSA issued a final rule on June 6, 1991 (56 FR 26036) reducing the impact speed requirements for air bag equipped cars.

In regard to the present rulemaking, comments received from Volvo and BMW indicated that meeting the 24 km/h (15 mph) FMH impact requirement set forth in the August 18, 1995 final rule would require the use of energy absorbing material at least one inch thick. In the view of these commenters, as well as Mercedes, employing padding sufficiently thick to meet the 24 km/h (15 mph) FMH impact requirement would preclude the use of inflatable systems or severely limit their effectiveness. The use of padding, in BMW's view, raises particular concerns in inflatable systems that deploy from the roof rails because such systems cannot deploy through one inch of padding. The agency agrees that compliance with the 24 km/h (15 mph) FMH impact requirement through the use of padding alone may require padding as thick as one inch and that padding this thick may interfere with the deployment of dynamic systems.

The agency has tentatively concluded that while the design and performance requirements of these systems may preclude compliance with Standard 201 at an impact speed of 24 km/h (15 mph), they may be designed to provide adequate protection against impact in the undeployed mode at an impact speed of 19 km/h (12 mph). NHTSA estimates that where padding would be required to provide adequate protection in a 19 km/h (12 mph) impact would not be thicker than one-half inch. The agency calculates that this impact speed would accommodate development of dynamic systems because the 19 km/h (12 mph) impact would not place a significant additional burden in terms of padding or other measures. An analysis of the effect of different padding thicknesses on existing passenger cars and LTVs contained in the agency's June 1995 Final Economic Assessment (FEA), FMVSS No. 201, Upper Interior Head Protection, determined that all of the sampled passenger cars and LTVs could meet the 19 km/h (12 mph) impact speed with one-half inch of additional padding on the A-pillars, side rails and B-pillars. As the vehicles examined by the agency and designed prior to the August 1995 amendments to Standard 201 would require additional padding of a half inch or less to provide adequate protection in a 19 km/h (12 mph) FMH impact, NHTSA believes that the 19 km/h (12 mph) impact speed would not present obstacles to the development and employment of dynamic systems.

One procedure, option 2, would use the existing FMH to simulate an occupant's head striking the interior of the vehicle in a crash. In this test, the headform would be propelled into specified targets within the vehicle at differing impact speeds. For those points that are not directly over a dynamic system or its attachment or inflation hardware, the specified impact speed would be 24 km/h (15 mph). For points directly over an undeployed dynamic system (including attachment points and inflation mechanisms), the headform would be propelled at the target at 19 km/h (12 mph) with the system in the undeployed mode and 29 km/h (18 mph) with the system deployed. In order to assure deployment of the system, the triggering mechanism would be tested through use of the lateral crash test contained in S6.12 of Standard 214. The agency is proposing that once triggered, the system would have to reach full deployment in 30 milliseconds (ms) or less.

The other optional test procedure now being proposed, option 3, employs a full scale side impact at 29 km/h (18 mph) into a fixed pole. In this test, any test points or targets inside the vehicle that do not intersect with a line oriented along any of the approach angles described in S8.13.4 and passing through an undeployed dynamic system or any of its components (excluding trim) would be subjected to a 24 km/h (15 mph) FMH impact at the target angles and conditions now contained in the Standard. For those targets that intersect with a line oriented along any of the approach angles described in S8.13.4 and passing through an undeployed dynamic system or any of its components (excluding trim), FMH impacts at a speed of 19 km/h (12 mph) would be employed to test the system in its undeployed condition. To test the effectiveness of the dynamic system in the deployed mode, a full scale 29 km/h (18 mph) side impact into a fixed rigid pole would be used. The point of impact would be aligned with the center of gravity of the head of a dummy seated in a designated front outboard seating position on the struck side. Initially, the seat would be positioned as directed in S6.3 and S6.4 of Standard 214 and the dummy located as directed in S7 of Standard 214. If this positions the dummy such that the point at the intersection of the rear surface of its head and a horizontal line parallel to the longitudinal centerline of the vehicle passing through the head's center of gravity is at least 50 mm (2 inches) forward of the front edge of the B-pillar at that same horizontal location, then the dummy is tested in this position. If not, the seat back angle is to be adjusted, a maximum of 5 degrees, until the 50 mm (2 inches) B-pillar clearance is achieved. If this is not sufficient to produce the desired clearance, the seat is to be moved forward to achieve that result. The agency recognizes that these modifications to the Standard 214 seating procedure will likely make it necessary to adjust other specifications of that procedure, such as the allowable pelvic angle range, the target H-point location, and lower extremity positions.

The agency asks for comments regarding seating procedure issues.

This pole test is nearly identical to the proposed ISO test procedure found in the ISO/TC22/SC10/WG3 draft ISO Technical Report *Road Vehicles, Test Procedure for Evaluating Various Occupant Interactions with Deploying Side Impact Air Bags* (February 9, 1995). The seating procedure for the pole test was designed to adhere to the extent possible to the proposed ISO test procedure which states to ''Seat the dummy so that its head is sufficiently within the front window opening that the striking pole is unlikely to contact the A- or B-pillar''. NHTSA notes that use of this test furthers the goal of international harmonization of standards and test procedures.

In order to accurately gauge the performance of the system in protecting the head, neck and torso, the test dummy would be a SID dummy modified to accept the Hybrid III head and neck. As is the case with the first and second options, the HIC value would not exceed 1000. In the proposed test, the one dummy would be placed in the front outboard seat of the struck side of the vehicle. However, the agency is continuing to consider the use of a second dummy in the rear outboard seating position of the struck side.

The March 7, 1996 ANPRM contained a suggestion that dynamically deployed devices be tested by the use of a side impact test employing a Moving Deformable Barrier (MDB). The proposed MDB test consisted of a 50 km/h (31 mph) lateral impact by an ISO #10997 MDB not less than 1270 mm (50 inches) high. However, even with the use of an MDB of sufficient height to simulate a high hooded striking vehicle, the resulting changes in velocity to the head and HIC scores are insufficient to assure real benefits from the use of dynamically deployed systems. While the use of this test was supported by AORC, the agency is not proposing this test.

NHTSA made this decision based on examination of crash test data submitted by BMW in which a 90 degree lateral moving barrier crash test using the MDB employed in Standard 301 testing produced HIC scores far below 1000. The agency then calculated that increasing the impact speed from 32 km/h (20 mph) to 48 km/h (30 mph) would not result in appreciable increases in HIC scores. Based on the data described above, NHTSA tentatively concludes that the MDB test would not be severe enough to promote safety. Accordingly, NHTSA has dropped consideration of this test.

