

**DISPOSITION OF PUBLIC COMMENTS**

Technical Criteria for Approving Side-Facing Seats, Policy No. PS-ANM-25-03

Jayson Claar

No.	Comment	Requested Change	Disposition
<b>Commenter: Bombardier</b>			
1	<p><b>For New Applications</b></p> <p>As stated in the proposed policy, previous side-facing seat installations were approved through the use of an exemption or SFAR 109. The first sentence of Attachment 1 of the proposed policy states that the additional injury criteria are “special condition[s] . . . proposed as part of the type certificate basis.”</p> <p>However, the existing means to certify side-facing seat installation exempts the applicant from protecting the occupants from injury. For some aircraft types, the exemptions are listed in the TCDS as part of the basis of certification. For new STC applications where the basis of certification is determined through CPR to be as per the TCDS, do the existing exemptions still apply? This would appear to be equivalent to using SFAR 109 for new applications, which the proposed policy indicates is acceptable. Or does this case count as “previously approved” as per the proposed policy?</p>	<p>Please clarify if the policy is applicable for new applications where an exemption is part of the aircraft TCDS.</p>	<p>The FAA has revised the implementation section to address previously approved exemptions and special conditions rather than type certificates and/or supplemental type certificates.</p>
2	<p><b>For Previously Approved Seats</b></p> <p>The proposed policy states “Previously approved side-facing seats may continue to be produced and installed, without changes, in airplanes.”</p>	<p>Please clarify that the policy is to be applicable to new divan designs, and not to revisions to existing STC’s where the divan design is existing and unchanged.</p>	<p>The FAA has revised the implementation section to address previously approved exemptions and special conditions rather than type certificates and/or supplemental type certificates.</p>

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	<p>This statement implies that the proposed criteria apply only to new side facing seat designs (assembly and installation). Therefore, existing approved divans may be installed in accordance with existing STC's, even if the STC data package is amended to capture design changes unrelated to the divan. This would be applicable for interior completion STC's where the STC data structure includes revisions to represent each specific configuration, even though the majority of the data remains the same.</p>		
3	<p><b>Process Concern</b></p> <p>The proposed policy contains statements that the criteria are a “special condition” as well as “guidance material” that “identifies one means, but not the only means, of compliance”. This calls the appropriateness of the process into question, as it does not seem to be correct that a Policy Statement should be used in place of established rule-making procedures.</p> <p>While acknowledging the fact that “guidance” is often written in the language of “regulation”, the proposed policy statement does provide a Definition of Key Terms (“must”, “should”, and “recommend”) that can be used to evaluate Attachment 1 in detail to determine if is guidance or regulation:</p>	<p>Engage the formal rulemaking process to develop new compliance requirements if this policy is going to be a mandatory interpretation of the regulations.</p>	<p>This policy statement is not being “used in place of established rule-making procedures.” Special conditions and exemptions are proposed and approved through rulemaking. In contrast, policy statements such as this one are non-binding. This is explained in the “Effect of Policy” section. This is the third policy statement on this subject, dating back to 1997, that proposes criteria for granting special conditions and/or exemptions for installation of side-facing seats. As explained in the “Policy” section of the policy statement, Attachment 1, which contains the provisions cited by the commenter, provides “detailed requirements contained in the proposed new special conditions.” The rulemaking procedures for imposing these requirements on particular applicants, as defined in 14 CFR § 11.38, remain unchanged. As with all rulemaking procedures, we will consider comments from the public in determining whether to issue final special conditions as proposed, or whether</p>

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	<p>Section 1.(a)-(f) deals mostly with test methodology, such as selection of test dummy, positioning etc. While this information is similar in content to AC 25.562, the word “must” is used through these paragraphs. Thus while the content appears to be guidance on one acceptable means to perform the required tests, it is being presented in the language of regulation. These paragraphs should be revised to follow the established language principles.</p> <p>Section 2.(a)-(h) add performance measures (injury pass/fail criteria) in addition to the performance measures in 25.562. The word “must” is used for most of these requirements, and thus is defined by the proposed policy as “regulation”.</p> <p>Sections 3-16 are design criteria applicable to airbag installations. As above, the word “must” is used throughout these requirements, therefore these are also defined as regulation and not guidance.</p> <p>Therefore, it is clear that the proposed policy statement contains new regulatory material. Regulations must be introduced through the established methods, not through policy statements. 25.562 should be revised to add the additional injury criteria for side-facing seats. A new standard should be created to address requirements for airbags, as airbag</p>		requested changes are appropriate.

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	<p>installations are not unique to side-facing seats. Many of the earlier questions regarding the applicability of new policy on existing and new designs would not be required if the normal rulemaking processes were followed.</p> <p>Of particular concern is the fact that manufacturers and operators of newer aircraft will be forced to bear the additional costs associated with demonstrating compliance to the new criteria, while it remains acceptable to install “9g” side-facing seats in older aircraft. While it is always important to improve the level of safety, the full rule-making process is required in this case to ensure that industry and the flying public receive a consistent and justified implementation of new regulations.</p>		
4	<p><b>Comments on Design Criteria</b></p> <p>1. Item 1(b) indicates that it is acceptable to conduct injury-assessment tests without yaw or floor misalignment. This is common practice with current dynamic seat tests. However, the “worst case” condition for requirement 2(h)(2) would be an inboard yaw condition, as the forward motion of the head would cause it to move over the seat-back support.</p> <p>2. Item 2(e) Leg Flail. A review of test videos shows that the legs of the second occupant of a side facing seat will often</p>	<p>1. Please clarify that criteria 2(h)(2) is only applicable to tests without yaw or floor misalignment. Also, please clarify Item 2(h)(2) to indicate which of the following is the “plane of the seat-back supporting surface”:</p> <ul style="list-style-type: none"> <li>a. the face of the back-rest cushion touching the dummy;</li> <li>b. the face of the back-rest cushion touching the seat structure; or,</li> <li>c. the most outboard face of the seat structure.</li> </ul>	<p>Comment 4.1: The FAA has deleted requirement 2(h)(2) in the policy. Further analysis of test data indicates that for side-facing seats, the intent of requiring a seat back to sufficiently support the head and spine can met by limiting neck loading to the limits cited in the proposed policy.</p> <p>Comment 4.2: The FAA has revised the wording of 2(e) to clarify that the requirement addresses axial rotation of the ADT upper leg (femur) with respect to its nominal (pre-test) position. The reference to the lower leg has been omitted. However since the pelvis does not tend to rotate laterally, the position of the lower leg remains a good indicator of the</p>

