Feva Star Seat™
Proof of Safety Document
Ref: 040419-001

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04 April 2019

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Proof of safety of child bicycle training seat.

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1 Objective of this document

1.1 To co-operate with third party safety authority towards proving safety for obtaining safety approval certification so that a new alternative beneficial product may be distributed and sold throughout Europe.

1.2 To demonstrate improvements relevant to existing standard requirements in the interests of consumer safety and/or demonstrate that existing standards cause safety risks during inevitable common modern application or product use, especially concerning mountain bikes.

2 Background information for reference

2.1 An alternative design of bicycle child carrier product exists. It is successfully developed and safely used to reduce risks associated with using chair seats on bicycles, especially mountain bikes. It has been tested in practice over a period of 5 years.

2.2 Until recently, reliable safety data in support of product development has been scarce. Relevant data and reliable information is available for reference.

2.3 Chair seats according to EN 14344 rely on passive children with support and restraint to be effective. This is not always beneficial for safety because chair seats cause safety risks that are evidently more serious than the risks that they reduce, especially during off-road application with mountain bikes.

2.4 Data evidence supports practical evidence to identify and demonstrate risks associated with chair seats as required by EN14344.

2.5 Data evidence supports the safety requirement to reduce the number of bicycle accidents involving children between the ages of 4 and 10 years by improving child cycling skills and awareness. Chair seats according to EN 14344 do not serve this objective.

2.6 Cycling with children is a low-risk activity based on reliable data. EN 14344 is a recommended standard for parents to restrain child passengers on bicycles in a sitting position in a chair. The standard focusses on the chair seat concept as a safe guideline, however it is definitely not the safest overall solution. A chair seat is not always necessary for safety due to valid risks caused by the chair and restraint system. There is an alternative solution for improved safety.

2.7 Reliable accident injury data reports indicate a significant number of injuries to the lumbar region of children, including the spine and torso. It is a risk that chair seats cause injuries by transferring excessive shock impact during cycling to the back and spine region of children. This risk is exaggerated on uneven terrain typically associated with mountain biking. The reported percentage injuries to the lumbar region of children in chair seats 9% (CASR- Road Safety Research Report) of the total injuries, is out of proportion relative to cycling accident injuries for all ages being 5% (ROSPA - royal society for the prevention of accidents), suggesting that the chair seat is a contributing safety risk factor.

2.8 An alternative seating position with limited restraint effectively reduces risks and provides alternative beneficial opportunities to improve safety.

2.9 Bicycles have evolved to become more capable and are being used in applications where terrain is uneven or unpredictable where chair seats are not always suitable for safety because of increased risk of injury caused by impact to a child's back, or falling due to loss of bicycle control.

2.10 Falling is the primary cause of injuries to children in child bicycle carriers.

2.11 A chair seat structure and restraint system according to EN14344 can not provide sufficient impact protection against serious injury in the event of a major collision with a vehicle because bicycles provide little structural protection or resistance. This fact is practical common sense.

2.12 Potential collision with vehicles is a valid serious safety concern when cycling on roads. According to data, this serious type of incident represents a low-risk occurrence over many years. It is not particularly relevant for off-road cycling where there are few motor vehicles, as with mountain biking.

2.13 Cycling helmets are commonly accepted as the most effective safety measure to prevent serious impact-causing head injuries to cyclists and passengers on bicycles.

2.14 Data reports do not support En14344 requirement for chairs as the only recommended seat for child carrier safety on bicycles.

2.15 Data indicates that parents do not cycle at high speed with children. There are no accident reports of high speed bicycle crashes involving children in child seats.

2.16 Most accidents occur due to loss of control at low speed or when a bicycle is stationary.

2.17 Parents modify cycling behaviour to protect children.

2.18 Improving control of a bicycle and child reduces risk of falling.

2.19 Enabling effective evasive action by the cyclist benefits safety.

3 References

3.1 DIN EN 14344 (2004) (English) : Child use and care articles – Child seats for cycles – Safety requirements and test methods [Authority: Directive 2001/95/EC]

3.2 Predicting bicycle setup for children based on anthropometrics and comfort. Karl Grainger, Zoe Dodson, Thomas Korff. Centre for Human Performance, Exercise and Rehabilitaion, Brunel University London, Uxbridge, U.K.

3.3 Transportation of children with bicycle seats, trailers, and other carriers: considerations for safety. S.J.Raferty, J. Oxley, J. Thompson, L.N. Wundersitz. Centre for Automotive Safety Research. University of Adelaide. CASR report series, CASR 139, November 2016.