The agency also examined the possibility of using the Standard 214 test procedure to evaluate dynamically deployed systems. Since manufacturers are already conducting Standard 214 tests, the testing of dynamically deployed systems could, theoretically, be pursued simultaneously through the use of a SID dummy with a Hybrid III head/neck. The agency examined several series of crash tests conducted pursuant to Standard 214. As is the case with testing using the MDB, examination of the data from Standard 214 testing indicates that these tests do not produce changes in head velocity sufficient to gauge the performance of systems intended to provide head protection in interior impacts. As the greatest loads experienced in Standard 214 testing are applied to the torso, contacts between the head and the vehicle interior or other structures are rare. In addition, test dummies are secured in the vehicle by belts during testing. HIC scores near or above 1000 occur only when the head strikes the MDB, which NHTSA believes to occur in eighteen percent of the Standard 214 type tests. Therefore, NHTSA tentatively concludes that using a Standard 214 test with the standard barrier height would not be appropriate.

Alternatively, as an attempt to adapt the Standard 214 test for use in evaluating head protection, another approach would be to conduct a lateral impact test with the Standard 214 MDB with a modified rigid face. The barrier face would be high enough to intrude into the upper interior parts of the greenhouse. However, even though head contact with the vehicle interior or barrier would occur, the agency calculates that the resulting HIC scores, in the absence of countermeasures, would be in the range of 225–300 for the driver and 250–325 for a rear seat passenger. Therefore, the head impacts and resulting HIC scores would be too moderate to promote improvements in head protection. The agency also considered employing a test using the FMVSS No. 301 ''Fuel System Integrity'' barrier at 32 km/h (20 mph) or 48 km/h (30 mph) to achieve higher lateral kinetic energy levels. While such a test would be more severe than the test specified in Standard 214, the agency has tentatively concluded that this approach also would not promote the introduction of highly efficient and effective dynamically deployed systems.

In addition to considering use of moving deformable barrier tests, NHTSA also examined the possibility of using a moving pole rather than a barrier to impact a stationary test vehicle. While such a test would be more severe than those involving a moving barrier, the agency has decided not to propose this test. When the test vehicle is propelled into a stationary pole, the vehicle will be free to interact dynamically with the pole and the resulting motion of the head and thorax are more likely to represent conditions encountered in actual crashes. While NHTSA is aware that a car-to-pole test procedure poses certain technical challenges, the agency believes that these are simpler to resolve in the short term compared to those involved in a moving pole test.

A. Option 2: Testing Deployed Dynamic Systems in FMH Impacts

1. Impact Speed

In order to assure that the goals of Standard 201 are not compromised by the proposed amendments, dynamic systems tested under this option would be subjected to 19 km/h (12 mph) FMH impacts in the undeployed state at target points directly over an undeployed dynamic system (including attachment points and inflation mechanisms), and a 29 km/h (18 mph) FMH impact into the same target points with the system deployed. While none of the manufacturers or suppliers who provided comments in response to the ANPRM supported the use of impact speeds above 24 km/h (15 mph) for testing of a deployed dynamic system, NHTSA believes that such an impact speed would result in a net increase in safety and would not place an undue burden on manufacturers. The agency notes that the selection of this impact speed provides important assurances that vehicles equipped with dynamic systems would, with the systems deployed, provide safety benefits commensurate with the decrease in the level of impact protection provided in less severe crashes where the dynamic system might not deploy.

2. System Deployment

As proposed, testing under option 2 would require FMH impacts into a deployed dynamic system. In order to ensure that dynamic systems would deploy in the event of a side impact, the agency is proposing that manufacturers choosing this option must also test the sensor and inflation system to determine that it will function in the event of a side impact. The agency is proposing that the lateral barrier test set forth in S6.12 of FMVSS No. 214, ''Side Impact Protection'' provides appropriate conditions for the testing of the triggering and inflation systems for dynamic head protection devices. Accordingly, NHTSA proposes that,

under option 2, manufacturers must test the triggering and inflation systems of dynamic head protection systems as part of testing conducted for certification to Standard 214. The agency notes that this test would not measure the performance of dynamic systems intended to provide head protection in frontal or rearward impacts and solicits comments on what test procedures, including those now contained in Standard 208 and Standard 301, might be used for this purpose.

As this proposed test would not actually measure the performance of dynamic head protection systems in protecting against impacts, the agency is also proposing that the system must reach full deployment within 30 milliseconds of the initial contact with the barrier. NHTSA believes that this time period is sufficiently brief to ensure that systems will deploy fully before they are contacted by occupants in a side impact but requests comments on this issue. The agency also requests comments on what means may be used to determine if a system has reached full deployment.

The agency is also aware that future dynamic head protection systems may be designed to provide protection to occupants in front and rear impacts. NHTSA solicits comments on what tests would be appropriate for evaluating deployment of such systems.

3. Target Angles

NHTSA is proposing that testing conducted under option 2, with the exception of the differing impact speeds for deployed and undeployed systems for target points where a deployed system would be interposed between the FMH and the target point, be identical to testing conducted under option 1. Under this proposal, the target angles now specified in the Standard would be used for testing under option 2, and for 19 km/h (12 mph) FMH impact testing under option 3. The agency believes that the use of these target angles is appropriate for both deployed and undeployed devices, but solicits comments on the question of whether the design of particular dynamic systems, i.e., inflatable padding (or larger side air bags), would require modifications to the existing target angles.

B. Option 3—Testing Deployed Dynamic Systems in Full Scale 29 km/h (18 mph) Side Impact Into Fixed Pole

NHTSA recognizes that some dynamic head protection systems now under consideration may deploy from the roof rail in a downward direction and interpose themselves between an occupant's head and the window opening. As these systems would provide head protection by preventing or cushioning impacts between the head or upper torso and the vehicle interior in side impacts without necessarily having any effect on the FMH impacts specified in the August 18, 1995 final rule, testing either under that standard or the proposed option 2 would preclude employment of these designs. However, preliminary reviews of the performance of these systems in testing reveals that they may offer significant safety benefits. In an effort to provide maximum flexibility to manufacturers in developing dynamic head protection systems, the agency is proposing to offer manufacturers the option of demonstrating compliance with Standard 201 through an optional test procedure combining the existing 24 km/h (15 mph) FMH impact, a 19 km/h (12 mph) FMH impact in the undeployed mode for points directly over an undeployed dynamic system (including attachment and inflation mechanisms) and a full scale side impact test with a 29 km/h (18 mph) side impact into a 254 mm (10 inch) rigid pole. In the latter test, the subject vehicle would be propelled into the pole so that the pole would impact at the center of gravity of the head of a seated dummy positioned on the designated front outboard seating position of the struck side. Since the FMH cannot be used for evaluating HIC in such an impact and the Hybrid III head and neck assembly appears to be the most biofidelic test device currently available, the agency is also proposing that the Hybrid III head and neck be used with the existing SID dummy for this test.

