



AEROSPACE STANDARD

AS8049™**REV. D**Issued 1990-07
Revised 2020-11

Superseding AS8049C

Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft

RATIONALE

This Aerospace Standard requires modifications, clarifications, and additions to address current industry standards for aircraft and rotorcraft seats, including consideration of current regulatory standards and guidance applicable to these seats as an industry standard.

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1. SCOPE

1.1 General

This SAE Aerospace Standard (AS) defines minimum performance standards, qualification requirements, and minimum documentation requirements for passenger and crew seats in civil rotorcraft, transport aircraft, and general aviation aircraft. The goal is to achieve comfort, durability, and occupant protection under normal operational loads and to define test and evaluation criteria to demonstrate occupant protection when a seat/occupant/restraint system is subjected to statically applied ultimate loads and to dynamic impact test conditions set forth in Title 14, Code of Federal Regulations (14 CFR) parts 23, 25, 27, or 29 (as applicable to the seat type, see Table 1).

Guidance for test procedures, measurements, equipment, and interpretation of results is also presented to promote uniform techniques and to achieve acceptable data.

While this document addresses system performance, responsibility for the seating system is divided between the seat supplier and the installation applicant. The seat supplier's responsibility consists of meeting all the seat system performance requirements and obtaining and supplying to the installation applicant all the data prescribed by this document. The installation applicant has the ultimate system responsibility in assuring that all requirements for safe seat installation have been met.

1.2 Applicability

This document addresses the performance criteria for forward and rearward facing seat systems (0 degrees to 18 degrees relative to the aircraft longitudinal axis) requiring static and dynamic testing to be used in civil rotorcraft, transport aircraft, and general aviation aircraft. For Type A-T oblique facing passenger seats greater than 18 degrees and no greater than 45 degrees relative to the aircraft longitudinal axis, additional performance criteria are found in AS6316. For side facing seats, additional performance criteria are found in AS8049/1. Seat systems greater than 45 degrees and less than 80 degrees are not addressed in this document.

1.3 Seat Types

This document covers all passenger and crew seats for use in aircraft type-certificated in the following categories shown in Table 1:

Table 1 - Seat type categories

Seat Type	Aircraft Category	Applicable Federal Regulations
A-T	Transport Airplane	14 CFR part 25
B-N	Normal Rotorcraft	14 CFR part 27
B-T	Transport Rotorcraft	14 CFR part 29
C-N	General Aviation Aircraft - Normal	14 CFR part 23
C-U	General Aviation Aircraft - Utility	14 CFR part 23
C-A	General Aviation Aircraft - Acrobatic	14 CFR part 23
C-C	General Aviation Aircraft - Commuter	14 CFR part 23

1.4 Units

In this document, U.S. customary units (in-pound) and International System of Units (SI) are provided. In all cases, the in-pound units take precedence and the SI (metric) units provided are approximate and conservative conversions. Those who routinely use SI units in practice may make the conversions more precise.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

- 2.1.1 SAE J211/1 Instrumentation for Impact Test - Part 1 - Electronic Instrumentation
- 2.1.2 SAE J211/2 Instrumentation for Impact Test - Part 2: Photographic Instrumentation
- 2.1.3 ARP5482 Photometric Data Acquisition Procedures for Impact Test
- 2.1.4 ARP5526 Aircraft Seat Design Guidance and Clarifications
- 2.1.5 AS8049/1 Performance Standards for Side-Facing Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation Aircraft
- 2.1.6 Gowdy, V., DeWeese, R., Beebe, M., Wade, B. et al., "A Lumbar Spine Modification to the Hybrid III ATD For Aircraft Seat Tests," SAE Technical Paper 1999-01-1609, 1999, doi:10.4271/1999-01-1609.
- 2.1.7 ARP5475 Abuse Load Testing for In-Seat Deployable Video Systems
- 2.1.8 AS6316 Performance Standard for Oblique Facing Passenger Seats in Transport Aircraft
- 2.1.9 ARP6909 Methods for Determining the Seat Reference Point (SRP) and the Buttock Reference Point (BRP) for Seats in Transport Aircraft, Civil Rotorcraft, and General Aviation Aircraft
- 2.1.10 ARP5765 Analytical Methods for Aircraft Design and Evaluation

2.2 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

- 2.2.1 Code of Federal Regulations, Title 14 Part 21 (14 CFR 21) Certification Procedures for Products and Parts
- 2.2.2 Code of Federal Regulations, Title 14 Part 23 (14 CFR 23) Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes
- 2.2.3 Code of Federal Regulations, Title 14 Part 25 (14 CFR 25) Airworthiness Standards: Transport Category Airplanes
- 2.2.4 Code of Federal Regulations, Title 14 Part 27 (14 CFR 27) Airworthiness Standards: Normal Category Rotorcraft
- 2.2.5 Code of Federal Regulations, Title 14 Part 29 (14 CFR 29) Airworthiness Standards: Transport Category Rotorcraft

- 2.2.6 Code of Federal Regulations, Title 14 Part 121 (14 CFR 121) Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft
- 2.2.7 Code of Federal Regulations, Title 49 Part 572 (49 CFR 572) Anthropomorphic Test Devices

2.3 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

- 2.3.1 FAA Advisory Circular 23-2A Change 1, Flammability Tests (dated February 13, 2013)
- 2.3.2 FAA Advisory Circular 25.853-1, Flammability Requirements for Aircraft Seat Cushions (dated September 17, 1986)
- 2.3.3 FAA Policy Statement PS-ANM-25.853-01 R2, Flammability Testing of Interior Materials (dated July 3, 2013)
- 2.3.4 FAA Policy Statement ANM-115-07-002, Policy Statement on Certification for Flammability of Lightweight Seat Cushions (dated April 16, 2009)
- 2.3.5 FAA Advisory Circular 25.562-1 Change 1, Dynamic Evaluation of Seat Restraint Systems and Occupant Protection on Transport Airplanes (dated September 30, 2015)

2.4 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

- 2.4.1 DOT/FAA/AR-00/12 Aircraft Materials Fire Test Handbook

3. GENERAL DESIGN

The term seat reference point (SRP) is used throughout this document. Refer to ARP6909 for definition and acceptable methods for determining the SRP.

3.1 Guidance

[Intentionally left blank]

3.2 Requirements

This section provides requirements for a seat and restraint system design that are not described elsewhere in this document. The seat structure, cushions, and occupant restraint shall be considered to act as a total system. Any substitution of these elements shall be made only on the basis of additional tests or rational analysis based on test.

- 3.2.1 Seat systems shall be designed to provide occupant impact protection at seat adjustment positions, orientations, and locations allowed during takeoff and landing.
- 3.2.2 Seat elements shall be designed so that, when evaluated under the test conditions of this document, they do not generate hazardous projections that could significantly contribute to injury to occupants that are seated or moving about the airplane or that could impede rapid evacuation.
- 3.2.3 Quick-release type fittings, adjustment handles, and buttons shall be designed, installed, and protected such that their positions can be easily verified, and that incorrect installation or inadvertent activation is unlikely.
- 3.2.4 [Intentionally left blank]
- 3.2.5 Electrical or electronic devices incorporated in a seat shall be supplied with grounding.

