SEAT ATTENUATOR APPROVAL PROCESS



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SCOPE

The aim of these new Seat Attenuator Guidelines is to give clear instructions to the relevant stakeholders that would like to design and implement or sell their own Seat Attenuator in accordance with Article 283 of Appendix J.

If the seat attenuator is designed other than by a car manufacturer, the Seat Attenuator will need to meet the design and performance requirements listed in the guidelines – the supplier of the Seat Attenuator will need to create a comprehensive technical dossier to allow car manufacture/ team to install the seat in a cross-country vehicle and to allow scrutineers to check compliance of the Seat Attenuator. The car manufacturer will need to demonstrate to the FIA that the anchorage points to fix the Seat Attenuator meet the load cases defined in the technical dossier.

If the Seat Attenuator is designed by a car manufacturer, the Seat Attenuator will need to meet the design and performance requirements listed in the guidelines – the supplier of the Seat Attenuator will need to create a comprehensive technical dossier to allow scrutineers to check compliance of the Seat Attenuator.

This is a living document that can be updated to reflect any new information or clarification that the FIA considers relevant to stakeholders. Please ensure that you take into consideration the latest available version.

1 INTRODUCTION

Motor sport, at both professional and amateur levels, inherently carries certain risks. The FIA is committed to mitigating these risks by establishing and promoting minimum safety performance that encompass all categories of the sport.

1.1 THE HEAVY-LANDING RELATED ISSUES

One safety concern in cross-country rallying is where a vehicle impacts the ground with high vertical force after a jump. Such incidents often generate a "severe crash pulse" that can cause spinal compression injuries to the driver and co-driver.

The design and performance requirements set into these Guidelines and Article 283 of Appendix J ae intended to allow the development of Seat Attenuator system aiming to mitigate the risk of spinal injuries. The definition of the crash pulse comes from the analysis of the data captured via the FIA World Accident Data Base (WADB). The crash pulses used to validate the performance of the Seat Attenuator meet the following criteria:
1st test - 40g peak pulse at an angle of 60 degrees
2nd test - 50g peak pulse at the most compliant direction of the system

1.2 RELEVANT DEFINITIONS:

SEAT:

Racing equipment designed to support the driver during both race and crash conditions. The seat includes the seat-shell plus all cladding and energy absorbing padding.

SEAT BRACKETS:

Metallic load bearing structures connecting the seat to the Seat Attenuator and/or in-car attachment points.

SEAT ATTENUATOR:

A safety device consisting of a specialized impact damper that suspends the competition seats within the vehicle's survival cell. Its primary function is to absorb and dissipate the energy from vertical impacts, mitigating the risk of spinal injuries.

LOAD ATTENUATOR:

A reversible load attenuation device, which in this document is represented by one or more oleo-pneumatic dampers.

BUMP STOP:

A component which is engaged only in the final part of the stroke and can be made of an elastomeric bumper or a crushable structure, which can be either embedded in the damper or external to it.

SPRUNG MASS:

The mass whose motion is controlled by the damper assembly.

SEAT ATTENUATOR CHARACTERISTIC:

The characteristic of the Seat Attenuator is defined as the Force vs Displacement curve of the seat in the direction of the stroke that the mechanism allows.
This is different from the damper characteristic unless the motion ratio (MR) between the seat and the damper is unitary and constant along the whole stroke, and a single damper configuration is used.

DAMPER CHARACTERISTIC:

In the most general configuration, the damper(s) characteristic differs from the Seat Attenuator characteristic, according to the MR between the two.

TECHNICAL DOSSIER:

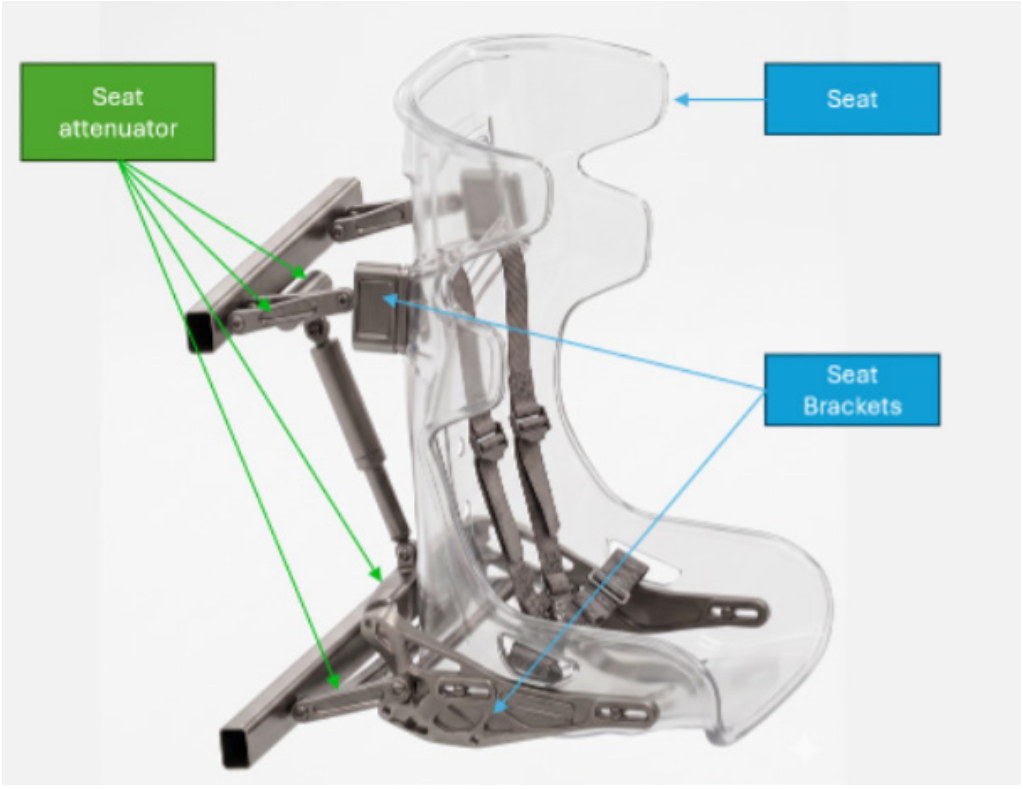
The Technical Dossier is a standardized document submitted by a manufacturer to the FIA to certify that a specific Seat Attenuator complies with the design and safety performance requirements specified into these Guidelines and provides the load cases for the in-car Seat Attenuator anchorage points. It serves as the official document against which all Seat Attenuator models, mounted into the cars, are inspected during technical scrutineering at events.

