C. American Society of Civil Engineers (ASCE), Parallel Centre, 1801 Alexander Bell Dr., Reston, VA 20191–4400.

D. American Society of Mechanical Engineers (ASME), Three Park Ave., New York, NY 10016–5990.

E. Gas Research Institute (GRI), 8600 West Bryn Mawr Ave., Chicago, IL 60631.

F. National Fire Protection Association (NFPA), 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269–9101.

II. Documents Incorporated by Reference, (Numbers in Parentheses Indicate Applicable Editions)

A. American Gas Association (AGA):
1. ''Purging Principles and Practices''—(1975)

B. American Society of Civil Engineers (ASCE):
1. ASCE 7–95 ''Minimum Design Loads for Buildings and Other Structures'' (1995).

C. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code, Section VIII, Divisions 1 and 2 (1998).

D. Gas Research Institute (GRI):
1. GRI–89/0176 ''LNGFIRE: A Thermal radiation Model for LNG Fires'' (June 29, 1990).
2. GRI–89/0242 ''LNG Vapor Dispersion Prediction with the DEGDIS Dense Gas Dispersion Model'' (April 1988–July 1990).
3. GRI–96/0396.5 ''Evaluation of Mitigation Methods for Accidental LNG Releases, Volume 5: Using FEM3A for LNG Accident Consequence Analyses.''

E. National Fire Protection Association (NFPA):
1. ANSI/NFPA 59A ''Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)'' (1996 edition).

Issued in Washington, D.C. on February 11, 2000.

John P. Murray,

Acting Deputy Administrator.

[FR Doc. 00–3799 Filed 2–29–00; 8:45 am]

BILLING CODE 4910–60–P

DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

49 CFR Part 572

[Docket No. NHTSA–2000–6940]

RIN 2127–AG66

Anthropomorphic Test Dummy; Occupant Crash Protection

AGENCY: National Highway Traffic Safety Administration (NHTSA), Department of Transportation.

ACTION: Final rule.

SUMMARY: This document amends 49 CFR Part 572 by adding design and performance specifications for a new dummy whose height and weight are representative of a fifth percentile female adult. This new dummy, which is part of the family of Hybrid III test dummies, can be used to accurately assess the potential for injuries to small-statured adults and teenagers. The new dummy is especially needed both to ensure that air bags protect small-statured adults and teenagers in frontal crashes and to minimize the risk of injury from air bags during those crashes. The dummy will also provide a means of gathering useful information in a variety of crash environments to better evaluate vehicle safety.

Adding the dummy to Part 572 is the first step toward using the dummy to evaluate the safety and effectiveness of air bags for small-statured adults and teenagers. The issue of amending various safety standards to specify use of the dummy in determining compliance with the performance requirements of those standards, *e.g.,* the agency's occupant protection standard, will be addressed in other rulemakings, particularly the agency's advanced air bag rulemaking for which a notice of proposed rulemaking was published in September 1998 and a supplemental notice of proposed rulemaking was published in November 1999.

DATES: *Effective Date:* This regulation becomes effective March 31, 2000. The incorporation by reference of the publications listed in the rule is approved by the Director of the Federal Register as of March 31, 2000.

Petitions: Petitions for reconsideration must be received by April 17, 2000.

ADDRESSES: Petitions for reconsideration should refer to the docket number of this rule 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 call Stan Backaitis, Office of Crashworthiness Standards, at 202–366–4912.

For legal issues, you may call Rebecca MacPherson, Office of the Chief Counsel, at 202–366–2992.

You may send mail to both of these officials at National Highway Traffic Safety Administration, 400 Seventh St., S.W., Washington, D.C., 20590.

SUPPLEMENTARY INFORMATION:

I. Summary of Decision

Based on our use of the Hybrid-III 5th percentile female (H–III5F) dummy in calibration tests and in frontal impact tests involving restraints such as air bags and belts, and after consideration of the public comments on our September 3, 1998 notice of proposed rulemaking (NPRM) (63 FR 46981), we have concluded that this dummy is suitable for both research and safety compliance assessments. Depending on the intended injury assessment needs, the dummy has the necessary instrumentation to measure the potential for injuries to the head, the upper and lower ends of the neck, the chest, the lumbar spine, the pelvis, and the femurs, as well as the forces on the iliac crests [1] caused by the lap belt. In extensive agency tests, the dummy exhibited excellent durability and robustness as a measuring test tool. Although other dummy users were invited to provide comments on their test experience with the H–III5F dummy, their responses to the NPRM were based primarily on data from calibration-type tests. Little of the data was from the dummy's response in systems tests. Accordingly, our judgment about the adequacy of the dummy in systems tests is based on our own test data. However, we believe that our conclusion is consistent with the calibration data submitted in response to the NPRM by other dummy users, since those data provide a reasonably good match with the agency data.

We have decided to add the H-III5F dummy to Part 572 as Subpart O, and designate it as the alpha version of the dummy. This dummy is not significantly different from the one proposed in the NPRM. Further changes to the dummy will be designated as beta, gamma, etc., to assure that modifications can be easily tracked and identified. The new dummy is defined by a drawing and specification package; a new procedures document for disassembly, assembly, and inspection; and performance parameters including associated calibration procedures as noted in Subpart O.

II. Background

Air bag-related fatalities and injuries to small female drivers seated close to the deploying air bag in low speed crashes have raised serious concerns about the safety of air bags for this portion of the population.[2] One way to

[1] The ilium is the expansive-superior segment of the three bones composing the left or right half of the pelvis.

[2] Close proximity to the air bag is one of the primary factors leading to serious injury or fatality. Several factors can lead to an individual being too close to the air bag at the time of deployment, including failure to wear a safety belt. Nevertheless, very small-statured women appear to constitute the largest segment of the driver population that may not be able to sit a safe distance from the air bag,

Continued

evaluate the protection provided by and the risks associated with air bag systems is through the use of human mechanical surrogates with a high degree of biofidelity, such as the family of Hybrid III-type crash test dummies. The desirability of a second adult-sized crash dummy, such as the fifth percentile adult female, has been apparent for a number of years. During a March 1997 National Transportation Safety Board hearing on the safety of air bag systems, several industry commenters addressed the need to revise Federal Motor Vehicle Safety Standard (FMVSS) No. 208, Occupant Crash Protection, by adopting new test procedures and test devices and by assessing the safety of the occupant protection systems with suitable injury assessment criteria. The commenters noted that the Hybrid III-type 5th percentile female dummy has been used by industry for research purposes for several years and supported its use in air bag certification programs.

The 5th percentile adult female dummy (H–III5F) is part of a family of Hybrid III-type dummies. The first Hybrid III dummy was a 50th percentile male dummy. NHTSA has specified use of that dummy for compliance testing under FMVSS No. 208 since 1986, initially on an optional basis, and more recently on a mandatory basis. The need for a family of Hybrid III-type dummies having considerably improved biofidelity and anthropometry was recognized by the Centers for Disease Control and Prevention (CDC) in 1987 when it awarded a contract to Ohio State University under the title ''Development for Multi-Sized Hybrid III Based Dummy Family.'' Development of the H–III5F dummy, along with the development of other family members,[3] has continued since then under the guidance of the Hybrid III Dummy Family Task Force of SAE.[4] The task force invited experts from biomechanics, instrumentation, and dummy design to guide this development. In defining the specifications for a small adult female dummy, the task force selected key body lengths and weights based on anthropometry data for the smallest fifth percent of the United States adult female population. Geometric and mass scale factors were developed to assure that each body segment had the same or similar mass densities as the corresponding Hybrid III body segment.

In 1997, we began an extensive test and evaluation program of the H–III5F dummy. The dummies were exposed to a variety of crash environments to determine their suitability and stability as measuring tools in the most severe crashes.

Upon completion of its evaluation of the H-III5F dummy, the agency tentatively concluded that it was ready for incorporation into Part 572. NHTSA placed in the docket a technical report entitled ''Development and Evaluation of the Hybrid III 5th Percentile Adult Female Dummy,'' minutes of SAE Hybrid III dummy family task group meetings relating to the dummy, and drawings of the proposed dummy. These documents provide the technical information relevant to rulemaking on the H–III5F dummy. On September 3, 1998, we published an NPRM proposing to incorporate the H–III5F dummy into Part 572 as subpart O, and invited comments (63 FR 46981).

We received comments from 14 organizations and one individual: First Technology Safety Systems (FTSS), Applied Safety Technology Corporation (ASTC), Robert A. Denton, Inc., Transportation Research Center, Inc. (TRC), International Electronic Engineering (IEE), TRW, Advocates for Highway and Auto Safety (Advocates), SAE Dummy Test Equipment Subcommittee (DTES), the American Automobile Manufacturers Association (AAMA), Florida International University (FIU), Toyota Motor Company (Toyota), the Insurance Institute for Highway Safety (IIHS), General Motors, North America (GM), DaimlerChrysler Corp. (DC), and Laurel Barker, a private citizen.

The comments tended to fall into two groups. Commenters either simply supported the rulemaking generally without being specific as to any particular aspect of the proposal, or, in addition to indicating overall support, provided very technical comments on specific portions of the proposal. Often, the latter group of comments dealt with procedures on how the dummy is set up and positioned for calibration tests or with the sufficiency and clarity of the dummy drawings. These highly technical comments are addressed at greater length in the ''Technical Analysis of Issues Report'' (TAIR–H–III5F) supporting this final rule. Where we have agreed with the comments, we have made appropriate changes in either the drawing package or the regulatory text. The TAIR–H–III5F is in the docket.

III. Dummy Drawings

Several of the commenters, including ASTC, FTSS, and to a lesser extent Denton, raised questions about the specifications in the drawings. To simplify analysis of the large number of detailed issues related to design specifications, we divided the comments into four categories: design, performance, manufacturing, and other issues.

Design Issues: This group of issues concerns those requested changes that, in our opinion, are essential to assure the dummy's structural consistency and its appropriate functioning. They involve a series of questions essential to dummy design, as well as missing or incomplete significant specifications. The issues involve dummy drawings that need to be changed either by adjusting existing specifications or adding further specifications to assure a correct fit and interface between components and their appropriate functioning in the impact environment. While these changes are important, they must be addressed with a degree of technical specificity that will likely be appreciated only by the two dummy manufacturers who commented on the NPRM. Accordingly, they are fully discussed in the TAIR–H–III5F .