Although the agency is considering the use of test dummies in both front and rear outboard seating positions in the pole test, it is currently proposing that a dummy be positioned in the front seat alone. NHTSA believes that a single dummy will be adequate to measure the effectiveness of dynamic systems in the pole test. Nonetheless, the agency is concerned that certain systems may only protect front seat occupants. This concern becomes heightened by the possibility that some designs may be, in the undeployed mode, located under target points that may be encountered by a rear seat occupant in a crash. As these target points would only be required to provide protection against a 19 km/h (12 mph) FMH impact, rear seat occupants who are not protected by the deployed system may encounter an increased risk of injury. The agency requests comments on the capability of dynamic systems to provide protection to rear seat occupants as well as the efficacy and consequences of placing an instrumented dummy in the rear outboard position on the struck side for the pole test.

In the March 7, 1996 ANPRM, the agency indicated that it was considering proposing the use of either a Moving Deformable Barrier (MDB) impact test with an impact speed of 50 km/h (31 mph) or a 30 km/h (18.6 mph) pole test as one of the options for testing dynamic head protection systems. After reviewing the comments received in response to the ANPRM and other available data indicating that the use of the MDB would not result in impacts severe enough to assess head protection, the agency is now proposing adoption of the pole test. The agency believes that the pole test is a more appropriate choice. Crash data reveals that serious to fatal injuries in side impacts are most likely to involve the head, chest and abdomen. These data also reveal that while vehicle-to-vehicle impacts, those simulated by MDB impacts, represent over 80 percent of side impact crashes with serious to fatal injuries, the much smaller percentage of impacts with narrow objects result in a disproportionately high rate of fatalities and injuries. These impacts with narrow objects, which are represented by the pole test, also present a serious safety concern. Use of the pole test, which simulates head impacts found in accident scenarios that cannot be reproduced using the MDB, provides a means for evaluating head protection systems and, in conjunction with the requirements of Standard 214, would promote a higher level of safety in side impacts. Accordingly, the agency has decided to propose under Option 3 that a 19 km/h (12 mph) FMH impact test for those points directly over an undeployed system and 29 km/h (18 mph) pole test be employed rather than the 50 km/h (31 mph) barrier test.

NHTSA notes that under option 3, manufacturers choosing to employ dynamic systems whose components are not stored in roof rails or other areas covered by Standard 201 would be required to meet the 24 km/h (15 mph) FMH impact test even though such a system, in its deployed state, may provide head protection against impact with the target points specified in this standard. The agency, therefore, requests comments on whether a dynamic system which, when deployed and observed in a side view, completely covers the 95th percentile ellipse as defined in SAE Recommended Practice J941—Motor Vehicle Driver's Eye Locations (June 92) would provide

protection against impacts with targets on the A-pillar, B-pillar and side rails.

1. Impact Speed

NHTSA believes that a 29 km/h (18 mph) impact speed is appropriate for the pole test. The agency notes that existing test data indicate that impacts into a rigid pole aligned with the center of gravity of the dummy's head will, in vehicles without dynamic systems, result in severe impacts with interior structures and/or the pole itself resulting in HIC values equivalent to fatal or near fatal injury. While this test is a severe test, review of test data from prototype dynamic systems indicates that these systems have the capability to provide sufficient protection to the head so that the HIC score resulting from such an impact is at or near the current standard. In the agency's view, the severity of this test and the anticipated safety benefit of systems that meet it, are such that any decrease in safety benefits resulting from the specification of a 19 km/h (12 mph) FMH impact instead of a 24 km/h (15 mph) FMH impact into the undeployed system would be offset by the reduction of severe or fatal injury in higher speed impacts where the deployed system would provide superior protection, particularly in collisions with narrow fixed objects.

2. Rigid Pole

The agency is proposing that the rigid pole shall be a vertically oriented metal structure beginning no more than 102 millimeters (4 inches) off the ground and extending to a minimum height of 2032 millimeters (80 inches). The pole would be 254 millimeters (10 inches) in diameter and mounted so that no part of its supporting structure would contact the test vehicle at any time after the vehicle's initial contact with the pole.

3. Impact Angle

The agency is currently proposing that the striking vehicle would strike the pole at an angle of 90 degrees. However, crash data indicates that impacts within the range of 30 to 60 degrees may be more representative of actual impacts. NHTSA therefore solicits comments on whether such impact angles would result in a test procedure better suited for evaluating performance in a crash. The agency is also concerned that the use of angles smaller than 90 degrees may present technical challenges in testing and solicits comments on this issue as well.

4. Propulsion System

NHTSA is not proposing to specify the manner in which a vehicle is propelled into the pole. As outlined in the PRE, the agency has examined a variety of test configurations for moving test vehicles sideways into the rigid pole, including mounting the vehicle on a test cart or employing low friction pads under the test vehicle's tires, and believes that such a test can be performed with sufficient accuracy, repeatability and reproducibility. Nonetheless, the agency has concerns about the effects of differing means of propelling test vehicles sideways while controlling pitch, yaw and roll and solicits comments on overcoming friction and controlling vehicle attitudes while conducting the proposed option 3 test.