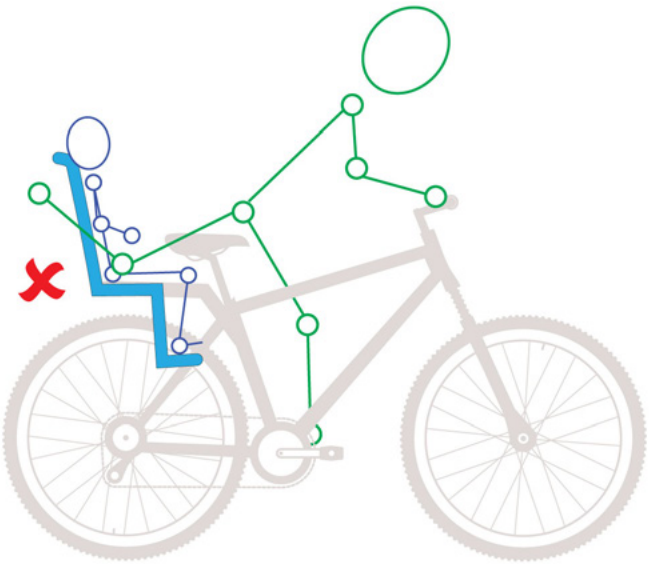
3.4 Feva Star Seat. A safety Sandards Discussion. Cycling Off-Road with Children, Teaching Cycling Skills and Awareness. Product safety risk information report and safety discussion toward certification. R. Buttle U.K., M. Friedrich (GER). November 2018.

4 SAFETY DIAGRAMS

4.1 Safety Diagram 1 – Unsafe dismount:

When cycling on uneven or unpredictable terrain it is often necessary for a cyclist to dismount a bicycle to recover control or maintain control to avoid danger. EN14344 standard requires children weighing more than 15kg to be positioned behind a cyclist that causes dangerous safety risks. The chair seat dimensions are a contributing safety risk factor:

Safety Diagram 1	Unsafe Dismount with of Rear Seat EN14344



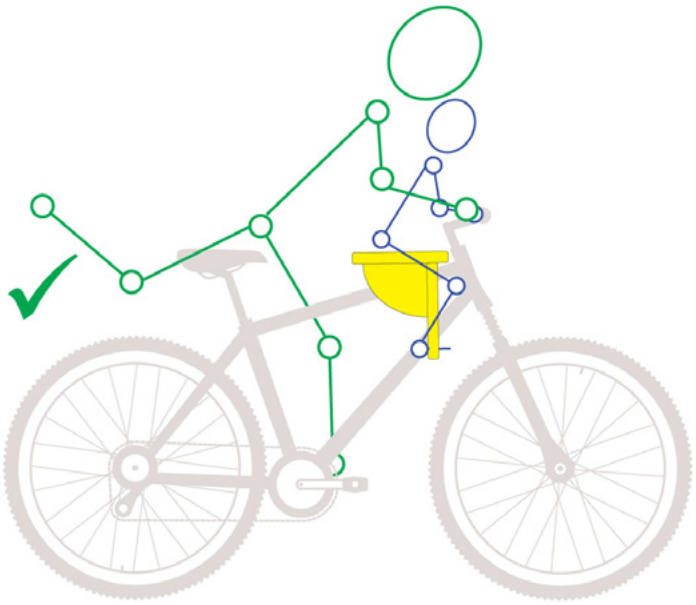
4.1.1 A cyclist cannot safely dismount a bicycle without risk of losing control or falling due to obstruction caused by the chair seat and position.

4.1.2 A bicycle becomes unstable with uneven weight distribution if a cyclist weight is off the bicycle. This causes risk of injury due to falling when a bicycle is moving or stationery.

4.2 Safety Diagram 2 – Safe dismount:

When cycling with a child passenger on uneven or unpredictable terrain it is very important for safety that the cyclist can easily and safely dismount a bicycle to maintain control and avoid danger. The Feva seat design improves safety in various ways:

Safety Diagram 2	Safe Dismount with Feva Star Seat



4.2.1 A cyclist can safely dismount a bicycle with lower risk of falling as there is less obstruction. The ability of a child to lean forward without shoulder restraints contributes to safety by creating space and allowing movement to improve balance.