CAR MANUFACTURER:

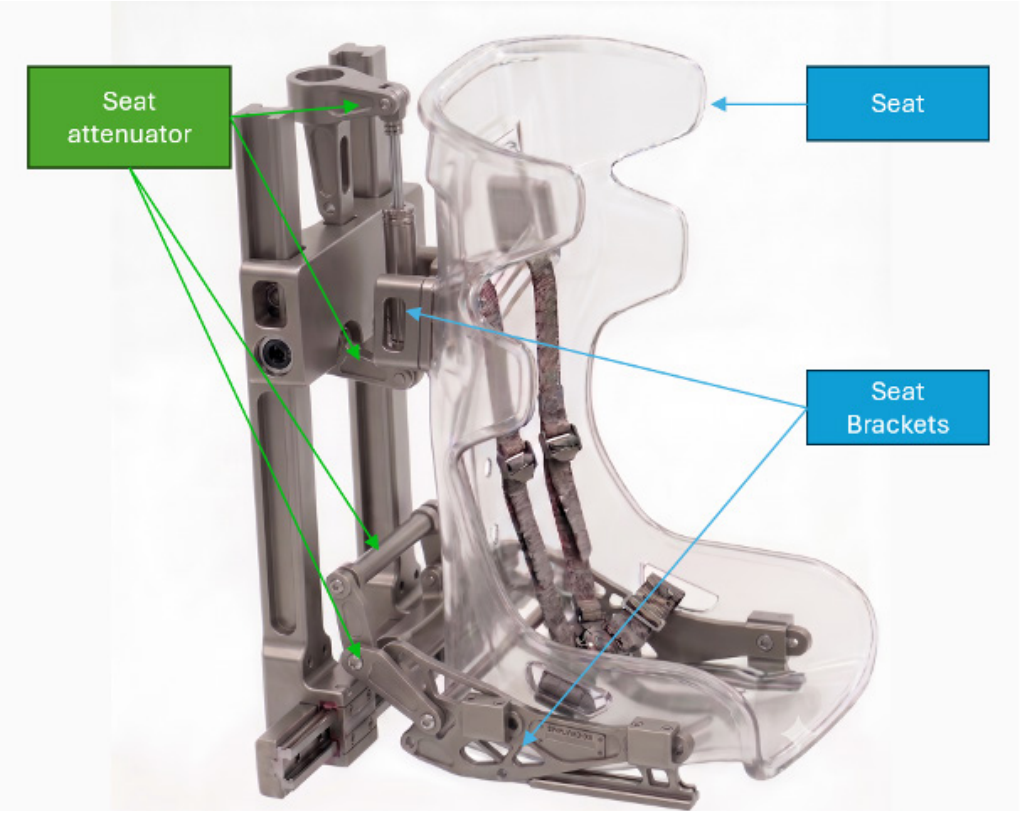
A car manufacturer (OEM) is an automotive group or brand registered with the FIA Manufacturers' Committee or having been registered in an FIA World Championship as a Manufacturer within the past 3 years. The OEM may develop a car internally or subcontract its development but must enter the vehicle under its own brand name.

TUNER:

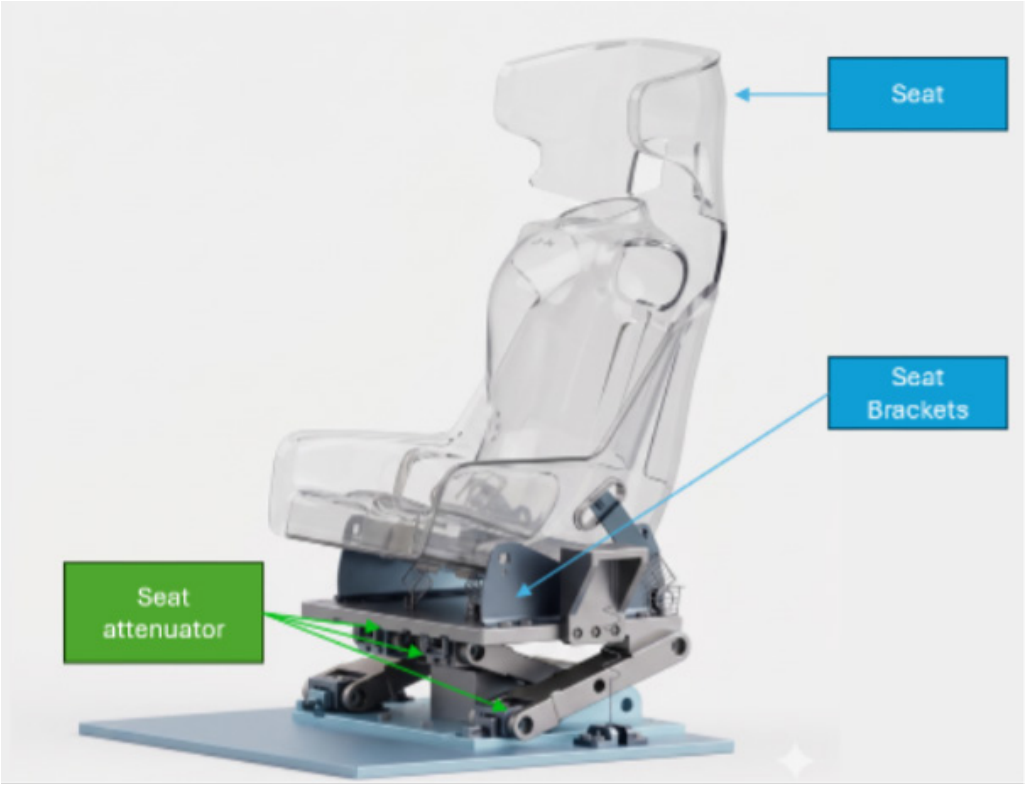
A tuner is a company, independent of any OEM, which designs and builds non-homologated vehicles in compliance with FIA technical regulations. Such vehicles may be entered under the tuner's own Competitor name.



