

would add little, if anything, to child passenger safety. Some suggested that the agency should focus on developing the Hybrid III ten-year-old dummy instead. Others suggested that the weighted six-year-old dummy be used only to assess the structural integrity of child restraints, and not to assess the crash forces imposed in the dynamic test.

The agency is considering all the comments on the May 2002 NPRM and will respond to them in the follow-on document to the NPRM. Today's NPRM proposes specifications for the weighted dummy simply to complement the May 2002 NPRM, *i.e.*, this document completes the dummy specifications called for in the May NPRM. By issuing this document, the agency does not intend to imply that it has concluded that the instrumented dummy will be fully used in Standard No. 213 compliance tests, with all its measurement capabilities. A final rule on the use of the weighted dummy in Standard No. 213 compliance tests, assuming the agency adopts such a provision in a final rule, will address all issues concerning the full or limited use of the dummy. Further, a final rule adopting the dummy into Part 572 will likely parallel NHTSA's final rule concerning use of the dummy in Standard No. 213.

II. Alternatives Considered

A. Objectives for the Weighted Dummy

The agency defined the following objectives for the weighted six-year-old child size dummy:

1. Develop a method for increasing the weight of the current H-III6C dummy from 52 pounds to over 60 pounds.
2. The system used to add weight to the H-III6C dummy must not interfere with the restraint system being used, and must not distort the kinematics and impact response of the dummy.
3. The weighted dummy must have sufficient durability in the intended impact exposures.
4. The weighted dummy must have repeatability and reproducibility in calibration and sled tests comparable to that of the H-III6C dummy.
5. The weighted dummy must be backed up with sufficient design and performance data to support its incorporation into 49 CFR part 572.
6. The weighted dummy must be useful in assessing the structural integrity of child restraints in dynamic testing.

B. Weighting Concepts

The agency evaluated several weighting concepts for developing a weighted H-III6C dummy. Initially, the agency placed a weighted vest on the dummy. However, upon inspecting this system, the agency determined that use of such a vest would be unacceptable in compliance testing. Since the weights are not rigidly attached to the dummy, they could rattle or even slap during dynamic tests, possibly interfering with the dummy's instrumentation responses. In addition, the vest, loaded with weighting materials, was somewhat bulky. The agency was concerned that this bulkiness could affect the positioning of the dummy and compromise the effectiveness of the tested restraint system.

NHTSA then considered mounting ballasts directly on the dummy's interior structure. The agency designed carbon steel masses (about 9 pounds) that could be rigidly mounted on the dummy's spine and pelvis. However, this resulted in the elevation of the upper torso by 1 inch. The agency determined that a more uniform distribution of the added weight between the upper and lower torso halves, and less elevation of the upper torso with respect to the lower torso, were necessary.

The agency discovered that a more uniform mass distribution, and a lowering of the upper torso, could be achieved through the use of a dense Tungsten alloy material. The increased density of the Tungsten alloy allowed each of the weights to be reduced in size as compared to the carbon steel weights. The dummy's seated height was increased by only 0.7 inch, while the carbon steel weights increased the dummy's seated height by 1 inch. The agency also was able to design the Tungsten alloy weights to distribute the added weight more uniformly between the upper and lower torso halves. The Tungsten alloy material allowed the agency to increase the added weight of the bottom of the lumbar spine (hereinafter referred to as "pelvis") from 3.8 pounds to 4.9 pounds while maintaining the thoracic spine weight increase at 5.2 pounds.⁶

The agency's preliminary testing and evaluation of the dummy with the Tungsten alloy weights attached to the thoracic spine and pelvis has indicated responses comparable to the responses of the H-III6C dummy. Therefore, the agency has tentatively concluded that attaching Tungsten alloy weights to the

H-III6C dummy's thoracic spine and pelvis met the agency's objectives for a weighted six-year-old child size dummy outlined above.

C. Evaluation of the Weighted Dummy

The agency subjected the weighted dummy to two types of impact evaluations in the laboratory environment: component calibration tests and sled tests.

Component calibration tests were conducted to compare the performance of the weighted dummy with that of the H-III6C dummy. The agency followed the calibration test procedures specified for the H-III6C dummy in 49 CFR part 572 subpart N. Since masses were added to the dummy's upper and lower torso, the agency limited its evaluation of the weighted dummy for certification responses to the thorax impact (specified in 49 CFR 572.124) and torso flexion (49 CFR 572.125) tests. Since the added weights would not influence the head drop, neck flexion and extension, and knee impact calibration tests, the agency did not conduct these tests with the weighted dummy.

The agency conducted ten high acceleration (HYGE) sled tests with both the H-III6C and the weighted dummies in seating configurations with adult restraint systems and belt positioning booster seats. All tests were performed using the Standard No. 213 pulse (24 G, 30 mph) and sled mounted seating buck. The dummies were seated in Century Breverra Metro and Graco Cherished Cargo booster seats and restrained with a 1999 Pontiac Grand Am rear seat lap/shoulder belts for all tests. One set of tests with the Century Breverra Metro booster seats was performed without belt retractors.

1. Calibration Tests

To evaluate the dummy's repeatability, structural integrity, and durability, the agency performed seven thorax impacts with the weighted dummy. The first four thorax calibration tests were conducted prior to a series of six Standard No. 213 sled tests. Three additional tests were conducted after the sled tests. The test results are detailed in NHTSA's Technical Report entitled "Evaluation of the Weighted Hybrid III Six-Year-Old Child Dummy" (October, 2001, Docket No. NHTSA-2002-11707-2). The results indicate the following responses.

The chest deflection responses of the weighted dummy met the calibration limits for the H-III6C dummy in all tests. However, the average chest deflection for the weighted dummy was approximately 41 mm, which is 1 mm below the target deflection of 42 mm

⁶ The spine weights consist of two 2.6-pound plates, one on each lateral side of the thoracic spine.