APTA STANDARDS PROGRAM

STANDARD

APTA PR-CS-S-011-99, Rev. 2

First Published: March 17, 1999

First Revision: March 22, 2004

Second Revision: April 24, 2024

PRESS Construction and Structural Working Group

Cab Crew Seating Safety Requirements

Abstract: This standard contains requirements for the strength, crashworthiness and fire safety of fixed cab crew seating for use in passenger rail locomotives and cab cars.

Keywords: cab car, crew seats, locomotive, rail

Summary: This standard specifies minimum strength, crashworthiness and fire safety requirements for fixed crew seats in the operator's compartment of a locomotive or cab car. This standard describes the test conditions and performance requirements necessary to demonstrate compliance. This standard becomes effective on the date of authorization stated on the title page.

Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and will use the same approach for its continued maintenance, which is detailed in the manual for the APTA Standards Program. This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the Construction and Structural as directed by Passenger Rail Equipment Safety Standards (PRESS).

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. APTA standards are mandatory to the extent incorporated by an applicable statute or regulation. In some cases, federal and/or state regulations govern portions of a transit system's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This document supersedes APTA PR-CS-S-011-99, Rev. 1, which has been revised. Below is a summary of changes from the previous document version:

- Moved requirements unrelated to seat operational loads, attachment strength, or smoke and flammability (i.e., design features, maintainability, and durability) to an informative appendix for reference only.
- Clarified seat attachment strength requirements related to testing and analysis.
- Clarified load application for operational load tests, with some modifications consistent with passenger seat standard.
- Clarified smoke and flammability requirements consistent with 49 CFR Part 238.103.
- Deleted reference to archived standard AAR-RP-5104 Locomotive Cab Seats.
- Reformatted according to current APTA standards.

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Introduction

This introduction is not part of APTA PR-CS-S-011-99, "Cab Crew Seating Safety Requirements."

This standard applies to all:

1. Railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
2. Railroads that provide commuter or other short-haul rail passenger train service in a metropolitan or suburban area, including public authorities operating passenger train service.

This standard does not apply to:

1. Rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
2. Tourist, scenic, historic or excursion operations, whether on or off the general railroad system of transportation;
3. Operation of private cars, including business/office cars and circus trains; or
4. Railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

Scope and purpose

This standard applies to fixed seats provided for crew members in control cabs of passenger railroad revenue service locomotives and cab cars in all new car procurements, retrofits and refurbishments. The purpose of this standard is to define seat strength, crashworthiness and fire safety performance requirements to establish a minimum level of safety for passenger train operators. This standard also defines the testing and/or analysis necessary to comply with the requirements of 49 CFR 238.233.

Cab Crew Seating Safety Requirements

1. Applicability

This standard defines minimum strength, crashworthiness and fire safety requirements for fixed crew seats installed in passenger locomotives and cab car cabs that are part of the general railroad system of transportation. This standard does not apply to flip-down seats in passenger locomotive or cab car cabs. This safety standard applies to new procurements, retrofits and refurbishments of fixed crew seats for passenger locomotives and cab cars. It describes the tests and seat performance requirements necessary to demonstrate compliance with this standard.

The requirements in this standard are derived in part from the Code of Federal Regulations (CFR) Title 49, Part 238, Section 233. Seat strength requirements are derived from APTA PR-CS-S-016.

