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DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 571

[Docket No. NHTSA 01–11110; Notice 1]

RIN 2127–AI10

Federal Motor Vehicle Safety Standards; Occupant Crash Protection

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

ACTION: Final rule; response to petitions for reconsideration.

SUMMARY: This document responds to petitions for reconsideration of the new, advanced air bag final rule; interim final rule that we published in May 2000. This document grants portions of the petitions and denies other portions of the petitions.

The May 2000 final rule amended our occupant crash protection standard to require that future air bags be designed so that, compared to current air bags, they create less risk of serious air bag-induced injuries, particularly for small women and young children; and provide improved frontal crash protection for all occupants, by means that include advanced air bag technology. The issuance of that rule completed the implementation of our 1996 comprehensive plan for reducing air bag risks. It was also required by the Transportation Equity Act for the 21st Century, which was enacted in 1998.

DATES: *Effective Date:* The amendments made in this rule are effective January 17, 2002.

Petitions: Petitions for reconsideration must be received by February 1, 2002.

ADDRESSES: Petitions for reconsideration should refer to the docket and notice number of this document and be submitted to: Administrator, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590.

FOR FURTHER INFORMATION CONTACT: For non-legal issues, you may contact Dr. Roger A. Saul, Director, Office of Crashworthiness Standards, NPS–10. Telephone: (202) 366–1740. Fax: (202) 493–2739. E-mail: Roger.Saul@NHTSA.dot.gov.

For legal issues, you may contact Edward Glancy or Rebecca MacPherson, Office of Chief Counsel, NCC–20. Telephone: (202) 366–2992. Fax: (202) 366–3820.

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I. Background: The Advanced Air Bag Final Rule

On May 12, 2000, we published in the **Federal Register** (65 FR 30680) a final rule; interim final rule to require advanced air bags. (Docket No. NHTSA 00–7013; Notice 1.) The rule amended Standard No. 208, *Occupant Crash Protection*, to require that future air bags be designed so that, compared to current air bags, they create less risk of serious air bag-induced injuries, particularly for small women and young children; and provide improved frontal crash protection for all occupants, by means that include advanced air bag technology.

To achieve these goals, the rule added a wide variety of new requirements, test procedures, and injury criteria, based on the use of an assortment of new dummies. Among other things, it replaced the current sled test with a rigid barrier crash test for assessing the protection of unbelted occupants.

The issuance of the rule completed the implementation of our 1996 comprehensive plan for reducing air bag risks. It was also required by the Transportation Equity Act for the 21st Century (TEA 21), which was enacted in 1998. That Act required us to issue a rule amending Standard No. 208:

> to *improve occupant protection* for occupants of different sizes, belted and unbelted, under Federal Motor Vehicle Safety Standard No. 208, *while minimizing the risk* to infants, children, and other occupants from injuries and deaths caused by air bags, *by means that include advanced air bags.*
> (Emphasis added.)

The rule will improve protection and minimize risk by requiring new tests and injury criteria and specifying the use of an entire family of test dummies: the existing dummy representing 50th percentile adult males, and new dummies representing 5th percentile adult females, 6-year-old children, 3-year-old children, and 1-year-old infants. With the addition of those dummies, Standard No. 208 will more fully reflect the range in sizes of vehicle occupants.

The rule will be phased in during two stages. The first stage phase-in will require vehicles to be certified as passing the unbelted test requirements [1] for both the 5th percentile adult female and 50th percentile adult male dummies in a 32–40 km/h (20–25 mph) rigid barrier crash, and belted test requirements [2] for the same two dummies in a rigid barrier crash with a maximum test speed of 48 km/h (30 mph). In addition, the first stage will require vehicles to include technologies that will minimize the risk of air bag-induced injuries for young children and small adults.

[1] "Unbelted test requirements" are requirements that specify the use of unbelted dummies in testing vehicles.

[2] "Belted test requirements" are requirements that specify the use of belted dummies in testing vehicles.

The second stage phase-in will require vehicles to be certified as passing the belted test requirements for the 50th percentile adult male dummy up to 56 km/h (35 mph). This requirement will provide improved protection for belted occupants.

First Stage Phase-in—Risk Minimization Provisions

During the first stage phase-in, from September 1, 2003 to August 31, 2006, increasing percentages of motor vehicles will be required to meet requirements for minimizing air bag risks, primarily by either automatically turning off the air bag when young children are present or deploying the air bag in a manner more benignly so that it is much less likely to cause serious or fatal injury to out-of-position occupants.[3] If they so wish, manufacturers may choose to use a combination of those approaches.

Manufacturers that decide to turn off the passenger air bag will use weight sensors and/or other means of detecting the presence of young children. To test the ability of those means to detect the presence of children, the rule specifies that child dummies be placed in child seats that are, in turn, placed on the passenger seat in both proper and (to simulate misuse) improper ways. It also specifies tests that are conducted with unrestrained child dummies sitting, kneeling, standing, or lying on the passenger seat.

The ability of air bags to deploy in a low-risk manner will be tested using child dummies on the passenger side and the small adult female dummy on the driver side. For manufacturers that decide to design their passenger air bags to deploy in a low risk manner, the rule specifies that unbelted child dummies be placed against the instrument panel in two different positions. The air bag is then deployed. This placement was specified because pre-crash braking can cause unrestrained children to move forward into or near the instrument panel before the air bag deploys. The ability of driver air bags to deploy in a low risk manner will be tested by placing the 5th percentile adult female dummy against the steering wheel in two different positions and then deploying the air bag.

First Stage Phase-in—Protection Improvement Provisions

In addition, the vehicle manufacturers will be required to meet a rigid barrier crash test with both unbelted 5th percentile adult female dummies and unbelted 50th percentile adult male dummies. The unbelted rigid barrier test replicates what happens to motor vehicles and their occupants in real world crashes better than the current sled test does. The maximum test speed for unbelted dummy testing will be 40 km/h (25 mph).

Our decision to set the maximum test speed for unbelted dummy testing at 40 km/h (25 mph) was issued as an interim final rule. We concluded that was the appropriate test speed for at least the TEA 21 implementation period (MY 2004–2007). We explained that that speed will provide vehicle manufacturers with the flexibility they need during that period to meet the technological challenges involved in simultaneously improving protection and minimizing risk. To achieve those twin goals, the manufacturers will have to comply with the wide variety of new requirements using an array of new dummies during this near-term time frame.

However, we did not draw any final conclusion about the appropriateness of that test speed in the longer run. We explained that, at this time, we cannot assess whether the uncertainty about the manufacturers' ability to improve protection further and minimize risk simultaneously will persist beyond the TEA 21 implementation period. We stated that, in addition, while we believed that it was unlikely that the selection of a 40 km/h (25 mph) maximum test speed (instead of a 48 km/h (30 mph) maximum test speed) would lead to a reduction in high speed protection during that period and the years beyond, we could not rule out that possibility. We noted that if manufacturers were to engage in significant depowering, it could result in lesser crash performance for teenage and adult occupants.

We stated that, to help resolve these issues and concerns, we were planning a multi-year effort to obtain additional data. We stated that, based on the results of those information gathering and analysis efforts, we would make a final decision regarding the maximum test speed for unbelted dummy testing in the long run, after providing opportunity for informed public comment.

The final rule made still other additions to Standard No. 208. To ensure that vehicle manufacturers upgrade their crash sensing and software systems as necessary to prevent late air bag deployments in crashes with soft pulses, they will be required to design their vehicles to meet an up-to-40 km/h (25 mph) offset deformable barrier test using belted 5th percentile adult female dummies. A late air bag deployment would allow enough time for even a belted occupant to move forward into the steering wheel or instrument panel during a crash before the air bag deploys. Thus, the occupant would be in contact with or very close to the air bag module when the air bag deploys, creating an increased risk of severe or fatal injury. In addition, the 5th percentile female dummy is added to the 48 km/h (30 mph) belted rigid barrier test that currently uses only the 50th percentile adult male dummy.

Second Stage Phase-in—Protection Improvement Provision

During the second stage phase-in, from September 1, 2007 to August 31, 2010, the maximum test speed for the belted rigid barrier test will increase from 48 km/h (30 mph) to 56 km/h (35 mph) in tests with the 50th percentile adult male dummy only. As in the case of the first-stage requirements, this second-stage requirement will be phased in for increasing percentages of motor vehicles. We explained that we did not include the 5th percentile adult female dummy in this requirement at this time because we have sparse information on the practicability of such a requirement. We stated that we would initiate testing to examine this issue and anticipated proposing increasing the test speed for belted tests using the 5th percentile adult female dummy to 56 km/h (35 mph), beginning at the same time that the belted test must be met at that speed using the 50th percentile adult male. That testing has already begun.

Preceding Rulemaking Proposals

The rule was preceded by a notice of proposed rulemaking (NPRM), which we published in the **Federal Register** (63 FR 49958) (Docket No. NHTSA–98–4405) on September 18, 1998, and a supplemental notice of proposed rulemaking (SNPRM), which we published in the **Federal Register** (64 FR 60556) (Docket No. NHTSA–99–6407) on November 5, 1999.

II. Petitions for Reconsideration

Eight petitions for reconsideration were submitted to the agency (see Docket No. 7013). Four of the petitions were from manufacturers of vehicles or air bags. Petitions were also filed by three industry associations representing vehicle manufacturers, and by a coalition of four consumer groups. In addition, Isuzu and TRW submitted requests for clarification before the period of time for filing petitions had

[3] The rule also establishes very general performance requirements for dynamic automatic suppression systems (DASS) and a special expedited petitioning and rulemaking process for considering procedures for testing advanced air bag systems incorporating a DASS.

run. Honda, Autoliv, and Ferrari filed comments that would be considered petitions for reconsideration had they been timely filed. These comments are addressed in today's document.

The coalition of consumer groups which filed a petition included the Center for Auto Safety, the Consumer Federation of America, Parents for Safer Air Bags, and Public Citizen. (We will refer to this coalition of consumer groups as the ''Consumer Groups.'') The Consumer Groups requested several changes to the final rule. First, they requested we amend the unbelted rigid barrier test requirements in the final rule to require a higher test speed for passenger cars (48 km/h (30 mph)) than for light trucks, vans and SUVs (40 km/h (25 mph)). Second, they requested that we require that the 40 km/h (25 mph) offset deformable barrier test be conducted with unbelted instead of belted dummies and that the vehicle impact the barrier on both the driver and passenger sides. Third, they asked that we require manufacturers to meet a 56 km/h (35 mph) belted barrier test with the 5th percentile adult female dummy as well as the 50th percentile adult male dummy. Fourth, they asked that we require vehicles to satisfy all rigid barrier test requirements in both the perpendicular and oblique modes.

The Coalition of Small Volume Automobile Manufacturers (COSVAM) petitioned us to expand the scope of a special provision we included in the final rule to accommodate the needs of small volume manufacturers (SVMs). The provision at issue permits manufacturers that produce fewer than 5,000 vehicles per year worldwide to wait until the end of the phase-in to meet the new requirements. COSVAM petitioned us to apply this provision to manufacturers that produce up to 10,000 vehicles per year. Alternatively, it petitioned that the 5,000 vehicle cap be limited to vehicles sold in the United States per year or that the 5,000 vehicle cap be averaged over the phase-in period. Under the averaged approach, if a manufacturer produced more than 5,000 vehicles in a single year, it could still take advantage of the exclusion as long as its average of production during the phase-in was not more than 5,000 vehicles per year.

The petitions from manufacturers and their associations requested numerous changes in other aspects of the final rule.

DaimlerChrysler and Toyota requested that the unbelted rigid barrier test be conducted at only 40 km/h (25 mph), with the possibility of a small tolerance, instead of the specified range of 32 to 40 km/h (20 to 25 mph). They claimed that meeting the requirements of the unbelted barrier tests at speeds below 40 km/h (25 mph) may prevent them from certifying compliance on the passenger side using the low risk deployment option. They also claimed they would have difficulty meeting the low risk deployment requirements on the driver side. Several petitioners also expressed concern over the seating position for the 5th percentile adult female test dummy in the barrier tests.

Several requests were made concerning the automatic suppression option, most of which concerned the level of seat belt cinch down force for the belted test procedures and the selection of child restraints. Toyota, the Alliance, DaimlerChrysler and Takata all stated that they believed the 134 N (30 pounds) cinch-down force specified in the final rule was unreasonable. Petitioners urged NHTSA to adopt a cinch down force of 67N (15 pounds), which is currently specified in Standard No. 213.

Toyota also raised several issues in its petition related to the use of current anthropomorphic test dummies and humans in automatic suppression tests. It urged the agency to work with industry in developing better test dummies because of the recognition problems many automatic suppression systems have with the current test dummies. Mitsubishi echoed this request.

We received several requests regarding the test procedures for both the driver and passenger low-risk deployment tests, as well as the 300 ms test duration specified in the final rule for those tests. Additionally, several issues regarding the low-risk deployment test procedures were raised at a December 2000 technical workshop that the agency conducted to explore issues related to test procedures. Several petitioners, including Toyota, the Alliance, TRW, and DaimlerChrysler argued against the extension of the 300 ms test data acquisition requirement for measuring injury criteria in the static low risk deployment tests. The petitioners argued that data should only be counted for the period prior to recoil of the head, neck and torso away from the air bag into the seat back, head restraint, B-pillar or other interior components. DaimlerChrysler petitioned the agency to change the test procedure for determining which stage or stages of the air bag to fire in the low risk deployment tests. It argued in favor of allowing the use of the dummies for which the low-risk deployment technology is designed to be used in the initial test. Thus, if a manufacturer certifies to the low-risk deployment requirement for the 6-year-old child dummy, the barrier test would be conducted using that dummy.

While the petitions regarding the low risk deployment tests for the passenger air bag addressed both the dummy head-on-instrument panel position and dummy chest-on-instrument panel test position, the greatest criticism was leveled against the chest-on-instrument panel position procedure. While other petitioners expressed general concerns about the test procedure in their petitions, the most comprehensive analysis was provided by TRW. TRW noted that when both the 3-year-old and the 6-year-old test dummies were initially positioned as specified and then moved forward, dummy contact with the windshield or instrument panel could result in the dummy being positioned at a considerable distance from the air bag unless the dummy were moved after contact was made.

Several petitioners, including TRW, DaimlerChrysler, and Toyota, sought clarification of what was meant by the ''geometric center of the right air bag tear seam,'' the point used to align the dummies in the static low risk deployment tests of passenger air bags. They noted that many passenger systems do not have a true tear seam. Instead, they may have a cover that opens as part of the instrument panel, or the instrument panel may be a solid structure with no visible tear seam. In both of these instances, the ''geometric center of the right air bag tear seam'' is difficult to determine and could vary depending on who is conducting the test.

Petitions concerning the positioning procedure for the low risk deployment test on the driver side focused on the procedure for the dummy chin-on-steering wheel rim test. Toyota stated in its petition that the final rule did not adequately ensure that the dummy's chin would not catch on the rim of the steering wheel, leading to artificially high neck extension bending moments. Honda raised similar concerns. Toyota also stated that using the seat to move the dummy forward results in pre-loading the dummy. Mitsubishi and TRW queried whether forward head movement was to cease if the dummy chest or torso impacted the steering wheel before the head contacted the windshield.

The Alliance, DaimlerChrysler, and Toyota petitioned for changes in the final rule's new injury criteria. The Alliance and DaimlerChrysler petitioned the agency to set the Head Injury Criterion (HIC) maxima for the 5th percentile adult female dummy and the 6-year-old child dummy at a maximum HIC of 779 and 723, respectively. The Alliance, Toyota and DaimlerChrysler petitioned the agency to adopt the Alliance's scaled chest acceleration maximum of 73 g for the 5th percentile adult female dummy. They expressed particular concern over the effect that the 60 g limit would have in the belted barrier test for the 50th percentile adult male dummy. In their petitions for reconsideration, both Toyota and DaimlerChrysler reiterated their concerns with the Hybrid III dummy neck design and with the adoption of Neck Injury Criterion (Nij) an injury criterion. Toyota asked that the introduction of Nij be delayed until certain bending moment issues are resolved. DaimlerChrysler asked the agency to measure only axial force rather than using Nij due to problems it believes the current Hybrid III neck has in measuring bending moments.

We also received petitions for reconsideration for and comments on both the changed label and on the issue of whether to allow additional information other than that required by the warning label. Toyota urged us to keep the existing warning label, except for the addition of the statement ''even with advanced air bags,'' arguing that the advanced air bag technology is not yet developed enough to justify a weaker label. DaimlerChrysler, Toyota, GM, the Alliance and Ford have all requested that NHTSA limit any information beyond that in the required label to the owner's manual. Parents for Safer Air Bags asked for clarification of the agency's position regarding the extent of information to be provided on the labels.

The Alliance, DaimlerChrysler, and Mitsubishi petitioned the agency to revise the current requirement that the telltale indicating the passenger air bag has been suppressed be visible to occupants of all ages, and urged us instead to adopt the requirements of Standard No. 101, Controls and Displays. DaimlerChrysler also requested the regulatory text be clarified to assure that the telltale would be visible to all occupants seated in a forward-facing position, and that it not be obstructed by a rear-facing child restraint. The Alliance requested that they be allowed to use the abbreviation ''pass'' in lieu of ''passenger'' in the message text. DaimlerChrysler requested that manufacturers be allowed to use a universal symbol representing the status of the air bag rather than a specified text.

Technical Workshop

Petitioners raised a large number of concerns about the various test procedures in their written submissions. The agency decided to hold a technical workshop so that it could better understand the specific concerns and to determine if the test procedures needed refinement. The workshop was held at NHTSA's Vehicle Research and Test Center in East Liberty, Ohio on December 6, 2000. Representatives of 18 vehicle manufacturers and 13 seat, sensor, and dummy manufacturers attended the workshop. Five different vehicles were used as test vehicles. Some of the five had been provided by the manufacturer because it was experiencing particular problems with the existing test procedures in these vehicles. The workshop focused on the cinch-down procedure for the child seats, and the positioning procedures for the low-risk deployment tests. There was some discussion about the positioning procedure for the 5th percentile adult female test dummy for the rigid barrier tests. After we had finished trying out the test procedures on the various test vehicles, we allowed parties to make presentations. TRW, DaimlerChrysler, Toyota, and others provided slide presentations highlighting their specific concerns. Copies of these presentations have been placed in the docket (NHTSA–00–7013–51).

III. Summary of Response to Petitions

We are making several changes to the final rule in response to the petitions. These changes include a number of refinements to the positioning procedures for the low risk deployment tests and, to a lesser degree, for the automatic suppression tests. We are also changing the test duration for the low risk deployment tests. Also, the test used for determining the stage(s) of the air bag to be used for the passenger side low risk tests is modified. We are also modifying the definition of small volume manufacturer for the purpose of the rule's phase-in schedule. We have also added an option to use human children instead of the newborn or 12-month-old dummies to test a vehicle's occupant recognition system.

We have decided against making any changes to the rigid and offset deformable barrier tests other than the seating procedure for the 5th percentile adult female test dummy. Nor are we making any changes to the required injury criteria. We are addressing petitions for reconsideration of the offset deformable barrier design in a separate rulemaking.

IV. Improving the Protection of Occupants in Serious Crashes

A. Maximum Test Speed for Unbelted Barrier Test

In their petition for reconsideration, the Consumer Groups requested that we amend the final rule to require passenger cars to meet a 48 km/h (30 mph) unbelted barrier test, while applying the 40 km/h (25 mph) maximum speed only to LTVs (light trucks, vans and SUVs).

These petitioners stated that, in their view, the primary reason why the agency lowered the standard's unbelted test speed to 40 km/h (25 mph) for all vehicles, including passenger cars, was because of the greater difficulties that SUVs and light trucks would have in complying with a 48 km/h (30 mph) unbelted test, due to their stiffer frames. In support of this assertion, the Consumer Groups cited a statement by the agency in the final rule preamble that ''a 40 km/h (25 mph) maximum test speed gives vehicle manufacturers more flexibility to address the greater compliance problems associated with vehicles, e.g., SUVs, with particularly stiff pulses.''

The Consumer Groups argued further that passenger cars can meet the new injury criteria in a 48 km/h (30 mph) unbelted test. In support of this argument, they alleged that test results show some passenger cars already meet the unbelted 48 km/h (30 mph) test requirements for both 50th percentile male and 5th percentile female dummies.

The Consumer Groups stated that since, in their view, manufacturers already build some cars that meet the 48 km/h (30 mph) unbelted test, NHTSA should have required cars to meet the 48 km/h (30 mph) unbelted test, while allowing LTVs to meet a 40 km/h (25 mph) test. They argued that this would provide manufacturers with additional time and necessary design flexibility to develop engineering solutions to meet 48 km/h (30 mph) test for LTVs at some future time. They also argued that a separate phase-in would take account of the need to improve occupant protection in light of the increased number of LTVs. The Consumer Groups stated that, with LTVs accounting for over half of new vehicle sales, the need for a high level of occupant protection for passenger car occupants is especially acute since car occupants are four times more likely to be killed in collisions with LTVs than their LTV counterparts. The petitioners noted that the agency has in the past adopted different phase-ins for different types of vehicles, with passenger cars being required to meet more stringent safety standards sooner than light trucks.

The Consumer Groups argued that the decision to apply the 40 km/h (25 mph) test speed to passenger cars as well as LTVs has serious consequences because in frontal crashes between light trucks/SUVs and cars, the lighter car experiences a higher crash severity than the heavier truck. The Consumer Groups argued that cars that need more protection received less protection under the final rule. The petitioners also argued that since a 48 km/h (30 mph) test speed represents median speed of all fatal frontal crashes, NHTSA is sacrificing passenger car occupants by not requiring 48 km/h (30 mph) protection at least for passenger cars.

After carefully considering the arguments that the Consumer Groups made in support of their request that we adopt a 48 km/h (30 mph) maximum test speed for passenger cars during the TEA 21 phase-in, we have decided to deny that request. The reasons for our denial are discussed below.

The Consumer Groups' argued that the agency's primary justification for adopting a 40 km/h (25 mph) maximum unbelted test speed for all light vehicles, including passenger cars was the greater difficulties that vehicles with particularly stiff crash pulses, e.g., SUVs, would have in meeting a 48 km/h (30 mph) unbelted test. They contrasted those difficulties with the fact that they believe some passenger cars already meet the unbelted 48 km/h (30 mph) barrier test for both the 50th percentile adult male dummy and the 5th percentile adult female dummy. They concluded that the agency should, therefore, have adopted a 48 km/h (30 mph) maximum speed for passenger cars.

We believe that the petitioners may have misunderstood the agency's reasoning. Contrary to the petitioners' assertion, the greater challenges posed by vehicles with stiffer crash pulses, including typical SUVs, was only one of many considerations, and not the paramount one, that led the agency to conclude that 40 km/h (25 mph) should be chosen as the maximum speed for the unbelted test in the near term. In the summary of our May 2000 final rule, NHTSA said that the maximum test speed for the unbelted test ''reflect the uncertainty of simultaneously achieving the twin goals of TEA 21,'' to provide improved frontal crash protection for all occupants and to minimize the risks of serious air bag-induced injuries.

NHTSA set forth six reasons for why it was in the best overall interest of safety to choose 40 km/h (25 mph) as the unbelted test speed. See 65 FR 30680, at 30687–30690. These reasons (presented in a condensed fashion) were as follows:

1. It is very important that advanced air bags be properly designed from the very beginning. Because of the potential for death and injury, we want to be cautious in how far and how fast vehicle manufacturers are required to advance the state of advanced air bag technologies in their vehicles. We are particularly concerned about the difficulties of trying to meet the unbelted rigid barrier test at 48 km/h (30 mph) with both adult dummies while simultaneously trying to reduce the risks of air bag-induced injuries and deaths. Since a significant percentage of current vehicles can already satisfy the new unbelted barrier crash test at 40 km/h (25 mph) with both the 5th percentile adult female dummy and the 50th percentile adult male dummy, we conclude that setting the maximum speed at that level will help vehicle manufacturers to focus their resources and compliance efforts during the first stage on meeting the risk reduction requirements. While advanced air bag technologies will facilitate simultaneously achieving the goals of improving protection and minimizing risk, we cannot forecast the pace of development of those technologies.

We noted that while the manufacturers' resources for dealing with air bags, as well as all the other engineering issues associated with future motor vehicles, are extensive, there are limits to how much can be done at any one time. We explained that we needed to consider the variety and complexity of changes in air bag testing and technology that will be required by the rule. We noted that the array of new requirements that the manufacturers will have to meet in the first stage is challenging. The May 2000 final rule specified the use of a new test dummy (the 5th percentile adult female) in high speed tests, added a new test (offset belted), adds new neck injury criteria, and made existing injury criteria more stringent (chest deflection). The rule also added an entire new series of risk minimization tests, which require manufacturers to install air bag suppression systems or low-risk deployment systems, or both.

Of particular concern here was that air bags must be tuned to inflate quickly enough to protect the unbelted mid-sized male dummy without posing risks to the unbelted small female dummy that will be positioned much closer to the air bag. At the same time, manufacturers are required to develop and tune suppression technologies, low-risk deployment technologies, or a combination of both of these technologies to meet the risk minimization requirements. Even now, more than one year later the issuance of the May 2000 final rule, NHTSA cannot forecast how long it will take to complete the process of simultaneously developing and incorporating all of these technologies into all vehicles lines. NHTSA decided that we would increase the risks of advanced air bags not being able to meet all of the new requirements if we adopted the more difficult 48 km/h (30 mph) unbelted test. Those were not, and are not, risks that the agency is willing to take with the available information.

Differences in crash pulse are but one of the many technological challenges that must be overcome to provide improved protection for all occupants as well as to reduce the risks of air bag-induced injuries. The need to develop and apply technology that works reliably is a challenge for both passenger cars and light trucks.

2. There are unresolved issues that make it difficult for vehicles to provide protection for both small females and mid-sized males in a 48 km/h (30 mph) unbelted test without compromising efforts to minimize the risks of serious air bag-induced injuries. A good example is the issue of the best strategy for using the two inflation levels of a dual-stage air bag to meet that test. The choice among competing strategies is complicated by the existence of ''gray'' or transition zones, i.e., ranges of conditions in which the air bag changes from one level of performance to another.

To date, the vehicle manufacturers have been required to certify compliance of their air bags based on only a single size of dummy at only a single seat adjustment position. Tuning an air bag to perform in that single combination of test conditions is a relatively simple task. No regulatory requirements preclude manufacturers from optimizing performance for that combination of test conditions while placing secondary importance on other sizes of occupants in other seat adjustment positions.

In the May 2000 final rule, NHTSA for the first time required manufacturers to balance the performance of their air bag systems for different sized occupants. In addition to protecting mid-size male dummies with the seat in the mid-track position, air bags will be required to protect small size female dummies with the seat all the way forward. This is a far more challenging task for air bag system designers. We expect that the new, more demanding requirements will encourage the use of dual-stage inflator technology. Although the challenge of this task may be compounded somewhat by a relatively stiff crash pulse, the task is formidable for all vehicles, regardless of crash pulse.

3. The vehicle manufacturers need design flexibility to address issues regarding performance in real world crash conditions not directly replicated by Standard No. 208's tests. One of the greatest limitations of early generation air bags is that they typically deploy in the same manner regardless of such factors as crash severity or occupant size, weight or position. Successful implementation of air bags designed to vary their performance in response to sensed differences in crash severity or other conditions presents a challenge to the manufacturers in that these air bags have ''gray'' or transition zones, i.e., ranges of conditions in which the air bag changes from one level of performance to another. We believe it is appropriate for the manufacturers initially to introduce relatively simple advanced systems. While we believe that more complex systems offer promise of even greater benefits, there are significant uncertainties regarding the feasibility and thus availability of such systems.

Standard No. 208 currently tests for a full frontal crash. While such a crash occurs less frequently, compared to offset crashes, in the real world, we have chosen the full frontal crash mode because it is very repeatable and provides a more demanding evaluation of restraint systems. However, NHTSA expects vehicle and air bag manufacturers will take into account other frontal crash modes, such as offset crashes and crashes into poles. To the extent that we make our full frontal crash test more stringent, we limit the ability of the manufacturers to take account of these other crash modes. This is because the most stringent test is the primary determinant of the design of air bag and vehicle performance. After the performance attributes of the air bag system are optimized for the most stringent test (in this case, the unbelted full frontal barrier crash), the manufacturers will typically run a check on performance in other relevant test conditions to ensure acceptable performance in those conditions as well. However, the ability to adjust performance to improve performance in these other test conditions is limited by the stringency of the most severe test. Choosing 48 km/h (30 mph), instead of 40 km/h (25 mph), as the maximum test speed for the unbelted full frontal crash would allow the manufacturers less flexibility to enhance performance in other test conditions. Again, while the need for design flexibility may be compounded somewhat by a relatively stiff crash pulse, that need is substantial for all vehicles, regardless of crash pulse.

