

# Effects of aging and use on Child Restraint Systems



Alianza Española para la Seguridad Vial Infantil  
Safety Child in Road Spanish Alliance

A study carried out by the AESVI Alliance Research Commission  
February 2022

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## Abstract

- 33% of car seats bought in Spain were not new according to SFERA Media Group “child car seats sale 2019 report”.
- The purchase of used or second-hand child restraint systems (CRS) is a common practice that has grown steadily in recent years and which, unfortunately, can also be carried out without official control, without professional advice and without a guarantee on the product. As a result, it is possible to buy products without user and assembly instructions, with structural deficiencies and even hygienic-sanitary problems.
- This well-known situation generates a debate about the possibility that these used CRS's do not work properly in case of a traffic accident

## Introduction

- Second-hand trade is already being postulated as the big change in consumption. The expansion of this type of business has grown at the same time as the economic crises suffered in Europe in the last decade, which has alerted and prompted the **Spanish Alliance for Child Road Safety, AESVI**, to promote and develop this detailed study.
- The aim of this report is to analyse the effects of the use and ageing of Child Restraint Systems and to find out objectively if the mechanical and functional properties of these used products decrease with the passage of time and the intense use of the car seat, and therefore, if there is less protection for the child in the event of an accident.
- And, to make families and society aware of the dangers of the uncontrolled sale of sensitive products whose main purpose is to ensure greater protection of childrens in cars.

To analyse the situation and provide possible solutions,, AESVI (the largest forum of national and international experts on child road safety in Spain) has carried out a scientific research report by well-known experts such as Juan J. Alba from the Department of Mechanical Engineering at the University of Zaragoza and Joan Forrellad, head of I+D and Crash Testing at Jane Group, both board members of AESVI.

## Methods

To develop this scientific research, AESVi randomly purchased 10 CRS from an online second-hand platform.

Each of the samples came from different areas of Spain and were purchased for a price of less than 100€, establishing a range of 0 to 18 kg in weight, seats equivalent to Groups 0+ and 0-1, which are specific for the most sensitive group of children.

This first group of car seat is, the most used by families and the most sensitive in terms of safety, as it is used from the newborn to approximately 4 years old baby.

No limitations were established as to their state of conservation and appearance. Nor were any selections made by brand.

Then, a random purchase process was carried out, with the CRS's being received by a Notary who was responsible for sending them directly to the laboratory where the tests were done (1).

## Methods

- The crash test study was carried out by the Applus+ IDIADA laboratory, which unpacked and documented each sample before and after the test.
- Each sample was classified and documented for the presence or absence of user instructions, labeling, etc.
- Each sample was classified according to the European Regulation under which it was approved for dynamic testing in accordance with that Regulation.
- As these were unique samples, only one single test could be performed for each CRS.
- The laboratory chose as the most representative test, a frontal crash test at 50 km/h, FF position installation, and RF for the Group 0+.
- The dummies used in the tests were the P Series as all samples had been approved according to the European ECE R44

## Sample Classification

The breakdown of CRS purchased is shown in Table 1, reflecting their group and approval standard, as well as the country in which they were approved (2).

Group 0+ (0-13Kg)		Group 0-1 (0-18Kg)		Group I (9-18Kg)		Total	Country of Homologation
R44/03	R44/04	R44/03	R44/04	R44/03	R44/04		
		1	1	1		3	France
		1		2		3	Germany
1						1	Luxembourg
		1				1	Netehrlands
			2			2	Spain
1		3	3	3		10	TOTAL

Table 1: Number of samples analysed and classification.

(1) *Laboratorio de Applus+ IDIADA, Santa Oliva (Tarragona), España – [www.applusidiada.com](http://www.applusidiada.com)*

(2) *Note that the country of type-approval does not necessarily have to be the same as the country of manufacture.*