2. Seat requirements

2.1 General

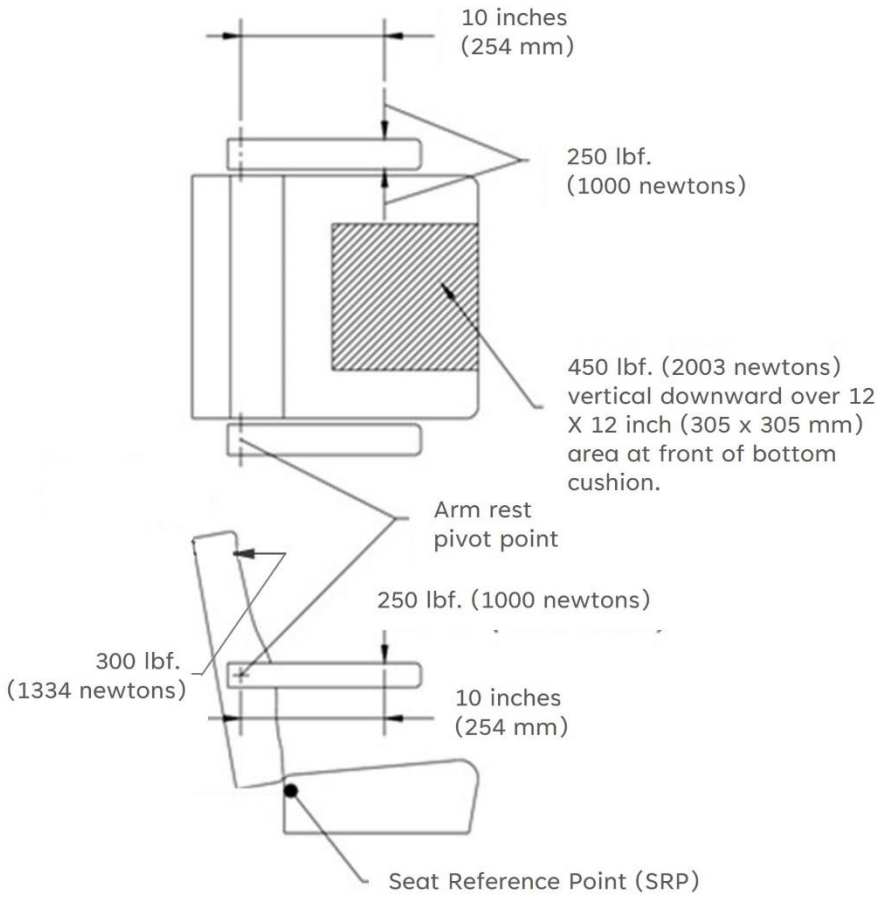
The seat shall be tested and/or analyzed as described in this section to demonstrate that it meets or exceeds the static and dynamic load conditions as given in sections 2.2 and 2.3. Seats tested shall be representative of actual production seats. Testing shall be done with the seat adjusted to the configuration(s) that produce the maximum stresses on the seat structure and mechanisms.

The static and dynamic testing shall be performed with a test setup duplicating as closely as possible the attachment of the production seat assembly. The seat assembly may be mounted to a simulated car body structure or rigid test fixture, as agreed to by the purchaser and seat manufacturer.

2.2 Operational load requirements

The seat shall be subjected to each of the individually applied static loads listed below and as shown in **Figure 1**. In each case, there shall be no significant permanent yielding or fracture of any structural material during the testing. Prior to static testing, it is permissible to apply and remove a 100 percent preload to relieve any manufacturing pre-stresses that may be present. All loads shall be applied and held for a minimum time of 5 seconds. A maximum of ⅛ in. (3 mm) permanent deflection is allowed for each load case. All adjustment mechanisms shall remain operable subsequent to testing. Measurements for permanent deflection shall be made after testing relative to an undeformed point located at the seat mounting.

FIGURE 1
Static Load Tests



2.2.1 Bottom cushion static load test

A vertical downward load of 450 lbf (2003 N) shall be applied uniformly over a 12 × 12 in. [305 × 305 mm] area located at the front center of the bottom cushion.

2.2.2 Back rest static load test

A horizontal load of 300 lbf (1334 N) in the aft direction shall be applied uniformly to the upper part of the seat back at an elevation of 36 in. (914 mm) above the floor, or 3 in. (76 mm) below the top of the seat back, whichever is lower. Reclining seats shall be in the full upright position. A fixture may be used to distribute the load across the seat back.

2.2.3 Armrest vertical load tests

A vertical downward load of 250 lbf (1000 N) shall be uniformly applied on each armrest with the center of the contact area located 10 in. (254 mm) from the pivot point of the armrest. For armrests less than 10 in. long, the load should be applied at the furthest point on the armrest from the axis of the pivot. The contact area shall not exceed 2 × 2 in. (5 × 5 cm).

2.2.4 Armrest horizontal load tests

A horizontal load of 250 lbf (1000 N) shall be applied perpendicular to each armrest with the center of the contact area located 10 in. (254 mm) from the pivot point of the armrest. Test shall be repeated in both directions, i.e., on the inner and outer surface of the armrest. For armrests less than 10 in. long, the load should be applied at the furthest point on the armrest from the axis of the pivot. The contact area shall not exceed 2 × 2 in. (5 × 5 cm).