4. A 40 km/h (25 mph) maximum test speed gives vehicle manufacturers more flexibility to address the greater compliance problems associated with vehicles, e.g., SUVs, with particularly stiff crash pulses. Since unbelted occupants moving forward in frontal crashes of these vehicles will have to be engaged more quickly than in vehicles with softer crash pulses, the task of designing air bag systems in stiff pulse vehicles is significantly more challenging.

This reason is based on the greater compliance difficulties for vehicles with relatively stiff crash pulses. As a generality, SUVs and other vehicles with frame rail construction have stiff crash pulses, while cars and other vehicles with uni-body construction have softer crash pulses. In a crash, the occupants travel forward more quickly toward the steering wheel and dashboard in a vehicle with a stiff crash pulse than they would in a vehicle with a softer crash pulse. Accordingly, air bags typically need to come out sooner and/or quicker in a vehicle with a similarly stiff crash pulse than they would in a vehicle with a softer pulse. To the extent that air bags must come out quicker in vehicles with stiff crash pulses makes it more difficult to minimize air bag risks in those vehicles because the methods for getting air bags out quicker, e.g., having a fast inflation rise rate, tend to make air bags more aggressive to out-of-position occupants. It is for this reason that the technological challenges faced by the vehicle manufacturers in simultaneously improving protection and minimizing risk can be somewhat greater for vehicles with stiff crash pulses than for other vehicles.

However, the above generalization about the relative crash pulses of cars and other light vehicles has important limitations. Some newer, more ''car-like'' SUVs, i.e., cross-over or hybrid SUVs, such as the Ford Escape and the Honda CRV, are not built with frame rail construction and do not have particularly stiff crash pulses. On the other hand, many small cars, despite their uni-body construction, have relatively stiff crash pulses, because the small space limits the energy absorption by the front of the vehicle. Further, the uncertainties associated with the task of simultaneously improving protection, while also minimizing risk, are formidable for all light vehicles, regardless of crash pulse.

5. It is unlikely that vehicle manufacturers will significantly depower their air bags and minimally comply with the 40 km/h (25 mph) test. Thus, NHTSA believes that it is not risking a substantial loss of benefits by establishing an unbelted barrier test of 40 km/h (25 mph).

We explained our view that the air bags most likely to be produced under a 40 km/h (25 mph) standard would offer at least as much overall high speed protection as the current redesigned air bags, i.e., those certified to the sled test option adopted in 1997. We noted that while manufacturers might make some adjustments in providing high speed protection for different size occupants, we believed it was unlikely that they would reduce the overall level of protection, much less switch to some kind of new, hypothetical air bag design that might minimally pass the 40 km/h (25 mph) test, but provide little or no protection to unbelted occupants in higher severity crashes.

We cited several reasons for this belief. We noted that most vehicle manufacturers did not respond to the flexibility provided by the sled test by providing air bags that only minimally complied with the sled test. They did not depower their air bags as much as they could have. We also noted that the vehicle manufacturers had specifically committed to not reducing high speed protection of air bag systems through significant and widespread depowering.

For these reasons, and the others discussed in the final rule preamble, we continue to believe that it is unlikely that there will be any significant reduction in safety benefits as a result of our adoption of the 40 km/h (25 mph) maximum test speed as an interim final rule. Put another way, we continue to believe that we are not risking a substantial loss of benefits by establishing a maximum unbelted barrier test speed of 40 km/h (25 mph). We observe that the Consumer Groups did not provide any data or analysis contradicting our arguments in this area.

Finally, we note that this fifth reason applies equally to all vehicles, regardless of whether they have a stiff or soft crash pulse.

6. Replacing the 48 km/h (30 mph) generic sled test with the 40 km/h (25 mph) unbelted rigid barrier test requires a significantly higher level of safety.

This reason applies equally to all vehicles, regardless of whether they have a stiff or soft crash pulse.

From this review of our six reasons for selecting a maximum test speed of 40 km/h (25 mph), it is apparent that the differences in crash pulses were not a paramount consideration in our assessment of the challenges presented by the advanced air bag rule. Given the uncertainties associated with overcoming those challenges, and a statutory requirement to issue a final rule in early 2000, NHTSA chose an approach that assures improved air bag protection for occupants of all sizes, without compromising efforts to reduce the risks of air bar-induced injuries to vulnerable occupants. As we said in the preamble to the May 2000 final rule:

> Such an approach is one that involves the least uncertainty for the occupants who have been most at risk. In other words, as long as the manufacturers improve the already substantial overall level of air bag protection provided by current redesigned air bags, the uncertainty involved in meeting the challenge to improve high-speed protection and minimize risk simultaneously *is best resolved at this point in favor of minimizing risk. This is especially true in the early stages of the introduction of advanced air bag technologies.*

65 FR 30680, at 30688 (Emphasis added).

We selected that test speed on a interim final basis in recognition of the possibility that those uncertainties may be resolved in the foreseeable future. To expedite the resolution of those uncertainties, we committed to a multi-year effort to obtain additional data to help resolve the issues and concerns relating to the unbelted test speed in the barrier crash test. See 65 FR 30692. To carry out that commitment, we published for public comment our plan for monitoring the performance of advanced air bags and gathering the information needed to make a final decision on the appropriate test speed for the unbelted test in the long run. See 66 FR 33657; June 25, 2001 (Docket No. NHTSA 2001–8953).

In the final analysis, the consumer groups provided no new data or analyses regarding our decision to select a maximum test speed of 40 km/h (25 mph). Further, they isolated and focused on a limited portion of all the considerations leading to that decision in arguing that that limited portion should overwhelm the big picture. Their petition simply highlights their judgment that they would have mandated a higher speed for the unbelted test, given the information that was available to us when we made our decision. We respect their judgment, but reached different conclusions after considering all of the risks and uncertainties in this area. It may be that we will ultimately propose coming to the same conclusion that the Consumer Groups are advocating—after we have gathered the additional information necessary to resolve the uncertainties. Until we have that information, however, our judgment remains that the most appropriate maximum speed for the unbelted test is 40 km/h (25 mph).

B. Minimum Test Speed for Unbelted Barrier Test

Under the May 2000 final rule; interim final rule, vehicle manufacturers are required to meet the rigid barrier crash test with unbelted 5th percentile adult female dummies and unbelted 50th percentile adult male dummies at all speeds from 32 km/h through 40 km/h (20 mph and through 25 mph).

In their petitions for reconsideration, DaimlerChrysler and Toyota requested that the unbelted rigid barrier test be conducted only at 40 km/h (25 mph) (or at 40 km/h (25 mph) with a small tolerance) instead of over a range of test speeds. They claimed that the need to meet the unbelted rigid barrier test with 50th percentile adult male dummies over the range of speeds between 32 km/h and 40 km/h (20 mph and 25 mph) creates a conflict with meeting the low risk requirements using 3-year-old and 6-year-old child dummies on the passenger side and using the 5th percentile adult female dummy on the driver side.

In addressing these petitions, we begin by noting that we addressed this issue in the final rule preamble, and made changes from the SNPRM to the final rule in light of this concern.

In the SNPRM, we proposed that manufacturers would need to meet the unbelted rigid barrier test at any speed between 29 km/h (18 mph) to the maximum speed (as discussed earlier, we were considering a range between 40 to 48 km/h (25 to 30 mph) for the maximum speed). This range represented a change from the belted barrier test and previous unbelted barrier tests, which required injury criteria to be met at any speed up to 48 km/h (30 mph).

In commenting on the SNPRM, GM and Ford supported the proposed lower test parameter 29 km/h (18 mph). AAM, DaimlerChrysler and Toyota supported a higher minimum test speed. VW and Honda supported a lower minimum test speed. Delphi urged the agency to return to its traditional ''any speed between zero and'' the maximum test speed, arguing that the minimum test speed will result in an unacceptable safety trade-off for individuals who could be aided by a deploying air bag in lower speed crashes.

In the final rule preamble, we explained that the concerns of the vehicle manufacturers opposed to the 29 km/h (18 mph) lower limit revolved around their ability to meet both the low risk deployment tests for whatever stages of the air bag would deploy in speeds up to 29 km/h (18 mph) and the unbelted high speed tests at any speed between 29 km/h (18 mph) and 40 to 48 km/h (25 to 30 mph). These manufacturers argued that while individual manufacturer's strategies will differ, the basic premise for dual-stage inflation systems is that the first stage can be tailored to reduce risk for children while offering protection for 5th percentile adult females while the second stage protects the 50th percentile adult male occupant. According to the manufacturers, in many cases a first stage air bag that would not harm children would not be sufficient to satisfy the injury criteria performance limits for the 50th percentile adult male dummy in a test at 40 km/h (25 mph) and may be insufficient to certify compliance in a 29 km/h (18 mph) test. In order to assure compliance with both the unbelted crash test requirement and a low risk deployment option utilizing a dual-stage air bag system, a manufacturer arguably would either have to drop the threshold for the second stage air bag close to 29 km/h (18 mph) to ensure compliance for the 50th percentile adult male or provide a higher-energy first stage inflator. The commenters asserted that if NHTSA were to impose the proposed speed range for the unbelted tests, we would create a situation that would make compliance with a low risk deployment option impossible, since it would not be possible to assure that only the first stage air bag deploys at 29 km/h (18 mph) for the out-of-position test.

For the final rule, we decided to raise the minimum test speed for the unbelted test from 29 km/h (18 mph) to 32 km/h (20 mph) while decreasing the maximum threshold for the various out-of-position tests from 29 km/h (18 mph) to 26 km/h (16 mph). We stated that we believed that this difference in speed between the two tests would be sufficient to resolve manufacturers' concerns in this area. We noted that the requirement we adopted built in a 6 km/h (4 mph) ''grey zone'' that would allow manufacturers to assure the deployment of both inflator stages, if needed, in all high speed tests, while preserving their ability to deploy only the first stage (or allow for deployment of a combination of benign stages) of the air bag in the low risk deployment tests.

In the final rule preamble, we stated that we were rejecting DaimlerChrysler's and Toyota's request that we test unbelted dummies only at 40 km/h (25 mph) because we continued to believe a range of speeds is necessary to adequately protect drivers and adult passengers.

In petitioning for reconsideration, DaimlerChrysler again requested testing only at 40 km/h (25 mph). That manufacturer argued that the requirement for protecting an unbelted 50th percentile adult male occupant during a rigid barrier test at speeds as low as 32 km/h (20 mph) and the requirement for static out-of-position tests to be conducted with whichever air bag stage is deployed during a 26 km/h (16 mph) rigid barrier test are in conflict and inconsistent with the reality of crash sensing and air bag inflator technology.

Toyota similarly argued that the agency's decision to reduce the test speed range from 29–40 km/h (18–25 mph) to 32–40 km/h (20–25 mph), although directionally correct, does not adequately address the concerns it outlined in its comment on the SNPRM. That company argued that conflicts exist between offering sufficient compliance margin for the 50th percentile male dummy in the upper speed ranges and the desire to minimize risk to out-of-position children and small adults. Toyota stated that it believes that given the limitations of current seat suppression technology, regardless of its performance in certification tests under controlled conditions, automakers must be allowed the design flexibility to offer seemingly redundant technologies to protect out-of-position children in the real world.

On reconsideration, after carefully considering DaimlerChrysler's and Toyota's requests that we specify testing of unbelted dummies only at 40 km/h (25 mph) instead of a range between 32–40 km/h (20–25 mph), we have decided to deny those requests. As discussed below, we again conclude that the 32–40 km/h (20–25 mph) range of speeds helps ensure adequate protection of drivers and adult passengers. Moreover, we believe that the change requested by these petitioners is unnecessary, particularly in light of another change we are making in response to the petitions for reconsideration.

In addressing the requests of DaimlerChrysler and Toyota, it is appropriate to begin by citing again the requirements of TEA 21, that the agency issue a final rule meeting two different, equally important goals:

To *improve occupant protection* for occupants of different sizes, belted and unbelted, under Federal Motor Vehicle Safety Standard No. 208, *while minimizing the risk* to infants, children, and other occupants from injuries and deaths caused *by air bags, by means that include advanced air bags.*

(Emphasis added.)

There is obviously a tension between improving occupant protection for occupants of different sizes, belted and unbelted, while also minimizing the risk to infants, children, and other occupants from injuries and deaths caused by air bags. This tension exists because the deployment process of the air bag that is needed to provide protection can also create risks for persons who are extremely close to the air bag before that deployment. It was because of this tension that Congress included the reference to ''advanced air bags''; it recognized the need for vehicle manufacturers to incorporate advanced technologies in their air bags in order for these two goals to be met simultaneously.

However, while we recognize that there is a tension between these goals, there is no conflict between requiring vehicles to meet the rigid barrier crash test with unbelted 5th percentile adult female dummies and unbelted 50th percentile adult male dummies at all speeds between 32 km/h and 40 km/h (20 mph and 25 mph) while also meeting risk minimization requirements. We will discuss this issue separately for the driver and passenger sides.

To address the risks posed by driver air bags, the rule requires vehicles to either (1) have a driver air bag that deploys in a low-risk manner to out-of-position occupants or (2) to have a feature that suppresses the air bag when a driver is out-of-position (including in dynamic events). We believe that all manufacturers are focusing on the first of these two options. The ability of air bags to deploy in a low-risk manner is tested in static, out-of-position tests, using unbelted 5th percentile adult female dummies placed against the steering wheel, and deploying the air bag with any stage(s) that may deploy during a 26 km/h (16 mph) rigid barrier test.

We believe the arguments raised by DaimlerChrysler and Toyota are primarily relevant to passenger side air bags and not to driver air bags. The information we have indicates that available technology enables vehicle manufacturers to meet the low risk and unbelted high speed protection requirements for driver air bags.

We recognize that passenger air bags pose a greater design challenge than driver air bags with respect to simultaneously meeting both low risk and unbelted high speed protection requirements. The challenge is greater for two reasons. First, passenger air bags typically need to be considerably larger than driver air bags to provide protection. Larger air bags typically create greater risk to out-of-position occupants than smaller air bags. Second, young children are more susceptible to risk than adults.

To address the risks posed by passenger air bags, the rule requires vehicles to either (1) have a passenger air bag that deploys in a low-risk manner to out-of-position occupants, (2) to have a feature that suppresses the air bag when a young child is present in a variety of positions, or (3) to have a feature that suppresses the air bag when a passenger is out-of-position (including in dynamic events). The risk minimization requirements must be met separately for 1-year-old, 3-year-old and 6-year-old children, and manufacturers may choose different options for these three classes of occupants. We developed the risk minimization requirements for passenger air bags in light of these classes of occupants because, on the passenger side, the vast majority of deaths and serious injuries from air bags have been to young children.

We believe that all manufacturers are focusing on suppressing the air bag for 1-year-old children. Thus, the requirements for those children are not relevant to the issues raised by DaimlerChrysler and Toyota.[4]

Manufacturers are generally focusing on the first two options for 3-year-old children and 6-year-old children; i.e., the low risk deployment requirements and/or suppressing the air bag in the presence of young children.

The ability of an air bag to deploy in a low risk manner is tested in static out-of-position tests, using unbelted 3-year-old and 6-year-old child dummies placed against the instrument panel in two positions, and deploying the air bag with any stages that may deploy during a 26 km/h (16 mph) rigid barrier test. Specified injury criteria performance limits must be met to pass the low risk test.

Manufacturers that decide to suppress the passenger air bag in the presence of young children will use weight sensors, pattern recognition sensors and/or other means of detecting their presence. To test the ability of those means to detect the presence of children, the rule

[4] We note that the risk minimization requirements using infant dummies differ in certain respects from those using 3-year-child dummies and 6-year-old child dummies. The third option cited above, for a feature that suppresses the air bag when a passenger is out-of-position, is not available for infant dummies because infants in rear facing child seats would always be extremely close to the air bag. Different requirements also apply with respect to determining which stages of an air bag are deployed in low risk deployment tests.

specifies that 3-year-old and 6-year-old child dummies are placed in child seats that are, in turn, placed on the passenger seat. It also specifies tests that are conducted with unrestrained child dummies sitting, kneeling, standing, or lying on the passenger seat. At the option of the manufacturer, the ability of a suppression system to detect the presence of a child may be demonstrated using human beings instead of test dummies.

While manufacturers are required to meet at least one of the options specified by the risk minimization requirements, they are free to meet more than one of those options. For example, they can suppress the air bag in the presence of young children and also provide air bags that deploy in a low risk manner.

We recognize that the combination of suppression and low risk deployment may best achieve the goal of minimizing air bag risks. For example, low risk deployment air bags may provide benefits that would not be provided by systems that simply suppress the air bag in the presence of young children. It was in light of this recognition, as well as to avoid unnecessary design restrictions, that we were willing to make some adjustments between the SNPRM and the final rule to facilitate use of low risk systems. In particular, we were willing to raise the minimum test speed for the unbelted test from 29 km/h (18 mph) to 32 km/h (20 mph) while decreasing the test speed threshold for determining the stages to deploy in the low risk deployment tests from 29 km/h (18 mph) to 26 km/h (16 mph).

However, we believe that granting DaimlerChrysler's and Toyota's request to raise further the minimum test speed for the unbelted test from 32 km/h (20 mph) to 40 km/h (25 mph) (the same speed as the maximum test speed) would have significant adverse safety consequences.

Unbelted occupants are at significant risk of serious injury and fatality in crashes with a delta V between 32 km/h and 40 km/h (20 mph and 25 mph). Indeed, the agency's Final Economic Assessment for the advanced air bag final rule estimated that air bags designed for an unbelted rigid barrier test with a maximum test speed of 40 km/h (25 mph) would save 472 lives in crashes within the 32 to 40 km/h (20 to 25 mph) range. Of these 472 lives saved, 372 would be on the driver side and 98 would be on the passenger side.

We also believe that the change requested by these petitioners is unnecessary. As noted earlier, available technology enables vehicle manufacturers to meet the low risk and unbelted high speed protection requirements for *driver* air bags, even without using dual stage air bags.

As for passenger air bags, we note that the advanced air bag final rule does not require manufacturers to meet low risk requirements for passenger air bags. They can alternatively choose to meet the standard's risk minimization requirements for passenger air bags by suppressing the air bag in the presence of 3-year-old and 6-year-old children. A number of vehicle manufacturers appear to be pursuing this option.

Also, as discussed later in this document, we are making another change in the final rule that should resolve any concerns as to whether the need to meet the standard's high speed protection requirements for unbelted 50th percentile adult male dummies prevents manufacturers from providing low risk deployment for small children. In particular, we have decided to use 5th percentile adult female dummies, instead of 50th percentile adult male dummies, in the 26 km/h (16 mph) rigid barrier test that is used for determining the stage(s) of the air bag to be used for the passenger side low risk tests.

Thus, if a vehicle manufacturer faces a situation where deployment of both stages of a dual stage air bag is necessary to meet the unbelted barrier test requirements for 50th percentile adult male dummies in a 32 km/h (20 mph) crash test, and, because of grey zone issues, it is possible that both stages may fire in a 26 km/h (16 mph) crash, the manufacturer can design its air bag system, using occupant recognition technology, so that only the first stage will fire in the presence of 5th percentile adult female dummies in crash tests at these severity levels. Since only the first stage of the air bag would fire when 5th percentile adult female dummies are used in a 26 km/h (16 mph) rigid barrier test, only the first stage would be fired when conducting the low risk tests using child dummies.

C. Additional Tests

In addition to their request concerning the maximum test speed for the unbelted barrier test, the Consumer Groups requested that we make a number of other changes to address what they consider to be shortcomings of the final rule. They argued that the final rule fails to follow the Congressional mandate of providing advanced air bag protection for all occupants, male and female, large and small, belted and unbelted. The Consumer Groups requested that we amend the final rule to add a number of tests. They also asked that we change one test from a belted test to an unbelted test. These requests of the Consumer Groups are addressed below.

1. The Consumer Groups' Requests

Protection for unbelted occupants in crashes with soft pulses. The Consumer Groups argued that the final rule does not require protection for unbelted occupants in crashes with soft pulses. They stated that although NHTSA recognizes that many air bag fatalities occur in low speed, soft pulse crashes, where the air bag deploys late and strikes an out-of-position occupant who has moved forward in the crash before the air bag deploys, the agency failed to require any test to protect against this in the final rule. The Consumer Groups argued that the agency instead adopted only a belted offset deformable barrier test and an automatic suppression test. They argued that neither of these tests requires protection for unbelted occupants in crashes with soft pulses.

The Consumer Groups argued that conducting the offset test with belted dummies ignores the fact that unbelted occupants are at greater risk from air bags than belted occupants. They also argued that manufacturers might respond to the up-to-40 km/h (25 mph) belted offset test by suppressing deployment, whereas specifying the use of unbelted dummies would more likely require deployment and the use of multi-stage inflators. The Consumer Groups apparently believed (erroneously) that the offset test is conducted with a dummy only on the driver's side and argued that this omits requiring protection for passengers.

The Consumer Groups also expressed concern that the agency dropped the proposed dynamic out-of-position test requirements. They stated that the final rule contains only a series of static tests that are far simpler to meet than a dynamic test. They stated that weight-based static sensors can be fooled into false readings. They argued that the agency compounded this problem by deleting ''rough road'' testing.

The Consumer Groups requested that we require that the up-to-40 km/h (25 mph) offset deformable barrier test be conducted with unbelted rather than belted dummies and on both the driver and passenger sides.

High speed crash protection for 5th percentile adult females. The Consumer Groups also argued that the final rule does not ensure high speed crash protection for 5th percentile adult females. They objected to the agency's adopting a 56 km/h (35 mph) belted test using 50th percentile adult male dummies while deferring the decision whether to propose using 5th percentile adult female dummies until additional testing is completed. They argued that the agency's explanation that there is sparse information on the practicability of such a requirement is inconsistent with actions taken by the agency with respect to other requirements in this rulemaking.

The Consumer Groups requested that we require manufacturers to meet a 56 km/h (35 mph) belted barrier test with the 5th percentile adult female dummy as well as the 50th percentile adult male dummy.

Protection for unbelted 5th percentile adult females in oblique crashes. The Consumer Groups also objected to the fact that the final rule does not specify that the rigid barrier tests using 5th percentile adult females are conducted at angles but are instead only conducted in the perpendicular mode. They argued that in specifying oblique testing only using 50th percentile adult male dummies, the agency assumes that if the male is protected, so will the female. The Consumer Groups argued that this logic has led to many small women being killed by air bags. These petitioners stated that an oblique test of the 1997 Dodge Caravan conducted by NHTSA shows that interaction of the air bag with the anatomy of small women can lead to fatal air bag injuries.

The Consumer Groups requested that we specify that vehicles must satisfy the requirements of all barrier tests in both the perpendicular and oblique modes.

2. Agency Response to Consumer Groups' Requests

As we address the Consumer Groups' requests for additional tests, we begin by noting that no matter how many tests we include in Standard No. 208, it would always be possible to identify additional tests that represent potential real world situations. However, as we explained in the final rule preamble, it is necessary to strike a balance between ensuring that there are sufficient tests to meet the need for safety, and avoiding unwarranted compliance burdens.

We note that some of the additional tests requested by the Consumer Groups are ones that we dropped during the course of the advanced air bag rulemaking. After considering the comments on our original September 1998 NPRM, we tentatively concluded that we could reduce the number of originally proposed tests without significantly affecting the benefits of the rule. We were persuaded by the commenters that reducing the amount of testing was important, given resource limitations and the costs to manufacturers associated with certifying vehicles to such a large number of new test requirements. At the same time, we wanted to be sure that the advanced air bag rule included sufficient tests to ensure that air bags are redesigned to meet the goals mandated by TEA 21. Considering both of these factors, we included a reduced number of tests in our November 1999 SNPRM and in our May 2000 final rule.

While the final rule for advanced air bags includes fewer tests than our original proposal, it nonetheless specifies an unprecedented number of new tests, and mandates a much more comprehensive assessment of air bag protection than the earlier version of Standard No. 208. In the past, the standard assessed air bag protection solely by means of rigid barrier crash tests (or a temporary sled test) using a single size of test dummy positioned well back from the air bag. The final rule adds an entirely new series of tests to assess low speed risk to occupants of many different sizes. For the first time in the history of Standard No. 208, the agency will use dummies representing a 12-month-old infant, a 3-year-old child, a 6-year-old child, and a 5th percentile adult female. All of these new dummies will be used in assessing risk of air bags. For the belted and unbelted tests assessing high speed protection, performance will be evaluated using both the mid-sized male dummy positioned well back from the air bag *and* the new 5th percentile female dummy positioned as far forward as the seat and/or vehicle interior allows. Also, a new belted offset test using the 5th percentile female dummy will help ensure that vehicle manufacturers upgrade their crash sensing and software systems, as necessary, to better address soft crash pulses.

With this background in mind, we will address the specific requests of the Consumer Groups.

Protection for unbelted occupants in crashes with soft pulses. As discussed earlier, the Consumer Groups argued that the final rule does not require protection for unbelted occupants in crashes with soft pulses, where the air bag may deploy late and strike an out-of-position occupant who has moved forward in the crash before the air bag deploys. They asked that we require that the 0–40 km/h (0–25 mph) offset deformable barrier test be conducted with unbelted rather than belted dummies. In considering the Consumer Groups' petition, we have considered both the possibility of changing the test from a belted test to an unbelted test, and of adding an unbelted test in addition to the belted test.

In developing the advanced air bag rule, we focused a great deal of attention on identifying a sensible, effective array of requirements for increasing protection and minimizing risk. A considerable portion of the new rule is designed to help ensure the safety of unbelted occupants in crashes where occupants may be out-of-position and very close to the air bag. Occupants may move forward toward the air bag in crashes with soft pulses and/or as a result of pre-crash braking before the air bag deploys.

On the passenger side, the vast majority of deaths and serious injuries from air bags have been to young children. The rule requires vehicles to meet requirements for minimizing these risks, primarily by either automatically turning off the air bag in the presence of young children or deploying the air bag in a manner much less likely to cause serious or fatal injury to out-of-position occupants. If they so wish, manufacturers may choose to use a combination of those two approaches. There is also an option for a feature that suppresses the air bag when a child is out-of-position (including in dynamic events).

Manufacturers that decide to turn off the passenger air bag in the presence of young children will use weight sensors and/or other means of detecting their presence. To test the ability of those means to detect the presence of children, the rule specifies that child dummies be placed in child seats that are, in turn, placed on the passenger seat. It also specifies tests that are conducted with unrestrained child dummies sitting, kneeling, standing, or lying on the passenger seat.

The ability of air bags to deploy in a low risk manner is tested using unbelted child dummies placed against the instrument panel. The air bag is then deployed, and specified injury criteria performance limits must be met.

To address the risks air bags pose to out-of-position drivers, the rule requires vehicles to either have a driver air bag that is deployed in a manner much less likely to cause serious or fatal injury to out-of-position occupants or to have a feature that suppresses the air bag when a driver is out-of-position (including in dynamic events). The ability of air bags to deploy in a low risk manner is tested using unbelted 5th percentile adult female dummies placed against the steering wheel.

The Consumer Groups did not present any analysis to support their contention that these requirements are inadequate, or to support their assertion that suppression devices are likely to be Afooled'' into false readings. Moreover, we disagree with their characterization of the final rule as containing ''only a series of static-based tests that are far simpler to meet than a dynamic test.'' The ease or difficulty in meeting a particular test requirement does not depend on whether the test is static or dynamic, but instead on the overall nature of the test requirement. Moreover, in some situations, static tests can offer advantages over dynamic tests. For example, by using static tests to evaluate the ability of a suppression system to detect the presence of children, we are able to test many more potential real world conditions relating to how children might be positioned than if we specified dynamic tests.

As to the petitioners' concerns about dropping the proposed dynamic out-of-position test option and the rough road tests, we explained in the November 1999 SNPRM that both proposed tests had proven to be unworkable in their existing forms, and that both tests were unnecessary for safety. As to the option for a full scale dynamic out-of-position test, we explained in the final rule preamble that other options included in the final rule would accommodate the various advanced air bag technologies under development. With respect to the rough road tests, we explained:

> While rough road performance is certainly important, we do not believe there is any evidence that this is likely to be a real world problem. It would also be difficult to develop a test procedure that would assure that a dummy responded like a human to the forces imparted by a rough road. Indeed, the procedure we had proposed in the NPRM turned out to be impractical and did not accomplish its objective. Given our limited resources, we do not believe there is a need at this time to develop test procedures in this area.

