

Memorandum

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject: INFORMATION: Policy Statement on Conducting
Component Level Tests to Demonstrate Compliance with
§§ 25.785(b) and (d)

Date: DRAFT

From: Manager, Transport Airplane Directorate, Aircraft
Certification Service, ANM-100

Reply to
Attn. of: ANM-03-115-31

To: See Distribution

Regulatory §§ 25.785(b) and (d)
Reference:

The purpose of this memorandum is to provide Federal Aviation Administration (FAA) certification policy on conducting component level tests in order to demonstrate compliance with the requirements of §§ 25.785(b) and (d). The tests described herein provide a standardized approach by which each potentially injurious item located within the headstrike zone can be assessed for occupant injury potential. These test methods are the product of an Aviation Rulemaking Advisory Committee recommendation and are harmonized with the Joint Aviation Authorities (JAA) and Transport Canada.

Although this policy memorandum focuses primarily on describing component level tests for seatback mounted accessories installed within the striking radius of the head, the same test methodologies can be applied more generally to any surface or other items that may be potentially injurious and are located within the headstrike zone (e.g., escape slide bustles, tables, etc.) that need to be addressed for compliance with §§ 25.785(b) and (d).

In addition to §§ 25.785(b) and (d) blunt trauma requirements, some aircraft certification bases include the additional (and more stringent) requirements of § 25.562(c)(5). These airplanes are required to demonstrate that an Anthropomorphic Test Dummy (ATD) exposed to the emergency landing dynamic conditions prescribed in § 25.562(b) will be protected such that the head injury criterion (HIC) will be less than 1000 units. The tests described herein do not address compliance with § 25.562(c)(5) HIC requirements.

Current Regulatory and Advisory Material

Section 25.785(b), Amendment 25-88, requires that each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing be designed so that a person making proper use of those facilities will not suffer serious injury in an emergency landing as a result of inertia forces specified in §§ 25.561 and 25.562.

Section 25.785(d), Amendment 25-88, requires, in pertinent part, that each occupant of a forward or aft facing seat be protected from head injury by the elimination of injurious objects within the striking radius of the head.

These same occupant injury protection requirements have existed within § 25.785 (with the exception of reference to § 25.562 which was added by Amendment 25-64) since the adoption of part 25. As such, the policy contained within this memorandum can be utilized for demonstrating compliance with § 25.785 at all amendments. This policy cannot, however, be used in lieu of HIC testing for airplanes whose certification bases specifically require compliance with the requirements of § 25.562(c)(5). Attachment 1 provides additional information for determining how certification bases considerations affect the applicability of the tests described herein.

In order to demonstrate compliance with §§ 25.785(b) and (d), two injury mechanisms must be examined. The first consideration is blunt trauma injuries experienced by the occupant resulting from the crash loads. This policy memorandum describes three impact test methods that can be used to evaluate blunt trauma injuries. The second injury mechanism is sharp or injurious edges or features. Sharp or injurious edges or features could cause additional injury and thus impede occupants from exiting the airplanes after a crash; they are therefore not acceptable. They are not allowed as design features of airplane interiors, nor are they allowed to be formed as a result of the impact tests described within this policy memo. Both injury mechanisms (i.e., blunt trauma and sharp or injurious edges or features) must be successfully addressed in order to make a determination of compliance with the requirements of §§ 25.785(b) and (d).

Advisory Circular (AC) 25-17, paragraph 81b(4), as supplemented by FAA memorandum dated July 13, 1994, provided a method for demonstrating compliance with § 25.785 blunt trauma requirements using a comparative bowling ball test. This approach allowed an applicant to compare the characteristics of a new (i.e., unapproved) feature against a previously approved configuration. If the blunt trauma characteristics (measured by bowling ball impact accelerations) associated with the new feature were less severe than the previously approved configuration, they were considered acceptable. Advisory Circular 25-17 also required an assessment of the test article for sharp or injurious edges or features post-test.

