Test report

Securing Pets in Cars

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1. Key story

Drivers are required by law to secure any objects or pets carried in their vehicles. Different restraint systems are avaible. An exemplary test illustrates the extremely high risk potential involved when an unrestrained dog on the rear window shelf is catapulted forward in a frontal crash at 50kph.

A comparative study of various pet restraint systems shows that good pet securing systems are available starting under €30.00. The decisive factor is where and how these systems are installed in the vehicle. At an impact speed of 50kph and using a 22kg dog dummy and a 4kg cat dummy, most of the systems failed. The only convincing and safe solution is using a pet carrier which is secured in the correct position. The test revealed that the safest place to put pet carriers is the floor behind the driver's or front passenger's seats or alternatively the boot.

With pets in carriers, these are the safest solutions both for the pets and the car occupants. As space behind the driver's or front passenger's seats is limited, only small carriers will fit (for small pets only). All other in-cabin pet restraint systems proved to be flawed, some of them seriously. The most flawed were dog restraint systems consisting of a harness with tie-in(s) to the vehicle belt or belt buckle. The system with only one tie-in is the weakest and cannot restrain the 22kg dog dummy. The carabiner connector breaks and the pet dummy crashes into the front seat backrest causing a deformation over 30cm deep. The force of the impact and the deep deformation seriously compromise the driver dummy's lumbar area. Also, most serious injuries must be expected for a pet. With the second harness restraint system, the harness remains connected to the car seatbelt. But as the harness is insufficiently fastened to the 3-point belt, the belt slackens upon impact allowing a dummy excursion of approx. 40cm forward. This minimises but does not prevent an impact with the front backrest. Again, serious injuries must be expected for a pet. This is deplorable because with more stable seatbelt fastening allowing only minimal excursions, this type of harness system would be a good alternative in cars with small boots. This type of harness should connect to belt buckles or Isofix attachments to minimise excursions.

In a second test, we secured a carrier on the rear seat bench with a 3-point belt. We noted weaknesses in and around the carrier trap door. The force of the cat dummy's impact tore

the trap door from its hinges and the dummy crashed into the front seat backrest. There is an inherent risk of injuries both for the pet and the cabin occupants. We noted serious additional weaknesses around the belt anchoring points. The forces punctually transmitted by the belt made the carrier case crack. The system thus offers little restraint for the pet.

Comparing the pet restraint systems, we found that a large dog can be safely secured and danger prevented for the occupants only by using a large carrier installed in the boot and a stable partition grille. With the pet carrier laded transversally, the loads for the pet will be moderate in an accident. With the additional floor-to-ceiling protection grille, the deformation of the backrests can be reduced. Backrest deformation exposes rear seat passengers to preventable loads.

This is the configuration offering the best in-vehicle protection to both pets and vehicle occupants.

2. Objective

Today, there are over 23 million pets in German households, of which some 8 million cats and over 5 million dogs. Once in a while these pets need to ride in a vehicle, for instance to be taken to the vet or on holidays or to leisure activities. Under German law, pets in vehicles are treated like cargo. The driver must secure them adequately. §23 StVO (German highway code) makes the driver responsible for preventing threats to vehicle safety from cargo and occupants including pets. In the event of an accident, an unsecured pet is exposed to severe injuries and also poses a serious threat to the other vehicle occupants. To minimise risks, adequate restraints and protective measures for the occupants and for the pets are equally important.

With this comparative study of various systems, we aim to highlight the respective strengths and weaknesses of these systems.

3. Selection of test products

3.1. Selection criteria

Cats and dogs are the pets most frequently riding in motor vehicles. The scope of this test covers only products for these two categories of pets. Carriers are best suited for cats. Several solutions are possible for dogs, depending on the vehicle, the size and the character of the dog. They cover both securing the dog in the cabin or in the boot.

3.2. Tested products

System(s) for small pets, cats and small dogs:

- Carrier secured on the floor behind the driver's or front passenger's seats

Figure 1: Stable carrier for small pets without belt anchoring points

The carrier prevents a cat from moving around inside the cabin uncontrolled and from distracting the driver. Securing the carrier on the floor behind the front seats restricts its range of movement in an accident. It cannot get out of control and be hurled through the cabin.

- Carrier secured in a 3-point belt

Figure 2: Small pet carrier secured on rear seat as recommended by the manufacturer

The carrier is secured in the vehicle's 3-point belt. The belt is routed over the carrier to retain it in its position on the rear seat.