The Consumer Groups were incorrect with respect to their apparent belief that the offset test is conducted with a dummy only on the driver's side. Dummies are positioned at both the driver and right front passenger positions.

These petitioners may, however, have meant to refer to the fact that the test is conducted only with the left side of the vehicle engaged with the barrier. (The left side of the vehicle is nearly always the driver side, although the driver sits on the right in a few vehicles.[5]) As we discussed in the final rule preamble, we believe that testing with the left side of the vehicle engaged with the barrier will be sufficient to help ensure that vehicle manufacturers improve their sensing systems. We stated, however, that we will monitor future air bag system designs and will consider changing this decision if we find that manufacturers are implementing sensor systems that optimize performance only for impacts into the left side of the vehicle.

The Consumer Groups also did not even attempt to demonstrate that requiring that the 0–40 km/h (0–25 mph) offset deformable barrier test to be conducted with unbelted rather than belted dummies (or with both belted and unbelted dummies) would result in any additional safety benefits, given the overall array of tests included in the advanced air bag rule to improve protection and minimize risk.

We added this particular test to encourage vehicle manufacturers to upgrade their crash sensing and software systems, as necessary, to better address soft crash pulses. As we noted in the final rule preamble, the improved sensing systems required by this test will benefit both belted and unbelted occupants. We also pointed out in the final rule that the belted offset test may represent the worst case scenario since the belt allows the dummy's head and neck to rotate into the path of the deploying air bag. This condition may better test for potential neck injuries than an unbelted test.

We also note that the unbelted rigid barrier test using 5th percentile adult female dummies, conducted at speeds between 32 and 40 km/h (20 and 25 mph), and the belted rigid barrier test using 5th percentile adult female dummies, conducted at speeds up to 48 km/h (30 mph), also help ensure protection of occupants who are close to the air bag, since the 5th percentile adult female dummies are positioned with the seats in the full forward position.

We conclude that it would be inappropriate to change the offset deformable barrier test from a belted test to an unbelted test. As discussed in previous rulemaking notices, this test was developed by Transport Canada. That agency found in its research that one of the causes of adverse effects of air bags is late deployment of some air bags in crashes with a ''soft crash pulse.'' In order to reproduce the softer, longer duration crash pulse, it selected the 40 percent offset barrier. Transport Canada found that in 40 km/h (25 mph) offset deformable barrier crash tests, the air bag typically deployed and was sometimes so late that the *belted* test dummy would be right on the steering wheel at that time, a ''worst case'' condition.

The test configuration represents a real world situation where small women who are wearing their seat belts may nonetheless be at risk from the air bag, since they are seated close to the air bag. This is a particularly common situation on the driver side, since small women typically need to sit close to the steering wheel in order to drive the vehicle.

By specifying that the belted 5th percentile adult female dummies are in the full forward position in this test, we can effectively test whether the air bag deploys late. Having the dummy unbelted would not improve the test. In addition, as noted earlier, the belted offset test may represent a worst case scenario as compared to the unbelted test. For all of these reasons, we believe it appropriate to maintain a belted 0–40 km/h (0–25 mph) offset deformable barrier test.

We have also considered the possibility of adding an unbelted 0–40 km/h (0–25 mph) offset deformable barrier test. Given the wide array of tests already included in the advanced air bag rule, and noting the fact that the Consumer Groups did not provide any evidence, we do not believe that there would be any significant benefits from adding this particular test.

After carefully considering the Consumer Groups' request that the 0–40 km/h (0–25 mph) offset deformable barrier test be conducted with unbelted rather than belted dummies, we decline to make that change.

High speed crash protection for 5th percentile adult females. The Consumer Groups also argued that the final rule does not ensure high speed crash protection for 5th percentile adult females, since the agency adopted a 56 km/h (35 mph) belted test using 50th percentile adult male dummies but deferred the decision whether to propose also using 5th percentile adult female dummies in that test until additional testing is completed. They requested that we require vehicles to meet a 56 km/h (35 mph) belted barrier test with the 5th percentile adult female dummy as well as the 50th percentile adult male dummy.

The Consumer Groups are incorrect in asserting that ''the final rule requires no high speed crash protection for the 5th% female.'' We note that while Standard No. 208 has long included high speed crash test requirements using 50th percentile adult male dummies, the advanced air bag rule establishes, for the first time, high speed crash test requirements using 5th percentile adult female dummies. For belted dummies, vehicles must meet injury criteria performance limits at speeds up to 48 km/h (30 mph), the

[5] DaimlerChrysler petitioned the agency to impact only the driver-side of the vehicle rather than the left-side. It noted that in some vehicles the driver sits on the right. We are not making the suggested change. Occupants on both the left and right side of the vehicle should be protected in an offset crash. However, one portion of the regulatory text, S18.1, references the driver side of the vehicle rather than the left side. That reference has been corrected.

same speed that has long been used for 50th percentile adult male dummies. For unbelted 5th percentile adult female dummies, vehicles must meet injury criteria performance limits at speeds from 32 km/h (20 mph) to 40 km/h (25 mph), the same speed range as will apply to unbelted tests with 50th percentile adult male dummies.

The final rule does increase the speed for the belted test using the 50th percentile adult male dummy from 48 km/h to 56 km/h (30 mph to 35 mph). This increase in test speed will be phased-in after the phase-in of the other requirements for advanced air bags is complete, beginning in the 2008 model year.

As we discussed in the advanced air bag final rule preamble, we did not include the 5th percentile adult female dummy in this requirement because we had sparse information on the practicability of such a requirement. We stated that we would initiate testing to examine this issue and anticipated proposing to increase the test speed for belted tests using the 5th percentile adult female dummy to 56 km/h (35 mph), beginning at the same time that the 50th percentile adult male is required to be used in belted testing at that speed. We note that Congress gave us money in our FY 2001 budget to do research to gather information in this area.

We disagree with the Consumer Groups' assertion that it is ''arbitrary and capricious'' for the agency to conduct testing that will help us determine whether a 56 km/h (35 mph) belted rigid barrier test requirement using 5th percentile adult female dummies is practicable, prior to proposing and adopting such a requirement. We believe that testing before imposing a requirement represents a rational approach to establishing safety performance requirements. We also disagree with the Consumer Groups' suggestions that we are being inconsistent as compared to our actions with some of the other requirements for advanced air bags, such as the out-of-position requirements for 5th percentile adult female drivers and children. The amount of testing and analysis that may be needed to establish the practicability of a particular requirement varies with the requirement at issue. We note, however, that we did conduct significant testing and analysis concerning the out-of-position requirements for 5th percentile adult female drivers and children.

After considering the Consumer Groups' request that we establish a requirement now for vehicles to meet a 0–56 km/h (0–35 mph) belted barrier test with the 5th percentile adult female dummy, we decline to take that action. However, depending on the results of our testing, we continue to anticipate proposing to increase the maximum test speed for belted tests using the 5th percentile adult female dummy to 56 km/h (35 mph), beginning at the same time that the 50th percentile adult male is required to be used in belted testing at that speed.

Protection for unbelted 5th percentile adult females in oblique crashes. The Consumer Groups also objected to the fact that the final rule does not specify that the rigid barrier tests using 5th percentile adult female dummies include oblique tests. They requested that we specify that vehicles must satisfy the requirements of all barrier tests in both the perpendicular and oblique modes.

We note that the oblique tests using the 5th percentile adult female dummy, as well as the oblique tests using the belted 50th percentile adult male dummy, were among the ones we dropped during the course of the advanced air bag rulemaking. We were persuaded by the commenters that reducing the amount of testing was important, given resource limitations and the costs to manufacturers associated with certifying vehicles to such a large number of new test requirements. Moreover, looking at the whole array of test requirements included in the advanced air bag rule, we believed that these tests were unnecessary.

As we have explained before, the primary purpose of oblique tests is to ensure that air bags are sufficiently wide to provide protection if an oblique crash results in the occupant moving forward at an angle. The test that presents the greatest challenge with respect to the width of the air bag is the unbelted test using the 50th percentile adult male dummy.

As we explained in the final rule preamble, we dropped the requirement for conducting oblique angle tests on vehicles using 5th percentile adult female dummies because we believed that if a vehicle can pass the perpendicular test with 5th percentile adult female dummies and the oblique tests with unbelted 50th percentile adult male dummies, it would also likely pass the oblique test using 5th percentile adult female dummies. We explained further that we dropped the belted oblique angled tests for the 50th percentile adult male dummy because, given the unbelted oblique tests using that dummy, we believed that the belted oblique angled tests are unnecessary. We noted that the unbelted oblique tests are more stringent than the belted oblique tests in this respect, since the belts limit occupant movement, and that the unbelted oblique tests, which are being retained, will ensure that air bags are sufficiently wide to provide protection when occupants move forward at an angle in oblique crashes.

Upon reconsideration, we continue to believe that the current array of tests strikes a reasonable balance between ensuring that there are sufficient tests to meet the need for safety, and avoiding unwarranted compliance burdens. Given the entire array of tests that both ensure protection and minimize risk, and in light of the reasons discussed above, we do not believe that adding additional oblique crash test requirements would produce significant safety benefits.

We disagree with the Consumer Groups' assertion that in specifying oblique testing only using 50th percentile adult male dummies, the agency ''assumes that, if the male is protected, so will the female.'' Our decision reflects careful analysis of the practical effects of the various requirements on air bag design, and the contribution each requirement makes to ensuring protection and reducing risks.

4. Positioning Procedure for the 5th Percentile Adult Female Test Dummy (Barrier Test)

The final rule established a new positioning procedure for the 5th percentile adult female test dummy in the dynamic crash tests. This procedure used the dummy legs' relationship with the front of the seat to determine where the dummy's H-point would be set. The seat would then be moved forward until the seat reached its full-forward position or until a dummy leg contacted the vehicle interior. Under the final rule, the legs are moved into position; e.g., the driver's leg is adjusted to place the foot on the pedal, only after the seat has been moved forward.

We received several comments and petitions regarding various aspects of the 5th percentile adult female dummy positioning procedure. Mitsubishi and DaimlerChrysler raised questions about the relationship between the seat cushion angle and the seat position. Honda commented that not specifying a seat position before the dummy is placed in the vehicle could lead to repeatability problems. As with the low-risk test conditions, Mitsubishi queried whether the centerline of the seat was the geometric center of the entire seat or only of the designated seating area. Honda, Mitsubishi, DaimlerChrysler, and the Alliance all had concerns about positioning the legs and feet. These concerns were focused on placement of the left foot on the foot rest, early interference of the dummy legs with the steering wheel or column, and the distance between the dummy's knees when initially positioning the dummy.

At the December, 2000 technical workshop, VW asked what seat position would be required for vehicles with seat cushions that could be lengthened or shortened. Honda noted that in some of its vehicles it could not position the seat in a full forward position using the existing procedure. A more general discussion followed exploring possible solutions to the problem raised by Honda.

We have reviewed the petitions and the seating procedure specified in the final rule. After experimenting with the test procedure in several vehicles, we have determined that the seating procedure specified in the final rule should be modified to better address potential problems in production vehicles. The primary problem with the existing seating procedure is that early dummy contact with the steering wheel, steering column, or knee bolsters can preclude placing the seat in the full forward seating position. As we noted in both the NPRM and the SNPRM, we believe it is critical to test with the seat in the most forward designated seating position because this represents the worst case position. A procedure where the final seat position is closer to mid-track than full forward circumvents the intent of the final rule. Since the existing procedure led to this result in some vehicles, we have determined the procedure and the regulatory text should be changed to address early contact with interior components.

Rather than requiring the knees be at a 90 degree angle when placing the dummy in the seat and moving the seat forward, we are now specifying that the knees be placed at a 120 degree angle at the beginning of the seating procedure. By changing the initial knee angle, it is now possible in most vehicles to move the seat into the full forward seat position and to have the right foot reach the accelerator. In some cases, the steering wheel or steering column will still prohibit moving the seat into a full-forward position. In those instances, we are now specifying that the steering wheel be adjusted upwards to facilitate dummy placement and that the legs then be splayed if needed. The steering wheel height will be returned to the mid-position prior to running the barrier tests. We note that we are making these changes not because we believe that people actually engage in such acts each time they enter their vehicle, but because the dummies are much more difficult to place in a vehicle given their relatively stiff structure.

There may be instances where, even with the new procedure, it is impossible to place the dummy in a full-forward seating position. In such instances, we will use the new procedure and move the seat forward until there is no more than a 5 mm (0.2 in) clearance between the dummy and the vehicle interior. Given the variety of vehicle interior designs, we do not believe it is possible to develop a test procedure that allows dummy placement in a full-forward position in every vehicle. However, we have determined that this is not a significant problem. Using the new procedure, we were able to place the dummy in a full-forward position most of the time. We did find that in the Dodge Grand Caravan we were only able to get the seat within one quarter inch of the full-forward position. In the Dodge Durango, we were only able to get the seat within one-and-one-quarter inch of the full-forward position. In both cases, the seat was much closer to the full-forward position than to the mid-track position. We do not expect manufacturers to introduce excessive molding and contouring into the vehicle interior to prevent the dummy from reaching the full forward position since that approach would invariably have a negative effect on vehicle sales. People will not buy cars that they cannot drive. To the extent manufacturers rely on such molding and contouring to keep the occupant away from the air bag, they will also have to provide some countermeasure to ensure that individuals can reach the accelerator and brake. If we find that manufacturers mold the steering column or knee bolsters primarily to prevent the dummy from being placed in a full-forward position, we may amend the regulation.

Other minor changes have been made in the seating procedure to ease placement of the dummy in the full-forward seat position and to address the specific issues raised by the commenters. First, the new seating procedure provides specific information on seat location and configuration prior to placing the dummy on the seat; this accounts for vehicle seat cushions that can be adjusted without changing the seat track. Second, the legs are positioned equidistant from the center of the steering wheel rim to improve repeatability. Third, the left foot is now positioned on the toe board unless it is impossible to maintain that position. In that case, the left foot is placed on the floor pan.

5. Issues Related to Minimizing the Risk of Injuries and Deaths Caused by Air Bags

The advanced air bag final rule implemented numerous measures designed to minimize the risk of serious injury or death caused by deploying air bags. On the passenger side, these measures were directed primarily towards small children, while on the driver side, the measures were directed toward individuals, primarily small women but also other out-of-position occupants, who are close to the air bag at the time of deployment. Because we wished to avoid being unnecessarily design-restrictive, the agency provided manufacturers with multiple compliance options to reduce these risks. On the passenger side, we allowed both automatic suppression and dynamic suppression systems, as well as systems that utilize low-risk deploying air bags. For the driver side, we allowed a dynamic suppression system or low-risk deployment systems.

While we are aware of some long-range development work in the area of dynamic suppression systems, we do not know of any manufacturers who currently plan on using such systems as a method of certifying compliance with the requirements of the final rule. We received no petitions for reconsideration on that option. We have received numerous petitions for reconsideration on various aspects of the automatic suppression and low-risk deployment options.

A. Automatic Suppression Requirements

Several petitions were filed concerning the automatic suppression option, most of which addressed the level of seat belt cinch-down force for the belted test procedures and the selection of child restraints. Additionally, Toyota stated that given the wide variation in ''cushion hardness'' and ''cover tightness'' in production seats, it did not believe it could certify compliance for the 6-year-old child using automatic suppression. It also raised concerns about the use of current test dummies for testing automatic suppression systems.

1. Child Restraints

The primary concern raised by petitioners regarding automatic suppression systems regarded the belt cinch-down requirement for rear-facing child restraints systems (RFCRS) and convertible child restraint systems. The final rule specifies that the car bed, the RFCRSs and the convertible child seats specified in Appendix A to the final rule all need to pass certain compliance tests with the child restraints in both a belted and unbelted condition. In the belted tests, the seat belt is to be cinched down at 134 N (30 lbf) as measured at the outboard section of the lap belt.

Toyota, the Alliance, DaimlerChrysler and Takata all commented that they believed the 134 N (30 lbf) cinch-down force was unreasonable. They argued that this force was impossible to achieve and often placed the child seat in an unrealistic position. They also argued that one would not expect to see a child seat installed with this level of force in the real world. Petitioners urged NHTSA to adopt a cinch-down force of 67N (15 lbf), which is currently specified in Standard No. 213. Toyota posited that perhaps NHTSA was measuring the seat belt force differently than manufacturers and suggested a detailed test procedure be provided to assure that the 134 N (30 lbf) force could be achieved.

Additional concerns were raised at the technical workshop held in December, 2000. Ford observed that a system it is evaluating, which uses a load cell built into the seat belt system, had difficulty differentiating between a child seat installed at 134 N (30 lbf) and a large adult occupant that was straining against the seat belt. Delphi noted that when RFCRSs were installed without a base at the required force level, the restraint flipped up against the back of the passenger seat unless towels or blankets were placed under the restraint. Isuzu remarked that on one of its vehicles, the load cell could not be placed in the position required by the final rule because of a sheath that encases the belt on the outboard side. Testing on the Isuzu vehicle provided for the workshop verified that the load cell being used at the workshop did not fit in the specified location. Finally, our own testing in preparation for the workshop indicated that the 134 N (30 lbf) force level was impossible to achieve with the car bed specified for testing because that car bed does not use a rigid structure for feeding the seat belt through the restraint. Indeed, we noted that the greater the force placed on the seat belt, the less realistic the test became, because the car bed was tipped up off the seat and toward the seat back.

Several commenters also noted that some of the child restraints listed in the appendix to the final rule were already obsolete. Toyota and the Alliance urged us to reconsider developing a standardized test device that could provide a common ''footprint'' for seat-based suppression systems. At the December workshop, DaimlerChrysler requested we clarify the time frame that child seats on the list would be used as potential test devices in the agency's compliance tests. DaimlerChrysler also urged the agency to establish a point in time, such as the date of certification, at which the list of child restraints becomes final for the purpose of compliance tests. It was concerned that it could be responsible for the recognition of child restraints for which the suppression system had not been designed.

Finally, DaimlerChrysler introduced in its petition some clarifying language regarding the use of Standard No. 225 restraint attachments in vehicles that are equipped with such attachments in the front seat. DaimlerChrysler also suggested that the automatic suppression tests be conducted with and without tethers, arguing that tethers can place additional weight on the seat and could reflect a ''worst case'' scenario.

We have decided to retain the 134 N (30 lbf) cinch-down requirement specified in the final rule for all child seats except the car bed. The car bed will be installed in accordance with the restraint manufacturer's installation instructions, and a cinch-down force will not be measured.

We believe the primary problem related to belt cinch-down is the level of variability in the load cell measurement. Indeed, we found at the December 2000 technical workshop that the load cell we used provided widely variable readings. Subsequent to the workshop we obtained a smaller load cell that is specifically designed for use on a seat belt. The smaller load cell is designed to measure loads only up to 447 N (100 lbf), which significantly decreases the amount of variability in measurement. With this load cell, we found that consistent results could be obtained for at least five minutes, establishing that the load cell was measuring force in a repeatable manner. These readings were above 134 N (30 lbf). Additionally, the child restraints were positioned in a stable and realistic manner. We were able to achieve the load levels using the test procedure laid out in the final rule, although in some instances the plastic button that some manufacturers place on belts to keep the buckle from sliding down on the unsecured belt had to be removed. Thus, we do not believe there is any need to change or refine the existing test procedure. While we are not adding a provision to the regulatory text, we do intend to remove the plastic button if it prevents us from reaching a 134 N (30 lbf) force. This button is not required under any Federal motor vehicle safety standards.

We note that it will likely be impossible to maintain a cinch-down force in excess of 134 N (30 lbf) once the test dummy or child is placed in the child restraint. The test procedure does not require that the cinch-down force remain stable once the restraint is occupied. This is because the intent behind the 134 N (30 lbf) cinchdown requirement is to replicate the installation of a child restraint by individuals who have been trained in such installation. Given our ability to consistently achieve a 134 N (30 lbf) force, we continue to believe some installers will install child restraints at this level. However, once a child is seated in that restraint, the amount of force applied to the seat belt will ease up.

We reject Toyota's suggestion that we adopt a maximum cinch-down force of 67 N (15 lbf). As noted by Toyota, this is the maximum force required by Standard No. 213. That standard specifies a cinch-down force between 53.2 N and 67 N (11.9–15 lbf). The purpose of measuring cinch-down force is different in Standard No. 213 than in Standard No. 208. In Standard No. 213, the intent is to replicate the circumstances under which most child restraints are installed and then to test how well the restraint protects an occupant when so installed. As such, 67 N (15 lbf) cinchdown force does not represent a ''worst case'' scenario for testing the child restraint. In Standard No. 208, we want to be sure that the air bag suppression systems in vehicles perform properly under a worst case scenario; i.e., when a properly installed seat that is cinched down in a manner that might fool an inadequate suppression system into believing the seat is occupied by someone other than a small child.

We recognize the difficulties Ford is currently experiencing with the load cells that it was planning to use in its vehicles. However, we believe manufacturers will be able to improve this type of technology, and note that even with this technology, the presence of pressure on the safety belt is only one of the factors considered by the suppression system to determine whether to suppress.

As for Isuzu's problems in getting a load cell to fit on the seat belt, we note that it may need to shorten the sheath on the belt to conduct compliance testing. As a larger matter, we hope Isuzu would do this anyway because we are concerned that its sheath may make routine installation of some child restraints unduly difficult. We recommend all vehicle manufacturers consult SAE recommended practice J1819, Securing Child Restraint System in Motor Vehicles (Rev 11/94) when designing their seat belts to assure a good fit between the vehicle and the child restraint.

We have decided against changing our test procedure to allow the use of rolled up blankets or towels when installing the child restraint. As noted in the final rule, we expect manufacturers to design their suppression systems to recognize the presence of a towel or blanket. However, we do not believe we should add a requirement that child restraints be tested with such objects since that would significantly add to the manufacturer's compliance burden. We recognize that in some instances testing facilities will need to exercise care in applying the cinch load so that the child restraint does not shift from the proper position.

We have updated the list of child restraints contained in Appendix A to Standard No. 208, removing those restraints that are no longer in production. These models have been removed from Appendix A, and replacement restraints have been added. We are not adopting Toyota and the Alliance's suggestion that a common ''footprint'' test device be developed for testing automatic suppression systems. As stated in the final rule, passing a compliance test using a test device that is not representative of near-term production child restraints provides no assurances that the automatic suppression systems will actually work in the real world. The only way to relieve this concern would be to require all child restraint manufacturers to incorporate that footprint into their restraints. We decided in the final rule that there was no need to be so design restrictive, and petitioners have offered no new arguments that would lead us to change our position on this matter.

We believe DaimlerChrysler's concern over how a manufacturer can assure a given vehicle will be tested using the restraints on a specific list is valid. Manufacturers are not responsible, as a matter of certification, for child restraints that are not included in the appendix on the date of vehicle certification. We believe the text of Appendix A is clear in that regard. However, problems may arise when the appendix is updated with insufficient leadtime to reasonably permit manufacturers to assure compliance of vehicles with the updated list. Other than the updated appendix that is part of this rule, which is effective in 30 days, we will specify in the text of any updated appendix that its effective date shall be at least one year from the date of publication. All vehicles certified on or after that effective date will need to comply with the standard using the restraints on the updated list. We believe this one-year leadtime will provide manufacturers with sufficient time to ensure that their vehicles comply. Providing an effective date in the text of the appendix will also avoid any confusion as to which set of restraints are to be used to test a given vehicle.

We note that some vehicle manufacturers may wish to certify compliance with the updated appendix prior to the effective date of the appendix. We will allow this type of ''early compliance'' as long as the manufacturer notifies us that it is irrevocably exercising this option.

We believe DaimlerChrysler's suggestion for clarifying language regarding the use of Standard No. 225 vehicle restraint attachments improves the clarity of the regulatory text. Accordingly, we have adopted those changes. However, we decline to accept DaimlerCrysler's suggestion that we test child restraints with any tethers attached. We believe attaching the tethers would represent the worst case scenario in only one instance; i.e., if the automatic suppression system used only the force of tension against the belt to determine whether to suppress. In this instance, the suppression system could determine that a heavier occupant was in the seat. However, as noted earlier, we do not believe a suppression technology could depend solely on the force measured against a seat belt and meet all of the test requirements for suppression systems.

2. Dummy Positioning

The final rule did not specify extremely detailed positioning procedures for dummies used in the testing of automatic suppression systems. Toyota petitioned that the positioning procedure be specified in greater detail, particularly the spacing between the knees (S22.2.2.6) and the feet (S22.2.2.5). It also petitioned to change the test procedure that tests for a child lying on the seat. Likewise, Mitsubishi raised questions about how to find the geometric center of the seat for determining the location of Plane B and questioned whether the seat height was in the mid-position. Toyota requested that Plane B be defined in relation to the H-point rather than the entire seat.

At the technical workshop, TRW presented data indicating that the knee angle established in the 5th percentile female seating procedure had the effect of shifting too much weight to the floor pan, making the weight on the seat resemble the weight of the 6-year-old test dummy.

DaimlerChrysler opined that the requirement to make sure any threads used to hold a dummy in position do not interfere with the air bag was overly stringent. It argued that the location of the thread in relationship to the air bag was irrelevant since the air bag is not deployed in any of the automatic suppression tests. Isuzu noted an apparent typographical error in the position that tests for a child leaning against the door (S24.2.3). It stated that the regulatory text should allow a maximum distance of 5 mm (0.2 in) between the dummy and the vehicle interior rather than a minimum distance of 5 mm (0.2 in).

For the most part, we have decided against adopting positioning procedures more detailed than those in the final rule. We want the positioning procedures to be broad to ensure that the automatic suppression systems will work in the myriad of occupant positions that occur in the real world. More precision in test positions would permit manufacturers to certify suppression systems that work when occupants are in the specified position but may not work if the occupant were positioned slightly out of this position. Accordingly, although the procedures set forth in the final rule may not be precisely repeatable, this is consistent with the purposes of the rule and helps to assure the proper performance of the suppression systems in the real world.

We have refined the seating procedure for the child-lying-on-seat position. As Isuzu noted in its petition, the final rule does not specify a longitudinal position. We agree that the position described in the final rule may be ambiguous with regard to the placement of the dummy against the vehicle's seat back. Accordingly, we have added language to the regulatory text specifying that the dummy is to be positioned as far back in the seat as possible.

We have also made some changes to the positioning procedure for the test that represents a child kneeling on the seat, facing forward (S22.2.2.6). Upon review of the regulatory text, the agency believes it makes more sense to state where the dummy should be positioned on the seat before placing the dummy on the seat, rather than having the dummy placed on the seat and then only later specifying how it was to be placed. Additionally, the requisite 90 degree angle at the knee has proven unworkable in vehicles with sloped seat cushions. This is because keeping the spine vertical and the knees at 90 degrees could mean that the legs do not fully contact the seat cushion. Accordingly, the reference to a specific leg angle has been removed and the legs are to follow the contour of the seat cushion while maintaining a vertical spine.

Plane B is used to place the child dummies roughly in the center of the seat. In defining Plane B in the final rule, we specified that the plane would be aligned along the geometric center of the seat parallel to the longitudinal centerline of the vehicle. We believe it may be clearer to specify that Plane B is aligned along the longitudinal centerline of the seat rather than the geometric center. We acknowledge that in vehicles where the outside seat bolster is larger than the inboard seat bolster, the center of the designated seating position may be slightly different than the center of the actual seat. We do not believe this difference will be significant. Accordingly, we have decided against adopting Toyota's recommendation to use the H-point. We believe it is appropriate to establish Plane B as a plane that can be practically and repeatedly defined. In keeping with our desire to have automatic suppression positioning procedures that are not overly specific, we have decided against adopting a plane that is defined by the H-point rather than the overall measurements of the seat.

As discussed above, the seating procedure for the 5th percentile adult female has been changed in various respects. One of those changes involves changing the initial knee angle from 90 degrees to 120 degrees. We believe this change will largely resolve the problem addressed by TRW's presentation at the technical workshop. We also note that using humans rather than test dummies may resolve any lingering problems in this regard.

DaimlerChrysler is correct that there is no need to specify that the placement of threads used to hold the dummy in position not interfere with the air bag. The automatic suppression tests do not involve deployment of the air bag. Accordingly, it is irrelevant where these threads are located relative to the air bag. This requirement has been removed.

Isuzu is correct that the intent of the leaning against the door test procedure is to have the dummy contact the door, not to avoid contact. Thus, the requirement for a minimum distance from the vehicle interior has been changed to specify a maximum allowable distance from the vehicle interior.