Example 1 of Seat – Seat Bracket – Seat Attenuator definitions



Example 2 of Seat – Seat Bracket – Seat Attenuator definitions



Example 3 of Seat – Seat Bracket – Seat Attenuator definitions

1.3 REGULATIONS REFERENCES

There are two FIA Standards for Seat eligible to be used with the Seat Attenuator:

i. **FIA Standard 8862-2009** "Advanced Seat"

ii. **FIA Standard 8855-2021** "Competition Seat"

Competitors are advised to check Appendix J and/or the Technical Regulations of the championship they intend to participate in to find out which standard is required.

QR1 – Appendix J 283 - 2026

Seats approved according to FIA Standards 8862-2009 are listed in Technical List No. 40.
Seats approved according to FIA Standard 8855-2021 are listed into the Technical List No. 91.

QR2 – 8862-2009 Technical List No. 40

QR3 – 8855-2021 Technical List No. 91

2 DESIGN AND FUNCTIONS

2.1 SEAT HOMOLOGATION

The seat and seat brackets to be used with the Seat Attenuator system must be homologated in compliance with the relevant FIA standard, which can be 8855-2021 or 8862-2009.

2.2 SEAT BRACKETS

The brackets used to connect the seat to the Seat-Attenuator and/or to the vehicle must be homologated together with the seat they are used with.

If the brackets are fully integrated into the Seat Attenuator, the full system must be subjected to the seat homologation tests. In this case, a preliminary assessment of the system must be submitted to the FIA Safety Department. Once homologated, no modification of the brackets is allowed without FIA approval. FIA approval must be requested by the owner of the seat homologation (Seat Manufacturer).

If the seat is already homologated and there is a need to change the brackets design, the seat manufacturer must request a Homologation Extension from the FIA for the new model.

In the case of the Seat Attenuator not being used as an integrated bracket for the seat, homologated brackets must be used between the seat and the Seat Attenuator. If the seat used is homologated according to FIA Standard 8862-2009, only circuit seat brackets are authorised. Rally seat brackets are forbidden.

2.3 SEAT ATTENUATOR CHARACTERISTIC

The design, dimensioning, material selection, manufacture, and validation of all components forming part of the pressurised system of the seat attenuator, including but not limited to the pressure cylinder, pressure relief valve, protective covers, fittings, and associated hardware, remain the sole responsibility of the seat manufacturer. The manufacturer shall ensure that all such components are suitably designed, tested, and validated to safely fulfil their intended function under all foreseeable operating conditions and throughout the service life of the system.

The main mechanical characteristics of the Seat Attenuator are the following ones:

- The mechanism must allow the possibility for the seat to travel downwards by at least 100mm,

The seat movement is recommended to be predominantly vertical, with a limited forward longitudinal component, ensuring optimal performance.

- Damping system

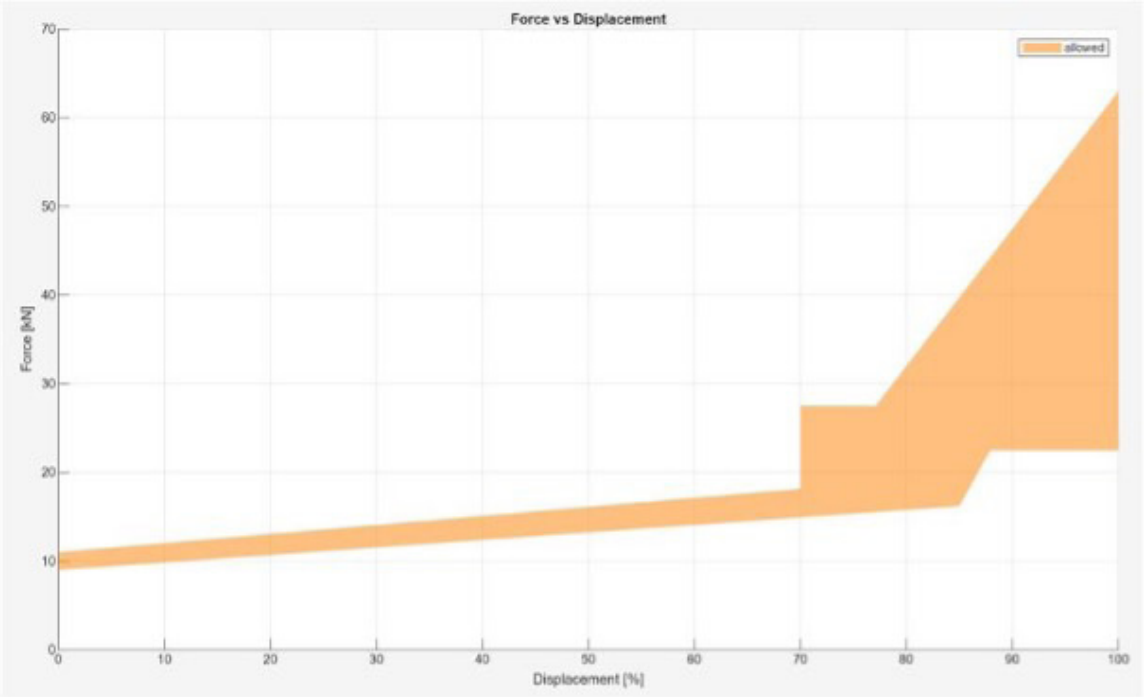
    - Force-displacement characteristic as described below.
    - A load attenuator (reversible damper system) must be used in at least the first 70% of the stroke.
    - The system may be made of multiple shock absorbers.
    - It must be installed in series between the chassis or safety cage, and the seat brackets. The fixings must respect the minimum requirements of Article 3.2.
    - An end-of-travel limiter must be included in the damping system.
    - If the damping system has a fluid reserve located in the cockpit, it must be firmly secured and fitted with a protective cover.
    - As an alternative to a protection cover, a pressurised device may be fitted with a pressure relief valve.
    - The design of the Seat Attenuator mechanism is free.

