



CHILDREN & CARS

A SAFETY MANUAL

CHILDREN & CARS

This safety manual helps anyone who drives with children reach a better understanding of child safety matters. For Volvo Cars, it's an issue that has engaged us for over 40 years.

*This is what we have learned.
Have a safe journey!*

1. KNOWLEDGE SAVES LIVES 7

EASY TO GET IT WRONG 7

CHILD RESTRAINTS 8

2. THE MOTHER TO BE 11

SAFETY FOR THE UNBORN CHILD 13

MEET HELENA HJORT 14

3. REARWARD-FACING CHILD SEATS 17

BABY'S FIRST JOURNEY 17

MEET THE STRÖMBERG LÖFVENIUS FAMILY 21

WHY REARWARD-FACING CHILD SEATS? 22

DOCUMENTING THE DIFFERENCE 27

MEET THE EXPERT LOTTA JAKOBSSON 31

CRASH TEST DUMMIES 33

FAQ ON REARWARD-FACING CHILD SEATS 36

MEET THE LEDIN HÖGLUND FAMILY 41

4. BELT-POSITIONING BOOSTERS 42

FAQ ON BELT-POSITIONING BOOSTERS 46

5. REQUIRED BY LAW 51

THE ELEPHANT IN THE REAR SEAT 51

REFERENCES 53







1.

Knowledge saves lives

ALL PARENTS WANT to give their children the best possible protection. In the car as well as everywhere else. Even so, children are still suffering injuries or even dying because of incorrectly fitted child seats, or because the type of child restraint they were using was wrong for their age, height and weight. Or – even worse – because they were travelling completely unrestrained in a car.

The cause of the problem is often simply a lack of knowledge. People sometimes think they have fitted a child seat correctly, when in fact they haven't. They may think that a child can safely switch from a rearward-facing seat to facing forwards at the age of just one or two years. When it shouldn't. They may think they have adjusted the safety belt correctly. When they haven't.

EASY TO GET IT WRONG

One Swedish study revealed that only 40% of three-year-olds had a rearward-facing child seat, although all three-year-olds should still be using seats which face the back of the car.

The same study found that some users of boosters placed the diagonal belt under the arm instead of across the shoulder, as well as incorrectly routing the lap belt. The lap section of the safety belt should go across the top of the child's thighs, not across the stomach.

A few children were even sitting on the lap of the driver or other passengers.

Airbags were another area where failings were found in usage/behaviour.

Contrary to recommendation, some children were seated with an active airbag. Children in a rearward-facing child seat must not sit in the front passenger seat with a frontal airbag (unless the airbag has been switched off).

This publication has been devised to help parents and others who carry child passengers to become better informed about the safety of children in cars. It should provide answers to many of the questions that new parents and parents-to-be often ask.

CHILD RESTRAINTS

At Volvo Cars we have the advantage of being able to look at child safety with both the car and child seat in mind, making them work together in the best possible way to ensure children have a safe journey.

Our focus lies on two kinds of child restraints – rearward-facing child seats and belt-positioning boosters, integrated or accessory, using the car's own safety belt.

Our most important mission? To stress the importance of using the right child restraint for the child's age, height and weight. All our tests, research and data, gathered for over 40 years, give the same answer: The safest way of travelling in a car is rearwards. Therefore, babies and young children should travel facing the rear of the car for as long as possible.

REARWARD FACING SEATS: NEWBORN TO 4 YEARS



Rearward facing baby seat



Rearward facing child seat

BELT-POSITIONING BOOSTERS: 4-10 YEARS



Booster seat



Accessory
booster cushion



Integrated
booster cushion



2.

The mother to be

Women sometimes ask whether it would be better not to use a safety belt when they're pregnant. They fear that the belt could harm their unborn baby in some way. The answer to this question is that they should definitely use a safety belt at all times, right up until the birth.

Equally important is the need to wear it correctly.

- The safety belt should be positioned as close to the wearer's body as possible. Check also that it has not twisted.
- The safety belt should be taut against the mid-shoulder, with the diagonal section of the belt between the breasts and along the side of the belly.
- The lap section of the belt should be flat against the side of the thigh, as low as possible below the belly. The belt is not to slide up across the belly.
- Make sure you are sitting in a comfortable position – you should be able to easily reach the steering wheel and the pedals, at the same time as the distance between the steering wheel and upper body – your torso – should be as great as possible.

Add-on devices are available to help position the safety belt for pregnant women. However, they are not developed in conjunction with the restraint systems in the different vehicles and there is, as yet, no evidence that safety belt positioners actually improve user safety in crashes. In fact, they might even be a hazard by introducing slack to the safety belt.



SAFETY FOR THE UNBORN CHILD

Today researchers and car manufacturers have comprehensive knowhow about how adults and children are best protected in the event of road accidents. There is also research into how to best protect an unborn baby in an accident, although there is still more to learn in this area.

Since 2001, researchers at Volvo Cars have been studying the specific needs of pregnant women as regards safety and comfort. One result of this work is the development of a unique computerised model of a pregnant woman.

This computer model is one tool to be used to increase the understanding of how a pregnant woman and her unborn child can be protected in a collision. Together with data from real life accidents, this model helps in the development and evaluation of car safety.

Head injuries are one of the injury categories noted in unborn babies involved in car crashes, both fatal and non-fatal. The most frequently documented cause of death in the unborn, however, is the partial or total detachment of the placenta from the wall of the uterus, which prevents the foetus from getting enough oxygen.

