SPCT-method – Pet crate testing

Scope

The SPCT[1] method refers to testing of pet crates for safety of pets and passengers in a collision with a car. It provides instructions how pet crate safety can be tested as there is no applicable standard.
The rear seat strength in a frontal collision is normally tested according to United Nations regulations no. 17 (ECE R17) with wooden blocks. The same frontal impact test is carried out with the dog crate as one of the three elements of the SPCT method.
Studies of statistics regarding the number of families with both dogs and children in Sweden have shown that an increasing number of rear-end collisions with a dog crate in the luggage compartment area will occur as the use of dog crates continue to increase. (Ny metod för analys av hundburars påverkan på bilars säkerhet, Anders Flogård, MIM Construction AB, 2008-02-22). A test of the crate performance and ability to not transfer energy into the back seat in a rear end collision is one of the test elements.
The robustness of the crate is also taken into account in the testing methodology to prevent injuries to animals and passengers in all types of collision directions.

References

[1]	ECE R17	*APPROVAL OF VEHICLES WITH REGARD TO THE SEATS, THEIR ANCHORAGES AND ANY HEAD RESTRAINTS*	Rev.2, Annex 9, 6 nov. 2009
[2]	ECE R44	*APPROVAL OF RESTRAINING DEVICES FOR CHILD OCCUPANTS OF VEHICLES*	Rev.2, Annex 7 - Appendix 2, 14 feb. 2011

1 Test object selection

The test objects are selected by the customer.

2 Test object

Drawings of the test object shall be submitted along with the test object.
The maximum permissible load for the test object shall be stated such as 45 kg or 2x35 kg.
Fasteners and mounting instructions for the vehicle must accompany the test object.

3 Testing

The testing consists of three elements. A frontal impact test in a car body with the crate installed in the luggage compartment, a barrier collision against the crate and the car body simulating a rear end collision and a drop test against a corner of the crate in order to test the robustness of the crate in all types of crash directions.

[1] SPCT stands for Safe Pet Crate Test

3.1 Frontal impact crash test

The parts included in the frontal crash test are as follows:

- Measuring of the test object
- Tuning of speed and deceleration pulse
- Photography and documentation prior to the test
- Testing and evaluation
- Photography and documentation after the test
- Evaluation of the criteria

3.1.1 Measuring of the test object
The test object is being controlled for compliance with the submitted drawings.

3.1.2 Prepare/connection of equipment
Make sure all the equipment is calibrated. Check the views and operation of the high-speed cameras.

3.1.3 Tuning of speed and deceleration pulse
The rear part of a prepared Volvo V70N body is mounted on the crash sled. The rear seat backs mounted in the body must have a 60/40 split and have an aluminum frame (2001-2004). The backs are positioned in the comfort mode.
The speed of the sled and the deceleration pulse simulates a front collision taken from the ECE R17 [1].

3.1.4 Installing the test object
The dog crate shall be placed in the luggage compartment in accordance to the manufacturer's instructions, see figure 1 in Appendix 1. If the test object consists of a separate area it requires a 45 kg payload and if the test object consisting of two separate areas it requires two payloads of 35 kg each. If permissible load is reduced by the manufacturer that same load should be used during testing.

3.1.5 Photography and documentation prior to the test
The positioning of the test object is photographed and documented.

3.1.6 Testing and Evaluation
The crash test is performed by accelerating the crash sled with the car body to a speed of 48-50 km/h and then decelerate the crash sled in 20-28 g to simulate a frontal impact car crash. The deceleration is measured by accelerometers mounted on the crash sled. The deceleration graph is analyzed after the test.

3.1.7 Photography and documentation after the test
Damage to the test object, the luggage compartment floor and seat backs are photographed and documented after the test.

3.1.8 Evaluation of the criteria

The criteria for the frontal crash test is based on the following:

- Risk for the pet to fall out of the test object during and after the crash?
- Sharp edges after the crash. Can the dog be severely injured by sharp edges if the car rolls over several times?
- Can the test object be opened and evacuated after the test without the need of tools and/or excessive force.
- Does the test object have an evacuation hatch. A hatch that can be used if the regular door can't be opened or accessed after an accident.