If a sliding mechanism is used, its angle should be within 80 degrees ±10 defined by a line parallel to the floor and a line parallel to the seat back, specifically in the XZ plan.

- Force displacement characteristic

The force displacement characteristic reacted by the seat during a descent at a speed of 3000mm/min (50mm/s) minimum, must refer to the graph below, where two phases have been identified.

The force must be intended as tangent to the seat trajectory and the displacement is a percentage of that available before interfering with other components



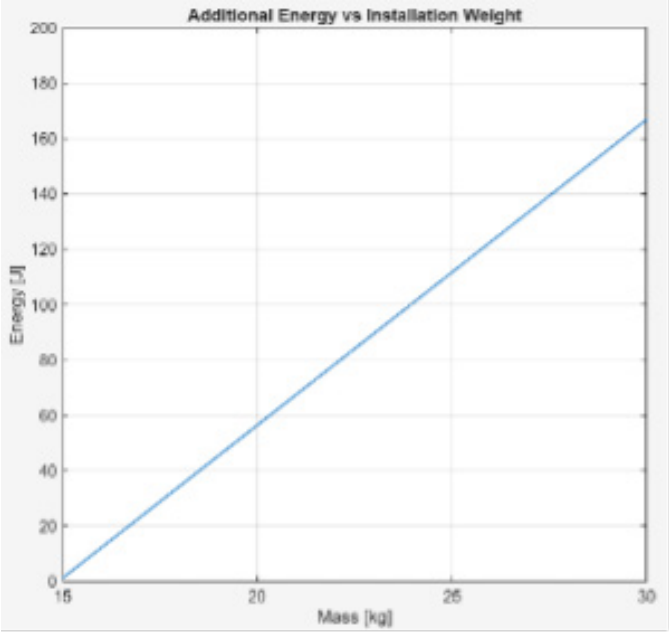
Phase 1 – from 0 to 70% of stroke

During Phase 1, the corridor refers to the characteristic of the damper (or a system of dampers working in parallel), calculated at the seat.
The obtained curve must be inside the corridor.
The area below it, calculated between 0 and 70% of stroke must be 910J minimum.
The initial and final force values of this curve refer to a driver weight of 78 kg. For drivers of different weights these values must be corrected according to the scale factor
(Occupant Weight [kg] + 20) / 98 [kg]

Phase 2 - from 70% to 100% of stroke

In Phase 2, an additional element is engaged.
The damper(s) providing the curve in Phase 1 can bottom out at this stage, but the stroke of the seat must continue up to 100%.
Different solutions can be adopted in this phase.
The curve obtained must be inside the corridor.
In Phase 2 the curve must lay within the corridor, and the area below it, calculated between 70% and 100% of stroke, must be 850J minimum
The total energy must be calculated by adding the energy obtained during Phase 1 to the energy obtained during Phase 2.

- For a sprung mass of 15 kg or less, the minimum energy requirement is 1760J.
- For a sprung mass greater than 15 kg, the minimum energy requirement is 1760J plus an additional value determined by the linear regression shown in the graph below.



2.4 DAMPER CHARACTERISTIC

In the most general configuration, the damper characteristic differs from the Seat Attenuator characteristic, according to the motion ratio between the two.
The motion ratio function, in tabular or analytical form, must be provided.
The damper characteristic should be measured under a uniaxial test machine, ideally in adiabatic conditions.
To be sure to meet the adiabatic conditions an initial quasi-static loading cycle should be performed at a speed around 1 mm/s.
Subsequent faster loading cycles should be performed until the gas spring response converges to the same curve. Ideally a speed of 100mm/s should be enough to obtain adiabatic behaviour.
Such measurements can be taken using either an a dynamic (speed controlled) press machine.

2.5 SEATBELT ATTACHMENT POINTS

- The seat belts may be mounted on the seat brackets or on any structure (frame) supporting the seat and connected to the one of the moving component of the seat attenuator system, which travels with the seat.

In addition, the seat belts must also have a secondary attachment to connect the seat belts to the chassis or to the safety cage of the vehicle. The secondary attachment will have free play and should not be tensioned in any of the Seat Attenuator motion extremities.

- Each seatbelt attachment point on the Seat Attenuator and/or seat brackets, as well as attachment points on the chassis and/or safety cage must sustain a minimum force of 15kN.

2.6 INSTALLATION OF THE SEAT BELTS

The seat belts must be installed in accordance with the prescriptions of Article 283-6.2.
The shoulder straps can be mounted either on the structure supporting the seat or on the rollcage.
If individual belt sections are attached to the seat support structure, they must always be doubled by a strap connecting the seat support structure to the rollcage/car chassis.
The seat belts must be installed so as not to interfere with the possible downwards movement of the seat as per the full prescribed travel (see Article 283-20.5).

2.7 INSTALLATION

- Mounting of the Seat Attenuator:

The system may be mounted either to the cockpit floor and/ or to the safety cage at the back of or below the seat.
Any Seat Attenuator system, together with its installation in the car, must be approved by the FIA Safety Department.
If individual belt sections are attached to the Seat Attenuator structure, they must always be doubled by a strap connecting the seat support structure to the rollcage/car chassis.

- Connecting with FIA data logger

Each independent load attenuation device must be equipped with a pressure sensor to continuously monitor the operation status of the global attenuator system.

The same sensor reference must be used on all devices installed in a single vehicle.

This sensor and its installation must be approved by the FIA and must be described in the seat attenuator presentation form.