3. Use of Humans for Testing Automatic Suppression Systems

Toyota raised several issues in its petition related to the use of current anthropomorphic test dummies and humans in automatic suppression tests. Initially, it urged the agency to work with industry in developing better test dummies because of the recognition problems many automatic suppression systems have with the current test dummies. Mitsubishi echoed this request. Not only are the current dummies not physiologically accurate enough to mimic the human form or characteristics, but according to Toyota, these dummies shift up the suppression threshold when compared to humans of the same weight. Thus, as many as 50 percent of the tests conducted by or on behalf of Toyota with the 5th percentile adult female test dummy did not detect the presence of that dummy at the weight needed to turn off the suppression system; i.e., to assure that the air bag would deploy in a crash.

Toyota was dissatisfied with the option that they certify their systems using humans within specified height and weight ranges because it believes those parameters allow for too much variation in physiology to make humans practical test objects.

Finally, Toyota maintained that NHTSA should specify as part of the regulatory text that it will conduct its compliance tests using the test device used by the vehicle manufacturer when it certified its system. Thus, if certification was based on tests with human test objects, NHTSA would conduct its compliance tests using humans. Likewise, if the manufacturer used a test dummy to certify compliance, the agency would use test dummies in running its compliance tests.

At the December 2000 workshop, TRW presented data indicating that the seated weight distribution of the 5th percentile adult female test dummy is sufficiently different from the seated weight distribution of a seated human who is in the weight and height range specified in the final rule.

We recognize there may be some variations in using humans instead of a test dummy. As discussed in both the SNPRM and the final rule, the fact remains that no physiologically accurate dummy currently exists. This is why we decided to allow manufacturers to certify compliance with the automatic suppression requirements using either the existing test dummies or human beings. Thus, while we note Toyota's concerns, we see no alternative beyond what is already in the final rule. If Toyota finds that its automatic suppression systems cannot adequately distinguish between the 6-year-old child dummy and the 5th percentile adult female test dummy, then it may certify compliance using humans.

As noted in the final rule, certifying compliance using humans for recognition purposes constitutes exercising a specific compliance option. Thus, NHTSA must be told whether certification to the automatic suppression option was based on recognition of dummies or of humans. We will conduct our compliance tests using the type of occupant used by the manufacturer. We note that manufacturers will not be able to come back to the agency, in the event of a noncompliance, and argue that the system would meet the requirements if another type of occupant were used. Likewise, manufacturers cannot use humans for some portion of the automatic suppression test for a given size child/dummy and test dummies for other portions related to that size child/dummy.

We do not believe it is useful to further restrict the size and weight ranges of the humans that may be used for conducting compliance tests. As an initial matter, further restrictions will make it more difficult to find surrogates for use in the tests. More importantly, adopting narrower parameters has the potential of reducing the effectiveness of automatic suppression systems in the real world. As explained above in our discussion of the positioning procedures for child-size occupants, we believe automatic suppression systems need to be very robust. This is why we have refused to adopt more stringent positioning procedures in many of the automatic suppression tests. The same rationale applies here.

B. Low-Risk Deployment Options

In the final rule, the agency adopted the low-risk deployment tests that were proposed in the SNPRM with two modifications. First, we decreased the speed in the crash test that determines the low-risk stage of deployment from 29 km/h (18 mph) to 26 km/h (16 mph). We have already addressed the comments and petitions for reconsideration that deal with this change. Second, we reduced the number of steps involved in placing the dummies in a final position because we were concerned that small variations in the procedure, as well as specific vehicle configurations, could lead to significant variations in final placement of the dummy. Since the only position we are interested in is the final one, it seemed reasonable to specify that position and not address how it was reached. However, we retained, with slight modifications, the step-by-step procedure proposed in the SNPRM for the head-on-instrument-panel test position because we believed it was impossible to specify a final position for that test with sufficient clarity. We also set the test duration at 300 ms, as measured by the point where the air bag is signaled to deploy, taking into account DaimlerChrysler's observation that peak injury readings could occur after the 100 ms time frame proposed in the SNPRM.

We received several petitions regarding the test procedures for both the driver and passenger low-risk deployment tests, as well as the 300 ms time frame specified in the final rule for those tests. Additionally, several issues regarding the low-risk deployment test procedures were raised at the December 2000 technical workshop. More detailed discussions are given below that directly address the petitioners' specific concerns.

1. 300 ms Test Duration

In the final rule, we extended the period of time for which we would collect data from the proposed 100 ms to 300 ms, relying in large part on DaimlerChrysler's comments to the SNPRM that the proposed 100 ms timeframe was too short to allow clearance of the dummy from the air bag in some systems.

Several petitioners, including Toyota, the Alliance, TRW, and DaimlerChrysler have argued against the extension of the 300 ms data acquisition requirement for measuring injury criteria in the low risk deployment tests. Toyota, Takata, and the Alliance argued that data should only be counted prior to impact of the head, neck and torso with interior components other than the air bag. Toyota indicated that its dynamic tests showed that interaction with these other interior components were not significant. However, in its static tests, the peak injury values were the result of dummy interaction with these components. Arguing that the dynamic tests better represent actual crash events, Toyota stated that the data produced as a result of interaction with interior components other than the air bag were of little consequence and should not be counted. Toyota, Honda and VW noted that their primary problem with the 300 ms time frame was that the lack of requirements regarding seat track, height, and seat back angle made it impossible for them to determine whether a dummy could meet all applicable injury criteria for that period of time since they could not determine how the dummy would respond in all the possible seat positions. The Alliance suggested the test last until the dummy was no longer in contact with the air bag or 300 ms, whichever occurs first.

DaimlerChrysler argued that since the 300 ms range was not included in either the NPRM or the SNPRM, commenters did not have sufficient opportunity to comment on it.

We adopted the 300 ms time duration after DaimlerChrysler commented that the 100 ms time duration proposed in the NPRM was insufficient for some air bag systems. Contrary to DaimlerChrysler's assertion, the issue of time duration for low risk deployment tests was raised in the SNPRM and the 300 ms requirement was adopted in light of the comments to that document. Because of the concerns originally raised by DaimlerChrysler, we continue to believe a time duration less than 100 ms would be too short.

We adopted a specific period of time for measuring injury criteria because we do not want manufacturers to claim that a test is over for compliance purposes even though air bag-related injuries are possible. In order to address the petitioners' concerns, NHTSA reviewed its out-of-position tests to determine if there is a need to further truncate the data. We reviewed twelve tests conducted at VRTC. Seven of the twelve tests were conducted with a 5th percentile adult female dummy in the driver position, and five were conducted using the 6-year-old child dummy on the passenger side. In the seven driver tests the sole failure mode was Nij, with the latest failure occurring at approximately 40 ms. The earliest moment of contact with the vehicle interior was at 62 ms, and the earliest point at which the dummy was clearly no longer in contact with the air bag was at 58 ms. In the five passenger tests there were HIC, chest deflection, Nij, neck tension, and neck compression failures. The earliest contact with the vehicle and the earliest clear indication that the dummy was no longer engaged with the air bag were both at approximately 50 ms. Two of the five tests had peak neck injury readings after 50 ms, with the latest peak measurement recorded at 104 ms.

We are not adopting the recommendation made by the Alliance that injury criteria be measured for 300 ms or until the dummy is no longer in contact with the air bag, whichever occurs first. We believe this proposal to subjectively determine when the dummy is no longer in contact with the air bag is inherently nonobjective, and would be unmanageable from a compliance perspective. Measuring injury criteria for a specific period of time is the most objective way to assure that the requisite injury criteria are met for the duration of the test.

As noted in the preamble to the final rule, we do not believe that all dummy contact with the vehicle interior would necessarily be the result of dummy interaction with an overly aggressive air bag. Nevertheless, we are concerned that peak injury measurements that are recorded early in the crash event could be the result of an air bag propelling the dummy backward with excessive force. Likewise, we are concerned that with a multiple-stage air bag, those stages that are deployed later in the crash event could be sufficiently aggressive to cause injury. The test duration for low risk deployment tests should accurately reflect the propensity of the deploying air bag to harm an occupant while it is deploying. Thus, we are adopting a time duration for the low risk deployment test of 125 ms from the initiation of deployment of the final stage air bag that will fire in a 26 km/h (16 mph) crash. We believe this time frame will adequately measure air bag-related injuries without penalizing manufacturers for injuries sustained by vehicle contact that is unrelated to the air bag deployment. However, we intend to monitor our test data to determine whether all air bag-related injuries are in fact being included within the specified time period. If they are not, we may consider increasing the period of time for measuring injury criteria in the compliance tests.

We believe that currently manufacturers would not deploy the last stage of an air bag more than 100 ms after first initiating an air bag deployment. Thus, the injury criteria would likely only be measured up to 225 ms, and often for an even smaller period of time. Vehicle manufacturers will be required to provide NHTSA with the time interval between the initial signal to deploy the air bag and the initiation of the final stage of deployment so that we will know when to stop counting the injury measurements. We note that the 300 ms time duration remains in full effect for all barrier tests.

2. Seat Positioning

Toyota requested that all the low risk test procedures incorporate specific seat positions. They argued that more specificity was needed to achieve repeatable results. At the public workshop, other participants echoed this request, stating that the lack of seat position requirements, when coupled with a 300 ms test duration, prevented them from controlling injury measurements after the dummy's head and chest had cleared the air bag. They said they would need to test in all possible seat positions to ensure that a dummy rebound would not cause unacceptably high injury measurements.

We believe we have largely resolved the petitioners' concerns regarding the location of the seat by reducing the duration of the low risk deployment tests. However, because we are rejecting a test duration that is defined by when the dummy clears the air bag, we believe there may still be value in specifying the seat position. Accordingly, seat track, seat height, head restraint, and seat back angle are now all specified in the positioning procedures for each of the low risk deployment tests.

3. Tests to Determine Which Stage of Deployment Will Be Used in the Low Risk Deployment Tests

The final rule requires all vehicles certified to the advanced air bag requirements pass a static low risk deployment test or dynamic suppression test on the driver side and a low risk deployment, automatic suppression test, or dynamic suppression test on the passenger side. These requirements are consistent with TEA 21's mandate to reduce the risk of air bag injury to all front-seat occupants in low speed crashes, particularly small women and children.

The low risk deployment test actually consists of two different types of tests, a dynamic crash test and a static low risk deployment test. Each type of test serves a specific purpose.

Prior to conducting the various static low risk deployment tests, the manufacturer must first determine which stage or stages of the air bag to deploy in the static low risk test. This is determined by running a dynamic, frontal barrier crash test at 26 km/h (16 mph) (except for the 12-month-old child dummy, where the dynamic test is run at 64 km/h (40 mph)). Under the May 2000 final rule, all of these dynamic tests, except for the one involving low risk deployment technology for infants, are run using an unbelted 50th percentile male dummy in the mid-track seat position.[6] The use of the 50th percentile male dummy in the dynamic crash test effectively makes crash speed the sole determinant of which stage or stages of the air bag fires in the static low risk deployment test. Injury measurements are not recorded.

Once the appropriate level of deployment has been determined, the specified static low risk deployment test is run for each of the dummies for which the manufacturer has certified to the low risk deployment option, and injury criteria are measured. The static low risk deployment tests are conducted with a 5th percentile adult female at the two specified positions on the driver side and either a 6-year-old child, or 3-year-old child dummy at the two specified positions on the passenger side (the manufacturer may use a combination of automatic suppression and low risk deployment systems).

The purpose of determining compliance with the injury criteria using the 5th percentile adult female dummy on the driver side and with the 6-year-old and/or 3-year-old dummies on the passenger side is to ensure that the low risk deployment is sufficiently benign to prevent air bag-related serious injuries or fatalities to the entire population of individuals who are exposed to a low risk deployment in a low-speed crash. Compliance with the injury criteria is determined using only the dummies that represents historically the most-at-risk individuals within the greater population because requiring tests using all the dummies represented by the greater population would be overly expensive. In issuing the final rule, we assumed that heavier individuals would not be seriously injured by an air bag that meets the injury criteria for the smaller dummy.

DaimlerChrysler petitioned us to have the dynamic tests run with the dummies which will be used in the static low risk deployment tests rather than with a 50th percentile adult male dummy. DaimlerChrysler's petition for reconsideration made four arguments: the sole purpose of the dynamic test is to determine what stage air bag to deploy in the static low risk deployment test; using the 50th percentile adult male test dummy is inconsistent with the use of the 12-month-old dummy in the dynamic portion of the infant low risk deployment test; the agency failed to consider the impact of using the 50th percentile adult male in the dynamic portion of the non-infant low risk deployment tests; and reducing the size of the dummies used in the dynamic portion of the low risk deployment tests will resolve many of its concerns regarding the size of the gray zone between the low risk deployment tests and the barrier tests since it will be able to design low risk deployment systems based on occupant recognition rather than on crash speed alone.

In a recent meeting with the agency, DaimlerChrysler changed its position and suggested that the dynamic portion of the test could be run with the 5th percentile adult female dummy on the passenger-side and the 50th percentile adult male dummy on the driver-side. While DaimlerChrysler did not provide a basis for its change in position, Volkswagen and BMW reiterated this potential approach in subsequent meetings and provided a basis for making the change. All three manufacturers expressed concern with the ability of current automatic suppression technology to reliably differentiate between a 6-year-old child and a small adult in real world conditions. Volkswagen and BMW indicated that the occupant recognition technology that they had studied can reliably differentiate between a small adult and a mid-size adult male. They expressed confidence that they could employ a low-risk deployment strategy that would assure all children and small adults would receive the benefit of a benignly deploying air bag at low speeds, while larger occupants could be provided with an air bag that deployed with more force. This design strategy would allow the manufacturer to provide protection to the larger occupant, while minimizing the risk of injury to smaller occupants. All three manufacturers stated that they would suppress the air bag in the presence of an infant.

Accordingly, we have decided to specify that the dynamic portion of the low risk test be run with the 5th percentile adult female on the passenger-side. Because we do not want manufacturers to rely on a seat-track based system to assure a low risk deployment at speeds up to 26 km/h (16 mph), we are further specifying that the test may be run with the passenger seat in any seat track position.

Low risk deployment options on the driver side remain the same as in the final rule. This is because there are not the same practicability concerns as there are on the passenger side and because no one needs the full-powered deployment of a driver air bag in low speed crashes.

4. Test Procedures for the Passenger Air Bag

As discussed briefly above, the positioning procedure for the chest-on-instrument-panel test was revised significantly in the final rule. The procedure for the head-on-instrument-panel test was largely adopted as proposed in the SNPRM. The Alliance stated in its petition that neither test position assured that the dummy's head

[6] In the infant test, the test is conducted with the 12-month-old child dummy in a belted rear-facing child restraint, since this is the only risk group the requirement attempts to protect.

or chest would actually be positioned against the instrument panel, contradicting the intent of the original ISO positions on which they were based.

a. Chest-on-Instrument Panel Test Procedure

While the petitions addressed both the head-on-instrument panel and chest-on-instrument panel test positions, the greatest criticism was leveled against the chest-on-instrument panel position. While Toyota and the Alliance expressed general concerns about the test procedure in their petitions, the most comprehensive analysis was provided by TRW. TRW noted that when both the 3-year-old and the 6-year-old test dummies are initially positioned as required and then moved forward, it soon becomes impossible to keep Point 1 in Planes C (a horizontal plane) and D (a vertical plane) as specified by the regulatory text because of contact with the windshield. The problem is more acute with the 6-year-old dummy than with the 3-year-old dummy, although it can occur with either dummy depending on vehicle design. While the regulatory text then specifies that the dummy may be lowered until there is a 5 mm (0.2 in) clearance from the windshield, TRW noted that the text does not then say whether to continue to move the dummy forward along a diagonal plane until there is contact with the instrument panel, or to leave the dummy in that position. Leaving the dummy in that position may result in the chest being a considerable distance from the instrument panel. Moving the dummy along a diagonal plane until there is contact with the instrument panel may mean that Point 1 is significantly lower than Plane C, the horizontal plane located at the center of the air bag tear seam. TRW noted that this is particularly problematic in vehicles with top-mounted air bags because Plane C is on or near the top of the instrument panel. It is also a problem in vehicles with deeply sloped windshields because contact with the windshield occurs relatively quickly. These concerns were echoed by Honda and Autoliv in their late submissions and by other manufacturers at the December 2000 technical workshop.

At that workshop, VW inquired as to whether a handgrip mounted on the front of the instrument panel would be considered as part of the instrument panel for the purpose of these tests. VW also queried whether it could place the legs of the 6-year-old dummy back on the dummy after the final position had been reached in vehicles where it was possible to do so. This request was similar to the one made by DaimlerChrysler in its petition that the legs of the 6-year-old dummy only be removed when necessary, as the removal of the legs could affect the dummy kinematics in a manner that may not be representative of a 6-year-old child.

Several petitioners and commenters asked for seat position requirements for the chest-on-instrument panel test procedure. We did not specify seat requirements for this test because the seat is not used in positioning the test dummy. The primary concern on the part of petitioners is that the lack of a specified seating position may lead to excessive test variability that is unrelated to air bag design, particularly if injury criteria are to be measured for 300 ms. Our resolution of this issue was discussed earlier.

We believe the primary problem with the seating procedure specified in the final rule is that it starts with the dummy in an elevated position and then moves the dummy forward along a horizontal plane. The SNPRM had proposed a test procedure where the dummy was positioned against the instrument panel and then moved up. We have reevaluated both positioning procedures and believe that the procedure proposed in the SNPRM largely resolves the problems experienced by petitioners. The regulatory text has also been simplified to make the positioning procedure clearer. In response to VW's question, the instrument panel would include any handgrips that are within Plane D.

Under the new test procedure, there may be some instances where the center of the chest, as indicated by Point 1, will not be in the same horizontal plane as the center of the air bag, as indicated by Plane C. This will be more likely in vehicles with top-mounted air bags. In that instance, we believe it is more important to place the chest against the instrument panel, than to establish Point 1 in Plane C. The only way to assure that Point 1 remains in Plane C and that the chest maintains contact with the instrument panel in all vehicles would be to remove the windshield for vehicles with top-mounted air bags. We believe this is an inappropriate test condition.

It is possible that even with the new positioning procedures, there may be instances where the deployment of the air bag will be closer to the dummy's head than Point 1. We believe that two vehicle designs could lead to such a scenario. First, if the windshield were severely sloped at a position rearward of the instrument panel, the dummy could strike the windshield before the chest is positioned near Plane C. Second, if the air bag were a top-mounted air bag, such an air bag could establish Plane C substantially higher than it would be in a mid-mounted air bag. In these instances, the chest-on-instrument panel test may test the effect of the air bag on the head and neck twice. The dummy would be positioned further away from the air bag than in the head-on-instrument panel test, so it is likely that the chest-on-instrument panel would produce lower injury measurements than the head-on-instrument panel test. However, it is possible that the particular kinematics may result in a greater stress on the neck. Accordingly, we will be paying particular attention to the test results from this chest-on-instrument panel test, particularly in vehicles with top-mounted air bags.

We have decided against allowing manufacturers to leave the legs on the 6-year-old dummy in vehicles that will accommodate the entire dummy in this position. Having the legs attached in some but not all compliance tests could lead to different injury measurements, because of the different dummy kinematics. We believe it is critical that all vehicles should be tested using the same test procedure.

b. Head-on-Instrument-Panel Test Procedure

The final rule specifies placement of the 3-year-old and 6-year-old test dummies such that the head is located on the instrument panel. This test procedure was challenged by several petitioners and commenters. Honda commented that it believed differences in the dummy's leg position could affect the kinematics of the crash and the injury measurements. It noted that it believes that this is particularly troublesome with top-mounted air bags. Honda maintained that the positioning procedure for the head-on-instrument panel test calls for rotating the dummy thighs and legs in a manner that does not sufficiently control the positioning of the legs. It offered no suggestions, however, on how to resolve its concerns. Toyota and TRW raised questions regarding dummy movement after contact has been made with the instrument panel. They noted that if the dummy were not moved once contact was made, the dummy could be a considerable distance from the instrument panel. This is because the knees could strike the instrument panel early in the positioning process, and the chest or head would still be some distance from the instrument panel. Toyota and TRW urged us to change the regulatory text to accommodate an early knee contact. At the public workshop, some participants, primarily Honda and Toyota, urged us to specify that the dummy be pushed forward once initial contact was made while others, primarily DaimlerChrysler and VW, urged that movement of the dummy stop once initial contact was made. The primary difference in opinion was due to concerns on the part of some participants that moving the dummy forward could change the leg angle, which they believe could lead to wide variations in the final placement of the dummy on the instrument panel. Those supporting the continued movement of the dummy argued that it was more important to get the dummy against the instrument panel than to maintain a level leg position.

Honda failed to provide any data indicating that more specific leg positioning procedures are needed. We acknowledge that the angle of the femur, as measured against the spine, could have some effect on the abdomen. However, we do not believe that slightly different angles would lead to inconsistent HIC or Nij measurements, the most critical injury criteria for this test. Thus, we have decided against adopting more specified leg positioning procedures. Likewise, we have decided against adopting the recommendation of VW and DaimlerChrysler that the leg remain parallel to the floorpan, when maintaining that position would result in the head not being placed on the instrument panel. We believe it is critical that the head be in contact with the instrument panel, even if the legs must be rotated out of a horizontal plane to achieve contact. Thus, under the new test procedure, early leg contact does not prevent placement of the dummy head on the instrument panel. Instead, the dummy is rotated forward until contact is achieved. While in some instances, this rotation could result in a relatively severe leg angle, as measured against the pelvis, we believe it is more critical that the head contact the instrument panel than that this angle remain constant.

c. Definition of Points, Planes and Materials

The positioning procedures for the low risk deployment tests specify two planes and one point. ''Plane C'' is defined as the horizontal plane through the geometric center of the right air bag tear seam. ''Plane D'' is defined as the vertical plane parallel to the vehicle longitudinal centerline through the geometric center of the right air bag tear seam. ''Point 1'' is defined as the center point of the dummy's chest/rib plate (the vertical mid-point of the frontal chest plate of the dummy on the midsagittal plane).

Questions were raised at the workshop about referencing Point 1 from a rigid structure on the dummy, such as the shoulder joints, rather than a point on the chest jacket. Several petitioners, including TRW, DaimlerChrysler, and Toyota sought clarification of what the agency meant by the term ''geometric center of the right air bag tear seam''. They noted that many passenger systems do not have a true tear seam. Rather, they may have a cover that opens as part of the instrument panel. The air bag may not be centered under the cover. Likewise, the instrument panel may be a solid surface with no visible tear seam. In both of these instances, the ''geometric center of the right air bag tear seam'' is difficult to determine and could vary depending on who is conducting the test. Finally, at the technical workshop, DaimlerChrysler requested that Plane D be established relative to the geometric center of the seat rather the geometric center of the air bag. This would allow them to take advantage of various countermeasures, such as a slight offset, that they use to reduce the aggressivity of the passenger air bag.

We have redefined the location of Point 1 to place it in a location relative to the upper edge of the chest jacket rather than the center of the chest/rib plate. The chest jacket, while relatively snug, still moves about the dummy's ribcage. Thus, the center of the chest/rib plate may be different relative to the internal hardware from one test to another. The upper edge of the chest jacket, however, remains largely the same, making it a preferable point of reference. We decided against measuring Point 1 relative to fixed hardware because we do not believe that degree of specificity is required and because there is very little exposed fixed hardware. Point 1 is now located on the front of the dummy chest jacket on the midsagittal plane by measuring a certain distance along the surface of the chest skin from the top of the skin at the neckline.

We agree that the final rule is not as clear as it could be in specifying the location of the planes. ''Air bag tear seam'' has no technical definition. Accordingly, the center of the tear seam could be subject to different interpretations. More importantly, the apparent air bag opening may be considerably different from the opening from which the air bag initially emerges. This is because the air bag covers may be designed in a manner that best accommodates the overall shape of the dashboard, with only a nominal relationship to the actual location of the air bag opening beneath the dashboard. Additionally, many dashboards have no discernable air bag cover, and the air bag enters the occupant compartment through a tear in the dashboard. At the technical workshop, the agency attempted to garner some consensus among industry on a better definition that would establish the vertical and horizontal planes along a point that was centered on where the air bag deployed. No one was able to come up with a location that was readily understandable and that was easily measured.

We do, however, believe that it would be more appropriate to specify that the planes be established using the geometric center of the opening through which the air bag deploys into the occupant compartment. This would not necessarily be the same as the geometric center of the air bag cover. Rather, it would be the geometric center of whatever frame or casing is used to allow the air bag to deploy in a controlled manner. Since this frame or casing cannot be seen without dismantling the dashboard, we intend to ask vehicle manufacturers to give us the location of the air bag opening as part of our pre-compliance test information requests.

The final rule specifies that the dummies be held in place using thread. Toyota requested specific definitions related to the material properties of the thread. TRW asked that the specification for thread be removed, arguing that other materials, such as tape, could work just as well. We agree with TRW. The material properties of the binding is irrelevant as long as it holds the dummy in place for the duration of the low speed deployment tests. Thread was merely specified because that is the material the agency has traditionally used. The regulatory text has been changed to remove the specification for thread.

We have chosen not to use the geometric center of the seat as a reference for Plane D. We have changed the definition to ''* * * vertical plane parallel to the vehicle longitudinal centerline through the geometric center of the opening through which the right front air bag deploys into the occupant compartment.'' We believe this is more practical for compliance tests and removes the problem of defining the tear seam.

5. Driver Side Air Bags

As with the low risk deployment tests for the passenger air bag, the agency did not provide final seat positions for the test dummy in tests for the driver air bag in the final rule. Toyota has petitioned that detailed seat positions be specified. For the reasons discussed in the section of this document addressing the passenger low risk deployment tests, we are adopting specific seat track, head rest, seat cushion angles, and seat back positions. Beyond Toyota's general request, all other petitions related to the driver air bag low risk deployment test procedure addressed concerns with the chin-on-rim procedure.

The purpose of the chin-on-rim test is to determine the risk of injury when a person's chest is directly in the path of the deploying air bag. The test is conducted with a 5th percentile adult female test dummy. The test procedure requires the dummy be moved up off the seat and positioned with spacer blocks.

Toyota stated in its petition that the procedure for the chin-on-rim test specified in the final rule did not adequately ensure that the dummy's chin would not catch on the rim of the steering wheel, leading to artificially high neck extension bending moments. Honda raised similar concerns. Toyota noted that the regulatory text specifies that the chin not be hooked over the rim, but noted that it believed a more detailed test procedure was needed to prevent the potential problem. It suggested that a point on the chin 40 mm below the mouth be placed at the uppermost edge of the rim. Toyota also stated that using the seat to move the dummy forward results in pre-loading the dummy, which it maintains moves the torso roughly 20 mm closer to the steering wheel than if only the dummy is moved forward. Toyota presented no data analyzing the effect of such pre-loading. Mitsubishi queried whether forward head movement was to cease if the dummy chest or torso impacted the steering wheel before the head contacted the windshield. TRW wanted to know if the dummy is further moved, and in what direction, if the head hits the windshield. It also asked whether the dummy's thorax instrument cavity rear face angle needs to be maintained during the positioning procedures. Honda noted at the technical workshop that the dummy could contact the windshield or the header long before the dummy's chin contacted the steering wheel. Honda questioned whether the dummy should be moved down so that contact with the steering wheel is made, even though this would lower the chest.

Toyota is correct that the agency intended to provide a procedure that prevents the chin from hooking over the steering wheel when it published the final rule. We also agree that Toyota's suggestion to define a point on the chin that contacts the steering wheel is a more objective means of ensuring that the chin does not hook over the rim. Accordingly, we have adopted that change in test procedure.

As to its concern with potential pre-loading, we note that Toyota failed to provide any data addressing the effect of potential pre-loading in its petition. We would agree that, in general, pre-loading is not desirable. However, we believe it is very important that the chin actually makes contact with the steering wheel. Additionally, we believe that placing the center of the chin directly on the steering wheel will reduce the likelihood of any pre-loading. Accordingly, we are not changing the procedure to address the possibility of pre-loading.

The thorax instrument cavity rear face angle is an initial position. We expect in many instances that this angle will need to be changed to address specific vehicle designs. This is because we believe it is very important to position the dummy parallel to the steering wheel before deploying the air bag. Keeping the dummy parallel serves multiple purposes. First, it should largely resolve Honda's concern that the dummy head will impact the windshield or header before the dummy's chin contacts the steering rim, as well as Mitsubishi's question on whether to stop moving the dummy if steering wheel contact is made before the head strikes the windshield. Second, it tests for a worst case scenario; i.e., a direct impact by the deploying air bag. Finally, we believe it provides the most repeatable test procedure.