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	<p>rotate as much as 90 degrees from the nominal seated orientation. However, at the same time this is occurring, the upper-leg segments are rotating forward as well. Thus, there is little torque on the upper-leg segment for the second occupant.</p>	<p>Furthermore, please revise the requirement to indicate whether it is “any portion” of the ATD head, or “the entire” ATD head that may not translate past the plane.</p> <p>2. Please clarify the wording of requirement 2(e) such that the 35 degrees are not measured from the nominal seating position, but measured in relation to the upper-leg segment at any time during the test.</p>	<p>femur axial rotation. Excessive axial rotation is most likely to occur when the occupant is seated next to an end closure that does not provide support for the lower leg or feet. In that configuration, the femur axial rotation can be surmised from the position of the lower leg.</p>
<p><b><i>Commenter: L-3 Communications</i></b></p>			
<p>1</p>	<p>L-3 Communications wishes to post comments related to Policy PS-ANM-25-03.</p> <p>We transmit herewith the comment letter prepared and separately submitted to your office today by Aerospace Industries Association (AIA) and General Aviation manufacturers Association (GAMA). L-3 supports the comment letter in its entirety and urges FAA to implement its recommendations .</p> <p>L-3 adds our own emphasis on the paragraph regarding “Implementation and Application Dates”. As has been previously agreed between industry and FAA we believe new policy should not be imposed on existing projects prior to the final issuance of the policy. Given the extent of the comments regarding</p>		<p>The FAA has addressed the AIA and GAMA comments separately from this commenter.</p> <p>As stated in the policy statement side-facing seats are considered a novel design for transport-category airplanes that include Amendment 25-64 in the certification basis, and were not considered when those airworthiness standards were issued. This revision to the policy for side-facing seats brings the level of safety of side-facing seats to the level envisioned in Amendment 25-64. The side-facing seats have some additional injury mechanisms that were not seen in the forward- and aft-facing seats. In the future the FAA may revise the regulations to include these requirements for side-facing seats. When that occurs the FAA would consider a cost benefit analysis.</p>

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	<p>applicability, scope, cost, and benefit of the new requirements we believe that the new policy should be completely vetted and issued in its final form prior to that policy's application to any project.</p>		
<p><b>Commenter: <i>Biomechanics Consulting</i></b></p>			
<p>1</p>	<p>The Policy Statement draws heavily on FMVSS 214, both for test procedures and injury criteria, but does not appear to reflect the process used to develop the FMVSS. More specifically, the regulatory methodology associated with the FMVSS includes: 1) an assessment of societal cost and benefit calculations per Presidential Executive Order 12866 (1993) (as restored in 2009 by EO 13497) and 2) test requirements that typically reflect AIS 2 and 3-level injury thresholds (Pike 1990). Furthermore, there are inherent differences (e.g. crash pulse and seating configurations) between the inertial head and neck loading typically associated with a crash event involving an occupant of a side facing seat in an aircraft and an occupant of a front facing seat in a passenger vehicle (Philippens 2009) that should be fully addressed before applying a requirement from one to the other.</p>		<p>As stated in the policy statement side-facing seats are considered a novel design for transport-category airplanes that include Amendment 25-64 in the certification basis, and were not considered when those airworthiness standards were issued. This revision to the policy for side-facing seats brings the level of safety of side-facing seats to the level envisioned in Amendment 25-64. The side-facing seats have some additional injury mechanisms that were not seen in the forward- and aft-facing seats. In the future the FAA may revise the regulations to include these requirements for side-facing seats. When that occurs the FAA would consider a cost benefit analysis.</p> <p>While the vehicle pulse produced in automotive side-impact tests differs somewhat from the sled pulse used for 14 CFR part 25 longitudinal tests, both tests are in the same range of severity (as compared to blast or crush events). There is no evidence to suggest that the aircraft pulse is different enough to prevent the ATDs used from producing valid responses.</p> <p>Some aircraft side-facing seat configurations, such as when an occupant is seated just aft of an interior wall, are quite similar to the automotive side-</p>

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			<p>facing-seat test condition. The validity of using the automotive test dummies and criteria is obvious in these cases. Some aircraft seating configurations are quite different from the automotive-test condition, such as when an occupant is seated in the middle of a couch, restrained primarily by belts. To provide the required level of safety for those seat configurations, the FAA developed unique test methods and injury criteria that are included in the proposed Special Conditions. Note that these aviation test methods and criteria may not be valid for the automotive-impact scenarios due to the configuration differences.</p>
2	<p>One of the reports (Philippens 2011) referenced in the Policy Statement, states that “tension force is the most discriminating parameter for predicting AIS 3+ injuries to the neck” and 1800 N (the value adopted in the Policy Statement) is the lower (more conservative) of two possible IARV’s presented in this report. (It should be noted that IARV’s are generally regarded as guidelines (Mertz 1993) rather than precise tolerance limits.) The other neck measurements specified in Section 2f should be clearly identified as (optional) recommendations. It would be premature and possibly counter-productive to offer them as requirements at this time.</p>		<p>While upper-neck tension was found to be the most discriminating for neck injuries in the test configurations studied, there was sufficient evidence from the FAA research and the scientific literature to indicate that tolerance limits were needed for the other loading modes to provide the required level of safety.</p>
3	<p>No data were presented to address the frequency/severity of sideways bending injury to femur and/or flank. If these are to</p>		<p>The femur injuries cited in DOT/FAA/AR-09/41 support the potential for femur injury. The findings cited in Stapp 2007-22-0014 support the potential</p>