3.2 Rear impact crash test

The elements included in the rear impact crash test are as follows:

- Measuring of the test object
- Preparation/connection of equipment
- Tuning of speed and deceleration pulse
- Installation of crash test dummy and test object
- Adjustments of the intrusion barrier
- Photography and documentation prior to the test
- Testing and evaluation
- Photography and documentation after the test
- Evaluation of the criteria

3.2.1 Measuring of the test object

The test sample is being controlled for compliance with the submitted drawings.

3.2.2 Preparation/connection of equipment

Make sure all the equipment is calibrated. Check that the correct measurement range is set for dummy accelerometers. Check the views and function of the high-speed cameras.

3.2.3 Tuning of speed and deceleration pulse

The rear part of a prepared Volvo V70N body is mounted on the crash sled. The rear seat backs mounted in the body must have a 60/40 split and have an aluminum frame (2001-2004). The backs are positioned in the comfort mode.
The speed of the sled and the deceleration pulse simulates a rear end collision taken from the ECE R44 [2].

3.2.4 Installing the crash test dummy and test object

A Hybrid III 50 percentile crash test dummy is placed in the left rear seat (position 4 in accordance with ISO encoding). The Dummy shall be equipped with a three-axial accelerometer in the head and a single axial accelerometer at the height of the upper thoracic vertebrae, T1, see figure 4 in Appendix 1. The dog crate shall be installed in the luggage compartment in accordance to the manufacturer's instructions, see figure 2 in Appendix 1. If the test object consists of a separate area it requires a 45 kg payload and if the test object consisting of two separate areas it requires two payloads of 35 kg each. If permissible load is reduced by the manufacturer that same load should be used.

3.2.5 Adjustments of the intrusion barrier

The intrusion barrier is adjusted so that a minimum of clearance against the luggage compartment floor is achieved. The deformation of the test object shall begin at about 100 mm of travel after the crash sled deceleration start, see figure 3 in Appendix 1.

3.2.6 Photography and documentation prior to the test

The positioning of the crash test dummy and the test object is photographed and documented.

3.2.7 Testing and evaluation

The crash test is performed by accelerating the crash sled with the body to a speed of 30-32 km/h and then decelerate the crash sled in 14-21 g to simulate a rear impact car crash. Deceleration is measured by accelerometers mounted on the crash sled. The deceleration graph is analyzed after the test.

3.2.8 Photography and documentation after the test

Damage to the test object, luggage compartment floor and seat backs are photographed and documented. The upholstery on the seat backs must be removed before taking photos.

3.2.9 Evaluation of the Criteria

The criteria for the rear impact crash test are based on the following:

- Head 3 ms acceleration and HIC 36. Acceleration data from the three axial accelerometer in the dummy head should be filtered using a CFC 1000 filter. The HIC 36 and the maximum acceleration during the main 3 milliseconds, multiple peaks, is calculated.
- T1 acceleration. The acceleration of the dummy upper thoracic vertebra is filtered using CFC 180 and the highest value is noted.
- Horizontal deformation of the seat back. The deformation of the seat back measured over the entire seat back flat part, with a reference steel scale or similar positioned towards the top and bottom of the seat back, see figures 5 and 6 in Appendix 1.
- Penetration depth of the seat back. Isolated holes or deformations from penetrating parts are measured in depth compared to the back flat part, see figure 7.
- Risk for the pet to fall out of the test object during and after the crash?
- Sharp edges after the crash. Can the dog be severely injured by sharp edges if the car rolls over several times?
- Can the test object be opened and evacuated after the test without the need of tools and/or excessive force.
- Does the test object have an evacuation hatch. A hatch that can be used if the regular door can’t be opened or accessed after an accident.

