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**Road vehicles — Reduction of misuse  
risk of child restraint systems —**

**Part 3:  
Prediction and assessment of misuse  
by Misuse Mode and Effect Analysis  
(MMEA)**

*Véhicules routiers — Réduction du risque de mauvaise utilisation des  
systèmes de retenue pour enfants —*

*Partie 3: Prédiction et évaluation des mauvaises utilisations par  
MMEA (analyse des modes de mauvaise utilisation et de leurs effets)*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety and impact testing*.

This second edition cancels and replaces the first edition (ISO 13215-3:1999) which has been technically revised.

The main changes are as follows:

- added introduction;
- added references to ISO 13215-1 and ISO 13215-2;
- added coding of misuse modes;
- added references to scientific papers and other literature supporting the use of MMEA;
- revised MMEA use case;
- editorial improvements.

A list of all parts in the ISO 13215 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

Whether or not adequate protection is provided to a child occupant in a vehicle crash depends not only on the inherent capability of the child restraint system to provide protection, but also on its proper installation and subsequent correct use. It is known that certain misuse configurations and interface problems can have serious consequences for child occupants in vehicle crashes.

A clear understanding of the kind and frequency of incorrect use has important implications for the design of child restraint systems and instructions for use, the vehicle in which they are used, education and loan programs, and legislation.

Reduction of misuse risk can be achieved in several ways. One effective way is to work in a systematic manner in the design phase of child restraint systems; to predict and evaluate possible misuse of the intended design, and to address possible misuse modes by an improved design. The MMEA method presented in this document has been developed to support this approach.

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# Road vehicles — Reduction of misuse risk of child restraint systems —

## Part 3:

# Prediction and assessment of misuse by Misuse Mode and Effect Analysis (MMEA)

## 1 Scope

This document specifies a method to predict and quantify misuse of child restraint systems (CRS) called Misuse Mode and Effect Analysis (MMEA). Such misuse can degrade the performance of CRSs.

As a predictive method it is intended to be applied by CRS manufacturers at an early stage, before the CRS is put into use by consumers.

Being predictive implies the possibility of incompleteness and errors. Such errors can be reduced if the proposed method is supported by field studies (for example, according to ISO 13215-1) and panel method evaluation (for example, according to ISO 13215-2).

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **child restraint system**

#### **CRS**

free-standing device intended to provide child vehicle occupants with an approved restraint

Note 1 to entry: Child restraint systems comprise various categories, such as infant restraints, toddler seats, booster cushions and booster seats.

### 3.2

#### **misuse**

any deviation from intended application and use which might reduce the protective performance of the *child restraint system* (3.1)

### 3.3

#### **ISOFIX**

system for the connection of a *child restraint systems (CRS)* (3.1) to vehicles, which has two rigid anchorages in a vehicle seating position located near the seat bight, corresponding rigid attachments on the CRS, and a means to limit the pitch rotation of the CRS

Note 1 to entry: In this document, the term ISOFIX includes flexible CRS attachments (LATCH, UAS).

[SOURCE: ISO 13216-1:1999, 3.6, modified — Note 1 to entry has been added.]

### 3.4

#### **vehicle seatbelt**

approved webbing used to restrain vehicle occupants

### 3.5

#### **buckle**

quick release device which enables the child to be held by the *child restraint system* (3.1), or the child restraint system by the structure of the car, and can be quickly opened

### 3.6

#### **harness**

internal webbing, in relevant cases, intended to restrain the child within the *child restraint system* (3.1)

### 3.7

#### **adjuster**

device through which a *strap* (3.8) passes and which, by means of moving, enables the effective length of the straps to be controlled to suit the circumstances

### 3.8

#### **strap**

flexible component designed to transmit forces

## 4 General

### 4.1 Conformance with this document

A CRS tested in accordance with the requirements of this document is considered correctly designed if, when any predicted misuse modes are assessed, it meets the acceptance criteria. Manufacturers of CRSs are advised to apply the MMEA method before type approval or self certification.

### 4.2 Assessment panels

The prediction and assessment of potential misuse modes are carried out by persons experienced in using and testing CRSs. Ideally, such persons should also be involved in panel testing and field studies of CRSs. See ISO 13215-1 and ISO 13215-2 for more details.

## 5 Assessment

### 5.1 Assessment form

The assessment shall be performed by using the form given in [Annex A](#). Guidance is given in [Annex B](#).

### 5.2 Preliminary steps

Prior to assessment, the examiner shall inspect the CRS for completeness and shall carefully read any attached information provided for the consumer such as instructions for installation and use. Particular attention shall be paid to warning instructions.

