

Rear-facing

What is "rear-facing"?

Rear-facing is the term used to refer to the direction of which an infant, toddler or young child faces. That is, towards the back of the vehicle.

What is "extended" rear-facing?

"Extended" rear-facing is often the term used to describe a child who rear-faces past one year of age.

To what age is it recommended to rear-face?

It is recommended to rear-face for a minimum of one year of age. This recommendation is backed by the Land Transport Safety Authority, Child Safety Foundation New Zealand, Safekids (worldwide), Safe2G0, Plunket, the American Academy of Pediatrics, The Children's Hospital of Philadelphia (CHOP), NHTSA and many more organisations throughout the world. All child passenger safety experts recognise the importance of rear-facing children particularly for that ever important first year of life. The American Academy of Pediatrics however takes it one step further and recommends that children ride in the rear-facing position until they're at least 2, though preferably until the rear-facing weight and height limitations of their child safety seat.

Whilst rear-facing till one year of age might seem like some new fandangled recommendation that popped out of thin air, this information has been repeated throughout New Zealand since at least the year 2000. Further more, children in Sweden have ridden rear-facing for a number of years and for quite some time Sweden has "led the way" in regards to rear-facing restraints and safety practices. Children in Sweden generally ride rear facing until they are three to five years old or as much as 25kg (55lbs), lowering traffic death and injury rates in Sweden considerably. It is uncommon to turn a child to forward-facing before these ages. "From 1992 through June 1997, only 9 children properly restrained rear-facing died in motor vehicle crashes in Sweden, and all of these involved catastrophic crashes with severe intrusion and few other survivors." (source: CPSAFETY).

Rear-facing is now catching on and taking off in other countries throughout the world such as Norway, Denmark, Finland, the USA, Canada, Sweden of course and now New Zealand.

Why is rear-facing safer?

Research has shown that rear-facing child restraints provide greater protection for children in the event of frontal/frontal offset and side impacts. Frontal/frontal offset crashes are by far the most frequent type of crash and are usually of much more severity than any other type of impact. According to accident statistics from Autoliv N.Z. Ltd frontal and frontal offset impacts account for 65.1% of fatal injuries in motor vehicle crashes and side impacts 29%. Because these types of crashes account for the majority of fatalities and injuries in motor vehicle crashes, this is why statistically the longer you rear-face, the better, it's called "best practice".

While some rear-facing restraints may not perform as well in rear impacts, it must be noted that rear and rear offset impacts account for approximately only 5.9% of fatal injuries in motor vehicle crashes and are usually of far, far less severity than frontal impacts. This is because typically in a frontal crash there are two vehicles travelling in opposite directions at high speeds. When these two cars collide with each other, both stop very abruptly, in a fraction of a second, with a tremendous amount of force and energy. Or, it may be just the one vehicle travelling at high speed and colliding with a stationary object. Rear impacts however most often occur when one vehicle has stopped (say at an intersection) and another car hits it from behind and usually this is at a very low speed, often causing minimal damage. Of course,

severe rear-impacts do occur, but as discussed above, are far less common than frontal and side impacts.

The most important parts of a child that we need to protect are the head, neck and spine. Rear-facing is the best protection for all of these important body parts. The rear-facing child has the frontal crash forces spread over their back, head and neck (a large portion of the body) in a crash. The rear-facing child is also supported by the back shell of the car seat meaning there is little stretching of the neck. However, how a forward-facing child is restrained is quite a contrast to that of a rear-facing child. In a frontal crash, the forward-facing child's torso is restrained by their harness straps. The head of the child however is restrained by nothing and thrusts violently forward, this places them at a much greater risk of serious head, neck and spinal cord injuries resulting in death or paralysis.

As demonstrated in the picture to the left, the infant's head is larger and heavier in proportion to its body than that of an older child, or adult. Their shoulders are also more narrow and flexible. This is important to know for proper placement and tightening of the harness straps.

As above, an infant's head is relatively large in relation to their body. In fact, an infant's head accounts for approximately twenty five percent of the child's body mass. This is a far cry from the mere six percent of body mass for a developed adult. Children are "top heavy" which is why they are far more susceptible to injury, in particular head, neck and spinal injuries.

When the heavy head of the forward-facing child is thrust forward in an accident, this puts an enormous amount of stress on the child's neck, which is trying to hold back the head. The heavy weight of the child's head can stretch the spinal cord. "According to documented research, autopsy specimens of infant spines and ligaments allow for spinal column elongation of up to two inches, but the spinal cord ruptures if stretched more than 1/4 inch. Real-world experience has shown that a young child's skull can be literally ripped from her spine by the force of a crash." (source: CPSTE).