The FAA recognized that there were shortcomings with the bowling ball test policy as it was originally published. Because of these shortcomings, the FAA noted in the July 13, 1994, memorandum our intent to develop more comprehensive policy on this subject. As such, this policy memorandum supersedes the guidance contained in AC 25-17, paragraphs 81b(4)(i) through b(4)(iv) regarding the bowling ball test pass/fail criteria and the subsequent FAA memorandum on this same subject, dated July 13, 1994. Likewise, the impact device described in Society of Automotive Engineers (SAE) standard J921 essentially performs the same function as the bowling ball test and therefore is also no longer acceptable for demonstrating compliance with the requirements of §§ 25.785(b) and (d). This policy memorandum does not supersede any of the other methods of compliance pertaining to §§ 25.785(b) and (d) contained within

AC 25-17. The remaining allowable methods of compliance described in AC 25-17 include padding potentially injurious surfaces and relocating objects outside of the headstrike zone.

Implementation of this new policy memorandum does not nullify any previously completed compliance determinations. However, all new compliance determinations should be made in accordance with this policy memorandum, the remaining methods of compliance identified in AC 25-17, or other methods of compliance established through the issue paper process.

Policy

Sections 25.785(b) and (d) require that seatbacks, components mounted on the seatbacks (such as video monitors, telephones, cup holders, etc.), and any other objects located within the striking radius of the head, be designed to prevent serious injury to an occupant whose head would impact the objects as a result of the emergency landing inertia forces.

The FAA has determined through 16g row to row dynamic tests that seatback accessories totaling less than three pounds do not exceed the performance criteria described below when installed in seatbacks that provide at least one inch of permanent deformation. Industry data indicate that “standard” airline passenger seatback designs generally provide more than one inch of permanent deformation. As a result, data substantiating seatback deformation is not required unless the seatback design contains unusual features that significantly increase the stiffness beyond that of traditional passenger seats.

If the seatback has been stiffened such that the one-inch permanent deformation assumption is questionable, testing may be required. For example, a business class pod seat with a separate composite seatback privacy shroud would not be considered a “standard” seatback and may require further investigation. Standard seatback designs containing accessories whose combined weight is less than three pounds can be accepted without further assessment for blunt trauma injury potential. These items still require assessment for the creation of sharp or injurious edges or features resulting from occupant impact.

In order to generate consistent compliance determinations, the test methods require, by necessity, absolute pass/fail criteria. This is a change from the approach that was previously accepted, which allowed approval based solely on comparative analysis. This change is necessary because the comparative bowling ball test could not adequately discriminate between injurious and non-injurious features. For example, a traditional seatback could have very effective energy absorption characteristics. However, this very effective energy absorbing seatback could be modified to include an item such as an “XYZ brand” video monitor, which could result in *slightly* degraded energy absorption characteristics. Under these circumstances, applying the guidance provided in AC 25-17, as modified by the FAA memorandum dated July 13, 1994, would lead one to conclude that the video monitor installation was unacceptable.

The converse was also possible; an applicant could present a very rigid “standard” seatback that provided very little energy-absorbing capability. Because “standard” seatbacks have been traditionally accepted as being adequately de-lethalized by inspection, an applicant could then show by comparison that the addition of the same “XYZ brand” video monitor would slightly improve the energy-absorption characteristics of the seatback assembly due to the somewhat crushable nature of the video monitor screen. The applicant could then conclude that the monitor that was determined to be unacceptable in the first example would be acceptable in the second example, even though the seat in the first example would provide greater occupant injury protection. This was not the intent of the previous guidance; therefore, the FAA has determined that changing to absolute pass/fail criteria is necessary.

Test Methods

In order to determine whether or not an item is “injurious” from a blunt trauma perspective, the item must be installed in a seatback and subjected to an impact test using either a 13 pound bowling ball, a Free Motion Headform as defined in 49 CFR part 572, subpart L, or a Head Component Test Device. Schematics describing each type of test and the corresponding pass/fail criteria are contained in detail in Attachments 2 through 4. If a seatback contains more than one potentially injurious item, the test must be repeated to strike each potentially injurious item using one of the test methods described in Attachments 2 through 4. All three test methods require that potentially injurious features be struck with a test device simulating a human head traveling at a minimum velocity of 34 ft./sec. The resulting peak accelerations must not exceed 200g’s, and accelerations in excess of 80g’s shall not exceed a cumulative duration of 3.0 milliseconds.