2.3 Seat attachment strength requirements

The seat and its attachment to the car shall have an ultimate strength capable of withstanding the dynamic, or quasi-statically equivalent, loads due to the following individually applied accelerations acting on the combined mass of the seat and a Hybrid III 95th-percentile male (H3-95M) ATD:

- **Longitudinal:** ±8g
- **Lateral:** ±4g
- **Vertical:** ±4g

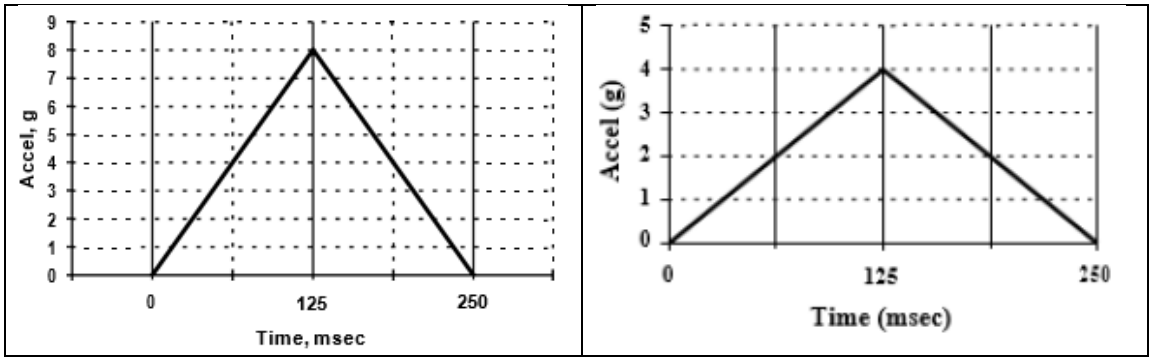
For the rear-facing 8g load case, i.e., the longitudinal load that accelerates the ATD into the seat back, the seat shall be dynamically tested using an uninstrumented H3-95M ATD. If an H3-95M ATD is not available, a Hybrid II 95th-percentile (H2-95M) ATD may be used if approved by the purchaser. The ATD shall be compartmentalized during the test, per the definition in this standard.

The 4g vertical upward load case, in which the seat is accelerated toward the mass of the ATD, may be demonstrated via quasi-static test or dynamic analysis. Either an H3-95M ATD or its equivalent mass shall be included for this load case.

Compliance with the other seat attachment requirements in Section 2.3 may be demonstrated via test or analysis, and the applied load need only be based on the mass of the seat. Yielding of the seat structure is permissible due to the applied load; however, the seat shall stay attached to the test fixture.

For a dynamic test or analysis, the acceleration pulse shall be triangular in shape with a peak acceleration as given above and shall have a 0.25-second duration, as shown in **Figure 2**. For a dynamic test, the crash pulse shall comply with the requirements established in SAE AS8049, Section 5.3.9.2 and Appendix A, using the values from **Table 1**.

FIGURE 2
Seat Attachment Test



8g acceleration pulse

4g acceleration pulse

TABLE 1
Crash Pulse Properties

Properties	Longitudinal	Lateral and Vertical
G_{req}	8g	4g
T_{req}	125 ms	125 ms
V	21.94 mph (9.807 m/s)	10.97 mph (4.904 m/s)
V_{tr}	10.97 mph (4.903 m/s)	5.48 mph (2.452 m/s)

3. Smoke and flammability

All materials used in the seat construction shall meet the requirements of 49 CFR Part 238.103. Test reports from recognized independent laboratories shall be submitted to the purchaser.

4. Test procedures and reports

All seat testing performed by the seat manufacturer shall be documented with test procedures and test reports. This shall include the procedures and reports for Operational Load and Seat Attachment Strength Tests.

Test procedures shall be submitted and approved by purchaser prior to actual testing. Tests shall be scheduled to allow the purchaser the option to witness testing. The purchaser may elect to accept existing test reports and procedures, provided that the seat to be purchased is demonstrated to be identical to that tested and the test reports and procedures meet the requirements listed below.

4.1 Test procedures

Test procedures shall as a minimum include:

- test objective
- complete description of item to be tested
- pass/fail criteria
- list of test equipment
- descriptions and/or drawings of test setup
- description of test personnel required
- date and location of tests
- sequential, step-by-step test procedure
- test data sheets (for recording data during testing, including pre- and post-test measurements)

4.2 Test reports

Test reports shall as a minimum include:

- a copy of the test procedure meeting the requirements listed above
- text or cover letter that gives a summary of the test results, the date and location of the test, and includes the signature of the people responsible for conducting the test and writing the report
- calibration data for all test measuring equipment
- completed test data sheets, including pre- and post-test measurements
- photos of test setup, pre- and post-test conditions, and results

5. Parts, service and maintenance manuals

When not superseded by the requirements of the purchaser's own specifications, as part of its work the seat manufacturer shall provide a manual or manuals. The manual(s) shall:

- Provide installation and removal information.
- Provide assembly and disassembly instructions.
- Serve as an aid in training the crew members in the safe use of the seat.
- Provide a list of replacement parts with part numbers and ordering information.
- Provide exploded views of the seat assembly and its components.
- Provide scheduled and unscheduled maintenance instructions and data, such as the periodic checking of fasteners (including torque values), lubrication instructions and cleaning instructions.
- Format and size of manual(s) shall be as agreed to by purchaser and seat manufacturer.