Each sensor must be connected to the car ECU/ datalogging system.

Furthermore, the live pressure values measured thank to these sensors must be readable through the display of the car.

The values of these sensors must be sent by CAN to the FIA datalogger, if any, according to the specification of the .dbc file available in the Cross-Country FIA Electronic Package.

Note that if two load attenuation devices are installed for a single seat attenuator system, it is requested to share the average values measured by the two sensors.

3 VALIDATION PROCESS

3.1 SEAT AND SEAT BRACKET

The seat and seat brackets must undergo a standard homologation process; as described into the document Homologation Regulations for Safety Equipment.

QR4 – Homologation Regulation for Safety Equipment

3.2 SEAT ATTENUATOR

The Seat Attenuator concept must be submitted to the Technical and Safety Departments for evaluation and validation via email: seat.attenuator@fia.com.

The final design must be validated through the following steps:

- Technical Dossier: A comprehensive file including:
  - An explanation of the Seat Attenuator's operation and characteristics.
  - The expected characteristic of the damper and the system.
  - The maximum structural stress transmitted by the Seat Attenuator to the car chassis, according to the FEM calculation performed by a car manufacturer or a company included in Technical List N°35.
  - A comprehensive dossier detailing the Seat Attenuator installation on a chassis.
  - Detailed technical drawings of the full system.
  - A complete user manual, including maintenance instructions.
  - A physical sample of the full system.
- Dynamic Testing: A physical test is required to verify the lumbar load mitigation performance of every new seat attenuator design submitted by a T1+ team.
  - Test provision and costs
  - The FIA will provide, at its own expense, a test slot consisting of two full days at the TASS laboratory. Should the initial test not be successful, the FIA will cover the costs for a third day. Any additional testing days required beyond this will be at the team's expense: 9300 euro/day (2026 rate, susceptible to adjustment in the future).
  - Test procedure
  - The physical sled test consists of crash pulses using a 50th percentile Hybrid III ATD (Anthropomorphic Test Device). A total of minimum two sled tests must be performed, one in each of the following two configurations:
  - Configuration A: 40 g, 7 m/s pulse, with the rig reclined at 60 degrees.
  - Configuration B: 50 g, 11 m/s pulse, with the rig reclined in the most compliant direction for the seat attenuator mechanism.

Teams intending to submit a new seat attenuator design are invited to contact us in order to arrange their test slot at TASS International (Automotive Campus 15, 5708 JZ, Helmond, NL; ref. Marco van de Polder : marco.van_de_polder@siemens.com)

- The pulse must reach 40G 60° tilted for an equivalent impact speed of 7m/s; with Hybrid III mannequin 50%.

Further information can be requested at seat.attenuator@fia.com

- FEM Calculation: The car manufacturer or tuner must send proof via the Finite Element Method (FEM) that the car attachment points can sustain the loads transmitted by the attenuator.
  - The FEM analysis must be performed by either the car manufacturer or a company included in Technical List No. 35.

QR5 – Companies Approved by the FIA for the calculation of Safety Cages

3.3 SEATBELT ATTACHMENT POINTS

The seatbelt attachment points must be verified by FEM calculation according to the specific test conditions indicated in Appendix A.

The FEM analysis of the seatbelt attachment points must be performed by either the car manufacturer or a company included in Technical List No. 35

3.4 VALIDATION DOCUMENTS

Once the validation process is successfully completed, the FIA will issue a letter assessing the compliance of the specific Seat Attenuator.

Following this, the FIA will require the manufacturer to issue a Technical Dossier detailing all technical specifications of the Seat Attenuator. This Technical Dossier will be made available to all relevant stakeholders and scrutineers to ensure compliance with the technical regulations.