In addition to the means of compliance described in Attachments 2 through 4, it remains acceptable to utilize the other means of compliance identified above.

Considerations for Seat Technical Standard Order (TSO) Holders

The FAA believes that the vast majority of these types of component tests will be conducted to address occupant injury considerations on seats. To the extent that seatback accessories are incorporated into the seat manufacturer’s drawings, these types of tests can be conducted in parallel to the seat TSO-C39b processes but cannot be approved under the TSO authorization (or Letter of Design Approval for foreign manufacturers). The FAA will accept statements made by seat TSO holders regarding the pass/fail criteria pertaining to the seatback mounted accessories, provided the testing is done in parallel with a TSO approval. The FAA is willing to delegate the data collection responsibilities for seatback de-lethalization tests to the seat manufacturers for these types of activities.

It is a common occurrence for seatback accessories not to be included in the TSO design approval. Instead, the seat TSO design approval often only considers the mass and location of seatback accessories and facilitates their installation into pre-coordinated

mounting provisions. Oftentimes this is because the TSO holders do not wish to be responsible for the design and manufacturing oversight of the accessories. In cases where the seatback accessories are not included in the TSO design approval, installation approval of the accessories is accomplished by the seat installer, even though the actual installation of the accessories into the seats is most likely accomplished by the seat manufacturer. Whether seatback accessories are included as part of the actual TSO design approval, or the TSO design approval only accounts for the mass and location of the accessories, it is acceptable for seat manufacturers to conduct the tests described in Attachments 2 through 4 to determine the occupant injury characteristics. In either case, adequate test article definition is still required, but can be encompassed by the seat manufacturers quality control system and conformity inspection processes.

A statement from the TSO-holding seat manufacturer that the seatback-mounted accessories meet the pass/fail criteria described in this memorandum along with submittal of the resultant test data should be sufficient for the installer to make a determination of compliance with §§ 25.785(b) and (d). This may be a specific statement or encompassed in a more general statement, but cannot be included in the TSO applicant's statement of conformance (per § 21.605(a)(1)), nor any other documents associated with the TSO approval (e.g., installation limitations drawing/document).

An example of the latter is as follows: The seat installer (e.g., an airplane manufacturer) includes the text from § 25.785(b) and (d) in its seat interface requirements document (or equivalent) that all seat suppliers must meet, and specifically requires that all seatback mounted accessories be evaluated for occupant injury potential (i.e., blunt trauma and sharp or injurious edges) per this memorandum. The seat supplier, upon delivery of the seats, should provide the test data and a statement to the installer that all of the requirements of the interface document have been met, thereby enabling the installer to make a determination that the occupant injury concerns have been adequately addressed.

The FAA is currently considering revisions to TSO-C39b that *may* allow assessment of certain blunt trauma injuries on seatback mounted accessories as part of the TSO process. If the TSO is so revised, the new TSO reporting allowances and requirements *may* supersede the prohibitions identified above regarding inclusion of this type of data as part of a TSO application package.

The same assessments described above can be made in parallel with, but not as a part of the TSO-C127a approval process. As a reminder, in those cases where the intended aircraft's certification basis includes § 25.562(c)(5), the blunt trauma assessments described above are not sufficient, and explicit compliance with § 25.562(c)(5) must be demonstrated.

Sharp and Injurious Edges

As a result of the impact tests described above, sharp edges may be formed that are injurious or may impede egress. This is not acceptable. An assessment of sharp or injurious edges must therefore be completed for each seatback mounted accessory, or any

other potentially injurious item located within the headstrike zone to determine compliance with the requirements of §§ 25.785(b) and (d).

The FAA recognizes that repeated tests may be necessary to develop and refine a seat/seatback accessory configuration that meets the occupant injury requirements. As such, the costs associated with utilizing production quality accessories for repetitive impact tests can become prohibitive. In order to help reduce the costs associated with these tests, the FAA has determined that blunt trauma evaluations of sharp and injurious edges or features can be evaluated independently, if so desired. The blunt trauma tests described in Attachments 2 through 4 can be conducted utilizing surrogate test articles in accordance with FAA Policy Memorandum (Draft) ANM-03-115-28, which is available on the Internet at <http://www.airweb.faa.gov/rgl>. Likewise, a component level assessment of sharp and injurious edges and features can be made of a seatback accessory by itself, if it is rigidly mounted in a test fixture and subjected to one of the test methods described in Attachments 2 through 4. If a seatback accessory does not show the propensity to create sharp or injurious edges when tested in a rigid fixture, this is sufficient to find compliance for the article as installed.

