MIM CONSTRUCTION AB

Crate Crash Test Market Report

“Consumers right to know the truth”

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The market is presented a number of Crash Tested crates for Dogs in Cars. But have the tests really been representative to the reality crates are facing in the hands of the consumers? This report is analyzing different test methods that have been used on the market to present dog crates as “Crash Tested” and the negative effects following.

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Introduction

The Author Anders Flogård has previously worked as a research engineer for ten years at the University of Chalmers, well-known for its contribution to reduction of whiplash injury risk in all cars. The work can be separated into two different periods. The first 5 years working as a whiplash crash test dummy developer with experience of hundreds of crash tests in Sweden, Austria and Japan. The last 5 years as a manager with responsibility to collect on scene crash data together with Volvo, Saab, Autoliv and the Swedish Road Authorities in different national and European projects, all in all about 500 crashes. Ongoing research project during 2019 is designing the next generation of female whiplash crash test dummy in the EU project Virtual.

There is still a lot to be done to improve the overall safety during transports of dogs in cars. The car industry has not been interested in taking care of the problem as the challenge interferes with design, fuel consumption and in the end, cost. Thus the responsibility to prevent consumers from exposing themselves to unknown risks has been given to the producers of dog transportation equipment. This has been done with various results, sometimes even increasing risks instead of improving the situation.

As the pet industry has been growing more and more, pet crate producers have defined their own standard for crash testing of crates. Also various independent consumer tests have been performed. Most of them have shared a lack of focus on real world safety and probable accidents. One reason could be that crates have been used differently in different parts of the world and that simple tests have only focused on a few aspects simultaneously. Another reason could be promoting a certain type of dog crate use because of lack of deeper knowledge about cars and safety standards.

Unfortunately the differences between most frequent use and test method / test results have in most cases not at all been explained to the public and sometimes tests have been used out of context only for promoting sales for specific producers. In general, a previous lack of knowledge is obvious to the author; often the relevance has been poor and misleading.

Without a real world relevance presented to the consumers, only good or bad and without any information about how the crate design preferably should be used, there has been and will always be a risk of misguiding consumers into misuse. Consumers will for a long time continue using their crates in unsafe ways, misguided by test setups that has not reflected state of the art and reality. Some consumer tests have even been set up against the instructions supplied by the manufacturer to promote specific qualities not representing the public majority use. In most tests only the dog has been taken into consideration and any impact on other passengers' safety has been disregarded.

A look at real world accidents statistics would serve as a base for a review of crash test methods and relevance if connected to legislation and crash science. Statistics from different sources show some differences in distribution but in general about 60% of all crashes have been found to be frontal, 20-25% rear end crashes, 15% side collisions and 5% roll over. Some of these occur as multiple crashes with more than one type of crash.

Legislation around transporting dogs shifts in different countries but within EU the dog has most commonly been considered as a part of the cargo, thus, should be properly restrained. This demand works twofold, the driver should not be disturbed physically while driving and the dog should not be thrown around in a crash as it might injure other passengers.

What restrained means from a legislation point of view is not at all clear as there have not been any references to dogs. A harness would fulfill the first demand, not disturbing the driver but would not necessary keep the dog restrained in a crash.

Another way to keep a dog restrained has been placing it in the trunk with a cargo net separating the trunk from the passenger compartment. But many cargo nets do not close the possibility for the dog to pass beside in the air bag zone. A dog crate has proven to be a better option as they always keep the dog inside the vehicle during and after a crash.

Some countries or areas outside EU have not considered the dog as being cargo that should be restrained and the legislations look different although many dog owners still think of the safety when choosing how to transport their dogs.

Crash science: There is a considerable knowledge about force ways into a chassis, deformation zones and cargo in trunk during impact within crash reconstruction that can be used to develop relevant tests. What can seem obvious to an experienced crash investigating engineer might not be expected by the layman.

The following analysis is focusing on dog crates only, as previous test methods used to define “crash tested dog crate” have been so fundamentally different from each other.

The frontal impact:

The frontal crash is the most common crash configuration and is representing about 60% of all crashes. A lot of the frontal crashes are single accidents. Either the car is running into an object or it is a front to front head on crash between two vehicles. A modern car is well prepared for frontal crashes with seat belts and airbags and rear seats taking a lot of the crash load if there is luggage in the trunk. With dogs inside the car it has to be considered the risk of being hit by the dog being thrown forward. With a poorly restrained dog crate there is the risk of being hit if the crate is not effectively stopped from being thrown forward.

There is an ISO Standard that tests cargo restraint system and car seats, the ISO 27955 (replacing the ECE R17). This test is commonly used as a reference for tests of dog crates. These dog crate tests can be separated into a number of sub groups all using the ISO 27955 frontal crash test deceleration pulse:

1. The typical open sled together with high strength load rings.
2. The typical sled and plank together with high strength load rings.
3. The typical sled together with bus seats and high strength load rings.
4. The typical sled together with a quarter body station wagon including rear seat and load rings.

1: The typical open sled together with high strength load rings.

The crash test was designed to show the excellence in strength in anchorage points of different crates. The crate was only attached to high strength load rings during the crash test deceleration.