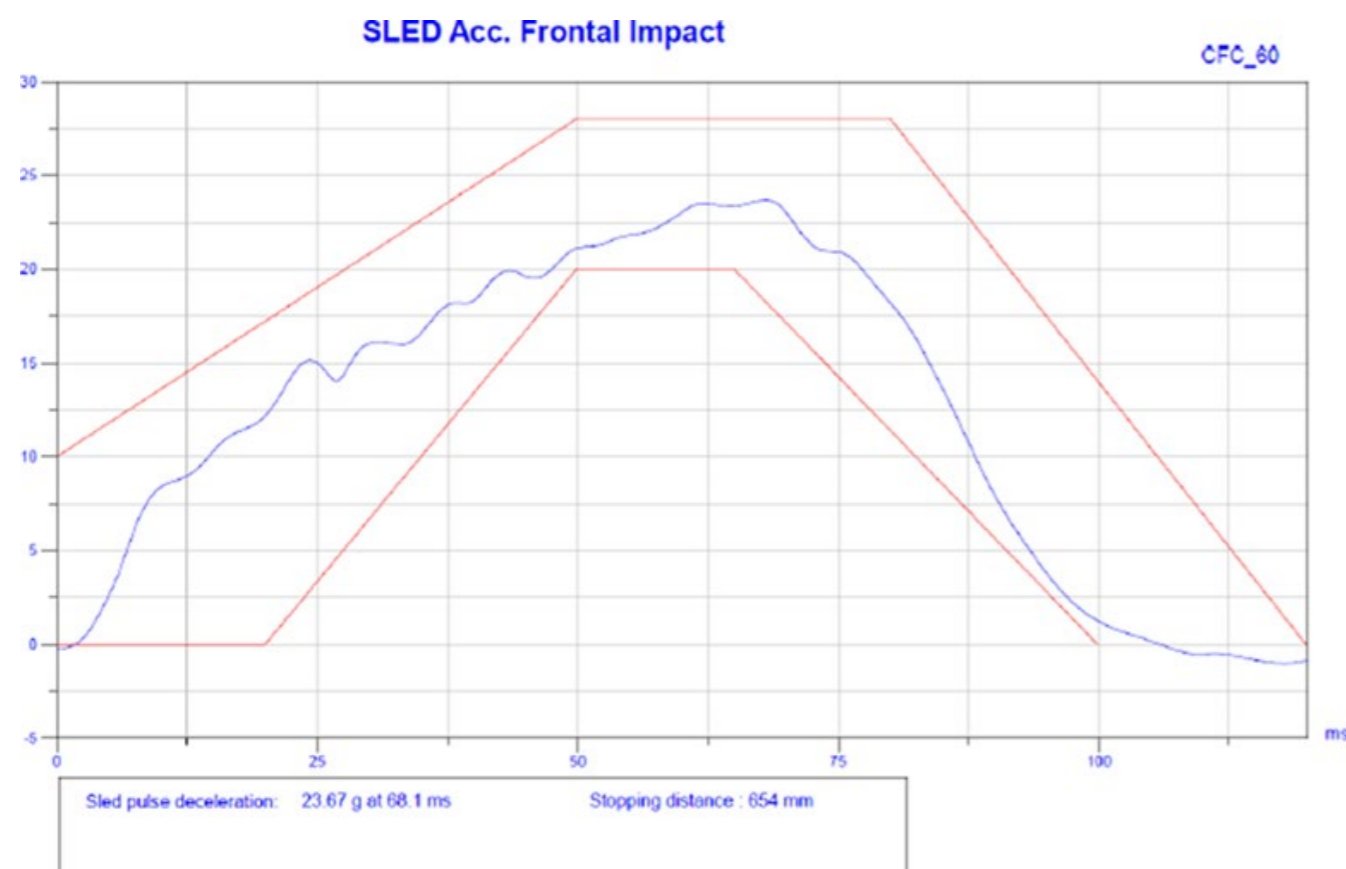
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## Preliminary Test and considerations

Prior to the crash tests, the status of the samples (CRS) was analysed in accordance with the requirements of the European Regulation, ECE R44.

According to the Regulation, it is mandatory that the CRSs must be (permanently) accompanied by an instruction manual with specific detailed information for its installation. They must also incorporate certain safety markings or warnings with detailed important information.

If these requirements are not met, the CRS cannot be accepted for the type approval process.



The authors of this study pointed out that the study only allowed for a single test sample, and therefore, following the provisions of the Regulation and the "worst case" criterion, the 50 km/h Rearward Facing frontal crash with the heaviest Dummy allowed in each of the CRS was chosen.

## Preliminary Test and considerations

Dummies and type of test (installation) according to the samples to be analysed:

1. CRS with weight classification 0 - 13 kg: dummy P 1.5 Frontal Impact, RF (Reward Facing) Upright position.
2. CRS with weight classification 9 - 18 kg: dummy P 3 Frontal Impact, FF (Forward Facing) upright position.
3. CRS with weight classification 0 - 18 kg: dummy P 3 Frontal Impact, FF (Forward Facing) upright position.