Performance Issues: This group of issues involves comments on drawings and specifications that we believe relate primarily to production decisions which dummy manufacturers need to address on their own. We believe further that the requested changes to the specifications falling in this category are of little consequence to the fit and function of the dummy. The performance issues primarily concern requests for the addition of new dimensions and specifications that have little, if any, functional significance for the part in question; expanding the specifications to include manufacturing processes and further details for material specifications; and assignment of dimensional and surface finish controls on parts that have no foreseeable effects to their fit and overall dummy performance.

In general, we have found no reason to include the requested information in the drawing set of the final rule. The inclusion of such information would be of little value, if any, and would not assure better quality of the manufactured dummy. Indeed, the addition of the specifications may reduce a dummy manufacturer's

even when properly restrained. Additionally, differences in body size may lead to more severe injury for a small-statured woman than for an unrestrained average-size male.

[3] The second dummy, the six-year-old child, was the subject of an NPRM published on June 28, 1998 (63 FR 35170), and a Final Rule published on January 13, 2000 (65 FR 2059).

[4] Minutes of the meetings of the taskforce are located in NHTSA's docket, Room 5111, 400 Seventh St., SW, and are available for public inspection. The minutes address development of the entire family of Hybrid III dummies, including the six-year-old dummy that is the subject of a previous rulemaking.

flexibility in selecting a superior production technique or process, and may inhibit competition.

The one exception is a comment by ASTC that the damping material to the ribs is not specified in the drawings package. Although the damping material and the bonding-to-the-rib processes are generally known, the agency is reluctant to specify them. We do not wish to inhibit the development and use of improved materials and bonding techniques. However, to assist those manufacturers that may not be aware of the existing technology, we have decided to add a note to drawing 880105–361 referencing the damping materials and bonding process used for the manufacture of ribs for the Hybrid III 50th percentile adult male dummy (H–III50M) (see drawings 78051–35 through –40). All comments addressing performance issues are fully discussed in the TAIR–H–III5F.

Manufacturing Issues: ASTC commented that the proposed drawing set does not allow another manufacturer to produce this dummy because it lacks surface contour information. ASTC stated that the surface contour information affects not only outside vinyl skin pieces, but also many internal structures such as skull, clavicle, clavicle link, and pelvic bone. ASTC argued the lack of surface contour information would create problems in interchangeability and equivalency between dummies produced by different manufacturers, and could also affect dummy performance. ASTC requested that the agency provide opportunities for commenters to review the dummy to answer their questions and provide patterns or parts for the surface contour information.

We gave careful consideration to these comments and examined several options for resolving ASTC's concerns. The drawing review option was impracticable for this dummy, since drawings were already released as part of the NPRM package. There was no way to assure that any contour definitions placed on the drawings would address all the concerns raised by the commenters. The availability of molds and patterns was also impracticable, since the agency does not own any molds and patterns for this dummy.

The agency has therefore decided to adopt a third option, *i.e.,* making a copy of the dummy available to interested manufacturers for non-destructive dimensional inspection and extraction of surface contour information. In order to provide all interested parties with the opportunity to inspect and measure the dummy, NHTSA will continue to make the dummy available to any interested party for a period of six months after the issuance of this final rule. Such access is subject to the following terms:

- All inspections are to take place at NHTSA's Vehicle Research and Testing Center (VRTC) and at VRTC's convenience, although reasonable attempts will be made to accommodate the interested party's schedule.
- An individual or company wishing to inspect the dummy will need to contract directly with TRC to make arrangements for an individual to oversee the measurement process. This oversight by TRC is necessary to ensure that the dummies are not damaged and are reassembled correctly without the undue expenditure of agency resources.

ASTC has already availed itself of this opportunity, although it was advised that, prior to the issuance of this rule, the dummy was subject to changes.

Other Issues: Some issues do not fall into any of the above categories. These issues relate to requests that the agency add new dimensions or specifications; incorporate a newly-developed ball bearing knee slider; specify a neck wrap for the dummy; specify a different hand design for the dummy; and adopt a dummy that is more representative of the overall adult female population than the H–III5F.

We believe that the new addition of new dimensions and specifications to the drawing package would serve little value. We have evaluated the specific comments and related drawings and have determined that, with a few exceptions, the requested additions would be of little value and would not assure better quality of the manufactured dummy. To the extent we believe the additions would be useful, we have made those changes to the drawing package. A more detailed explanation of the agency's examination of the comments and their related drawings can be found in the TAIR–H–III5F.

While the new ball bearing knee slider may be appropriate for future rulemaking, it has not been fully evaluated yet by either NHTSA or the SAE. Accordingly, we believe that incorporating it into Part 572 at this time would be premature.

VRTC, in cooperation with the SAE Hybrid-III Dummy Family Task Force, has developed a new head skin to prevent the air bag from becoming wedged into a small cavity between the chin and neck of the dummy during a crash test. This head skin incorporates a vinyl cover that provides a more realistic jaw line (temporomandibular joint (TMJ) design). Our tests indicated that the TMJ significantly reduces the likelihood that an air bag will become caught between the dummy's chin and neck. In contrast, tests on various neck wraps did not produce the expected improvements.[5] Accordingly, the agency proposed in the NPRM incorporating the TMJ as part of the H–III5F head skin. The TMJ appears to adequately reduce the likelihood that the air bag will be caught in the dummy's head/neck junction. Accordingly, we have incorporated the TMJ as part of the final rule. We note that significant advances in neck wraps that will better control air bag wedging are still possible. If such an improved design becomes available, it could be added to the dummy in a future rulemaking.

Denton expressed concern that the proposed hand for the dummy was incapable of gripping, was too large for the dummy, and was subject to excessive wear. We believe that the change in the size of the hand proposed by Denton would have no significant impact on the performance of the dummy. The SNPRM for the FMVSS No. 208 advanced air bag rulemaking did not propose a requirement that the dummy be able to grip the steering wheel. Since the only rulemaking for which the use of the H–III5F is presently contemplated will not have a gripping requirement, we do not believe we need to incorporate a grippable hand at this time. We have also not experienced any problems with durability in the more than fifty tests that we have conducted using the H–III5F.

Finally, the single private citizen who commented on the NPRM stated that she believed we should use a dummy that is more representative of adult females than the H–III5F dummy, i.e., one that is approximately 5′3″ tall and 125 pounds. A dummy this size would be representative of a 50th percentile adult female. Since no one has developed such a dummy, we are unable to give consideration to incorporating one into Part 572 at this time. While numerous dummies of various sizes could be developed for test purposes, practical and financial concerns limit the agency to base the selection of representative dummies to those sizes that address the safety needs of the entire range of the population. By incorporating both the H–III5F, which is representative of the smaller end of the driving population, and the existing H–III50M, which is representative of a mid-size male, we believe the majority of the adult female population is adequately represented in the applicable crash tests.

[5] A summary report of this evaluation has been placed in the docket.

IV. Calibration Procedures

The agency proposed calibration tests involving head drop tests, neck pendulum tests, thorax and knee impacts, and torso flexion tests. AAMA, TRC, GM, TRW and Toyota were the principal commenters on test procedures.

Discussion of the vast majority of these comments is left to the TAIR–H–III5F because they raise relatively minor issues related to adjustments in the test procedure. However, the comments raise an issue as to whether the proposed semi-static torso flexion test should be a calibration test or simply an initial, as received, inspection test. This distinction is important because inspection tests usually are performed at the time the dummy is received from the manufacturer and are not necessarily repeated to establish the dummy's suitability for vehicle or vehicle component testing. An additional concern, unrelated to the inspection test issue, was raised that the impact probes specified for the knee and thorax tests were unduly design restrictive.

The semi-static torso flexion test (upper torso half relative to the lower half) was proposed as a calibration specification for this dummy. AAMA and TRC objected to characterizing this procedure as a calibration test, claiming it is not critical to the dummy's performance. Rather, they suggested it be retained as an inspection test as shown in the SAE User's Manual. Further, they claimed that the preflexion test is not needed and that the upper torso return angle upon release of the bending force should be eliminated.

The commenters have not provided any factual support for the claim that flexion stiffness of the mid-torso is not critical to the dummy's performance, and that the occasional assessment of stiffness during the dummy's inspection is sufficient. They have argued that the SAE User's Manual lists this test as an ''inspection test'' which is supplemental to the calibration tests to ensure that a component meets its design intent. They note that inspection tests are performed by the dummy manufacturer on new parts, but that the dummy user may conduct inspection tests only after a part is damaged or replaced. The agency does not agree that the test should be limited to inspection. The dummy's torso midsection provides an important coupling and transfer of loads between the upper and lower torso halves. The lumbar spine and the pelvis bone cavity control the fit of the abdomen at the rear and bottom of the torso while the upper torso flesh and the ribcage control the fit of the upper torso half. Thus, the bottom of the ribcage as it glides around and pushes on internal surfaces of the abdomen has a substantial influence not only on the extent the torso will flex, but also on how the load transfer between the upper and lower torso halves will be distributed. We believe the flexion procedure is necessary as a calibration test to ensure that when the dummy is used, its torso flexion stiffness is consistent, provides consistent upper torso kinematics relative to the lower torso, and does not cause or contribute to the variability of dummy response measurements in other body segments. A procedure relegated to an inspection category would not serve these purposes. Without calibration tests, a user will not know if the dummy has the correct mid-section stiffness and if the responses of the other body segments were or were not affected by mid-section variability.

We also disagree with the suggestion that the return angle during the bending stiffness test of the lumbar spine/upper torso assembly is not needed. There will be a substantial difference in overall torso kinematics between a seated dummy that can and a seated dummy that cannot return its upper torso half from a flexed position to an upright posture, particularly after full flexion has occurred. Without return, the flexion is substantially plastic, while evidence of a specific return would be indicative of the torso mid-section having certain elastic, more human-like properties. Evidence of consistent return would indicate that the forces of restitution are intact, while no or indefinite return would indicate a substantial change within the internal mechanisms of the mid-torso structure, such as failure of the lumbar spine, abdomen, or a substantial shift between interfacing body segments within the abdominal cavity. Analysis of all of the test results indicate that the upper torso of a structurally intact dummy returns consistently within 8 degrees of the starting position, indicating the adequacy of the specified return angle.

The commenters also suggested removal of the preflex provision, claiming such a provision is not needed and would interfere with the waiting time between tests recommended in the SAE User's Manual. A preflex provision was proposed to provide an opportunity for the mating parts to inter-align between themselves, so that the internal structures within the dummy's mid-torso are not sprung or misaligned at the time of testing. This would be of particular importance, for example, after either a severe test exposure or a lengthy period of non-use. The agency conducted preflexing in its tests, and found that the procedure developed a stabilized set-up posture. We see no reason to remove a provision that helps to assure a stabilized posture and better and more consistent measurements, including the integrity of the interconnection between the upper and the lower torso halves. In response to FTSS' comments about excessive flexing angle of the torso for stabilization purposes, the proposed provision for flexing the torso 3 times by 40 degrees from its initial vertical upright position is being reduced to a nominal 30 degrees in the forward direction. The agency found 30 degrees of flexion sufficient to achieve stabilized interalignment of parts within the dummy's abdominal area.