6. Engineering drawings

As part of its work and prior to the supply of seats, the seat manufacturer shall submit engineering drawings for approval. The drawings shall, as a minimum, include the following:

- overall dimensions (with tolerances) of the seat assembly
- weight and location of the center of gravity of the seat assembly
- depictions of the range of motions of all adjustments and tolerances in the ranges of motion
- mounting requirements including hole sizes, recommended bolt sizes and torque requirements, and recommended grade of bolts to be used for mounting
- location and operation of all seat controls
- forces required to operate the seat controls during normal use
- description of materials including cushion and fabric, as well as colors and model numbers.

7. Submittals for approval

The seat manufacturer shall submit for approval the items contained in **Table 2**.

TABLE 2
Submittal Requirements

Submittal	Reference Standard Section
Operational Load Test Report	2.2
Seat Attachment Strength Test Report	2.3
Smoke and Flammability Test Report	3
Test Procedures	4.1
Parts, Service and Maintenance Manual(s)	5
Engineering Drawing(s)	6

Related APTA standards

APTA PR-CS-006-98, "Attachment Strength of Interior Fittings for Passenger Railroad Equipment"
APTA PR-CS-016-99, "Passenger Seats in Passenger Railcars"

References

This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

Code of Federal Regulations, 49 CFR Part 238, Federal Railroad Administration Passenger Equipment Safety Standards

Humanetics Technical Data Sheet, for Models H3-5F, H3-50M, H2-95M, and H3-95M

SAE AS8049, Performance Standards for Seats in Civil Rotorcraft and Transport Airplanes SAE ARP750, Passenger Seat Design Commercial Transport Aircraft

Definitions

anthropomorphic test device (ATD): Also known as a crash test dummy, a biofidelic representation of a human body, built to the requirements in 49 CFR 572 and used to assess the risk of injury under simulated collision conditions.

compartmentalization: A seat design strategy that aims to contain an occupant between the seat and an adjacent fixture, such as a control stand, during a collision, to prevent the occupant from traveling long distances and impacting other, more hostile objects. During the rear-facing 8g sled test, ATD compartmentalization is evaluated until the point of maximum rearward motion of the ATD. The ATD's torso must be confined by the seat back (which may be potentially deformed) until the point of maximum rearward progress.

fixed seat: Seat that cannot be rotated, or flipped up/down, and not of the walkover-type design. These seat types face only in the direction in which they are mounted.

flip-up seat: Seats that have bottom cushions that can be flipped up to provide additional floor space.

g: An acceleration equal to 32.2 ft/s^2 (9.8 m/s^2).

lateral crash pulse: A time-based acceleration curve, triangular and symmetrical in shape, and having a 250 ms base and a 4g peak. A lateral crash pulse is in the horizontal direction and perpendicular to the normal direction of travel of the car.

longitudinal: Descriptive of a direction parallel to the normal direction of car travel.

longitudinal crash pulse: A time-based acceleration curve, triangular and symmetrical in shape, and having a 250 ms base and an 8g peak. A longitudinal crash pulse is in the direction parallel to the normal direction of travel of the car.

purchaser: The agency or organization (transit authority or car builder) responsible for the acquisition of seating equipment.

seat manufacturer: The agency or company responsible for the design, speculation compliance and warranty of the seat and its design.

Seat Reference Point (SRP): Defined by SAE AS8049, based on an H3-95M ATD.

shall: Practices directed by "shall" are required practices.

should or may: Practices directed by "should" or "may" are recommended practices.

Abbreviations and acronyms

ATD anthropomorphic test device (also referred to as a crash test dummy; see 49 CFR Part 572)
CFR Code of Federal Regulations
FRA Federal Railroad Administration
in inch
lbf pound-force
N Newton
SAE Society of Automotive Engineers
SRP Seat Reference Point

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published	—	—	—	Oct. 14, 1998	March 17, 1999
First revision	—	—	—	—	March 22, 2004
Second revision	Dec. 14, 2023	Feb. 1, 2024	Feb. 18, 2024	April 24, 2024	April 24, 2024

Appendix A: Informative

> **NOTE:** This appendix is for informational purposes only and is not required for compliance with this standard. The content of Appendix A was copied from the original version of this standard for historical reference only. The statements in this appendix may be considered as suggestions or considerations, even when prefaced by "shall"; they are not necessary for compliance with this standard.