VI. Issues Related to Injury Criteria

A. Head Injury Criteria (HIC)

In the final rule, we adopted a new Head Injury Criteria applicable to vehicles meeting the new, advanced air bag requirements. For the 50th percentile adult male dummy, Standard No. 208 has required manufacturers to certify that the dummy HIC measurement does not exceed 1000 when calculated over a period of 36 ms. Under the new criteria, that measurement is now limited to 700, but is calculated over a much shorter 15 ms period. The HIC for the new 5th percentile adult female dummy is also 700 when calculated over 15 ms, as is the HIC for the 6-year-old child dummy. Lower maximum HIC were established for the 3-year-old and 12-month-old dummies.

The Alliance and DaimlerChrysler petitioned the agency to scale the HIC measurements for the 5th percentile adult female dummy and the 6-year-old child dummy at a maximum HIC of 779 and 723, respectively. The Alliance argued that these proposed limits were derived from the new maximum HIC for the 50th percentile adult male dummy using a scaling relationship that considered the size differences of the heads of the three dummies. It further argued that we did not consistently apply these scaling relationships when establishing a maximum HIC of 700 for all three dummies.

Petitioners have not provided biomechanical data to support their contention that a higher maximum HIC for the 5th percentile adult female dummy or the 6-year-old child dummy is appropriate. Rather, petitioners appear to base their scaling technique on the premise that the experimental population was the representative size of the 50th percentile adult male head or that the analysis that produces HIC somehow explicitly accounted for head size and the HIC relationship now represents only the 50th percentile male. While it is true that the mean head size of the experimental population is approximately equal to that of the 50th percentile adult male, the head size of the experimental population also spans that of the entire adult population. In particular, the experimental population correlates with the size of a 5th percentile adult female in about 30% of the cases, with a 50th percentile adult male in about 33% of the cases and with a 95th percentile adult male in about 37% of the cases. Furthermore, there is insufficient data to develop a statistically significant relationship of how head size modifies HIC threshold levels, i.e., that the smaller size of the 5th percentile adult female head results in a higher HIC threshold than a 50th percentile adult male head. Consequently, we believe that there is no need or justification to provide different maximum HIC levels for any sub-group of the adult population, and we continue to support a maximum HIC value of 700 for both adult dummy sizes.

As previously discussed in the biomechanical technical report released with the final rule, we have no biomechanics data on the skull fracture and brain injury tolerances for children. Thus, we scaled the HIC for the 6-year-old child dummy, the 3-year-old child dummy, and the 12-month-old child dummy based on geometric size and material strength. Since exact scaling is inappropriate for the reasons given above, judgement was used to determine whether the scaled limits were reasonable. The scaled measurement for the 6-year-old child dummy was 723, a limit slightly higher than that for the adult population. However, since the scaling is an inexact science and much of this rule is designed to reduce the risk of death or serious injury to small children, we believe that raising the maximum HIC for the 6-year-old child would be inappropriate.

Agency low risk deployment tests of seven 1999 model year vehicles indicates that a maximum HIC of 700 for the 6-year-old child test dummy is practicable. One hundred percent of the vehicles tested in position 1 (chest-on-instrument panel) and in position 2 (head-on-instrument panel) measured a maximum HIC of less than 700. These injury levels were obtained in vehicles that have not been designed to the low risk deployment requirements of the final rule. We see no reason to raise the maximum HIC for this dummy.

B. Chest Injury Measurements

In the SNPRM, the agency had proposed a maximum chest acceleration for the 5th percentile adult female dummy of 60 g. The Alliance recommended a maximum allowable chest acceleration rate of 73 g. Instead of adopting the Alliance's proposal, we decided to adopt the 60 g limit. This is the same acceleration limit that has been in place for the 50th percentile adult male dummy for some time. The Alliance's recommended chest acceleration limit was obtained using scaling procedures that only considered the effects of the geometric differences between 50th percentile adult males and 5th percentile adult females. We determined that considering these factors alone insufficiently accounted for the risk to out-of-position occupants and to elderly women, who have been disproportionately injured by deploying air bags. Accordingly, we adopted a maximum chest g of 60 for the 5th percentile adult female test dummy.

The Alliance, Toyota [7] and DaimlerChrysler petitioned the agency to adopt the Alliance's scaled chest acceleration measurement of 73 g. They expressed particular concern over the effect the 60 g limit would have in the belted barrier test for the 50th percentile adult male dummy. According to the petitioners, the agency's measurement is far too conservative. They argued that the more conservative limit could cause difficulties in meeting the belted 48 km/h (30 mph) test and thus could lead manufacturers to lower the output of the seat belt load limiters, which would then require air bags to be repowered in order to achieve acceptable injury measurements in the 50th percentile adult male test dummy in the 56 km/h (35 mph) belted crash tests. DaimlerChrysler also argued that while existing seat belt designs can meet the 60 g limit, the levels so closely approach that level that manufacturers cannot certify compliance to the belted tests with a reasonable margin of compliance.

As noted above, the Alliance's recommended chest acceleration limit of 73 g for the 5th percentile adult female dummy was obtained using scaling procedures that consider only the geometric differences between the 50th percentile adult male and the 5th percentile adult female. This scaling method discounts any possible decrease in bone strength experienced by an older driver. Yet we know that older drivers are at increased risk from a deploying air bag. When one allows for the decreased bone mass, the scaled measurement is 61.6 g, only nominally more than the level specified in the final rule. Additionally, as noted above, any scaling method will be inexact, and some degree of judgement is required to determine how injury criteria should be scaled for different populations. The tests with the 5th percentile adult female dummies are intended to minimize to the greatest extent possible the likelihood that an individual would be severely injured or killed by a deploying air bag. Discounting the effect of decreased bone density would lead to the anomalous event where the most at-risk population would not receive the full benefits of the advanced air bag systems.

Petitioners have presented no data to substantiate their claim that a higher chest acceleration limit for the 5th percentile adult female dummy is necessary to avoid repowering air bags. However, NHTSA and Transport Canada have co-sponsored vehicle crash tests conducted at Transport Canada to determine whether the petitioners' claim has merit. Transport Canada conducted belted barrier tests at 48 km/h (30 mph) with both the 5th percentile adult female test dummy and with the 50th percentile adult male test dummy. We also looked at NCAP test results for vehicles of the same make, model, and production year to determine whether either the 50th percentile adult male dummy were measuring chest g's in excess of 60 g in 56 km/h (35 mph) belted tests.[8]

Twenty-six vehicles were tested at Transport Canada with the 5th percentile adult female dummy in both the driver and passenger position. The seats were positioned full forward. All dummies in the driver position and 25 dummies in the passenger position passed the 60 g chest acceleration limit, establishing 60 g as a practicable injury measurement. Only five of the dummies on the driver side recorded acceleration rates greater than 50 g. Three of these dummies contacted the steering rim, and we have determined that the higher chest g measurement was probably a result of that interaction. In the two cases where there was no steering wheel contact, we believe the higher injury measurements were likely the result of very stiff shoulder belts.

These observations were borne out by the results of the NCAP tests with the 50th percentile adult male dummy. In cases where the higher chest acceleration was probably the result of contact with the steering wheel, the male dummy experienced low chest accelerations at a comparable speed because it did not strike the steering wheel. In the two cases where NHTSA attributed the higher measurements to a stiff shoulder belt, the male dummy also measured high chest acceleration measurements in the 56 km/h (35 mph) NCAP tests. There were a number of vehicles tested in which the chest acceleration for the 5th percentile adult female was well below 60 g, and where the injury measurements of the 50th percentile adult male in the NCAP tests earned the vehicle a four- or five-star rating. Accordingly, we cannot accept Toyota's argument that a 60 g chest acceleration will require repowered air bags to provide protection to the 50th percentile male in a 56 km/h (35 mph) belted crash test.

We have reviewed three vehicle crash tests in which the lower thorax/abdomen of the 5th percentile adult female dummy contacted the steering rim, producing high chest g measurements and low chest deflection measurements. In these cases, the close proximity of the dummy's lower thorax/

[7] Toyota also recommended the agency adopt sternal deflection rate (SDR) as the appropriate chest measurement rather than acceleration. The agency had initially proposed adopting SDR, but dropped its proposal in the SNPRM because the biomechanics community argued persuasively that SDR was insufficiently developed to be used in compliance testing. We refer the reader to our discussion of SDR in the SNPRM.

[8] Although Toyota limited its argument that repowered air bags would be needed because of the 56 km/h (35 mph) belted barrier test using a 50th percentile adult male dummy, we reviewed the NCAP test results of vehicles tested with a 5th percentile adult female dummy to see if the chest acceleration indicate an overly stiff seat belt that was not designed for smaller occupants. The 5th percentile adult female dummy registered chest g readings that were slightly higher than those registered by the 50th percentile adult male dummy, but the readings were still significantly lower than 60 g.

abdomen to the steering wheel rim prevented the lower portion of the air bag from fully inflating. As a result, the lower thorax/abdomen was not offered protection and impacted the steering wheel rim. We believe that the injury criteria selected for the advanced air bag rule should be sensitive to the injurious loading mode of steering wheel rim contact. Chest deflection, measured only at the central upper thorax, and chest acceleration with a performance limit of 73 g would not identify these cases of steering wheel rim contact as injurious, whereas a performance limit of 60 g for chest acceleration would correctly identify this as injurious occupant interaction with the vehicles. Consequently, we continue to support a performance limit of 60 g for the 5th percentile adult female.

C. Neck Injury Criteria

As part of the final rule, we adopted a new neck injury criterion (Nij). Nij measures both neck axial force (tension and compression) and neck bending moments (flexion and extension). Prior to the issuance of the rule, neck injuries were not directly accounted for in barrier tests, although the 36 ms HIC duration did indirectly address concerns with neck injuries in real world crashes. We rejected DaimlerChrysler and Toyota's arguments in favor of not adopting Nij as part of the final rule. Our rationale was largely based on concerns the two manufacturers had regarding the suitability of the Hybrid III dummy neck for measuring extension.

In their petitions for reconsideration, both Toyota and DaimlerChrysler have reiterated their concerns with the Hybrid III neck design and with the adoption of Nij as an injury criterion. As in its response on the SNPRM, Toyota states that it believes the 5th percentile adult female Hybrid III neck is reading artificially high neck moments in crash tests that are not found in tests using the 50th percentile adult male test dummy. It also believes that the location of the load cell at the top of the neck does not address the likelihood of injury in the low- to mid-portion of the neck, the location where it believes most neck injuries actually occur. Finally, Toyota noted that a relaxed human neck can accommodate 15 degrees of rotation between the neck and the head, which the Hybrid III neck cannot. Due to the combination of these concerns, Toyota petitioned that the introduction of Nij be delayed until the bending moment issues are resolved. DaimlerChrysler petitioned the agency to measure only axial force rather than using Nij due to problems it believes the current Hybrid III neck has in measuring bending moments. It also averred that using Nij with the Hybrid III neck would require manufacturers to place rapidly deploying air bags in vehicles.

We have decided against either altering or eliminating Nij as an injury measurement. A full discussion of petitioners' arguments and our response to those arguments is provided in the technical paper "Supplement: Development of Improved Injury Criteria for the Assessment of Advanced Automotive Restraint Systems" (Docket No. NHTSA–00–7013–3).

We believe that the dummies do not generate artificially high neck moments in crash tests. Toyota indicated that a review of crash films did not point to likely neck injury, even though high injury measurements were recorded. We do not believe a review of crash films is a useful means of determining strain on the neck. This is because when there is a high loading rate and the cervical musculature is partially activated, the human neck can experience large extension moments even though the rotation of the head is small.[9] Testing at VRTC indicated that the moments experienced by human volunteers prior to noticeable head rotation were similar to the moments registered by the Hybrid III test dummy. The moments experienced by humans in a crash would be higher because the informal tests were static tests and because the neck was not pushed to the point of pain. Thus, we believe that the moments produced by the dummy neck when there is little head-to-torso rotation are a reasonable representation of what the human neck would experience in a similar crash environment.

Likewise, we do not believe that the neck on the 5th percentile adult female dummy produces neck injury measurements that are not representative of injury risk in real world crashes. Toyota stated that the risk of neck injury was roughly the same among all adult occupants, but that the 5th percentile adult dummy could not meet the required injury criteria, while the 50th percentile adult male dummy could. The neck of the 5th percentile adult female dummy was based on a scaled down version of the 50th percentile adult male dummy. Thus, there should be no test artifact that manifests in one dummy but not the other.

We agree with Toyota that most flexion injuries in the real world that are the result of inertial loading (i.e., loading of the neck due to restraints of the torso by seat belts) occur in the middle or lower cervical spine. However, research indicates that flexion and extension bending moments calculated at the occipital condyle are a good predictor of overall neck injury even though the site of injury was located below the occipital condyles in the middle cervical spine (C3–C4).[10] Additionally, for air bag loading, the upper cervical spine has been the predominant injury site for both children and adults. While real world data seems to indicate that tension and/or extension are the predominant injury mechanism in air-bag induced upper cervical spine injuries, research has shown that flexion can also produce similar upper cervical spine injuries.[11] Consequently, we believe it is appropriate to monitor the loads at occipital condyles using the upper load cell instrumentation, including tension, compression, flexion, and extension, to improve safety in both inertial and air bag loading situations.

Likewise, we disagree with DaimlerChrysler's contention that only axial forces should be measured because the axial force best determines real world risk of injury and a Nij requirement would require smaller or more aggressive air bags to counteract problems with the Hybrid III neck. We believe there is a good kinematic and dynamic correlation between the Hybrid III neck and the human neck. The Hybrid III neck is effective at measuring the risk of neck injury in the real world. High moment readings are consistent with injuries resulting from exposure to aggressive air bags. DaimlerChrysler suggested that the Thor dummy neck may be more biofidelic, but we note that Thor is still under development. If we determine that it is an adequate instrument for compliance testing and is a better predictor of occupant injury, we may incorporate it into Standard No. 208. Nevertheless, the possibility that an enhanced dummy neck will be available in the future is not a persuasive reason

[9] See "Human Tolerance to Impact Conditions as Related to Motor Vehicle Design" SAE document J885, July 1986, which states "* * * the neck can be injured without exceeding its static angular range of motion * * * Measures of the neck may be a better indicator of injury potential [than angular rotation].

[10] Mertz H J and Patrick L M, Strength and Response of the Human Neck, Proceedings of the Fifteenth Stapp Car Crash Conference, SAE Paper No. 710855, (1971). Mertz H J and Partick L M, Investigation of the Kinematics and Kinetics of Whiplash during Vehicle Rear-end Collisions, Proceedings of the Eleventh Stapp Car Crash Conference, SAE Paper No. 670919, (1967).

[11] Nightingale R W, Winkelstein B A, Van Ee C A, Myers B S, Injury Mechanisms in the Pediatric Cervical Spine During Out-of-position Airbag Deployments, 42nd Annual Proceedings of the Association for the Advancement of Automotive Medicine, (1998).

to delay action until that neck is available. While axial force may be an accurate indicator of injury in a single loading mode, the neck is subject to many loading modes in a crash, including flexion, extension, fore/aft shear, lateral bending, and torsion. These other loading modes also cause neck injury in the real world. This is why the agency adopted the Nij formula, which incorporates the relevant measurements for evaluating neck injury during frontal impact. We note much of the automotive industry has accepted Nij as a valid injury measurement.[12]

VII. Issues Related to Labels, Telltales, and Owner's Manual Information

A. Warning Labels

In the final rule we added a new warning label that must be used in vehicles with advanced air bags. We also discussed in the preamble that we would not prohibit additional labels on the sun visor that provided design-specific information on how to use a vehicle's advanced air bag technology. The regulatory text, however, did not remove the prohibition against adding additional information on the sun visor.

We received petitions for reconsideration for and comments on both the changed label and on the issue of whether to allow additional information other than that required by the warning label. Toyota urged us to keep the existing warning label, except for the addition of the statement ''even with advanced air bags'', arguing that the advanced air bag technology is not yet developed enough to justify a weaker label. DaimlerChrysler, GM, the Alliance and Ford have all requested that we limit any information beyond that in the required label to the owner's manual and that no additional information be allowed in the vehicle interior. Parents for Safer Air Bags asked for clarification of the agency's position.

As noted above, S4.5.1(b)(3) prohibits any information other than an air bag maintenance label or a SUV rollover warning label from appearing on the same side of the sun visor as the air bag warning label, and prohibits any additional information about air bags or the need to wear seat belts on either side of the sun visor. However, this was not our intent. Rather, as stated in the preamble to the final rule, we intended to allow additional, design-specific information on the sun visor and near the new air bag warning label. We did not believe such information should be automatically relegated to the owner's manual because we believed that people are more likely to read a highly visible warning label than an owner's manual.

In response to the NPRM, DaimlerChrysler, GM, and the Alliance had all supported the position expressed in the preamble to the final rule. Indeed, the agency's decision to allow additional information was based on comments from these entities, as well as comments from the NTSB and the Center for Automotive Safety. GM, DaimlerChrysler, and the Alliance have now all changed their original position and now urge the agency not only to prohibit any additional information on the sun visor, but to limit such information to the owner's manual. The basis of the various petitions is that sun visor labels that carry different information may be confusing and may result in information overload. The petitioners also stated that allowing additional information would be inconsistent with our previous position that warning labels should be uniform to maximize the effectiveness of the message.

We have decided to allow additional labels on the sun visor that provide design-specific information about a particular advanced air bag system. We note that advanced air bag systems are different from traditional air bag systems in that those systems may have unique design characteristics. Thus, a manufacturer could determine that additional labels may provide crucial information that the vehicle owner should be aware of.

Some systems, particularly those that rely on automatic suppression technology, may allow the vehicle occupant to change the status of the air bag. For example, in the case of a vehicle certified to the automatic suppression requirement, the required telltale will not be illuminated in most instances. Under the regulation, the telltale must remain off if an occupant as large as the 5th percentile adult female is seated in the passenger seat. Additionally, the regulation allows manufacturers to have the telltale turned off if the passenger seat is empty, even though the air bag may be suppressed. Thus, an adult may not even be aware of the presence or purpose of the telltale until a child is placed in the passenger seat and the telltale illuminates. We are confident that our automatic suppression procedures are broad enough to ensure that the telltale will illuminate in most instances. However, those procedures are not representative of all possible seating positions or all child restraints. Thus, it is possible that a particular restraint would not be detected by an automatic suppression system, or that an unrestrained child could be in a position that was not detected by the automatic suppression system.

If the driver of the vehicle or another occupant was aware that the telltale should be illuminated whenever the air bag is suppressed, then they could move the child to the back seat. If for some reason that were not possible, the driver would be aware of the need to either resecure the child restraint, replace the restraint if necessary, or place the child in the seat such that the air bag system is suppressed.

While a detailed description of how the air bag system works would be contained in the owner's manual, we are concerned that people may not consult their owner's manual sufficiently to recognize that the absence of an illuminated telltale means the air bag is not suppressed. However, a vehicle manufacturer could place specific information about the air bag system next to the air bag label, where it may be more likely to be read. Alternatively, the manufacturer could determine that an additional label placed elsewhere in the vehicle, either permanently or as a temporary label, best informs vehicle occupants about the vehicle's air bag system. A manufacturer could also determine that no additional labels are needed.

Accordingly, we have amended the regulatory text to clarify that such a label could be placed, at the manufacturer's option, on the sun visor alongside the air bag warning label. No change has been made to the regulatory text regarding the permissibility of labels elsewhere in the vehicle because we have never prohibited labels that convey specific, accurate information about air bags or seat belts in locations other than the sun visor. However, any additional labels, regardless of where they are placed in the vehicle, cannot be confusing or misleading when read in conjunction with other labels required by this or other standards. The regulatory text has accordingly been amended at S 4.5.1 (g).

As discussed in the final rule, we have decided against allowing the existing labels in vehicles certified to the advanced air bag requirements. The new label uses a different pictogram and removed two of the warnings that are required on labels not certified to the advanced air bag requirements. The new label does not say that children should never be placed in front of an air bag, because the advanced air bag requirements are intended to specifically address that risk. We also removed the statement that one should

[12] See ''Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Air Bags'' (August 8, 2000). (NHTSA–99–5098–31)

sit as far away from the air bag as possible because while this information is helpful, we did not believe it addressed a serious enough safety risk to merit overcrowding the label. We added an instruction to read the vehicle owner's manual to familiarize oneself with the advanced air bag system in the vehicle. Thus, we do not believe the new label is any weaker than the existing label, particularly since the vehicle manufacturer may provide more vehicle-specific information in the form of a label on the sun visor or elsewhere in the vehicle.

Additionally, the agency has discovered that when S4.5.1(b) was amended to remove the requirements for warning labels in vehicles manufactured before February 25, 1997, the cross-reference in S4.5.1(c)(2) was not changed. Previously S4.5.1(b) set forth the requirements for air bag warning labels in vehicles manufactured before February 25, 1997. S4.5.1(c)(1) set forth the requirements for the air bag alert label in those same vehicles and cross-referenced S4.5.1(b)(1). S4.5.1(b)(2) set forth the requirements for air bag warning labels in vehicles manufactured on or after February 25, 1997. S4.5.1(c)(2) set forth the requirements for the air bag alert label in those vehicles, and cross-referenced S4.5.1(b)(2). In the final rule S4.5.1(b) was amended to drop the requirements for a label in the older vehicles because there was no longer any need to retain the requirement. S4.5.1(b)(2) was redesignated S4.5.1(b)(1) and the new label required for vehicles certified to the advanced air bag requirements was designated as S4.5.1(b)(2). Because there were no changes to the air bag alert requirements, S4.5.1(c) was not amended.

Under the current regulatory text, S4.5.2(c)(2) could be interpreted as being limited to vehicles certified to the advanced air bag requirements, even though the title to that section refers to all vehicles manufactured on or after February 25, 1997. S4.5.1(c)(1) should have been removed since the original cross-reference was removed. We are amending S4.5.1(c) to remove the reference to vehicles manufactured before February 25, 1997 and to clarify that an air bag alert is needed in any vehicle manufactured on or after that date whenever the required air bag label is not visible when the sun visor is in the stowed position.

B. Telltales

The final rule requires a telltale for vehicles with automatic suppression systems. The telltale has a specified text and must be positioned in a location forward of and above the H-point of the driver's and passenger's seat in their forwardmost position. The final rule allowed for multiple levels of illumination as long as the telltale remains visible at all times to front-seat occupants of all ages. The telltale need not illuminate when the passenger seat is empty.

The Alliance, DaimlerChrysler, and Mitsubishi petitioned the agency to revise the current requirement that the telltale be visible to occupants of all ages, and urged us instead to adopt the requirements of Standard No. 101, *Controls and Displays.* DaimlerChrysler also requested the regulatory text be clarified to assure that the telltale would be visible to all occupants seated in a forward-facing position, and that it not be obstructed by a rear-facing child restraint. The Alliance requested that they be allowed to use the abbreviation ''pass'' in lieu of ''passenger'' in the message text, and DaimlerChrysler requested that manufacturers be allowed to use a universal symbol representing the status of the air bag rather than a specified text. Additionally, DaimlerChrysler requested the regulatory text be changed to clarify that a telltale is only required in vehicles with automatic suppression systems.

We have removed the requirement that the telltale be visible to occupants of all ages, since such a requirement is nonobjective. We have, however, kept the requirement that it be visible to occupants whose eyes have adjusted to ambient light conditions. Otherwise, the regulatory text has been changed to be more consistent with Standard No. 101.

While we do not believe it would be reasonable to expect an occupant who was not sitting in a forward-facing position to see a telltale that is forward of the H-point with the seat in its full-forward position, we see no reason to adopt DaimlerChrysler's suggestion that the telltale only be visible to forward-facing occupants. We believe that implicit in the requirement is the recognition that a rear-facing individual would not be able to see the telltale. Since the vast majority of occupants who are not in the forward facing position are infants, who would not be able to interpret the message, we see no need to further specify that the telltale only be visible to forward facing occupants. We do agree, however, that there is a benefit to affirmatively stating that the telltale cannot be obscured by a rear facing child restraint. Accordingly, the regulatory text has been amended to prohibit the placement of a telltale in a location where such a restraint could prevent a properly-seated driver from seeing the telltale.

We note that the portions of the regulatory text dealing with automatic suppression systems already specify that a telltale be installed in the vehicle. Neither the low risk deployment option nor the dynamic suppression option have such a requirement. Nevertheless, we believe it is worthwhile to clarify in the portion of the regulatory text dealing with telltale requirements that a telltale is only required in vehicles with automatic suppression systems.

We have decided to allow manufacturers to abbreviate ''passenger'' to ''pass,'' since we do not believe the abbreviation will be confusing when combined with the rest of the required text. Allowing ''pass'' will also allow manufacturers to meet both the U.S. and Canadian requirements. However, we have decided against allowing manufacturers to use a universal symbol indicating that the passenger air bag is off in lieu of the written warning, because we believe such an action would be premature. We note that the agency has been working on harmonizing Standard No. 101, and that a universal ''air bag off'' symbol is being considered as part of this harmonization activity. It is possible that when Standard No. 101 is amended, the agency may decide to allow manufacturers to use a symbol rather than written text.

C. Owner's Manual Information

The final rule requires certain information be placed in the owner's manual of vehicles with advanced air bag systems. DaimlerChrysler requested the regulatory text specify that some of the required information need only be included in the owner's manual of vehicles with automatic suppression systems. We believe DaimlerChrysler has raised a valid point and have amended the regulatory text accordingly.

VIII. Issues Related to Phase-in Requirements for Small Volume Manufacturers

The final rule gave small volume manufacturers, as well as manufacturers of vehicles built in two or more stages, the maximum time allowable to certify to the new advanced air bag requirements. TEA 21 requires us to specify that all vehicles manufactured after August 31, 2006 must meet the new, advanced air bag requirements promulgated by the final rule. The rule defined a small vehicle manufacturer for purposes of this exclusion from the phase-in requirements as manufacturers that produce no more than 5,000 vehicles per year worldwide.

The Coalition of Small Volume Automobile Manufacturers (COSVAM) petitioned us to expand that definition to manufacturers of no more than 10,000 vehicles per year. Alternatively, it petitioned that the 5,000 vehicle cap be limited to vehicles sold in the United States per year or that the 5,000 vehicle cap be averaged over the phase-in period. Under the averaged proposal, if a manufacturer produced more than 5,000 vehicles in a single year, it could still take advantage of the exclusion as long as the average of production during the phase-in was not more than 5,000 vehicles per year.

We previously rejected COSVAM's position that the appropriate vehicle cap for small manufacturers be 10,000. COSVAM has offered no new arguments that would lead us to change our position on this. However, we recognize that currently only the United States requires advanced air bag technology under any timeframe. It is highly unlikely that the advanced air bag requirements will be required in another country sooner than in the U.S. Thus, we believe it is reasonable to limit the vehicle cap to not more than 5,000 vehicles produced or assembled by the original vehicle manufacturer for the U.S. market per year. This provision does not apply to registered importers because they are not original vehicle manufacturers. Likewise it would not apply to vehicles produced or assembled by the original vehicle manufacturer in one production year and then imported to the U.S. in the following production year.

We are rejecting the alternative that manufacturers be allowed to average vehicle production because we believe this alternative is more unwieldy than the one we have adopted, and because a dramatic increase in production over a short period of time could average out to 5,000 vehicles and still constitute a production volume for a single year of substantially more than 5,000 vehicles. We note, however, that the new criteria would be easier to meet than this option for any small volume manufacturer that sold vehicles anywhere other than in the United States.

IX. Other Issues

A. Dummy Containment

In the final rule, the agency defined the parameters for the dummy containment requirement that has long been part of Standard No. 208. Until the May 2000 final rule, the requirement read, ''all portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment throughout the test.'' The regulation did not define what was meant by ''throughout the test.'' In order to clarify the agency's longstanding position on this requirement, we amended this language in the final rule. The regulatory text now requires that the dummy be contained within the outer surfaces of the vehicle passenger compartment until both the dummies and the vehicle have stopped moving.

DaimlerChrysler argued in its petition that this clarification constitutes a new test requirement that was not subject to notice and comment. It also stated that the change has no demonstrable benefit or safety need and could have unforeseen consequences.