5. Impact Point

The agency is proposing that the impact specified in option 3 occurs with the center line of the rigid pole aligned with the impact reference line on the struck side of the vehicle, passing through, in the lateral direction, the center of gravity of the head of the dummy located in the front outboard seating position. This dummy, and the vehicle seat, would be positioned in accordance with the procedures specified in Standard 214, if this positions the dummy's head such that the point at the intersection of the rear surface of its head and a horizontal line parallel to the longitudinal centerline of the vehicle passing through the head's center of gravity is at least 50 mm (2 inches) forward of the front edge of the B-pillar at that same horizontal location. If not, the seat back angle is to be adjusted, a maximum of 5 degrees, until the 50 mm (2 inches) B-pillar clearance is achieved. If this is not sufficient to produce the desired clearance, the seat is to be moved forward to achieve that result. The initial pole-to-vehicle contact must occur within an area bounded by two transverse vertical planes located 38 mm (1.5 inches) forward and aft of the impact reference line. NHTSA notes that experience in conducting this type of test is, compared to Standard 214 tests, somewhat limited. Based on its knowledge gained in conducting Standard 214 tests, the agency believes that a tolerance of +/-38 mm (1.5 inches) is sufficient for the pole test. The agency requests comments on the degree of difficulty of achieving an impact within the ranges specified above and the feasibility of using the existing-Standard 214 seat positioning and dummy seating procedures and/or the proposed modifications to those procedures.

6. SID/H3 Test Dummy

NHTSA is proposing specifications and qualification requirements for the SID/H3 dummy, which would be set forth in subpart M of part 572. The specifications consist of a drawing package containing all of the technical details of the redesigned neck bracket. NHTSA believes that these drawings and specifications would ensure that the resulting SID/H3 dummies vary little in their construction. Performance criteria would serve as calibration checks and further assure the uniformity of dummy assembly, construction, and instrumentation. As a result, the repeatability of performance in impact testing would be ensured.

The SID/H3 combination was developed as part of NHTSA's research program, and is essentially a Hybrid III dummy head and neck mounted to a modified SID torso. The modifications include replacing the existing SID neck bracket with a new neck bracket. Without this modification, the use of the Hybrid III head and neck with the SID torso results in a head center of gravity that is 38 mm (1.5 inches) higher than that of the SID head mounted on the SID torso. In order to retain the same neck alignment and head profile as the existing SID, the new neck bracket, when used to mount the Hybrid III head and neck, results in the CG of the Hybrid III head being 19 mm (0.75 inches) higher than the CG of the SID head when mounted on the SID torso. In addition, adoption of the Hybrid III neck component and the new neck bracket would add a negligible amount of weight, 0.59 kilograms (1.3 pounds), to the SID dummy. NHTSA believes that the resulting head CG height and neck weight would not pose any obstacle to the use of the SID/H3 dummy because the new dummy seating height is nearly identical to that of the SID and the weight is still less than that of the Hybrid III. The Hybrid III head is instrumented with a tri-axial accelerometer package, positioned to measure the acceleration of the center of gravity. This permits the measurement of HIC.

The agency believes that this SID/H3 combination, which joins proven components of existing dummies through the use of a redesigned neck bracket, is the best configuration currently available for evaluating head and neck behavior in side impacts.

7. Biofidelity

Biofidelity is a measure of how well a test device duplicates the responses of a human being in an impact. The Hybrid III dummy is specified in Standard No. 208. Its biofidelity in frontal impacts is well accepted, particularly for forehead impacts. SID, or the Side Impact Dummy, is specified for use in Standard

214. Its biofidelity in assessing damage to the thorax and pelvis in side impacts is also well accepted. Therefore, NHTSA's concern, in developing a component test using the SID/H3 combination, was whether the Hybrid III head and neck responses for lateral acceleration could provide a valid basis for the evaluation of human injury in such impacts.

The agency notes that the biofidelity of the Hybrid III head and neck in lateral impacts has been evaluated by the international biomechanics community, as well as by NHTSA. NHTSA conducted a review of research in which the Hybrid III head and neck were subjected to head drop and neck pendulum tests. The results and methodology of this drop testing were compared with data obtained on head impact tests performed on cadavers. A comparison of the relationship between acceleration and HIC scores for both the cadavers and the Hybrid III head indicates that the lateral impact responses of the Hybrid III head is representative of human cadavers up to HIC scores of 2500. Since lateral impacts with dynamic head protection systems or other interior components are likely to produce accelerations and HIC scores within this range, the agency has concluded the Hybrid III head may be used to assess these impacts. The biofidelity rating for the Hybrid III head and neck and the SID torso, based on existing data, is far beyond the minimum acceptable level for side impact evaluation.

8. Repeatability and Reproducibility

NHTSA has evaluated the repeatability and reproducibility of the proposed test procedure, with particular focus on the HIC responses. Repeatability refers in this context to the control of variation of SID/H3 responses in replicate tests using the same dummy, while reproducibility refers to control of variation of SID/H3 responses in replicate tests using different dummies.

The agency considers +/−10 percent to be an acceptable range of variability and a measure of good repeatability or reproducibility, while +/−5 percent is considered to be highly acceptable variability and an indicator of excellent repeatability or reproducibility.

As a starting point, the agency notes that it has previously determined that the Hybrid III head, as a component of the full Hybrid III dummy, has highly acceptable variability or excellent repeatability and reproducibility in frontal crashes. NHTSA also notes that the biofidelity of the Hybrid III head and neck in lateral impact was examined in a series of head drop tests and head/neck assembly pendulum impact tests by two GM researchers in 1990. In addition to examination of the GM tests, NHTSA conducted a series of drop tests on the Hybrid III head and pendulum tests on the Hybrid III head and neck assembly. These tests were designed to provide a controlled impact environment so that any variability was limited to the Hybrid III components and the test procedure.

The agency found that the average percent variation for peak head resultant acceleration for the Hybrid III head in lateral drop tests is highly acceptable. The degree of variation encountered indicated that repeatability and reproducibility for the tests were excellent. Lateral pendulum impact tests on the head/neck assembly indicated that the average percent variation for occipital moment was excellent for both repeatability and reproducibility. The average percent variation for neck rotation was excellent for repeatability and good (nearly excellent) for reproducibility. In addition, the SID/H3 combination was tested through a series of 29 km/h (18 mph) sled lateral impact tests. Two vertical, rigid plates were mounted perpendicular to the direction of motion of the sled, at the head and the torso heights, respectively. During the test, the head and the torso would impact the plates. Two test series, each with three tests, were conducted using a SID/H3 dummy with the standard or the new neck brackets. The test results show nearly the same average HIC values (within 4 percent) and the average percent variations indicating that repeatability for HIC is excellent.

Based on the above tests and analyses, which are described in more detail in the PRE, NHTSA has tentatively concluded that the repeatability and reproducibility of the proposed SID/H3 are sufficient for this rulemaking.