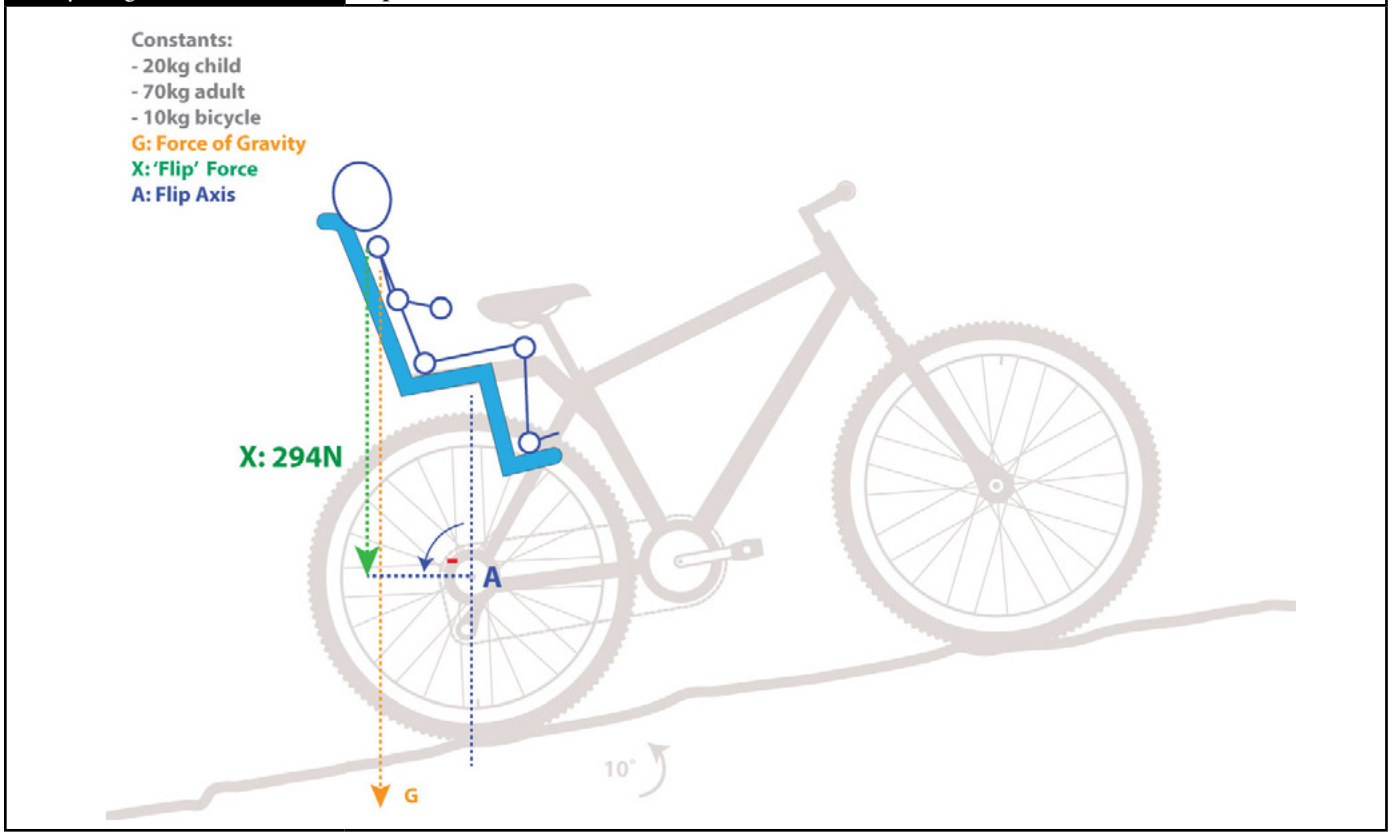
4.2.2 A bicycle with a child passenger remains balanced when the cyclist weight is off the bicycle because the position of the seat enables safe weight distribution between the wheels. The ability for a cyclist to safely push a bicycle over unsafe terrain carrying the weight of a child is important for safety especially on a mountain bike.

4.3 Safety Diagram 3 – Flip Force Effect of rear seat EN14344

When cycling uphill, the centre of gravity of the child passenger is behind the flip axis of the bicycle and the force exerted by the weight of the child has a negative impact on safety.

Shoulder restraints prevent a child from moving to lean forward to compensate for any imbalance caused by an incline or obstacle that may be encountered while cycling.