Systems for dogs:

- Dog harness with tie-in to vehicle belt (buckles or Isofix attachments)

Figure 3: Dog harness with double tie-in to vehicle belt

This is a harness going over the dog's head and around its chest. It can be attached either to the seatbelt, the belt buckles or Isofix attachments. To optimise positioning and restraint, the tie-ins run on both sides of the dog's body. For this test, we selected a product tying into the seatbelt, as Isofix attachments are not featured in every car. A solution attaching to the belt buckles was not available from this manufacturer.

- Dog harness with single tie-in to belt buckle

Figure 4: Dog harness with single tie-in to belt buckle

Unlike the dog harness with double tie-in to the vehicle belt, this system attaches via a simple carabiner connector and strap. The carabiner attaches to the harness and the strap to the belt buckle. This ensures a fixed but one-sided connection with the vehicle. The single tie-in gives the dog more room to move, but at the same time it does not keep the dog in a fixed position. This single attachment carries the whole load.

- Carrier in the boot

Figure 5: Stable carrier in the boot without additional attachments

The dog carrier is placed in the boot without additional restraint. It is placed transversally right next to the backrests to distribute loads for the pet homogeneously. Restraint is provided by the backrests. The carrier itself is a stable plastic structure.

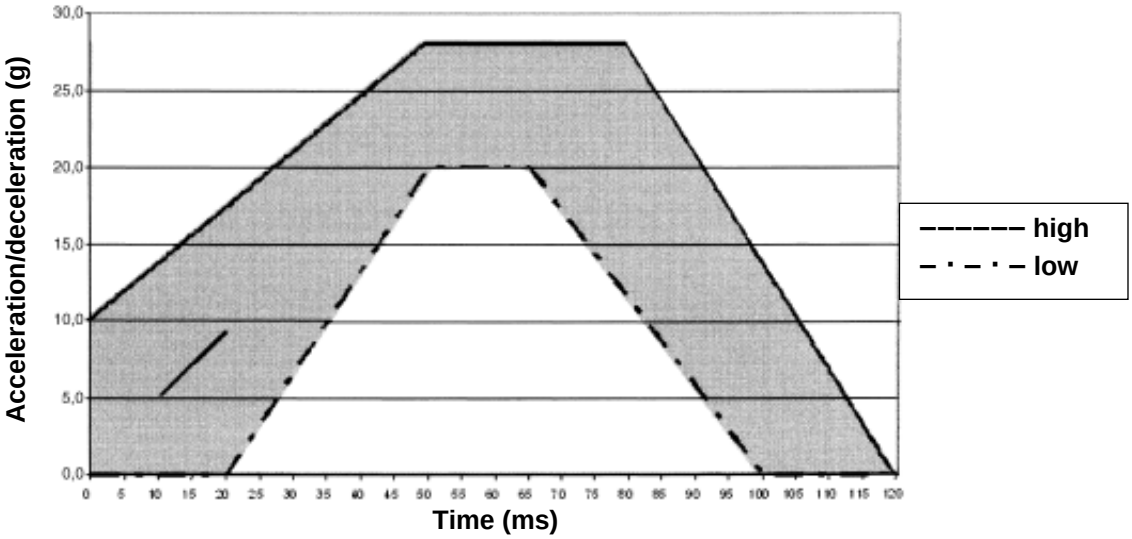
- Boot partition grille for estate cars

Figure 6: Partition grille for estate cars

For modern passenger cars, vehicle-specific partition grilles to which the C pillars provide stable support are only available for estate cars. In compact cars, the cabin can only be separated from the boot by all-purpose partition grilles which are considerably less stable than vehicle-specific partition grilles. Attached mostly between the ceiling and load floor, they are not able to absorb high loads.

4. Test procedure

To test their protection potential, all restraint systems were sled-tested. All systems were mounted in an Opel/Vauxhall Astra body in white with the seatbelts and seat system arranged to simulate the original car. The impact speed was 50kph. Deceleration was in conformity with ECE R17 requirements (backrest stability).



For the test, a 22kg dog dummy and an almost 4kg cat dummy were used. An adult dummy was placed on the driver's seat.

4.1. Test 1 – unrestrained dog

In this test configuration, a dog is transported unrestrained in the cabin. Most dogs are transported on the rear window shelf where they have unrestricted view. The worst case scenario includes a pet placed directly behind a passenger as the rear window shelf and the passenger's head are on the same level. This is why the dog dummy was placed directly behind the driver on the rear window shelf.

Result:

Upon the impact, the dummy on the driver's seat moves forward to the point where it is restrained by the seatbelt. Practically maintaining the impact speed, the dog dummy on the rear window shelf is hurled across the cabin at approximately 50kph. After 140ms, it hits the driver's headrest, bends the entire backrest and hits the side of the adult dummy's head before crashing into the windscreen.