V. Performance Requirements

In this rulemaking, NHTSA is proposing to require passenger cars and LTVs not to exceed specified HIC(d) limits when any of the specified upper interior components are impacted by the FMH in accordance with the specified test procedure or specified HIC limits when SID/H3 dummies are employed in the side impact crash test outlined in option 3. As indicated in the present version of Standard 201, HIC(d) is calculated when using the FMH and represents the HIC that would be experienced by a full dummy or actual vehicle occupant.

The agency is proposing a single, across-the-board limit of HIC(d) 1000 for all specific upper interior components whether protected by a dynamic system or not and regardless of whether the system is deployed or undeployed. When testing of a dynamic system is undertaken under option 3, involving the full side impact pole test and a SID/H3 dummy, the upper limit would also be a HIC(d) of 1000.

VI. Costs

Evaluation of costs associated with this proposed rule is conditioned by several factors. The proposed amendments would not impose any new performance requirements. Instead, these changes are being instituted to enable vehicle manufacturers to use innovative technologies to further occupant protection. Only those manufacturers deciding to install those technologies would be subject to the new requirements. Since no new requirements are included in the proposal, the costs incurred would be compliance test costs and expenses rather than vehicle costs relating to the design and implementation of safety countermeasures. Since the proposed optional test procedures are still under development, a complete accounting of test costs cannot be produced at this time.

The compliance costs for the proposed option 1 would be the same as those for the August 1995 final rule. Compliance costs for the proposed option 2 test would only be slightly higher due to the additional requirement of testing system deployment through employment of the Standard 214 lateral moving barrier crash test. Assuming that a Standard 214 lateral crash test was performed solely for the purpose of testing system deployment, NHTSA estimates that each test would cost approximately $10,000, plus the cost of the test vehicle.

The agency believes that proposed test option 3 would require the greatest expenditure among all the test options. NHTSA estimates that the pole test would cost in the range of $10,000 to $13,000 (excluding the cost of the test vehicle) with an additional $1,750 for calibration tests for the head, neck, lumbar spine, thorax, and pelvis. The cost of fabricating a new neck bracket for joining the Hybrid III head to the SID torso is estimated to be approximately $200 to $300. Due to the use of existing SID torsos, Hybrid III head/neck hardware and standard laboratory calibration equipment, NHTSA believes that there would be little or no extra costs for the pole test beyond the test itself. The severity of the pole test would not create a need for more rib replacements than currently

experienced in side crash testing. Further, most, if not all, crash test facilities have a fixed frontal barrier with a pole crash test hardware that can be installed as an option. Pole tests using both fixed and moving poles have been conducted by manufacturers for research and development purposes for 30 years. Some of the roll, pitch and yaw specifications (to be determined), needed to control the relationship of the pole centerline to head CG, may add cost to the existing Tow cable and rail systems. For example, a pair of above ground stabilization rails and trollies may cost an added $15,000 to $20,000 per facility to build, fabricate and install. Roll, pitch and yaw instrumentation may be needed to measure compliance with the test procedure boundaries.

VII. Benefits

NHTSA's analysis of benefits is presented in the PRE. This analysis is necessarily incomplete due to the fact that the design, research and development of dynamic head protection systems is still in its infancy. Nonetheless, the agency was able to provide a benefits estimate through the use of prior analyses prepared for the existing version of Standard 201 and test data provided by BMW obtained from testing of the Inflatable Tubular System (ITS). Estimates of the effectiveness of the ITS system were applied to a baseline HIC distribution prepared for the August 1995 final rule. Use of this analysis indicated that if systems whose effectiveness was equivalent to the BMW ITS were employed in the existing passenger car and light truck fleet there would be 572–655 fewer fatalities and 640–990 fewer moderate to critical nonfatal injuries each year.

NHTSA also recognizes that the proposed modifications to Standard 201 might also increase the risk of injury in lower speed crashes. As noted above, those manufacturers availing themselves of option 2 to test dynamic systems would perform FMH impact tests at 19 km/h (12 mph) into an undeployed system and 29 km/h (18 mph) into a deployed system. The agency calculates that reducing the impact speed for the FMH under options 2 and 3 to 19 km/h (12 mph) from the 24 km/h (15 mph) impact used under the August 18, 1995 final rule would result in 1075 more MAIS 1–3 injuries. However, increasing the impact speed from 24 to 29 km/h (18 mph) when the FMH is impacted into a deployed system would, in NHTSA's estimation (using the Mertz-Prasad method), result in systems that would prevent 119 fatalities and 125 MAIS 4 and 5 injuries. (Calculations using the Lognormal method show an increase of 1,273 MAIS 1 injuries but 311 fewer fatalities as well as 512 fewer MAIS 2–5 injuries).

Since NHTSA is not proposing to mandate systems meeting either option 2 or option 3 (such as the BMW ITS), it is difficult to predict which manufacturers would choose to install dynamic systems and what the effectiveness of each system would be. The agency's preliminary analysis, however, makes it clear that these systems would reduce fatal and near fatal injuries.

VIII. Effective Date

The agency is proposing that the final rule become effective 30 days after it is published. NHTSA is proposing that the final rule's effective date be less than 180 days after publication in an effort to facilitate the early introduction of dynamic systems that may be in an advanced stage of development or actually in production. As production of vehicles with dynamic systems may begin prior to the effective date of the final rule, NHTSA will allow manufacturers of such vehicles to include them in their calculation of complying vehicles under S6.1.5 if such vehicles meet the requirements of S6.1(b) or S6.1(c) as promulgated in the final rule.

IX. Risk of Injury

In the request for comments contained in the March 7, 1996 ANPRM, the agency requested information on the potential, if any, for increased neck injury as the result of the deployment of dynamic head protection systems. Commenters responding to this inquiry indicated either that there was insufficient information to address this concern or, in the case of Mercedes and BMW, preliminary evaluations of dynamic systems indicated that they did not increase stress on the neck. NHTSA has not performed any significant research or testing on this issue. Therefore, the agency requests comments on the issue of whether the use of dynamic head protection systems would increase neck loads and potential injuries in a crash.

The agency is also concerned that the use of dynamic head protection systems such as inflatable padding, side air bags or similar systems that deploy across window openings, might pose other risks to occupants. One concern is that the use of pyrotechnic inflators, and to a lesser extent compressed gas inflators, may be a source of auditory pain or injury. NHTSA notes that dynamic head protection devices may require placement of inflators in relatively close proximity to the ears of vehicle occupants. In addition, deployment of the dynamic systems themselves may have the potential for exposing the ear to noise and pressure, particularly if the occupants are out-of-position. The agency solicits comments on the issue of whether dynamic systems have the potential to cause injury to the ear and auditory system of occupants.