The question is, why? Researchers think that the uterus itself is elastic enough to withstand the deformation caused by the crash forces, but that the placenta is not equally elastic and therefore not as resilient.

What is perfectly plain, however, is the fact that pregnant women should always use their safety belts.



'There's another life inside of me that needs protecting'

HELENA HJORTH, STOCKHOLM, SWEDEN

How have you found driving a car while pregnant?

'Initially, there was no particular difference. But as my belly has grown it has gotten harder to get in and out of the car, it has been harder to get the safety belt to sit right and to find a comfortable position in the seat. Now that I'm at the end of the pregnancy, I'm very conscious of the fact that there's another life inside of me that needs protecting. But the thought has also crossed my mind that the safety belt may harm my child if it is positioned incorrectly if I am in a crash.'

Have you found out what position the safety belt should be in?

'A friend of mine who was a bit ahead of me in her pregnancy obtained an add-on that fixed the belt to stop it sliding up onto the belly. But the information I found was that a properly positioned safety belt offers more protection. And I found out what position the safety belt should be in – tight against the shoulder and diagonal along the side of the belly. And the lap belt should be under the belly against the thighs. That was useful to find out.'

Is there anything else you have changed when driving pregnant?

'Yes, trying to sit as far from the wheel and air bag as possible while still being able to reach everything.'

How are you going to get home from the maternity ward?

'We're actually going to take a taxi with our baby in a baby seat. It feels like a good time not to be driving ourselves. We'll have plenty of other things to think about!'



AIRBAG

3.

Rearward-facing child seats

BABY'S FIRST JOURNEY

For most babies, their first car ride is the drive home from the maternity unit. It's an exciting but still rather jittery time for most. A new little person has come into the world. And a new life is beginning for the parents and any older siblings too.

Ahead of you is a new routine, punctuated by feeds, sleeps both short and long, and nappy changing. Most things will have been planned and prepared for, but there will always be a few details to iron out.

One thing which really must be planned for is that first journey home. Right from the start, your baby needs to have his or her own baby seat – properly anchored, correctly fitted and facing the rear of the car. This baby seat will provide good protection for the first few months of the baby's life.

The seat should always be the right size for the baby. When the baby has grown to such an extent that its head reaches the top of its seat or beyond, the time has come to change to a bigger seat.

You can move your baby to a bigger seat earlier than this. There are other kinds of rearward-facing child seats which provide equally good protection for a growing baby. But they must always be of a suitable size for your baby at the time.

Tested child seats

Any parent who has ever chosen a child seat for a baby will agree that it is no easy task. Before you buy one of the many child seats available on the market, make sure that the seat is optimal for your car and that you know how to install it. Volvo Cars has its own range of child seats that are tried and tested in cars to ensure that they meet strict requirements on safety, usage and installation.

An international standard

Given the vast number of child restraints on the market and the danger with not fitting them correctly in the car, many stakeholders saw the need for a joint effort. In 1999, international cooperation between car manufacturers, child seat manufacturers, public authorities and other stakeholders resulted in ISOFIX – an international standard for anchoring child seats in vehicles.

ISOFIX consists of a specification for the child seat attachments and a corresponding specification for vehicle anchorages. Two anchorage points are built into the car between the seat backrest and seat cushion. A seat base can be attached securely in place using these anchorage points, and the baby or child seat can then be quickly and easily attached or detached. In addition, a third anchorage point, usually called “top tether”, is included, enabling connection of straps routed over the seat backrest. When required by the child seat, this should be used in addition to the lower anchorage points.

Some types of ISOFIX seats do not require a separate base. Instead they are attached directly into the car’s anchorage points. Depending on the market, ISOFIX child seat connectors are rigid, allowing for a click-in installation, or non-rigid, using latches for attachment.

ISOFIX anchorage points are to be found in all new cars. The number of different child seats available with ISOFIX attachments is steadily increasing, but there is still a wider range of seat types secured by the car’s safety belts on offer. ■



'As a new parent you really become conscious of safety'

DANIEL STRÖMBERG AND ANNA LÖFVENIUS WITH DAUGHTER INGRID,
6 MONTHS OLD, GOTHENBURG, SWEDEN

How did you prepare for the arrival of Ingrid?

'We test drove the route to the hospital and tried to keep track of when during the day there was congestion. We had also bought a baby seat with ISOFIX. We thought the baby seat was a bit loose when we fitted it, so we had to check with a dealer how it was supposed to fit before we felt safe. Then we were ready.'

Tell us about your journey home from the maternity ward.

'Well, we were obviously pretty nervous to be leaving the safe bubble of the hospital and taking responsibility for our own child. In a car, no less! You're completely convinced that someone is going to drive into you. We've never driven more carefully than we did that time. We took extra care looking at every crossroads and tried to brake as gently as possible. You realise how vulnerable babies are – they have no control over their necks. A little thing like how tight the belt in the baby seat should be turns into a big thing when you're doing it for the first time. But everything went fine!'