The impact probes specified by the NPRM for knee and thorax tests were meant to be generally cylindrical in shape and of a certain diameter and mass. TRC stated that the type of test probe specified in the NPRM unnecessarily restricts the design of the probe and puts additional maintenance burden on test laboratories. TRC prefers the wording used in current drafts of the SAE User's Manuals. TRC states that the wording was chosen by committee consensus to allow a wide range of design options without affecting impact results. In the case of the SAE H–III6C manual, TRC claims, the wording for the knee probe is more correct and preferred.

Up to now, all of the agency-specified dummy impact probes have been defined as rigid body cylinders of a specified diameter and mass. Similarly, with a few exceptions, most SAE User's Manuals, which are patterned after the agency's test procedures, also specify cylindrical impact probes, although in practice such probes may not be perfectly cylindrical. The addition of several new dummies to 49 CFR Part 572 may make it necessary for some dummy calibration laboratories to equip the existing test facilities with several new impact probes. Some of those probes, particularly those made of a light-weight material, may be difficult to design in a pure cylindrical form.

We agree with TRC that more latitude in the selection of impact probes will allow the various laboratories greater flexibility in the use of existing impactors and/or in developing new ones. At the same time, it is essential that alternate impact probes do not create problems such as imprecision in the geometry of the impact face which could lead to inappropriate interface with dummy components at the time of impact, introduction of vibratory effects due to potential resonances, inter-mass impacts within the impactor, and kinematic differences due to differences in shape and mass moments of inertia. Similarly, the measurement of impact force must be sensed by an accelerometer in a location whose signal is not distorted by insufficient rigidity and geometry of the structures on which it is mounted. It is also noted that while the current specification for impactors defines the general shape of the impactor the agency intends to use, that specification does not prohibit any test facility from using an impactor of its choice, as long as the user is confident that the alternate impactor will generate the same results under identical test conditions.

While the agency believes that, for the sake of consistency and simplicity, it would be best if all impact probes for dummy testing were of cylindrical design as defined in the NPRM, we also believe that TRC's comments have merit and would provide the test laboratories with sufficient flexibility when selecting impactors. Accordingly, we have redefined the impact probes in generic terms and will accept other impactor configurations for compliance purposes, as long as they have the same (1) Mass, (2) Impact surface configuration, (3) Defined mass moment of inertia in yaw and pitch with respect to the principal axis, (4) Structural integrity, (5) An identically aligned accelerometer on the rear face of the impactor, (6) Free air resonant frequency of not less than 1000 Hz, and (7) Functionality and freedom of interference with the dummy's other body segments during the impact.

V. Calibration Response Corridors

The agency proposed calibration corridors for the head, neck flexion/extension, thorax resistive force and deflection, knee load and torso-flexion. Comments on the response corridors were received from the following organizations: TRC, AAMA, GM, DC and TRW. During the agency's data analysis process, we contacted AAMA and SAE DTESC for further details and clarification of their comments. All comments are discussed in the TAIR–H–III5F.

None of the commenters objected to the proposed head response corridor of 250 G to 300 G. All of the commenters either directly or indirectly agreed with the proposed response corridor for the head. Accordingly, the 250 G to 300 G impact response corridor is retained in the Final Rule as proposed in the NPRM.

We proposed neck response corridors in flexion in terms of neck moments, maximum head flexion-rotation angle, and moment decay time. For flexion, we specified a deflection range of the D plane from 80–92 degrees, a peak moment of 69 N-m to 83 N-m, and a positive moment decay for the first 10 N-m between 80 and 100 ms after time-zero. FTSS, AAMA, TRW, and TRC provided specific comments on neck flexion response corridors and a process for defining the measurement of the peak moment.

The commenters recommended we set the D plane rotation value between 77 and 91 degrees, the same as the value contained in SAE Engineering Aid 25 (February, 1999). Our analysis of D plane rotation data pooled from TRW, TRC, GM, DC, FTSS, and NHTSA yielded a mean of 85 degrees with a standard deviation of 4.78 based on a sample of n=76. The technical community agrees that the acceptable rate of variability could be as high as ± 8% from the mean but should not exceed 10%. The 8% limit suggests a calibration corridor of 77–91 degrees. While this is a slightly broader corridor than the one proposed in the NPRM, we believe the specification, based on the 8% limit, makes it acceptable for the final rule.

Commenters also recommended we adopt the SAE maximum value of 69–84 N-m for flexion moment. Analysis of the pooled data yielded a mean of 74.8 N-m with a standard deviation of 4.22 based on a sample of n=66. Allowing 8% variability, the pooled data-based response corridor would be between 69 and 81 N-m, slightly smaller than the range proposed in the NPRM. Inasmuch as the NPRM proposed a nearly identical moment corridor, we have chosen to retain the proposed range of 69–83 N-m, at approximately 9% variability level. The analysis of the pooled data vis-a-vis positive moment decay likewise supported the retention of the 80–100 ms time range proposed in the NPRM.

The agency proposed neck response corridors in extension in terms of neck moments, maximum head extension angle, and moment decay time. For extension, we specified a head deflection range from 97–109 degrees, a peak negative moment corridor of −55 N-m to −69 N-m, and a negative moment decay for the first −10 N-m between 94 and 114 ms after time-zero. Commenters recommended a corridor of 99–114 degrees for neck extension, a corridor of −52 to −66 N-m for peak moment, and, for moment decay time, a corridor of 94–114 ms after time zero as a more reasonable fit to the existing data base, based largely on the SAE Engineering Aid 25.

Upon review of the substantial neck extension data submitted in comments, we reevaluated the proposed corridors and found a substantial degree of agreement with the commenters' recommendations for revising the head rotation and decay time. For the peak moment corridors, we believe a range narrower than the SAE recommended corridor is appropriate. Based on an analysis of pooled data with a mean of 58.7 N-m with a standard deviation of 3.6 N-m based on a sample of n=67, the SAE corridor would allow a variance of 11.86% from the mean. Since dummy neck performance at full extension is less important in the rebound mode than in a frontal impact, a variation in response range slightly larger than 8% is acceptable. Nevertheless, a variation of 10% is at the outer limits of an acceptable range. Accordingly, we have revised the neck extension corridor to center on the mean value at 107 degrees for a range of head rotation between 99 and 114 degrees, with a decay time corridor value of 94–114 ms. We have also changed the peak moment corridor to a range between −53 N-m and −65 N-m to center better on the mean value of −59 N-m while staying within a 10% variability limit.

The agency proposed thorax impact response corridors in terms of sternum to spine compression at 48–55 mm and peak force at 3900 N to 4400 N. AAMA, FTSS, TRC, and TRW urged the agency to adopt the 50–58 mm compression corridor contained in SAE Engineering Aid 25. AAMA suggested the adoption of the peak force resistance corridor of 3900 N to 4400 N. Upon review of all available data, we agreed with the commenters' requests that the chest compression corridor be adjusted to 50–58 mm and the peak force level be retained at 3900–4400 N as proposed in the NPRM

Commenters also urged that the pertinent regulatory text regarding measurement of peak force "at any time" be changed to "after 25 mm displacement and prior to reaching the minimum permissible sternum displacement" to accommodate an inertial data spike at the beginning of the test that is an artifact of the test. Since this initial spike is neither biofidelic in nature nor an indicator of a bad rib set, we believe establishing limitations for the moment outside the required compression corridor is appropriate. We examined all of the available impactor force-chest deflection data traces and found that the first force peak occurs between 7–8 mm and drops down to a minimum value at around 15 mm of sternum displacement. A 25 mm displacement allowance would be far in excess for any spike that would be an artifact and could discount spikes that are indicative of a bad chest. The data indicates that a 18 mm sternum displacement will adequately discount artifacts and still account for deficiencies in the chest structure. Accordingly the peak force may be exceeded by five percent in a transition compression zone that is between 18 mm and 50 mm, *i.e.,* prior to reaching the minimum required sternum displacement limit of 50 mm.

The AAMA and TRC expressed concern over the torso flexion test and the knee response. TRW and FTSS expressed concern over the knee response as well. During the data analysis process, we contacted AAMA and SAE DTESC for further details and clarification of their recommendations for modifying the torso flexion and knee impact response corridors.

In the NPRM, the agency proposed a semi-static torso resistance flexion force value of 289–378 N. Our analysis of the pooled data indicated that the torso flexion force should be adjusted to reflect the mean of the larger, pooled data and be set at 320–390 N when the torso flexion angle is 45 degrees.

The NPRM proposed a knee impact response corridor of 3360 N to 4080 N. Commenters recommended a corridor between 3400 N and 4200 N, based on the SAE corridor. Upon receipt of comments and supplemental data from TRW, DC, and FTSS, we recomputed the response corridor. The resultant average values were found to be very close to the proposed mean in the NPRM. A corridor of 3456–4057 N for that data would fall within an 8% variation. Inasmuch as the SAE recommended corridor is well beyond even a 10% variation and is not supported by available data, we have concluded that the range of the recomputed data should be rounded off and set at 3450 N to 4060 N.

VI. Instrumentation (Accelerometers and Load Cells)

In the NPRM, the agency proposed ''generic'' specifications for dummy-based sensors. The generic specifications apply to the following sensors: (1) The accelerometer (SA572–S4), (2) Force and moment transducers for upper neck (SA572–S11) and lower neck (SA572–S26), lumbar spine (SA572–S12), anterior-superior iliac spine load cell (SA572–S13), single axis femur load cell (SA572–S10), and (3) The thorax based chest deflection potentiometer (SA572–S50). Of the 20 comments received, only three addressed the generic specifications for transducers. They were: Robert A. Denton, Inc., GM, and AAMA. A full discussion of comments can be found in the TAIR–H–III5F.

After analyzing the comments received, we have concluded that generic specifications for the transducers or sensors used in crash test dummies can be defined sufficiently and will provide a broader latitude for the user industry to select suitable sensors. The input from these comments is being incorporated into generic sensor specifications in the drawing set.