A safety standard is intended to be supplemented by procurement specifications prepared by the Purchaser and directed to the Seat Manufacturer. These procurement specifications shall, as a minimum, include:

- Expected environmental operating conditions and standards against which measurable results should be obtained for conditions such as temperature ranges, humidity, salt atmosphere, ultraviolet radiation, static electricity and vibration.
- Drawing of the cab or other intended location of the cab seat showing controls to be manipulated by the occupant.
- Drawings or specifications giving visibility requirements for the occupant.
- Normally used cleaning agents.
- Narrative as to the duties normally performed by the occupant of the seat, including time periods during which these duties are to be performed.
- Format for parts, service and maintenance manual.

The procurement specifications may, at the option of the Purchaser, modify the requirements of this standard where special conditions make such modifications reasonable and do not unduly or unreasonably alter the intent of this standard with respect to the crashworthiness design of the seat and the safety and comfort of the occupant.

APTA recommends that representatives of the ultimate users or occupants of the seat be consulted when either preparing procurement specifications given in this section or conducting tests described in this standard.

Ergonomic and comfort analysis

For each application of the seat design, the seat manufacturer shall provide an analysis demonstrating that the seat and its application provide optimal ergonomics and comfort for the occupant. As a minimum, the analysis shall demonstrate the following:

a. That the seat adjustments shall be capable of accommodating the size range of crew members specified such that all tasks normally performed by the crew members can be accomplished with optimal comfort and safety.
b. That the seat design provides adequate visibility for the range of occupants specified.
c. That the seat design provides optimal occupant long-term comfort over the time period specified by the purchaser.

As an option for the purchaser, a field test may be substituted for the Ergonomic and Comfort Analysis. Details of the field test shall be agreed to between the seat manufacturer and the purchaser.

Operator sizes

Cab crew seats shall be designed to accommodate operator sizes from the 5th-percentile female (average 108 lb, 5 ft, 2 in.) through the 95th-percentile male (198 lb, 6 ft, 2 in.) as defined by MIL-STD-1472E. Surrogates of these occupants include the Hybrid III dummies. The Hybrid III 5th-percentile female dummy

and the 95th-percentile male dummy are both scaled versions of the Hybrid III 50th-percentile male dummy specified under 49 CFR Part 572 Subpart E. The size and weight of both the Hybrid III 5th-percentile female and the 95th-percentile male dummies are based on anthropometric studies by the Human Biomechanics and Simulation Standards Committee Task Force of the Society of Automotive Engineers (SAE). These dummies represent the lower and upper extremes of the U.S. adult population, respectively.

Seat features

All crew cab seating shall have, as a minimum, the following features:

- fully upholstered back rest and bottom cushion
- reclining back rest
- folding armrests
- vertical adjustment
- rotation
- fore/aft adjustment
- adjustable lumbar support
- vibration dampening

In addition, the following features are optional, but recommended:

- bottom cushion rake adjustment
- vertical adjustment to armrests
- fore/aft adjustment to bottom cushion with respect to back cushion

Environmental protection

The seat assembly shall be protected from corrosion and shall be designed to the environmental conditions expected in railroad service or as specified in the Procurement Specifications. Factors such as temperature ranges, humidity, vibration, ultraviolet radiation and salt atmosphere shall be considered in the seat design.

Static electricity

The seat design should incorporate a means to minimize the buildup of static electricity.

Inspection for maintainability

The seat shall be designed to readily permit the inspection of all adjustment devices and the seat structure to mitigate the effects of normal use, normal cleaning, wear and corrosion.

Life of seat structure

The seat shall be designed for a 10-year life and shall be such that the strength of the seat structure and attachment to the car shall not be compromised by environmental factors, in-service use (wear) and dissimilar metals over the specified life of the seat. All members of the primary seat structure shall be protected to minimize deterioration from environmental factors. Structural members shall be protected or designed to accommodate deterioration without compromise of safety or function. The design must address loss of strength caused by vibration; humidity; dissimilar metals; in-service impact damage; and other expected conditions, including spillage, exposure to cleaning agents or dirt.

Seat controls

All seat controls such as adjustment handles, levers, knobs and buttons shall be designed with optimum ergonomic locations for accessibility and operation from the seated position. Seat controls shall be protected

against inadvertent or unsafe activation and shall be designed to be not easily removed. Activation of any seat controls shall not result in any unsafe, rapid or unexpected movement that could contribute to operator injury. All seat controls shall be operable from the seated position.