- 3.2.6 Adjustable features (seat swivel, back recline, and stowage of movable tables, armrests, footrests, etc.) shall not deploy under the dynamic impact test conditions of this document in a manner that could significantly contribute to serious occupant injury or impede rapid egress of any aircraft occupant.
- 3.2.7 When an under-seat baggage restraint is incorporated in a passenger seat, it shall be designed to restrain at least 20 pounds (9.1 kg) or its placarded weight of stowed items per passenger place under the dynamic and static (forward and sideward directions only) test conditions of this document in a manner that will not significantly impede rapid egress from the seat.
- 3.2.8 [Intentionally left blank]
- 3.2.9 [Intentionally left blank]
- 3.2.10 Rearward-facing seats shall be designed with a back height sufficient to provide 36.5 inches (930 mm) of support for the occupant as measured from the SRP to the top of the seat back or headrest along the seat back tangent line with the seat in the position identified for taxi, takeoff and landing.
- If there is a gap between the bottom of the seat back and the SRP waterline with the seat in any adjusted position, it shall be no more than 4.0 inches (100 mm).
- If an adjustable headrest is incorporated into the seat back design, the evaluation of the back height shall be performed with the seat in the position identified for taxi, takeoff and landing with the headrest adjusted to its highest position.
- If a headrest separate from the seat is provided, a maximum gap of 4.0 inches (100 mm) may exist between the bottom of the headrest and the top of the seat back. However, the headrest must be appropriately sized and located to provide head support for the intended range of occupant size.
- 3.2.11 Seat track fitting locking devices shall readily indicate positive engagement and locking when installed in the aircraft environment (carpets, track covers, etc.).
- 3.2.12 The use of pure static friction between two or more flat or curved surfaces in direct contact as the sole means to restrain items of mass is not acceptable. Items restrained by mechanical fasteners such as screws, bolts, nuts, hook and loop fasteners, tape, hooks, springs, clamps, detents, rivets, etc., are not considered friction restrained items.
- 3.2.13 Seats equipped with foldup armrests shall incorporate means to preclude any armrest from extending beyond adjacent seat backs into any ingress/egress space behind the seat.
- 3.2.14 [Intentionally left blank]
- 3.2.15 Except for rearward facing seats and seats equipped with multiple anchorage point pelvic restraints (e.g., Y-belts), the pelvic restraint system shall be designed such that the vertical angle between the pelvic restraint centerline and the SRP waterline shall range from 35 to 55 degrees. The SRP waterline is a line/plane passing through the SRP parallel to the floor waterline. The pelvic restraint centerline is formed by a line from the pelvic restraint anchorage to a point located 9.75 inches (250 mm) forward of the SRP and 7.0 inches (180 mm) above the SRP waterline. In addition, the pelvic restraint anchorage point(s) must be located no further than 2.0 inches (51 mm) forward of the SRP.
- 3.2.16 All hinged armrest caps installed along an aisle must close as a result of normal movement of a person along the aisle. Caps must not snag clothing or present any other impediment to egress when contacted by a person moving in either direction along the aisle.
- 3.2.17 Safety belt restraint systems must be equipped with a metal-to-metal latching device.

- 3.2.18 Seat stowage compartments shall be designed to prevent the contents from becoming a hazard by shifting under the load conditions identified in Table 4A and 5.3.1. A placard must indicate the maximum weight of the contents allowed in each stowage compartment.
- 3.2.19 The SRP must be determined using only one of the methods described in ARP5526. The selected method shall be documented, and must be used consistently when evaluating all variations of the seat model or future changes to the seat model design.
- 3.2.20 Literature pockets shall be designed as part of the seat system for a minimum content weight of 3 pounds (1.36 kg) each.
- 3.2.21 The design and installation of the occupant restraint system shall prevent unbuckling or detachment due to applied inertial forces or impact of the occupant hands/arms during an emergency landing through impact and rebound.
- 3.2.22 Type A-T, C-N, C-U, C-A, and C-C passenger seats shall be designed to accommodate a range of occupants from a two year old child to a 99th percentile male in stature. Type B-N and B-T passenger seats shall be designed to accommodate a range of occupants from a 5th percentile female to a 95th percentile male in stature.
- 3.2.23 Restraint systems, including their attachments and webbing lengths, shall be adjustable to function properly to safely restrain the range of occupants defined in 3.2.22. Interior surroundings that are part of the restraint system shall also be sized to accommodate this range of occupants.
- 3.2.24 Type B-N and B-T seats shall have an upper torso restraint.

3.3 Materials and Workmanship Requirements

- 3.3.1 Materials must be suitable and durable for use in aircraft seats, as established by tests or experience, accounting for the effects of environmental conditions such as temperature and humidity expected in service.

The suitability and durability of all materials used for parts, the failure of which could adversely affect aircraft and occupant safety, must:

- a. Be established on the basis of experience or tests.
 - b. Meet specifications that the parts have the strength and other properties assumed in the design data. Suitable specifications are:
 - 1. Industry approved specifications.
 - 2. Military approved specifications.
 - 3. Specifications approved under the seat manufacturer's Quality Management System.
 - c. Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.
- 3.3.2 The methods and processes of fabrication and assembly used must produce consistently sound structure. If a fabrication process requires close control to reach this objective, the process must be performed in accordance with a process specification. Suitable specifications are:
 - a. Industry approved specifications.
 - b. Military approved specifications.
 - c. Specifications approved under the seat manufacturer's Quality Management System.

3.3.3 Magnesium alloys may be used in aircraft seat construction provided they are tested to and meet the flammability performance requirements in the FAA Fire Safety Branch document: Aircraft Materials Fire Test Handbook - DOT/FAA/AR-00/12, Chapter 25, Oil Burner Flammability Test for Magnesium Alloy Seat Structure.

3.3.4 Each part of the structure must be protected against deterioration or loss of strength in service due to any cause and have provisions for ventilation and drainage where necessary for protection.

3.4 Fire Protection Requirements

NOTE: Inflatable airbag material is not required to meet the requirements of 3.4.1. Inflatable airbag material shall meet the requirement of 3.4.7.

3.4.1 All materials used on Type A-T and Type B-T seats shall meet the fire protection requirements of 14 CFR Part 25, Appendix F, Part 1 (Amendment 25-111), except where material properties, size and quantity would not create or propagate a cabin fire on or around the seat. The material's fire protection properties may also be demonstrated by following FAA Policy Statement PS-ANM-25.853-01 R2, Flammability Testing of Interior Materials (dated July 3, 2013).