VII. Biofidelity, Pressure Distribution and Occupant Sensing Capability

Biofidelity is a desirable and useful feature of this dummy which, because of the extended measuring capability, is largely endorsed by the commenters. However, IEE said there was a need to improve the dummy's proximity sensing and the pressure profile of the seated dummy's buttocks. Likewise, AAMA recommended we include a lower neck cell and an instrumented tibia as optional transducers.

The IEE request for redesign of the dummy buttocks and for proximity sensing are technically premature and beyond the scope of this rulemaking. This dummy in its original design was not intended to have such sensing and pressure profile capabilities. The development of such capabilities are still in the early stages of research. Considerably more research, testing and evaluation will need to be done before such technologies mature and become acceptable for safety certification activities. Nevertheless, IEE's comment may indicate a direction for possible future research and development.

Likewise, AAMA's comments on the lower neck load cell and instrumented tibia are worthy of consideration. The lower neck load cell and instrumented tibia have both been used by NHTSA in its research programs. However, their use in a compliance application is not anticipated for the near future. We have not evaluated their responses systematically for consistency and stability. Additionally, the instrumented tibia is currently patented by Denton.

Based on our test experience with the upper neck load cell, we believe the lower neck load cell would provide stable and repeatable measurements. Accordingly, we are willing to incorporate it into Part 572 as optional instrumentation. Unless the patent rights on the Denton tibia are freely licensed or expire, any incorporation into the CFR, even as optional instrumentation, would be inappropriate.

VIII. User's Manual—Procedures for Assembly, Disassembly and Inspection (PADI)

The NPRM noted in sections 572.130(a)(2) and 572.131(b) that the final rule package will contain a ''User's Manual for the Hybrid III 5th Percentile Female Dummy.'' Responding to the NPRM, TRC recommended and DTES requested that the agency incorporate the SAE User's Manual by reference in the final rule. We acknowledge the DTES'' diligent development efforts and contribution toward clarifying several assembly and disassembly issues and in illustrating the importance of this document. NHTSA commends the DTES for their excellent work, and encourages the manual's further development as the test data begins to accumulate from the dummy's application in the field. Nevertheless, we have decided against incorporating the manual into part 572.

During initial dummy assessment stages, the agency had to establish methods for an initial dummy inspection and assembly. Part of the agency test protocol was based on draft SAE user's manuals of December 1994 and February 1998. Subsequent to the issuance of the NPRM, the SAE provided user's manual updates in February and July, 1999. The final manual consists basically of two parts: inspection/assembly and calibration.

We have examined and worked with the SAE User's Manual. We found it to be well suited for research use. However, because of redundancies, ambiguities, and in some areas subjectivity, it is far less suitable for regulation and compliance purposes. If employed in its present form, it could become a source of different interpretations and misunderstandings, and as a result create difficulties for both the agency and dummy users in enforcement and compliance certification programs. Also, the SAE User's Manual is copyrighted by both SAE and FTSS. Until the copyright status of the document is resolved, its usefulness as a reference document would be highly limited, particularly for publication by the agency through the electronic media. Further, the recommended SAE User's Manual includes both inspection and calibration procedures, while the agency format requires only an inspection document involving the dummy's initial conformance to dimensional mass and fit-for-assembly specifications, as well as objective assembly and disassembly procedures.

For these reasons, NHTSA has decided against adopting the SAE User's Manual and has developed a publication, ''Procedures for Assembly, Disassembly, and Inspection (PADI) of the Hybrid III 5th Percentile Small Adult Female Crash Test Dummy, Alpha Version'' (PADI–5F),[6] dated January 2000, for the following reasons:

- The agency-developed procedure for disassembly, assembly and inspection provide unambiguous, direct and straightforward instructions;
- The document references only essential and updated drawings based on the final rule parts list;
- It includes important and detailed photographic views to facilitate the assembly-disassembly process, including the mounting of generic instrumentation;
- It provides specific information for calibration laboratories, particularly useful for disassembly of any single major component, checkout procedures for instrumentation polarity, and measurement of impactor moment of inertia;
- It provides recommendations for cable and connector routing and attachment based on lessons learned in the agency test program;
- It includes important torque specifications for all fasteners used in the dummy;
- It supports all elements of the final rule and will facilitate the dummy's use in agency required testing activities; and
- Its publication and copying are not hampered by copyright claims.

IX. Dummy Availability for Evaluation

At the issuance of the NPRM, both FTSS and ASTC had been manufacturing the H–III5F dummy for several years. Numerous organizations possessed the dummy when the NPRM was published. Since the publication of the NPRM, the proposed dummies have been available through both FTSS and ASTC. We believe that over 100 post-NPRM dummies have been sold. Additionally, over a year has passed since the issuance of the NPRM. During this time, all interested parties have had ample time to procure and evaluate the dummy and provide additional comments. The agency expressly invites and routinely considers all comments submitted outside of the comment period, but prior to arriving at a final agency position. Also, during this period, considerable further discussions have taken place at the SAE DTES regarding the adequacy of the dummy in calibration and other test applications. In addition, the agency has made available the master dummy for review and inspection, as well as test data from this dummy developed in the advanced air bag crash test program. Interested parties have had sufficient opportunity to avail themselves of the information that is contained in the minutes of those meetings. Inasmuch as no comments were received regarding the availability of the dummy, it is assumed that dummy availability is not a problem.

[6] NHTSA believes that the name ''user's manual'' for this document is a misnomer given its intended purpose. As the name implies, the user's manual should provide instructions on how to use the dummy, rather than how to inspect it and perform its assembly/disassembly.

X. Other Issues

When we published the NPRM for the H–III5F dummy, we decided to specify that the dummy conform to this part in every respect before its use in any test, but not after. The NPRMs for the Hybrid III 3-year-old child test dummy (January 28, 1999; 64 FR 4385) and the 12-month-old infant dummy (CRABI) (March 8, 1999; 64 FR 10965) proposed the same specification as the one proposed for the small adult female dummy. A full explanation of the agency's rationale can be found in the NPRM for the H–III5F dummy. The AAMA argued that post-test dummy compliance information remains important, particularly if a noncompliance may be related to a failure of the test dummy.

We continue to believe that a post-test calibration requirement is not in the public interest. Generally the post-test calibration provides an objective check of the validity of the electronic data acquired during the test, but this will not be true if the severity of the test damaged the dummy. The pre-test calibration should adequately address the suitability of the dummy for testing. Accordingly, we see no need to require post-test calibration checks.

Regulatory Analyses and Notices

Executive Order 12866 and DOT Regulatory Policies and Procedures

Executive Order 12866, ''Regulatory Planning and Review'' (58 FR 51735, October 4, 1993), provides for making determinations whether a regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and to the requirements of the Executive Order. The Order defines a ''significant regulatory action'' as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or Tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

We have considered the impact of this rulemaking action under Executive Order 12866 and the Department of Transportation's regulatory policies and procedures. This rule is not considered a significant regulatory action under section 3(f) of the Executive Order 12866. Consequently, it was not reviewed by the Office of Management and Budget. This rulemaking document was not reviewed by the Office of Management and Budget under E.O. 12866, ''Regulatory Planning and Review.'' The rulemaking action is also not considered to be significant under the Department's Regulatory Policies and Procedures (44 FR 11034, February 26, 1979).

This document amends 49 CFR Part 572 by adding design and performance specifications for a new 5th percentile adult female dummy which the agency may later separately propose for use in the Federal motor vehicle safety standards. This rule indirectly imposes requirements on only those businesses which choose to manufacture or test with the dummy, in that the agency will only use dummies for compliance testing that meet all of the criteria specified in this rule. It may indirectly affect vehicle and air bag manufacturers if it is incorporated by reference into the advanced air bag rulemaking.

The cost of an uninstrumented H–III5F dummy is approximately $33,400. Instrumentation would add $29,000 to $99,100 to the cost, depending on the amount of instrumentation.

Because the economic impacts of this proposal are so minimal, no further regulatory evaluation is necessary.

Executive Order 13132

We have analyzed this rule in accordance with Executive Order 13132 (''Federalism''). We have determined that this rule does not have sufficient Federalism impacts to warrant the preparation of a federalism assessment.

Executive Order 13045

Executive Order 13045 (62 FR 19885, April 23, 1997) 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 rule is not subject to the Executive Order because it is not economically significant as defined in E.O. 12866. It also does not involve decisions based on health risks that disproportionately affect children.

Executive Order 12778

Pursuant to Executive Order 12778, ''Civil Justice Reform,'' we have considered whether this rule will have any retroactive effect. This rule does not have any retroactive effect. A petition for reconsideration or other administrative proceeding will not be a prerequisite to an action seeking judicial review of this rule. This rule does not preempt the states from adopting laws or regulations on the same subject, except that it does preempt a state regulation that is in actual conflict with the federal regulation or makes compliance with the Federal regulation impossible or interferes with the implementation of the federal statute.

Regulatory Flexibility Act

Pursuant to the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996) whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (*i.e.,* small businesses, small organizations, and small governmental jurisdictions). However, no regulatory flexibility analysis is required if the head of an agency certifies the rule will not have a significant economic impact on a substantial number of small entities. SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities.

I have considered the effects of this rulemaking action under the Regulatory Flexibility Act (5 U.S.C. § 601 *et seq.*) and certify that this proposal will not have a significant economic impact on a substantial number of small entities. The rule does not impose or rescind any requirements for anyone. The Regulatory Flexibility Act does not, therefore, require a regulatory flexibility analysis.

National Environmental Policy Act

We have analyzed this 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.

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.

National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law 104–113, section 12(d) (15 U.S.C. 272) directs us to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies, such as the Society of Automotive Engineers (SAE). The NTTAA directs us to provide Congress, through OMB, explanations when we decide not to use available and applicable voluntary consensus standards.

The H–III5F dummy that is the subject of this document was developed under the auspices of the SAE. All relevant SAE standards were reviewed as part of the development process. The following voluntary consensus standards have been used in developing the dummy:

- SAE Recommended Practice J211, Rev. Mar95 ''Instrumentation for Impact Tests''; and
- SAE J1733 of 1994–12 ''Sign Convention for Vehicle Crash Testing, Surface Vehicle Information Report''.

Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal 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 in any one year (adjusted for inflation with base year of 1995). Before promulgating a NHTSA rule for which a written statement is needed, section 205 of the UMRA generally requires us to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows us to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if we publish with the final rule an explanation why that alternative was not adopted.

This rule does not impose any unfunded mandates under the Unfunded Mandates Reform Act of 1995. This rule does not meet the definition of a Federal mandate because it does not impose requirements on anyone. Further, it will not result in costs of $100 million or more to either State, local, or tribal governments, in the aggregate, or to the private sector. Thus, this rule is not subject to the requirements of sections 202 and 205 of the UMRA.