Safety Diagram 3	Flip Force Effect of Rear Seat EN14344



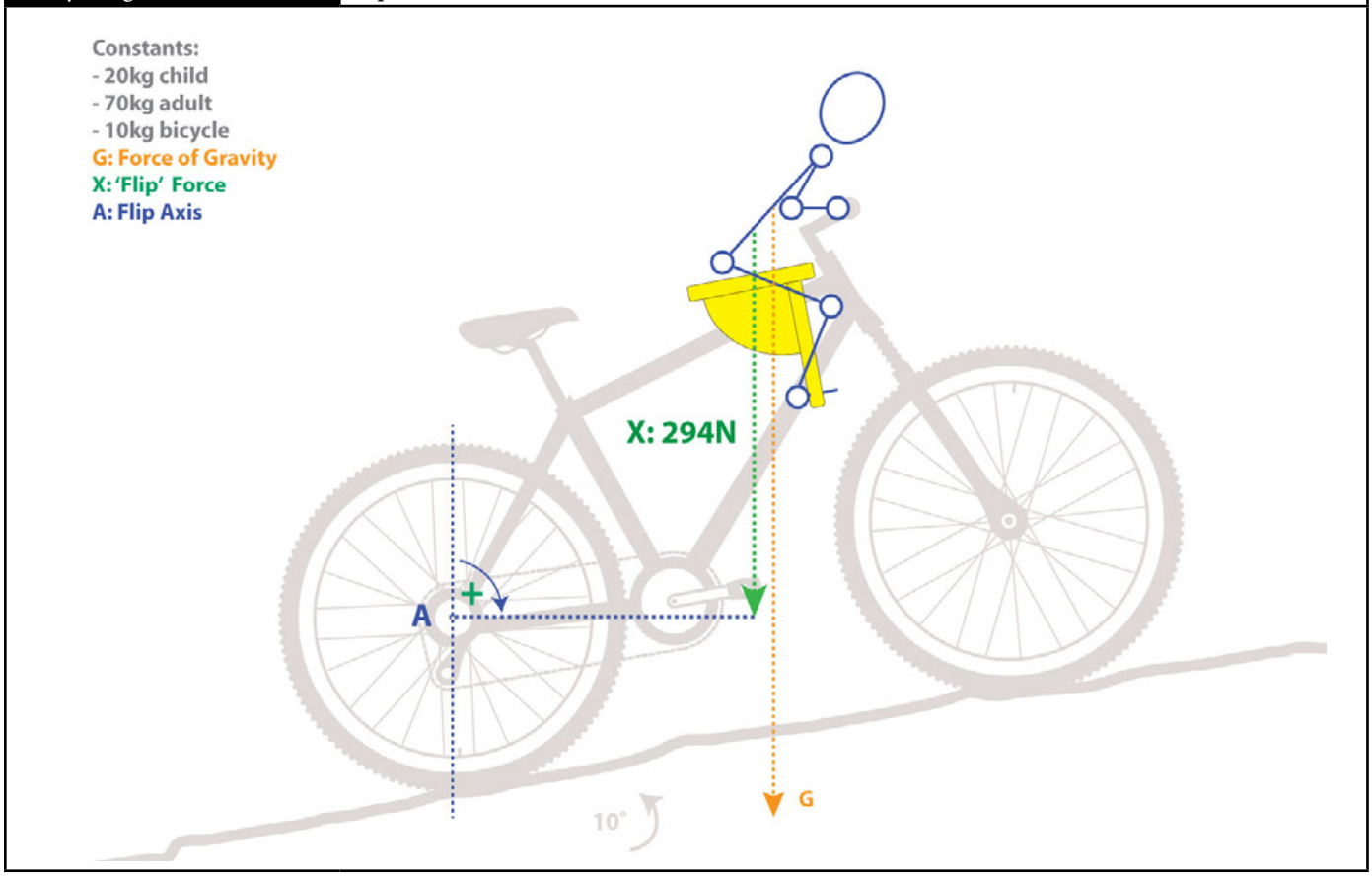
4.3.1 The position of the seat causes a negative flip force that contributes to the risk of losing control and falling.

4.3.2 If a cyclist is required to push the bicycle and the cyclist weight is not used to stabilize the bicycle carrying a child in a rear seat, the negative flip force effect of the EN14344 seat is increased that increases the risk of injury due to loss of control and falling.

4.4 Safety Diagram 4 – Flip Force Effect of Feva Seat:

When cycling uphill, the effort required by a cyclist to balance a bicycle and overcome the forces of gravity and friction increase. The Feva design improves safety relevant to the seat position, size and restraint system in various ways to improve weight distribution and bicycle stability:

Safety Diagram 4	Flip Force Effect of Feva Star Seat



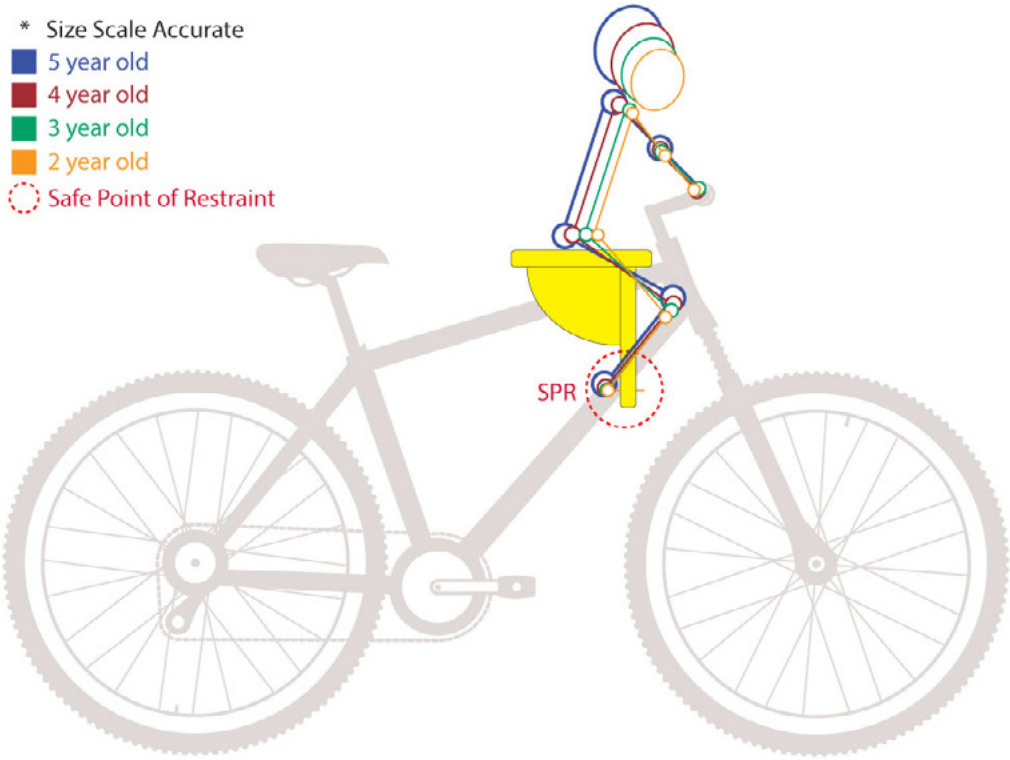
4.4.1 A child passenger can lean forward without shoulder restraints to improve the centre of gravity and reduce the flip force effect so that a bicycle is more stable and easier for the cyclist to manage with improved control.