All materials used on Type B-N, Type C-N, Type C-U, and Type C-A seats shall have flame-resistant properties. The materials shall be tested to and shall meet the requirements of paragraph 8.b of FAA Advisory Circular (AC) 23-2A Change 1, Flammability Tests (dated February 13, 2013).

All materials used on Type C-C seats shall be tested to the fire protection requirements of 14 CFR Part 23, Appendix F, Part 1 (Amendment 23-62) and shall meet the flammability performance requirements defined in 14 CFR 23.853(d)(3) (Amendment 23-62), except where material properties, size, and quantity would not create or propagate a cabin fire on or around the seat.

3.4.2 Cushion systems on Type A-T and Type B-T passenger, flight attendant and observer seats shall meet the fire protection requirements of 14 CFR Part 25, Appendix F, Part 2 (Amendment 25-111). The material's fire protection properties may also be demonstrated by following FAA AC 25.853-1, Flammability Requirements for Aircraft Seat Cushions (dated September 17, 1986) and, where applicable, FAA Policy Statement ANM-115-07-002, Policy Statement on Certification for Flammability of Lightweight Seat Cushions (dated April 16, 2009).

3.4.3 Insulation on electrical wire and cable on all Type A, Type B and Type C seats shall meet the fire protection requirements of 14 CFR Part 25, Appendix F, Part 1(a)(3) (Amendment 25-111).

3.4.4 If ashtrays are installed in or attached to the seat, they shall be self-contained, completely removable types. The ashtray housing shall be fire resistant and sealed to prevent burning materials from falling into seat structure in case the ashtray is missing. Ashtrays in folding armrests shall be designed to preclude release of burning material when the armrest is folded with or without the ashtray lid closed.

3.4.5 Electrical components in a seat shall have provisions to preclude initiation of a fire from overheating.

3.4.6 If oxygen generators are incorporated into a seat, provisions shall be made to preclude damage to the seat, including initiation of a fire due to the heat produced by the generator. The adequacy of the design shall be demonstrated.

3.4.7 Inflatable airbag material shall not have an average burn rate of greater than 2.5 inches/minute when tested using the horizontal flammability test defined in Part 25, Appendix F, Part I, Paragraph (b)(5).

3.5 Allowable Permanent Deformations

Seat permanent deformations for each tested seat shall be measured at all critical locations with regard to egress after static and dynamic tests. Measuring points, as described in the following subparagraphs, shall be identified and marked on the test seat, and their positions measured in the lateral, vertical, and longitudinal directions relative to fixed points on the test fixture. The following sub-paragraphs describe the minimum deformations required; however, complex seats may require many more measuring points to define their deformed envelope. These measurements shall be recorded before and after the tests. The difference between the pretest and posttest measurements shall be recorded and reported as permanent deformations.

It is assumed that the maximum seat deformation will result from the structural evaluation except for seat back deformations which are usually critical in a row-to-row HIC test. Once accomplished, it is not necessary to repeat deformation measurements for the injury criteria (e.g., multiple row) tests, unless the structural and injury criteria tests were combined into one test.

For dynamic tests, if floor deformations are applicable, consistency in pretest and posttest measurements shall be maintained. If the pretest measurements are made before floor deformations are applied, the posttest measurements shall be made after floor deformations have been removed. Conversely, if the pretest measurements are made after floor deformations are applied, the posttest measurements shall be made before removal of floor deformations.

3.5.1 Longitudinal Direction

The longitudinal measurement in the forward direction shall be made at the forward-most hard point of the seat.

Depending on the seat design, the forward-most hard point post-test may not be the forward-most hard point pre-test and multiple points may need to be measured.

If the seat exhibits longitudinal deformation in the aft direction, the maximum rearward longitudinal measurement shall be made at the aftmost point(s) of the seat and at a point where clearance with an exit path, or an undeformed seat behind is at a minimum.

If Test 1 is conducted using a horizontal (acceleration or deceleration) test facility, the required angle of the test setup to produce the load condition imposes a load on the seat back and that load is not representative of the Test 1 load condition. In this case, measurement of aft deformation on the seat back is not meaningful and is not required. If Test 1 is conducted using a vertical test facility (drop tower), deformation measurements on the seat back are meaningful and shall be recorded and reported. The Test 1 load condition is defined in 5.3.1.1.

3.5.2 Downward Direction

There is no limitation on downward permanent deformation provided it can be demonstrated that the feet or legs of occupants will not be injured or entrapped by the deformation, and that adequate clearance for that deformation can be assured by the seat design, with full consideration of the potential presence of under seat baggage or stowed items.

3.5.3 Seat Rotation

The seat bottom rotational permanent deformation shall not result in an angle that exceeds 20 degrees pitch down or 35 degrees pitch up from the horizontal plane. This rotational deformation shall be measured between the fore and aft extremities of the seat pan at the centerline of each seat bottom (Figure 1A). Rotation of the seat pan shall not cause entrapment of the occupant.

3.5.4 Sideward Direction

The maximum sideward permanent deformations towards an aisle shall be measured for heights below 25 inches (635 mm) above the floor and for heights 25 inches (635 mm) or more above the floor. The determination of which parts of the seat are at what heights is made prior to testing and before applying floor deformation.

3.5.5 Other Deformation Limits

The most forward surface of a seat back centerline must not deform to a distance greater than one half the original distance to the forward-most hard structure on the seat that supports the seat bottom cushion (see Figure 1B). The posttest measurement may be made with the seat back returned to its pretest upright or structurally deformed position using no more than a 35-pound (155-N) force applied at the centerline of the top of the seat back.

3.5.6 Stowable Seats

A stowable seat (manual or automatic) installed near exits or in exit paths must stow posttest and remain stowed without interfering with the exits or exit paths. The permanent deformation shall not exceed 1.5 inches (40 mm) from the pretest upright position. For seats that are stowed manually, a posttest stowage force not to exceed 10 pounds (45 N) per seat place above the original stowage force may be used to stow the seat prior to measurement of permanent deformation. For seats that stow automatically, a posttest stowage force no greater than 10 pounds (45 N) per seat place, applied at the centerline of the seat back (or seat pan if appropriate), may be used to assist with automatic retraction prior to the calculation of permanent deformation.

3.5.7 Deployable Items

3.5.7.1 General

Seats may be equipped with items that may be deployed in flight for passenger use and are typically required to be stowed for taxi, takeoff and landing (such as, food tray tables, leg rests, arm caps over in-arm tray tables, deployable video monitors, cup holders, personal electronic device holders, etc.).

Deployment of such items during testing defined in this document shall be reported as permanent deformation. If the item partially deploys, a load of 10 pounds (45 N) shall be applied in the inertial load direction of the test to further deploy the item before the deformation measurement is made. If normal passenger movement returns the item to its original position and it remains in that position, the deployment does not need to be reported as permanent deformation. If the item does not return to its original position, then the final position will be recorded and reported as permanent deformation.

Normal passenger movement is the act of the seated occupant getting up out of the seat and moving to egress the airplane (i.e., unbuckling their restraint, standing, turning towards the aisle and moving into the aisle). It does not include additional movements to stow or latch an item in place.