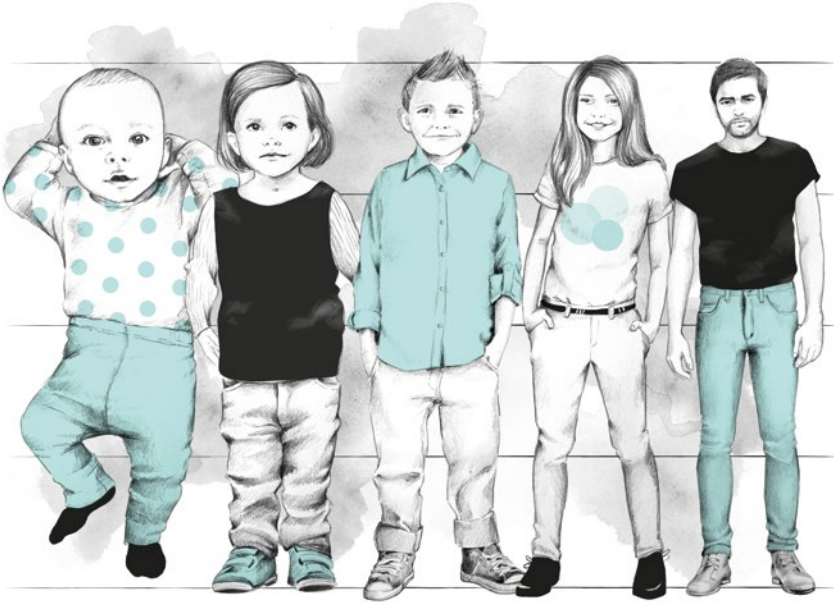
How did you opt to position the baby seat?

'We positioned it on the back seat behind the passenger seat, with a mirror on the headrest of the back seat so that whoever is driving can look over their shoulder and see Ingrid. We chose that position because we thought it was the least distracting for the driver. As a new parent, you really do become conscious of safety – you don't mess about with it!'



BODY PROPORTIONS

Birth to adulthood



Newborn

2 years

6 years

12 years

Adult

Source: Burdi et al, 1969

WHY REARWARD-FACING CHILD SEATS?

Babies and children are especially fragile passengers. Relative to the rest of their bodies, their heads are large and heavy. The head of a nine-month-old baby, for instance, makes up 25 per cent of its total weight. By way of comparison, the head of an adult male only constitutes six per cent of total body weight. A baby's head has quite different proportions too. Its face is relatively small compared with the rest of its head.

If a baby or child suffers head injuries, it often entails brain damage, which is usually much more serious than facial injuries. Head injuries in babies are frequently more severe because their skulls are thinner than an adult's, providing less protection for the brain.

Soft skeleton

The neck vertebrae of a new-born baby are composed of separate portions of bone joined by cartilage. In other words, the baby's skeleton is still soft. This cartilage turns into bone over the first three years of the baby's life.

The process of cartilage hardening into bone continues right up until puberty. There is similar gradual development of the muscles and ligaments in the neck.

Human neck vertebrae also change shape progressively throughout the years as a person grows, from the horizontal vertebrae of the small child to the saddle-shaped ones of the adult. Being saddle-shaped also means that the vertebrae inter-lock and support each other if the head is thrown forward. The young child lacks this extra protection. [See illustration on page 25]

Rearwards is safer

The safest way of travelling in a car is rearwards. Therefore, babies and young children should travel facing the rear of the car for as long as possible.

In a frontal impact collision, the head of a forward-facing car occupant is thrown forward with considerable force. The only thing restraining the head is the neck. An adult neck can withstand this strain relatively well, but a small

child's neck cannot. Given that frontal impact collisions are the most common type of crash and the most serious type too, it is particularly important for very young children to sit in rearward-facing seats.

Sweden first with child safety ideas

The idea of rearward-facing car seats for children came from Sweden in the 1960s, the brainchild of Professor Bertil Aldman of Chalmers University of Technology in Gothenburg.

Professor Aldman took his inspiration from the special seats used by Gemini mission astronauts during take-off and landing, which were moulded to distribute G forces across the whole back. The principle behind rearward-facing child seats is exactly the same. In the event of a frontal impact collision, the whole of the child's back and head takes the strain of the impact, not just its much weaker neck.

Thanks to Professor Aldman, rearward-facing child seats came into widespread use in Sweden much earlier than elsewhere. The benefits are reflected in crash statistics.

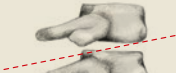
DEVELOPMENT OF THE NECK VERTEBRAE

■ Cartilage ■ Bone

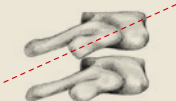
Side view

Top view

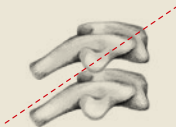
0-12 months



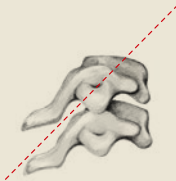
1-3 years



3-6 years



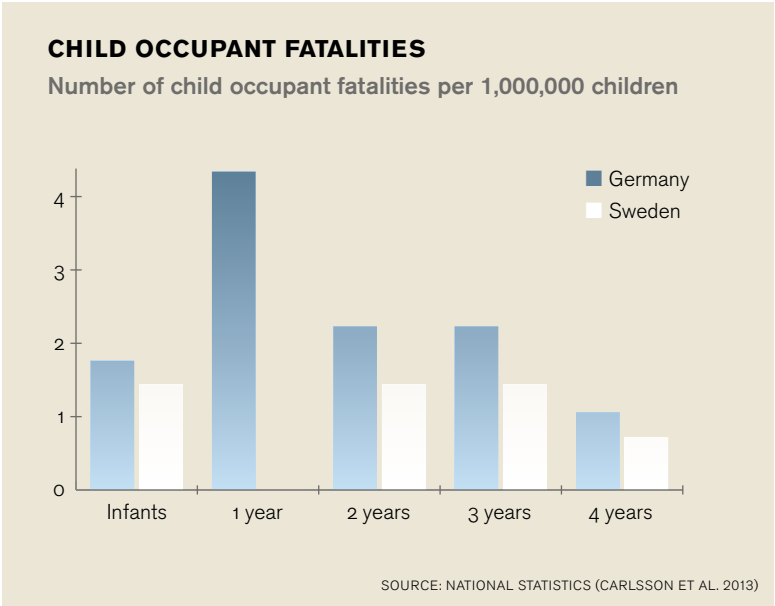
Adult



Research on data from insurance company Folksam, for instance, shows that the risk of a young child being killed or seriously injured is five times greater in a forward-facing seat than in a rearward-facing one.

