VTI särtryck

Nr 206 • 1994

ECE Regulation 44 – An Update on the Current Revision

Thomas Turbell, Swedish Road and Transport Research Institute, Sweden

John A. Jeyes, Department of Transport, London, England

Reprint from SAE Technical Paper Series, SP-986, Child Occupant Protection, paper 933084, pp. 29–33 (Child Occupant Protection Symposium, San Antonio, Texas, November 7–8, 1993)

VTI särtryck

Nr 206 • 1994

ECE Regulation 44 – An Update on the Current Revision

**Thomas Turbell, Swedish Road and Transport Research
Institute, Sweden**

John A. Jeyes, Department of Transport, London, England

Reprint from SAE Technical Paper Series, SP-986,
Child Occupant Protection, paper 933084, pp. 29–33
(Child Occupant Protection Symposium, San Antonio,
Texas, November 7–8, 1993)

ECE Regulation 44 - An Update on the Current Revision

Thomas Turbell

Swedish Road and Transport Research Institute

John A. Jeyes

Department of Transport, London

**Reprinted from: Child Occupant Protection
(SP-986)**

SAE *The Engineering Society
For Advancing Mobility
Land Sea Air and Space®*
I N T E R N A T I O N A L

**Child Occupant Protection Symposium
San Antonio, Texas
November 7-8, 1993**

400 Commonwealth Drive, Warrendale, PA 15096-0001 U.S.A. Tel: (412)776-4841 Fax: (412)776-5760

The appearance of the ISSN code at the bottom of this page indicates SAE's consent that copies of the paper may be made for personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay a \$5.00 per article copy fee through the Copyright Clearance Center, Inc. Operations Center, 27 Congress St., Salem, MA 01970 for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

SAE routinely stocks printed papers for a period of three years following date of publication. Direct your orders to SAE Customer Sales and Satisfaction Department.

Quantity reprint rates can be obtained from the Customer Sales and Satisfaction Department.

To request permission to reprint a technical paper or permission to use copyrighted SAE publications in other works, contact the SAE Publications Group.

GLOBAL MOBILITY DATABASE

All SAE papers, standards, and selected books are abstracted and indexed in the SAE Global Mobility Database.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

ISSN 0148-7191

Copyright 1993 Society of Automotive Engineers, Inc.

Positions and opinions advanced in this paper are those of the author(s) and not necessarily those of SAE. The author is solely responsible for the content of the paper. A process is available by which discussions will be printed with the paper if it is published in SAE transactions. For permission to publish this paper in full or in part, contact the SAE Publications Group.

Persons wishing to submit papers to be considered for presentation or publication through SAE should send the manuscript or a 300 word abstract of a proposed manuscript to: Secretary, Engineering Activity Board, SAE.

Printed in USA

90-1203B/PG

ECE Regulation 44 - An Update on the Current Revision

Thomas Turbell

Swedish Road and Transport Research Institute

John A. Jeyes

Department of Transport, London

ABSTRACT

After 12 years since the introduction and approx. 500 approvals according to ECE Regulation 44 on Child Restraint Systems a major revision is now being done. The revision is scheduled to be completed in 1993. The main features of the update are:

- Better Definitions and Instructions
- Air Bag interaction
- Mandatory strong crotch straps
- Higher buckle opening forces
- New mass group and dummy
- More realistic dynamic testing
- Compatibility checks on vehicle seating positions
- Side impacts
- Various other improvements
- Conformity of production
- Longer term solutions dependant on ISO

The paper will present an update on some of the most interesting parts of this work.

ECE REGULATION 44

The European Regulation ECE Reg. 44 for child restraint systems (CRS) was introduced in 1981. /1/ Since then it has been subjected to 5 amendments. The Regulation has been adopted by the following 15 countries:

Germany (E1)
 France (E2)
 Italy (E3)
 Netherlands (E4)
 Sweden (E5)
 Belgium (E6)
 Hungary (E7)
 Czech and Slovak Fed. Republic (E8)
 United Kingdom (E11)
 Austria (E12)
 Luxembourg (E13)
 Norway (E16)
 Finland (E17)
 Denmark (E18)

Romania (E19)

A total number of approx. 500 approvals have been made. These approvals can be divided into the different system types like this:

11 Carrycot restraints and carbeds
 85 Rearward facing infant seats
 44 Rearward facing child seats
 121 Forward facing child seats
 179 Boosters

407 of these approvals are still valid.