If the spinal cord stretches too far in an accident this can cause it to tear, thus resulting in paralysis or death of the child. This is often described as "internal decapitation". Even babies who "appear" to have strong neck muscles and good head control are susceptible to these risks.

Young children have immature cervical vertebrae (neck bones) that are not strong enough to protect the spinal cord adequately in an accident when forward-facing in a frontal crash. The vertebrae are still in pieces joined by cartilage. These pieces are soft and have not yet ossified into a complete circle of bone which will enclose and protect the spinal cord.

Because the vertebrae are still in pieces (joined only by cartilage), a child that is forward-facing faces a heightened risk of damage to the spinal cord when their head and neck pull forward and back in a frontal crash.

Small children also have poorly developed, fragile, flexible neck muscles, loose ligaments to allow for growth, small rib cages, undeveloped abdominal muscles, soft spinal columns and unprotected relatively larger abdominal organs.

The vertebrae do not completely ossify until ages 3-6 years old. This is why rear-facing for as long as possible is safest, because it gives more support and protection to the incomplete vertebrae and therefore the spinal cord.

At one time, doctors and other organisations suggested turning infants to the forward facing position at about 6 months. This information is now outdated, 6 months is far too young to turn a child to the forward-facing position. Still, there are some doctors and organisations repeating this incorrect information because they have been reading old literature, or because they have not been told, or researched otherwise.

When and how were the first rear-facing safety seats "born" and how did researchers and experts come to realise its importance?

"The impetus for modern child safety was born in Sweden 1963. The first rear-facing child safety seat was designed by Bertil Aldman of Chalmers University in Gothenburg, Sweden. While watching an American TV program, Aldman noticed the position of the astronauts in the Gemini space capsule. By lying on their backs, in opposite direction to the force of acceleration, they were better able to withstand the acceleration. Professor Aldman believed that this principle could be applied to protect a child in the event of a head-on collision." "Since its inception in 1970, Volvo has gathered over 35,000 real world accident reports, nearly 5,000 of which involving children up to the age of 10 years old. Volvo's own research shows that a 90% reduction in injury is reported with children who are rearward facing." (Reference: Auto News)

Infant seats aside, experts and pioneers have been studying the effects of acceleration and deceleration for very many years. One such pioneer was John Stapp. Stapp's life was dedicated to aerospace safety in particular, and safety in general. He was one of the greatest advocates of car safety belts and in his time he was considered a crash safety expert. Dr. Stapp's researched deceleration with aid of a rocket sled that consisted of a 680kg carriage mounted on a 610 metre standard gauge railroad track supported on a heavy concrete bed, and a 14 metre mechanical braking system.

"Dr. Stapp's research on the decelerator had profound implications for both civilian and military aviation. For instance, the backward-facing seat concept, which was known previously, was given great impetus by the officer's crash research program, which proved beyond a doubt that this position was the safest for aircraft passengers and required little harness support, and that a human can withstand much greater deceleration than in the forward position. As a result, all of the Air Force Military Air Transportation Service (MATs) were equipped with this type of seat. Commercial airlines were made aware of these findings. The British Royal Air Force also installed it on many of their military transports." (Reference: John Stapp)

"By May 1948 he had taken 16 rides in the backward-facing position, with g stresses up to 35 times the pull of gravity. This was double the stress that had previously been set as the limit of human tolerance. These experiments proved that backward-facing seats would give air transport passengers optimum crash protection." (Reference: Stapp.org)

Rear-facing concerns, myths, questions and issues

- What about their legs, isn't it dangerous for them to "hang" over the edge and touch the back of the vehicle seat?

The legs touching the back of the vehicle seat is not considered a big enough risk to deem rear-facing unsafe and warrant the decision to turn a child forward. Most children, especially long legged children or those over 1 will touch the back of the vehicle seat at some point, this is completely normal and is not regarded as a major safety hazard. Injuries to the lower extremity are usually less severe with fewer long-term complications than injuries to the head, neck or spine, which occur more commonly when a child is seated in the forward-facing position.

Furthermore, a child is not necessarily "exempt" from injuries to the lower extremity when they are forward-facing. According to research by the Department of Pediatrics at the University of Washington, "Crash reconstruction data demonstrated that the likely mechanism of lower extremity injury was contact between the legs and the front seatbacks. In the CDS database, we identified 15 children with lower extremity injuries in a forward-facing child seat, usually (13 out of 15) placed in the rear seat, incurred in frontal impacts (11 out of 15). Several (5 out of 15) children were in unbelted or improperly secured forward-facing car seats. Injury Severity Scores varied widely (5-50). CONCLUSIONS: Children in forward-facing car seats involved in severe front or rear crashes may incur a range of lower extremity injury from impact with the car interior component in front of them." (Reference: Crash analysis of lower extremity injuries in children restrained in forward-facing car seats during front and rear impacts).