Effects: In commercial vehicles there are load rings that outperform the strength in passenger car load rings that can take advantage in having good anchorage points on a crate. But the risk of giving consumers the feeling of being safe using load rings in passenger cars as the only means to prevent the crate from coming loose has been neglected. This test has probably fooled many consumers into an unsafe behavior using rear seats folded down to give more space because of an exaggerated trust in load rings.[1] As an example a well-known manufacturer have used load rings that breaks at about 800N, less than 10% of the crash strength needed at 50 km/h with two large dogs in a crate. This particular load ring cannot stand more than 5kg attached firmly in the ISO 27955 crash test. No known station wagon on the market has been able to handle two large dogs in a crate using the load rings only.

2: The typical sled and plank together with high strength load rings.

This crash test has been designed to be as simple as it gets and is cost saving. There are hardly any real world cases where this test is relevant. Cars simply don’t have a plank on the floor taking all the frontal crash loads.

Some crates have been attached with as much as 8 straps into high strength load rings during this test to not break or open the door in dog rebound due to poor locking mechanisms. Some crates have even been tested with an extra harness to pass the test and the harness has later been excluded but the crate itself has still been promoted as crash tested in sales info.

Effect: Crates have been promoted as crash tested without any explaining results proving quality of test. The consumer has often been fooled by the fact that the crate will later not be used like it was tested unless the dog owner has made or added something extra that was not included. This test has also made consumers believe that load rings are adequate for the loads involved, look at point 1.

3: The typical sled together with bus seats and high strength load rings.

This test has used a flat sled with mounted bus or MPV seats in front of the crate. It also used high strength load rings that can only be found in commercial vehicles and some MPV: s. This test would be relevant to any owner of a bus or MPV but these models probably represents only a small fraction of all vehicles that are being used with dog crates. Typical models have been Ford Tourneo's, VW Caravelle and VW Caddy.

Effect: This test has fooled many consumers. Misleading relevance has not been explained by testers, test has not been aiming for the majority of users. Some crates have been reinforced to pass the specific test before the test was made public. This test has also made consumers believe that load rings would be adequate for the loads involved, look at point 1.

4: The typical sled together with a station wagon rear seat and load rings.

This test has used a standard station wagon body with rear seats put on top of a crash test sled. Load rings used were standard load rings placed in a standard configuration. Crates were installed to producer's instruction and loaded with dog dummies to the maximal limit. Door opening due to dog rebound speed from elastic crate/seat back interaction during impact have been noted on many crate models with this test. (Door opens due to overload by the dog bouncing back inside the crate). The test most likely represents more than 80% of all use of crates that has specifically been made to be used behind a station wagon rear seat bench. Unfortunately, very few crates have been tested like this except in real world accidents.

Effect: The test reflects the majority use of dog crates on the European market and has been representative to all use in station wagons. The consumers have been directed towards a safe use of dog crates in normal cars by using the rear seat back as a barrier, thus improving overall safety for dog owner and families.

The rear end impact:

About every fourth real world accident is a rear end impact. The very dynamic rear end crash has proven to be a crash full of unwanted effects. The crate is normally placed in the rear end crumple zone that is being built in to cars to protect all passengers from overload accelerations. This has made the rear end crash test difficult to perform in a repeatable way. It is yet very important because it is the only real threat to the passengers in the rear seats. All other crash directions have proven to not be a big threat to passengers as long as the rear seat back has been up. But in the rear end crash case there is intrusion that works through the crate straight into the rear seat back. The majority of all rear end crashes have not given large intrusions but at some point they start to be really dangerous. The amount of intrusion depends on the intruding vehicle speed and weight. (*I have recorded cases with dogs in the trunk with interior intrusions up to 500mm or 20”).*

A crate does not need to be very rigid to destroy the seat back completely as the intruding vehicle might weigh 1 500-20 000kg compared to a 120kg dog crate pushing on the rear seat in a frontal impact. Any thought on building rigid crates will be in direct conflict with the safety of the passengers traveling in the rear seat. Thus, having some kind of a protection system must be regarded as essential. A clever dog crate must work together with the crumple zone or it has to be placed somewhere outside the crumple zone.

(The scenario works like this: The rear end of the trunk starts to accelerate into the car. This means that the dog and crate is hit by the intruding vehicle front. With some padding like several layers of sheet metal this would be less severe but it means the rear facing crate end is thrown against the dog that then packs up against it, thus leaving lots of empty space in front of the dog inside the crate. When the acceleration is done we have the rebound phase. The packed up dog is thrown forward into the forward facing side of the crate. The less space left for the dog, the less speed difference gained before impacting the other end of the crate and less injuries sustained by the dog. At this point our hit car has gained lots of speed forward and might also crash into other cars or objects in front. Again the room between the dog and the front wall inside the crate is of importance. If the rebound phase and a secondary crash into another car in front happen together, the distance is even more important to the dog.)

A stiff crate that does not change in length protrudes forward during the intrusion from behind and impacts the rear seat back. The more room there is between trunk rear end and crate, the better, as there is less chance of impacting the seat with the crate. A crate that collapses easily will also help the situation.