In the last years there has been a growing concern that Reg. 44 is partly outdated and that a number of amendments has to be done. The International Organisation of Consumers Union (IOCU) has been pushing hard for amendments and has also been instrumentive in proposing changes. In 1992 the responsible ECE-group in Geneva, GRSP, established an ad hoc group with the task to elaborate on all the pending proposals and to propose a major revision of the Regulation. The ad hoc group was chaired by John Jeyes from the UK Department of Transport. There has been 5 meetings with this group and the findings and proposals are scheduled to be presented to GRSP in the end of 1993. This paper will describe the status of the most important proposals as by summer 1993. Parallel to the work in this ad hoc group there is an ISO Working Group on child restraints (ISO/TC 22/SC 12/WG 1) working with many of the problems. There is a close interaction between these two groups. Some items have been left to a later revision of the Regulation because the ISO-group are still working with them.

DEFINITIONS

The "Universal type" approval has been very common in the past. It has been used in the sense that these systems can be used in all types of cars. In the earlier days of the Regulation it was required that there was a list of vehicles supplied with the

CRS indicating where the seat could be used. These lists were not properly checked by the CRS manufacturers and eventually they included all existing cars on the market. The requirement for such a list was later abandoned from the Regulation. The problem of poor fitting however remained.

The ad hoc Group is proposing to define a "New Universal" category which will be tested under more realistic conditions (described later) and for which a vehicle compatibility check will become available and could become mandatory for vehicle manufacturers. Also, the child restraint manufacturer would be required to give appropriate advice on the packaging to guide prospective purchasers on how to check whether a particular product is suitable for their vehicle including reference to the owner's handbook in cases where new vehicles (in the future) would be subject to the compatibility checks (also described later).

For child restraints which do not pass the new more realistic dynamic test but which can pass the existing test, it is proposed that a new "Restricted" category be introduced with a requirement for the manufacturer to produce a list of vehicle models for which the restraint is suitable.

Another proposal is for improved "installation instructions" to ensure correct routing of the adult belt through the child restraint. This involves a colour coding system on the restraint itself.

AIR BAG INTERACTION

A major concern has been the interaction between a deploying passenger air bag and a rearward facing child seat placed in the front passenger position. Although no accident of this type is known at the moment, laboratory tests have shown that this is a potentially fatal combination. Passenger air bags are also being introduced in a big scale in Europe also in high volume family cars. A simple solution would be not to place any rearward facing CRS in the front seat if there is an air bag present. However this solution is unrealistic since this is the only place that can be used if there is a single adult in the car who needs to have some supervision of the child. A small child in a rearward facing seat in the rear seat of the car is impossible to supervise and also the child has no eye contact with the driver which will imply severe distractions. There is a concern that the child seats will be misused and positioned in a forward facing position if they have to be put in the rear seat.

The best solution to this problem would be some kind of automatic disconnection of the air bag if a child seat is installed in the front seat. Some car manufacturers are working along this line but so far no solution has been presented. An interim technical solution would be that families who need to use the front seat for their CRS can have a passenger air bag temporarily disconnected by an authorised car dealer.

Until the technical solutions are available it is proposed that warning labels shall be used. Reg. 44 will require that all rearward facing CRS have a warning label with the following text:

EXTREME HAZARD
Do not use in passenger seats
equipped with airbags.

This label shall be permanently attached and visible in the installed position. It shall also be provided in the language of the country where the device is sold. There is also a need for a similar warning label in the car. This has to be covered by some other Regulation since Reg. 44 only deals with the approval of child restraints.

MANDATORY STRONG CROTCH-STRAPS

There is a concern that the present system with 4-point harness belts and a weak crotch-strap in forward facing seats can induce submarining in crashes. There are also a few cases where unattended children in parked cars have slid out of the seat downwards and have been strangled by the lap belt. The proposal of the ad hoc group is therefore to make it mandatory with strong crotch-straps on forward facing child seats.

HIGHER BUCKLE OPENING FORCES

The present requirement on the buckle release force calls for an opening force of 10 N for the unloaded buckle. This low force will make it possible for most children to open the buckles. If this is observed in time it can be corrected by an adult in the car but there are indications that the buckles may have been open in several fatal crashes where a buckle failure has been suspected. The proposal is now to increase the buckle opening force to 40 N which has been used in the Swedish National Regulation since 1975.

NEW MASS GROUP AND DUMMY

There is a concern within the ad hoc group that small children shall travel in rearward facing seats as long as possible. A number of cases with severe neck injuries to children in forward facing child seats have been extensively discussed in Europe the last years. In the British Standard a new extended group 0 for infants up to 18 months has recently been introduced. In Sweden all group 0 and group 1 systems (0-3 years) have been rearward facing for the last 25 years. The idea of an extended group 0 called 0+ has been picked up by the ad hoc group. The upper limit of this group has not been finally decided yet but it will probably be in the range of 18 to 24 months of age. The dynamic testing of this group requires a new dummy to be specified and produced. The Netherlands (TNO) and the UK (TRL) are co-operating in this work. Although the new

mass group is likely to lead to heavier, bulkier infant seats, the existing Group 0 will be retained so it will still be possible to approve the existing infant seats suitable for children up to 10 kg mass which are easy to use and convenient to carry around.