If testing with a surrogate test article yields unacceptable blunt trauma results, or an accessory develops sharp and injurious edges or features characteristics when tested while mounted in a rigid test fixture, it may be necessary to more accurately represent the energy-absorbing characteristics of the seat and seatback accessory acting together as a system. In these cases it may be necessary to conduct the tests described in Attachments 2 through 4 on the accessory installed in the seatback assembly. If this testing approach does not yield acceptable results, it remains acceptable to conduct testing to meet the HIC requirements of § 25.562(c)(5), and thereafter demonstrate that no sharp or injurious features were created.

Considerations for Airplane Manufacturers and Airplane Modifiers

An airplane manufacturer/modifier may also utilize the methods described above and in Attachments 2 through 4 to determine that features located within the striking radius of an occupant's head are non-injurious in accordance with §§ 25.785(b) and (d). In these cases, the development of an FAA-approved test plan, test article conformity, and test witnessing responsibilities must be coordinated with the aircraft certification office with oversight responsibility for the installation or modification in accordance with FAA Order 8110.4().

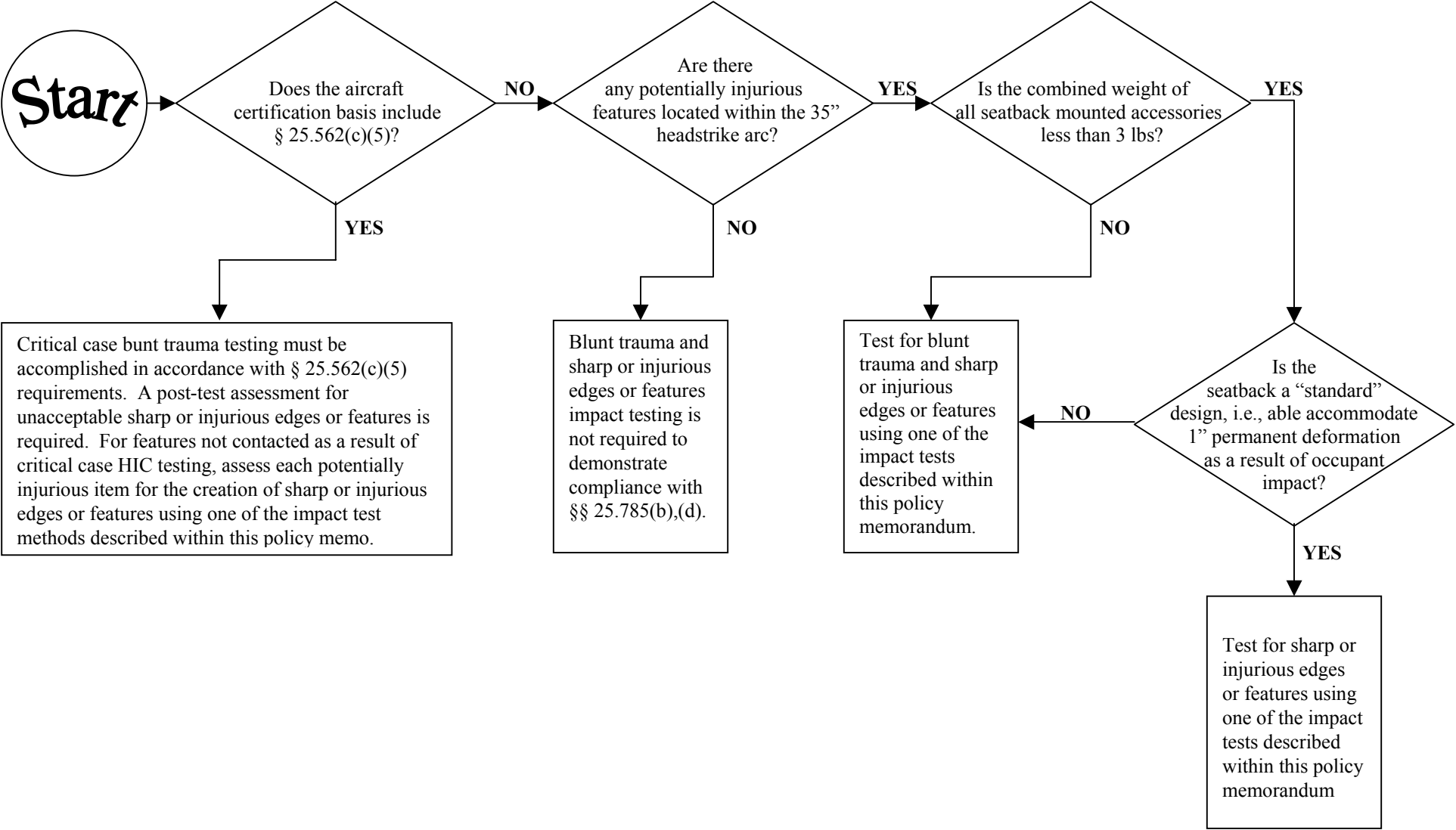
Effect of Policy

The general policy stated in this document does not constitute a new regulation or create what the courts refer to as a "binding norm." The office that implements policy should follow this policy when applicable to the specific project. Whenever an applicant's proposed method of compliance is outside this established policy, it must be coordinated with the policy issuing office (e.g., through the issue paper process or equivalent). Similarly, if the implementing office becomes aware of reasons that an applicant's

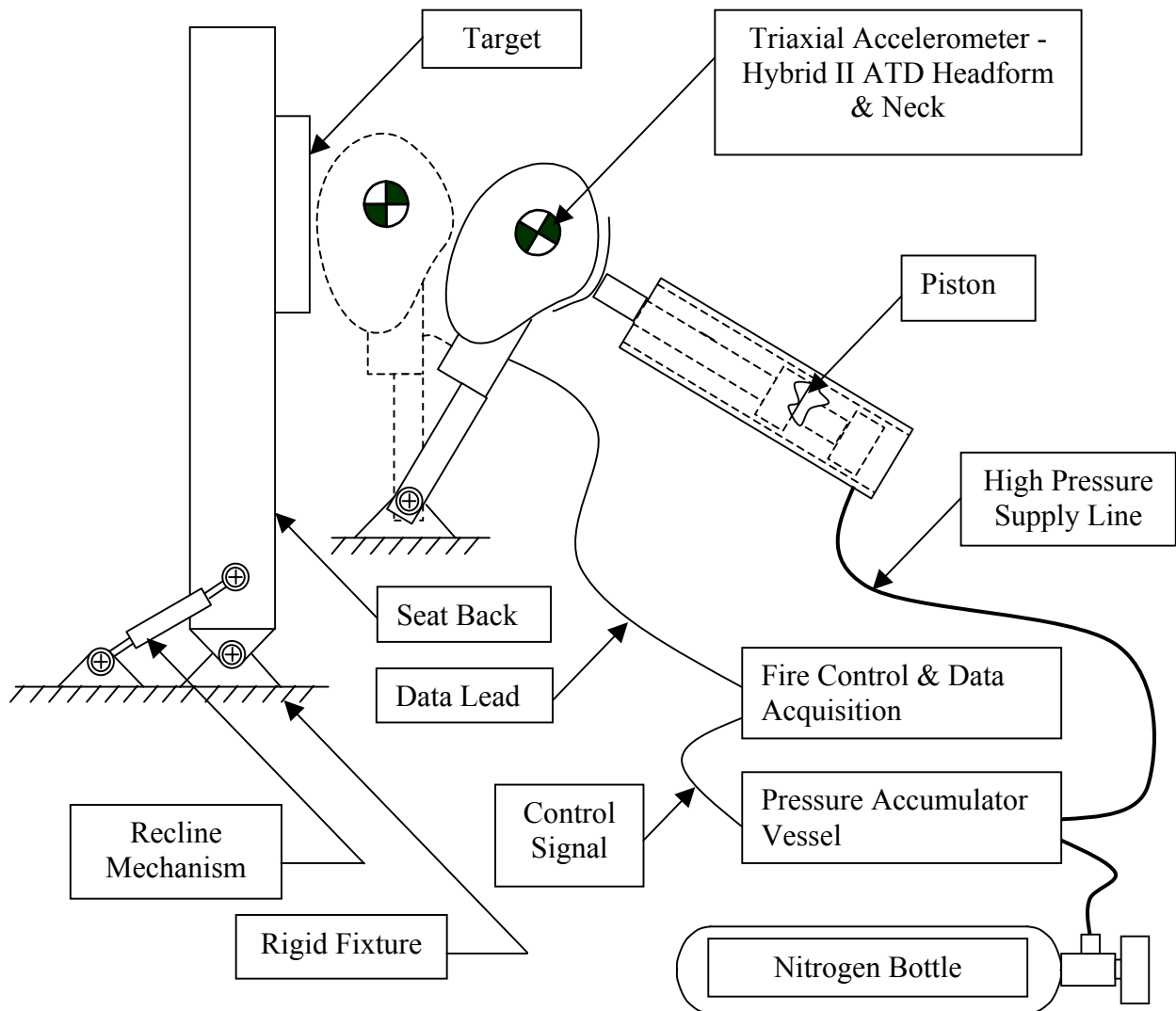
proposal that meets this policy should not be approved, the office must coordinate its response with the policy issuing office.