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	<p>be addressed at this time, even as (optional) recommendations, the maximum (rather than average) voluntary value is more appropriate, as it is more likely to provide some meaningful protection while not needlessly restricting design and possibly compromising other aspects of safety performance.</p>		<p>for torso injury. The average range of motion values cited are necessary to achieve the same level of safety provided by the requirement for full-body support contained in the previous policy. The flail limits are intended to restrict design less so than in the previous requirements.</p>
4	<p>One of the reports (DeWeese 2007) referenced in the Policy Statement, indicates that adopting the limits contained in FMVSS 214 "would provide the same safety benefits for occupants of aircraft seats as they would for motorists." This does not appear to take into account the differences between aircraft and passenger vehicle impact environments (Philippens 2009).</p>		<p>As stated in the policy statement side-facing seats are considered a novel design for transport-category airplanes that include Amendment 25-64 in the certification basis, and were not considered when those airworthiness standards were issued. This revision to the policy for side-facing seats brings the level of safety of side-facing seats to the level envisioned in Amendment 25-64. The side-facing seats have some additional injury mechanisms that were not seen in the forward- and aft-facing seats. In the future the FAA may revise the regulations to include these requirements for side-facing seats. When that occurs the FAA would consider a cost benefit analysis.</p> <p>While the vehicle pulse produced in automotive side-impact tests differs somewhat from the sled pulse used for 14 CFR part 25 longitudinal tests, both tests are in the same range of severity (as compared to blast or crush events). There is no evidence to suggest that the aircraft pulse is different enough to prevent the ATDs used from producing valid responses.</p> <p>Some aircraft side-facing seat configurations, such as when an occupant is seated just aft of an interior</p>

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			<p>wall, are quite similar to the automotive side-facing-seat test condition. The validity of using the automotive test dummies and criteria is obvious in these cases. Some aircraft seating configurations are quite different from the automotive-test condition, such as when an occupant is seated in the middle of a couch, restrained primarily by belts. To provide the required level of safety for those seat configurations, the FAA developed unique test methods and injury criteria that are included in the proposed Special Conditions. Note that these aviation test methods and criteria may not be valid for the automotive-impact scenarios due to the configuration differences.</p>
	<p align="center"><b><i>Commenter: Aerospace Industries Association (AIA) and General Aviation Manufacturers Association (GAMA)</i></b></p>		
1	<p>AIA and GAMA are supportive of standardizing the injury testing criteria in special conditions for side facing seats. The policy statement’s standardization of technical criteria will improve industry’s ability to plan for compliance expectations of special conditions while preserving a standardized approach for the FAA to draft consistent future special conditions.</p> <p>As special conditions are a suitable rulemaking action regarding novel or unusual design features that the Code of Federal Regulations do not yet address, it is presumed the FAA will apply special conditions until the FAA promulgates future regulations to align with the current</p>		<p>The FAA agrees with the AIA and GAMA comment.</p> <p>Those possible revisions to part 25 would be considered along with the other rulemaking projects that the FAA is considering.</p>

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	<p>methods of compliance in the special conditions. AIA and GAMA are supportive of an SFAR 109 revision, which is not limited to private us, as appropriate Federal Aviation Regulations to address side facing seats and would be eager to contribute to the SFAR 109 revision process.</p> <p>Though special conditions are FAA rulemaking actions, some significant considerations are not typically measured in the special condition development process such as the evaluation of expected benefits, financial impact, or potential consequences its promulgation may impose. The absence of these considerations raise the question of what is the expected measureable gain in safety, noting there is not a significant accident history for business jets that contain small numbers of passengers and even a smaller number of passengers occupying side facing seats. AIA and GAMA request that the FAA describe the expected measurable gain in safety to include a comparison from previous examples of accidents/incidents involving injuries to occupants of side facing seats prior to the issuance of this policy statement and associated special conditions to the projected or actual improvements this policy statement and associated special conditions will provide.</p>		<p>The FAA conducted the regulatory cost/benefit analysis for dynamic seat testing during the rulemaking process associated with Amendment 25-64 to part 25. This revision to the policy for side-facing seats brings the level of safety of side-facing seats to the level envisioned in Amendment 25-64. The side-facing seats have some additional injury mechanisms that where not seen in the forward- and aft-facing seats.</p>

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2	<p>The intent of the CAMI research was to develop neck injury criteria and injury tolerance levels for the certification of side-facing seats. While the majority of the research was extensive and thorough and provided a clear pass/fail criteria based on that research, AIA/GAMA have concerns with additional injury criteria which fell short of a clear factual based decision but nonetheless adds new pass/fail leg flail criteria based on an admitted conservative approximation which lack evidence to substantiate an appropriate limit. This conservative approximation of testing criteria, combined with subjective estimates of actual test results such as in the case of leg flail, will prove extremely arduous with an insignificant, if any, gain in safety. Therefore, AIA and GAMA recommend in the absence of thorough research, certain injury criteria, such as leg flail, should be deferred until it can be substantiated by research.</p>		<p>The injuries sustained in the PMHS tests are not ambiguous in origin (the spiral fracture in one subject and the distal-shaft fracture in the other subject are indicative of torsion loading). The injury is repeatable and would be expected in any impact that produces significant torsion loading of the femur. The test results show that sufficient torsion to cause serious injury can be caused by inertial forces acting on an unsupported lower leg. The only way to prevent an injury caused by rotation of a joint beyond its natural limit is to prevent that rotation. Additional research could further define the relationship between rotation angle and injury probability, and help in developing more-sophisticated methods of determining the rotation during tests. However, at this time, limiting rotation to a value unlikely to cause injury is the only means of providing the level of safety provided by the previous requirement for full-body support.</p>
3	<p>The Policy Statement may also introduce a temporary competitiveness issues with European completion centers as some of the VIP market can choose foreign completion centers to avoid this current rule. It would set up an unfair marketplace in the interim until EASA was to determine their path as well. AIA and GAMA request that this policy statement</p>		<p>It is possible that some airplanes affected by this new policy may be operated in different countries that may not require compliance with these proposed special conditions. However, this is commonplace when new regulations are developed.</p> <p>Concerning EASA, they are aware of the research that we conducted and the development of the special conditions. We will continue our efforts to harmonize our policies and rules with EASA,</p>