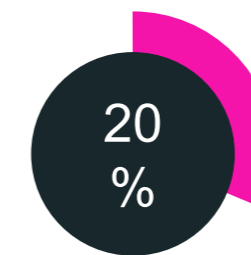
# Remarks

The results of the checks prior to the dynamic test are shown in the following graphs:

	Marking	Instructions	Homologation Label	Harness Conditions	Absorption Materials	Upholstery Conditions
Sample 01						
Sample 02						
Sample 03						
Sample 04						
Sample 05						
Sample 06						
Sample 07						
Sample 08						
Sample 09						
Sample 10						

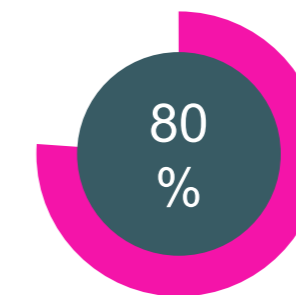
## MARKING

Not Present



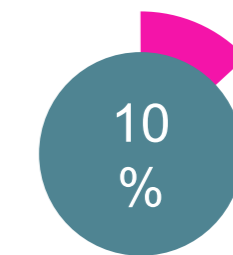
## INSTRUCTIONS

Not Present



## HOMOLOGATION LABEL

Not Present



## HARNESS CONDITIONS

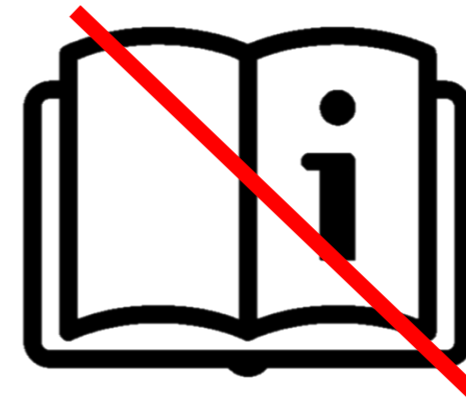
## ABSORPTION MATERIALS

## UPHOLSTERY CONDITIONS

Regular	10%	40%	20%
Damaged	0%	20%	30%
Very Damaged	20%	40%	40%

## Results

Regarding to the instruction manual, 8 out of 10 CRS didn't have it, which is considered as a way of depriving the consumer of information that may be essential for its correct installation and use.



A high degree of deterioration has also been detected during the tests in all car seat bodies, with a large loss of the absorption properties of materials such as EPP or expanded PE.

The inspection of the upholstery showed clear signs of ageing of the material due to the passage of time, use, climatic variations and poor storage.

In three of the samples, harness problems were detected, consisting of poor routing (samples 03 and 04), twisting (sample 01), dirt and poor maintenance. This dirt causes a common malfunction and ineffectiveness of the baby restraint system, which is aggravated in frontal impacts.

## Sample Remarks

Sample 01	Belt tensioner blocked after crash. Dummy cannot be released
Sample 02	Belt tensioner heavily soiled, retaining teeth with embedded dirt residues
Sample 03	Incorrectly routed harness
Sample 04	Isofix without third point, no instruction on the seat. Broken and dislodged porestilen.
Sample 05	Tubular steel structure in good condition. Plastic structure broken after impact
Sample 06	Failure in upper anti-rotational axis. Seat is thrown out in the test
Sample 07	Lack of back and head absorption material
Sample 08	Harness buckle blocked and twisted after test
Sample 09	Belt tensioner guides loosened after testing. Missing parts absorption
Sample 10	Twisted belt, Anti-rotation handle with defective locking position

## Dynamic Test

Only one of the tests set out in Regulation 44 was sufficient to determine **that 9 out of the 10 CRS randomly purchased on the second hand market would be unable to perform their function** within the limits required by the Regulation.

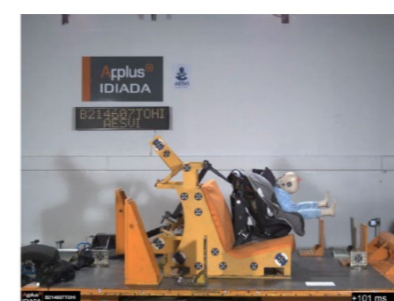
The general behaviour observed was marked by significant deterioration of the harnesses and their attachments. As a consequence, the retention efficiency of the dummy was drastically reduced, dangerously increasing dummy's excursion, which in some cases exceeded 150 mm the X-axis limits (horizontal displacement).