3.5.7.2 Seat Back Food Tray Tables

In row-to-row HIC tests, the primary objective is to evaluate occupant head injury. Seat back food tray table deployment is secondary to that objective. The deployment of the seat back food tray table is adequately evaluated during the structural tests (with the exception noted below). In the event that the seat back food tray table deploys, the following requirements are applicable:

3.5.7.2.1 Seats Forward of an Exit Path or Passageway

For seats forward of an exit path or passageway, any seat back food tray table deployment, including those caused by the ATD head strikes, shall be treated as permanent deformation.

3.5.7.2.2 All Other Seats

For other seats, if the seat back food tray table deploys as a result of the ATD head striking the seat back or tray table during a row-to-row HIC test, the deployment is acceptable and does not need to be considered as permanent deformation. The food tray table shall be easily pushed out of the way but is not required to remain in that position. In this situation, "easily pushed out of the way" is not required to be by normal passenger movement.

If the seat back food tray table deploys as a result of the ATD head striking the seat back or tray table during the test and the food tray table is not easily pushed out of the way, the deployment shall be reported as permanent deformation per 3.5.7.1.

If the seat back food tray table deploys, not as a result of the ATD head striking the seat back or tray table, the deployment shall be reported as permanent deformation per 3.5.7.1.

Determination of the seat back food tray deploying as a result of the ATD head striking the seat back or tray table during the test shall be made by review of the high-speed film/video.

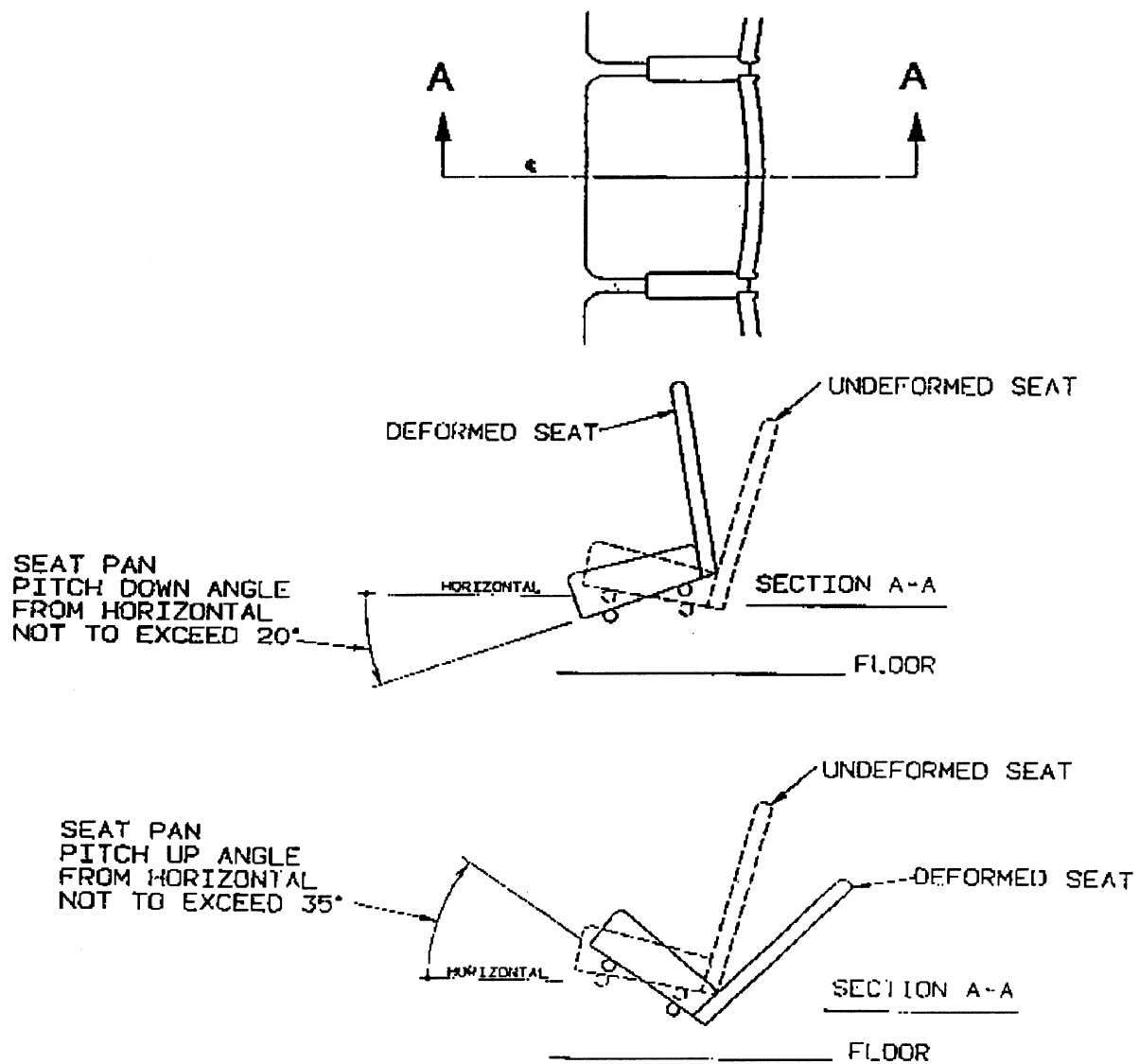
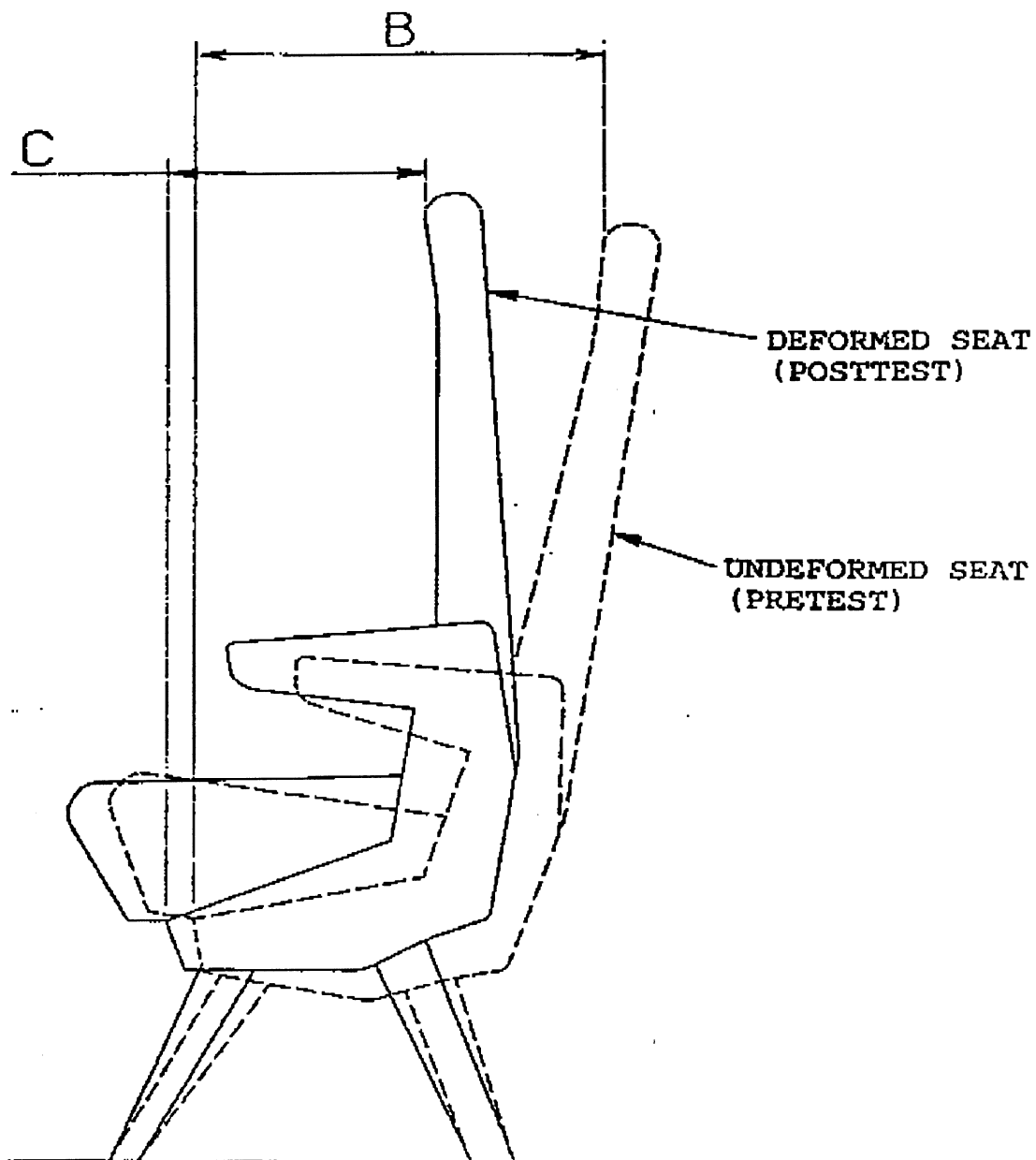