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	and special conditions be harmonized with EASA and enforced simultaneously to prevent any unintended temporary competitiveness issues.		including this policy.
4	<p>AIA and GAMA are concerned with the broad implementation of this policy statement and suggest that implementation should be limited to new projects and significant changes to TC/STCs. We are not aware of any Airworthiness Directives or field service issues that would support this immediate and broad applicability as currently suggested. AIA and GAMA recommend that the wording under the implementation section be changed to clearly indicate this policy will be imposed on new side facing seat designs that are considered a significant change as defined by 14 CFR 21.101 (Change Product Rule) and that the applicability of the new test standards should be to projects applied for after the effective date of the policy. Furthermore, as the current Advisory Circular 21.101 identifies interior modifications as not significant, the installation of a new side facing seat should never require a new certification basis.</p>		<p>The FAA concurs, in principle, that existing designs will not be affected. The implementation section has been revised to address the existing airplanes, with respect to the existing exemptions and special conditions, rather than type certificates, amended type certificates, and supplemental type certificates. As a result, 15 airplane models currently have exemptions for the multiple-place side-facing seats that are listed on the type-certificate data sheets. These are covered under the previously approved section of the policy statement and, as stated in that section, this policy statement has no effect on those previous approvals. We have further clarified that the existing seats installed on these airplanes may continue to be used without changes. Also, newly manufactured seats, modified previously designed seats, and new designs of seats that can be certified in accordance with the limitation of those exemptions, are acceptable. This includes newly manufactured airplanes of the models covered by these existing exemptions. The same is true of the special conditions for the single-place seat.</p>
5	<p><b>Implementation “NEW”</b> As read under the “new” section of the policy statement:</p>		<p>The FAA agrees. This section has been changed to remove this sentence.</p>

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	<p>“Finally, due to the nature of the potential injuries resulting from occupants being exposed to emergency-landing conditions in side-facing seats, we recommend the new criteria be considered for incorporation into future deliveries of already approved side-facing-seat installations.”</p> <p>The language in the “New” section will likely cause considerable confusion as it is likely to be interpreted by ACO’s as a way to require immediate compliance to all projects including already approved side facing seat installations. This statement provides no value added and can only add confusion, therefore AIA and GAMA recommend the FAA remove this statement in order to prevent interpretation or inconsistencies issues.</p>		
6	<p>As majority of the criteria refers to airbags it appears to imply and assume that airbags are the only feasible current and future solution to meet the injury criteria. Although that may currently be the only approach, other approaches may be developed and considered. AIA and GAMA recommend the FAA remove the assumption that airbags are the only solution and provide language in the policy statement that considers other potential solutions.</p>		<p>The FAA does not agree with the AIA and GAMA comment that infers that airbags are the only way to comply with these special conditions. If all of the requirements in special conditions 1 and 2 can be met without an airbag system in the shoulder belt, then there is no need to address any of the requirements in special conditions 3 through 16. For example, given a properly designed seat with a structure on the forward side of the seat, it is possible to meet all of the requirements of special conditions 1 and 2 without the airbag system in the shoulder belt.</p>

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7	<p><b>Attachment 1 (1)(a)</b></p> <p>Adding additional criteria for rebound seems outside of the scope of the original requirements of the regulation. Maintaining the restraint system on the occupant during the rebound phase is new criteria that will need additional research to support as different labs stop the event in multiple ways, leading to different rebound scenarios that may affect the ATD and the restraints.</p>		<p>The FAA does not agree with the AIA and GAMA position that retaining the occupant is outside the original requirements of the regulation. One of the main original requirements, regarding seats and seat belts, is that the occupant must be retained in the seat by the seat belt, and that the seat must remain attached to the airplane. This requirement's history dates as far back as CAR 4B. In some of the side-facing seat testing, the FAA has found, at the end of the test, the occupant not sitting on the seat but on the floor with the restraint system holding them to the seat. We do not consider this an acceptable result of the test. We have developed criteria specifying that the occupant, seat belt, and seat are a load path that must be maintained during the entire test.</p> <p>Acceleration-type sled facilities inherently have difficulty realistically representing a long-duration event. Post-test braking action of those types of sled systems can cause an ATD on a couch to rebound further than if the test had been conducted at a deceleration facility. Extending the duration of video and data collection may be necessary to determine if specific occupant/seat responses are solely an artifact of post-test sled braking.</p>
8	<p><b>Attachment 1 (2)(e)</b></p> <p>The 35 degree limitation was established using a literature survey of static range of motion "external rotation is approximately 18 degrees for the 5% male and 45 degrees for the 95% female population." Instead of justifying the 35 degree limitation, the</p>		<p>The injuries sustained in the PMHS tests are not ambiguous in origin (the spiral fracture in one subject and the distal-shaft fracture in the other subject are indicative of torsion loading). The injury is repeatable and would be expected in any impact that produces significant torsion loading of the femur. The test results show that sufficient</p>

