

Appendix 5 - Occupant Restraint Systems

For AASA sanctioned events V0.5

Background

Risk management principles follow a hierarchy of actions, designed to reduce or eliminate hazards to health and safety. High priority actions are always more effective in managing risk and must always be implemented where possible and practical to do so. Where a higher priority action is assessed as being impractical or further action is required, actions at a lower level must be implemented. The generally accepted hierarchy is:

- Eliminate: Don't do the activity (e.g. Stop Motor Sport altogether, don't race)
- Isolate: Separate people from the hazard (e.g. Remote-controlled lights, not flags)
- Substitute: Find a safer alternative to the hazard (e.g. ceramic brake pads, not asbestos)
- Engineer: Make things safer (e.g. safety harnesses, safety cages, fuel bladders)
- Administrate: Write rules to be followed (e.g. nobody on pit wall at starts)
- Personal Protective Equipment PPE: last line of protection (e.g. Helmets, apparel)

As can be seen from the above, occupant restraint systems (Safety Belts, Harnesses) represent the fourth line of protection when higher-level risk management actions have been implemented. Engineering requirements are those generally aimed at the automobile and represent the primary risk management interaction with those responsible for the construction and preparation of a competition automobile.

Hazards

We must assess the protection offered by occupant restraint systems. Such systems offer protection against the following hazards.

- Occupants striking the interior surfaces and fittings of the automobile in a frontal collision.
- Occupants striking the upper interior surfaces and fittings of the automobile in a rollover.
- Occupants being wholly ejected from the automobile and striking the ground or other objects at speed.
- Occupants being partially ejected from the automobile and crushed in a rollover.
- Occupants being partially ejected from the automobile and striking external objects.
- Occupants not properly restrained in normal competition causing loss of control.

Restraint systems can also introduce or exaggerate hazards under certain circumstances. These must also be taken into consideration when deciding on the appropriate levels of protection required for a particular activity.

What are the hazards that can be introduced or exaggerated by the use of occupant restraint systems?

- Occupant entrapment in automobile due to a failure of release mechanisms
- Bruising and injury from impact against restraint.
- Restriction of movement to shoulder and neck leading to a reduced of field of vision
- Breathing restrictions
- Competitive disadvantage in driver change situations.
- Financial viability of events due to cost of restraint equipment.

Types of Restraint

Level 1 – No Restraint

No restraint required. This may be appropriate for the following situations:

- Low speed events in which the likelihood of collision and rollover incidents is remote, and where the wearing of a restraint may affect the driver's ability to control the automobile.
- Karts and other lightweight automobiles without crushable structures and rollover protection where the occupant is less likely to sustain injury by being thrown clear in an incident.
- Automobiles of historical significance where the structure or nature of the automobile would render the fitment of occupant restraint systems impractical without modification that would seriously affect their historical significance. This exemption will be recorded in the AASA Passport.

Level 2 – Two strap lap belt

A two-strap belt that couples in the centre and passes over the occupants hips. Such a restraint may be appropriate for:

- Low speed events in which the likelihood of collision and high speed rollover incidents is remote, and where the wearing of a more complex restraint may affect the driver's ability to control the automobile.
- Automobiles of historical significance where the structure or nature of the automobile would render the fitment of more complex systems incorporating upper body restraint impractical without modification that would seriously affect their historical significance. This exemption will be recorded in the AASA Passport.

Level 3 – Lap-sash belt

A lap sash safety belt is composed of a single strap mounted to the automobile at one end below the driver's hips on one side, and at the other end to a point at shoulder height on the same side. It is attached in use via a sliding detachable buckle to a second strap or semi rigid stalk. This is mounted to the automobile at the occupant's hips on the other side. This effectively forms a lap belt with additional diagonal restraint across the occupant's chest. Such a harness may incorporate an automatic retraction and locking system to enable the harness to adapt to occupants of varying size and seat location. A lap-sash belt is the standard requirement for all front seat occupants in automobiles operating on public roads. As such, the use of such belts should be regarded as the minimum acceptable in all competition events meeting the definition of "Road Level Risk".