(The scenario works like this: The passenger seat is accelerating forward by the impacting vehicle pushing the complete car. This motion is dampened by the crumple zone in the trunk. With a stiff crate being pushed forward during crumpling we have an impact against the seat back where the passenger already is getting pushed forward as the seat accelerates forwards together with the car. The extra load from the stiff crate then pushes the passenger into even higher accelerations that can give whiplash, head injuries and also the possibility to actually in the end get crushed between the seat back and safety belt.)

The intrusion effect has proven to be far from easy to create for an evaluating crash test. The test set up needs a crash test dummy seated in front of the seat back to enable recordings of acceleration forces. To get the acceleration effects from the intruding crate right and a good balance between intruding forces and crash acceleration, a test set up is needed where the crate will be pushed forward together with a forward directed acceleration (like in reality). This cannot be recorded and evaluated by any other simplification. As the crumple zone works together with the intrusion during the acceleration forward just hitting a crate with a pendulum will not work, the important dynamic effects are left out. A pendulum test would only prove how resistant the crate is but not the recorded increased risk of injuries to the passenger in front or the dynamics of the dog inside the crate.

The test has been developed at the independent test site RISE in Borås, Sweden. The rear end test has used parts of a child seat test, the ECE R44 rear end test acceleration representing a car being hit from behind. The intrusion affecting the crate has been limited to about 125mm to record the interaction without destroying the test set up. Head accelerations and T-1 accelerations have been recorded and compared to an identical test performed without a crate to evaluate the increased risk. A further description can be found at RISE.

The dynamics of a Roll Over:

A roll over can be a violent experience but has not been considered to give high acceleration levels. The center of gravity fall distance has most often been found to be not more than about half a meter. This does not apply to a somersaults roll over where most of the dynamics happen over the front or rear of the car. These somersaults normally involve so many unknown force directions that making a relevant repeatable test has not yet been done. But in all roll overs, forces have been found in all directions and the rigidity of the crate has proven to be of importance. Thus a rigidity test has been considered to be the best way to evaluate roll over.

Only known physical test has been performed by RISE where the crate have been loaded with dog dummies and dropped 700mm into a steel plate with one corner hitting the plate first. This has given a twist to the crate that reveals weak spots like corners and door hinges/door locks. It has also revealed brittle material as unsuitable as the dog can escape if the crate has opened up.

Effect: Crates has to be designed to resist twisting hits that occur in other directions than front and rear end crashes.

The side impact:

The side impacts are rather rare and the forces can be very diverse dependent on where along the side the car was hit. A direct hit at the rear of the car will give forces straight into the crate and the dog is at high risk being injured if there are too stiff crate structures. At many of these rear end side impacts there has been a lot of rotation involved and it has not been uncommon that the trunk actually opens up when the locking mechanism collapses.

There will be both translation and rotation in different proportions dependent on where along the side the car was hit. A single test cannot handle all force variations in this crash scenario. Robustness is of importance and all brittle materials should be avoided.

Simulations:

Mathematical simulation programs have advanced to the level where a computer can simulate a crash scenario. This can be done by adding known material properties and give the right interaction properties between the different pieces involved in the structure together with a given load. Car manufacturers do this all the time to find better and lighter structures. But in the end they always have to verify and improve the simulation with real testing. And often the two results differ because the interaction properties were not assumed correctly. Thus, any attempt in trying to simulate the behavior of a crate is guessing if it is not verified. A dog crate looks rather different from most other standard simulations where there might be more knowledge about how to handle boundaries. Unfortunately, I have seen unrealistic results that cannot reflect reality as there are no materials that stiff.

Effect: Consumers will believe that results that are not even realistic are equal as if tested to verify a safe behavior in a real-life crash. There is not much relevance to what happens when a crate interacts with load rings, seat structures, dogs and intruding elements in a clean mathematical simulation. Without real world verification by physical testing this should not be presented as a crash test, since such marketing may be mis-guiding to the consumer, providing a false sense of safety.

Conclusions:

There is a need to harmonize the concept of crash testing dog crates. Normal consumers cannot see the difference between what is truly-, with decent relevance- and what is claimed to be- crash tested. The consumer should not be left having to understand the relevance between genuine safety and other test methods used that often is focusing on minor problems and sometimes even out of context.

The need to harmonize and improve testing is similar to what was once done in the world of cars; experts gathered (not just one or two) and shaped relevant state of the art consumer tests like Euro NCAP and US NCAP. These consumer tests have since contributed to an increased crash safety more than any other fact by focusing on the real world use of cars and relevant crash tests. These tests are used to promote real world safety beyond what is known to increase development instead of protecting economic interests. A crash test method simulating real-life car crashes, taking into consideration pet and human passenger safety is superior to any other test method presently in use.

The most comprehensive tests have been performed by RISE (Former SP) in Borås Sweden. The crash test methodology used has 3 different tests included, all exploring individual aspect of the dog crate safety.

References

[1] B. Johan Ivarsson and Johan Davidsson, Dogs in passenger vehicles– crash safety evaluation of travel crates, INTERNATIONAL JOURNAL OF CRASHWORTHINESS, Taylor & Francis, 2017.