4.4.2 Seat dimensions do not obstruct the cyclist ability to lean forward to improve balance and control.

4.5 Safety Diagram 5 – Safe point of restraint for foot-hold position.

In order to accommodate the weight and size of a child safely between a cyclist and the handlebars of a bicycle, it is necessary to prevent the feet of a child from interfering in the front wheel of the bicycle. This safe point of restraint is constant relative to the front wheel of a bicycle. Adjustment of this position is not necessary for comfort or safety depending on the design of the seat. Relevant age children of average size dimensions are able to sit safely and comfortably on the Feva seat using one foot-hold position.

Safety Diagram 5	Foothold Safe Point of Restraint



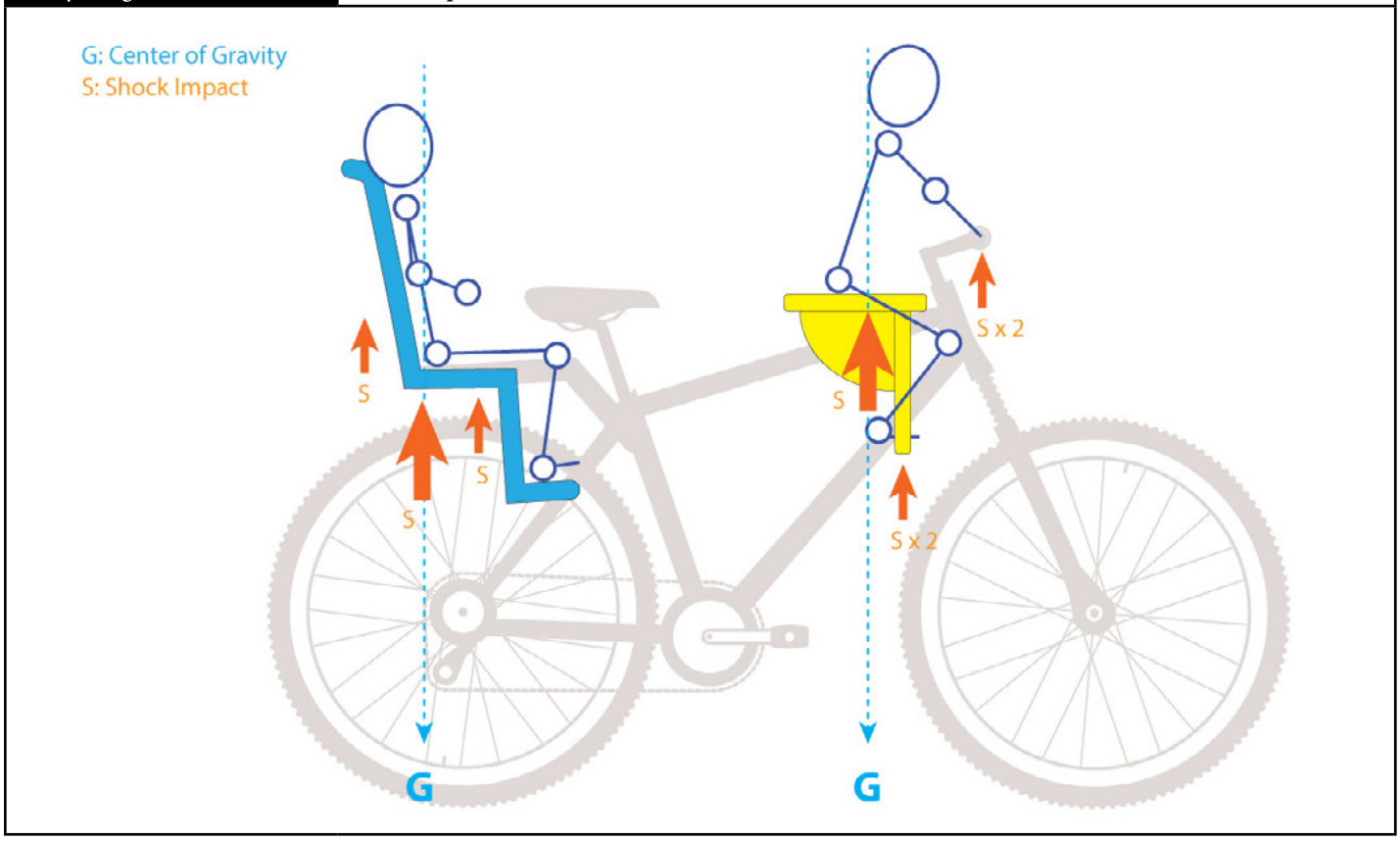
4.5.1 This is possible because of the size of the seat platform that enables a larger child to sit further back on the saddle.