3.3 Drop Test in order to simulate a roll over situation

The elements included in the drop test:

- Measuring of the test object
- Preparation/connection of equipment
- Suspension of the test object in the release mechanism
- Measuring of vertical drop height and the adjustment of impact angle
- Photography and documentation prior to the test
- Testing and evaluation
- Photography and documentation after the test
- Evaluation of the criteria

3.3.1 Measuring of the test object
The test object is being checked for compliance by submitted drawings.

3.3.2 Preparation and connection of equipment
Make sure all the equipment is calibrated. If the test should be recorded with a digital video recorder, check the view and the operation of the camera.

3.3.3 Suspension of the test object in the release mechanism
A release mechanism that is not likely to affect the subject is being positioned above a rigid drop target. The test object is attached with straps to the release mechanism, see figure 8 in Appendix 1.

3.3.4 Measuring of the vertical drop and the adjustment of impact angles
The weakest corner of the test object shall be exposed to the drop test and this point is to be decided through an engineering assessment. The position of the test object is adjusted by straps and rotated around the vehicle's intended longitudinal axis 45° and then rotated around the vehicle transverse axis 15°, see figure 8 in Appendix 1. The drop height for the lowest point of the test object is adjusted to 70 cm above the rigid drop target.
If the test object consists of a separate area it requires a 45 kg payload and if the test object consisting of two separate areas it requires two payloads of 35 kg each. If permissible load is reduced by the manufacturer that same load should be used.

3.3.5 Photography and documentation prior to the test
The positioning of the test object is photographed and documented.

3.3.6 Testing and evaluation
The test object is released by a release mechanism against the drop target. The impact speed is calculated to be approximately 3.7 m/s. The test can be recorded by a digital video camera upon request to facilitate further analysis.

3.3.7 Photography and documentation of the damages to the test objects
Damage to the test object is photographed and documented.

3.3.8 Evaluation of criteria

The criteria for the simulation of the roll-over situation are based on the following:

- Risk for the pet to fall out of the test object during and after the crash?
- Sharp edges after the crash. Can the dog be severely injured by sharp edges if the car rolls over several times?
- Can the test object be opened and evacuated after the test without the need of tools and/or excessive force.
- Does the test object have an evacuation hatch. A hatch that can be used if the regular door can't be opened or accessed after an accident.

4 Calculating criteria

The overall test results from the three test phases are added together to form green, yellow or red results in Table 1 below. Description of the criteria contained in Chapter 3.1.8, 3.2.9 and 3.3.8 above.

Table 1

Test	Criteria	Green	Yellow	Red
All test elements	Risk for the pet to fall out of the test sample during and after the test	No	-	Yes
	Sharp edges after the test	No	-	Yes
	Test sample able to be opened and evacuated after the test without the use of tools/violence	Yes	-	No
	Accessible evacuation hatch	Yes	No	-
Rear end collision	Head 3 ms acc	< 70 g	70-80 g	> 80 g
	HIC 36	< 400	400-500	> 500
	T1-acc	< 70 g	70-80 g	> 80 g
	Horizontal deformation of the seat back	< 50 mm	-	> 50 mm
	Depth of penetration into the seat back	< 15 mm	-	> 15 mm

In order to get a "Green" result when tested it is required that the entire column "**Green**" is achieved. If the test object has no evacuation hatch the result may never be green. If any of the criteria is yellow (and no red), the complete test result is "Yellow". If any of the criteria is red, the complete test result is "Red".

5 Measurement uncertainty

SP works consistently with relative measurement uncertainties, ie. uncertainties are given in percent of displayed or estimated value. To facilitate the reporting process, we specify to the maximum extent possible the same measurement uncertainty for different tests. To achieve this, all instruments is checked for their detailed contributions to the overall measurement uncertainty.
Measurement uncertainty for the frontal crash test and rear end collision test will be determined according to the derivation of the measurement uncertainty of crash testing, and dimensional analysis (length).
Measurement uncertainty for the drop test is determined according to the derivation of the uncertainty of drop tests.