Level 4 – Four-strap harness

A four-strap harness has four straps in contact with the occupant's body. Two of these straps pass over the occupant's hips to form a lap belt whilst a strap over each shoulder extends down to the lap-belt section providing upper body restraint. The shoulder straps may be separate straps that attach to a 4-way buckle assembly, or may be permanently attached to the relevant lap belts by the harness manufacturer. A four-strap harness provides improved restraint capabilities in forward and rollover impacts compared to a Lap-sash belt. It also provides a significant increase in the ability of the restraint to minimise lateral movement in the event of a side impact.

A four-strap harness is the minimum requirement for all competition that exposes the occupants to greater than Road Level Risk. This includes the following:

- Circuit races
- Tarmac rallies
- Gravel rallies with Special Stage sections
- Off Road Events
- Speedway and Superspeedway events.

A four-strap harness is not acceptable in automobiles with recumbent occupant seating however.

Level 5 – Five-strap harness

A five-strap harness is created when a crotch belt is added to what is otherwise a four-strap harness. Contrary to popular belief, this fifth belt is not intended to prevent “submarining” by restraining the occupant at the crotch area in the same manner as the shoulder straps bear on the shoulder. Rather, it is designed to hold the buckle in place low on the body by reacting against the forces applied by the shoulder straps. The primary restraint is always through the lap and shoulder straps.

A five-strap harness can be used whenever a four-strap harness is specified. A five strap harnesses must be used whenever the mounting points for the lap belt cannot meet the requirements shown in Drawing RS-8. This is particularly important when the occupant’s seat is in a more reclined position.

Level 6 – Six-strap harness

A six-strap harness utilises two separate crotch straps in place of the single strap used with a five-strap harness. This type of harness is indicated whenever the occupant is seated in a significantly reclined/recumbent position but may also provide a benefit in a Touring Car scenario. With a recumbent driver, the lower two crotch belts are designed to be passed under the driver’s legs, and mount to the chassis in an area close to the hips. This mounting point is often co-located with the main lap belt mountings. These straps assist in preventing forward motion whilst also assisting to maintain the buckle’s location against shoulder strap tension. Such harnesses should be used with an appropriate supporting seat structure.

In a Touring Car (Saloon) situation, the two straps must pass through the seat between the driver’s legs and be mounted slightly behind that area. The two straps should be mounted well apart to help pull the belts away from the genital area.

General

Strap width

The use of 75mm wide straps on any restraint system is highly recommended. The wider straps spread the loads over a larger area of the skeletal structure, reducing the likelihood of injury. All SFI and FIA spec harnesses utilise 75mm straps for the primary harness. Harnesses designed for use with certain types of head restraint utilise narrower 50mm shoulder straps. Such harnesses are marked accordingly and must only be used in conjunction with the appropriate head restraint.

Strap length

Harness straps should be kept as short as possible. In spite of the theory that a certain amount of stretch in a harness is good, the occupant is far better protected by being held rigidly by the harness whilst allowing the crushing of the automobile to reduce the overall acceleration. A loose belt will mean that the occupant will travel at undiminished speed in the initial stage of the collision, whilst

the automobile slows down. The occupant then suffers a double impact: first with the harness straps, and then the remainder of the impact as the automobile reduces speed.

Short straps assist with keeping the belts tight. Short shoulder straps also provide better protection in lateral and rollover situations where the occupant has a tendency to rise, or move sideways, during the impact.

Supplementary Straps

Harnesses with two straps over each shoulder have been developed for use with certain types of Frontal Head Restraint. The primary strap passes under the device whilst the other passes over, and restrains the device. As the upper straps do not contact the body, they are not considered as additional straps for the purposes of identification. Mounting of the shoulder straps with such designs shall be in accordance with the instructions supplied by the harness manufacturer.

Harness Serviceability

At scrutiny, and during competition, a seat belt restraining device must always be serviceable and fit for purpose during competition. Any seat belt/restraining device must always be in physically good condition, be free of signs of fraying or cuts and tears, have no evidence of UV or visible light damage, and no sign of any chemical contamination, when visually inspected.

A seat/belt/restraining device must also be in the date range of the serviceable period, as advised by the manufacturer.

However, due to extensive testing by a reputable external contractor, an FIA labelled belt, assuming continuance of serviceable condition, may be used for up to five years beyond the end of use date as provided by the manufacturer. Notwithstanding the date range, a restraining device must be suitable for service, as inspected at event scrutiny, at all times during competition.

An SFI labelled seat belt restraining device, may not be used beyond its end date, except for up to one year after expiry, and in one event only, at which the AASA Vehicle Passport MUST be endorsed to ensure belt replacement is undertaken before use in a subsequent event.