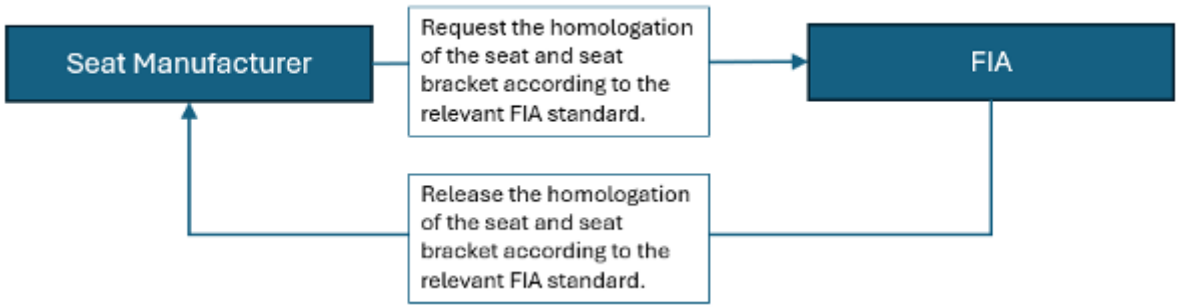


Chart 1 - Validation Process for Seat Manufacturer

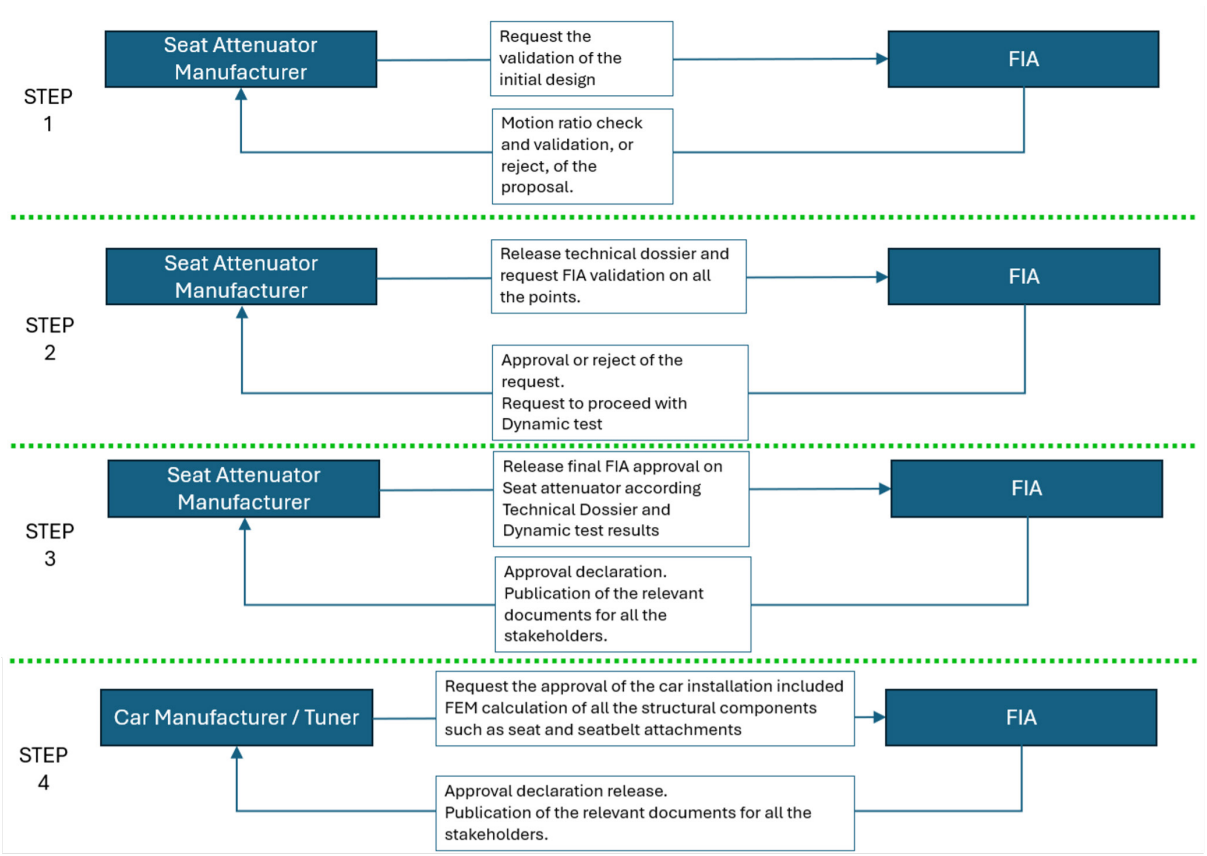


Chart 2 -Validation Process for Seat Attenuator Manufacturer

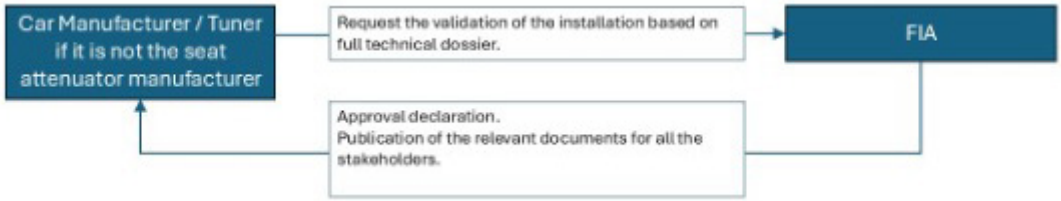


Chart 3 - Validation Process for Car Manufacturer / Tuner If it is not the Seat Attenuator Manufacturer

APPENDIX A

Load cases for FEM calculations for Seat Attenuator

DEFINITIONS

SEAT MOCK-UP:

Structure with a 8862 realistic shape represented by 10mm Aluminum shell.

SEAT FRAME:

Structure integral with the seat connected to the moving end of the Seat Attenuator mechanism.

SEAT MECHANISM:

Suspension system (1,2,3) connecting the seat frame to the roll cage, or car's chassis, which embeds the absorbing element and allows the descent of the seat.

SEAT BELT FRAME ANCHORAGES:

Harness anchorages present on the seat frame. In the image below they are indicated by red dots. There are two possible configurations for these installations:

i. Six seat belt attachments all connected to the seat frame.

ii. Four seat belt attachments if the two shoulder seat belt are attached to the car's chassis.

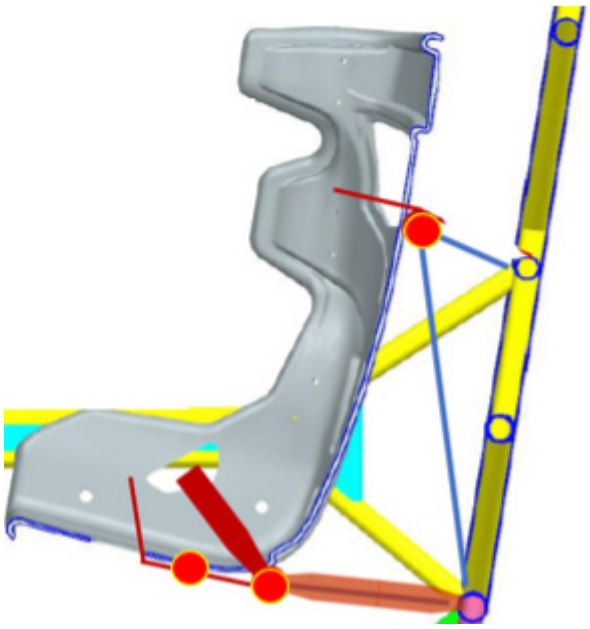


Figure A1 – Example six seat belt attachments all connected to the seat frame

SEAT BELT CHASSIS ANCHORAGES:

Anchorage points on the car's chassis where the seat belts are connected. There are two possible configurations for these installations:

i. Six slack belt attachments, if all the seat belts are connected to the seat frame.

ii. Four slack belt attachments, along with two shoulder seat belt attachments.