Unlike conventional air bag systems designed to protect occupants in frontal crashes, side impact air bags and dynamic head protection systems are in a comparatively early stage of development. In addition, the agency anticipates that these systems may exist in a variety of configurations, each offering specific advantages and disadvantages. Under these conditions, NHTSA recognizes that knowledge of the characteristics of dynamic systems may be limited. Nonetheless, the agency is concerned that dynamic systems may have the potential to cause injury to particular classes of vehicle occupants, particularly those who are unrestrained and out of position at the time of deployment. The agency solicits comments regarding the possibility of increased injury, if any, posed to occupants by dynamic systems including unrestrained occupants, occupants small in size or weight and children secured in child seats and infant carriers.

This proposed rule would not have any retroactive effect. Under section 103(d) of the National Traffic and Motor Vehicle Safety Act (Safety Act; 15 U.S.C. 1392(d)), whenever a Federal motor vehicle safety standard is in effect, a State may not adopt or maintain a safety standard applicable to the same aspect of performance which is not identical to the Federal standard, except to the extent that the State requirement imposes a higher level of performance and applies only to vehicles procured for the State's use. Section 105 of the Safety Act (15 U.S.C. 1394) sets forth a procedure for judicial review of final rules establishing, amending or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court.

X. Rulemaking Analyses and Notices

A. Executive Order 12866 and DOT Regulatory Policies and Procedures

NHTSA has considered the impact of this rulemaking action under E.O. 12866 and the Department of Transportation's regulatory policies and procedures. This

rulemaking document was reviewed under E.O. 12866, ''Regulatory Planning and Review'' and is considered significant under the Department of Transportation's regulatory policies and procedures.

The agency has prepared a Preliminary Regulatory Evaluation describing the economic and other effects of this rulemaking action. Summary discussions of many of those effects are provided above. For persons wishing to examine the full analysis, a copy is being placed in the docket.

B. Regulatory Flexibility Act

NHTSA has also considered the effects of this rulemaking action under the Regulatory Flexibility Act. I hereby certify that it would not have a significant economic impact on a substantial number of small entities. The cost of new passenger cars or light trucks would not be affected by the proposed amendment. The proposed amendment would primarily affect passenger car and light truck manufacturers which are not small entities under 5 U.S.C. 605(b). The Small Business Administration's regulations at 13 CFR Part 121 define a small business, in part, as a business entity ''which operates primarily within the United States.'' (13 CFR § 121.105(a)).

The agency estimates that there are at most five small manufacturers of passenger cars in the U.S., producing a combined total of at most 500 cars each year. The agency does not believe small businesses manufacture even 0.1 percent of total U.S. passenger car and light truck production each year. The primary cost effect of the proposed requirements would be on manufacturers of passenger cars and LTVs. Final stage manufacturers are generally small businesses. However, NHTSA believes that the proposed requirements would not be burdensome for final stage manufacturers. The amendments proposed in this rulemaking do not impose any additional mandatory requirements on manufacturers or final stage manufacturers but rather provide these manufacturers with a means for evaluating advanced dynamic head protection systems should they choose to install such systems. Further, since two of the options the agency is proposing are component tests, a final stage manufacturer could test, or could sponsor a test, of a padded component or dynamic system outside of the vehicle on a test fixture, to the extent such testing may be needed to support certification. Manufacturer associations could also sponsor generic tests to determine the amount and type of padding or design of dynamic system needed for basic structures that would be used by a number of final stage manufacturers, to reduce certification costs.

Other entities which would qualify as small businesses, small organizations and governmental units would be affected by this rule to the extent that they purchase passenger cars and LTVs. They would not be significantly affected, since the potential cost increases associated with this action should only slightly affect the purchase price of new motor vehicles. Accordingly, the agency has not prepared a preliminary regulatory flexibility analysis.

C. National Environmental Policy Act

NHTSA has analyzed this rulemaking action for the purposes of the National Environmental Policy Act. The agency has determined that implementation of this action would not have any significant impact on the quality of the human environment.

D. Executive Order 12612 (Federalism) and Unfunded Mandates Act

The agency has analyzed this rulemaking action in accordance with the principles and criteria set forth in Executive Order 12612. NHTSA has determined that the amendment does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

In issuing this proposal to permit optional testing to accommodate dynamic head protections systems, the agency notes, for the purposes of the Unfunded Mandates Act, that it is pursuing the least cost alternative. As noted above, any manufacturer may choose one of three options to test for compliance with Standard 201, including the test procedure established in the August 18, 1995 final rule. As this rulemaking does not require manufacturers to meet new minimum performance requirements but sets minimum performance criteria for optional systems, it does not impose new costs.

E. Civil Justice Reform

This proposed amendment does not have any retroactive effect. Under 49 U.S.C. 21403, whenever a Federal motor vehicle safety standard is in effect, a State may not adopt or maintain a safety standard applicable to the same aspect of performance which is not identical to the Federal standard, except to the extent that the state requirement imposes a higher level of performance and applies only to vehicles procured for the State's use. 49 U.S.C. 21461 sets forth a procedure for judicial review of final rules establishing, amending or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court.

XI. Submission of Comments

Interested persons are invited to submit comments on the proposal. It is requested but not required that 10 copies be submitted.

All comments must not exceed 15 pages in length. (49 CFR 553.21). Necessary attachments may be appended to these submissions without regard to the 15-page limit. This limitation is intended to encourage commenters to detail their primary arguments in a concise fashion.

If a commenter wishes to submit certain information under a claim of confidentiality, three copies of the complete submission, including purportedly confidential business information, should be submitted to the Chief Counsel, NHTSA, at the street address given above, and seven copies from which the purportedly confidential information has been deleted should be submitted to the Docket Section. A request for confidentiality should be accompanied by a cover letter setting forth the information specified in the agency's confidential business information regulation. 49 CFR part 512.

All comments received before the close of business on the comment closing date indicated above for the proposal will be considered, and will be available for examination in the docket at the above address both before and after that date. To the extent possible, comments filed after the closing date will also be considered. Comments received too late for consideration in regard to the final rule will be considered as suggestions for further rulemaking action. Comments on the proposal will be available for inspection in the docket. The NHTSA will continue to file relevant information as it becomes available in the docket after the closing date, and it is recommended that interested persons continue to examine the docket for new material.