We disagree that the agency's characterization of when the test is over for the purpose of dummy containment was not subject to notice and comment. In the SNPRM, we noted that the requirement for dummy containment would remain in effect until the technician physically removed the dummy from the vehicle. We received no comments on this proposal. The requirement in the final rule that the dummy remain contained within the vehicle until both the dummies and the vehicle have stopped moving is actually less restrictive than the criteria presented in the SNPRM, although we believe the practical effect is the same. Additionally, we do not believe that specifying what ''throughout the test'' means imposes any additional burden on vehicle manufacturers. Rather, it merely clarifies the agency's longstanding position that the dummy remain fully contained within the vehicle until the test is definitively over. Since this is not a new requirement, there are neither any additional benefits nor any chance of unforseen consequences. However, we do believe that providing a specific frame of reference as to when the test is over helps manufacturers since there cannot be any doubt about what the agency means by requiring the dummy to remain inside the vehicle A''throughout the test.''

B. Partial Compliance

In its petition, Toyota asked the agency to confirm its understanding that it could certify vehicles without advanced air bag technologies to the 32–40 km/h (20–25 mph) unbelted barrier test in lieu of the sled test. Toyota's understanding of the partial compliance option is correct.

The final rule allows manufacturers to certify compliance with the unbelted performance requirements for the 50th percentile adult male dummy using the barrier at test speeds between 32 and 40 km/h (20–25 mph) as long as the dummies satisfy the new injury criteria as maximum injury values even if the vehicles are not certified to the other advanced air bag requirements. Alternatively, manufacturers may continue to certify compliance using the sled test, with its existing injury criteria, or the up-to-48 km/h (30 mph) unbelted barrier test, using its existing injury criteria. For vehicles certified to the new, advanced air bag requirements, only the first test option will be allowed. We note that, as with all the other compliance options, the vehicle manufacturer must advise us of which option it has used to certify compliance, and that election will be irrevocable.

C. Cross Reference for Test Duration

DaimlerChrysler noted that the regulatory text incorrectly references S4.10 as a cross reference for test duration for measuring injury criteria. DaimlerChrysler is correct that the proper cross-reference is S4.11. The regulatory text has accordingly been changed.

D. Combination of Standard No. 208's Oblique Barrier Test and Standard No. 301's Oblique Barrier TestFerrari requested the test speed for the oblique barrier test in Standard No. 301 be reduced to 40 km/h (25 mph). It stated that prior to the final rule, these two test requirements could be combined because the test configuration and test speed were the same. Ferrari believes that the adoption of a 40 km/h (25 mph) test speed for one, but not both tests, now requires additional tests. If it does not conduct separate tests, Ferrari claims it will be forced to design its vehicles to meet the Standard No. 208 test at 48 km/h (30 mph).

We recognize that vehicle manufacturers often ''piggyback'' dynamic compliance tests. They may run a single dynamic test that can be used to certify compliance to more than one safety standard. Nevertheless, we do not agree with Ferrari's contention that manufacturers will need to run additional tests or certify to the 48 km/h (30 mph) unbelted barrier test. The 48 km/h (30 mph) belted barrier test will remain in Standard No. 208 for all vehicles until September 1, 2007, when a higher belted barrier test speed of 56 km/h will be phased in for the 50th percentile adult male.[13] Since the Standard No. 301 barrier test does not measure injury criteria, there is no reason that a manufacturer could not continue to combine its Standard No.

[13] We hope to propose using the higher test speed for the 5th percentile adult female as well, beginning September 1, 2007.

301 test and Standard No. 208 belted barrier test until that time.

E. Effective Date for New Data Filtering Technique

The final rule specified that injury criteria be calculated using a phaseless digital filter. In its comments to the SNPRM, DaimlerChrysler had argued for using phaseless filters to measure Nij and had suggested the regulatory text specify the filters conform with SAE recommended practice J211. The final rule expanded on this request and, for the sake of consistency, specified the use of phaseless filters for measuring all injury criteria. Since no time frame was placed on the use of phaseless filters, the requirement became effective on June 12, 2000, the effective date of the final rule.

In its petition for reconsideration DaimlerChrysler urged that the effective date be changed to September 1, 2001. It argued that the June 12, 2000 effective date could negatively affect a manufacturer's ability to certify compliance with vehicles that were under production as of that date. It also requested we change the formulation of V in the existing sled test (S13.1).

The purpose of establishing an early effective date was two-fold. First, the early effective date allows manufacturers to earn credits for vehicles that meet the requirements of the advanced air bag final rule before the beginning of the phase-in. Second, the early effective date ensures that the final rule is published in the Code of Federal Regulations in a timely manner. However, the early effective date also imposed a new filtering requirement on all vehicles subject to Standard No. 208 on or after June 12, 2000.

We decided to specify the use of phaseless filters in response to DaimlerChrysler's comment to the SNPRM that phaseless filters should be used for measuring neck injury. We believe it is worthwhile to be consistent in requiring phaseless filters for all injury measurements. Accordingly, the final rule did not distinguish between neck injury measurements and other injury measurements in specifying phaseless filters. We believe that there is only a negligible difference in calculated injury criteria between data collected with phaseless filters and data collected without phaseless filters (less than 1.0 percent). Thus, we do not believe there should be any problem certifying compliance with the standard, even if the data was not collected using phaseless filters.

While we do not believe the new requirement will have any effect on a manufacturer's ability to certify compliance with the standard, we accept that the data collection for 2001 model year vehicles may have been done without such filters. Accordingly, we are changing the effective date for that portion of the final rule to September 1, 2001.

6. Use of human child to detect the presence of an infant

In the SNPRM to the May 2000 final rule, we proposed to allow manufacturers to certify compliance with the automatic suppression requirements using children and small adults because the existing test dummies are insufficiently biofidelic for all pattern recognition systems to recognize. We did not propose to allow manufacturers to use infants instead of the newborn or 12-month-old child dummies because all tests involving these dummies have the dummy placed in a child restraint. We received no comments on whether to use infants rather than test dummies, and we adopted the final rule without including infants in S29. Subsequent to the issuance of the final rule, we have become aware of occupant recognition technology that relies on the existence of a human to work. We believe this type of technology may be, in some respects, as good as or superior to technologies that rely solely on weight or the pattern of an object on the seat to determine whether to suppress the air bag. Since the absence of a provision allowing the use of a human infant would preclude this technology, and since our only reason for not including such a provision was because we were unaware of any emerging technology that required the use of a human infant, we have decided to amend S29 to allow the automatic suppression tests using a car bed and tests using a RFCRS or convertible child restraint be conducted with a child between 8.2 and 9.1 kg (18–20 lb) and between 61 and 66 cm (24–26 in).

10. Rulemaking Analyses and Notices

A. Executive Order 12866 and DOT Regulatory Policies and Procedures

NHTSA has considered the impact of this rulemaking action under Executive Order 12866 and the Department of Transportation's regulatory policies and procedures. This rulemaking document has been reviewed by the Office of Management and Budget under E.O. 12866, ''Regulatory Planning and Review.'' The rulemaking action has also been determined to be significant under the Department's regulatory policies and procedures. The agency concludes that the impacts of today's amendments are so minimal that a regulatory evaluation is not required. Rather, readers who are interested in the costs and benefits of advanced air bags are referred to the agency's Final Economic Assessment for the May 2000 final rule. NHTSA has determined that the costs and benefits analysis provided in that document remain unchanged in response to today's rule.

B. Regulatory Flexibility Act

We have considered the effects of this rulemaking action under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) This action will not have a significant economic impact on a substantial number of small businesses because it does not significantly change the requirements of the May 2000 final rule. Small organizations and small governmental units will not be significantly affected since the potential cost impacts associated with this rule should only slightly affect the price of new motor vehicles.

C. National Environmental Policy Act

NHTSA has analyzed this proposed amendment for the purposes of the National Environmental Policy Act and determined that it will not have any significant impact on the quality of the human environment.

D. Executive Order 13132 (Federalism)

The agency has analyzed this rulemaking in accordance with the principles and criteria contained in Executive Order 13132 and has determined that it does not have sufficient federalism implications to warrant consultation with State and local officials or the preparation of a federalism summary impact statement. The final rule has no substantial effects on the States, or on the current Federal-State relationship, or on the current distribution of power and responsibilities among the various local officials.

The final rule is not intended to preempt state tort civil actions, except that the required labels must contain the required text, and no additional text, and any additional labels cannot misleading or confusing, as specified in the regulatory text.

E. Unfunded Mandate Reform Act

The Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local or tribal governments, in the aggregate, or by the private sector, of more than $100 million annually (adjusted for inflation with base year of 1995). While the May 2000 final rule is likely to result in over $100 million of annual expenditures by the private sector, today's final rule makes only small adjustments to the May 2000 rule. Accordingly, there will not be a significant increase in cost to the private sector.

F. Executive Order 12778 (Civil Justice Reform)

This final rule does not have any retroactive effect. Under section 49 U.S.C. 30103, 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. 30161 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.

G. Paperwork Reduction Act

Under the Paperwork Reduction Act of 1995, a person is not required to respond to a collection of information by a Federal agency unless the collection displays a valid OMB control number. This rule does not propose any new information collection requirements.

H. Regulation Identifier Number (RIN)

The Department of Transportation assigns a regulation identifier number (RIN) to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. You may use the RIN contained in the heading at the beginning of this document to find this action in the Unified Agenda.

I. Plain Language

Executive Order 12866 requires each agency to write all rules in plain language. Standard No. 208 is extremely difficult to read as it contains multiple cross-references and has retained all of the requirements applicable to vehicle of different classes at different times. Because portions of today's rule amend existing text, much of that complexity remains. Additionally, the availability of multiple compliance options, differing injury criteria and a dual phase-in have added to the complexity of the regulation, particularly as the various requirements and options are accommodated throughout the initial phase-in. Once the initial phase-in is complete, much of the complexity will disappear. At that time, it would be appropriate to completely revise Standard No. 208 to remove any options, requirements, and differentiations as to vehicle class that are no longer applicable.

J. Executive Order 13045

Executive Order 13045 applies to any rule that: (1) Is determined to be ''economically significant'' as defined under E.O. 12866, and (2) concerns an environmental, health or safety risk that NHTSA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, we must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by us.

This rulemaking directly involves decisions based on health risks that disproportionately affect children, namely, the risk of deploying air bags to children. However, this rulemaking serves to reduce, rather than increase, that risk.

K. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) requires NHTSA to evaluate and use existing voluntary consensus standards [14] in its regulatory activities unless doing so would be inconsistent with applicable law (e.g., the statutory provisions regarding NHTSA's vehicle safety authority) or otherwise impractical. In meeting that requirement, we are required to consult with voluntary, private sector, consensus standards bodies. Examples of organizations generally regarded as voluntary consensus standards bodies include the American Society for Testing and Materials (ASTM), the Society of Automotive Engineers (SAE), and the American National Standards Institute (ANSI). If NHTSA does not use available and potentially applicable voluntary consensus standards, we are required by the Act to provide Congress, through OMB, an explanation of the reasons for not using such standards.

The agency is not aware of any new voluntary consensus standards addressing the changes made to the May 2000 final rule as a result of this final rule.

[14] Voluntary consensus standards are technical standards developed or adopted by voluntary consensus standards bodies. Technical standards are defined by the NTTAA as ''performance-based or design-specific technical specifications and related management systems practices.'' They pertain to ''products and processes, such as size, strength, or technical performance of a product, process or material.''

List of Subjects in 49 CFR Part 571

Imports, Incorporation by reference, Motor vehicle safety, Reporting and recordkeeping requirements, Tires.

In consideration of the foregoing, NHTSA amends 49 CFR Chapter V as follows:

PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

1. The authority citation for Part 571 of Title 49 continues to read as follows:

Authority: 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.50.

2. Section 571.208 is amended as follows:

A. By amending S4.5.1 by revising the heading, pearagraphs (b)(1), (b)(2) and (b)(3), (c), (f) and by adding paragraph (g).

B. By revising S4.11(a), S4.13, S6.6, S14.1(d), S14.3, S15.3.6 through S16.3.5.4, S18 and S18.1, S19 through S26.4, and S29 through S29.3.

C. By revising Appendix A.

The revisions and addition to § 571.208 read as follows:

§ 571.208 Standard No. 208; Occupant crash protection.

* * * * *

S4.5.1 *Labeling and owner's manual information.*

* * * * *

(b) * * *

(1) Except as provided in S4.5.1(b)(2), each vehicle shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in either Figure 6a or 6b of this standard, as appropriate, and shall comply with the requirements of S4.5.1(b)(1)(i) through S4.5.1(b)(1)(iv).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 30 mm (1.2 in) in diameter.

(iv) If the vehicle does not have a back seat, the label shown in Figure 6a or 6b may be modified by omitting the statement: ''The BACK SEAT is the SAFEST place for children.''

(2) Vehicles certified to meet the requirements specified in S19, S21, or S23, by means of an automatic suppression system, shall have a label permanently affixed to either side of the sun visor, at the manufacturer's option, at each front outboard seating position that is equipped with an inflatable restraint. The label shall conform in content to the label shown in Figure 8 of this standard and shall comply with the requirements of S4.5.1(b)(2)(i) through S4.5.1(b)(2)(iv).

(i) The heading area shall be yellow with the word ''WARNING'' and the alert symbol in black.

(ii) The message area shall be white with black text. The message area shall be no less than 30 cm^2 (4.7 in^2).

(iii) The pictogram shall be black on a white background. The pictogram shall be no less than 30 mm (1.2 in) in length.

(iv) If the vehicle does not have a back seat, the label shown in the figure may be modified by omitting the statement: ''The BACK SEAT is the SAFEST place for CHILDREN.''

(3) The vehicle manufacturer may, at its option, affix an additional label adjacent to the label shown in Figure 8 that provides specific information about the vehicle's advanced air bag system as long as the information is not confusing or misleading when read in conjunction with Figure 8.

(c) *Air bag alert label.* If the label required by S4.5.1(b) is not visible when the sun visor is in the stowed position, an air bag alert label shall be permanently affixed to that visor so that the label is visible when the visor is in that position. The label shall conform in content to the sun visor label shown in figure 6(c) of this standard, and shall comply with the requirements of S4.5.1(c)(1) through S4.5.1(c)(3).

(1) The message area shall be black with yellow text. The message area shall be no less than 20 square cm.

(2) The pictogram shall be black with a red circle and slash on a white background. The pictogram shall be no less than 20 mm in diameter.

(3) If a vehicle does not have an inflatable restraint at any front seating position other than that for the driver, the pictogram may be omitted from the label shown in figure 6c.

* * * * *

(f) *Information to appear in owner's manual.*

(1) The owner's manual for any vehicle equipped with an inflatable restraint system shall include an accurate description of the vehicle's air bag system in an easily understandable format. The owner's manual shall include a statement to the effect that the vehicle is equipped with an air bag and lap/shoulder belt at both front outboard seating positions, and that the air bag is a supplemental restraint at those seating positions. The information shall emphasize that all occupants, including the driver, should always wear their seat belts whether or not an air bag is also provided at their seating position to minimize the risk of severe injury or death in the event of a crash. The owner's manual shall also provide any necessary precautions regarding the proper positioning of occupants, including children, at seating positions equipped with air bags to ensure maximum safety protection for those occupants. The owner's manual shall also explain that no objects should be placed over or near the air bag on the instrument panel, because any such objects could cause harm if the vehicle is in a crash severe enough to cause the air bag to inflate.

(2) For any vehicle certified to meet the requirements specified in S14.5, S15, S17, S19, S21, S23, and S25, the manufacturer shall also include in the vehicle owner's manual a discussion of the advanced passenger air bag system installed in the vehicle. The discussion shall explain the proper functioning of the advanced air bag system and shall provide a summary of the actions that may affect the proper functioning of the system. The discussion shall include, at a minimum, accurate information on the following topics:

(i) A presentation and explanation of the main components of the advanced passenger air bag system.

(ii) An explanation of how the components function together as part of the advanced passenger air bag system.

(iii) The basic requirements for proper operation, including an explanation of the actions that may affect the proper functioning of the system.

(iv) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a complete description of the passenger air bag suppression system installed in the vehicle, including a discussion of any suppression zone.

(v) An explanation of the interaction of the advanced passenger air bag system with other vehicle components, such as seat belts, seats or other components.

(vi) A summary of the expected outcomes when child restraint systems, children and small teenagers or adults are both properly and improperly positioned in the passenger seat, including cautionary advice against improper placement of child restraint systems.

(vii) For vehicles certified to meet the requirements of S19.2, S21.2 or S23.2, a discussion of the telltale light, specifying its location in the vehicle and explaining when the light is illuminated.

(viii) Information on how to contact the vehicle manufacturer concerning modifications for persons with disabilities that may affect the advanced air bag system.

(g) *Additional labels placed elsewhere in the vehicle interior.* The language on additional air bag warning labels placed elsewhere in the vehicle interior shall not cause confusion or contradiction of any of the statements required in the air bag sun visor label, and shall be expressed in symbols, words and abbreviations required by this standard.

* * * * *

S4.11 *Test duration for purpose of measuring injury criteria.*

(a) For all barrier crashes, the injury criteria specified in this standard shall be met when calculated based on data recorded for 300 milliseconds after the vehicle strikes the barrier. For low risk deployment tests, the injury criteria shall be met when calculated based on data recorded for 125 milliseconds after the initiation of the final stage of air bag deployment designed to deploy in a barrier crash up to 26 km/h (16 mph).

* * * * *

S4.13 *Data channels.* For vehicles manufactured on or after September 1, 2001, all data channels used in injury criteria calculations shall be filtered using a phaseless digital filter, such as the Butterworth four-pole phaseless digital filter specified in Appendix C of SAE J211/1, rev. Mar 95, incorporated by reference in S4.7.

* * * * *

S6.6 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar 95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S6.6(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 6806 N (1530 lbf) when Fz is in tension

(ii) Fzc = 6160 N (1385 lbf) when Fz is in compression

(iii) Myc = 310 Nm (229 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 135 Nm (100 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz/Fzc) + (Mocy/Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 4170 N (937 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 4000 N (899 lbf) at any time.

* * * * *

S14.1 *Vehicles manufactured on or after September 1, 2003, and before September 1, 2006.*

* * * * *

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.1.

* * * * *

S14.3 *Vehicles manufactured on or after September 1, 2007, and before September 1, 2010.*

(a) For vehicles manufactured for sale in the United States on or before September 1, 2007, and before September 1, 2010, a percentage of the manufacturer's production, as specified in S14.3.1, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements of this standard).

(b) Manufacturers that sell two or fewer carlines, as that term is defined at 49 CFR 583.4, in the United States may, at the option of the manufacturer, meet the requirements of this paragraph instead of paragraph (a) of this section. Each vehicle manufactured on or after September 1, 2008, and before September 1, 2010, shall meet the requirements specified in S14.5.1(b) (in addition to the other requirements specified in this standard).

(c) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having been previously certified in accordance with Part 567 of this chapter are not subject to the requirements of S14.3.

(d) Vehicles that are manufactured by an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States are not subject to the requirements of S14.3.

* * * * *

S15.3.6 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar 95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: Tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S15.3.6(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 4287 N (964 lbf) when Fz is in tension

(ii) Fzc = 3880 N (872 lbf) when Fz is in compression

(iii) Myc = 155 Nm (114 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 67 Nm (49 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz/Fzc) + (Mocy/Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 2620 N (589 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

S15.3.7 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572, Subpart O Hybrid III 5th percentile female test dummy.

S16. *Test procedures for rigid barrier test requirements using 5th percentile adult female dummies.*

S16.1 *General provisions.* Crash testing to determine compliance with the requirements of S15 of this standard is conducted as specified in the following paragraphs (a) and (b).

(a) *Belted test.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 48 km/h (30 mph), into a fixed rigid barrier that is perpendicular within a tolerance of ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

(b) *Unbelted test.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard, except S16.3.5. Impact the vehicle traveling longitudinally forward at any speed, from 32 km/h (20 mph) to 40 km/h (25 mph), inclusive, into a fixed rigid barrier that is perpendicular within a tolerance of ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S16.2 of this standard.

S16.2 *Test conditions.*

S16.2.1 The vehicle, including test devices and instrumentation, is loaded as in S8.1.1.

S16.2.2 Movable vehicle windows and vents are placed in the fully closed position, unless the vehicle manufacturer chooses to specify a different adjustment position prior to the time the vehicle is certified.

S16.2.3 Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

S16.2.4 Doors are fully closed and latched but not locked.

S16.2.5 The dummy is clothed in form fitting cotton stretch garments with short sleeves and above the knee length pants. A size 7 1/2W shoe which meets the configuration and size specifications of MIL–S–21711E (see S4.7) or its equivalent is placed on each foot of the test dummy.

S16.2.6 Limb joints are set at one g, barely restraining the weight of the limb when extended horizontally. Leg joints are adjusted with the torso in the supine position.

S16.2.7 Instrumentation shall not affect the motion of dummies during impact.

S16.2.8 The stabilized temperature of the dummy is at any level between 20.6° C and 22.2° C (69° F to 72° F).

S16.2.9 *Steering wheel adjustment.*

S16.2.9.1 Adjust a tiltable steering wheel, if possible, so that the steering wheel hub is at the geometric center of its full range of driving positions.

S16.2.9.2 If there is no setting detent at the mid-position, lower the steering wheel to the detent just below the mid-position.

S16.2.9.3 If the steering column is telescoping, place the steering column in the mid-position. If there is no mid-position, move the steering wheel rearward one position from the mid-position.

S16.2.10 *Driver and passenger seat set-up.*

S16.2.10.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S16.2.10.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S16.2.10.3 *Seat position adjustment.* If the passenger seat does not adjust independently of the driver seat, the driver seat shall control the final position of the passenger seat.

S16.2.10.3.1 If the seat is adjustable in the fore and aft and/or vertical directions, move the seat to the rearmost position at the full down height adjustment. If the seat cushion adjusts fore and aft, independent of the seat back, set this adjustment to the full rearward position. If the seat cushion contains a height adjustment, independent of the seat back, set this adjustment to the full down position. Record a seat cushion reference angle.

S16.2.10.3.2 Using only controls which move the seat fore and aft, move the seat to the full forward position. If seat adjustments other than fore-aft are present and the seat cushion reference angle changes from that measured in S16.2.10.3.1, use those adjustments to maintain as closely as possible the angle recorded in S16.2.10.3.1.

S16.2.10.3.3 If the seat height is adjustable, determine the maximum and minimum heights at this position, while maintaining, as closely as possible, the angle recorded in S16.2.10.3.1. Set the seat at the midpoint height with the seat cushion reference angle set as closely as possible to the angle recorded in S16.2.10.3.1. Mark location of the seat for future reference.

S16.3 *Dummy seating positioning procedures.* The 49 CFR Part 572 Subpart O 5th percentile adult female test dummy is positioned as follows:

S16.3.1 *General provisions and definitions.*

S16.3.1.1 All angles are measured with respect to the horizontal plane unless otherwise stated.

S16.3.1.2 The dummy's neck bracket is adjusted to align the zero degree index marks.

S16.3.1.3 The term "midsagittal plane" refers to the vertical plane that separates the dummy into equal left and right halves.

S16.3.1.4 The term "vertical longitudinal plane" refers to a vertical plane parallel to the vehicle's longitudinal centerline.

S16.3.1.5 The term "vertical plane" refers to a vertical plane, not necessarily parallel to the vehicle's longitudinal centerline.

S16.3.1.6 The term "transverse instrumentation platform" refers to the transverse instrumentation surface inside the dummy's skull casting to which the neck load cell mounts. This surface is perpendicular to the skull cap's machined inferior-superior mounting surface.

S16.3.1.7 The term "thigh" refers to the femur between, but not including, the knee and the pelvis.

S16.3.1.8 The term "leg" refers to the lower part of the entire leg including the knee.

S16.3.1.9 The term "foot" refers to the foot including the ankle.

S16.3.1.10 The longitudinal centerline of a bucket seat cushion is determined at the widest part of the seat cushion. Measure perpendicular to the longitudinal centerline of the vehicle.

S16.3.1.11 For leg and thigh angles use the following references:

S16.3.1.11.1 *Thigh*—a straight line on the thigh skin between the center of the ½–13 UNC–2B tapped hole in the upper leg femur clamp (see drawings 880105–504 (left thigh) and 880105–505 (right thigh), upper leg femur clamp) and the knee pivot shoulder bolt (part 880105–527 in drawing 880105–528R & 528L, sliding knee assy. w/o pot).

S16.3.1.11.2 *Leg*—a straight line on the leg skin between the center of the ankle shell (parts 880105–609 & 633 in drawing 880105–660, ankle assembly) and the knee pivot shoulder bolt (part 880105–527 in drawing 880105–528R & 528L, sliding knee assy. w/o pot).

S16.3.2 *Driver dummy positioning.*

S16.3.2.1 *Driver torso/head/seat back angle positioning.*

S16.3.2.1.1 With the seat in the position determined in S16.2.10, use only the controls which move the seat fore and aft to place the seat in the rearmost position, without adjusting independent height controls. If the seat cushion reference angle automatically changes as the seat is moved from the full forward position, maintain, as closely as possible, the seat cushion reference angle in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.2.1.11.

S16.3.2.1.2. Fully recline the seat back, if adjustable. Install the dummy into the driver's seat, such that when the legs are positioned 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.2.1.3 *Bucket seats.* Center the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion.

S16.3.2.1.4 *Bench seats.* Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and aligned with the center of the steering wheel rim.

S16.3.2.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.2.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

S16.3.2.1.7 Gently rock the upper torso relative to the lower torso laterally in a side to side motion three times through a ±5 degree arc (approximately 51 mm (2 in) side to side) to reduce friction between the dummy and the seat.

S16.3.2.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. Keeping the leg and the thigh in a vertical plane, place the foot in the vertical longitudinal plane that passes through the centerline of the accelerator pedal. Rotate the left thigh outboard about the hip until the center of the knee is the same distance from the midsagittal plane of the dummy as the right knee ±5 mm (±0.2 in). Using only controls which move the seat fore and aft, attempt to return the seat to the full forward position. If either of the dummy's legs first contacts the steering wheel, then adjust the steering wheel, if adjustable, upward until contact with the steering wheel is avoided. If the steering wheel is not adjustable, separate the knees enough to avoid steering wheel contact. Proceed with moving the seat forward until either the leg contacts the vehicle interior or the seat reaches the full forward position. (The right foot may contact and depress the accelerator and/or change the angle of the foot with respect to the leg during seat movement.) If necessary to avoid contact with the vehicles brake or clutch pedal, rotate the test dummy's left foot about the leg. If there is still interference, rotate the left thigh outboard about the hip the minimum distance necessary to avoid pedal interference. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seat is a power seat, move the seat fore and aft to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior. If the steering wheel was moved, return it to the position described in S16.2.9. If the steering wheel contacts the dummy's leg(s) prior to attaining this position, adjust it to the next higher detent, or if infinitely adjustable, until there is 5 mm (0.2 in) clearance between the wheel and the dummy's leg(s).

S16.3.2.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ±0.5 degree, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to ensure that it is properly installed. If the torso contacts the steering wheel, adjust the steering wheel in the following order until there is no contact: telescoping adjustment, lowering adjustment, raising adjustment. If the vehicle has no adjustments or contact with the steering wheel cannot be eliminated by adjustment, position the seat at the next detent where there is no contact with the steering wheel as adjusted in S16.2.9. If the seat is a power seat, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the steering wheel as adjusted in S16.2.9 and the point of contact on the dummy.

S16.3.2.1.10 If it is not possible to achieve the head level within ±0.5 degrees, minimize the angle.

S16.3.2.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gage (drawing TE–2504, incorporated by reference in 49 CFR Part 572, Subpart O, of this chapter). The angle shall be set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible by adjustments specified in S16.3.2.1.9 and S16.3.2.1.10.

S16.3.2.1.12 If the dummy is contacting the vehicle interior after these adjustments, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments, the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forwardmost position, move the seat forward until the contact point is 5 mm (0.2 in) or less from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position without making contact, or until the seat reaches its forwardmost position, whichever occurs first.

S16.3.2.2 *Driver foot positioning.*

S16.3.2.2.1 If the vehicle has an adjustable accelerator pedal, adjust it to the full forward position. Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the leg and then place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. If the vehicle has an adjustable accelerator pedal and the right foot is not touching the accelerator pedal when positioned as above, move the pedal rearward until it touches the right foot. If the accelerator pedal in the full rearward position still does not touch the foot, leave the pedal in that position.

S16.3.2.2.2 If the ball of the foot does not contact the pedal, change the angle of the foot relative to the leg such that the toe of the foot contacts the undepressed accelerator pedal.

S16.3.2.2.3 Place the left foot on the toe-board with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toe-board and floor pan, and not on the wheel-well projection or foot rest.