4.5.2 A jockey sitting position also enables children to safely and comfortably bend their knees and ankles to fit comfortable on the seat with one secure foot-hold located at a safe point of restraint behind and away from the bicycle front wheel.

4.6 Safety Diagram 6: Shock Impact effect on the body of child passengers.

Accident safety data reveals that there is a relatively significant number ratio of injuries to children in child bicycle chair seats (9% of injuries) occurring to the lumbar region including back and spine of children compared with the same type of injury occurring in general cycling accidents (5% of injuries). This indicates that impact of the chair seat on a child's body could be contributing to these injuries.

Safety Diagram 6	Shock Impact Effect



4.6.1 EN14344 causes excess shock impact to be absorbed and more focussed behind the coccyx of children and the chair seat design and shoulder restraint requirements prevent a child from using muscles and limbs to naturally absorb excess shock.

4.6.2 The Feva seat design enables contact with the handlebars and a child is able to use muscles to support body-weight and absorb shock. The centre of gravity is in front of the coccyx and impact is behind and away from the bicycle front wheel.

5 Safety Proof Strategy

5.1 Demonstrate safety according to standard DIN EN14344, the recommended standard used for comparison and review.

5.2 Select points of non-compliance according to EN14344 and demonstrate that the specific points are not relevant to the Feva seat for safety by proving alternative safety benefits and/or identifying current risks for consumers using chair seats based on factual information.

6 Alternative child seat design for bicycles

6.1 The standard EN14344 relies on passive restraint &protection for safety, whereas the Feva training seat requires active participation in order to control & educate for safety. This is a completely different approach to safety.

6.2 The product safety requirements are therefore different with respect to the EN14344 points concerning the recommended standard specific requirements and should be considered as part of an alternative approach to safety in the context of a complete product solution based on data, rather than isolated points of non-compliance. The Feva seat provides safety benefits by alternative design as a training seat that cannot meet specific points for chairs - in order to achieve safety improvements to conform with the overall spirit of the EU General Product Safety Directive where it succeeds.

6.3 This proof document specifically relates to the standard EN14344 to comply with existing certification protocol employed by authorities.

7 The primary safety improvements are:

7.1 • Reduced risk of falling with improved control of bicycle and child – the main cause of injuries.

7.2 • Improved communication with increased cyclist awareness of child behaviour.

7.3 • Improved child cycling skills and awareness through supervised education and physical cycling skills development of children before they learn to cycle independently.

8 The primary safety benefits are:

8.1 • Reduced number of accidents involving child bicycle seats

8.2 • Reduced number of accidents involving child cyclists

9 Obvious identified points of non-compliance according to DIN EN 14344

9.1 • REF: Table 2 - Dimensions of seat

9.2 • REF: 6.1.1.4 Requirements for footrest adjustment

9.3 • REF: 7.4.6 Backrest dynamic test

9.4 • REF: 9. Restraint system- Shoulders not passed

9.1 REF Table 2 - Dimensions of seat.

9.1.1 Dimensions of standard chair seats according to Table 2 EN 14344 are not relevant to the Feva seat for safety because the Feva seat is a saddle seat that successfully reduces valid risks and offers safety benefits by alternative design.

9.1.2 The Feva seat is a minimally sized saddle that supports a child passenger in a similar manner to the way a bicycle saddle supports a cyclist with additional features to reduce safety risks based on relevant data available and practical testing. There are safety benefits to this design that super-cede the benefits provided by chair seats. The Feva seat must be positioned in front of a cyclist to be effective and safe. The minimal size dimensions are necessary for safety in this position. Improved communication with a child and increased cyclist awareness of child behaviour with constant forward vision benefits safety that is a specific objective of the Feva seat. Another specific important objective of the design is to maximize operating space for a cyclist and limit obstruction or interference. Another objective is to enable a child to participate under supervision for education and skills development purposes

that requires movement of the child's upper body.