Plaque for operating instructions

As part of the seat installation, a plaque shall be provided that instructs the crew member as to how to safely operate the seat and its controls. The plaque shall provide any necessary cautions or warnings concerning its unsafe use. Graphics rather than verbiage should be used to the maximum extent possible. The location of the plaque shall be determined jointly by the purchaser, builder and seat manufacturer. However, the plaque shall be located in a place visible to the potential occupant and/or operator of the seat. The plaque shall be permanently attached to its mounting and shall be resistant to casual attempts to remove it. The legend and graphics on the plaque shall remain legible after having been exposed to the normal railroad environment, including normal wear, cleaning agents and ultraviolet radiation.

Design features

Materials and workmanship

The seat shall be made of materials suitable for use in the railroad environment. All materials shall be new and of first-class quality. The seat shall be free of protrusions, sharp edges or corners that could cause injury or catch or damage the occupant's clothing with the seat adjusted to any position. The seat shall be free of rattles or loose joints that could create noise or vibration during normal operation. All parts of the seat shall be interchangeable with parts of like seats. No unusual adjustments or procedures such as grinding or bending of materials shall be required to replace parts that are designed to be replaced.

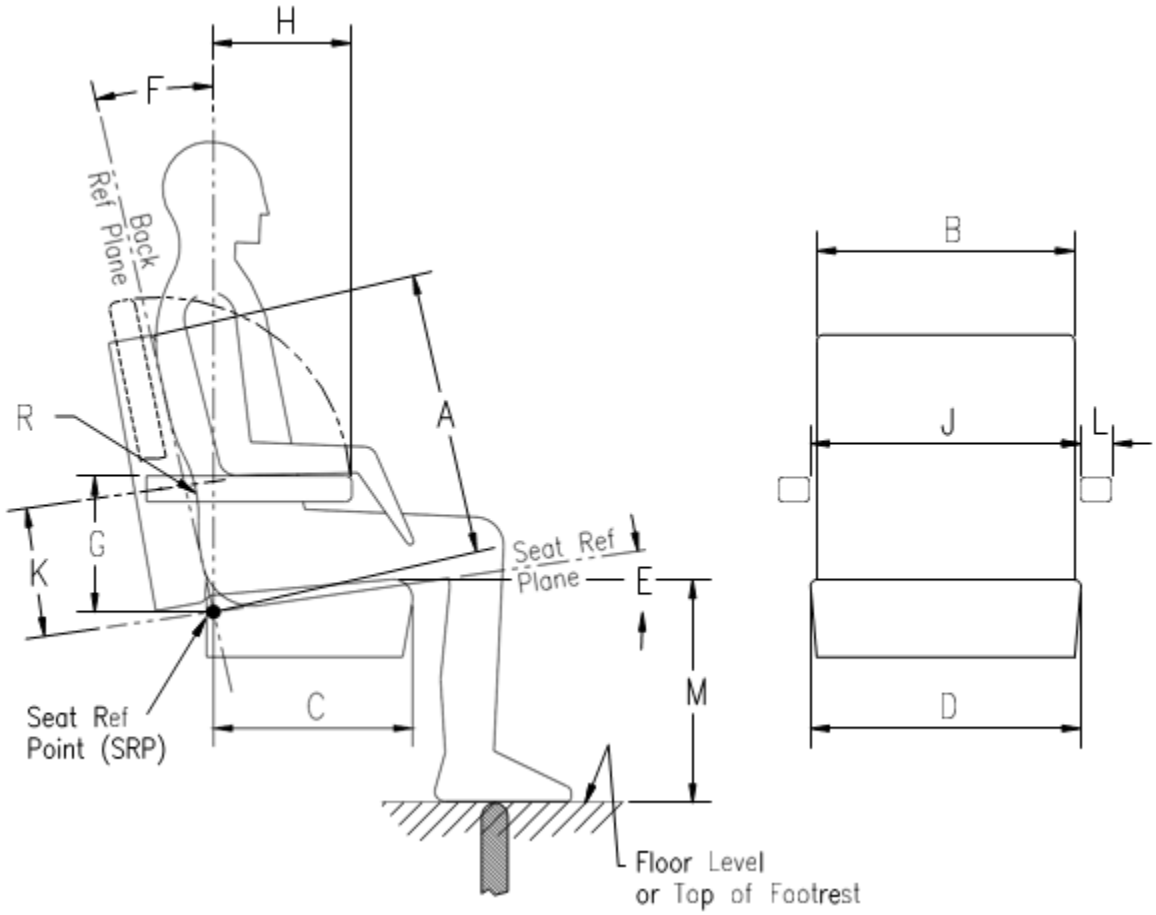
Dimensions

Cab crew seats should be designed according to the dimensions shown on **Table 3** and **Figure 3**.