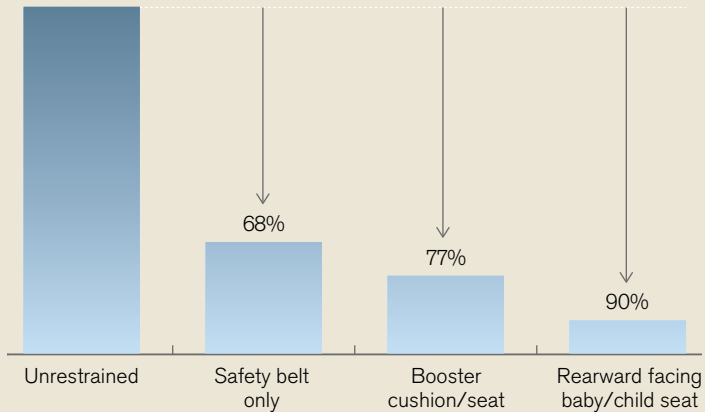
If you compare Swedish crash statistics with those of countries where most children travel facing forwards, the differences are striking.

One example is Germany: Note in particular the differences at one year old. That is the age when German children start using forward-facing child seats, whereas relatively more Swedish children travel in rearward-facing seats until the age of three or four.



INJURY RISKS PER RESTRAINT TYPE

Children aged 0–15 in Volvo cars in Sweden



SOURCE: VOLVO CARS TRAFFIC ACCIDENT DATABASE (JAKOBSSON ET AL. 2005)

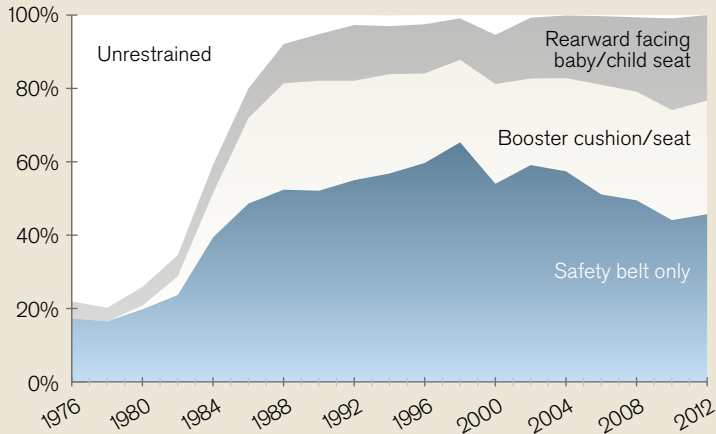
DOCUMENTING THE DIFFERENCE

Volvo has been working with Professor Aldman ever since the work with the three-point safety belt in the 1950s. One of the fruits of this collaboration was the rearward-facing child seat launched by Volvo in 1972, a first in the car industry. Another is the world first booster developed and introduced by Volvo Cars in 1978.

The Volvo Traffic Accident Research Team has been investigating and collecting data on Swedish road crashes involving relatively new Volvos ever since the early 1970s. The team's findings are added to a database which, to date, has documented more than 42,000 crashes, involving over 70,000 people in all. A unique resource for researchers wanting to establish more facts about child safety.

TYPES OF RESTRAINT USAGE 1976–2012

Children aged 0–15 years in Volvo cars in Sweden



SOURCE: VOLVO CARS TRAFFIC ACCIDENT DATABASE

Thousands of cases studied

Since 1976, more than 7,000 children aged 0–15 were involved in car crashes included in Volvo cars traffic accident database. Over the same period, the use of safety belts and child seats increased dramatically, from about 20% in 1976 to almost 100% in the last ten years. The risk of a child sustaining injuries as a car occupant has decreased continuously over the years, which is a result of both increased use of restraints and improved vehicle safety.

Increased protection

The effects of the increased use of restraints are plainly reflected in injury statistics. The type of protection system used is obviously very important.

In terms of preventing injuries of moderate level or higher for children aged 0–15, using an adult safety belt provides approximately 68% better protection than using no restraint at all. (See chart on page 27.)

The corresponding injury-reducing effect, as compared to those with no restraint, is as high as 90% for children using rearward facing child seats and 77% for children using boosters.

It is also important for children to use a type of child restraint suitable for their current age, height and weight. ■

'Rearward-facing child seats dramatically reduce the risk of injuries'

LOTTA JAKOBSSON, SENIOR TECHNICAL LEADER AT VOLVO CARS SAFETY CENTRE, GOTHENBURG, SWEDEN

What is the most important thing to consider when driving with children?

'Children need specific child seats – a safety belt isn't adequate. The child seat you choose needs to be suited to the child's size and age, and should be replaced according to the child's growth. The child seat's function is to distribute force in the best way possible to the child's stronger body parts during a collision. Volvo Cars always recommends the use of rearward-facing seats for as long as possible – at least until the age of 3 or 4.'

Why is it so important for children to travel facing backwards?