Applicants should expect that the certificating officials will consider this information when making findings of compliance relevant to new certificate actions. Also, as with all advisory material, this policy statement identifies one means, but not the only means, of compliance.

Attachment 1 Process Flowchart



Attachment 2 Head Component Tester



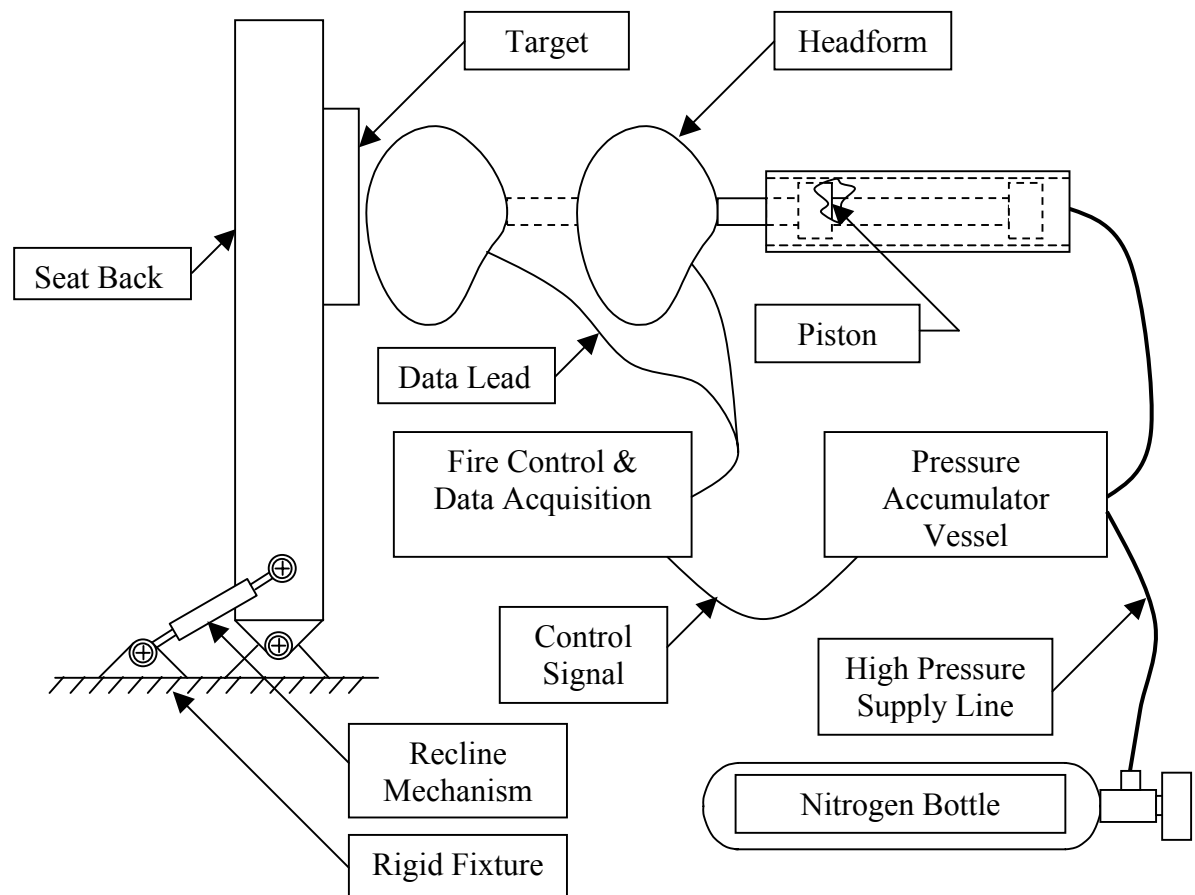
The head component test device is a Hybrid II Anthropomorphic Test Dummy (ATD) head and neck mounted on a pendulum. The head/neck assembly is accelerated with a pneumatic piston to achieve the desired impact velocity. The ATD head is instrumented with an accelerometer that records the acceleration forces associated with the impact. The following criteria describe the test requirements:

