Paris, 30th of January 2014

There are currently two main restraint systems available for car seats intended for toddlers of approximately 1 to 4 years old: the 5-point harness and the shield system. The aim of this statement is to explain why Maxi-Cosi considers that it is better to protect a child in a toddler seat with a 5-point harness, as according to numerous tests. Additionally, an international research study on shield systems is addressed, together with a brief explanation on the modification of the roll-over test in the ECE R44-04 legislation.

1. Benefits of 5-point safety harnesses

There are 3 main reasons why Dorel chooses to equip its toddler car seats with a 5-point harness:

- 1.1 Crash forces are transferred from the seat to the child's rigid body parts that can take high loads: shoulders and hips/pelvis bone.
- 1.2 Children are secured more firmly and therefore remain in the safest position in the car seat during all types of accidents (frontal or side impacts, but also roll-over accidents).
- 1.3 A 5-point harness offers easy adjustment to the growing child and a perfect fit for children of all sizes and shapes.

1.1 <u>Safer deceleration by restraining rigid body parts</u>

A 5-point harness works with 5 main attachment points that make sure that children are restrained by the rigid parts of their body: shoulders and hips. The 5-point harness transfers the crash forces from the harness to the rigid points of the body and into the seat. Dorel's experience with a 5-point harness shows that a child's soft parts (abdomen area) are better protected and do not have to endure high loads. This is a natural way to secure a body, and it is applied widely in other industries such as car racing, roller coaster rides and rock climbing equipment, notably for this reason.

Soft parts of a body may not withstand the forces of a crash in the same way as rigid parts do. When a child is restrained by its soft lower abdomen, he/she can fold over the belt or object, and that belt or object can intrude into the abdomen area. Small children who are restrained only by the car seat belt (and are not placed in a child's car seat) run the risk that the vehicle belt penetrates the abdomen area all the way up to the spine. This leads to damage in organs that are located in this area (e.g. stomach, liver, kidneys), or even causes spinal cord injuries.

With the current crash test dummies (both P as Q dummy types) the loads on the rigid parts of the body can be analysed in detail. The limits of the forces that these body areas can withstand have been established. All car seats developed by Dorel are designed so that the forces are optimally distributed and that they remain within these limits. Currently it is not possible to measure the loads on the soft lower abdomen area, as the current crash test dummies are not equipped with sensors in these areas. As a consequence, it is difficult to assess precisely when the forces on their soft abdomen











exceed the limits that children can withstand without suffering serious injuries in this area. However, Dorel is convinced that its 5-point harnesses are currently the safer solution to protect the abdomen area.

1.2 Firm restraining to remain in the safest position

Although crash tests are designed to simulate real accidents as accurately as possible, accidents are more complex than crash tests. While tests go in one unique direction (forward, rearward or from the side), in accidents there is often a combination of different impacts and crash forces are deployed from different directions.

In the case of a car accident where different forces are applied (for instance a roll-over), there is a risk of submarining or ejection of the child from the car seat. The 5-point harness makes sure that the child is tightly secured by a one-pull movement, and keeps the child in the safest position within the protective seat shell, whatever the accident may involve.

1.3 Perfect fit to the growing body

A 5-point harness is easy to adjust to different height positions and therefore offers a perfect fit for different body sizes. The shoulder straps can be easily adjusted in height in order to have a straight horizontal line from the car seat shell to the shoulder. This positioning ensures that the forces applied in an accident are best transferred to the car seat shell and the rigid shoulder bones of the child.

2. International Research

The effects of the loads on the soft abdomen area and the chest area when using shield systems and booster seats for children are not sufficiently known yet. Therefore, the United Nations has assembled a Task Force consisting of international experts to conduct a research study with the objectives to establish injury limits and assess the overall risks for children. This subgroup has been recently established and focusses on the measurement of the forces on the abdomen and deformations of the chest of the child by developing new sensors for the crash test dummies. The group is chaired by Child Seat Expert Dr. H. Johannsen of the Technical University of Berlin. The research report is expected in the summer of 2014 and will be published by the United Nations.

3. Amendment to ECE R44-04 legislation: improvement of roll-over test

Car seats homologated to the current ECE R44-04 legislation undergo a basic roll-over test. This test though, after careful examination, was showed to have some shortcomings. A car seat that passed ECE R44-04 legislation showed insufficient restraining capabilities during a simulated roll-over test. Crash tests by UTAC (independent testing organization for the automobile industry) have showed that after two full roll-overs, the dummy was ejected from a car seat with a shield systems http://youtu.be/4vSEHihbAvI (roll-over with harness is visible via: http://youtu.be/rJ11pEj8qhA) Even if crash tests do not exactly correspond to a real accident, this highlights that there are cases where a risk of ejection exists.











How to best protect a child in toddler car seat? Dorel Juvenile Europe

To prevent such ejection from a car seat, an amendment has therefore been approved, which introduce a more severe test to better reproduce roll-over crashes. This amendment has been active since December 2013. From now on, any car seat (new or modified*) that passes the ECE R44-04 approval process will also have passed this stricter roll-over test. In the UN R129 (i-Size) legislation, this test was already validated in November 2013 and is expected to be enforced from May 2014 onwards.

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^{*} Any modification of components, materials, suppliers, production processes a new homologation is needed.