Picture 3: Máximo desplazamiento X / X maximum displacement



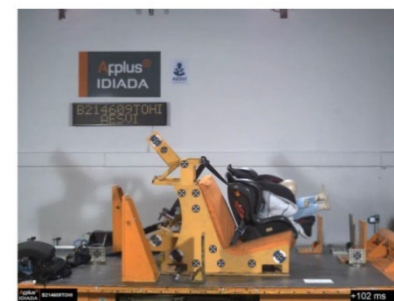
Picture 3: Máximo desplazamiento X / X maximum displacement



Picture 7: Máximo desplazamiento X / X maximum displacement



Picture 11: Máximo desplazamiento X / X maximum displacement



Picture 15: Máximo desplazamiento X / X maximum displacement



Picture 19: Máximo desplazamiento X / X maximum displacement



Picture 23: Máximo desplazamiento X / X maximum displacement



Picture 31: Máximo desplazamiento X / X maximum displacement



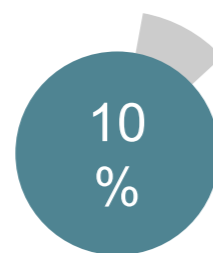
Picture 35: Máximo desplazamiento X / X maximum displacement

## Results

In 7 CRS (samples 01, 02, 03, 04, 05, 08 and 09), displacements above the limits set by the regulation were measured. In all of them, the X-axis displacement value was above the 550 mm limit set in the regulation.

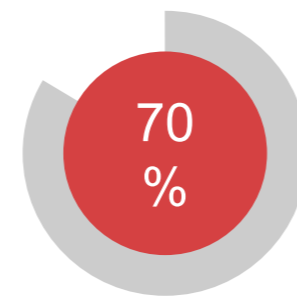
### Fulfill ECE R44 Requirement

Only 10% fulfill ECE R44 Requirements (see pag. Comments)