'Most parents are aware that children's neck muscles are weak during the early years. But what many don't know is that the skeleton isn't fully developed either. Rearward-facing seats dramatically reduce the risk of injuries in the event of a collision. In the event of a highly violent frontal impact, it is the difference between life and death.'

What is Volvo doing to make children's car journeys safer?

'The advantage we have is that we can work with both cars and child seats, for instance integrated booster cushions in the back seat. We are also pushing issues relating to standardisation and cooperation between the auto industry and child seat manufacturers. We need to get even better at making child seats lightweight, flexible and easy to handle. That will offer us an even greater opportunity to get more parents in all countries to use child seats in the best way possible.'



Volvo Cars' expert Lotta Jakobsson is an Adjunct Professor at Chalmers University of Technology, as well as Chairperson of the International Standardization's (ISO) working group for child safety.



CRASH-TEST DUMMIES

The world's first crash-test dummy was called Sierra Sam. The size of an adult male of large build, he was made in 1949 to test ejector seats for the US Air Force.

In 1956 the Air Force shared its findings with the automotive industry. The first dummy to be developed specifically for research on car crashes appeared six years later.

Today's crash test dummies have little in common with Sierra Sam. All the early ones were rather rudimentary, built to confirm that safety systems such as safety belts were effective. They had few measurement points, and were not very much like humans at all.

Sophisticated electronics

Modern crash-test dummies, however, are built to respond much more like humans. They have the same weight, size and proportions as the type of human they are made to simulate. Their heads are designed to react like real heads in a crash, as are other parts of their anatomy such as the neck, the knees and the thorax.

On the inside they have advanced electronic equipment for measuring acceleration/deceleration, displacements and the various loads and forces to which the body is subjected in a crash.

Crash-test dummies come in many sizes and types these days. Most are used in frontal impact crash tests, but there are also dummies developed for testing in side-on and rear-end impact.

The type used most often was developed to represent a mid-sized adult male. There is also an extra tall and heavy variant of the male crash test dummy, but the adult female dummy is remarkably small and petite.

Besides this twelve-year-old/woman, there are other child dummies representing children aged ten, six and three years, as well as babies of eighteen, twelve, nine and six months, and new-born babies.

New cars are safer

The crash test dummies are one tool for the car industry to continue to improve safety when it comes to cars and traffic. Volvo's own on-going research into the outcomes of actual road crashes shows that the risk of injury among people who have crashes in cars built in early 2000 or later is reduced by two-thirds compared to people travelling in cars built 20 or 30 years earlier. The continuous development of car structure as well as developments in advanced safety belt technology and airbags contributed to this improvement.

Active safety systems with automatic braking in the risk of accidents also improve safety by reducing the force of impact or, in the best-case scenario, even entirely avoiding an accident in the first place.

None of these improvements would have been made without research. And crash-test dummies still have an important part to play in this research, as does all the knowledge gleaned from studying real-life crashes. ■



HOLLY

■ FAQs ON REARWARD-FACING CHILD SEATS

What should I look for when choosing a rearward-facing child seat?

The child seat should suit the size of your child and fit your car. Also make sure that the seat has the requisite type approval. See page 51 for more information on type approval standards and labelling.

What do I need to think about when buying a second-hand rearward-facing child seat?

Don't buy a second-hand child seat unless it is a relatively new one. Make sure that any seat you buy is undamaged, has the right type approval label, and that all its fittings and installation instructions are supplied with it.

What is ISOFIX?

A standardised anchorage system for baby and child seats. ISOFIX is known as LATCH in the United States and UAS in Canada.

Is a strapped-in carrycot a safe alternative for babies?

No, it is not a safe alternative. The carrycot may be fixed in place, but the baby inside it will not be properly restrained.

Is a transversal infant bed a safe alternative?

For small children that need to lie down in a flat position at all times (e.g. some premature babies), make sure to use an infant bed that is certified for this purpose.

A rearward-facing baby seat should be used unless there are significant medical considerations against this, as facing the rear is always a safer alternative.

Can you be sure that the airbag really has been switched off or disabled?

Yes, the Volvo Passenger Airbag Cut Off Switch (PACOS) is safe and reliable. But you do have to check carefully that the switch is definitely in the OFF

position. If you have any doubts about whether the airbag is really disabled, contact your authorised dealership. Check the options for your brand of car and the regulations that apply in your country.

In the baby seat – how tight should the child harness be?

The harness should always be tight to the baby's body. A thumb rule is two fingers, but not more, between the harness and the child for appropriate tightness.

How long should we go on using the baby seat?

The most important thing is that the seat used should be suitable for the size of the baby at the time, in order to give it the support it needs.

Once the baby has grown so that its head reaches the top of its baby seat or beyond, the time has come to move it to a rearward-facing seat for a larger child.

What should I do if my child doesn't want to sit in its seat?

Stop and take a break. For a baby it might be a good idea to take a brand new baby seat indoors and let the baby first get used to it at home.

How long should children go on using rearward-facing seats?

Young children should continue to use rearward-facing seats for as long as possible. It is recommended that children go on using rearward-facing seats until they are three years old, but preferably longer. The older a child is, the stronger its neck will have grown. In addition, the taller a child is, the smaller its head will be in relation to the rest of its body.

Not being able to stretch out its legs fully will not affect the child's safety.

Why is this so important?

Because a child's vulnerable neck cannot withstand the strain involved if the head is flung forward in a frontal impact. In a forward-facing child seat, the

neck is subjected to very substantial forces. In a rearward-facing child seat, these forces are distributed across the whole of the child's back and head. The forces arising in rear-end impact are generally not as high.