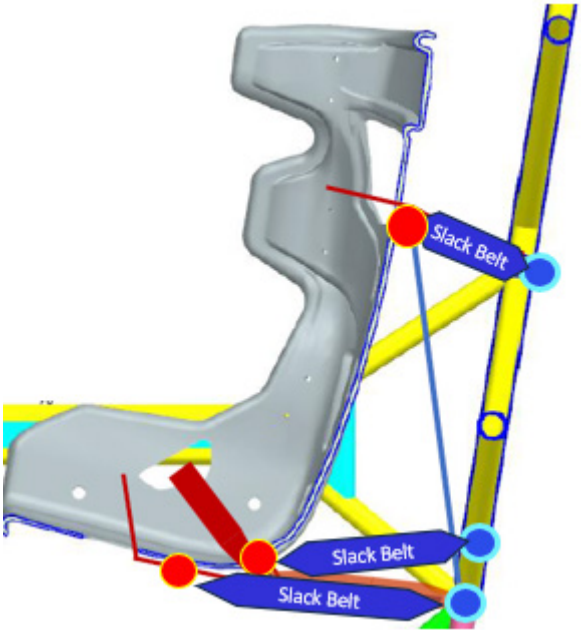


Figure A2 – Example six slack belt configuration

MECHANISM ANCHORAGES:

Fixation points of the Seat Attenuator to the car's chassis.

SEAT BELT STRAP:

Seat belt strap mock-up connecting the frame anchorages, or the car's chassis anchorages depending on the installation, to the point of load application. They must be simulated with elements that have no flexural stiffness.

SEAT'S H-POINT:

The theoretical pivot center of the occupant's torso and thigh, representing the hip joint location when seated. It serves as the primary reference point for safety systems layout and occupant positioning within the simulation environment.

LOAD CASES

The load cases described below aim to verify the structure of the Seat Attenuator under the main impact scenarios. It remains understood that the applicant for FIA approval is required to report any other situation known to them that could compromise the safety of the Seat Attenuator and/or its installation.

The load application on the seatbelt must be validated by the FIA. The relevant information must be sent to seat.attenuator@fia.com

FOREWORD

In the load cases specified below, any reference to "Seat Mechanism Assessment" refers to the simulation of the entire system, from the mock-up seat to the mechanism anchorages. Unless otherwise indicated, loads must be applied to the "Seat belt Straps".

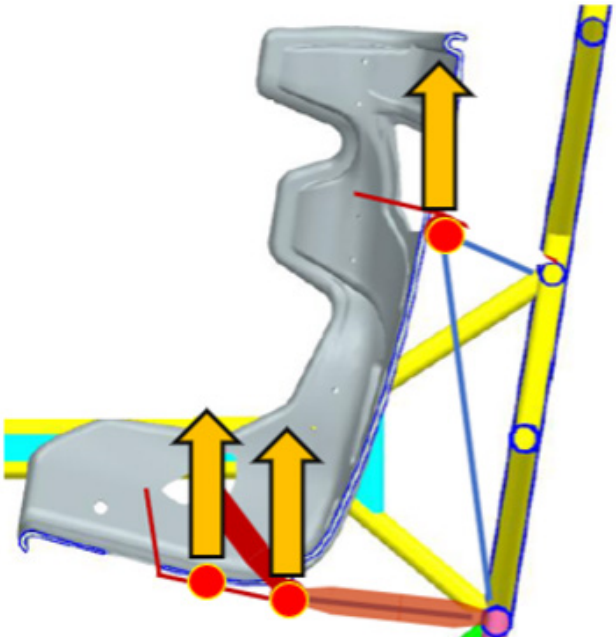
1 VERTICAL UPWARD

1.A SEAT FRAME ASSESSMENT

This simulation aims to evaluate each individual seat belt attachment under vertical loads. The load application is 15 kN on each seat belt frame anchorage, with a separate analysis conducted for each attachment.

1.B SEAT MECHANISM ASSESSMENT

This simulation aims to evaluate the full system under the load transferred by the seat belt under vertical upward loads.
The load application is (52/6)*n kN equally divided and applied on the seat belt frame anchorage (simultaneously).
n represents the number of seatbelt straps attached to the seat frame, which can be either 4 or 6, depending on the installation type.

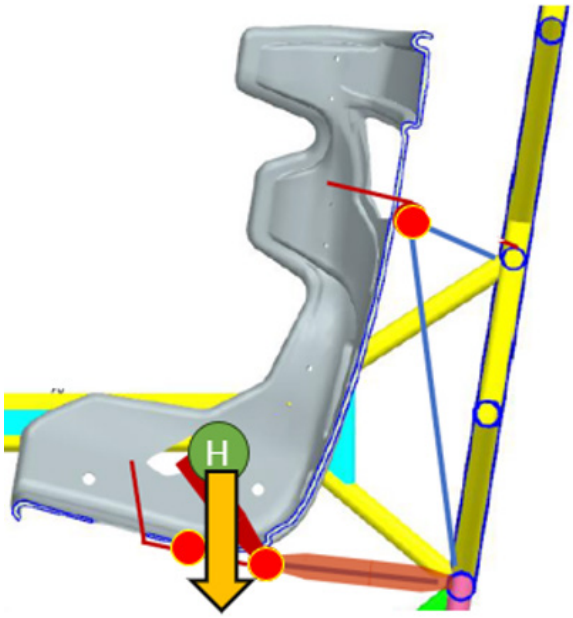


2 VERTICAL DOWNWARD

This simulation aims to evaluate the full system under the load transferred by the driver's body under vertical downward loads.

SEAT MECHANISM ASSESSMENT

The load application is 63 kN applied to the Seat's H-Point.