9.1.3 The standard requirements and dimensions for chair seats according to table 2 of EN14344 make positive safety objectives impractical to implement without increasing safety risk for the following reasons:

9.1.4 Front chair seat dimensions obstruct cyclist movement and ability to lean forward or shift bodyweight properly to achieve optimal balance when cycling, especially up hill. The Feva seat enables increased operating space for the cyclist and child to lean forward to improve control.

9.1.5 Front chair seat and rear chair seat dimensions according to standard increases the risk of causing injury to children while loading or unloading children to or from a chair seat. It is not always practical for a cyclist to support a bicycle as-well-as load, or unload a child to or from a carrier and it is therefore necessary to use an auxiliary bicycle support stand or additional bicycle support for safety. This is not practically available increasing risk of an accident occurring. The Feva seat enables a cyclist to support a bicycle without additional stands or supports and simultaneously safely load, or unload a child to, or from the seat thereby reducing the safety risk of injury caused by falling. The Feva Seat enables access without a backrest and sides to manage the child seat safely without climbing off a bicycle to attend to the child passenger.

9.1.6 Rear seat dimensions obstruct cyclist leg movement over the bicycle saddle (safety diagram 1), preventing the ability of a cyclist to jump off the bicycle to recover control in case of emergency. The requirement for a cyclist to safely jump off a bicycle and maintain control of the handle bars is essential for recovering safety when losing control, especially cycling uphill on unpredictable terrain. In case of emergency or danger, the Feva seat enables a cyclist to jump off a bicycle without obstruction while maintaining hold of the handle-bars to recover control while the bicycle remains balanced when being pushed with significantly reduced "Flipping" force to benefit safety.

9.1.7 The dimensions of the standard Table 2 front mounted seats do not accommodate children up to age 5 years including enable sufficient space for a cyclist to safely operate a bicycle without interference or obstruction. The dimensions of the Feva seat enable a larger child up to 5 years old to be safely placed in front of a cyclist while enabling sufficient operating space and imposing minimal obstruction to improve balance and control deemed necessary for safety.

9.1.8 The standard seat dimensions and sitting position detract from the child cycling learning experience. Positioned where supervision is possible, education and physical development of children is also possible to benefit safety as the highest number of accidents involving children on bicycles include children between the ages of 4 and 10. This coincides with the ages that children learn to cycle and high-lights the requirement for education. The Feva seat offers a positive solution for safety. A major safety benefit of the Feva seat is improving child cycling skills in a managed environment through improving awareness, balance, physical strength and confidence. This requires child movement and participation with managed parental interference to achieve safety by supportive education.

9.1.9 The standard chair dimensions contribute to restrict movement of children in a contained position.

9.1.10 A child passenger in a chair seat does not utilise relevant muscles required for cycling, or develop concentration, awareness and responsibility for safety. The chair seat does not benefit children as they adapt to cycling or benefit learning responsibility for their own safety. The Feva seat dimensions do not obstruct natural upper body movement when cycling so that children develop their own muscles to support bodyweight. This takes place in a managed environment where the parent can naturally supervise physical development while improving balance, spacial awareness and self-confidence in children. These skills benefit safety as children adapt to cycling.

9.1.11 Chair seat design contributes to risk of injuries to a child's torso because it requires that excessive shock impact of cycling that is not absorbed by the chair is absorbed into the coccyx and spine region of children (safety diagram 6). This is potentially dangerous and could result in increasing injuries. Relevant injury data is extremely important to consider for safety and evidence raises serious concern regarding safety of chair seats in general. The Feva seat surface provides a stable saddle platform to allow seating in a forward jockey position that is deemed optimal for effecting balance and also for absorbing and dispersing cycling shock impact more naturally through multiple contact points with a bicycle including limbs (arms and legs). The impact to the child's coccyx is reduced that benefits safety.

9.1.12 Bicycles offer little collision protection. The impact protection offered by a chair seat is inadequate in providing proper protection in-case of a serious collision. It is also inadequate at preventing injuries due to minor falls causing side impact. Based on a low number of serious collision reports with other vehicles compared with the relatively high number of injuries due to loss of control causing bicycles to fall, especially considering the overall risk contribution regarding chair seats, it is beneficial for safety to improve control for cyclists so that the cyclist can be more responsible for the safety of children. Compared to the Feva seat,

chair seats can cause increased risk of imbalance and/or obstruction for the cyclist resulting in increased risk of loss of control of a bicycle that is the major cause of relevant injuries to children. The safety requirement to adequately protect a child with the chair seat in the event of a serious collision is super-ceded by the important safety requirement to maintain control of the bicycle in order to prevent falling causing all kinds of injuries according to available safety data. The Feva seat dimensions despite the mounting position, have relatively minimal impact on the operating space of the cyclist that is required in order to pedal freely and lean forward to achieve balance when cycling and dismounting, or pushing the bicycle in a controlled manner, or loading and unloading children onto the bicycle to ensure safety. The Feva seat reduces multiple safety risks that contribute collectively to the majority of child bicycle accidents.