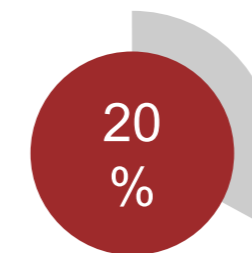
### Head Displacement

70% exceed Head Displacement limits


















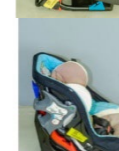




### Chest Acceleration

20% exceed 55g limit chest acceleration



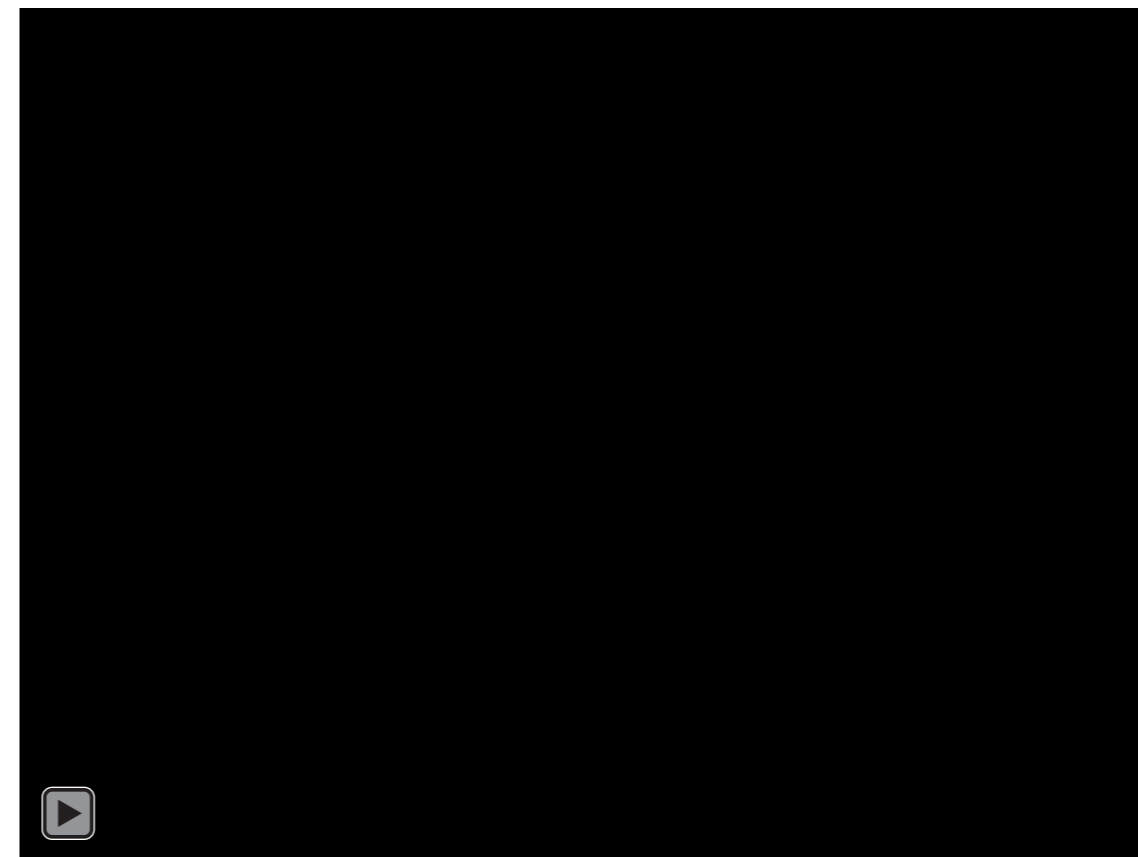
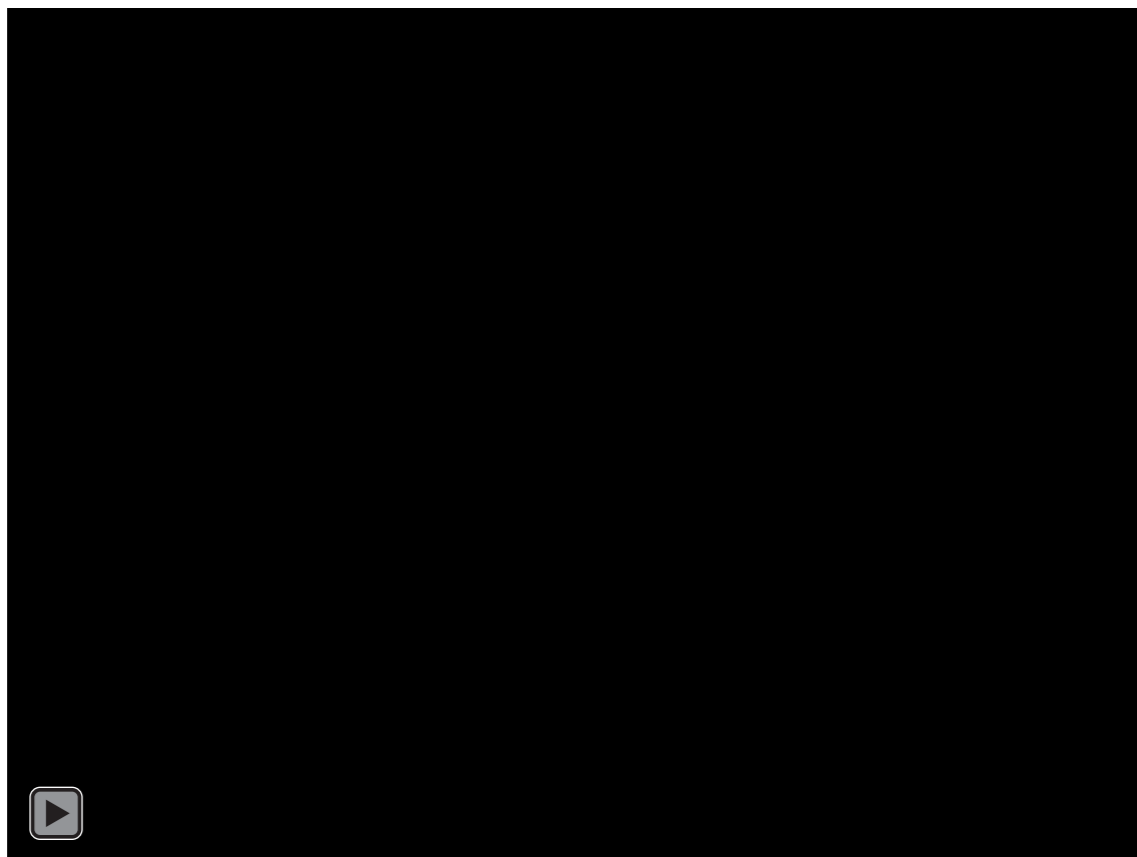
# Results