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	<p>Policy Memo simply states “Project limitations did not allow for a determination of PMHS femur torque or the specific angle that causes injury.” The only conclusion made is that 35 degrees is a “conservative limit.”</p> <p>Originally this policy was described and presented at the Atlantic City conference and included the angle of rotation as 45 degrees. AIA and GAMA question why it has been reduced to 35 degrees based on an admitted conservative approximation rather than factual data due to “project limitations”. Although we recommend deferring the leg flail angle of rotation test until it can be substantiated by research, at the very least it should be a more reasonable 45 degrees as opposed to the overly conservative estimation of 35 degrees to read: “e) Leg: Flailing of the lower-leg segments, such that the upper-leg segment experiences torque, shall be limited to 45 degrees of rotation about the upper-leg centerline in either direction from the nominal seated orientation.”</p>		<p>torsion to cause serious injury can be caused by inertial forces acting on an unsupported lower leg. The only way to prevent an injury caused by rotation of a joint beyond its natural limit is to prevent that rotation. Additional research could further define the relationship between rotation angle and injury probability, and help in developing more-sophisticated methods of determining the rotation during tests. However, at this time, limiting rotation to a value unlikely to cause injury is the only means of providing the level of safety provided by the previous requirement for full-body support.</p>
9	<p><b>Attachment 1 (2)(h)(2)</b></p> <p>Specifies that, “The ATD head shall not translate beyond the plane of the seat-back supporting surface.”</p> <p>There are concerns that there could be confusion for this requirement as to the specific direction of the translation. For</p>		<p>We have revised the wording of 2(e) to clarify that the requirement addresses axial rotation of the upper leg (femur) with respect to its nominal (pre-test) position. The reference to the lower leg has been omitted. However, because the pelvis does not tend to rotate laterally, the position of the lower leg remains a good indicator of the femur axial</p>

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	<p>clarity the recommendation is to change the sentence to read: “Head and neck support: The ATD head shall not laterally translate (with respect to the aircraft) beyond the plane of the seat-back cushion support surface.”</p>		<p>rotation. Excessive axial rotation is most likely to occur when the occupant is seated next to an end closure that does not provide support for the lower leg or feet. In that configuration, the femur axial rotation can be surmised from the position of the lower leg.</p>
<p>10</p>	<p><b>Attachment 1 (2)(h)(3)</b>                      Adding criteria that the seating system must provide a safe installation for 2 year olds up to 95% males (and pregnant women) is in addition to current requirements of forward/aft facing seats and appears to make the criteria for types of side facing occupants more critical than those of a conventional seat.</p>		<p>We believe this comment is referring to Attachment 1, special condition 3.                       This is the same criteria for current airbag special conditions.</p>
<p>11</p>	<p><b>Attachment 1 (2)(h)(14)</b>                      The second part of this requirement that stipulates that failure of a single airbag-system to deploy is a major failure condition and that its probability should be considered independent of the probability of the crash event where deployment is expected, is overly conservative. While a major failure condition has been typically used for emergency egress systems in the past, those past applications were for systems like escape slides whose failure would be expected to affect a significant number of passengers, as distinct for the failure to function of a single airbag which affects only a single passenger. A major failure condition would imply a limited on</p>		<p>We believe this comment is referring to Attachment 1, special condition 14.                       This requirement is the same as has been required for lap-belt special conditions, and the manufacturers of the devices have demonstrated compliance with this requirement. AIA and GAMA state, in their own comment number 12, below, that the industry has been meeting this requirement. The FAA proposes no change to the requirement as this will maintain the same level of safety as is being provided to all airbag systems.</p>

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	<p>failure probability of improbable, which would require the deployment system to either have redundant means for activation (dual string) or maintenance/inspection intervals so short to the point of not being viable economically.</p> <p>Recommendation -Given that the failure of a single airbag system to activate during an accident is a hazardous failure and that a conservative assumption for probability of the need for activation is <math>1 \times 10^{-5}</math>/flight hour, then the required failure probability of a single airbag system should be on the order of <math>1 \times 10^{-2}</math>/flight hour.</p>		
12	<p><b>Attachment 1 (14)</b></p> <p>AIA and GAMA request that the FAA provide clarification of why the last sentence was added to subparagraph 14. Despite the rarity of the level of the event and the fact that industry currently meets this requirement, why was the last sentence added?</p>		<p>The last sentence was added to provide a clear understanding of the requirement, and assumptions that are made, in the analysis of these systems. This is needed when determining the correct inspection intervals. The FAA proposes no changes to this section.</p>
13	<p><b>Attachment 2</b></p> <p>Attachment 2, “It is believed that the angle of rotation can be determined by observing lower-leg flailing in typical high-speed video of the ...”</p> <p>Again AIA and GAMA are concerned with the testing criteria that are based on an assumption and evaluate the test with a subjective observation of the video. The</p>		<p>The FAA has replaced “It is believed” with definitive wording suited to the policy. When an occupant is seated next to an end closure, lower-leg flail can be readily determined from video as documented in DOT/FAA/AM-07/13. We agree with the commenter that determining the rotation angle is easier to accomplish when the ATD is seated next to and end closure that holds the legs in a direction normal to the inertial load. In FAA tests,</p>

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	<p>observation may be easier to accomplish when the ATD is seated immediately adjacent to the armrest or monument that holds the legs in a direction normal to the inertial load. However, in any other seat position the ATD will align with the direction of inertial loading and make this measurement very difficult to judge (for industry and the FAA). AIA and GAMA suggest that this testing criterion be postponed until further research is conducted to reliably evaluate this angle of rotation. The FAA will also need to develop guidance which includes the addition of instrumentation in the knees of both Hybrid II and ES2-RE ATD before this becomes a pass/fail requirement for all positions.</p>		<p>that seat configuration was the only one to produce excessive axial rotation. Additional video-camera angles may be necessary to evaluate the criteria if a seat configuration produces excessive rotation while the femurs are not normal to the inertial load.</p>
	<p><b>Commenter: Embraer</b></p>		
1	<p><b>Applicability/Process Issues:</b> To apply new criteria to airplanes with exemptions in existing certification bases does not comply with the requirements of 14 CFR 21.101, which maintains the certification basis unchanged unless the modification is significant. Because the current Advisory Circular 21 .101 identifies interior modifications as not significant, the installation of a new SFS should never require a new certification basis. The applicability of the new test standard should be to projects applied for</p>		<p>The FAA has revised the implementation section to address previously approved exemptions and special conditions, rather than type certificates and/or supplemental type certificates. This revision addresses this part of the comment.</p>