Additionally - According to research by the Center for Injury Research and Prevention, The Children's Hospital of Philadelphia, and University of Pennsylvania School of Medicine "The lower extremity is among the most frequently injured body regions for children restrained by forward facing child restraint systems (FFCRS), accounting for 28% of their clinically significant injuries, defined as AIS 2 and greater injuries excluding concussions." (Reference: Lower

extremity injuries in children seated in forward facing child restraint systems).

Another concern most parents have about their child touching the back of the vehicle seat and bending their knees is whether or not they are really comfortable. It would be never, or at least close to never that you see a child sit on the ground with their legs stretched out straight in front of them, so to the same can be said for when they are rear-facing. They will naturally bend their legs and be quite comfortable doing so.

Furthermore, some forward-facing kids complain of "dead legs" which are sore and uncomfortable because their feet are left "dangling" in the air from being forward-facing and having nothing to rest their feet on.

- What do I do when my child has outgrown their infant carrier?

If your child has grown out of their infant carrier before they are one year of age and you wish to rear-face them for a longer period of time, it is suggested that you move them to a rear-facing convertible car seat. A convertible car seat is one that both rear-faces and forward-faces at a later date (and when they're big enough and ready enough). Convertible car seats are bigger than infant carriers therefore they cater for larger children. Rear-facing convertible car seats often have quite good weight limits for the rear-facing position. However, this is not always the case, see below:

- What do I do about my rear-facing convertible car seat? It has a very low rear-facing weight limit!

Unfortunately some convertible car seats may only allow you to rear face up to 9 or maybe 10kg. If this is the case for you, then contact the manufacturer of your restraint (if possible) and ask if you can use your restraint for just a little above the rear-facing weight limit and up until your child is one year of age. If this isn't possible then you can purchase a restraint which lets you rear-face for higher weight limits, or you may have to prematurely turn your child to the forward-facing position. If so, at least make sure that at all times you have the upper tether strap installed and used for your restraint.

- If my baby can hold his/her head up, can they be turned to face forward?

Even babies who appear to have strong neck muscles and good head control are susceptible to the risks of forward-facing prematurely. 'Head control' is not a good indication as to whether or not to turn a child to the forward-facing position.

- Because my seat says I can forward face from 8,9,10 kg (etc.) that means that my baby is ready to be turned, right?

No, that is not right. Weight alone is not an indication of whether or not to turn your child to the forward-facing position. These weight limits hold no relevance as to how your baby's spine, skeleton, muscles and vertebrae have so far developed, they are merely entry level weight limits.

- But having my child forward-facing is easier for me because I can see them so does this mean it's better? Isn't it dangerous to be driving and to not be able to see my child?!

Everyone has different circumstances and they really need to weigh up the pros and cons. However, what's convenient, doesn't always mean it is best and doesn't change the fact that an infant's body is still incredibly undeveloped compared to that of an older child or adult. If your child has remained rear-facing for however long so far, then try your best to keep persevering till the very bare minimum of one year of age. If you are considering turning your child because you are worried about not being able to see them, you might want to consider the use of a baby mirror, usually found in baby stores, this mirror will enable you to see your child without having to turn around (just look through the rear view mirror). As for is it dangerous to not be able to see them when you're driving. It is quite possibly dangerous for some children with serious medical conditions (whatever they may be) that need to be closely monitored at all times. However, I don't watch my children when they're sleeping - so why would I need to watch them while they're in the car?

Types of rear-facing seats sold in New Zealand

Graco Safe Seat (USA)

Graco Logico S Base (European)

Graco Logico S Carrier (European)

Infant seats with bases

Quite a few infant seats sold in New Zealand now come with "bases" which enable you to get the capsule in and out of the vehicle quickly and securely. The base stays installed in the vehicle while the infant stays in the carrier (they are two independent pieces). Infant capsules do tend to fit newborns better than convertible car seats.

Some infant seat bases are secured to the vehicle with the seatbelt, LATCH belts or rigid ISOFIX anchorages.

Weight limits on these infant seats vary from anywhere from 9 to 13kg.

Unlike convertible car seats that can both rear-face AND forward-face, infant seats are for REAR-FACING ONLY.

Most infant seats with bases do not have stabilising bars although some may come with a "foot stand" which limits backwards (towards the front of the car) rotation of the seat.