S16.3.2.2.4 If the left foot cannot be positioned on the toe board, place the foot perpendicular to the lower leg centerline as far forward as possible with the heel resting on the floor pan.

S16.3.2.2.5 If necessary to avoid contact with the vehicle's brake or clutch pedal, rotate the test dummy's left foot about the lower leg. If there is still pedal interference, rotate the left leg outboard about the hip the minimum distance necessary to avoid the pedal interference. If the left foot does not contact the floor pan, place the foot parallel to the floor and place the leg as perpendicular to the thigh as possible.

S16.3.2.3 *Driver arm/hand positioning.*

S16.3.2.3.1 Place the dummy's upper arms adjacent to the torso with the arm centerlines as close to a vertical longitudinal plane as possible.

S16.3.2.3.2 Place the palms of the dummy in contact with the outer part of the steering wheel rim at its horizontal centerline with the thumbs over the steering wheel rim.

S16.3.2.3.3 If it is not possible to position the thumbs inside the steering wheel rim at its horizontal centerline, then position them above and as close to the horizontal centerline of the steering wheel rim as possible.

S16.3.2.3.4 Lightly tape the hands to the steering wheel rim so that if the hand of the test dummy is pushed upward by a force of not less than 9 N (2 lb) and not more than 22 N (5 lb), the tape releases the hand from the steering wheel rim.

S16.3.3 *Passenger dummy positioning.*

S16.3.3.1 *Passenger torso/head/seat back angle positioning.*

S16.3.3.1.1 With the seat in the position determined in S16.2.10, use only the controls which move the seat fore and aft to place the seat in the rearmost position, without adjusting independent height controls. If the seat cushion reference angle automatically changes as the seat is moved from the full forward position, maintain as closely as possible the seat cushion reference angle in S16.2.10.3.1, for the final forward position when measuring the pelvic angle as specified in S16.3.3.1.11.

S16.3.3.1.2 Fully recline the seat back, if adjustable. Install the dummy into the passenger's seat, such that when the legs are 120 degrees to the thighs, the calves of the legs are not touching the seat cushion.

S16.3.3.1.3 *Bucket seats.* Center the dummy on the seat cushion so that its midsagittal plane is vertical and coincides with the vertical longitudinal plane through the center of the seat cushion.

S16.3.3.1.4 *Bench seats.* Position the midsagittal plane of the dummy vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the midsagittal plane of the driver dummy.

S16.3.3.1.5 Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

S16.3.3.1.6 Place the legs at 120 degrees to the thighs. Set the initial transverse distance between the longitudinal centerlines at the front of the dummy's knees at 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion.

S16.3.3.1.7 Gently rock the upper torso relative to the lower torso laterally side to side three times through a ±5 degree arc (approximately 51 mm (2 in) side to side).

S16.3.3.1.8 If needed, extend the legs slightly so that the feet are not in contact with the floor pan. Let the thighs rest on the seat cushion to the extent permitted by the foot movement. With the feet perpendicular to the legs, place the heels on the floor pan. If a heel will not contact the floor pan, place it as close to the floor pan as possible. Using only controls which move the seat fore and aft, attempt to return the seat to the full forward position. If a dummy leg contacts the vehicle interior before the full forward position is attained, position the seat at the next detent where there is no contact. If the seats are power seats, position the seat to avoid contact while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior.

S16.3.3.1.9 For vehicles without adjustable seat backs, adjust the lower neck bracket to level the head as much as possible. For vehicles with adjustable seat backs, while holding the thighs in place, rotate the seat back forward until the transverse instrumentation platform of the head is level to within ±0.5 degrees, making sure that the pelvis does not interfere with the seat bight. Inspect the abdomen to insure that it is properly installed.

S16.3.3.1.10 If it is not possible to orient the head level within ±0.5 degrees, minimize the angle.

S16.3.3.1.11 Measure and set the dummy's pelvic angle using the pelvic angle gage (drawing TE–2504, incorporated by reference in 49 CFR Part 572, Subpart O, of this chapter). The angle shall be set to 20.0 degrees ±2.5 degrees. If this is not possible, adjust the pelvic angle as close to 20.0 degrees as possible while keeping the transverse instrumentation platform of the head as level as possible as specified in S16.3.3.1.9 and S16.3.3.1.10.

S16.3.3.1.12 If the dummy is contacting the vehicle interior after these adjustments, move the seat rearward until there is a maximum of 5 mm (0.2 in) between the contact point of the dummy and the interior of the vehicle or if it has a manual seat adjustment, to the next rearward detent position. If after these adjustments the dummy contact point is more than 5 mm (0.2 in) from the vehicle interior and the seat is still not in its forward most position, move the seat forward until the contact point is 5 mm (0.2 in) or less from the vehicle interior, or if it has a manual seat adjustment, move the seat to the closest detent position without making contact, or until the seat reaches its forward most position, whichever occurs first.

S16.3.3.2 *Passenger foot positioning.*

S16.3.3.2.1 Place the passenger's feet flat on the toe board.

S16.3.3.2.2 If the feet cannot be placed flat on the toe board, set them perpendicular to the leg center lines and place them as far forward as possible with the heels resting on the floor pan.

S16.3.3.3 *Passenger arm/hand positioning.*

S16.3.3.3.1 Place the dummy's upper arms in contact with the seat back and the torso.

S16.3.3.3.2 Place the palms of the dummy in contact with the outside of the thighs.

S16.3.3.3.3 Place the little fingers in contact with the seat cushion.

S16.3.4 *Driver and passenger adjustable head restraints.*

S16.3.4.1. If the head restraint has an automatic adjustment, leave it where the system positions the restraint after the dummy is placed in the seat.

S16.3.4.2 Adjust each head restraint to its lowest position.

S16.3.4.3 Measure the vertical distance from the top most point of the head restraint to the bottom most point. Locate a horizontal plane through the midpoint of this distance. Adjust each head restraint vertically so that this horizontal plane is aligned with the center of gravity (CG) of the dummy head.

S16.3.4.3 If the above position is not attainable, move the vertical center of the head restraint to the closest detent below the center of the head CG.

S16.3.4.4 If the head restraint has a fore and aft adjustment, place the restraint in the forwardmost position or until contact with the head is made, whichever occurs first.

S16.3.5 *Driver and passenger manual belt adjustment (for tests conducted with a belted dummy)*

S16.3.5.1 If an adjustable seat belt D-ring anchorage exists, place it in the manufacturer's design position for a 5th percentile adult female with the seat in the position specified in S16.2.10.3.

S16.3.5.2 Place the Type 2 manual belt around the test dummy and fasten the latch.

S16.3.5.3 Ensure that the dummy's head remains as level as possible, as specified in S16.3.2.1.9 and S16.3.2.1.10 and S16.3.3.1.9 and S16.3.3.1.10.

S16.3.5.4 Remove all slack from the lap belt. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this operation four times. Apply a 9 N (2 lbf) to 18 N (4 lbf) tension load to the lap belt. If the belt system is equipped with a tension-relieving device, introduce the maximum amount of slack into the upper torso belt that is recommended by the manufacturer. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the shoulder belt to be retracted by the retractive force of the retractor.

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S18 *Test procedure for offset frontal deformable barrier requirements using 5th percentile adult female dummies.*

S18.1 *General provisions.* Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at each front outboard seating position of a vehicle, in accordance with the procedures specified in S16.3 of this standard. Impact the vehicle traveling longitudinally forward at any speed, up to and including 40 km/h (25 mph), into a fixed offset deformable barrier under the conditions and procedures specified in S18.2 of this standard, impacting only the left side of the vehicle.

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S19 *Requirements to provide protection for infants in rear facing and convertible child restraints and car beds.*

S19.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S19.2 or S19.3, under the test procedures specified in S20.

S19.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S19.2.1 through S19.2.3.

S19.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger air bag which results in deactivation of the air bag during each of the static tests specified in S20.2 (using the 49 CFR Part 572 Subpart R 12-month-old CRABI child dummy in any of the child restraints identified in sections B and C of appendix A of this standard and the 49 CFR part 572 subpart K Newborn Infant dummy in any of the car beds identified in section A of appendix A, as appropriate), and activation of the air bag system during each of the static tests specified in S20.3 (using the 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S19.2.2 The vehicle shall be equipped with at least one telltale which emits light whenever the passenger air bag system is deactivated and does not emit light whenever the passenger air bag system is activated, except that the telltale(s) need not illuminate when the passenger seat is unoccupied. Each telltale:

(a) Shall emit yellow light;

(b) Shall have the identifying words ‘‘PASSENGER AIR BAG OFF’’ or ‘‘PASS AIR BAG OFF’’ on the telltale or within 25 mm (1.0 in) of the telltale; and

(c) Shall not be combined with the readiness indicator required by S4.5.2 of this standard.

(d) Shall be located within the interior of the vehicle and forward of and above the design H-point of both the driver's and the right front passenger's seat in their forwardmost seating positions and shall not be located on or adjacent to a surface that can be used for temporary or permanent storage where use of the storage space could obscure the telltale from either the driver's or right front passenger's view, or where the telltale would be obscured from the driver's view if a rear facing child restraint is installed in the right front passenger's seat.

(e) Shall be visible and recognizable to a driver and right front passenger during night and day when the occupants have adapted to the ambient light roadway conditions.

(f) Telltales need not be visible or recognizable when not activated.

(g) Means shall be provided for making telltales and their identification visible and recognizable to the driver and right front passenger under all driving conditions. The means for providing the required visibility may be adjustable manually or automatically, except that the telltales and their identifications may not be adjustable under any driving conditions to a level that they become invisible or not recognizable to the driver and right front passenger.

(h) The telltale must not emit light except when the passenger air bag is urned off or during a bulb check upon vehicle starting.

S19.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag system is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S19.2.2.

S19.3 *Option 2—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S19.4 of this standard when the passenger air bag is deployed in accordance with the procedures specified in S20.4.

S19.4 *Injury criteria for the 49 CFR Part 572, Subpart R 12-month-old CRABI test dummy.*

S19.4.1 All portions of the test dummy and child restraint shall be contained within the outer surfaces of the vehicle passenger compartment.

S19.4.2 Head injury criteria.

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5} (t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 390.

S19.4.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 50 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S19.4.4 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S19.4.4(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 1460 N (328 lbf) when Fz is in tension

(ii) Fzc = 1460 N (328 lbf) when Fz is in compression

(iii) Myc = 43 Nm (32 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 17 Nm (13 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij ’ (Fz / Fzc) + (Mocy / Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 780 N (175 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 960 N (216 lbf) at any time.

S19.4.5 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572 Subpart R 12-month-old CRABI test dummy.

S20 *Test procedure for S19.*

S20.1 *General provisions.*

S20.1.1 Tests specifying the use of a car bed, a rear facing child restraint, or a convertible child restraint may be conducted using any such restraint listed in sections A, B, and C of Appendix A of this standard respectively. The car bed, rear facing child restraint, or convertible child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test.

S20.1.2 Each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position, if adjustable fore and aft, at full rearward, middle, and full forward positions. If the child restraint or dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S20.1.3 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a handle, the vehicle shall comply in tests conducted with the handle at both the child restraint manufacturer's recommended position for use in vehicles and in the upright position.

S20.1.4 If the car bed, rear facing child restraint, or convertible child restraint is equipped with a sunshield, the vehicle shall comply in tests conducted with the sunshield both fully open and fully closed.

S20.1.5 The vehicle shall comply in tests with the car bed, rear facing child restraint, or convertible child restraint uncovered and in tests with a towel or blanket weighing up to 1.0 kg (2.2 lb) placed on or over the restraint in any of the following positions:

(a) with the blanket covering the top and sides of the restraint, and

(b) with the blanket placed from the top of the vehicle's seat back to the forwardmost edge of the restraint.

S20.1.6 Except as otherwise specified, if the car bed, rear facing child restraint, or convertible child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a right front outboard vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply with the unbelted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system.

S20.1.7 If the car bed, rear facing child restraint, or convertible child restraint comes equipped with a detachable base, the vehicle shall comply in tests conducted with the detachable base attached to the child restraint and with the detachable base unattached to the child restraint.

S20.1.8 Do not attach any tethers.

S20.1.9 *Seat set-up.* Unless otherwise stated,

S20.1.9.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S20.1.9.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S20.1.9.3 If the seat cushion adjusts fore and aft, independent of the seat back, set this adjustment to the full rearward position.

S20.1.9.4 If the seat height is adjustable, determine the maximum and minimum heights at the full rearward, middle, and full forward positions. Set the seat at the mid-point height for each of the three fore-aft test positions.

S20.1.9.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S20.1.9.6 If adjustable, set the head restraint at the full down and full forward position.

S20.1.10 The longitudinal centerline of a bucket seat cushion is determined at the widest part of the seat cushion. Measure perpendicular to the longitudinal centerline of the vehicle.

S20.2 *Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag.* Each vehicle that is certified as complying with S19.2 shall meet the following test requirements.

S20.2.1 *Belted rear facing and convertible child restraints.*

S20.2.1.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of Appendix A of this standard.

S20.2.1.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane''.

S20.2.1.3 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of the right front outboard vehicle seat cushion. For bench seats, ''Plane B'' refers to a vertical plane through the right front outboard vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.2.1.4 *Facing rear.*

(a) The vehicle shall comply in both of the following positions, if applicable:

(1) Without attaching the child restraint anchorage system as specified in S5.9 of FMVSS No. 213 to a vehicle seat anchorage system specified in FMVSS No. 225, align the child restraint system facing rearward such that Plane A is aligned with Plane B.

(2) If the child restraint is certified to S5.9 of FMVSS No. 213, and the vehicle seat has an anchorage system as specified in FMVSS No. 225, attach the child restraint to the vehicle seat anchorage instead of aligning the planes. Do not attach the vehicle safety belt.

(b) While maintaining the child restraint positions achieved in S20.2.1.4(a), secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint in the rear facing mode.

(c) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

(d) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.1.5 *Facing forward (convertible restraints only).*

(a) The vehicle shall comply in both of the following positions, if applicable:

(1) Without attaching the child restraint anchorage system as specified in S5.9 of FMVSS No. 213 to a vehicle seat anchorage system specified in FMVSS No. 225, align the child restraint system facing forward such that Plane A is aligned with Plane B.

(2) If the child restraint is certified to S5.9 of FMVSS No. 213, and the vehicle seat has an anchorage system as specified in FMVSS No. 225, attach the child restraint to the vehicle seat anchorage instead of aligning the planes. Do not attach the vehicle safety belt.

(b) While maintaining the child restraint positions achieved in S20.2.1.5(a), secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint in the forward facing mode.

(c) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

(d) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2 *Unbelted rear facing and convertible child restraints.*

S20.2.2.1 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A of this standard.

S20.2.2.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S20.2.2.3 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the longitudinal centerline of the right front outboard vehicle seat cushion. For bench seats, ''Plane B'' refers to a vertical plane through the right front outboard seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.2.2.4 *Facing rear.*

(a) Align the child restraint system facing rearward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.2.5 *Facing forward.*

(a) Align the child restraint system facing forward such that Plane A is aligned with Plane B and the child restraint is in contact with the seat back.

(b) Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.2.3 *Tests with a belted car bed.*

S20.2.3.1 The vehicle shall comply in tests using any car bed specified in section A of Appendix A of this standard.

S20.2.3.2 (a) Install the car bed by following, to the extent possible, the car bed manufacturer's directions regarding proper installation of the car bed.

(b) Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to secure the car bed.

(c) Position the 49 CFR Part 572 Subpart K Newborn Infant dummy in the car bed by following, to the extent possible, the car bed manufacturer's instructions provided with the car bed for positioning infants.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and close all vehicle doors. Wait 10 seconds, then check whether the air bag is deactivated.

S20.3 *Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.*

S20.3.1 Each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position, if adjustable fore and aft, at the full rearward, middle, and, subject to S16.3.3.1.8, full forward positions. All tests are conducted with the seat height, if adjustable, in the mid-height position.

S20.3.2 Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at the right front outboard seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S20.3.1, subject to the fore-aft seat positions in S20.3.1. Do not fasten the seat belt.

S20.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S20.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S20.4 *Low risk deployment test.* Each vehicle that is certified as complying with S19.3 shall meet the following test requirements.

S20.4.1 Position the right front outboard vehicle seat in the full forward seat track position, adjust the seat height (if adjustable) to the mid-height position, and adjust the seat back (if adjustable) to the nominal design position for a 50th percentile adult male as specified in S8.1.3. Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If the seat cushion adjusts fore and aft, independent of the seat back, set this adjustment to the full rearward position. If adjustable, set the head restraint at the full down position. If the child restraint or dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S20.4.2 The vehicle shall comply in tests using any child restraint specified in section B and section C of appendix A to this standard.

S20.4.3 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S20.4.4 For bucket seats, ''Plane B'' refers to a vertical plane parallel to the vehicle longitudinal centerline through the geometric center of the right front outboard seat cushion. For bench seats, ''Plane B'' refers to a vertical plane through the right front outboard seat parallel to the vehicle longitudinal centerline that is the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

S20.4.5 Align the child restraint system facing rearward such that Plane A is aligned with Plane B.

S20.4.6 If the child restraint is certified to S5.9 of FMVSS No. 213, and the vehicle seat has an anchorage system as specified in FMVSS No. 225, attach the child restraint to the vehicle seat anchorage instead of aligning the planes. Do not attach the vehicle safety belt.

S20.4.7 While maintaining the child restraint position achieved in S20.4.5, secure the child restraint by following, to the extent possible, the child restraint manufacturer's directions regarding proper installation of the restraint in the rear facing mode. Place any adjustable seat belt anchorages at the manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S20.4.8 Position the 49 CFR Part 572 Subpart R 12-month-old CRABI dummy in the child restraint by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating infants.

S20.4.9 Deploy the right front outboard frontal air bag system. If the air bag system contains a multistage inflator, the vehicle shall be able to comply at any stage or combination of stages or time delay between successive stages that could occur in the presence of an infant in a rear facing child restraint and a 49 CFR Part 572, Subpart R 12-month-old CRABI dummy positioned according to S20.4 in a rigid barrier crash test at speeds up to 64 km/h (40 mph).

S21 *Requirements using 3-year-old child dummies.*

S21.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S21.2, S21.3, S21.4 or S21.5, under the test procedures specified in S22 or S28, as applicable.

S21.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S21.2.1 through S21.2.3.

S21.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger air bag which results in deactivation of the air bag during each of the static tests specified in S22.2 (using a 49 CFR Part 572 Subpart P 3-year-old child dummy and, as applicable, any child restraint specified in section C and section D of appendix A to this standard), and activation of the air bag system during each of the static tests specified in S22.3 (using a 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S21.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S21.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S21.2.2.

S21.3 *Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the passenger air bag system which meets the requirements specified in S27.

S21.4 *Option 3—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S21.5 of this standard when the passenger air bag is deployed in accordance with both of the low risk deployment test procedures specified in S22.4.

S21.5 *Injury criteria for the 49 CFR Part 572, Subpart P 3-year-old child test dummy.*

S21.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S21.5.2 *Head injury criteria.*

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5} (t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 570.

S21.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 55 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S21.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 34 millimeters (1.3 in).

S21.5.5 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: Tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S21.5.5(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 2120 N (477 lbf) when Fz is in tension

(ii) Fzc = 2120 N (477 lbf) when Fz is in compression

(iii) Myc = 68 Nm (50 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 27 Nm (20 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz / Fzc) + (Mocy / Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 1130 N (254 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 1380 N (310 lbf) at any time.

S21.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR Part 572 Subpart P 3-year-old child test dummy.

S22 *Test procedure for S21.*

S22.1 *General provisions and definitions.*

S22.1.1 Tests specifying the use of a forward facing child restraint, including a booster seat where applicable, may be conducted using any such restraint listed in section C and section D of Appendix A of this standard, respectively. The child restraint may be unused or have been previously used only for automatic suppression tests. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 3-year-old child of the same height and weight as the 3-year-old child dummy.

S22.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position at the full rearward, middle, and the full forward positions. If the dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) clearance.

S22.1.3 Except as otherwise specified, if the child restraint has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a right front outboard vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached.

S22.1.4 Do not attach any tethers.

S22.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S22.

S22.1.6 For leg and thigh angles use the following references:

(a) *Thigh*—a straight line on the thigh skin between the center of the 5⁄16 × 1⁄2 in. screw (part 9001024, item 10 in drawing 210–0000 sheet 2 of 7, complete assembly (HYB III 3 YR OLD)) and the knee bolt (part 210–5301 in drawing 210–5000–1 & –1, leg assembly).

(b) *Leg*—a straight line on the leg skin between the center of the ankle bolt (part 210–5701 in drawing 210–5000–1 & –2, leg assembly) and the knee bolt (part 210–5301 in drawing 210–5000–1 & –2, leg assembly).

S22.1.7 *Seat set-up.* Unless otherwise stated,

S22.1.7.1 *Lumbar support adjustment.* Position adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position.

S22.1.7.2 *Other seat adjustments.* Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.

S22.1.7.3 If the seat cushion adjusts fore and aft, independent of the seat back, set this adjustment to the full rearward position.

S22.1.7.4 If the seat height is adjustable, determine the maximum and minimum heights at the full rearward seat track position, the middle seat track position, and the full forward seat track position. Set the seat at the mid-point height for each of the three fore-aft test positions.

S22.1.7.5 The seat back angle, if adjustable, is set at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S22.1.7.6 If adjustable, set the head restraint at the full down and full forward position.

S22.2 *Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag.* Each vehicle that is certified as complying with S21.2 shall meet the following test requirements:

S22.2.1 *Belted test with forward facing child restraints or booster seats.*

S22.2.1.1 Install the restraint in the right front outboard seat in accordance, to the extent possible, with the child restraint manufacturer's instructions provided with the seat for use by children with the same height and weight as the 3-year-old child dummy.

S22.2.1.2 Locate a vertical plane through the longitudinal centerline of the child restraint. This will be referred to as ''Plane A''.

S22.2.1.3 For bucket seats, ''Plane B'' refers to a vertical longitudinal plane through the longitudinal centerline of the seat cushion of the right front outboard vehicle seat. For bench seats, ''Plane B'' refers to a vertical plane through the right front outboard vehicle seat parallel to the vehicle longitudinal centerline the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

22.2.1.4 The vehicle shall comply in both of the following positions, if applicable:

(a) Without attaching the child restraint anchorage system as specified in S5.9 of FMVSS No. 213 to a vehicle seat anchorage system specified in FMVSS No. 225 and without attaching any tethers, align the child restraint system facing forward such that Plane A is aligned with Plane B.

(b) If the child restraint is certified to S5.9 of FMVSS No. 213, and the vehicle seat has an anchorage system as specified in FMVSS No. 225, attach the child restraint to the vehicle seat anchorage instead of aligning the planes. Do not attach the vehicle safety belt.

S22.2.1.5 *Forward facing child restraint*

S22.2.1.5.1 Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. Cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the child restraint. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S22.2.1.5.2 Position the 49 CFR Part 572 Subpart P 3-year-old child dummy in the child restraint such that the dummy's lower torso is centered on the child restraint and the dummy's spine is against the seat back of the child restraint. Place the arms at the dummy's sides.

S22.2.1.5.3 Attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.6 *Booster seat*

S22.2.1.6.1 Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant. For booster seats designed to be secured to the vehicle seat even when empty, cinch the vehicle belts to any tension from zero up to 134 N (30 lb) to secure the booster seat. Measure belt tension in a flat, straight section of the lap belt between the child restraint belt path and the contact point with the belt anchor or vehicle seat, on the side away from the buckle (to avoid interference from the shoulder portion of the belt).

S22.2.1.6.2 Position the 49 CFR Part 572 Subpart P 3-year-old child dummy in the booster seat such that the dummy's lower torso is centered on the booster seat cushion and the dummy's back is parallel to and in contact with the booster seat back or, if there is no booster seat back, the vehicle seat back. Place the arms at the dummy's sides.

S22.2.1.6.3 If applicable, attach all belts that come with the child restraint that are appropriate for a child of the same height and weight as the 3-year-old child dummy, if any, by following, to the extent possible, the manufacturer's instructions provided with the child restraint for seating children.

S22.2.1.6.4 If applicable, place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt portion. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times. Apply a 9 to 18 N (2 to 4 lb) tension load to the lap belt. Allow the excess webbing in the upper torso belt to be retracted by the retractive force of the retractor.

S22.2.1.7 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S22.2.1.8 Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2 *Unbelted tests with dummies.* Place the 49 CFR Part 572 Subpart P 3-year-old child dummy on the right front outboard seat in any of the following positions (without using a child restraint or booster seat or the vehicle's seat belts):

S22.2.2.1 *Sitting on seat with back against seat back*

(a) Position the dummy in the seated position and place it on the right front outboard seat.

(b) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion. Position the torso of the dummy against the seat back. Position the dummy's thighs against the seat cushion.

(c) Allow the legs of the dummy to extend off the surface of the seat.

(d) Rotate the dummy's upper arms down until they contact the seat back.

(e) Rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.2 *Sitting on seat with back against reclined seat back.* Repeat the test sequence in S22.2.2.1 with the seat back angle 25 degrees rearward of the manufacturer's nominal design position for the 50th percentile adult male. If the seat will not recline 25 degrees rearward of the nominal design position, use the closest position that does not exceed 25 degrees.

S22.2.2.3 *Sitting on seat with back not against seat back.*

(a) Position the dummy in the seated position and place it on the right front outboard seat.

(b) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion. Position the dummy with the spine vertical so that the horizontal distance from the dummy's back to the seat back is no less than 25 mm (1.0 in) and no more than 150 mm (6.0 in), as measured along the dummy's midsagittal plane at the mid-sternum level. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Position the dummy's thighs against the seat cushion.

(d) Allow the legs of the dummy to extend off the surface of the seat.

(e) Position the upper arms parallel to the spine and rotate the dummy's lower arms until the dummy's hands contact the seat cushion.

(f) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(g) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.4 *Sitting on seat edge, spine vertical, hands by the dummy's sides.*

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion.

(b) Position the dummy in the seated position forward in the seat such that the legs are vertical and the back of the legs rest against the front of the seat with the spine vertical. If the dummy's feet contact the floor pan, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the dummy spine vertical. To keep the dummy in position, a material with a maximum breaking strength of 311 N (70 lb) may be used to hold the dummy.

(c) Place the upper arms parallel to the spine.

(d) Lower the dummy's lower arms such that they contact the seat cushion.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.5 *Standing on seat, facing forward.*

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel rim. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion. Position the dummy in a standing position on the right front outboard seat cushion facing the front of the vehicle while placing the heels of the dummy's feet in contact with the seat back.

(b) Rest the dummy against the seat back, with the arms parallel to the spine.

(c) If the head contacts the vehicle roof, recline the seat so that the head is no longer in contact with the vehicle roof, but allow no more than 5 mm (0.2 in) distance between the head and the roof. If the seat does not sufficiently recline to allow clearance, omit the test.

(d) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(e) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(f) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.6 *Kneeling on seat, facing forward.*

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion.

(b) Position the dummy in a kneeling position in the right front outboard seat with the dummy facing the front of the vehicle with its toes at the intersection of the seat back and seat cushion. Position the dummy so that the spine is vertical. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) If necessary use a material with a maximum breaking strength of 311 N (70 lb) or spacer blocks to keep the dummy in position.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.7 *Kneeling on seat, facing rearward.*

(a) In the case of vehicles equipped with bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the center of the steering wheel. In the case of vehicles equipped with bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal centerline of the seat cushion.

(b) Position the dummy in a kneeling position in the right front outboard seat with the dummy facing the rear of the vehicle. Position the dummy such that the dummy's head and torso are in contact with the seat back. Push down on the legs so that they contact the seat as much as possible and then release. Place the arms parallel to the spine.

(c) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(d) Wait 10 seconds, then check whether the air bag is deactivated.

S22.2.2.8 *Lying on seat.* This test is performed only in vehicles with 3 designated front seating positions.

(a) Lay the dummy on the right front outboard seat such that the following criteria are met:

(1) The midsagittal plane of the dummy is horizontal,

(2) The dummy's spine is perpendicular to the vehicle's longitudinal axis,

(3) The dummy's arms are parallel to its spine,

(4) A plane passing through the two shoulder joints of the dummy is vertical,

(5) The anterior of the dummy is facing the vehicle front,

(6) The head of the dummy is positioned towards the passenger door, and

(7) The horizontal distance from the topmost point of the dummy's head to the vehicle door is 50 to 100 mm (2–4 in).

(8) The dummy is as far back in the seat as possible.

(b) Rotate the thighs as much as possible toward the chest of the dummy and rotate the legs as much as possible against the thighs.