Figure 1A - Maximum posttest seat pan rotation



DIMENSION "C" MUST BE
AT LEAST 50% OF DIMENSION "B"

Figure 1B - Maximum seat back permanent deformation
(NOTE: Applicable for forward facing seats only)

4. STRENGTH

All seats qualified for occupancy during taxi, takeoff and landing shall be capable of withstanding, within the criteria defined below, both statically and dynamically applied loading.

4.1 Static Strength

Seats shall be designed to withstand the ultimate loads determined by using the load factors specified in Table 4A. Forces representing the sum of each occupant weight specified in Table 4A, plus the complete seat weight (including all trim and accessories), plus the total weight of any item of mass restrained by the seat (e.g., under-seat baggage, stowage compartment weight plus weight of contents, literature pocket content weight, etc.), all multiplied by the appropriate load factor from Table 4A, shall be applied to the seat (see 5.1.7 and 5.1.9). The forward, side, down, up, and aft loads shall be applied separately for at least 3 seconds without failure. Static strength shall be demonstrated under all variations of seat occupancy and positions that produce critical loading of any structural member. Ultimate loads need only be applied for allowed takeoff and landing positions.

For ultimate load conditions, the strength of fittings (a part or terminal used to join one structural member to another) in the seat and occupant restraint shall be 1.15 (if demonstrated by analysis) or 1.0 (if demonstrated by test) times the ultimate load factors specified in Table 4A, except as specified in 4.1.3 for seat attachments and occupant restraint attachments.

For flight and ground load conditions, the strength of the seat attachments to the aircraft structure and the occupant restraint attachments to the seat or aircraft structure shall be 1.15 (if demonstrated by analysis) or 1.0 (if demonstrated by test) times the airplane model specific flight and ground loads.

If a part requires more than one special factor, the highest applicable factor shall be used and not a combination of the applicable factors.

For Type A-T seats:

The seat structure, occupant restraints and their attachments must withstand the 4.0 g ultimate sideward load factor specified in Table 4A. For the seat attachments to the aircraft structure and the occupant restraint attachments to the seat or aircraft structure, the 1.33 fitting factor required in 4.1.3 is already included in the 4.0 g sideward load factor.

Any special factors (1.15 fitting factor, bearing, casting, etc.) applicable to seat structure and occupant restraint parts shall have that factor applied to the ultimate 4.0 g sideward load factor, and all other load factors specified in Table 4A (see next paragraph for seat and occupant restraint attachments).

The minimum sideward load factor applied to the seat attachments and occupant restraint attachments shall be 4.0 g. Any special factors (bearing, casting, etc.) that exceed the 1.33 fitting factor applicable to the seat attachments and occupant restraint attachments shall have that factor applied to the ultimate 4.0 g sideward load factor divided by 1.33, and all other load factors specified in Table 4A.

4.1.1 Pilot and Copilot Loads

Pilot and copilot seats shall be capable of withstanding an ultimate rearward load of 1000 pounds (4.45 kN) applied 8 inches (200 mm) above the SRP to provide for the application of pilot forces to the flight controls. Consideration must be given to any seat adjustment position or configuration that the pilot may use while controlling the aircraft.

4.1.2 Limit Loads

All seat systems shall be capable of withstanding aircraft specific limit loads without any detrimental permanent deformations. Pilot and copilot seats shall be capable of withstanding a limit rearward load of 667 pounds (3 kN) rearward limit load applied 8 inches (200 mm) above the SRP without any detrimental permanent deformation.

4.1.3 Seat and Occupant Restraint Attachments

The strength of the seat attachments to the aircraft structure and the occupant restraint attachments to the seat or aircraft structure shall be 1.33 times the ultimate loads specified in Table 4A (except as noted for Type A-T seat sideward). This requirement only applies to seats in their position(s) for taxi, takeoff, and landing.

4.1.4 Casting Factors

If castings are used in the construction of the seat or occupant restraint, the castings shall have a casting factor and related inspection requirements in accordance with Table 4B (Type A-T seats) or Table 4C (All Type B and C seats). If a fitting in the seat or occupant restraint is or contains a casting, the casting shall be substantiated to the higher of the casting factor, the 1.33 fitting factor for ultimate load conditions or the 1.15 factor for ground or flight loads, but not the combination of factors.

A casting factor must be applied to all load carrying cast structural parts. These castings can be classified as critical or noncritical as defined below, and must have the appropriate casting factor applied based on the inspection/test requirements defined for that part.