Those persons desiring to be notified upon receipt of their comments in the rules docket should enclose a self-addressed, stamped postcard in the envelope with their comments. Upon receiving the comments, the docket supervisor will return the postcard by mail.

List of Subjects in 49 CFR Part 571

Imports, Motor vehicle safety, Motor vehicles, Rubber and rubber products, Tires.

In consideration of the foregoing, 49 CFR part 571 would be amended as follows:

PART 571.201—[AMENDED]

1. The authority citation for part 571 would continue to read as follows:

Authority: 49 U.S.C. 322, 21411, 21415, 21417, and 21466; delegation of authority at 49 CFR 1.50.

§ 571.201 [Amended]

2. Section 571.201 would be amended by adding a definition of *Dynamically deployed interior protection system* to S3, revising S6.1, S6.2 and S7, and by adding S8.13.3 and S8.16 through S8.28 as follows:

S3. Definitions

* * * * *

Dynamically deployed interior protection system means a protective device or devices which are integrated into a vehicle and which, when activated by an impact to or by the vehicle, provides, through means requiring no action from occupants, protection against head impacts with interior structures and components of the vehicle in crashes.

* * * * *

S6.1 *Vehicles manufactured on or after September 1, 1998 and before September 1, 2002.* Except as provided in S6.3, for vehicles manufactured on or after September 1, 1998 and before September 1, 2002, a percentage of the manufacturer's production, as specified in S6.1.1, S6.1.2, S6.1.3, or S6.1.4, shall conform, at the manufacturer's option with said option selected prior to, or at the time of, certification of the vehicle, to one of the following:

(a) When tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do not apply to any target that cannot be located using the procedures of S10.

(b) When equipped with a Dynamically Deployed Interior Protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). For target locations specified in S10 that, when the Dynamically Deployed Interior Protection system is not deployed, are, when viewed from any of the angles specified in S8.13.4, over the stowed system, including mounting and inflation components but exclusive of any cover or covers, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 19 km/h (12 mph) with the system undeployed. For target locations specified in S10 that, when the Dynamically Deployed Interior Protection system is not deployed, are, when viewed from any of the angles specified in S8.13.4, over the stowed system, including mounting and inflation components but exclusive of any cover or covers, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 29 km/h (18 mph) with the system fully deployed. The requirements do not apply to any target that can not be located using the procedures of S10. The dynamic system shall, when tested under the lateral impact of S6.12 of Standard No. 214, 49 CFR 571.214, deploy fully within 30 milliseconds.

(c) When equipped with a Dynamically Deployed Interior Protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). For those target locations specified in S10 that when the Dynamically Deployed Interior Protection system is not deployed, are over the stowed system, including mounting and inflation components but exclusive of any cover or covers, when viewed from any of the angles specified in S8.13.4, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 19 km/h (12 mph) with the system undeployed. The requirements do not apply to any target that can not be located using the procedures of S10. Each vehicle shall, when equipped with a dummy test device specified in 49 CFR part 572, subpart M, and tested under conditions of S8.16 through S8.28, comply with the requirements specified in S7 when laterally crashed into a fixed, rigid pole of 254 mm in diameter, at any velocity up to and including 29 kilometers per hour.

* * * * *

S6.2 *Vehicles manufactured on or after September 1, 2002.* Except as provided in S6.3, vehicles manufactured on or after September 1, 2002 shall, when tested under the conditions of S8, conform, at the manufacturer's option with said option selected prior to, or at the time of, certification of the vehicle, to one of the following:

(a) When tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). The requirements do not apply to any target that cannot be located using the procedures of S10.

(b) When equipped with a Dynamically Deployed Interior Protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform specified in S8.9 at any speed up to and including 24 km/h (15 mph). For target locations specified in S10 that, when the Dynamically Deployed Interior Protection system is not deployed, are, when viewed from any of the angles specified in S8.13.4, over the stowed system, including mounting and inflation components but exclusive of any cover or covers, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 19 km/h (12 mph) with the system undeployed. For target locations specified in S10 that, when the Dynamically Deployed Interior Protection system is not deployed, are, when viewed from any of the angles specified in S8.13.4, over the stowed system, including mounting and inflation components but exclusive of any cover or covers, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 29 km/h (18 mph) with the system fully deployed. The requirements do not apply to any target that can not be located using the procedures of S10. The dynamic system shall, when tested under the lateral impact of S6.12 of Standard No. 214, 49 CFR 571.214, deploy fully within 30 milliseconds.

(c) When equipped with a Dynamically Deployed Interior Protection system and tested under the conditions of S8, comply with the requirements specified in S7 at the target locations specified in S10 when impacted by the free motion headform

specified in S8.9 at any speed up to and including 24 km/h (15 mph). For those target locations specified in S10 that when the Dynamically Deployed Interior Protection system is not deployed, are over the stowed system, including mounting and inflation components but exclusive of any cover or covers, when viewed from any of the angles specified in S8.13.4, comply with the requirements specified in S7 when impacted by the free motion headform specified in S8.9 and tested under the conditions of S8 at any speed up to and including 19 km/h (12 mph) with the system undeployed. The requirements do not apply to any target that can not be located using the procedures of S10. Each vehicle shall, when equipped with a dummy test device specified in Part 572, Subpart M, and tested under conditions of S8.16 through S8.28, comply with the requirements specified in S7 when laterally crashed into a fixed, rigid pole of 254 mm in diameter, at any velocity up to and including 29 kilometers per hour.

* * * * *

S7 *Performance Criterion.* The HIC(d) shall not exceed 1000 when calculated in accordance with the following formula:

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$$HIC = [\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a dt]^{2.5} (t_2 - t_1)$$

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Where the term *a* is the resultant head acceleration expressed as a multiple of *g* (the acceleration of gravity), and t1 and t2 are any two points in time during the impact which are separated by not more than a 36 millisecond time interval.

(a) For the free motion headform; HIC(d) = 0.75446 (free motion headform HIC) + 166.4.

(b) For the 49 CFR part 572, subpart M, anthropomorphic test dummy; HIC(d) = HIC

* * * * *

S8 Test conditions.

* * * * *

S8.13 * * *

S8.13.3 At the time of initial contact between the headform and the vehicle interior surface, except for the testing of a fully deployed dynamic system, some portion of the forehead impact zone of the headform contacts some portion of the target circle.