In some cases, the infant carrier can be installed with or without its base (read your instruction manual). A lot of people use infant seats with bases as they find them much more convenient to get out and about with baby.

Infant seats with 5 point harnesses are preferred. However, if you for some reason must use an infant carrier with a three point harness it's better to use one that positions the crotch strap quite close to the crotch, rather than down by the feet (as with some capsules). This means there is less "play" for the hips and legs to move if you're in a side impact. Whereas with infant seats where the "buckle" is positioned so far down near the feet, infants (especially newborns) have been known to tuck their little legs up and move them completely to one side.

If you're shopping for an infant capsule, try and find one with a front harness adjuster rather than a fiddly one at the back of the seat. And if you're getting an infant capsule with a base, it helps if the base is adjustable and often saves you from having to use rolled up towels and pool noodles to get a good recline angle.

Another feature to look out for is EPS Foam. EPS Foam is the polystyrene looking material that's also present in bicycle helmets that helps "absorb" (for lack of a better word) some of the energy when something i.e. the head, collides with it.

Don't forget to read your car seat manual to see what position you should have the handle of the carrier in when you're using it in your vehicle. There are also "Australian" infant capsules with bases, please read below for more info.

Edinburgh Infant Capsule

Maxi Cosi CabrioFix

Graco Snugride (USA)

Infant seats without bases

In New Zealand most of the seats that come without a "base" are European seats and some American ones. Weight limits do vary between 9kg (20lbs) and 13kg (28.6lbs) depending on your seat (read the user manual.)

The seat pictured to the top left is a typical "European" infant capsule. All (unless your manual states otherwise) European infant capsules without bases require the use of a three point belt and cannot be used with a lap belt. These three point belts have to be of somewhat significant length. Problems fitting in to the vehicle are very common with these style of seats as some seatbelts in some cars tend to be quite short. For this method of installation the lap portion of the belt is fed through the footing area of the capsule and the sash part around the back of the capsule, this limits downwards (towards the front of the car) rotation and sideways rotation.

Don't forget to read your car seat manual to see what position you should have the handle of the carrier in when you're using it in your vehicle. A lot of "European" infant seats may require the handle be in the upright position (which in a way, acts as an anti-rebound device). Some might also need to be positioned like the picture to the left and some might even have to be pointed towards the front of the car. This is why it is very important you read your user manual and look at the stickers on your restraint. Never leave the handle up assuming it will be safe, some handles are not reinforced enough to withstand the forces in an accident (particularly side impacts) and can quite literally snap off and seriously injure a child.

There are also "American" infant capsules that can be used without bases. Some might require the use of the same kind of belth path as a "European" seat however some need only require a lap belt, or the lap belt portion of a three point belt.

It can often be quite difficult to get the necessary "no more than an inch of movement at the belt path" rule with a seat with no base (whether American or European). For this reason they might not always sit so snugly and tightly installed in to the vehicle as some other seats.

If the fitting of your infant capsule is quite loose, put your hand in the position where their bottom would be and push down firmly to compress the vehicle cushion whilst tightening the belt at the same time. Be careful though that this does not tip your car seat towards the back of the car. If after this you still have quite a loose installation then you may need to consider the use of another style of car seat.

Safe-n-Sound Platinum

HiPod Ibiza

Safe-n-Sound Unity

Rear-facing "Australian" Infant and Convertible Car Seats

One of the most popular rear-facing convertible car seats used in New Zealand are the Australian ones. The "Australian" infant seats however are not as commonly used.

All Australian rear-facing convertible car seats have:

- Rear-facing tethers that tether either side of the seat and are directed towards the back of the car where they meet at a hook which attaches to an approved anchor point.
- Stabilising bars (also known as "rebound bars") that stop the seat from "cocooning" or "flipping" towards the back of the car in a rear-impact or on rebound from a frontal crash.
- 6 point harnesses (ones that have a split crotch strap) designed to reduce the loads on the genital area. This is with the exception of their infant carriers where a 6 point harness is not required and is not considered necessary. In these cases, they will have instead a 5-point harness.

All rear-facing car seats that conform to ASNZS1754 will have the features above.

The rear-facing tethers are designed to prevent overrotation both forwards (towards the front of the car) and sideways. Along with the stabilising bar, they also increase ride down time .

Make sure you check out the rear-facing weight limit before you purchase if "extended" rear-facing (past 1 year of age) is something you wish to do. Unfortunately weight limits for Australian rear-facing seats stop at 12kg and some convertible car seats only rear face up to as little as 9kg (20lbs).