SAMPLE		DUMMIE	SPEED <i>Km/h</i>	STOPPING DISTANCE <i>mm</i>	DISPLACEMENT <i>(mm)</i>	TIME <i>(ms)</i>	CHEST ACCELERATION (3ms) Dsip. X      Dsip. Y		
<i>Limits</i>			<b>50 +0 -2</b>	<b>650 + - 50</b>	<b>X:550 Y:800</b>	<b>---</b>	<b>&lt; 55</b>	<b>&lt; 30</b>	
		01-XC2111/03253	P3	48.44	654	X: <b>599,85</b> Y: 716,22	X: 103 Y: 289	52.20	15.07
		02-XC2111/03254	P3	48.28	655	X: <b>561,75</b> Y: 716,22	X: 101 Y: 298	47.16	09.95
		03-XC2111/03255	P3	48.73	651	X: <b>575,47</b> Y: 594,61	X: 96 Y: 0	45,57	11.01
		04-XC2111/03256	P3	48.83	655	X: <b>555,03</b> Y: 643,34	X: 102 Y: 62	45.87	09.04
		05-XC2111/03257	P3	48.83	664	X: <b>703,47</b> Y: 723,66	X: 114 Y: 300	41.60	10.27
		06-XC2111/03258	P3	48.78	667	X: --- Y: ---	X: --- Y: ---	<b>103.57</b>	11.66
		07-XC2111/03259	P3	48.60	651	X: 512,01 Y: 658,01	X: 100 Y: 205	<b>70.20</b>	17.74
		08-XC2111/03260	P3	48.78	661	X: <b>591,40</b> Y: 629	X: 101 Y: 300	46.89	8.43
		09-XC2111/03261	P3	48.55	652	X: <b>625,75</b> Y: 652,186	X: 102 Y: 245	52.14	13.00
		10-XC2111/03262	P1.5	48.63	646	Contact with Dashboard	X: --- Y: ---	40.43	4.50

## Results

Sample number 06 had a very serious malfunction which resulted in the ejection of the dummy as a consequence of the disconnection between the car seat base and the shell.

Probably, this car seat was acquired with some serious structural defect or fault.