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.

List of Subjects in 49 CFR Part 572

Incorporation by reference. Motor vehicle safety.

In consideration of the foregoing, NHTSA amends 49 CFR Part 572 as follows:

PART 572—ANTHROPOMORPHIC TEST DUMMIES

1. The authority citation for Part 572 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. 49 CFR Part 572 is amended by adding a new Subpart O consisting of 572.130–572.137 to read as follows:

Subpart O—Hybrid III 5th Percentile Female Test Dummy, Alpha Version

Sec.
572.130 Incorporation by reference.
572.131 General description.
572.132 Head assembly and test procedure.
572.133 Neck assembly and test procedure.
572.134 Thorax assembly and test procedure.
572.135 Upper and lower torso assemblies and torso flexion test procedure.

572.136 Knees and knee impact test procedure.
572.137 Test conditions and instrumentation.

Subpart O—Hybrid III 5th Percentile Female Test Dummy, Alpha Version

§ 572.130 Incorporation by reference.

(a) The following materials are hereby incorporated into this Subpart by reference:

(1) A drawings and specification package entitled ''Parts List and Drawings, Part 572 Subpart O Hybrid III Fifth Percentile Small Adult Female Crash Test Dummy (H–III5F, Alpha Version)'' (January 2000), incorporated by reference in § 572.131, and consisting of:

(i) Drawing No. 880105–100X, Head Assembly, incorporated by reference in §§ 572.131, 572.132, 572.133, 572.134, 572.135, and 572.137;

(ii) Drawing No. 880105–250, Neck Assembly, incorporated by reference in §§ 572.131, 572.133, 572.134, 572.135, and 572.137;

(iii) Drawing No. 880105–300, Upper Torso Assembly, incorporated by reference in §§ 572.131, 572.134, 572.135, and 572.137;

(iv) Drawing No. 880105–450, Lower Torso Assembly, incorporated by reference in §§ 572.131, 572.134, 572.135, and 572.137;

(v) Drawing No. 880105–560–1, Complete Leg Assembly—left, incorporated by reference in §§ 572.131, 572.135, 572.136, and 572.137;

(vi) Drawing No. 880105–560–2, Complete Leg Assembly—right incorporated by reference in §§ 572.131, 572.135, 572.136, and 572.137;

(vii) Drawing No. 880105–728–1, Complete Arm Assembly—left, incorporated by reference in §§ 572.131, 572.134, and 572.135 as part of the complete dummy assembly;

(viii) Drawing No. 880105–728–2, Complete Arm Assembly—right, incorporated by reference in §§ 572.131, 572.134, and 572.135 as part of the complete dummy assembly;

(ix) The Hybrid III 5th percentile small adult female crash test dummy parts list, incorporated by reference in § 572.131;

(2) A procedures manual entitled ''Procedures for Assembly, Disassembly, and Inspection (PADI) of the Hybrid III 5th Percentile Small Adult Female Crash Test Dummy, Alpha Version'' (January 2000), incorporated by reference in § 572.132;

(3) SAE Recommended Practice J211/1, Rev. Mar 95 ''Instrumentation for Impact Tests—Part 1—Electronic Instrumentation'', incorporated by reference in § 572.137;

(4) SAE Recommended Practice J211/2, Rev. Mar 95 ''Instrumentation for Impact Tests—Part 2—Photographic Instrumentation'' incorporated by reference in § 572.137; and

(5) SAE J1733 of 1994–12 ''Sign Convention for Vehicle Crash Testing'', incorporated by reference in § 572.137.

(b) The Director of the Federal Register approved the materials incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies of the materials may be inspected at NHTSA's Technical Reference Library, 400 Seventh Street S.W., room 5109, Washington, DC, or at the Office of the Federal Register, 800 North Capitol Street, NW, Suite 700, Washington, DC.

(c) The incorporated materials are available as follows:

(1) The Parts List and Drawings, Part 572 Subpart O Hybrid III Fifth Percentile Small Adult Female Crash Test Dummy, (H–III5F, Alpha Version) (January 2000) referred to in paragraph (a)(1) of this section and the Procedures for Assembly, Disassembly, and Inspection (PADI) of the Hybrid III 5th Percentile Small Adult Female Crash Test Dummy, Alpha Version referred to in paragraph (a)(2) of this section, are available from Reprographic Technologies, 9000 Virginia Manor Road, Beltsville, MD 20705 (301) 419–5070.

(2) The SAE materials referred to in paragraphs (a)(3) and (a)(4) of this section are available from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pa. 15096.

§ 572.131 General description.

(a) The Hybrid III fifth percentile adult female crash test dummy is defined by drawings and specifications containing the following materials:

(1) Technical drawings and specifications package P/N 880105–000 (refer to § 572.130(a)(1)), the titles of which are listed in Table A;

(2) Parts List and Drawings, Part 572 Subpart O Hybrid III Fifth Percentile Small Adult Female Crash Test Dummy (H–III5F, Alpha Version) (January 2000) (refer to § 572.130(a)(1)(ix)).

TABLE A

Component assembly	Drawing No.
Head Assembly	880105–100X
Neck Assembly	880105–250
Upper Torso Assembly	880105–300
Lower Torso Assembly	880105–450
Complete Leg Assembly—left	880105–560–1
Complete Leg Assembly—right.	880105–560–2
Complete Arm Assembly—left	880105–728–1
Complete Arm Assembly—right.	880105–728–2

(b) Adjacent segments are joined in a manner such that, except for contacts existing under static conditions, there is no contact between metallic elements throughout the range of motion or under simulated crash impact conditions.

(c) The structural properties of the dummy are such that the dummy conforms to this Subpart in every respect before use in any test similar to those specified in Standard 208, Occupant Crash Protection.

§ 572.132 Head assembly and test procedure.

(a) The head assembly (refer to § 572.130(a)(1)(i)) for this test consists of the complete head (drawing 880105–100X), a six-axis neck transducer (drawing SA572–S11) or its structural replacement (drawing 78051–383X), and 3 accelerometers (drawing SA572–S4).

(b) When the head assembly is dropped from a height of 376.0±1.0 mm (14.8±0.04 in) in accordance with subsection (c) of this section, the peak resultant acceleration at the location of the accelerometers at the head CG may not be less than 250 G or more than 300 G. The resultant acceleration vs. time history curve shall be unimodal; oscillations occurring after the main pulse must be less than 10 percent of the peak resultant acceleration. The lateral acceleration shall not exceed 15 G (zero to peak).

(c) *Head test procedure.* The test procedure for the head is as follows:

(1) Soak the head assembly in a controlled environment at any temperature between 18.9 and 25.6 °C (66 and 78 °F) and a relative humidity from 10 to 70 percent for at least four hours prior to a test.

(2) Prior to the test, clean the impact surface of the skin and the impact plate surface with isopropyl alcohol, trichloroethane, or an equivalent. The skin of the head must be clean and dry for testing.

(3) Suspend and orient the head assembly as shown in Figure 19 of 49 CFR 572. The lowest point on the forehead must be 376.0±1.0 mm (14.8±0.04 in) from the impact surface. The 1.57 mm (0.062 in) diameter holes located on either side of the dummy's head shall be used to ensure that the head is level with respect to the impact surface.

(4) Drop the head assembly from the specified height by means that ensure a smooth, instant release onto a rigidly supported flat horizontal steel plate which is 50.8 mm (2.0 in) thick and 610 mm (24.0 in) square. The impact surface shall be clean, dry and have a micro finish of not less than 203.2×10^{-6} mm (8 micro inches) (RMS) and not more than 2032.0×10^{-6} mm (80 micro inches) (RMS).

(5) Allow at least 2 hours between successive tests on the same head.

§ 572.133 Neck assembly and test procedure.

(a) The neck assembly (refer to § 572.130(a)(1)(ii)) for the purposes of this test consists of the assembly of components shown in drawing 880105–250.

(b) When the head-neck assembly consisting of the head (drawing 880105–100X), neck (drawing 880105–250), bib simulator (drawing 880105–371), upper neck adjusting bracket (drawing 880105–207), lower neck adjusting bracket (drawing 880105–208), six-axis neck transducer (drawing SA572–S11), and either three accelerometers (drawing SA572–S4) or their mass equivalent installed in the head assembly as specified in drawing 880105–100X, is tested according to the test procedure in subsection (c) of this section, it shall have the following characteristics:

(1) *Flexion.* (i) Plane D, referenced in Figure O1, shall rotate in the direction of preimpact flight with respect to the pendulum's longitudinal centerline between 77 degrees and 91 degrees. During the time interval while the rotation is within the specified corridor, the peak moment, measured by the neck transducer (drawing SA5572–311), about the occipital condyles may not be less than 69 N-m (51 ft-lbf) and not more than 83 N-m (61 ft-lbf). The positive moment shall decay for the first time to 10 N-m (7.4 ft-lbf) between 80 ms and 100 ms after time zero.

(ii) The moment shall be calculated by the following formula: Moment (N-m)= $M_y - (0.01778m) \times (F_x)$.

(iii) M_y is the moment about the y-axis, F_x is the shear force measured by the neck transducer (drawing SA572–S11), and 0.01778m is the distance from force to occipital condyle.

(2) *Extension.* (i) Plane D, referenced in Figure O2, shall rotate in the direction of preimpact flight with respect to the pendulum's longitudinal centerline between 99 degrees and 114 degrees. During the time interval while the rotation is within the specified corridor, the peak moment, measured by the neck transducer (drawing SA5572–S11), about the occipital condyles shall be not more than −53 N-m (−39 ft-lbf) and not less than −65 N-m (−48 ft-lbf). The negative moment shall decay for the first time to −10 N-m (−7.4 ft-lbf) between 94 ms and 114 ms after time zero.

(ii) The moment shall be calculated by the following formula: Moment (N-m) = $M_y - (0.01778m) \times (F_x)$.

(iii) M_y is the moment about the y-axis, F_x is the shear force measured by the neck transducer (drawing SA572–S11), and 0.01778 m is the distance from force to occipital condyle.

(3) Time-zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. All data channels shall be at the zero level at this time.

(c) *Test Procedure.* The test procedure for the neck assembly is as follows:

(1) Soak the neck assembly in a controlled environment at any temperature between 20.6 and 22.2 °C (69 and 72 °F) and a relative humidity between 10 and 70 percent for at least four hours prior to a test.