TABLE 3
Seat Dimensions

	Dimensions in Inches (Millimeters) or as Noted				
Description	**Figure 3 Item**	**Max.**	**Nom.**	**Min.**	**Notes (SRP to be determined according to SAE J 826)**
Back Cushion Height	A	25 (635)	21 (533)	18 (457)	
Back Cushion Width	B	22 (559)	20 (508)	18 (457)	
Bottom Cushion Length	C	18 (457)	17 (432)	16 (406)	Can be adjustable to degrees
Bottom Cushion Width	D	22 (559)	20 (508)	18 (457)	
Bottom Cushion Angle	E	12 deg.	10 deg.	7 deg.	Can be adjustable to 0 deg.
Back Cushion Angle	F	12 deg.	15 deg.	0 deg.	Adjustable from min. to max.
Armrest Height	G	8.5 (216)	8 (203)	7 (178)	Can be adjustable
Armrest Length	H	12 (305)	10 (254)	8 (203)	
Armrest Lateral Spacing	J	22 (559)	20 (508)	18 (457)	
Lumbar Support	K	11 (279)	10 (254)	9 (229)	Adjustable from min. to max.
Armrest Width	L	5 (127)	3 (76)	2 (51)	
Lumbar Curvature	R	12 (305)	10 (254)	6 (152)	Adjustable from min. to max.
Seat Height	M	19 (483)	17.5 (445)	16 (406)	Adjustable from min. to max.

FIGURE 3
Seat Dimensions



Cushions and upholstery

Cushions shall be contoured to provide optimal occupant retention and comfort during normal operation. Cushioning material shall be durable and shall be capable of passing the cushion life test described herein. Seat cushion covering should not cause sliding of the occupant and should not be easily torn or cracked. The upholstery material should permit good ventilation.

Recline

Seat back should recline according to the dimensions specified. Recline control should provide for infinite adjustment through the range specified. Recline mechanism design shall be such that activation of the recline control does not allow a sudden change in back rest position.

Armrests

Crew cab seats should be equipped with two folding armrests. Armrests should be horizontal when in the down position. Armrests shall fold up from the horizontal position such that occupant ingress and egress from the seat is completely unimpeded in any seat adjustment configuration. Top of armrests should be padded.

Vertical adjustment

Crew cab seats shall be capable of a minimum of 3 in. (76 mm) of vertical adjustment. Ideally, the vertical adjustment should allow for an infinite number of vertical locations between the extremes of adjustment and

should not require that the occupant reduce or remove their weight from the seat to raise the seat. Vertical adjustment mechanisms that do not meet this requirement shall be approved by the purchaser.

Rotation

The seat should have a minimum of 180 deg. of rotation (swivel) from forward to rear facing position. Rotation should be such that at the 90 deg. position, the seat faces the centerline of the car. The rotation mechanism shall have positive locks in the forward (0 deg.) and the rearward (180 deg.) positions. The design of the rotation mechanism should require minimal effort for proper operation. For example, the rotation mechanism should be supported with ball or roller bearings to minimize the need for adjustment.

Lumbar support

The seat back cushion shall have an adjustable lumbar support to provide adequate occupant support and should accommodate the range of occupants specified. The lumbar support mechanism shall be adjustable both in curvature and vertical location. Vertical adjustment shall have two positions approximately 2 in. (51 mm) apart.

Maintainability

The seat shall be easy to maintain and clean and shall require no unscheduled adjustments or lubrication for the specified life of the seat. Design of seat shall be such that parts can be replaced with the use of standard hand tools. Components of like seats are interchangeable. Pockets where dirt and debris can collect should be minimized.

Durability

The seat and its adjustment mechanisms not referenced in **Table 4** shall be demonstrated to provide a 10-year life through simulated life cycle testing agreed between seat manufacturer and purchaser. Testing shall simulate actual expected use as closely as possible by placing simulated loads in the seat where indicated.

A cycle is defined as moving the seat component from one extreme position to the opposite extreme position and then returning to the original position.

After testing, the seat shall not exhibit failure of any component or result in wear that would compromise the structural integrity of the seat. Seat controls and adjustments shall not exhibit any substantial change in function or force required to activate.

Results of testing shall be documented by test reports as described below.