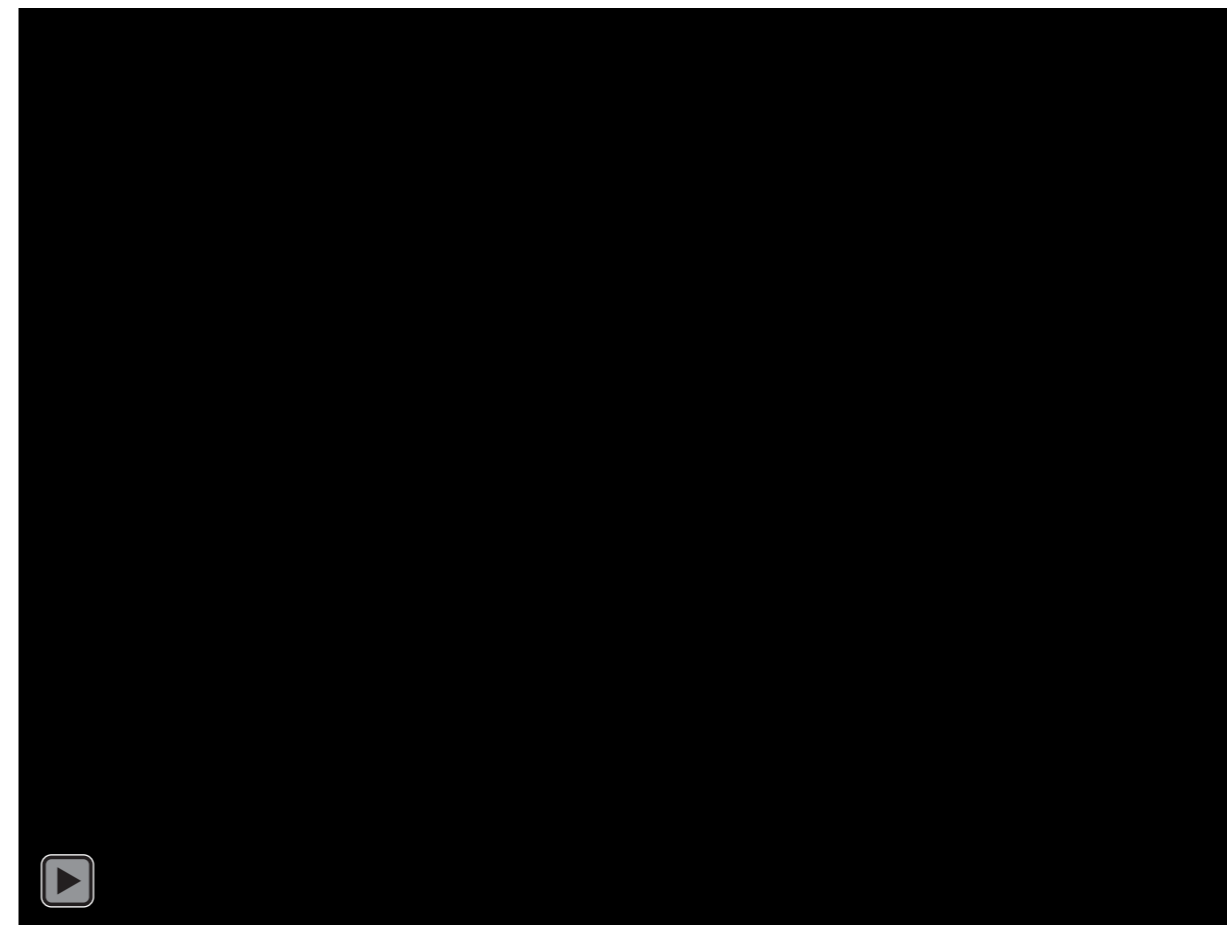
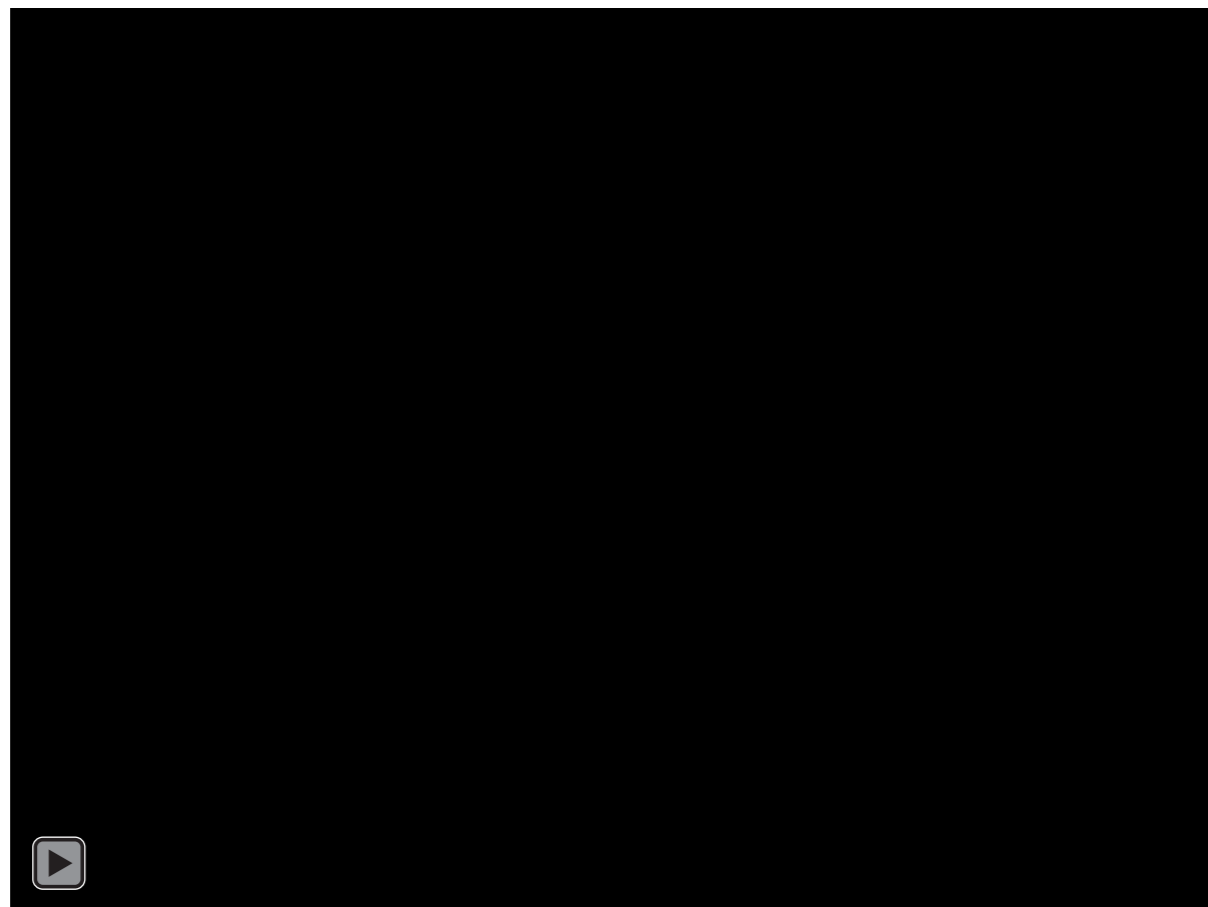