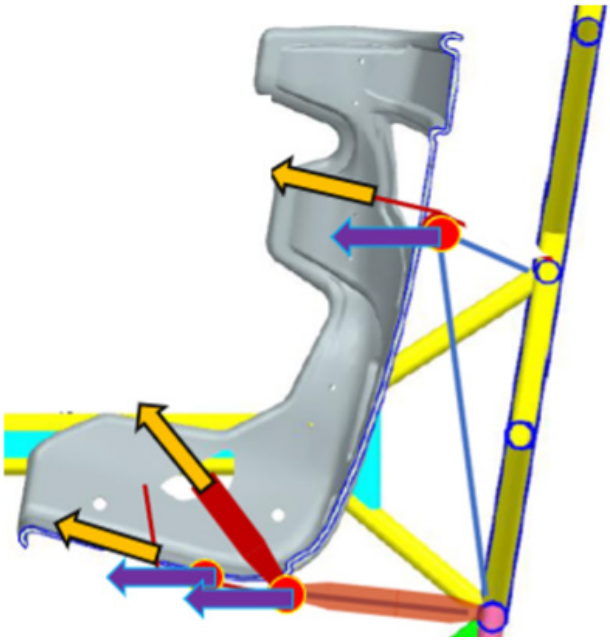
3 LONGITUDINAL FRONT

3.A SEAT FRAME ASSESSMENT

This simulation aims to evaluate each individual seat belt attachment under longitudinal (front) loads.
The load application is 15 kN on each Seat belt Strap, with a separate analysis conducted for each attachment.
The load case is indicated by Orange Arrows in the image below

3.B SEAT MECHANISM ASSESSMENT

This simulation aims to evaluate the full system under the load transferred by the seat belt under longitudinal loads.
The load application is (90/6)*n kN equally divided and applied on the Seat Belt Frame Anchorage (simultaneously) in the longitudinal direction.
n represents the number of seatbelt straps attached to the seat frame, which can be either 4 or 6, depending on the installation type.
The load case is indicated by Purple Arrows in the image below



4 LONGITUDINAL REAR

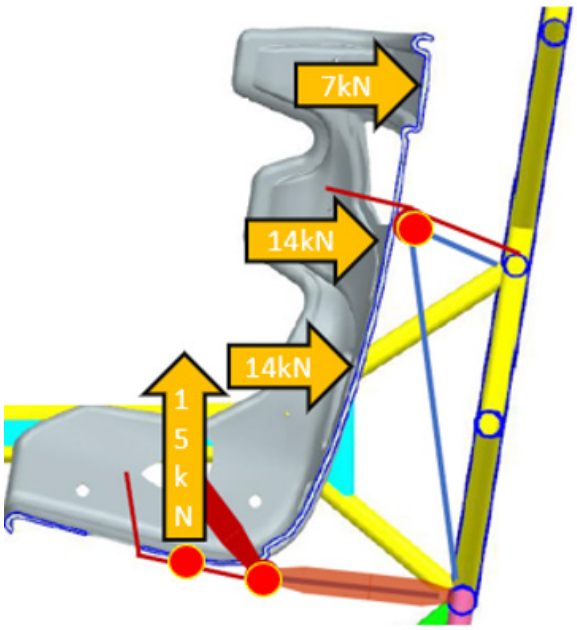
This simulation aims to evaluate the full system under the loads applied to the Seat Mock-up according to the FIA Standard 8862-2009 Rear test plus the vertical upward loads on the crotch straps.

SEAT MECHANISM ASSESSMENT

The load application is:

- 15 kN on each Crotch Belt Anchorage,
- 7kN at rear head seat support (refer to the 8862-2009 standard for exact position)*
- 14kN at rear shoulder seat support (refer to the 8862-2009 standard for exact position)*
- 14kN at rear back seat support (refer to the 8862-2009 standard for exact position)*

All the loads must be applied simultaneously.
All the loads indicated with * must be simulated using Multi Points Constrain (MPC)

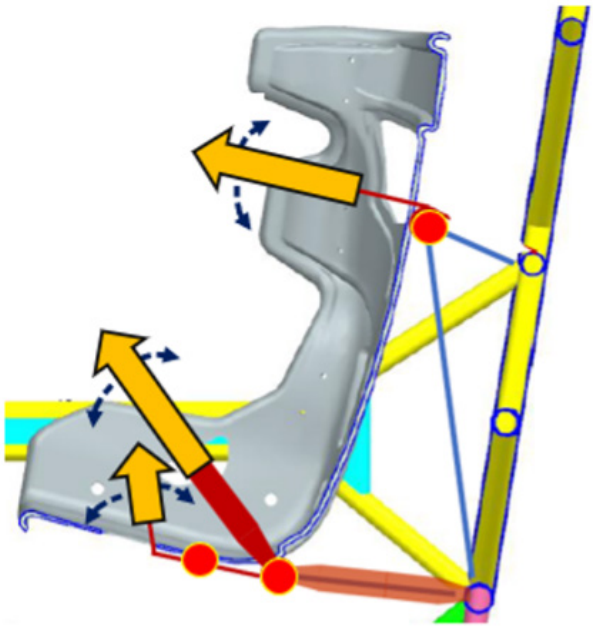


5 LONGITUDINAL VERTICAL

This simulation aims to evaluate the full system under the load transferred by the seat belt under loads with the direction that is most demanding for the structural integrity of the mechanism.

SEAT MECHANISM ASSESSMENT

The load application is (90/6)*n kN equally divided and applied on the Seat belt Strap (simultaneously).
n represents the number of seatbelt straps attached to the seat frame, which can be either 4 or 6, depending on the installation type.



6 LATERAL

This simulation aims to evaluate the full system under the loads applied to the Seat Mock-up according to the FIA Standard 8862-2009 Side test (indicated by red Arrows in the image below) plus loads on the Seat belt straps (indicated by green Arrows in the image below).

SEAT MECHANISM ASSESSMENT

The load application is:

- 15 kN on each Seat Belt Straps applied on the pivoting point of each strap in the lateral (Y) direction
- 7kN at side head seat support (refer to the 8862-2009 standard for exact position)*
- 11kN at side shoulder seat support (refer to the 8862-2009 standard for exact position)*
- 14kN at side back seat support (refer to the 8862-2009 standard for exact position)*

All the loads must be applied simultaneously.
All the loads indicated with * must be simulated using Multi Points Constrain (MPC)



The loaded anchorages must be on the opposite side with respect to the one where the side test loads are applied, to maximise the stress applied to the seat mechanism.