Figure 7: 0ms – the dog dummy in its original position on the car's rear window shelf

Figure 8: 50ms – the dog dummy is hurled across the cabin unrestrained

Figure 9: 150ms – the dog strongly deforms the backrests and hits the driver's head and neck

This scenario may have serious consequences for the car occupants. The 22kg dog hits the front seats at approximately 50kph and may cause most severe head injuries to the passengers. Developing an impact load comparable to a weight of half a tonne, the animal itself faces a very high injury risk hitting both the seat and the driver and crashing into the windscreen and dashboard.

4.2. Test 2 – dog restrained in belt/dog harness

In view of the restricted boot capacity of small vehicles, pets can only be restrained in the cabin, mostly using harnesses with tie-ins to the vehicle belts. The dog is restrained on both sides, which prevents the animal from moving freely but improves load distribution and restraint. The different restraint systems are installed in the vehicle either by means of the belt buckles, the belt webbing or the Isofix attachments.

4.2.1. Dog harness with one tie-in

Systems with one tie-in to the belt buckle are easy to use. However, the impact energy of the forward-moving dog is so high that the carabiner attached to the dog's harness does not withstand the load and breaks. As a result, the dog hits the front seat's backrest at full speed.

Figure 10: Broken carabiner hook

The amount of energy is high enough to cause a deformation of roughly 30cm of the seat which may cause injuries to the driver's vertebral column.

Figure 11: 0ms – the dog in its original position on the rear bench

Figure 12: 83ms – with the dog dummy moving forward, the carabiner does not withstand the load and breaks

3

Figure 13: 125ms – the dog dummy bumps into the driver's backrests, causing extreme deformation

Such an impact is likely to cause severe back injuries to the passenger and most severe – if not fatal – injuries to the dog. This combination provides no protection at all.

4.2.2. Dog harness with two tie-ins

The second dog harness tested was equipped with two tie-ins to the vehicle belt system. Screw lock carabiners are used on either side to attach the lap belt to the harness. Additional plastic clamps hold the carabiners in place.

Figure 14: Carabiners and clamps are used to attach the dog harness on either side

The plastic clamps do not withstand the load of the forward-moving dog and the two carabiners shift towards the seat centre. This and the somewhat slackened seatbelt cause the dog to be hurled forward by more than 40cm and crash into the front seats.

Figure 15: Under load, the clamps shift towards the centre of the lap belt creating considerable belt slack

The restraining potential of the intact harness system prevents any further forward motion and contains the deformation of the driver's seat. There is no load transmitted to the driver's lumbar area. As the seatbelt slackens upon the impact, the dog may sustain severe injuries when crashing into the seat. There are no additional loads exerted on the driver. However, with the seat set farther back, also the driver may sustain injuries.

Figure 16: 0ms – the dog in its original position

Figure 17: 75ms – upon the impact, the dog is hurled forward. The load makes the belt clamps shift towards the centre, and the seatbelt slackens

Figure 18: 100ms – the dog harness restrains the pet only after it hit and deformed the driver's backrest

4.3. Test 3 – pet carrier restrained with vehicle belt

According to manufacturer specifications, the carrier for small dogs or cats is installed on the rear seat bench using the vehicle belt. Due to the weak attachment and the carrier's instability, the carrier failed the test.

Figure 19: Pet carrier trap door torn from its hinges and belt attachment points destroyed

Upon the impact, the cat dummy is hurled forward tearing the trap door from its hinges before hitting the front backrest at almost full speed. The carrier's belt attachment points are severely damaged, and the top part of the carrier breaks. Under a slightly higher load, the system would fail completely and the carrier would no longer be restrained. While the pet is likely to sustain the most severe injuries, the front passengers may have to sustain additional loads.

Figure 20: 0ms – the carrier in its original position

Figure 21: 90ms – the pet carrier's anchoring points burst when the cat dummy forces the trap door open

Figure 22: 140ms – the dummy flings the trap door open before hitting the front passenger backrest at almost full speed

4.4. Test 4 – pet carrier secured in footwell behind front seats

A safe place for the in-vehicle transport of pets is the footwell behind the front seats. As space behind the driver's or front passenger's seats is limited, only carriers for small pets will fit (cats or small dogs). As the carrier has little room to move, the impact energy is absorbed early after the impact. The pet carrier is barely deformed as the load on the carrier is spread on the large substructure of the seat. Being positioned transversely to the impact direction, the pet only faces minor injuries. No additional loads are exerted on the car occupants.