* * * * *

S8.16 *Test weight—vehicle to pole test.* Each vehicle is loaded to its unloaded vehicle weight, plus 136 kilograms of its rated cargo and luggage capacity (whichever is less), secured in the luggage or load-carrying area, plus the weight of the necessary anthropomorphic test dummy. Any added test equipment is located away from impact areas in secure places in the vehicle.

S8.17 *Vehicle test attitude—vehicle to pole test.* Determine the distance between a level surface and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its ''as delivered'' condition. The ''as delivered'' condition is the vehicle as received at the test site, filled to 100 percent of all fluid capacities and with all tires inflated to the manufacturer's specifications listed on the vehicle's tire placard. Determine the distance between the same level surface and the same standard reference points in the vehicle's ''fully loaded condition.'' The ''fully loaded condition'' is the test vehicle loaded in accordance with S8.16. The load placed in the cargo area is centered over the longitudinal centerline of the vehicle. The pretest vehicle attitude is the same as either the ''as delivered'' or ''fully loaded'' attitude or is between the ''as delivered'' attitude and the ''fully loaded'' attitude.

S8.18 *Adjustable seats—vehicle to pole test.* Adjustable seats are placed in the adjustment position so that the 49 CFR part 572, subpart M dummy is situated, when positioned as specified in S8.28, so the point at the intersection of the rear surface of the dummy's head and a horizontal line parallel to the longitudinal centerline of the vehicle passing through the head's center of gravity is at least 50 mm (2 inches) forward of the front edge of the B-pillar at that same horizontal location.

S8.19 *Adjustable seat back placement—vehicle to pole test.* Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer, or in a position no more than 5 degrees forward from this nominal design riding position, as specified in S8.28. If the manufacturer's nominal design riding position is not specified, set the seat back at the first detent rearward of 25 [degrees] from the vertical, or in a position no less than 20 degrees from the vertical, as allowed by S8.28. Place each adjustable head restraint in its highest adjustment position. Position adjustable lumbar supports so that they are set in their released, i.e., full back position.

S8.20 *Adjustable steering wheels—vehicle to pole test.* Adjustable steering controls are adjusted so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

S8.21 *Windows and sunroof—vehicle to pole test.* Movable windows and vents are placed in the fully open position. Any sunroof will be placed in the fully closed position.

S8.22 *Convertible tops—vehicle to pole test.* The top, if any, of convertibles and open-body type vehicles is in the closed passenger compartment configuration.

S8.23 *Doors—vehicle to pole test.* Doors, including any rear hatchback or tailgate, are fully closed and latched but not locked.

S8.24 *Impact reference line—vehicle to pole test.* On the striking side of the vehicle, place an impact reference line at the intersection of the vehicle exterior side structure and a transverse vertical plane passing through the center of gravity of the head of the dummy seated in accordance with S8.28, in a designated front outboard seating position.

S8.25 *Rigid Pole—vehicle to pole test.* The rigid pole is a vertical metal structure beginning no more than 102 millimeters (4 inches) off the ground and extending to a minimum height of 2,032 millimeters (80 inches). The pole is 254 mm (10 inches) in diameter and set off from any mounting surface, such as a barrier or other structure, so that the test vehicle will not contact such a mount or support at any time before or after impact with the pole.

S8.26 *Impact configuration—vehicle to pole test.* The rigid pole is stationary. The test vehicle is propelled sideways so that its line of forward motion forms an angle of 90 degrees with the vehicle's longitudinal center line. The impact reference line is aligned with the center line of the rigid pole so that, when the vehicle-to-pole contact occurs, the center line of the pole contacts the vehicle area bounded by two transverse vertical planes 38 mm (1.5 inches) forward and aft of the impact reference line.

S8.27 *Anthropomorphic test dummy*—vehicle to pole test. S8.27.1 The anthropomorphic test dummy used for evaluation of a vehicle's head impact protection conform to the requirements of subpart M of part 572 of this chapter. In a test in which the test vehicle is to be struck on its left side, the dummy is to be configured and instrumented to be struck on its left side, in accordance with subpart M of part 572. In a test in which the test vehicle is to be struck on its right side, the dummy is to be configured and instrumented to be

struck on its right side, in accordance with subpart M of part 572.

S8.27.2 The 49 CFR part 572, subpart M, test dummy specified is clothed in form fitting cotton stretch garments with short sleeves and midcalf length pants. Each foot of the test dummy is equipped with a size 11EEE shoe, which meets the configuration size, sole, and heel thickness specifications of MIL-S–13192 (1976) and weighs 0.57 +/−0.09 kilograms (1.25 +/−0.2 pounds).

S8.27.3 Limb joints are set at between 1 and 2 g's. Leg joints are adjusted with the torso in the supine position.

S8.27.4 The stabilized temperature of the test dummy at the time of the side impact test is at any temperature between 20.6 degrees C. and 22.2 degrees C., at any relative humidity between 10 percent and 70 percent.

S8.27.5 The acceleration data from the accelerometers installed inside the skull cavity of the test dummy are processed according to the requirements of SAE Recommended Practice J211, March 1995, ''Instrumentation for Impact Tests,'' Class 1000.

S8.28 *Positioning procedure for the Part 572 Subpart M Test Dummy—vehicle to pole test.*

The 49 CFR part 572, subpart M test dummy shall be positioned in the front outboard seating position on the struck side of the vehicle in accordance with the provisions of S7 of Standard No. 214, 49 CFR 571.214, and the vehicle seat shall be positioned as specified in S6.3 and S6.4 of that same standard. If this does not position the dummy such that the point at the intersection of the rear surface of its head and a horizontal line parallel to the longitudinal centerline of the vehicle passing through the head's center of gravity is at least 50 mm (2 inches) forward of the front edge of the B-pillar at that same horizontal location, then the seat and/or dummy positions may be adjusted. First, the seat back angle is to be adjusted, a maximum of 5 degrees, until the 50 mm (2 inches) B-pillar clearance is achieved. If this is not sufficient to produce the 50 mm (2 inches) clearance, the seat is to be moved forward to achieve that result. If the seat is moved from the position specified in S6.3 of Standard No. 214, 49 CFR 571.214, the target H-point location is to be moved from that specified in S7.2.1 of that standard. The horizontal and vertical distances moved must be equal to those necessary to reposition the vehicle seat to achieve the 50 mm (2 inches) B-pillar clearance described in this section.

Issued on August 19, 1997.

L. Robert Shelton,

Associate Administrator for Safety Performance Standards.

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