Critical castings are load carrying structural parts in the load path from the occupant to the seat attachment to the airplane, including occupant restraint hardware. Critical castings are also parts whose failure would result in uncontrolled seat motion, or would result in a seat becoming jammed in a position that impedes egress, interferes with the operation of the aircraft or prevents the seat from returning to the taxi, takeoff and landing position.

Noncritical castings are load carrying structural parts that carry load from the occupant not associated with the load path from the occupant to the seat attachment to the airplane or an item of mass retained by the seat. Such a part could be a cast part in the underseat baggage restraint or a cast part retaining an item of mass.

The orientation of the seat (forward facing, aft facing, side facing, oblique facing) or the type of occupant restraint system (lap belt only, three-point restraint, four-point restraint, etc.) must be taken into consideration as to whether the load carrying structural part is in the load path from the occupant to the seat attachment to the airplane.

Nonstructural castings are lightweight parts that only carry their own inertia load. Such parts must weigh less than 0.33 pound (0.15 kg). No casting factor need be applied to these parts.

4.1.5 Headrest Loads (Rearward Facing Seats)

When a headrest is used on a rearward facing seat, the headrest shall not deflect through an angular displacement of more than 25 degrees with respect to the backrest angle at maximum applied load. The load shall be applied through the center of gravity of the headrest for 3 seconds. The load shall be applied to the headrest in its fully extended position. The load may be applied to the headrest as part of a complete seat or to the headrest with the seat back rigidly mounted in a fixture.

The applied load is calculated by multiplying the combined weight of the head and headrest and the applicable aircraft forward load factor in Table 4A. The weight of the head shall be 13 pounds (5.9 kg), and the weight of the headrest shall include all components up to the structural interface with the seat back. The headrest load for all Type B seats shall also include a 1.33 fitting factor. The minimum applied load for Type A-T and all Type C seats shall be 200 pounds (890 N).

The weight of a headrest that is integral or a continuation of the backrest structure shall include the portion of the backrest that is 25.5 inches (648 mm) above the SRP. For these headrests, the load shall be applied 34 inches (864 mm) above the SRP or the headrest center of gravity, whichever is greater.

Table 4A - Ultimate load factors and occupant weight

		Type A-T Seat	Type B-N Seat Type B-T Seat	Type C-N Seat	Type C-U Seat	Type C-C Seat	Type C-A Seat
		Airplane (Transport Category)	Rotorcraft (Normal and Transport Category)	General Aviation (Normal Category)	General Aviation (Utility Category)	General Aviation (Commuter Category)	General Aviation (Acrobatic Category)
		Factor	Factor	Factor	Factor	Factor	Factor
Load Factors (Load Direction Relative to Aircraft)	Forward	9.0	16.0	9.0 ⁽⁴⁾	9.0 ⁽⁴⁾	9.0 ⁽⁴⁾	9.0 ⁽⁴⁾
	Sideward	4.0 ⁽¹⁾⁽²⁾	8.0 ⁽²⁾	1.5 ⁽²⁾⁽⁴⁾	1.5 ⁽²⁾⁽⁴⁾	1.5 ⁽²⁾⁽⁴⁾	1.5 ⁽²⁾⁽⁴⁾
	Upward	3.0 ⁽²⁾	4.0 ⁽²⁾	3.0 ⁽²⁾⁽⁴⁾	3.0 ⁽²⁾⁽⁴⁾	3.0 ⁽²⁾⁽⁴⁾	4.5 ⁽²⁾⁽⁴⁾
	Downward	6.0 ⁽²⁾	20.0 ⁽²⁾⁽³⁾	3.0 ⁽²⁾⁽⁴⁾	3.0 ⁽²⁾⁽⁴⁾	6.0 ⁽²⁾⁽⁴⁾	3.0 ⁽²⁾⁽⁴⁾
	Aftward	1.5	1.5	N/A	N/A	N/A	N/A
Occupant Weight		170 pounds (77 kg)	170 pounds (77 kg)	170 pounds (77kg) ⁽⁵⁾	190 pounds (86 kg) ⁽⁵⁾⁽⁶⁾	170 pounds (77 kg) ⁽⁵⁾	190 pounds (86 kg) ⁽⁵⁾⁽⁶⁾

⁽¹⁾ The 1.33 fitting factor does not need to be applied to the 4.0 g sideward load factor (see 4.1).

⁽²⁾ Increase these load factors as necessary for airplane model specific flight and ground loads. All seat adjustment positions and occupancy variations, including those used in flight, must be evaluated when using these increased load factors.

⁽³⁾ Load to be applied after stroking of the seat energy absorbing system.

⁽⁴⁾ For Type C seats, load factors may need to be increased according to 14 CFR 23.562(d).

⁽⁵⁾ For airplane specific flight and ground loads as defined in the approved operating envelope of the airplane, an occupant weight of 215 pounds (98 kg) shall be used. The strength of the seat attachments to the aircraft structure and the occupant restraint attachments to the seat or aircraft structure shall be 1.33 times these flight and ground loads.

⁽⁶⁾ The 190-pound occupant weight includes allowance for the weight of a parachute.

Table 4B - Casting inspection/test requirements for type A-T seats

Classification	Casting Factor	Inspection Requirements	Test Requirements
Critical Casting	1.50 or greater	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽²⁾ and 3) Inspection of structurally significant areas and areas where defects are likely to occur using radiographic inspection methods. ⁽²⁾	One casting undergoes a static test and is shown to: 1) Support 1.50 times the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support 1.15 times the limit load (see 4.1.2) without detrimental permanent deformation.
	1.25 to 1.50	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽²⁾ and 3) Inspection of structurally significant areas and areas where defects are likely to occur using radiographic inspection methods. ⁽²⁾	Three castings undergo static tests and are shown to: 1) Support 1.25 times the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support 1.15 times the limit load (see 4.1.2) without detrimental permanent deformation.
	1.0 to 1.25	See Note 4 below for specific process requirements. Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽²⁾ and 3) Inspection of structurally significant areas and areas where defects are likely to occur using radiographic inspection methods. ⁽²⁾	One casting undergoes a static test and is shown to: 1) Support the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support the limit load (see 4.1.2) without detrimental permanent deformation.
Noncritical Casting	2.0 or greater	Each casting receives inspection of 100% of its surface using visual inspection methods.	None.
	1.50 to 2.0	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials). ⁽²⁾⁽³⁾	None.
	1.25 to 1.50	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽²⁾⁽³⁾ and 3) Inspection of structurally significant areas and areas where defects are likely to occur using radiographic inspection methods. ⁽²⁾⁽³⁾	None.
	1.0 to 1.25 ⁽¹⁾	See Note 5 below for specific process requirements. Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽²⁾ and 3) Inspection of structurally significant areas and areas where defects are likely to occur using radiographic inspection methods. ⁽²⁾	Three castings undergo static tests and are shown to: 1) Support the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support limit loads (see 4.1.2) without detrimental permanent deformation.
Nonstructural Casting	Not Required	None.	None.

⁽¹⁾ Alternatively, the requirements for a critical casting with a casting factor of 1.0 or greater are met.