- Each potentially injurious seatback mounted feature within the 35" headstrike arc must be assessed. To the extent practicable, the test articles should be positioned in order to strike the center of each item, with a direction of motion that is perpendicular to the seatback/seatback-mounted accessory. If the seat pitch is such that an item is located outside of the 35" headstrike arc, it need not be assessed.

- Each potentially injurious item should be mounted in a seatback that is connected to a rigid mounting fixture that shares the appropriate mounting points of the seatback (i.e., pivot and recline mechanism mounting). It is not necessary to represent a production seat except for the seatback, recline mechanism and their attachment to structure.
- The ATD forehead should strike the center of the target.
- The impact velocity must be a minimum of 34 ft./sec.
- Electronic instrumentation shall be accomplished in accordance with SAE J211. Accelerations shall be measured in accordance with the requirement of Channel Class 1000.
- Pass/Fail Criteria: Peak accelerations shall not exceed 200g's; accelerations in excess of 80g's shall not exceed a cumulative duration of 3.0 milliseconds. The impact shall not cause the formation of any sharp or injurious edges or features that may impede egress.

Attachment 3

Free Motion Headform Test Device

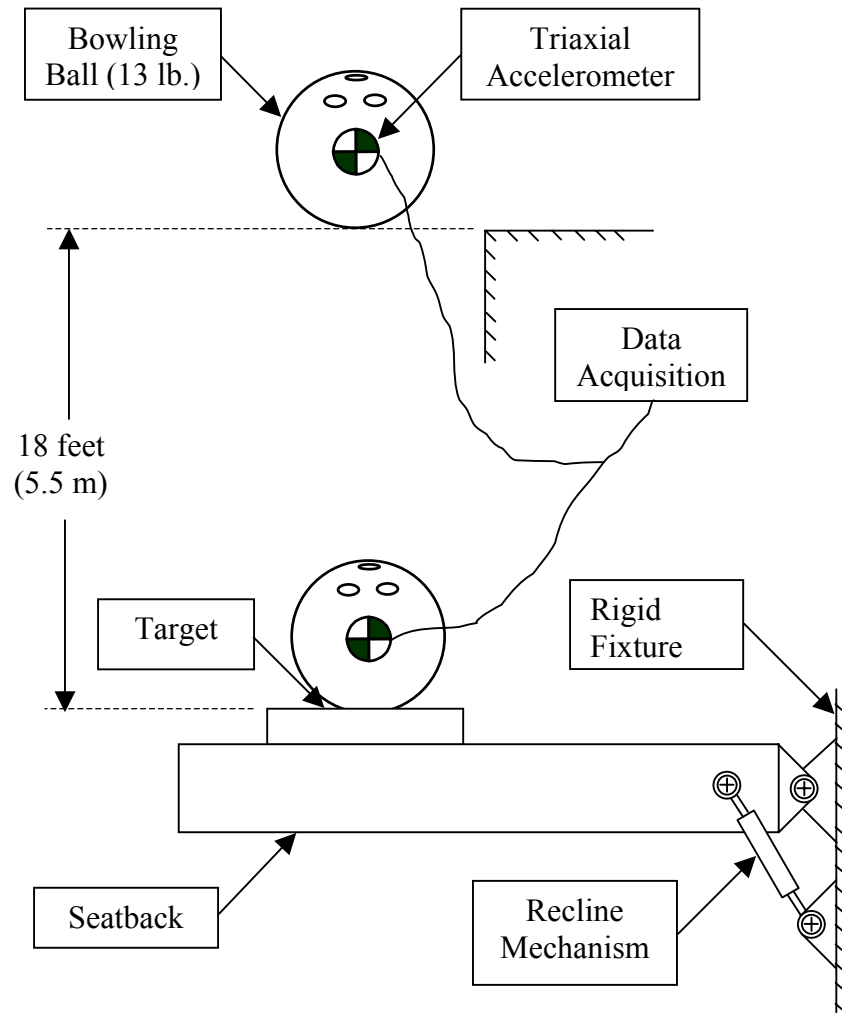


The Free Motion Headform (FMH) device is defined in 49 CFR part 572, subpart L, and is used primarily by the automotive industry to demonstrate compliance with Federal Motor Vehicle Safety Standards (FMVSS) 201U. This device can be used in a manner similar to FMVSS 201 to evaluate blunt trauma injury. The following criteria describe the test requirements:

- Each potentially injurious seatback-mounted feature within the 35" headstrike arc must be assessed. To the extent practicable, the test articles should be positioned in order to strike the center of each, with a direction of motion that is perpendicular to the seatback/seatback-mounted accessory. If the seat pitch is such that an item is located outside of the 35" headstrike arc, it need not be assessed.
- Each potentially injurious item should be mounted in a seatback that is connected to a rigid mounting fixture that shares the appropriate mounting points of the seatback (i.e., pivot and recline mechanism mounting). It is not necessary to represent a production seat except for the seatback, recline mechanism and their attachment to structure.