(c) Move the dummy's upper left arm parallel to the vehicle's transverse plane and the lower left arm 90 degrees to the upper arm. Rotate the lower left arm about the elbow joint and toward the dummy's head until movement is obstructed.

(d) Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

(e) Wait 10 seconds, then check whether the air bag is deactivated.

S22.3 *Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.*

S22.3.1 Each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position at the full rearward, middle, and, subject to S16.3.3.1.8, full forward positions. All tests are conducted with the seat height, if adjustable, in the mid-height position.

S22.3.2 Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at the right front outboard seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S22.3.1. Do not fasten the seat belt.

S22.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S22.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S22.4 *Low risk deployment tests.*

S22.4.1 Each vehicle that is certified as complying with S21.4 shall meet the following test requirements with the 49 CFR Part 572, Subpart P 3-year-old child dummy in both of the following positions: Position 1 (S22.4.2) and Position 2 (S22.4.3).

S22.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsaggital plane which is 114 mm (4.5 in) ± 3 mm (± 0.1 in) along the surface of the skin from the top of the skin at the neck line. This is referred to as ''Point 1.''

S22.4.1.2 Locate the vertical plane parallel to the vehicle longitudinal centerline through the geometric center of the opening through which the right front air bag deploys into the occupant compartment. This is referred to as ''Plane D.''

S22.4.1.3 Locate the horizontal plane through the geometric center of the opening through which the right front air bag deploys into the occupant compartment. This is referred to as ''Plane C.''

S22.4.2 *Position 1 (chest on instrument panel).*

S22.4.2.1 If a seat is adjustable in the fore and aft and/or vertical directions, move the seat to the rear-most seating position and full-down height adjustment. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full-rearward position. If the seat back is adjustable, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest position.

S22.4.2.2 Place the dummy in the front passenger seat such that:

S22.4.2.2.1 The midsagittal plane is coincident with Plane D.

S22.4.2.2.2 The legs are initially vertical to the floor pan. The legs and thighs shall be adjusted to the extent necessary for the head/torso to contact the instrument panel as specified in S22.4.2.3.

S22.4.2.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.2.3 Without changing the seat position and with the dummy's thorax instrument cavity rear face vertical, move the dummy forward until the dummy head/torso contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy and the angle of the thigh with respect to the torso. Once contact is made, raise the dummy vertically until Point 1 lies in Plane C. If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered, which may change the dummy's fore-aft position.)

S22.4.2. If possible, position the legs of the dummy so that the legs are vertical and the feet rest flat on the floor pan of the vehicle. If the positioning against the instrument panel does not allow the feet to be on the floor pan, the feet shall be parallel to the floor pan.

S22.4.2.5 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.3 *Position 2 (head on instrument panel).*

S22.4.3.1 Place the passenger seat in the full rearward seating position. Place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If adjustable in the vertical direction, place the seat in the mid-height position. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full rearward position. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. If adjustable, set the head restraint in the lowest position.

S22.4.3.2 Place the dummy in the front passenger seat such that:

S22.4.3.2.1 The midsagittal plane is coincident with Plane D.

S22.4.3.2.2 The legs are vertical to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan, and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 86 to 91 mm (3.4 to 3.6 in), with the thighs and the legs of the dummy in vertical planes.

S22.4.3.2.3 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S22.4.3.3 Move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S22.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seating position of the seat, slide the dummy forward until contact is made. Maintain the thorax instrument cavity rear face vertical orientation, the height of the dummy, and the angle of the thigh with respect to the horizontal.

S22.4.3.5 If head/torso contact with the instrument panel has not been made, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints until the head or torso comes into contact with the vehicle's instrument panel.

S22.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S22.4.4 Deploy the right front outboard frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash test at or below 26 km/h (16 mph), under the test procedure specified in S22.5.

S22.5 *Test procedure for determining stages of air bag systems subject to low risk deployment (low speed crashes) test requirement.*

S22.5.1 The test described in S22.5.2 shall be conducted with an unbelted 50th percentile adult male test dummy in the driver seating position according to S8 as it applies to that seating position and an unbelted 5th percentile adult female test dummy either in the right front seating position according to S16 as it applies to that seating position or at any fore-aft seat position on the passenger side.

S22.5.2 Impact the vehicle traveling longitudinally forward at any speed, up to and including 26 km/h (16 mph) into a fixed rigid barrier that is perpendicular ± 5 degrees to the line of travel of the vehicle under the applicable conditions of S8, S10, and S16 excluding S10.7, S10.8, S10.9, and S16.3.5.

S22.5.3 Determine which inflation stage or combination of stages are fired and determine the time delay between successive stages. That stage or combination of stages, with time delay between successive stages, shall be used in deploying the air bag when conducting the low risk deployment tests described in S22.4, S24.4, and S26.

S22.5.4 If the air bag does not deploy in the impact described in S22.5.2, the low risk deployment tests described in S22.4, S24.4, and S26 shall be conducted with all stages using the maximum time delay between stages.

S23 *Requirements using 6-year-old child dummies.*

S23.1 Each vehicle that is certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S23.2, S23.3, or S23.4, under the test procedures specified in S24 or S28, as applicable.

S23.2 *Option 1—Automatic suppression feature.* Each vehicle shall meet the requirements specified in S23.2.1 through S23.2.3.

S23.2.1 The vehicle shall be equipped with an automatic suppression feature for the passenger frontal air bag system which results in deactivation of the air bag during each of the static tests specified in S24.2 (using a 49 CFR Part 572 Subpart N 6-year-old child dummy in any of the child restraints specified in section D of Appendix A of this standard), and activation of the air bag system during each of the static tests specified in S24.3 (using a 49 CFR Part 572 Subpart O 5th percentile adult female dummy).

S23.2.2 The vehicle shall be equipped with a telltale light meeting the requirements specified in S19.2.2.

S23.2.3 The vehicle shall be equipped with a mechanism that indicates whether the air bag is suppressed, regardless of whether the passenger seat is occupied. The mechanism need not be located in the occupant compartment unless it is the telltale described in S23.2.2.

S23.3 *Option 2—Dynamic automatic suppression system that suppresses the air bag when an occupant is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the passenger frontal air bag system which meets the requirements specified in S27.

S23.4 *Option 3—Low risk deployment.* Each vehicle shall meet the injury criteria specified in S23.5 of this standard when the passenger air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S24.4.

S23.5 *Injury criteria for the 49 CFR Part 572 Subpart N 6-year-old child dummy.*

S23.5.1 All portions of the test dummy shall be contained within the outer surfaces of the vehicle passenger compartment.

S23.5.2 *Head injury criteria.*

(a) For any two points in time, t_1 and t_2, during the event which are separated by not more than a 15 millisecond time interval and where t_1 is less than t_2, the head injury criterion (HIC_{15}) shall be determined using the resultant head acceleration at the center of gravity of the dummy head, a_r, expressed as a multiple of g (the acceleration of gravity) and shall be calculated using the expression:

$$\left[\frac{1}{(t_2 t_1)}\int_{t_1}^{t_2} a_r dt\right]^{2.5}(t_2 t_1)$$

(b) The maximum calculated HIC_{15} value shall not exceed 700.

S23.5.3 The resultant acceleration calculated from the output of the thoracic instrumentation shall not exceed 60 g's, except for intervals whose cumulative duration is not more than 3 milliseconds.

S23.5.4 Compression deflection of the sternum relative to the spine, as determined by instrumentation, shall not exceed 40 mm (l.6 in).

S23.5.5 *Neck injury.* When measuring neck injury, each of the following injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash

event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S23.5.5(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 2800 N (629 lbf) when Fz is in tension

(ii) Fzc = 2800 N (629 lbf) when Fz is in compression

(iii) Myc = 93 Nm (69 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 37 Nm (27 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

$$Nij = (Fz / Fzc) + (Mocy / Myc)$$

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 1490 N (335 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 1820 N (409 lbf) at any time.

S23.5.6 Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given for the 49 CFR Part 572 Subpart N 6-year-old child test dummy.

S24 *Test procedure for S23.*

S24.1 *General provisions and definitions.*

S24.1.1 Tests specifying the use of a booster seat may be conducted using any such restraint listed in section D of Appendix A of this standard. The booster seat may be unused or have been previously used only for automatic suppression. If it has been used, there shall not be any visible damage prior to the test. Booster seats are to be used in the manner appropriate for a 6-year-old child of the same height and weight as the 6-year-old child dummy.

S24.1.2 Unless otherwise specified, each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position at the full rearward seat track position, the middle seat track position, and the full forward seat track position. If the dummy contacts the vehicle interior, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the point on the dummy that would first contact the vehicle interior. All tests are conducted with the seat height, if adjustable, in the mid-height position, and with the seat back angle, if adjustable, at the manufacturer=s nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3.

S24.1.3 Except as otherwise specified, if the booster seat has an anchorage system as specified in S5.9 of FMVSS No. 213 and is tested in a vehicle with a right front outboard vehicle seat that has an anchorage system as specified in FMVSS No. 225, the vehicle shall comply with the belted test conditions with the restraint anchorage system attached to the vehicle seat anchorage system and the vehicle seat belt unattached. It shall also comply with the belted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system and the vehicle seat belt attached. The vehicle shall comply with the unbelted test conditions with the restraint anchorage system unattached to the vehicle seat anchorage system.

S24.1.4 Do not attach any tethers.

S24.1.5 The definitions provided in S16.3.1 through S16.3.10 apply to the tests specified in S24.

S24.1.6 For leg and thigh angles, use the following references:

S24.1.6.1 *Thigh*—a straight line on the thigh skin between the center of the 5/16–18 UNC–2B threaded access hole in the upper leg clamp (drawing 127–4004, 6 YR H3—upper leg clamp) and the knee screw (part 9000248 in drawing 127–4000–1 & –2, leg assembly).

S24.1.6.2 *Leg*—a straight line on the leg skin between the center of the lower leg screw (part 9001170 in drawing 127–4000–1 & –2, leg assembly) and the knee screw (part 9000248 in drawing 127–4000–1 & –2, leg assembly).

S24.2 *Static tests of automatic suppression feature which shall result in deactivation of the passenger air bag.* Each vehicle that is certified as complying with S23.2 shall meet the following test requirements.

S24.2.1 Except as provided in S24.2.2, conduct all tests as specified in S22.2, except that the 49 CFR Part 572 Subpart N 6-year-old child dummy shall be used.

S24.2.2 *Exceptions.* The tests specified in the following paragraphs of S22.2 need not be conducted: S22.2.1.5, S22.2.2.3, S22.2.2.5, S22.2.2.6, S22.2.2.7, and S22.2.2.8.

S24.2.3 *Sitting back in the seat and leaning on the right front passenger door*

(a) Position the dummy in the seated position and place the dummy in the right front outboard seat. For bucket seats, position the midsagittal plane of the dummy vertically such that it coincides with the longitudinal center line of the seat cushion. For bench seats, position the midsagittal plane of the dummy vertically and parallel to the vehicle=s longitudinal centerline and the same distance from the longitudinal centerline of the vehicle as the center of the steering wheel.

(b) Place the dummy's back against the seat back and rest the dummy's thighs on the seat cushion.

(c) Allow the legs and feet of the dummy to extend off the surface of the seat. If this positioning of the dummy's legs is prevented by contact with the instrument panel, move the seat rearward to the next detent that provides clearance. If the seat is a power seat, move the seat rearward, while assuring that there is a maximum of 5 mm (0.2 in) distance between the vehicle interior and the part of the dummy that was in contact with the vehicle interior.

(d) Rotate the dummy's upper arms toward the seat back until they make contact.

(e) Rotate the dummy's lower arms down until they contact the seat.

(f) Close the vehicle's passenger-side door and then start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system.

(g) Push against the dummy's left shoulder to lean the dummy against the door; close all remaining doors.

(h) Wait 10 seconds, then check whether the air bag is deactivated.

S24.3 *Static tests of automatic suppression feature which shall result in activation of the passenger air bag system.*

S24.3.1 Each vehicle certified to this option shall comply in tests conducted with the right front outboard seating position at the full rearward seat track position, the middle seat track position, and, subject to S16.3.3.1.8, the full forward seat track position. All tests are conducted with the seat height, if adjustable, in the mid-height position.

S24.3.2 Place a 49 CFR Part 572 Subpart O 5th percentile adult female test dummy at the right front outboard seating position of the vehicle, in accordance with procedures specified in S16.3.3 of this standard, except as specified in S24.3.1. Do not fasten the seat belt.

S24.3.3 Start the vehicle engine or place the ignition in the ''on'' position, whichever will turn on the suppression system, and then close all vehicle doors.

S24.3.4 Wait 10 seconds, then check whether the air bag system is activated.

S24.4 *Low risk deployment tests.*

S24.4.1 Each vehicle that is certified as complying with S23.4 shall meet the following test requirements with the 49 CFR Part 572 Subpart N 6-year-old child dummy in both of the following positions: Position 1 (S24.4.2) or Position 2 (S24.4.3).

S24.4.1.1 Locate and mark a point on the front of the dummy's chest jacket on the midsagittal plane which is 139 mm (5.5 in) ± 3 mm (± 0.1 in) along the surface of the skin from the top of the skin at the neckline. This is referred to as ''Point 1.''

S24.4.1.2 Locate the vertical plane parallel to the vehicle longitudinal centerline through the geometric center of the opening through which the right front air bag deploys into the occupant compartment. This is referred to as ''Plane D.''

S24.4.1.3 Locate the horizontal plane through the geometric center of the opening through which the right front air bag deploys into the occupant compartment. This is referred to as ''Plane C.''

S24.4.2 *Position 1 (chest on instrument panel).*

S24.4.2.1 If a seat is adjustable in the fore and aft and/or vertical directions, move the seat to the rearmost seating position and full down height adjustment. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full rearward position. If the seat back is adjustable, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest position.

S24.4.2.2 Remove the legs of the dummy at the pelvic interface.

S24.4.2.3 Place the dummy in the front passenger seat such that:

(a) The midsagittal plane is coincident with Plane D.

(b) The upper arms are parallel to the torso and the hands are next to where the thighs would be.

(c) Without changing the seat position and with the dummy's thorax instrument cavity rear face 6 degrees forward of the vertical, move the dummy forward until the dummy head/torso contacts the instrument panel. If the dummy loses contact with the seat cushion because of the forward movement, maintain the height of the dummy while moving the dummy forward. If the head contacts the windshield before head/torso contact with the instrument panel, maintain the thorax instrument cavity angle and move the dummy forward such that the head is following the angle of the windshield until there is head/torso contact with the instrument panel. Once contact is made, raise or lower the dummy vertically until Point 1 lies in Plane C. If the dummy's head contacts the windshield and keeps Point 1 from reaching Plane C, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the head and the windshield. (The dummy shall remain in contact with the instrument panel while being raised or lowered which may change the dummy's fore-aft position.)

S24.4.2.4 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.3 *Position 2 (head on instrument panel).*

S24.4.3.1 Place the passenger seat in the full rearward seating position. Place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If adjustable in the vertical direction, place the seat in the mid-height position. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full rearward position. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest position.

S24.4.3.2 Place the dummy in the front passenger seat such that:

(a) The midsagittal plane is coincident with Plane D.

(b) The legs are perpendicular to the floor pan, the back of the legs are in contact with the seat cushion, and the dummy's thorax instrument cavity rear face is 6 degrees forward of vertical. If it is not possible to position the dummy with the legs in the prescribed position, rotate the legs forward until the dummy is resting on the seat with the feet positioned flat on the floor pan and the back of the legs are in contact with the front of the seat cushion. Set the transverse distance between the longitudinal centerlines at the front of the dummy's knees at 112 to 117 mm (4.4. to 4.6 in), with the thighs and the legs of the dummy in vertical planes.

(c) The upper arms are parallel to the torso and the hands are in contact with the thighs.

S24.4.3.3 Move the seat forward, while maintaining the thorax instrument cavity rear face orientation until any part of the dummy contacts the vehicle's instrument panel.

S24.4.3.4 If dummy contact has not been made with the vehicle's instrument panel at the full forward seating position of the seat, slide the dummy forward on the seat until contact is made. Maintain the thorax instrument cavity rear face orientation, the height of the dummy, and the angle of the thigh with respect to the horizontal.

S24.4.3.5 If head/torso contact has not been made with the instrument panel, maintain the angle of the thighs with respect to the horizontal while applying a force towards the front of the vehicle on the spine of the dummy between the shoulder joints until the head/torso comes into contact with the vehicle's instrument panel.

S24.4.3.6 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. Material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S24.4.4 Deploy the right front outboard frontal air bag system. If the frontal air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages and at any time delay between successive stages that could occur in a rigid barrier crash at speeds up to 26 km/h (16 mph) under the test procedure specified in S22.5.

S25 *Requirements using an out-of-position 5th percentile adult female dummy at the driver position.*

S25.1 Each vehicle certified as complying with S14 shall, at the option of the manufacturer, meet the requirements specified in S25.2 or S25.3 under the test procedures specified in S26 or S28, as appropriate.

S25.2 *Option 1—Dynamic automatic suppression system that suppresses the air bag when the driver is out of position.* (This option is available under the conditions set forth in S27.1.) The vehicle shall be equipped with a dynamic automatic suppression system for the driver air bag which meets the requirements specified in S27.

S25.3 *Option 2—Low risk deployment.* Each vehicle shall meet the injury criteria specified by S15.3 of this standard, except as modified in S25.4, when the driver air bag is statically deployed in accordance with both of the low risk deployment test procedures specified in S26.

S25.4 *Neck injury criteria driver low risk deployment tests.* When measuring neck injury in low risk deployment tests for the driver position, each of the following neck injury criteria shall be met.

(a) *Nij.*

(1) The shear force (Fx), axial force (Fz), and bending moment (My) shall be measured by the dummy upper neck load cell for the duration of the crash event as specified in S4.11. Shear force, axial force, and bending moment shall be filtered for Nij purposes at SAE J211/1 rev. Mar 95 Channel Frequency Class 600 (see S4.7).

(2) During the event, the axial force (Fz) can be either in tension or compression while the occipital condyle bending moment (Mocy) can be in either flexion or extension. This results in four possible loading conditions for Nij: tension-extension (Nte), tension-flexion (Ntf), compression-extension (Nce), or compression-flexion (Ncf).

(3) When calculating Nij using equation S25.4(a)(4), the critical values, Fzc and Myc, are:

(i) Fzc = 3880 N (872 lbf) when Fz is in tension

(ii) Fzc = 3880 N (872 lbf) when Fz is in compression

(iii) Myc = 155 Nm (114 lbf-ft) when a flexion moment exists at the occipital condyle

(iv) Myc = 61 Nm (45 lbf-ft) when an extension moment exists at the occipital condyle.

(4) At each point in time, only one of the four loading conditions occurs and the Nij value corresponding to that loading condition is computed and the three remaining loading modes shall be considered a value of zero. The expression for calculating each Nij loading condition is given by:

Nij = (Fz / Fzc) + (Mocy / Myc)

(5) None of the four Nij values shall exceed 1.0 at any time during the event.

(b) *Peak tension.* Tension force (Fz), measured at the upper neck load cell, shall not exceed 2070 N (465 lbf) at any time.

(c) *Peak compression.* Compression force (Fz), measured at the upper neck load cell, shall not exceed 2520 N (566 lbf) at any time.

(d) Unless otherwise indicated, instrumentation for data acquisition, data channel frequency class, and moment calculations are the same as given in 49 CFR Part 572 Subpart O 5th percentile female test dummy.

S26 *Procedure for low risk deployment tests of driver air bag.*

S26.1 Each vehicle that is certified as complying with S25.3 shall meet the requirements of S25.3 and S25.4 with the 49 CFR Part 572 Subpart O 5th percentile adult female dummy in both of the following positions: Driver position 1 (S26.2) and Driver position 2 (S26.3).

S26.2 *Driver position 1 (chin on module).*

S26.2.1 Adjust the steering controls 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. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering wheel so that the vehicle wheels are pointed straight ahead.

S26.2.2 Locate the vertical plane parallel to the vehicle longitudinal axis which passes through the geometric center of the opening through which the driver air bag deploys into the occupant compartment. This is referred to as ''Plane E.''

S26.2.3 Place the seat in the full rearward seating position. If adjustable in the vertical direction, place the seat in the mid-height position. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full rearward position. If the seat back is adjustable, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If the seat cushion contains an independent seat cushion angle adjustment mechanism, adjust the seat cushion angle to the middle of the range of seat cushion angles. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restrain in the lowest position.

S26.2.4 Place the dummy in the driver's seat such that:

S26.2.4.1 The midsagittal plane is coincident with Plane E.

S26.2.4.2 The legs are perpendicular to the floor pan and the back of the legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.2.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering wheel angle (i.e., if the steering wheel angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

S26.2.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.2.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.2.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering wheel.

S26.2.6 While maintaining the spine angle, adjust the height of the dummy so that a point on the chin 40 mm below the center of the mouth (chin point) is in the same horizontal plane as the geometric center of the opening through which the air bag deploys into the occupant compartment. If the seat prevents the chin point from being in the same horizontal plane, adjust the dummy height to as close to the prescribed position as possible.

S26.2.7 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.3 *Driver position 2 (chin on rim).*

S26.3.1 Place the seat in the full rearward seating position. If adjustable in the vertical direction, place the seat in the mid-height position. If the seat cushion adjusts fore and aft, independent of the entire seat, adjust the seat cushion to the full rearward position. If the seatback is adjustable, place the seat back at the manufacturer's nominal design seat back angle for a 50th percentile adult male as specified in S8.1.3. If the seat cushion contains an independent seat cushion angle adjustment mechanism, adjust the seat cushion angle to the middle of the range of seat cushion angles. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. Position an adjustable head restraint in the lowest position.

S26.3.2 Adjust the steering controls 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. If there is no setting at the geometric center, position it one setting lower than the geometric center. Set the rotation of the steering wheel so that the vehicle wheels are pointed straight ahead.

S26.3.3 Locate the vertical plane parallel to the vehicle longitudinal axis which passes through the geometric center of the opening through which the driver air bag deploys into the occupant compartment. This is referred to as ''Plane E.''

S26.3.4 Place the dummy in the driver's seat position such that:

S26.3.4.1 The midsagittal plane is coincident with Plane E.

S26.3.4.2 The legs are perpendicular to the floor pan and the back of the legs are in contact with the seat cushion. The legs may be adjusted if necessary to achieve the final head position.

S26.3.4.3 The dummy's thorax instrument cavity rear face is 6 degrees forward (toward the front of the vehicle) of the steering wheel angle (i.e., if the steering wheel angle is 25 degrees from vertical, the thorax instrument cavity rear face angle is 31 degrees).

S26.3.4.4 The initial transverse distance between the longitudinal centerlines at the front of the dummy's knees is 160 to 170 mm (6.3 to 6.7 in), with the thighs and legs of the dummy in vertical planes.

S26.3.4.5 The upper arms are parallel to the torso and the hands are in contact with the thighs.

S26.3.5 Maintaining the spine angle, slide the dummy forward until the head/torso contacts the steering wheel.

S26.3.6 While maintaining the spine angle, position the dummy so that a point on the chin 40 mm below the center of the mouth (chin point) is in contact with the rim of the uppermost portion of the steering wheel. If the dummy's head contacts the vehicle windshield or upper interior before the prescribed position can be obtained, lower the dummy until there is no more than 5 mm (0.2 in) clearance between the vehicle's windshield or upper interior, as applicable.

S26.3.7 If the steering wheel can be adjusted so that the chin point can be in contact with the rim of the uppermost portion of the steering wheel, adjust the steering wheel to that position and readjust the spine angle to coincide with the steering wheel angle. Position the dummy so that the chin point is in contact with the rim of the uppermost portion of the steering wheel.

S26.3.8 If necessary, material with a maximum breaking strength of 311 N (70 lb) and spacer blocks may be used to support the dummy in position. The material should support the torso rather than the head. Support the dummy so that there is minimum interference with the full rotational and translational freedom for the upper torso of the dummy and the material does not interfere with the air bag.

S26.4 Deploy the left front outboard frontal air bag system. If the air bag system contains a multistage inflator, the vehicle shall be able to comply with the injury criteria at any stage or combination of stages or time delay between successive stages that could occur in a rigid barrier crash at speeds up to 26 km/h (16 mph) under the test procedure specified in S22.5.

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S29 *Manufacturer option to certify vehicles to certain static suppression test requirements using human beings rather than test dummies.*

S29.1 At the option of the manufacturer, instead of using test dummies in conducting the tests for the following automatic suppression and occupant recognition parts of the low risk deployment test requirements, human beings may be used as specified. If human beings are used, they shall assume, to the extent possible, the final physical position specified for the corresponding dummies for each test.

(a) If a manufacturer decides to certify a vehicle using a human being for a test of the passenger automatic suppression, it shall use humans for the entire series of tests, e.g., 3-year-old children for each test of the system involving 3-year-old test dummies. If a manufacturer decides to certify a vehicle using a test dummy for a test of the system, it shall use test dummies for the entire series of tests, e.g., a Hybrid III 3-year-old child dummy for each test of the system involving 3-year-old child test dummies.

(b) For S19.2, instead of using the 49 CFR Part 572 Subpart R 12-month-old child dummy, a human child who weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(c) For S19.2, instead of using the 49 CFR Part 572 Subpart K newborn infant dummy, a human child who weighs between 8.2 and 9.1 kg (18 and 20 lb), and who is between 61 and 66 cm (24 and 26 in) tall may be used.

(d) For S21.2 and S21.5.1, instead of using the 49 CFR Part 572 Subpart P 3-year-old child dummy, a human child who weighs between 13.4 and 18 kg (29.5 and 39.5 lb), and who is between 89 and 99 cm (35 and 39 in) tall may be used.

(e) For S23.2 and S23.5.1, instead of using the 49 CFR Part 572 Subpart N 6-year-old child dummy, a human child who weighs between 21 and 25.6 kg (46.5 and 56.5 lb), and who is between 114 and 124.5 cm (45 and 49 in) tall may be used.

(f) For S19.2, S21.2, and S23.2, instead of using the 49 CFR Part 572 Subpart O 5th percentile adult female test dummy, a female who weighs between 46.7 and 51.25 kg (103 and 113 lb), and who is between 139.7 and 150 cm (55 and 59 in) tall may be used.

S29.2 Human beings shall be dressed in a cotton T-shirt, full length cotton trousers, and sneakers. Specified weights and heights include clothing.

S29.3 A manufacturer exercising this option shall upon request:

(a) Provide NHTSA with a method to deactivate the air bag during compliance testing under S20.2, S20.3, S22.2, S22.3, S24.2, and S24.3, and identify any parts or equipment necessary for deactivation; such assurance may be made by removing the air bag; and

(b) Provide NHTSA with a method to assure that the same test results would be obtained if the air bag were not deactivated.

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Appendix A to § 571.208—Selection of Child Restraint Systems

A. The following car bed, manufactured on or after December 1, 1999, may be used by the National Highway Traffic Safety Administration to test the suppression system of a vehicle that has been certified as being in compliance with 49 CFR 571.208 S19:

Cosco Dream Ride 02–719

B. Any of the following rear facing child restraint systems, manufactured on or after December 1, 1999, may be used by the National Highway Traffic Safety Administration to test the suppression system of a vehicle that has been certified as being in compliance with 49 CFR 571.208 S19. When the restraint system comes equipped with a removable base, the test may be run either with the base attached or without the base.

Britax Handle with Care 191
Century Assura 4553
Century Avanta SE 41530
Century Smart Fit 4543
Cosco Arriva 02727
Cosco Opus 35 02603
Evenflo Discovery Adjust Right 212
Evenflo First Choice 204
Evenflo On My Way Position Right V 282
Graco Infant 8457

C. Any of the following forward-facing convertible child restraint systems, manufactured on or after December 1, 1999, may be used by the National Highway Traffic Safety Administration to test the suppression system of a vehicle that has been certified as being in compliance with 49 CFR 571.208 S19, or S21:

Britax Roundabout 161
Century Encore 4612
Century STE 1000 4416
Cosco Olympian 02803
Cosco Touriva 02519
Evenflo Horizon V 425
Evenflo Medallion 254

D. Any of the following forward-facing toddler/belt positioning booster systems, manufactured on or after December 1, 1999, may be used by the National Highway Traffic Safety Administration as test devices to test the suppression system of a vehicle that has been certified as being in compliance with 49 CFR 571.208 S21 or S23:

Britax Roadster 9004
Century Next Step 4920
Cosco High Back Booster 02–442
Evenflo Right Fit 245

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Jeffery W. Runge,

Administrator.

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