How do you fit a rearward-facing child seat?

Follow the specific instructions carefully. ISOFIX is a standardised anchorage system which often makes it easier to fit child seats. The rigid ISOFIX attachments provide a confirmation (clicking sound and green indication) when correct installation is achieved.

A child seat secured using the car's safety belt is as safe as one secured using the ISOFIX attachments. Just make sure the safety belt is securely tightened. Many Volvo cars also feature additional anchorage points in the front seat floor rails for easy attachment of extra tethers for large rearward facing seats. If you encounter any problems, ask the seat retailer for help.

Which is the safest place in the car for a child?

In a Volvo, all passenger seat positions are equally safe, but there will probably be other factors influencing your choice of location. Many people prefer to have their child within reach, i.e. in the front passenger seat. However, if there is a rearward facing child seat in the front seat, the passenger airbag must definitely be switched off. The rear seat is consequently the only option for rearward-facing child seats if the front seat has a passenger airbag which cannot be switched off. In some cars, the passenger airbag can be turned off when required. Your car may have a switch for this purpose – check the owner's manual for instructions. Please note that regulations vary from country to country. In some countries children are not allowed to be seated in the front seat.

Is it alright for the child to sit on an adult's lap instead?

No. Children should never be allowed to travel on laps. Each child needs a place of its own in the car, and a child restraint appropriate for its size and age.

Do side airbags pose any risk to my child?

No, Volvo side airbags are designed to keep your child from harm in a collision, as long as he or she is travelling in an appropriate rearward-facing child seat.

Does it pose any harm if for instance a child plays with a doll or watches a film on a hand-held device?

Unsecured items can turn into dangerous projectiles in a collision. Ensure an upright seating position for the child with the belt positioned correctly.

What should I do if my child falls asleep with its head hanging at a sharp angle?

If it appears not to bother the child, it probably looks worse than it is. If it bothers you, you can always stop and prop up the child's head with a pillow or cushion.

In Sweden there is a certification called "Plus test". What is this?

"Plus test" is a voluntary certification which evaluates neck loads in a frontal impact test. By choosing a seat with a "Plus test" label you know that it will protect the neck of the child in a crash, something which is not evaluated in the regulatory testing.

Is a forward-facing child seat with internal harness a suitable choice for my two year old child?

For best protection, a two year old child should travel facing the rear, to ensure a good support of the neck in case of a frontal impact. ■

'Our children are going to travel backwards as long as possible'

KLARA AND MAGNUS LEDIN HÖGLUND WITH THEIR KIDS ALLAN, 3 YEARS OLD, AND PELLA, 5½ YEARS OLD, STOCKHOLM, SWEDEN

Both of your children use rearward-facing seats. Why?

'We are very safety-conscious and try do everything by the book. We carefully checked the facts when we had our first child, and the risk of injury in a collision is five times greater if the child is travelling forwards at an early age. So naturally, Allan and Pella are going to travel backwards for as long as it's possible.'

Has travelling backwards posed any challenges to you?

'Allan suffers from motion sickness, so we have considered whether we should turn him around to see if it gets better. But we don't know whether it will help – so we'll keep going for a little while longer. Pella is getting bigger so she sits cross-legged but hasn't complained about that yet. Some people we meet say "oh, just turn them to face forwards – you're never going to crash," but we feel that you can't just assume that. Safety always comes first.'

Do you have any tricks for using rearward-facing seats?

'In terms of motion sickness, it often gets better if Allan is watching a film or if we plan to drive at times when he can fall asleep. We have also chosen our child seats very carefully. Mainly to ensure they meet safety requirements, but also so that they can be tilted backwards a little so that the children can sleep in them. And to make sure that there is space for them to sit cross-legged when they get bigger.'





4.

Belt positioning boosters

SOONER OR LATER the child will outgrow its rearward-facing child seat. This is generally at around three or four years old. It is now time for him or her to travel facing forwards, seated on a belt-positioning booster. The booster cushion can be with or without a backrest. A booster cushion with a backrest is also called a booster seat. Make sure that the booster's guiding device is designed to keep the lap belt low down in front of the hips and across the tops of the thighs. These projections also help keep the booster cushion in place in a collision. The child and booster are always restrained by using the car's safety belt. Some boosters can also be attached to the vehicle using the ISO-FIX anchorages. Some cars, including a number of Volvo models, have their own integrated booster cushions – a very user-friendly form of child restraint.

Booster seats usually provide improved comfort for smaller children, and any side projections built into the top of the backrest section can provide the child's head with lateral support, especially when sleeping. Different types of torso side projections also help the child sit more comfortably and supported, depending on the size and behaviour of the child. Having a backrest for the booster cushion can also help the safety belt stay comfortably in place in the mid-shoulder position.

Not too far out on the shoulder

When a child is buckled in using a safety belt, it is important for the belt to be positioned correctly. The main reason for using a booster seat is to achieve

the right belt geometry, not to help the child to see more. Furthermore, the less slack there is, the better the belt will protect your child.

The booster is there to raise the child higher, to bring the safety belt into a better position across the hips or thighs. The lap section of the belt must always be worn as low down as possible, and not across the stomach. The diagonal section of the belt should sit firmly across the shoulder and chest, preferably lying comfortably on mid-shoulder. Remove any slack after you have fastened the child's safety belt. It is not harmful if the belt is partly on the child's neck. It may not look very comfortable, but it will not harm the child in case of a crash. If the car was to stop abruptly, the child's head would move forward and the belt would move further out onto the shoulder. The risk of injury is much greater if the diagonal belt is worn too far out on the shoulder. This could allow it to slip further down the arm in the event of a crash, increasing the risk of head impact and injuries to the soft parts of the chest and belly. With the belt now too far down the arm, the child would not be restrained as well as it should be.