(2) Torque the jam nut (drawing 9000018) on the neck cable (drawing 880105–206) to 1.4 ± 0.2 N-m (12.0 ± 2.0 in-lb).

(3) Mount the head-neck assembly, defined in subsection (b) of this section, on the pendulum described in Figure 22 of 49 CFR 572 so that the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum as shown in Figure O1 for flexion tests and Figure O2 for extension tests.

(4)(i) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 7.01 ± 0.12 m/s (23.0 ± 0.4 ft/s) for flexion tests and 6.07 ± 0.12 m/s (19.9 ± 0.40 ft/s) for extension tests, measured by an accelerometer mounted on the pendulum as shown in Figure 22 of 49 CFR 572 at the instant of contact with the honey comb.

(ii) Stop the pendulum from the initial velocity with an acceleration vs. time pulse which meets the velocity change as specified below. Integrate the pendulum acceleration data channel to obtain the velocity vs. time curve:

TABLE B

Pendulum pulse				
Time	Extension		Flexion	
ms	m/s	ft/s	m/s	ft/s
10	2.1–2.5	6.9–8.2	1.5–1.9	4.9–6.2
20	4.0–5.0	13.1–16.4	3.1–3.9	10.2–12.8
30	5.8–7.0	19.5–23.0	4.6–5.6	15.1–18.4

§ 572.134 Thorax assembly and test procedure.

(a) Thorax (Upper Torso) Assembly (refer to § 572.130(a)(1)(iii)). The thorax consists of the part of the torso assembly shown in drawing 880105–300.

(b) When the anterior surface of the thorax of a completely assembled dummy (drawing 880105–000) is impacted by a test probe conforming to section 572.137(a) at 6.71± 0.12 m/s (22.0 ± 0.4 ft/s) according to the test procedure in subsection (c) of this section:

(1) Maximum sternum displacement (compression) relative to the spine, measured with chest deflection transducer (drawing SA572–S5), must be not less than 50.0 mm (1.97 in) and not more than 58.0 mm (2.30 in). Within this specified compression corridor, the peak force, measured by the impact probe as defined in section 572.137 and calculated in accordance with paragraph (b)(3) of this section, shall not be less than 3900 N (876 lbf) and not more than 4400 N (989 lbf). The peak force after 18.0 mm (0.71 in) of sternum displacement but before reaching the minimum required 50.0 mm (1.97 in) sternum displacement limit shall not exceed by more than five percent the value of the peak force measured within the required displacement limit.

(2) The internal hysteresis of the ribcage in each impact as determined by the plot of force vs. deflection in paragraph (1) of this section shall be not

less than 69 percent but not more than 85 percent. The hysteresis shall be calculated by determining the ratio of the area between the loading and unloading portions of the force deflection curve to the area under the loading portion of the curve.

(3) The force shall be calculated by the product of the impactor mass and its deceleration.

(c) Test procedure. The test procedure for the thorax assembly is as follows:

(1) The dummy is clothed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. The weight of the shirt and pants shall not exceed 0.14 kg (0.30 lb) each.

(2) Soak the dummy in a controlled environment at any temperature between 20.6 and 22.2 °C (69 and 72 °F) and a relative humidity between 10 and 70 percent for at least four hours prior to a test.

(3) Seat and orient the dummy on a seating surface without back support as shown in Figure O3, with the limbs extended horizontally and forward, parallel to the midsagittal plane, the midsagittal plane vertical within ±1 degree and the ribs level in the anterior-posterior and lateral directions within ±0.5 degrees.

(4) Establish the impact point at the chest midsagittal plane so that the impact point of the longitudinal centerline of the probe coincides with the midsagittal plane of the dummy within ±2.5 mm (0.1 in) and is 12.7 ±1.1 mm (0.5±0.04 in) below the horizontal-peripheral centerline of the No. 3 rib and is within 0.5 degrees of a horizontal line in the dummy's midsagittal plane.

(5) Impact the thorax with the test probe so that at the moment of contact the probe's longitudinal center line falls within 2 degrees of a horizontal line in the dummy's midsagittal plane.

(6) Guide the test probe during impact so that there is no significant lateral, vertical or rotational movement.

§ 572.135 Upper and lower torso assemblies and torso flexion test procedure.

(a) Upper/lower torso assembly. The test objective is to determine the stiffness effects of the lumbar spine (drawing 880105–1096), and abdominal insert (drawing 880105–434), on resistance to articulation between the upper torso assembly (drawing 880105–300) and the lower torso assembly (drawing 880105–450) (refer to § 572.130(a)(1)(iv)).

(b)(1) When the upper torso assembly of a seated dummy is subjected to a force continuously applied at the head to neck pivot pin level through a rigidly attached adaptor bracket as shown in Figure O4 according to the test procedure set out in subsection (c) of this section, the lumbar spine-abdomen assembly shall flex by an amount that permits the upper torso assembly to translate in angular motion relative to the vertical transverse plane 45 ± 0.5 degrees at which time the force applied must be not less than 320 N (71.5 lbf) and not more than 390 N (87.4 lbf), and

(2) Upon removal of the force, the torso assembly must return to within 8 degrees of its initial position.

(c) *Test procedure.* The test procedure for the upper/lower torso assembly is as follows:

(1) Soak the dummy in a controlled environment at any temperature between 18.9 and 25.6 °C (66 and 78 °F) and a relative humidity between 10 and 70 percent for at least four hours prior to a test.

(2) Assemble the complete dummy (with or without the legs below the femurs) and attach to the fixture in a seated posture as shown in Figure O4.

(3) Secure the pelvis to the fixture at the pelvis instrument cavity rear face by threading four ¼ inch cap screws into the available threaded attachment holes. Tighten the mountings so that the test material is rigidly affixed to the test fixture and the pelvic-lumbar joining surface is horizontal.

(4) Attach the loading adapter bracket to the spine of the dummy as shown in Figure O4.

(5) Inspect and adjust, if necessary, the seating of the abdominal insert within the pelvis cavity and with respect to the torso flesh, assuring that the torso flesh provides uniform fit and overlap with respect to the outside surface of the pelvis flesh.

(6) Flex the dummy's upper torso three times between the vertical and until the torso reference plane, as shown in Figure O4, reaches 30 degrees from the vertical transverse plane. Bring the torso to vertical orientation and wait for 30 minutes before conducting the test. During the 30 minute waiting period, the dummy's upper torso shall be externally supported at or near its vertical orientation to prevent it from drooping.

(7) Remove all external support and wait two minutes. Measure the initial orientation angle of the torso reference plane of the seated, unsupported dummy as shown in Figure O4. The initial orientation angle may not exceed 20 degrees.

(8) Attach the pull cable and the load cell as shown in Figure O4.

(9) Apply a tension force in the midsagittal plane to the pull cable as shown in Figure O4 at any upper torso deflection rate between 0.5 and 1.5 degrees per second, until the angle reference plane is at 45 ± 0.5 degrees of flexion relative to the vertical transverse plane.

(9) Continue to apply a force sufficient to maintain 45 ± 0.5 degrees of flexion for 10 seconds, and record the highest applied force during the 10-second period.

(10) Release all force at the attachment bracket as rapidly as possible, and measure the return angle with respect to the initial angle reference plane as defined in paragraph (6) 3 minutes after the release.

§ 572.136 Knees and knee impact test procedure.

(a) Knee assembly. The knee assembly (refer to §§ 572.130(a)(1)(v) and (vi)) for the purpose of this test is the part of the leg assembly shown in drawing 880105–560.

(b)(1) When the knee assembly, consisting of sliding knee assembly (drawing 880105–528R or –528L), lower leg structural replacement (drawing 880105–603), lower leg flesh (drawing 880105–601), ankle assembly (drawing 880105–660), foot assembly (drawing 880105–651 or 650), and femur load transducer (drawing SA572–S14) or its structural replacement (drawing 78051–319) is tested according to the test procedure in subsection (c), the peak resistance force as measured with the test probe-mounted accelerometer must be not less than 3450 N (776 lbf) and not more than 4060 N (913 lbf).

(b)(2) The force shall be calculated by the product of the impactor mass and its deceleration.

(c) *Test procedure.* The test procedure for the knee assembly is as follows:

(1) Soak the knee assembly in a controlled environment at any temperature between 18.9 and 25.6 °C (66 and 78 °F) and a relative humidity from 10 to 70 percent for at least four hours prior to a test.

(2) Mount the test material and secure it to a rigid test fixture as shown in Figure O5. No part of the foot or tibia may contact any exterior surface.

(3) Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur.

(4) Guide the pendulum so that there is no significant lateral vertical or rotational movement at the time of initial contact between the impactor and the knee.

(5) The test probe velocity at the time of contact shall be 2.1 ± 0.03 m/s (6.9 ± 0.1 ft/s).

§ 572.137 Test conditions and instrumentation.

(a) The test probe for thoracic impacts shall be of rigid metallic construction, concentric in shape, and symmetric about its longitudinal axis. It shall have a mass of 13.97 ± 0.023 kg (30.8 ± 0.05 lbs) and a minimum mass moment of inertia of 5492 kg-cm^2 (4.86 lbs-in-sec^2) in yaw and pitch about the CG. ⅓ of the weight of the suspension cables and their attachments to the impact probe must be included in the calculation of mass, and such components may not exceed three percent of the total weight of the test probe. The impacting end of the probe, perpendicular to and concentric with the longitudinal axis, must be at least 25 mm (1.0 in) long, and have a flat, continuous, and non-deformable 152.4 ± 0.25 mm (6.00 ± 0.01 in) diameter face with a maximum edge radius of 12.7 mm (0.5 in). The probe's end opposite to the impact face must have provisions for mounting of an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe. No concentric portions of the impact probe may exceed the diameter of the impact face. The impact probe shall have a free air resonant frequency of not less than 1000 Hz.

(b) The test probe for knee impacts shall be of rigid metallic construction, concentric in shape, and symmetric about its longitudinal axis. It shall have a mass of 2.99 ± 0.01 kg (6.6 ± 0.022 lbs) and a minimum mass moment of inertia of 622 kg-cm^2 (0.55 lbs-in-sec^2) in yaw and pitch about the CG. ⅓ of the weight of the suspension cables and their attachments to the impact probe may be included in the calculation of mass, and such components may not exceed five percent of the total weight of the test probe. The impacting end of the probe, perpendicular to and concentric with the longitudinal axis, must be at least 12.5 mm (0.5 in) long, and have a flat, continuous, and non-deformable 76.2 ± 0.2 mm (3.00 ± 0.01 in) diameter face with a maximum edge radius of 12.7 mm (0.5 in). The probe's end opposite to the impact face must have provisions for mounting an accelerometer with its sensitive axis collinear with the longitudinal axis of the probe. No concentric portions of the impact probe may exceed the diameter of the impact face. The impact probe must have a free air resonant frequency of not less than 1000 Hz.