MORE REALISTIC DYNAMIC TEST RIG

There are several aspects of the current dynamic test rig used for "universal" and "semi-universal" category child restraints which are not very representative of current car seating positions, at least in Europe. The most important of these are the anchorage positions and the use of a static belt on the test rig. Anchorage positions on the test rig do not reflect the range of positions on modern cars. In order to optimise the seat belt geometry for the adults the car manufacturers have started to install the lower anchoring points much more forward than before. In combination with many existing designs of framed child seats this will lead to very unstable installations and large head excursions at an impact. The proposal of the ad hoc group is to move the anchor points to more typical locations.

It has been questioned whether the present crash test procedure with a static belt and a defined slack is adequate. A retractor belt would be more realistic. This problem has been addressed by the ad hoc group along two lines. One solution is to define a standard retractor belt and to use that belt in the dynamic test. The other solution is to continue to use the static belt but to define the slack and the pre-impact tension of the belts more strictly. The final decision is that a specified retractor belt shall be used.

Both the proposals for more realistic anchorage positions and retractors will make it difficult for some types of child restraint, especially forward-facing frame seats typical of the Group 1 mass group, to comply with the existing limit for the forward displacement of the dummy's head in the impact test. Even this displacement is more than the space available in some small cars so other criteria have been discussed. A displacement criterion is in fact not very relevant since a displacement is not dangerous by itself. The injury producing event is when the head hits something in the car interior. This aspect is covered in the "vehicle-specific" approvals where there are no displacement limits prescribed but where the impact speed into the car interior is measured and regulated. A possible solution would be to measure the head acceleration of the dummy and to install typical impact surfaces on the test sled. The problem of measuring the head acceleration and also the neck forces is discussed in the ISO-group and it will not be solved in time for this series of amendments to the Regulation. An interim solution to limit the head velocity relative to the test sled when passing through the existing displacement limit has therefore been proposed. The final solution is that the present limits will be kept for forward facing

seats. Rearward facing seats will be allowed to pass the forward excursion limits if the chest acceleration does not exceed the conventional limits if the child seat hits the simulated instrument panel on the test sled.

COMPATIBILITY CHECKS ON VEHICLE SEATING POSITIONS

The concept of a "universal" category of child restraint suitable for most car seating positions is central to the philosophy of Regulation 44 as it gives a great advantage to consumers in terms of convenience and being able to use the same restraint in different seats and cars.

It also makes it easier to supply child restraints through a wider network of retailers. Unfortunately, the disadvantage is that the word "universal" is an exaggeration as they cannot be ideally suited to every car and seating position. The improved dynamic test rig will improve the current situation but it is also necessary to address the problem from the vehicle side. An accommodation fixture (or "gabarit" as it is based on a French design) is being proposed for checking the compatibility of seating positions with the "New Universal" category. These checks will ensure adequate adult seat belt length and geometry and proposals to amend the current UN-ECE Recommendation on seat belt installation, will encourage vehicle manufacturers to provide information in the owner's handbook on whether all "New Universal" child restraints are suitable. Alternatively, manufacturers could list makes and models of child restraints which are suitable or provide their own "specific vehicle" models or built-in restraints.

SIDE IMPACTS

Side impacts are not covered by the present Regulation and the ad hoc group is waiting for a proposal from the ISO-group. As a short-term solution the ad hoc group is discussing to have some geometrical requirements on the side-wings of rearward facing child seats. Since there is almost always a forward velocity component in side impacts, deeper side-wings can be useful in rearward facing seats since the child is pushed into the seat at an impact.

VARIOUS OTHER IMPROVEMENTS

The opportunity was taken to include other improvements, some of which require design changes and other which simply classify the requirements. Proposals requiring possible design changes include:

BETTER HARNESS SYSTEMS - A problem with many of the existing designs of harness systems is that they can be disassembled by the consumer and not correctly assembled again. This usually occurs

when there is a need to change e.g. the height if the shoulder strap anchoring location. A change in Reg. 44 makes it mandatory to have harness systems in which it is impossible to pull the belt through any adjuster and thus making the possibility of an incorrect re-threading unnecessary.

ADEQUATE SEAT BACK STRENGTH - The strength of the seat backs is not properly regulated in Europe. The only requirement is that the seat should be strong enough to withstand its own inertial forces in a collision. This is a problem for the child passengers in two ways. Unrestrained luggage may not be stopped by the seat backs and may become dangerous projectiles in a crash. The seat back itself may also produce loads on the CRS or hit the child. This solution to this problem is not in the scope of the Regulation on child restraints. The need for an amendment to Reg. 17 on seats has been pointed out by the ad hoc group. Such an amendment will probably require a dynamic test of the seats including load from unrestrained luggage.