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	<p>after the effective date of the policy.</p> <p>In regards to any interim or time-limited exemptions, any exemption time limit should be tied to the date of production of the airplane on which the SFS would be installed and not to the installation date of the SFS. This would avoid the scenario where a simple modification to an existing SFS installation (done after the aircraft has been in service and the limit date in the exemption has past) that does not comply with the new standard would drive the need to redesign the SFS or its installation for that one airplane to comply with the new standard.</p>		<p>The exemption would not be temporary, it would be permanent, but limited to a configuration and not generally applied to the type design. This will be made clear in any exemption granted under this section, and would be listed, by serial number or date of manufacture, on the type-certificate data sheet for those airplanes. This change addresses this part of the comment.</p>
2	<p>Lea Flail Evaluation:</p> <p>The objective of all the test series in FAA report AR-09/41 was to “... investigate neck injuries in side-facing aircraft seats and to develop neck injury criteria and injury tolerance levels.” The tests did nothing to significantly evaluate the leg injuries found during the post-testing examination of the human subjects. There were no measurements taken during the testing to determine what level of leg flail resulted in the injuries found post-test.</p> <p>Due to this lack of data, the policy proposes a flail limit of 35 degrees, which is based on a 50% percentile static range of motion. There is no evidence to</p>		<p>The injuries sustained in the PMHS tests are not ambiguous in origin (the spiral fracture in one subject and the distal-shaft fracture in the other subject are indicative of torsion loading). The injury is repeatable and would be expected in any impact that produces significant torsion loading of the femur. The test results show that sufficient torsion to cause serious injury can be caused by inertial forces acting on an unsupported lower leg. The only way to prevent an injury caused by rotation of a joint beyond its natural limit is to prevent that rotation. Additional research could further define the relationship between rotation angle and injury probability, and help in developing more-sophisticated methods of determining the rotation during tests. However, at this time, limiting rotation to a value unlikely to cause injury is the</p>

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	<p>substantiate that this is the appropriate limit for a dynamic event on healthy passengers.</p> <p>The proposed means of compliance (use of "typical high speed video") does not consider that the dummy's upper legs commonly rotate forward during the pulse, making it impossible to accurately measure the flail angle of ,the lower leg relative to the upper leg using a camera oriented 90 degrees to the seat orientation. We note that, as far as Embraer is aware, no one has ever attempted to measure leg flail, so the efficacy of the proposed method has yet to be proven.</p>		<p>only means of providing the level of safety provided by the previous requirement for full-body support.</p> <p>When an occupant is seated next to an end closure, lower-leg flail can be readily determined from video as documented in DOT/FAA/AM-07/13. We agree with the commenter that determining the rotation angle is easier to accomplish when the ATD is seated next to an end closure that holds the legs in a direction normal to the inertial load. In FAA tests, that seat configuration was the only one to produce excessive axial rotation. Additional video-camera angles may be necessary to evaluate the criteria if a seat configuration produces excessive rotation while the femurs are not normal to the inertial load.</p>
3	<p>Leg Flail Limiting Means:</p> <p>Embraer notes that there has been no development of solutions to limit leg flail and the following points should be considered:</p> <p>Airbags in lap belts have been in aviation service for more than 10 years (confirm). The use of airbags in SFS to limit head movement is not significantly different from the lap belt function, giving considerable technical confidence that shoulder belt airbags are a viable solution. Lack of similar experience in leg flail prevention installations, combined with the significant risk of the creation of a tripping</p>		<p>The policy statement provides what the limits are for the rotation but does not intend to mandate a means of compliance.</p> <p>The requirement for full-body support, which this policy replaces, prevented leg flail by means of supporting surfaces. Tests of typical seating configurations revealed that excessive axial rotation is most likely to occur when the occupant is seated next to an end closure that does not provide support for the lower leg or feet. Other seating configurations that do not produce excessive rotation may not need a leg-flail limiter.</p>

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	<p>hazard by the flail prevention means.</p> <p>Embraer has been studying the use of an airbag-based mechanism but this is currently technically difficult and unproven, and demonstrates that, at best, air bags are an unproven solution in this application. While the proposed policy memo does not specifically propose airbags to limit leg flail, Embraer is unaware of any other potential solution for multiplace SFSs.</p> <p>Because of this lack of technical maturity, along with the lack of technical robustness in the determination of the leg flail limit (more below on this subject), Embraer believes that the leg flail criterion is too immature to require at this point. Embraer recommends that this requirement be removed from the policy.</p>		
4	<p>Test criteria:</p> <p>Paragraph 1 .e.(1) If the leg flail standard is maintained, there is a need to establish a criterion for ,the lateral (longitudinal in airplane axis) placement of feet.</p> <p>As previously mentioned, there is a need for additional guidance on how lower leg flail is to be measured relative to the upper leg when the upper leg translates forward during the pulse.</p>		Foot (leg) placement is specified in the proposed special conditions paragraph 1(e)(1).
5	(h)(2) Head and neck support - The		The FAA has deleted requirement 2(h)(2). Further

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	<p>critterion for the head to not translate behind the back support is based on rear facing flight attendant seats where zero translation is easy. There is no technical justification provided for why zero aft translation is the correct minimum standard for SFS. In addition, the policy should provide guidance on how this aft translation is to be measured.</p>		<p>analysis of test data indicates that, for side-facing seats, the intent of requiring a seat back to sufficiently support the head and spine can be met by limiting neck loading, to the limits cited in the proposed policy.</p>
6	<p>Embraer believes that the FAA should reconsider the applicability of this new policy on in-process projects as described above. In addition, the technical justification for the leg flail limit, as well as the maturity of flail prevention means, shows that it is premature to impose this requirement at this point. Embraer believes that more medical research and additional technical development is necessary before FAA and industry can reasonably proceed with this requirement.</p>		<p>The FAA has revised the policy to relieve the burden, only when it is in the public interest to grant an exemption from the regulations, that in-work projects would otherwise incur if they were required to meet the new criteria.</p> <p>The injuries sustained in the PMHS tests are not ambiguous in origin (the spiral fracture in one subject and the distal-shaft fracture in the other subject are indicative of torsion loading). The injury is repeatable and would be expected in any impact that produces significant torsion loading of the femur. The test results show that sufficient torsion to cause serious injury can be caused by inertial forces acting on an unsupported lower leg. The only way to prevent an injury caused by rotation of a joint beyond its natural limit is to prevent that rotation. Additional research could further define the relationship between rotation angle and injury probability, and help in developing more-sophisticated methods of determining the rotation during tests. However, at this time, limiting rotation to a value unlikely to cause injury is the only means of providing the level of safety</p>