(c) Head accelerometers shall have dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 and be mounted in the head as shown in drawing 880105–000 sheet 3 of 6.

(d) The upper neck force/moment transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S11 and be mounted in the head neck assembly as shown in drawing 880105–000, sheet 3 of 6.

(e) The thorax accelerometers shall have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 and be mounted in the torso assembly in triaxial configuration within the spine box instrumentation cavity and as optional instrumentation in uniaxial for-and-aft oriented configuration arranged as corresponding pairs in three locations on the sternum on and at the spine box of the upper torso assembly as shown in drawing 880105–000 sheet 3 of 6.

(f) The optional lumbar spine force-moment transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S15 and be mounted in the lower torso assembly as shown in drawing 880105–450.

(g) The optional iliac spine force transducers shall have the dimensions and response characteristics specified in drawing SA572–S16 and be mounted in the torso assembly as shown in drawing 880105–450.

(h) The pelvis accelerometers shall have the dimensions, response characteristics, and sensitive mass locations specified in drawing SA572–S4 and be mounted in the torso assembly in triaxial configuration in the pelvis bone as shown in drawing 880105–000 sheet 3.

(i) The single axis femur force transducer (SA572–S14) or the optional multiple axis femur force/moment transducer (SA572–S29) shall have the dimensions, response characteristics, and sensitive axis locations specified in the appropriate drawing and be mounted in the femur assembly as shown in drawing 880105–500 sheet 3 of 6.

(j) The chest deflection transducer shall have the dimensions and response characteristics specified in drawing SA572–S51 and be mounted to the upper torso assembly as shown in drawings 880105–300 and 880105–000 sheet 3 of 6.

(k) The optional lower neck force/moment transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S27 and be mounted to the upper torso assembly as shown in drawing 880105–000 sheet 3 of 6.

(l) The optional thoracic spine force/moment transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing SA572–S28 and be mounted in the upper torso assembly as shown in drawing 880105–000 sheet 3 of 6.

(m) The outputs of acceleration and force-sensing devices installed in the dummy and in the test apparatus specified by this part shall be recorded in individual data channels that conform to SAE Recommended Practice J211/10, Rev. Mar95 ''Instrumentation for Impact Impact Tests;—Part 1—Electronic Instrumentation,'' and SAE Recommended Practice J211/2, Rev Mar95 ''Instrumentation for Impact Tests—Part 2—Photographic Instrumentation'', (refer to §§ 572.130(a)(3) and (4) respectively) except as noted, with channel classes as follows:

(1) Head acceleration—Class 1000

(2) Neck:

(i) Forces—Class 1000

(ii) Moments—Class 600

(iii) Pendulum acceleration—Class 180

(3) Thorax:

(i) Rib acceleration—Class 1000

(ii) Spine and pendulum accelerations—Class 1000

(iii) Sternum deflection -Class 180

(iv) Forces—Class 1000

(v) Moments—Class 600

(4) Lumbar:

(i) Forces—Class 1000

(ii) Moments—Class 600

(iii) Torso flexion pulling force—Class 60 if data channel is used

(5) Pelvis:

(i) Accelerations—Class 1000

(ii) Iliac wing forces—Class 180

(6) Femur forces—Class 600

(n) Coordinate signs for instrumentation polarity shall conform to the Sign Convention For Vehicle Crash Testing, Surface Vehicle Information Report, SAE J1733, 1994–12 (refer to section 572.130(a)(4)).

(o) The mountings for sensing devices shall have no resonance frequency less than 3 times the frequency range of the applicable channel class.

(p) Limb joints must be set at one G, barely restraining the weight of the limb when it is extended horizontally. The force needed to move a limb segment shall not exceed 2G throughout the range of limb motion.

(q) Performance tests of the same component, segment, assembly, or fully assembled dummy shall be separated in time by not less than 30 minutes unless otherwise noted.

(r) Surfaces of dummy components may not be painted except as specified in this subpart or in drawings subtended by this subpart.

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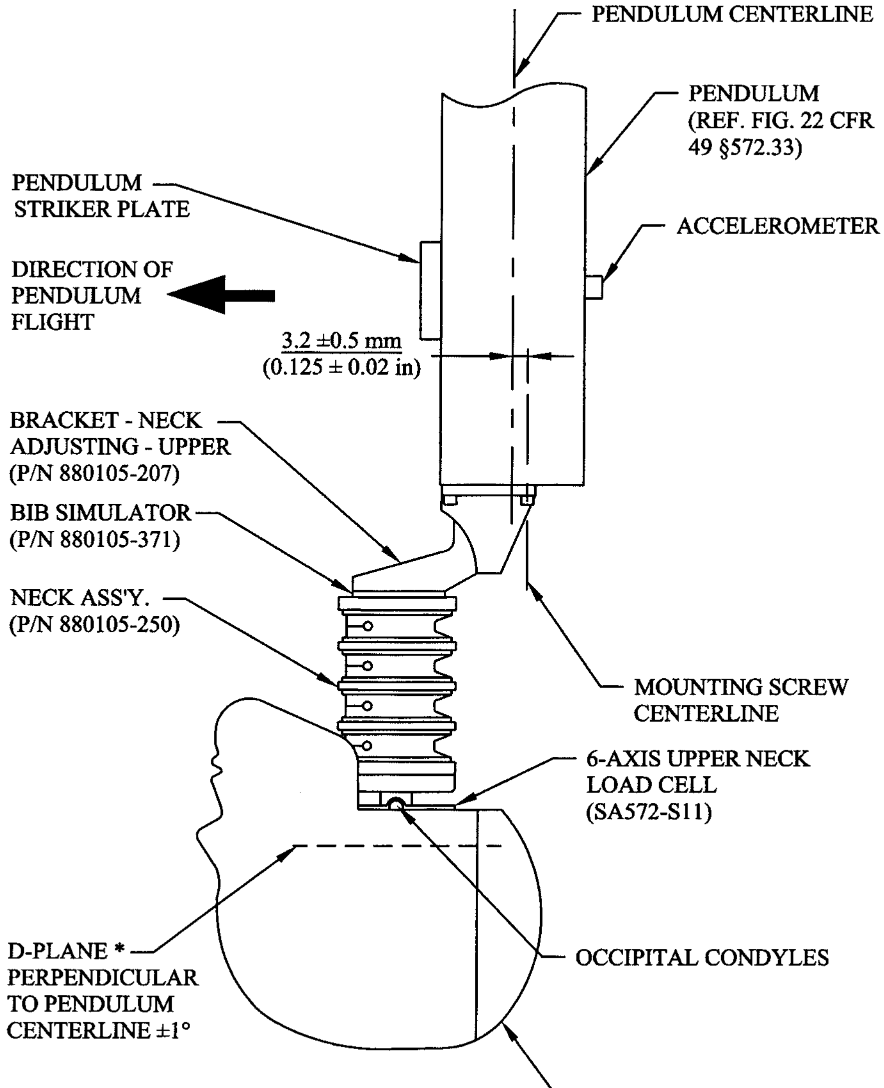
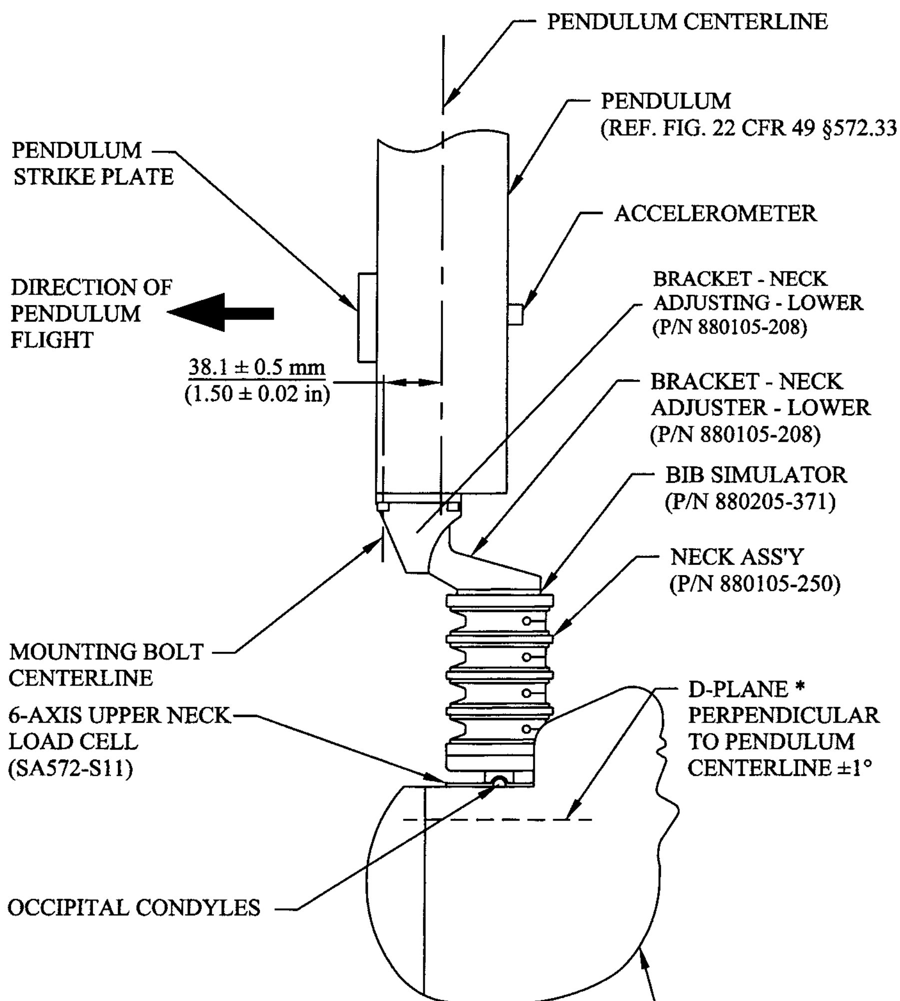
FIGURE O1

NECK FLEXION TEST SETUP SPECIFICATIONS



* D-PLANE IS DEFINED AS AN IMAGINARY PLANE PERPENDICULAR TO THE SKULL CAP/SKULL INTERFACE.