6 Test report

A test report in accordance with SP's general writing rules shall also include:

- A summary of the test result
- A graph showing the head and neck acceleration for the crash test dummy
- Deformations measured in the backrests and photographs of these
- A description of the condition of test object after each of the three test elements
- Graphs showing the deceleration pulses and corridors of ECE R44 and ECE R17
- A result matrix with maximum reference values
- Measurement uncertainty and how it is calculated
- An overall drawing of the test object

Appendix 1

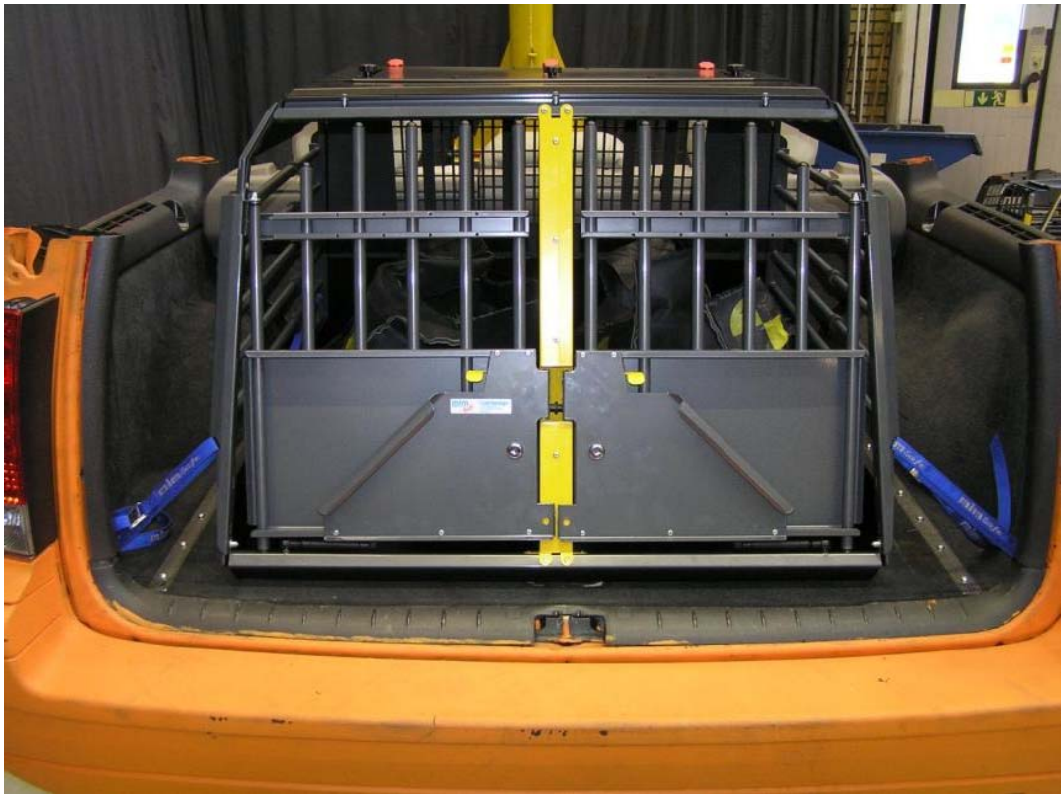

Figure 1, Set-up, frontal impact test

Figure 2, Set-up, rear impact test

Appendix 1

Figure 3, The crash barrier position when the crash bars starts deforming (braking)