Never under the arms

Under no circumstances should the child travel with the diagonal belt under the arm. In a crash, the upper body of the child would not be properly restrained, causing an increased risk of head impacts as well as the safety belt penetrating the softer parts of the chest and stomach. There would also be a greater risk of chest or stomach injuries because the human skeleton is weaker lower down the thorax. The safety belt provides optimum protection if it is placed across the stronger body parts, such as the pelvis, ribcage and shoulder.

Never use an ordinary soft cushion or pillow in place of a proper booster. An ordinary cushion would be too soft and would not be properly anchored like a booster is. In a crash situation, a cushion would simply be flattened, causing the child to slip forward, out under the lap belt.

Why use booster?

A factor which makes a child more vulnerable is the fact that its pelvis is still relatively undeveloped. Apart from overall size, one key difference between the pelvis of a child and that of an adult is that the distinctive pelvic structure called the iliac crest is not fully developed in the child. The size and shape of the wearer's hips has a direct bearing on the way the safety belt stays in place. The shape of the iliac crest in adult hips helps keep the lap belt low down in the event of a crash, preventing it from riding up and possibly damaging the internal organs. The human pelvis remains relatively rounded in shape until the child reaches about ten years old. The iliac crest does not develop its more angular adult shape until puberty.

The booster allows the geometry of the safety belt to function in a better way with respect to the child occupant. The booster raises the child, so that the lap part of the safety belt can be positioned over the thighs, which reduces the risk of the abdomen interacting with the belt. An important feature regarding booster cushions is the belt-positioning device (guiding horns); keeping the belt in position during a crash by restraining the booster. This feature is not necessary for integrated boosters. The booster also sets the child in a more upright position and more adaptive thigh support, so he/she will not scoot forward in the seat to find a more comfortable leg position when seated. Slouching may result in sub-optimal belt geometry.

Volvo Cars recommends children should use a booster until they are 140 centimetres (4' 7") tall and ten years old. Important factors are the child's size (height and hip size), age (hip development) and the car's specific safety belt geometry. ■

■ FAQs ON BELT POSITIONING BOOSTER

When can I move my child to a belt positioning booster?

When the child has grown out of its large rearward facing child seat. The child should be at least three years old, preferably older.

What should I look for when choosing a booster, with or without a backrest?

One that is suitable for your type of car, comfortable for your child, and labelled with the correct type approval.

Is a booster cushion just as good as a booster seat?

Smaller children will generally find that a booster seat is more comfortable and provides lateral support, helping to keep them in a good safety belt position. If there are side projections built into the top of the booster's backrest, these can help provide support to a sleeping child. Otherwise, in a safe car, provided the safety belt is correctly positioned on the child's body, the level of protection will be the same, with or without a backrest section of the booster.

My booster seat backs up against the head restraint, creating a gap between the two. Is this still safe?

The car's safety belt makes this perfectly safe. It is the car's safety belt that absorbs the incoming force during harsh braking or in a collision. The head restraint's position may mean that the booster seat has a more upright stance that may be perceived as less comfortable, but the fact is that from the safety viewpoint it is equally good provided the car's safety belt is correctly positioned.

How do you position the safety belt correctly?

The diagonal belt should go down across the shoulder, closer to the neck than the edge of the shoulder. It doesn't matter if the belt is partly on the child's neck. It is dangerous to position the belt too far out on the shoulder: if the

worst comes to the worst, the top of the child's body could slide out over the belt in a crash. For the same reason, you should never let your child wear the diagonal belt under the arm. The lap belt needs to be worn across the hips or thighs. For most types of accessory booster, the belt needs to be held down by the guiding horns on the booster cushion itself to keep the booster in position as well.

There should be no slack present in either the diagonal or the lap belt. Remove any slack after you fasten the child's safety belt.

Are boosters attached to the ISOFIX anchors better than those without?

The booster's attachment to the vehicle is not supposed to influence the protection provided by the booster and safety belt. The anchorage in the ISOFIX attachments helps secure the booster in place mainly when it is not being used. Irrespectively of the ISOFIX attachments it is the safety belt that secures the child in the restraint.

Could a child ever use an ordinary cushion instead of a booster cushion, perhaps in someone else's car?

No. An ordinary cushion is too soft. In a crash it would simply be flattened, causing the child to slip forward, out under the lap belt. The child should always use a certified booster.

Is it all right for the child to sit on an adult's lap instead?

No. Children should never be allowed to travel on laps. Each child needs a place of its own in the car, and a child restraint appropriate for its size and age.

Which seat in the car is safest?

In a Volvo all seats are equally safe for children, given they are using an appropriate child restraint.

What do I do if my child won't sit on the booster?

You must persuade him or her. You could also try out another booster.

Should the airbag in front of the front passenger seat always be switched off if there is a child restraint installed in the front seat?

The airbag should always be switched off if there is a rearward-facing child seat installed in the front passenger seat. However, recent research shows that when a forward-facing child (in appropriate restraints) is positioned in the front passenger seat, the airbag (in some car models) should not be switched off. This recommendation is due to the development of frontal airbags, which has taken place during the last few years. Always check your car's manual to see what applies to your car.