Sample Ref. **XC-2111/03258**  
Test Numner **B214611TOHI**

SRI 0-18Kg - Group 0-1 - ECE R44/03  
Homologation mark from: FRANCE

## Results

Sample number 05, showed a major breakage in the rear backrest support area of the shoulder harness which caused excessive frontal displacement (X) with a dangerous excursion of the dummy head. Poor routing and/or excessive ageing of the plastic body of the CRS could have contributed to this breakage.



Sample Ref. **XC-2111/03257**  
Test Numner **B214610TOHI**

SRI 0-18Kg - Group 0-1 - ECE R44/03  
Homologation mark from: SPAIN



## Results

Only one of the CRS tested (sample 10) showed a correct behaviour in displacements and accelerations, within the tolerable limits, but this test.

According to the provisions of UN Regulation R4404 "In this configuration, an additional test is necessary without the 100mm diameter bar, in order to verify that the result is within the limits of the Regulation."



## Conclusion

- The general behaviour observed showed dangerous deterioration of the harnesses and their attachments to the CRS structure. Harness misalignments, harness twisting, dirt and poor maintenance cause also a common dysfunction and lack of efficiency, that finally **would mean a high risk of child's head impact against a rigid surface or car structure.**
- The deterioration of the child seats is evident in their upholstery, with a **large loss of their absorption properties.** There is also a **great loss in the absorption materials** themselves.
- It was without doubts that the passage of time, the long use, climatic variations or poor storage, can **seriously affect their conservation, and often the loss of essential components.**

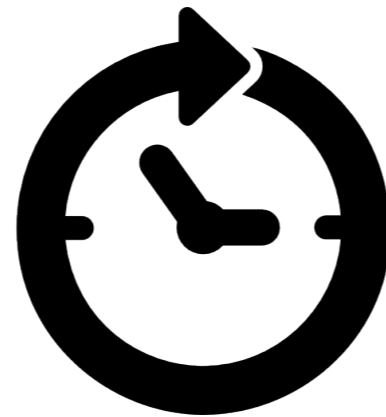


## Discussion

- The ECE R44 Regulation emphasises a number of requirements aimed at providing information to the user about the child car seat. However, the fact that most of the CRSs in the sample showed irregularities in the fulfilment of these requirements highlights the need for the administration to carry out **more educational work to explain to users why this type of information can be decisive for the safety of their children.**
- In view of the results obtained, it is considered **urgent for the Administration to prohibit the sale of second-hand child restraint systems, due to the high risk involved in relying on a CRS whose basic functions may be alarmingly reduced.**
- Therefore, it seems sensible to think of a technical service that certifies the sale of these used CRS, and that validates its sale by demanding minimum values of conservation and functioning of their vital components. And, as long as this inspection is not possible, **their sale should be stopped**, due to the high risk involved in trusting a CRS whose protective qualities have been reduced.

## Discussion

- It is evident that functional deficiencies meant that practically none of the Car seat samples passed the dynamic test, either due to degradation of their materials, inadequate maintenance or loss of effectiveness of the padding. Therefore, it is considered necessary **to work on the development of a regulation related to the service life of these products.**



- In order to prevent consumers from buying products lacking information or with defects in their assembly, it is considered necessary **to regulate the sale and purchase of second-hand child car seats** in order to ensure sufficient guarantees, legal consumers protection and, most importantly, the child safety.

# THANKS!



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Read more: [https://www.which.co.uk/news/article/parents-still-using-second-hand-car-seats-despite-safety-issues-av1CW4W6J2r5?utm\\_source=which&utm\\_medium=link&utm\\_campaign=text\\_share](https://www.which.co.uk/news/article/parents-still-using-second-hand-car-seats-despite-safety-issues-av1CW4W6J2r5?utm_source=which&utm_medium=link&utm_campaign=text_share) - Which?
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