⁽²⁾ Or equivalent inspection method.

⁽³⁾ The number of castings per production batch to be inspected by nonvisual methods may be reduced when an approved quality control procedure is established.

⁽⁴⁾ It must be demonstrated, in the form of process qualification, proof of product, and process monitoring that, for each casting design and part number, the castings produced by each foundry and process combination have coefficients of variation of the material properties that are equivalent to those of wrought alloy products of similar composition. Process monitoring must include testing of coupons cut from the prolongations of each casting (or each set of castings, if produced from a single pour into a single mold in a runner system) and, on a sampling basis, coupons cut from critical areas of production castings. The acceptance criteria for the process monitoring inspections and tests must be established and included in the process specifications to ensure the properties of the production castings are controlled to within levels used in design.

⁽⁵⁾ Castings are manufactured to approved specifications that specify the minimum mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis.

Table 4C - Casting inspection/test requirements for all type B and type C seats

Classification	Casting Factor	Inspection Requirements	Test Requirements
Critical Casting	2.0 or greater ⁽¹⁾	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of the part using approved nondestructive inspection. ⁽²⁾	None.
	1.50 to 2.0	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽³⁾ and 3) Inspection of 100% of the part using radiographic inspection methods. ⁽³⁾	None.
	1.25 to 1.50	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽³⁾ and 3) Inspection of 100% of the part using radiographic inspection methods. ⁽³⁾	Three castings undergo static tests and are shown to: 1) Support 1.25 times the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support 1.15 times the limit load (see 4.1.2) without detrimental permanent deformation.
Noncritical Casting	2.0 or greater	Each casting receives inspection of 100% of its surface using visual inspection methods.	None.
	1.50 to 2.0	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽³⁾⁽⁴⁾	None.
	1.25 to 1.50	Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽³⁾⁽⁴⁾ and 3) Inspection of 100% of the part using radiographic inspection methods. ⁽³⁾⁽⁴⁾	None.
	1.0 to 1.25	See Note 5 below for specific process requirements. Each casting receives: 1) Inspection of 100% of its surface using visual inspection methods, and 2) Inspection of 100% of its surface using penetrant inspection methods (non-ferromagnetic materials) or magnetic particle inspection methods (ferromagnetic materials), ⁽³⁾⁽⁴⁾ and 3) Inspection of 100% of the part using radiographic inspection methods. ⁽³⁾⁽⁴⁾	Three castings undergo static tests and are shown to: 1) Support the ultimate loads in Table 4A without failure for 3 seconds, and 2) Support limit loads (see 4.1.2) without detrimental permanent deformation.
Nonstructural Casting	Not Required	None.	None.

⁽¹⁾ Applicable only to Type C-N, Type C-U, Type C-C, and Type C-A seats.

⁽²⁾ When an approved quality control procedure is established and an acceptable statistical analysis supports reduction, nondestructive inspection may be reduced from 100% and applied on a sampling basis.

⁽³⁾ Or equivalent inspection method.

⁽⁴⁾ The number of castings inspected by nonvisual methods may be reduced below that specified when an approved quality control procedure is established.

⁽⁵⁾ Castings must be procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis.

4.2 Dynamic Strength/Occupant Protection

The seat structure, cushions, and occupant restraint, as a system, shall be designed to withstand the dynamic impact load conditions prescribed in 5.3 and meet the pass/fail criteria of 5.4.

5. SEAT QUALIFICATION

Initial static qualification of a seat shall be performed by static tests. Initial dynamic qualification of the seat shall be performed by dynamic tests or by the use of computer modeling techniques that are validated by dynamic test in accordance with ARP5765. Subsequent qualifications related to design changes to seats of a similar design may be performed by rational analysis based on existing qualification test or computer modeling data.

5.1 Static Qualification Tests

- 5.1.1 The test seat shall be complete to the extent that the primary structure, the occupant restraint system, and the seat attachment fittings to the aircraft are accurately represented. Items that are not part of the seat primary structure, the omission of which will not alter the test and pass/fail criteria, may be excluded from the test article, but their weight must be included when determining the static loads.
- 5.1.2 A body block shall be installed in each occupant place that will be loaded and shall be restrained by the occupant restraint. The body blocks shown in Figures 2, 3, 4A, and 4B are satisfactory for static test purposes. They may be refined or modified if desired; however, the resultant load application point for each static test shall comply with 5.1.6 (Table 5).
- 5.1.3 For the application of down loads, representative distributed loading of the seat pan (as opposed to loading rigid boundary members) must be achieved.
- 5.1.4 The body block shall be placed either on the actual bottom cushion or on a non-rigid foam block representative of the bottom cushion. The back cushion or a non-rigid foam block representing the back cushion shall be in place.
- 5.1.5 Forward loads on seat backs of rearward-facing seats and rearward loads on seat backs of forward-facing seats shall be applied by a body block as shown in Figure 2, or by a rigid block with the same back dimensions. The back cushion or an equivalent non-rigid foam block shall be placed between the body block and the back structure to distribute the load over the seat back rather than just the rigid boundary structure.