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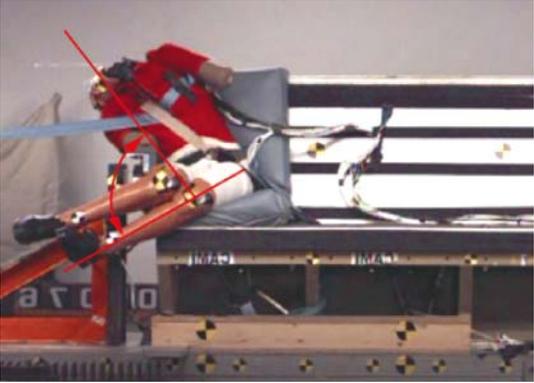
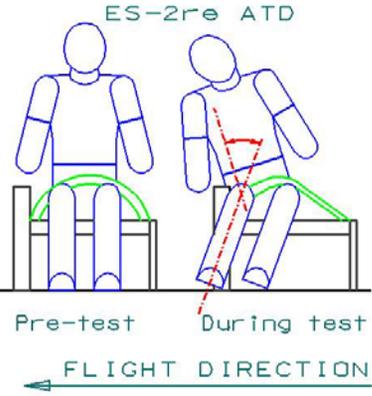
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			<p>provided by the previous requirement for full-body support.</p> <p>When an occupant is seated next to an end closure, lower-leg flail can be readily determined from video as documented in DOT/FAA/AM-07/13. We agree with the commenter that determining the rotation angle is easier to accomplish when the ATD is seated next to an end closure that holds the legs in a direction normal to the inertial load. In FAA tests, that seat configuration was the only one to produce excessive axial rotation. Additional video-camera angles may be necessary to evaluate the criteria if a seat configuration produces excessive rotation while the femurs are not normal to the inertial load.</p>
<p><b>Commenter: ANAC</b></p>			
1	<p>Attachment 1, Special Condition 2(e): how to evaluate, in practical means, the leg flailing angle? Normally for this kind of installation, it is possible for the ATD body to rotate as a whole, making this evaluation difficult (see bottom picture):</p>		<p>The injuries sustained in the PMHS tests are not ambiguous in origin (the spiral fracture in one subject and the distal-shaft fracture in the other subject are indicative of torsion loading). The injury is repeatable and would be expected in any impact that produces significant torsion loading of the femur. The test results show that sufficient torsion to cause serious injury can be caused by inertial forces acting on an unsupported lower leg. The only way to prevent an injury caused by rotation of a joint beyond its natural limit is to prevent that rotation. Additional research could further define the relationship between rotation angle and injury probability, and help in developing more-sophisticated methods of determining the</p>

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	 <p>In this case, it is simple to evaluate the leg flailing angle: the upper leg is kept relatively in place while the lower legs rotate</p>  <p>Schematics of above picture</p>		<p>rotation during tests. However, at this time, limiting rotation to a value unlikely to cause injury is the only means of providing the level of safety provided by the previous requirement for full-body support.</p> <p>When an occupant is seated next to an end closure, lower-leg flail can be readily determined from video as documented in DOT/FAA/AM-07/13. We agree with the commenter that determining the rotation angle is easier to accomplish when the ATD is seated next to an end closure that holds the legs in a direction normal to the inertial load. In FAA tests, that seat configuration was the only one to produce excessive axial rotation. Additional video-camera angles may be necessary to evaluate the criteria if a seat configuration produces excessive rotation while the femurs are not normal to the inertial load.</p>

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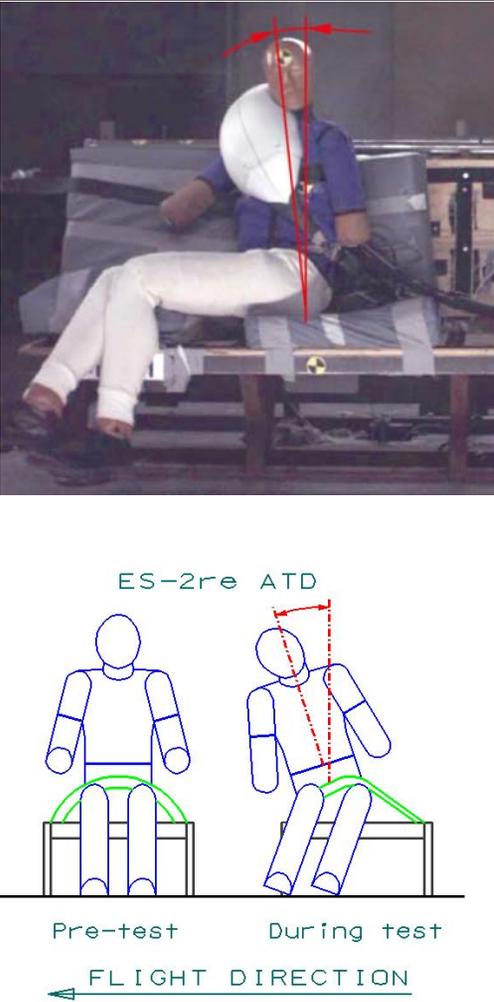
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	 <p data-bbox="199 771 714 828">How to evaluate the leg flailing angle in this case?</p>		
2	<p data-bbox="199 885 745 1096">Attachment 1, Special Condition 2(h)(3): for evaluation of lateral flexion of ATD torso, is it correct to perform an photometric evaluation of the test shooting (for example, according to the picture below)?</p>		<p data-bbox="1323 876 1921 974">Additional camera views may be necessary to discern whether the torso flexion is forward or lateral.</p>