Whilst other rear-facing seats of other safety standards let you use the seat with the shoulders above the harness slots for Australian rear-facing seats you must always have the harness set at or above the shoulders and NEVER below. Therefore, Australian seats may also be grown out of relatively early height wise.

Cosco Scenera

Evenflo Triumph

Rear-facing "American convertible car seats"

Another popular rear-facing convertible car seat are the "American" type ones i.e. Cosco, Evenflo, Safety 1st etc.

No American car seat sold in New Zealand permits the use of the tether when rear-facing. Its use is strictly for forward-facing only.

These seats may install with LATCH (so are compatible with vehicles that have the isofix system) or the seatbelt.

Rear-facing weight limits range from 13.6kg to 16kg depending on the seat make and model. Always read your instruction manual or stickers on the side of the seat for this information. Quite a few of them also will not permit you to forward-face children under one in them.

Rear-facing "American" convertible car seats sold in New Zealand all conform to FMVSS213 and should display the yellow "S" mark sticker on the seat.

The Cosco Scenera tends to be quite a popular "American" seat for those who want to practice "extended" rear-facing as it offers a weight limit of (16kg) and is sold at quite an affordable price, usually around \$200.

Brio Zento

Brio Zento

Britax Multi-tech

Rear-facing "Swedish" car seats

The Swedish are regarded as "world leaders" when it comes to rear-facing. As of 12.04.2008 there is only one "Swedish" seat available for sale in New Zealand. That seat is called the Brio Zento. The arrival of a "Swedish" rear-facing seat has been long awaited by passionate extended rear-facing advocates in New Zealand.

There are quite a few rear-facing seats sold in Sweden but because those are not sold in New Zealand and this is a New Zealand based child passenger safety advocacy and education website I'll not discuss them so you don't get too confused!

This Brio Zento (New Zealand's only Swedish seat) has a rear-facing weight limit of 25kg (however it also offers forward-facing 12-18kg and booster seat 15-25kg). It can also be used until the eyes/tips of the ear are in alignment with the top of the seat shell OR the shoulders are more than an inch (2.5cm) above the top slots of the seat.

The Brio Zento has tethers on either side of the seat that wrap their webbing around a solid and unmoveable structural metal part of the vehicle, therefore there is no need for anchor bolts, meaning they are a little more versatile since you don't need to install an anchor bolt in every vehicle you ride in. These tethers either wrap themselves around the metal vehicle seat legs, or through the seat bight and around the hinges of the seat. This limits rotation towards the back of the vehicle. These tethers can be fitted in most vehicles.

Some would have you believe that a "Swedish" seat is completely impractical and quite cumbersome. It's true, they're not tiny things, but then you wouldn't expect them to be for the age, height and weight they cater for. However a "myth" or misconception that is often bandied about is that you have to have a very large amount of room in your vehicle to install a "Swedish" seat. This is simply just not true at all for all of them. A lot of their vehicles are no bigger than our own.

While some seats do require a sizeable amount of room to be able to fit in to the vehicle, some designs of "Swedish" seats can be installed in even very small vehicles. This is because for older children the "Swedish" seats can sit almost as upright as a forward-facing child seat needing a recline of only an astounding 10°. Other rear-facing child seats sold in New Zealand must only have reclines of between 45° and 30°, nothing less. Some "Swedish" seats even take up far less room than a traditional rear-facing Australian convertible car seat which are quite popular in New Zealand.

Video Footage:

Crash test of a Forward-Facing child

Side camera Crash test of a Rear-Facing child

Overhead view of a Rear-Facing child

Additional information on rear-facing:

Car Safety Seats: A Guide for Families 2006

Is Your Baby Ready to Face Forward in the Car?

MSNBC: Toddlers Should Face the Rear Longer

Rear-Facing Car Seats: What You Need to Know, by Kathleen Weber

Rear-Facing Seats

Car Time - Stage 1: Safe Travel in a Rear-facing Infant Seat

Rear-Facing Car Seat Rules - Why You Should Consider Extended Rear-Facing

Reference:

Child safety in cars - Literature review

Booster Seats - Dr. E.R. Segedin April 2006

SafetyBeltSafe Technical Information (Scroll down to the section on Rear-facing vs. forward-facing)

Safety For the Growing Child - Experiences From Swedish Accident Data

Danger with children - The researchers' facts about children and car security (Swedish)

Land Transport New Zealand - Fitting children into child restraints

Pediatric cervical spine injuries: report of 102 cases and review of the literature

How Long Should Babies Ride Facing the Back of the Car?

National Child Passenger Safety Certification Training Program - Student Manual - April 2007

Why Rear-Facing is Safest

Rear-Facing - Unmatched Safety