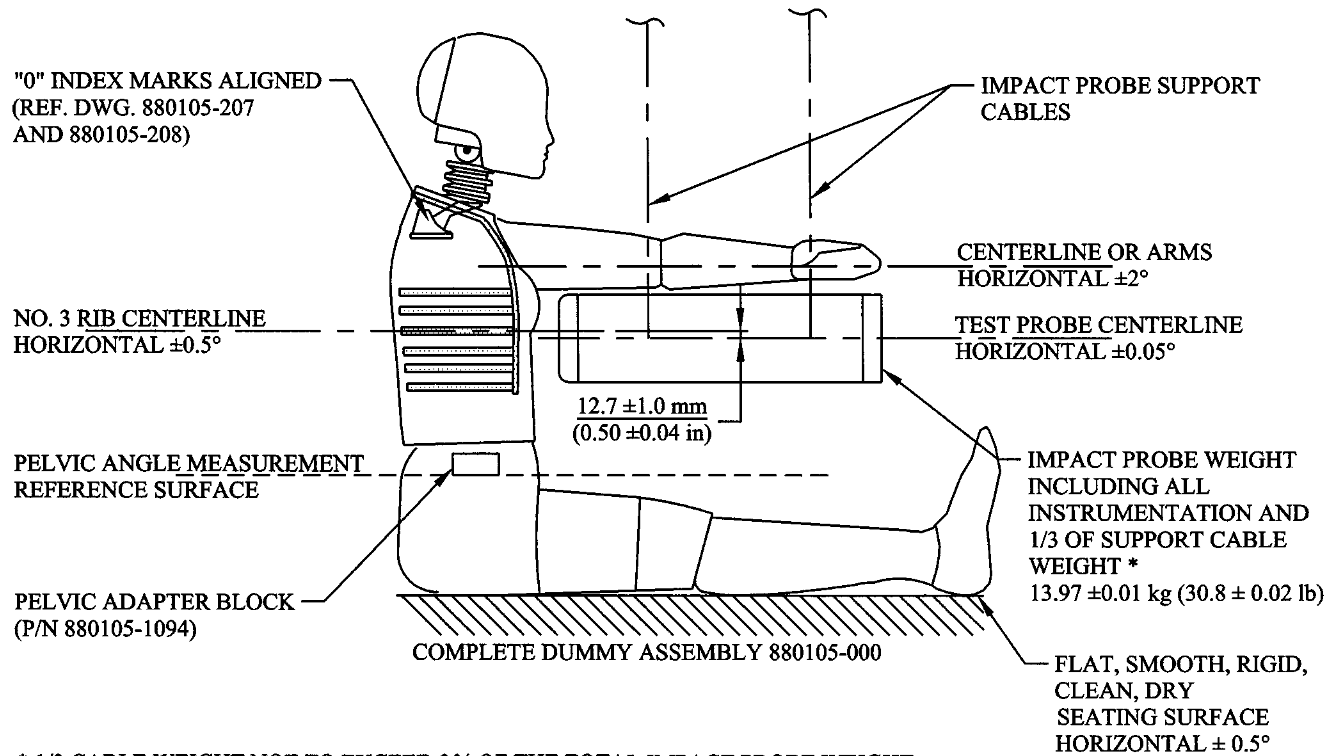
FIGURE O2
NECK EXTENSION TEST SETUP SPECIFICATIONS



* D-PLANE IS DEFINED AS AN IMAGINARY PLANE PERPENDICULAR TO THE SKULL CAP/SKULL INTERFACE.

FIGURE 03

THORAX IMPACT TEST SETUP SPECIFICATIONS



* 1/3 CABLE WEIGHT NOT TO EXCEED 3% OF THE TOTAL IMPACT PROBE WEIGHT

FIGURE O4

TORSO FLEXION TEST SET UP SPECIFICATIONS

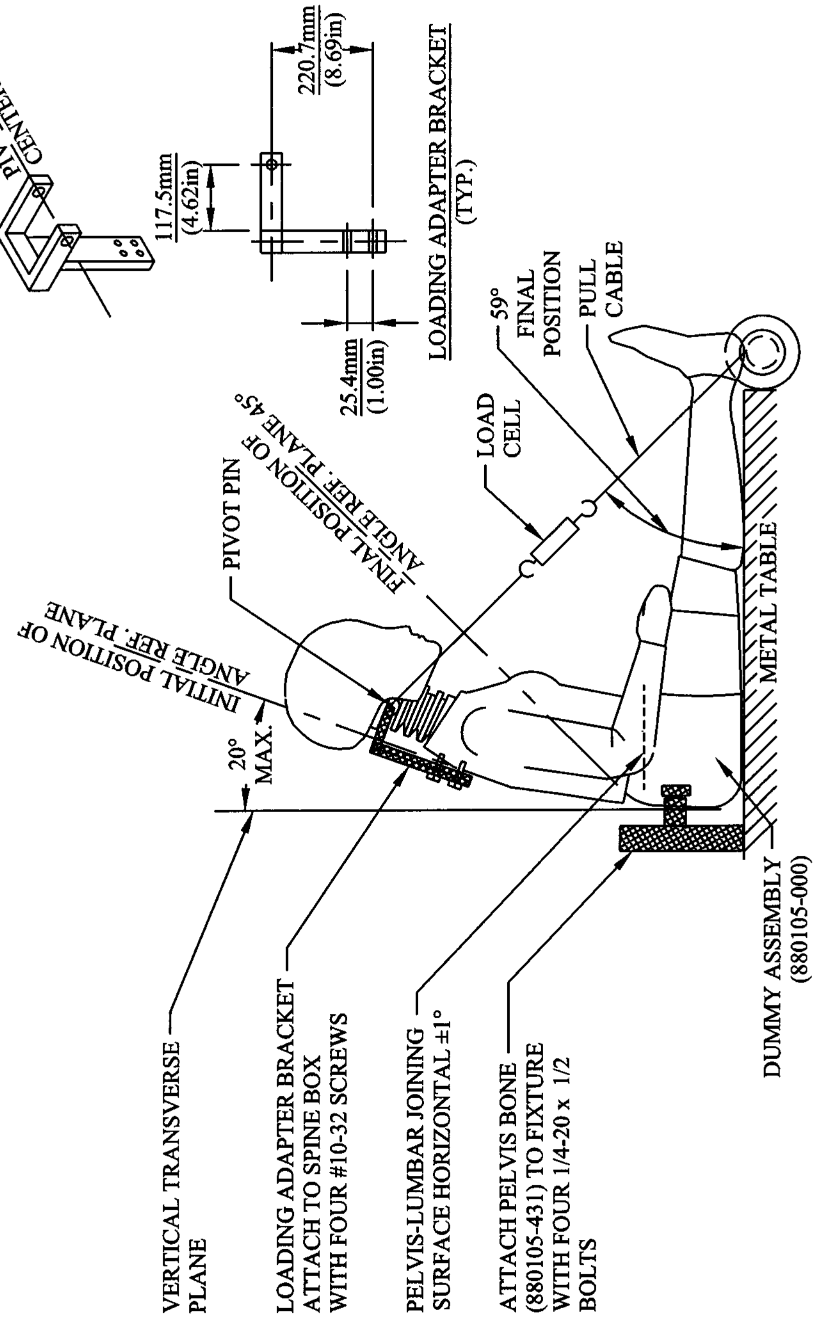
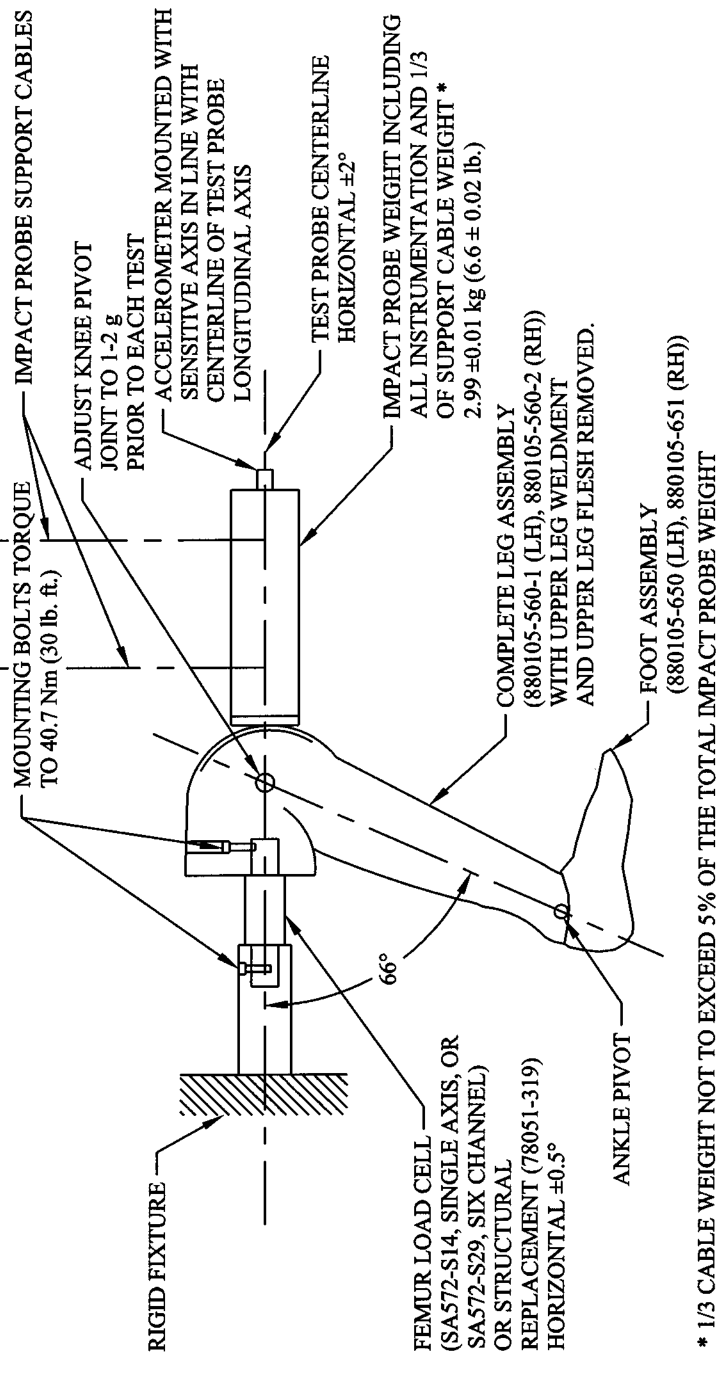


FIGURE O5

KNEE IMPACT TEST SETUP SPECIFICATIONS



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