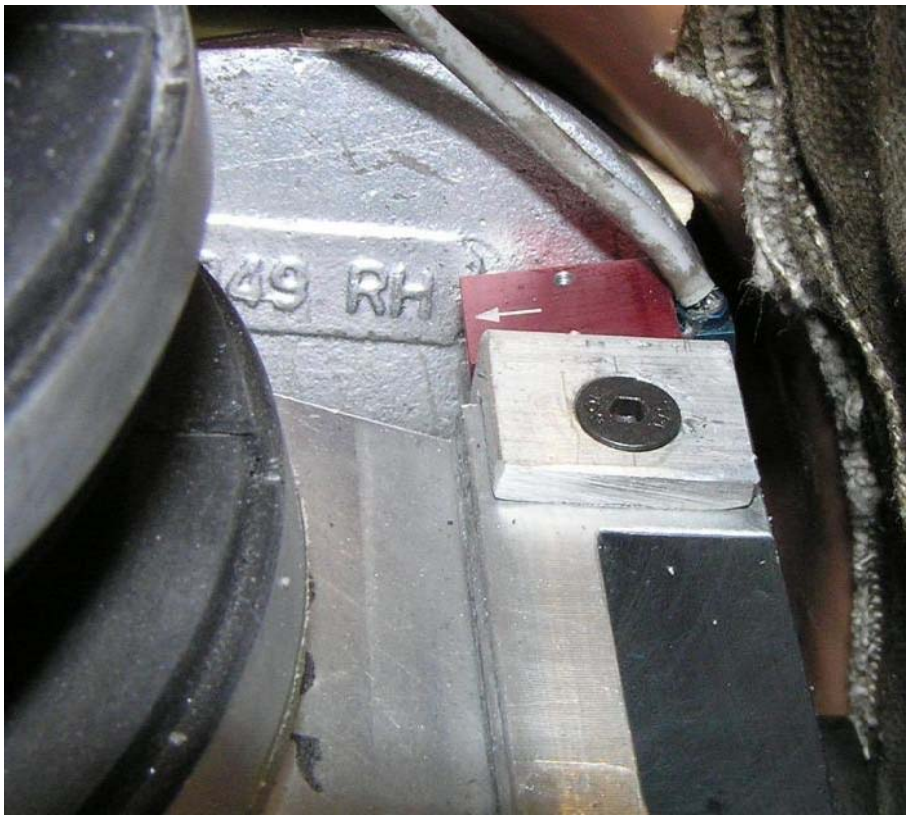

Figure 4, Location of the T1 accelerometer in the crash test dummy

Appendix 1

Figure 5, Measuring the horizontal deformation of the seat back

Figure 6, Measuring the horizontal deformation of the seat back

Appendix 1

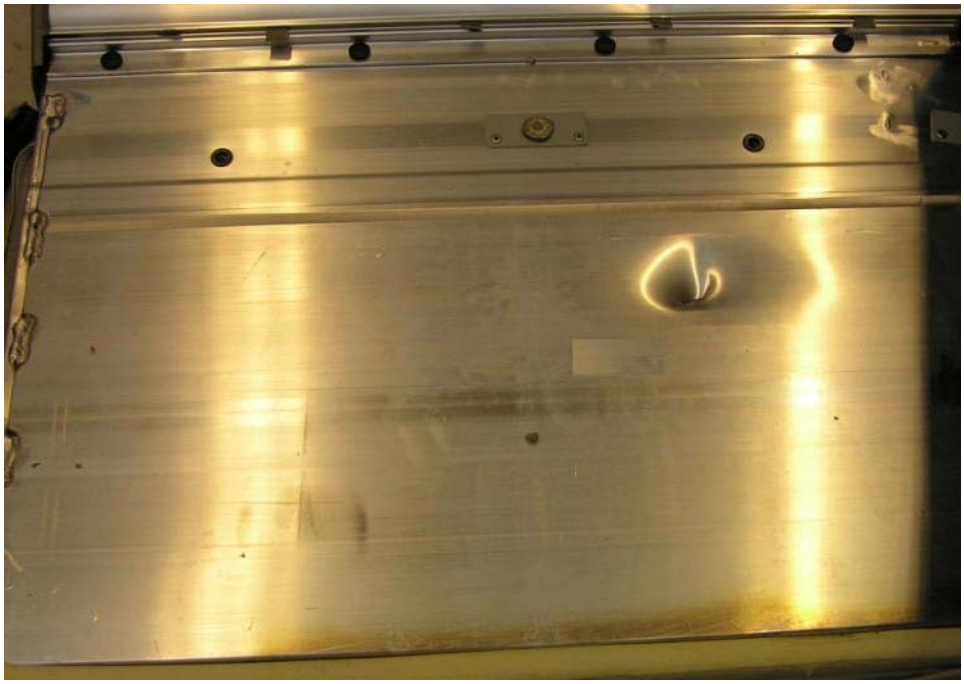

Figure 7, Penetration hole after the rear impact test

Figure 8, Angle adjustment of the test object before the drop test