- The FMH forehead should strike the center of the target.
- The impact velocity shall be at least 34 ft./sec.
- Electronic instrumentation shall be accomplished in accordance with SAE J211. Accelerations shall be measured in accordance with the requirement of Channel Class 1000.
- Pass/Fail Criteria: Peak accelerations shall not exceed 200g's; accelerations in excess of 80g's shall not exceed a cumulative duration of 3.0 milliseconds. The impact shall not cause the formation of any sharp or injurious edges or features that may impede egress.

Attachment 4 Bowling Ball Test Device



Bowling ball tests should be conducted with a bowling ball weighing a minimum of 13.0 lbs., and instrumented with a triaxial accelerometer that records the accelerations associated with impact. The following criteria describe the test requirements:

- Each potentially injurious seatback-mounted feature within the 35" headstrike arc must be assessed. To the extent practicable, the test articles should be positioned in order to strike the center of each item, with a direction of motion that is perpendicular to the seatback/seatback-mounted accessory. If the seat pitch is such that an item is located outside of the 35" headstrike arc, it need not be assessed.
- Each potentially injurious item should be mounted in a seatback that is connected to a rigid mounting fixture that shares the appropriate mounting points of the seatback (i.e., pivot and recline mechanism mounting). It is not necessary to represent a

production seat except for the seatback, recline mechanism and their attachment to structure.

- The impact velocity must be a minimum of 34 ft./sec. Note: It is not necessary to measure the impact velocity provided the bowling ball is dropped from a minimum height of 18 feet above the impact surface.
- Electronic instrumentation shall be accomplished in accordance with SAE J211. Accelerations shall be measured in accordance with the requirement of Channel Class 1000.
- Pass/Fail Criteria: Peak accelerations shall not exceed 200g's; accelerations in excess of 80g's shall not exceed a cumulative duration of 3.0 milliseconds. The impact shall not cause the formation of any sharp or injurious edges or features that may impede egress.