How long should children go on using a booster?

It is difficult to give a precise limit. Volvo Cars recommends children should use a booster until they are 140 centimetres (4' 7") tall and ten years old. Volvo Cars accident research shows that children aged up to ten need a booster, but that eleven and twelve-year-olds also benefit from travelling on one.

The regulated height recommendations or regulations vary from country to country. The most important thing is that the lap belt should be worn correctly across the hips. This is important even after the child has been travelling for a time and has moved about in the safety belt.

Is a booster as safe as a forward-facing child seat with internal harness for my four year old child?

The booster together with the car's safety belt is a good protection for the child, given that the belt stays in a good position over the shoulder and hip during the ride. Choose a booster seat that helps to provide good belt fitment for your child. If the child is small and is not fitting well, a child seat should be considered, but then use a rearward-facing child seat for the best protection of your child. ■





5.

Required by law

THE REGULATIONS GOVERNING which restraints children of various ages may use in cars vary from country to country, as do the prescribed types of child restraint.

Children travelling in cars should always use an appropriate type of child restraint, correctly fastened.

Type approval and labelling

Type approval standards and labels vary from country to country. In Europe and a number of other countries, child restraints must be marked with an E, which stands for ECE approval. This means that they comply with the appropriate UN ECE regulation for child restraints and are approved for use in countries which apply this standard.

For more information on Volvo child restraints contact your nearest Volvo dealership.

THE ELEPHANT IN THE REAR SEAT

Of course, there are always some people who don't buckle up, some of the time. Perhaps neglecting to put on their own safety belts, or to properly buckle up their kids before they drive off. Maybe it doesn't seem a long journey at all. Perhaps the child is fractious and it seems impossible to make it stay in the child seat long enough to fasten the straps. Or perhaps they think... it's just around town, and we won't be driving very fast.

But, at a speed of only 40 km/h (just under 25 mph), a child who normally weighs only 30 kg (66 pounds) will suddenly weigh the equivalent of a tonne in the event of a collision with an unyielding object.

That's a metric tonne – 2,204 pounds!

Danger to other occupants

If a child is unrestrained in the rear seat, he or she risks serious injury or even death if the car collides head-on. And anyone in the seat in front risks having this great weight unleashed on them from within the car, with equally serious consequences. Or the child could even go straight through the windscreen and hit the object that stopped the car dead in its tracks – a scenario every bit as terrifying as the first.

A few more comparisons to bear in mind:

Travelling unrestrained and then crashing at just 15 km/h (9.3 mph) is rather like climbing up onto a dining chair and letting yourself fall headlong onto the floor.

But if the car is going at 20 km/h (12.4 mph), the severity of the crash is more like arranging four dining chairs one on top of the other before you let yourself fall.

To visualise a crash at 30 km/h (18.6 mph), imagine arranging eight chairs, one on top of another, before you take the plunge.

Eight chairs make quite a tower – and quite a fall. Yet 30 km/h doesn't seem very fast at all. It's less than the new 20 mph speed limit in some residential areas in the UK, for instance. Even 'just around town', most of us drive faster than that.

So... please use those safety belts and child restraints.

Always.

For everyone in the car. ■

REFERENCES

Burdi, Huelke, Snyder and Lowrey, **Infants and children in the adult world of automobile safety design: Pediatric and anatomical considerations for design of child restraints**, Journal of Biomechanics, Vol. 2, 1969

Carlsson, Strandroth, Bohman et al. **Review of child car occupant fatalities in Sweden during six decades**, IRCOBI conf., 2013

Gustafsson, Cosini, **Barns färd i bil**, VTI rapport 716, the Swedish Road and Transport Research Institute (VTI) 2011

Isaksson-Hellman, Jakobsson, Gustafsson and Norin, **Trends and effects of child restraint systems based on Volvo's Swedish accident database**, SAE Technical Paper, Series No. 973299, 1997

Isaksson-Hellman and Norin, **How thirty years of focused safety development has influenced injury outcome in Volvo cars**, Proceedings of the 49th annual AAAM conference, USA, 2005

Jakobsson, Isaksson-Hellman and Lundell, **Safety for the growing child – Experiences from Swedish accident data**, 19th ESV conference, Washington DC, 2005

Jakobsson, Lechelt, Walkhed, **Balance of vehicle and child seat protection for the older children in child restraints**, International Conference on Protection of Children in Cars, München, 2012

Tarriere, **Children are not miniature adults**, IRCOBI conference, 1995

Tingvall, **Children in cars. Some aspects of the safety of children as car passengers in road traffic accidents**. Acta Paediatrica Scandinavica supplement, 339, 1987

Turbell, Thomas, **The Swedish approach to child safety in cars**, the Swedish Road and Transport Research Institute (VTI), 2002

The descriptions and facts in this publication relate to Volvo Cars international model range. The cars, baby and child seats and other accessories available may differ from country to country. The manufacturer reserves the right to make changes at any time and without prior notice.

Produced by Volvo Cars to help all those who carry child passengers – parents, taxi drivers, or anyone else – reach a better understanding of child safety matters.

EDITOR Gun Bengtsson and Dominique Amkell, Volvo Car Group.

PROJECT MANAGER Katarina Mistic, Spoon. **ART DIRECTOR** Mathias Lövström, Spoon.

PHOTOGRAPHY Michael Jönsson. **ILLUSTRATIONS** Madelen Lindgren.

PRINTING Elanders Sverige AB, Mölnlycke, 2016.







V O L V O

501030225 (ENGLISH)