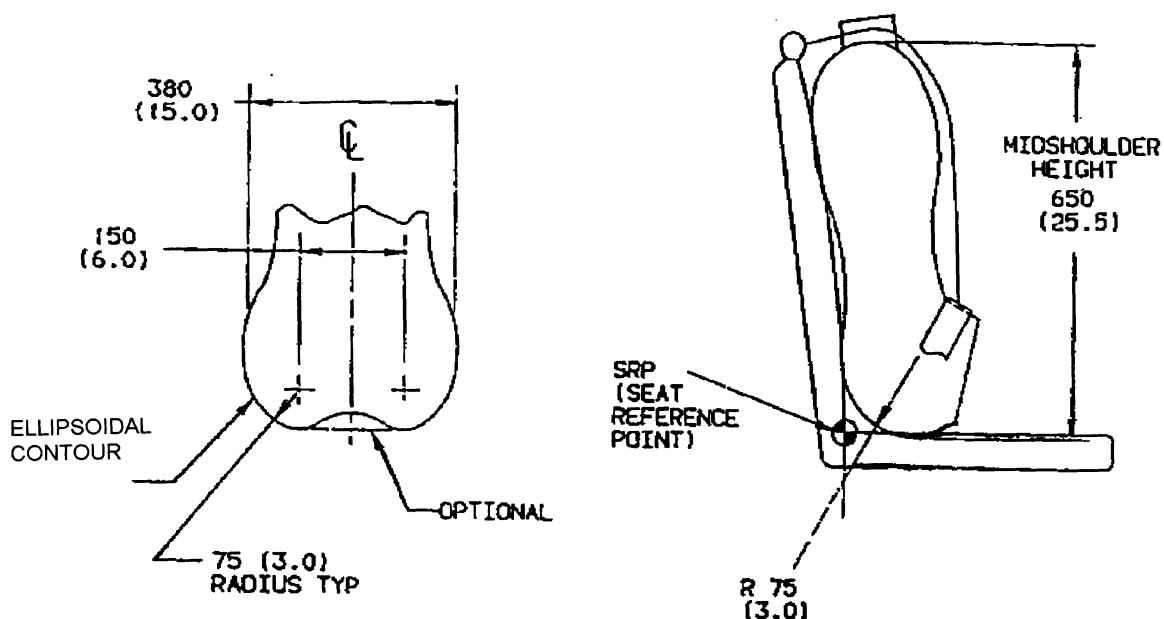


Figure 2 - Optional body block for static testing

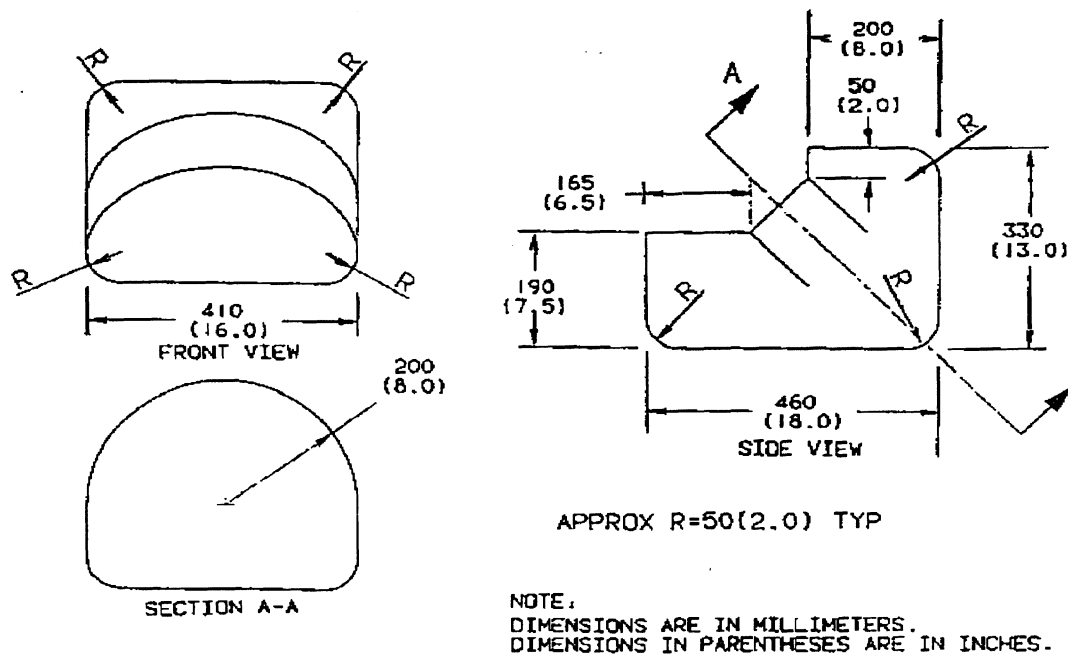


Figure 3 - Optional body block for static testing

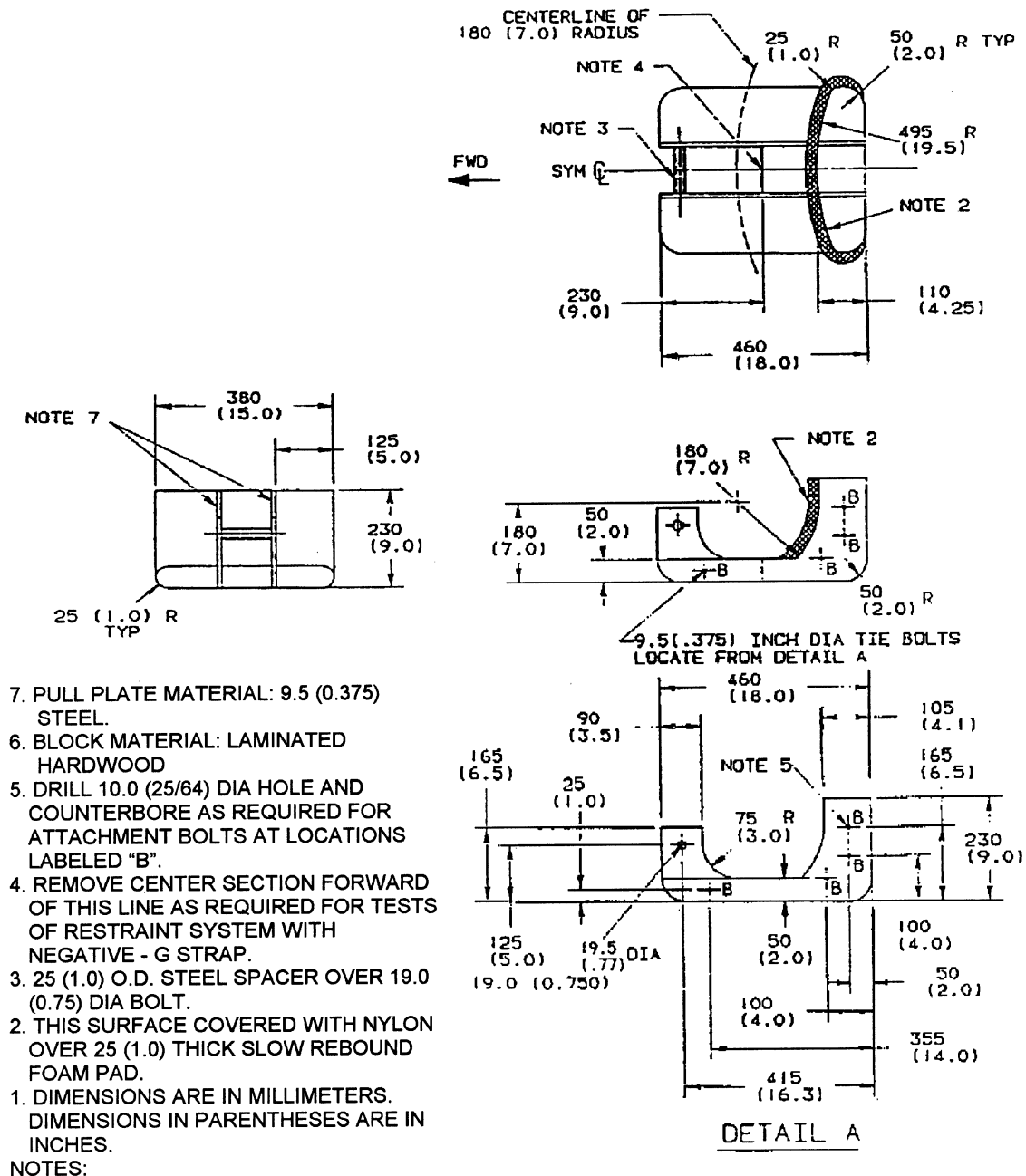


Figure 4A - Lower torso block