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	 <p>ES-2re ATD</p> <p>Pre-test      During test</p> <p>← FLIGHT DIRECTION</p> <p>Schematics of above picture.</p>		
3	Attachment 1, Special Condition 1 (c): we would like to have clarification about the wording “If a seat that does not have a homogeneous surface...”. We believe that	To change the wording of SC 1 (c) (Attachment 1)	This section will be revised to similar language that is in the policy statement ANM-03-115-30. The homogenous surface that the draft policy and issue paper should be addressing is the structure installed

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	<p>the previous wording for this item, present in the policy ANM-03-115-30 (Attachment 1, item 2 b): "...if a seat is installed aft of structure (e.g., an interior wall or furnishing) that does not have a homogeneous surface, an additional test(s) may be required to demonstrate that the injury criteria are met for the area which an occupant could contact..." is more correct.</p>		<p>forward of the seat (e.g., an interior wall or furnishing). The FAA has made this change in the text.</p>
<p><b>Commenter: Boeing</b></p>			
<p>1</p>	<p>Boeing Commercial Airplanes has reviewed the subject proposed policy and is fully supportive of it. We are very pleased with the development of these empirically-based pass/fail criteria for 90-degree side-facing seats, as proposed. Additionally, we appreciate the FAA's effort in developing this acceptable method of compliance with §25.785(b) and bringing it to publication.</p> <p>While we are satisfied with the proposed pass/fail criteria for 90-degree side-facing seats, we wish to encourage the FAA to continue this work to develop requirements for seats installed between 18-degrees and 90-degrees. Seats installed between 18- and 90-degrees have become more common in the industry. The current methods of compliance are based on</p>		<p>The FAA recognizes that Boeing supports this new policy statement.</p> <p>The request for the FAA to continue this work to develop requirements for seats installed at angles between 18 and 90 degrees will be considered outside of this policy statement.</p>

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	<p>individual evaluations of each installation and the development of aircraft-specific pass/fail criteria. Generalized pass/fail criteria would standardize this process and streamline the development of these 18- to 90-degree side-facing seats.</p>		
<b>Commenter: EASA</b>			
1	<p>Paragraphs 1 a) and b) are difficult to understand, both in terms of exactly what is and isn't acceptable and also in terms of why particular test conditions are proposed. For instance;</p> <p>is it required that all seat places must be subject to a test with a ES-2re ATD? ("All injury-assessment tests shall be conducted using an ES-2re ATD (49 CFR Part 572 Subpart U) or equivalent in <u>each</u> seat place being assessed.") If yes, why would data from a test in a particular seat place not be applicable to an identical second seat place?</p> <p>Hybrid II ATDs may be installed in seat places "forward" of the one being evaluated for occupant injury. Again, as above, if it is intended that each seat place have a test performed with a ES-2re ATD installed, why does the Hybrid II ATD usage allowance not also include places aft of that being tested?</p>	<p>The memo should be expanded to fully explain the rationale behind each of the technical/test requirements.</p>	<p>The intention is that each seat place be evaluated for injury by the ES-2re. If multiple ES-2re's are not available, then multiple tests could be run by using an H-2 forward of the ES-2re as a reaction surface. There is no need for an ATD aft of the ES-2re in injury-criteria tests.</p>
2	<p>The intent of paragraph 1) c) of</p>	<p>The paragraph should be modified to</p>	<p>This section will be revised to similar language that</p>

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	Attachment 1 is not clear.	require the assessment of every injurious surface/object that could be contacted by the occupant, regardless of the fact that it is installed on the seat or on its surrounding.	is in the policy statement ANM-03-115-30. The homogenous surface that the draft policy and issue paper should be addressing is the structure installed forward of the seat (e.g., an interior wall or furnishing).
3	For what concerns leg flailing, the term “design review” seems more appropriate than “by inspection” to demonstrate the effectiveness of the means of limiting leg flailing for all range of occupants.	Amend the Policy Statement accordingly.	The intent is to review the actual test video to ensure that the leg-flailing requirement is addressed. Therefore, we do not agree that, in all cases, “by inspection” would be adequate.
4	When assessing the impact of the occupant with other objects criteria to cover the range of occupants are provided. On the other hand, in the assessment of body-to-body contact it is not required to take into account the range of occupants.	The Memo should provide the background for this decision.	Body-to-body contact is directly assessed by test for the 50% male-size occupant. Support surfaces (including inflatable restraints) must provide that support in a consistent manner for all occupant statures. Therefore, if a support surface provides sufficient control of lateral failing to prevent body-to-body contact for a 50% occupant, and interacts with other occupant sizes in the same manner, then that surface should also provide some control over lateral flailing (and body-to-body contact) for those other-size occupants.
5	In paragraph 2) h) 2) of Attachment 1 the meaning of the expression “beyond the plane of the seat –back supporting surface” should be clarified. Does this mean the head is not allowed to travel forward of the most forward edge of the backrest? Does it mean the head cannot compress the Headrest/backrest cushion?	Please clarify the meaning of the expression “beyond the plane of the seat –back supporting surface”.	The FAA has deleted requirement 2(h)(2). Further analysis of test data indicates that for side-facing seats, the intent of requiring a seat back to sufficiently support the head and spine can be met by limiting neck loading to the limits cited in the proposed policy.
6	There is a typo in the third row at page 11		The FAA agrees and has made the change.

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	of the Memo. The leg injury criteria are specified in 25.562(c)(6) and not 25.562(b)(6).		
7	The Memo does not address seat belt buckle orientation on side-facing seats. The potential for inadvertent unbuckling of the belt during the deceleration pulse is higher for occupants of side-facing seats. The seat belt design and installation should be required to prevent unbuckling due to inadvertent impact with the hands/arms of the occupant during an emergency landing.	It is suggested that the Policy Statement covers this issue.	The FAA agrees with the comment. A requirement has been added to ensure that the latch will not become disengaged by inertial forces or occupant action during the test.