Cushion durability test

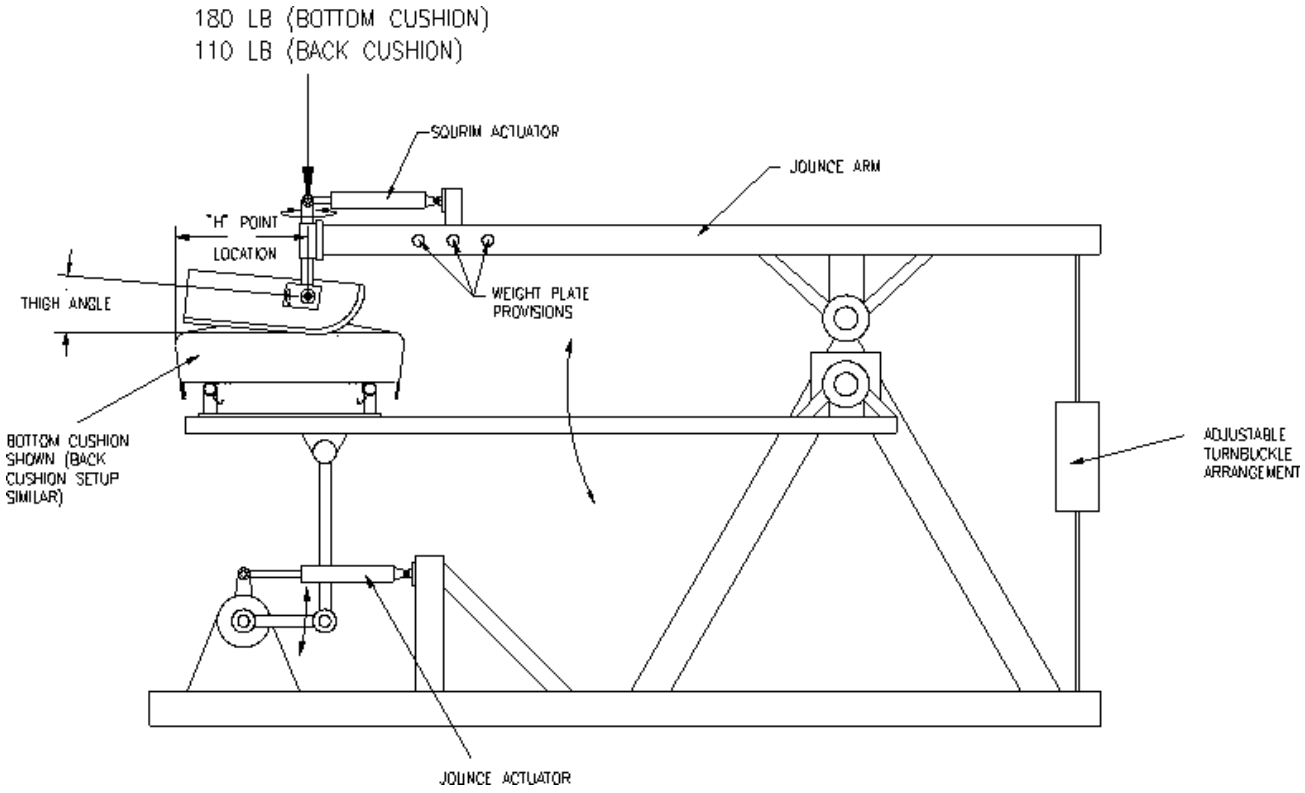
A cushion durability test shall be performed using SAE J 1454 as a guide. Tests shall be performed on both bottom and back cushion. Test shall consist of an automotive “jounce and squirm” test using a “jounce and squirm” machine similar to that shown in **Figure 4**. Each cushion shall be subjected to the following:

- 200,000 jounce cycles at 100 cycles per minute
- 4,000 squirm cycles at 4 cycles per minute
- 180 lb. load on bottom cushion
- 110 lb. on back cushion

Jounce and squirm cycles shall be applied simultaneously, although motions shall be independent. Thigh and torso forms shall be employed to transmit the motions to the cushions. Forms shall be located as would a seated passenger, using the procedure given in SAE J 826.

As a result of testing, cushions shall not show undue wear or signs of failure. Cushion upholstery shall show no tearing or ripping and shall remain attached to the cushion pans or structure. Upholstery stitching shall show no signs of unraveling or breakage. Cushion foam shall show no signs of tearing, shearing or loss of height.

FIGURE 4
"Jounce and Squirm" Machine



Service life cycle test

The durability of the seat and its adjustment mechanisms shall be demonstrated by testing as shown in **Table 4**:

TABLE 4
Life Cycle Test Requirements

Component	Test Cycles	Load Condition
Recline Mechanism	15,000	None
Armrest Folding	20,000	None
Vertical Adjustment	20,000	185 lb.
Fore/Aft Adjustment	20,000	185 lb.

Loads shall be placed in the seat to simulate the weight of the 50th-percentile male.