Figure 23: Good restraint of the pet carrier and even load distribution

4.5. Test 5 – pet carrier secured in boot

Requiring more space, larger dogs are best transported in the boot. The safest option is a pet carrier matching the dog's size and installed transversely to the direction of travel. Stable backrests effectively restrain the carrier. As the pet is positioned transversely to the direction of travel, loads are distributed over the whole body and the vertebral column is not compressed. However, damage to the carrier and backrest deformation reveal the high amount of impact energy released by the 22kg dog dummy. Especially if loads are high, injuries to rear passengers cannot be ruled out. A good solution would be a stable grille separating cabin and boot and covering the rear backrest.

Figure 24: 125ms – upon impact, the dog carrier is pushed into the backrest

Figure 25: Post-crash deformation showing the high load on the rear backrest

Using a partition grille only and no carrier for the transportation of an animal, the pet can move freely but, depending on the pet's position, loads on its vertebral column may be very high especially in the direction of travel. Occupant protection can be ensured by using stable partition grilles meeting ECE R17 requirements. The safest option is the combination of a partition grille and a pet carrier.

5. Summary/ADAC recommendations

Drivers are required to use the same level of care to ensure that both pets and occupants or cargo are suitably restrained in a vehicle. §23 StVO (German highway code) makes the driver responsible for securing pets. Restraint systems should be suitable for the space available in the car and the pet's size. While a cat is very easy and safe to transport in the car, securing a large dog will require more attention and effort.

Securing pets does not only aim to ensure the safety of the animal but also that of the occupant. This applies both to harsh braking and accidents. In the event of a frontal impact at approximately 50kph, unrestrained pets can generate high impact loads of thirty times their own weight. This means that a 20kg dog has an impact load in excess of half a tonne which is an additional load for the vehicle occupants and may reduce or invalidate the protection of safety systems such as seats, seatbelts or airbags. To keep the accident risk for occupants and pets as low as possible, it is essential that they are secured adequately.

To accommodate different-sized dogs, dog harnesses are available in various sizes. Very stable harnesses can reduce the occupants' injury risk provided they come with large belts with metal attachments and two tie-ins. This is the only way to ensure load absorption and to minimise the load on the animal. The pet's forward excursion depends on the seatbelt length. Stable attachment points in the vehicle are a prerequisite. The attachment must allow barely any clearance to prevent the seatbelt from slackening, which will lead to more excursion. Pets should best be tied in to the belt buckle system or Isofix attachments. Leashes are not recommended to secure pets as they do not restrain the animal and pose a danger for the occupants. Also, they present a very high neck injury risk for the animal. Using this type of restraint system, the pet's free movements can be dangerous for both the animal and the occupants.

Transporting pets in estate and/or hatchback cars using a boot partition grille is a very safe transport option. However, as many older vehicles have insufficient backrest stability

(notably with split backrests), stably anchored ceiling-to-floor boot partition grilles in compliance with DIN standards (75410-2) should be preferred. Stable boot partition grilles can reduce the additional injury risk for the occupants. The animal will neither distract the driver nor get in the way of rescue services. However, it is essential that the grille be mounted securely as it will not restrain the animal otherwise in the event of an accident. If the tailgate and partition grille are far apart and the animal has much room to move freely in the boot, the animal may sustain increased loads in the event of an accident (pre-crash acceleration when positioned in the direction of travel).

A pet carrier can be used in combination as a remedy. It is also an alternative for transporting pets in the boot, provided the carrier is positioned correctly in the vehicle. To ensure optimum load distribution over the vehicle and to prevent spinal compression in the animal, the pet carrier should be placed as closely to the backrest as possible and transversely to the direction of travel.

Also, using a small carrier to transport a pet in the cabin is acceptable, if the carrier is placed in the footwell behind the front seats in a way that it does not skid around. If a pet carrier is secured on the rear bench or on the front passenger’s seat by means of the vehicle’s 3-point belt, high forces are punctually transmitted to the carrier, which may cause the case to crack; this protects neither the pet nor the occupants.

6. ADAC demands

- When transporting animals in vehicles, they must be secured at all times to pose no increased injury risk for both the passengers and the animal itself in the event of an accident
- Pet restraint systems should be crash-tested and meet ECE R17 or DIN75410-2 requirements
- The car’s operating instructions must include precise and clear information on how to correctly secure pets
- Restraint systems for transporting pets on the rear seats (e.g. dog harnesses) must have a short and stable attachment system to prevent the pet from crashing into the front seats with severe consequences