Window Nets

Circuit Racing

Automobiles which are required to have a safety cage Class 2 or 3 are required to have a safety nets fitted to the driver's door.

Ride Vehicles

Automobiles which are specifically designed for passengers required to have a safety cage Class 2 are required to have a safety nets fitted to the drivers and passenger's door.

Off Road Racing

Automobiles which are required to have a safety cage Class 2 or 3 are required to have a safety nets fitted to the driver's and navigator's door. Unless wrist restraints to SFI 3.3 are fitted in accordance with the AASA Off Road Racing General Requirements section 19 restraining each occupant's limbs within the vehicle.

Tarmac/Gravel Rallying

Automobiles which are required to have a safety cage Class 2 or 3 are required to have a safety nets fitted to the driver's and navigator's door.

Fitment

Automobiles which are required to have a safety cage Class 2 or 3 are required to have a safety nets fitted to the driver's and navigator's as follows:

- The window net must cover the opening forward to the centre of the steering wheel.
- It may be altered to ensure unrestricted view of mirrors.
- The net must be fastened to ensure that the mechanism can be detached with one hand even if the vehicle is overturned. The lever or handle must be visibly a different colour.
- Press button systems are allowed provided it is visible from outside the vehicle.
- Where an unmodified door (post 1970) retains the original OEM shatterproof window on the drivers or passenger's door then that is sufficient to comply with these requirements.
- Where an automobile retains the original OEM door, latches and hinges then the net may be mounted on the door frame all other automobiles must be mounted to the safety cage.

Mounting of restraint systems

Mounting of each restraint system should be in accordance with any guidelines/instructions supplied by the harness manufacturer.

In any case, mountings should be to a substantial section of the automobile. The forces involved in a serious impact are substantial, with shoulder/lap straps being forced to bear in excess of 800kgF each. By default, the shoulder straps should be attached to the safety cage, where such is fitted. Owners of road cars that will see substantial track time should consider fitting a demountable harness bar close behind the front seats. This will enable the use of a Level 4 harness. Child restraint anchorages on the rear parcel shelf are almost certainly not strong enough.

Note: whilst competition harnesses are very strong, they do not comply with the ADR requirements for road use. If you use your competition automobile on the road, the OE lap/sash belt must be retained and used for all open road sections.

Where lap and crotch strap mountings are made onto unreinforced areas of the floor pan, reinforcement plates must be used beneath the floor. These must be of minimum dimensions 50mm x 75mm x 3mm, with rounded edges. Utilise factory harness mounts where appropriate, but be aware that many manufacturers utilise metric threads, such as M11 x 1.25, rather than the more common 7/16-20 threads found on most eyebolts from specialist motorsport suppliers.

Where eyebolts are used, they must be aligned so the hole is perpendicular to the path of the strap. The eyebolts must be screwed home onto the surface of the mount. Crushable washers (copper, aluminium) should be used under the head to obtain correct alignment. Leaving a gap under the head of an eyebolt can reduce its strength by 50%. The locks of snap-in strap mounts must be secured with split pins through the holes provided to prevent accidental release.

Where mounting plates are bolted to the mounting point, care must be taken to ensure that the strap is not pinched. Utilise a spacer of sufficient height to clear the strap. Mounting bolts should be minimum of Grade 8.8 (Grade 8 imperial), 10mm minimum diameter in single shear or 8mm in double shear. It is desirable that the mounting plate bears on the shank of the bolt, not the thread.

Application

Hierarchy

In the event of a conflict, each requirement specified in Event and Series Regulations shall take priority over the general requirements of the present Appendix.

Minimum Restraint Level

Event/Group	National	Club	Testing
Touring Events%	3	3	3
Motorkhana	2	2	2
Trials	2	2	2
Extreme Events	3	3	3
Karting	1	1	1
Speed Events and Solo Drifting	4	3	3
Drift Battles	5	4	4
Races	5/6*	4/6*	4/6*
Gravel Rally	5	4	4
Tarmac Rally	5	4	5
Off Road	5	5	5
Speedway	5	5	5
Drag Racing	5/6*	4/6*	4/6*

Note: % Or as otherwise required by statutory authorities
 * Formula cars and others with recumbent driving position require a Level 6 six-strap harness