9.2 REF 6.1.1.4 Requirements for footrest adjustment.

9.2.1 The standard requirements for footrest adjustment are not relevant to the Feva seat because the alternative design foot hold of the Feva Seat comfortably and safely caters for use by relevant age children (safety diagram 5).

9.2.2 The chair seat standard requires adjustment for safety to accommodate children of different sizes and relevant ages that would use the chair seat. By design, the chair seat requires a child to sit with the femur extended at approximately 90 degrees to the child's vertical torso and the tibia (lower leg) is vertical to the footrest. As the length of the children's legs vary and there is little room for movement being contained within the confinement of the chair seat, the design must include extensions or adjustments for child comfort and safety.

9.2.3 The Feva Seat requires a child to sit in a jockey-type position leaning slightly forward and does not obstruct adjustment of body joint angles between the ankle and hip of a child so that variations in the length of appropriately aged children's legs are safely and comfortably accommodated simply by naturally adjusting ankle, knee and hip joint angles within normal comfortable parameters. The most important consideration for safety of the foot hold is to prevent a child's foot from entrapment in the wheel, or interfering with moving parts of a bicycle. In order to place a child between the handlebars and cyclist, the safe point of restraint for the child's feet is located at one place on most bicycles relative to the front wheel. The Feva seat successfully and safely deals with passenger comfort and safety risks concerning the foot hold position.

9.2.4 Max. and min. inner leg length measurements of child passengers can be specified to consumers with appropriate indicators to further improve safety.

9.3 REF 7.4.6 Backrest dynamic test.

9.31 This requirement is not relevant to the Feva design. A backrest according to standard requirements creates safety risks that negate the benefits of improving overall control as indicated.

9.3.2 The cyclist is positioned directly behind the child and naturally provides care-giving physical and psychological support to children carried on the bicycle that is effective towards achieving safety. One of the main safety objectives of the Feva seat is to develop a child's physical strength and balance in a managed environment. The safety benefits become evident as children develop advanced cycling ability at a young age. This helps reduce the high number of bicycle accidents involving children aged 4-10 years.

9.4 REF 9. Restraint system - Shoulders not passed.

9.4.1 The restraint system according to EN 14344 requires shoulder restraints. This requirement presents safety risks and prevents safety benefits. Chair seats are designed with passive restraint and containment of a child to achieve safety. This is necessary for safety when containing, restraining and pacifying a child within the confinement of a safety seat so that safety depends largely on protection provided by the seat and the child cannot physically balance its bodyweight or participate in the activity. This standard requirement is based on perceived risks rather than actual risks that are known by data records of accidents and injuries. It is not possible while cycling to safely supervise and educate a child carried behind a cyclist. Not being able to manage a passenger while cycling makes passive restraint necessary for safety. This is the case with the standard EN14344. The Feva seat enables supervision and management in a front position without the need to fully restrain a child or climb off a bicycle. Total passive restraint including shoulder restraint is not necessary for safety considering little impact protection offered by the bicycle as well as inadequate impact protection, offered by the seat. The Feva seat has no shoulder restraints that benefits safety because of physical development benefits and cycling skills benefits towards achieving safe cycling, as well as a child's natural ability to contribute towards balancing the bicycle and take instinctive evasive and self-protective action.

9.4.2 The Feva seat adequately restrains children to address risks and required improvements that are supported by data and this includes the requirement to increase awareness and cycling skills in children between the ages of 4 and 10.

9.4.3 Shoulder restraints confine additional weight carried on a bicycle to the backrest of a chair, thereby raising the overall centre of gravity of the combined bicycle mass, increasing the risk of imbalance and increasing the bicycle “flipping force” on uneven terrain (safety diagram 3). This serious risk is exaggerated when cycling uphill and becomes very dangerous in the event a cyclist loses momentum and has to jump off a bicycle to recover control. In practice, especially on a mountain bike, the safety requirement to act in danger is essential. The restraint system of the Feva seat provides essential support and restraint that does not include shoulder restraint to benefit control towards safety. In order to accommodate children up to 22kg in front of a cyclist, operating space is necessary for safety and it is important for a child passenger to be able to lean forward to free up space for the cyclist to lean forward when cycling up hill (safety diagram 4). This benefits balance and bicycle control and improves the centre of gravity to reduce the bicycle “flipping force”. The leg straps and lap strap of the Feva seat are monitored and adjusted by the cyclist while on the bicycle from behind the passenger as required to improve safety that reduces safety risks associated with shoulder harnesses that often cause imbalance as children are loaded to and from seats.