LOCK-OFF DEVICES - There are two types of lock-off device, one that is used with booster seats to prevent the child from slackening the adult belt and one which is used with frame seats to enable the lap portion of the adult belt to be tensioned and locked, thus providing stability in normal use. The Group is proposing new definitions for "class A and B devices" and tests that will prescribe a certain amount of slip in these devices.

STRENGTH AND DURABILITY ISSUES - Some problems have been encountered with the mechanical strength in impact of some seat shells and buckles and with the durability in normal use of some harness adjusters which are integral with the child restraint structure. A static test has been added to test the strength of shells and buckles and a new durability test has been added for the adjusters.

TWIN SEATS ALLOWED - A normal car can only accommodate five persons in restraint systems. This is a problem for families with more than three children. Changes have been made in the Regulation in order to make it possible to approve CRS for more than one child. These changes concern the definitions and how to select dummy combinations for the tests. The first product to be expected on the market will be an infant seat for twins. Another change will allow for "specific-vehicle" approval of extra seats mounted in the rear part of station wagons. It will also be possible to approve e.g. a complete rear seat with integrated boosters and 3-point retractor belts in 4 positions.

CONFORMITY OF PRODUCTION

Special routines for the conformity of production have been included in the Regulation for some years. The responsibility to conduct production control tests is now on the CRS manufacturers. In some cases this has not been properly managed and the follow-up procedures have differed in the

European countries. This has raised some complaints that the competition is not fair. Another problem is that systems completely built into the cars e.g. integrated booster seats have to be tested every second week in a complete car or car body. This will put a substantial burden on the car manufacturers and might stop this development which actually is the way we want to see things going in the future. There will be some changes in the Regulation concerning the procedures for the conformity of production.

LONGER TERM SOLUTIONS DEPENDANT ON ISO WORKING GROUP

Various activities of the ISO Working Group such as the development of modified dummy necks (including suitable transducers for measuring neck force) and biomechanical limits for head acceleration may produce results which can be applied as longer term amendments to the Regulation. However, undoubtedly the most important development is ISOFIX.

ISOFIX - It is today natural that when a consumer buys a car radio it will fit in the instrument panel of his car. This is because the hole in the panel and the electrical connections have been standardised. The same ought to be true also for child restraints. One of the main problems of CRSs today is that they are misused or not used because of the poor fitting conditions. In order to solve this problem the Swedish delegation to the ISO-group started in 1990 to make the first prototypes for an "ISOFIX" system that would specify the interface between the car and the child restraint systems. /2/ The ISO-group followed up that work and at present several different concepts are evaluated. A draft ISO Standard can be expected in 1994. Although the "ISOFIX" can not be included in the present update of Reg. 44 it has been regarded as the solution to many of the existing problems and some provisions to make it easy to implement it quickly when it is ready have been made.

CONCLUSIONS

Every six hours there is a child killed in Europe as a car passenger. It can be estimated that 1000 out of the 1400 children killed in Europe annually could be saved by using proper child restraints correctly. The proposed changes in the Regulation described above can not achieve this goal alone. The main problem is still that the child restraint systems are not used all the time and that they are not used correctly. This message must be made clear to the people responsible for legislation and information.

REFERENCES

/1/ ISO/WD 13214 Road Vehicles - Child restraint systems - Compilation of safety regulations and standards, 1993

/2/ T Turbell et al, ISOFIX, A New Concept of Installing Child Restraints in Cars, STAPP Conference, San Antonio, 1993.

NOTE A complete description of all proposed changes can be obtained from VTI, Sweden, Fax +46 13 20 40 33

**Swedish Road and
Transport Research Institute**

Forskar för ett liv i rörelse.

Research for an active community.

Statens väg- och transportforskningsinstitut har kompetens och laboratorier för kvalificerade forskningsuppdrag inom transporter och samhällsekonomi, trafiksäkerhet, fordon, miljö samt för byggande, drift och underhåll av vägar och järnvägar.

The Swedish Road and Transport Research Institute has laboratories and know-how for advanced research commissions in transport and welfare economics, road safety, vehicles and the environment. It also has research capabilities for the construction, operation and maintenance of roads and railways.

Adress
581 95 Linköping

Address
**S-581 95 Linköping
Sweden**

Telefon
013 - 20 40 00

Telephone
+ 46 13 20 40 40

Fax
013 - 14 14 36

+ 46 13 14 14 36

Telex
50 125 VTISGI S