### 5.3 Assessment procedure

#### 5.3.1 General

The product name/number and the name of the manufacturer shall be entered into the head of the form (see [Annex A](#)).

### 5.3.2 Potential misuse modes

The part and, respectively, the function, subject to potential misuse modes shall be described in the first column. Any misuse mode the examiner anticipates shall be listed in the second column. If the potential misuse mode matches an ISO code for misuse mode (see [Clause 7](#)), this code can be entered in the third column. If no matching misuse code is found, then enter N/A.

In columns 4 and 5 the examiner shall determine the effects of such anticipated misuse and its cause.

### 5.3.3 Assessment of misuse modes

The assessment is determined by occurrence of a misuse mode and its severity.

Occurrence is the degree of likelihood that a specific misuse will result in the predicted misuse mode. Severity assesses how serious the misuse mode may be with respect to safety of a child in the CRS.

#### 5.3.3.1 Rating of occurrence

The occurrence is rated between "0" (no misuse) and "10" (highest degree of misuse) as follows:

no misuse	0
misuse rather unlikely	1
relatively little misuse	2 – 3
occasional misuse	4 – 6
repeated misuse	7 – 8
misuse almost inevitable	9 – 10

NOTE Examples of supporting papers for determining the rating of occurrence can be found in References [\[3\]](#), [\[4\]](#), [\[5\]](#), [\[6\]](#) and [\[7\]](#).

#### 5.3.3.2 Rating of severity

The severity of failure as a result of misuse mode is rated as follows:

no effect on safety	0
hardly noticeable effects	1
insignificant failure	2 – 3
moderate failure	4 – 6
severe failure	7 – 8
very high severity failure	9 – 10

NOTE Examples of supporting papers for determining the rating of severity can be found in References [\[8\]](#), [\[9\]](#), [\[10\]](#), [\[11\]](#) and [\[12\]](#).

#### 5.3.3.3 Risk priority number (RPN)

The risk priority number is achieved by multiplying the individual ratings for occurrence and severity.

#### 5.3.4 Corrective actions

If the assessment of an individual misuse mode does not comply with the requirements of 6.1 and 6.2 respectively, the CRS (or part/function evaluated) shall be deemed to have failed unless corrective actions are taken.

Such corrective actions are subject to a further assessment which shall be listed within the form under "Actions taken" and "Revised assessment". Thereafter the examiner shall decide whether further actions are required. This shall be listed in the last column.

## 6 Requirements

### 6.1 Acceptance criteria of a single misuse mode

The result of the assessment is a failure if the RPN of the initial assessment, or after corrective action(s) of the revised assessment, is 15 or more.

In addition, a very high severity failure (9-10) shall result in a failure assessment even if the occurrence rating is misuse rather unlikely (1).

### 6.2 Acceptance criteria of more than one misuse mode

If three or more misuse modes have an RPN of 12 or more, the CRS is deemed to have failed.

## 7 Coding of typical misuse modes

As applicable, the coding of typical misuse modes from ISO 13215-1 can be used in the MMEA evaluation.

The following codes are used in ISO 13215-1, the first code implies "correct use":

**B. Installation configuration**

**B1** = as intended

**B2** = other than intended

**B3** = child seat incompatible with child

**C. Attachment with vehicle seatbelt**

**C1** = correctly used

**C2** = not used

**C3** = wrong routing of vehicle seatbelt

**C4** = excessive slack in vehicle seatbelt

**C5** = belt clip/guide applicable but not used

**C6** = wrong positioning of seatbelt buckle

**C7** = top tether applicable but not used

**C8** = lower tether applicable but not used

**C9** = support leg applicable but not used

**C10** = child seat not locked in base

**D. Attachment with ISOFIX/LATCH/UAS**

**D1** = correctly used

**D2** = not used

**D3** = partially used (one of two)

**D4** = top tether applicable but not used

**D5** = lower tether applicable but not used

**D6** = support leg applicable but not used

**D7** = rebound bar not tightened (rear facing CRS)

**D8** = adjustment mechanism not adjusted

**D9** = child seat not locked in base

**E. Additional strap(s) (if required other than lower and top tether ISOFIX/LATCH/UAS)**

**E1** = correctly used/not applicable

**E2** = not used

**E3** = extra strap(s) attached to wrong detail

**E4** = belt adjusters wrongly threaded

**E5** = used with excessive slack

**F. Child seat harness**

**F1** = buckle closed and visible

**F2** = buckle partially closed

**F3** = buckle riding up

**F4** = harness clip applicable but not used

**G. Harness adjustment**

**G1** = straps comfortably tight, no slack

**G2** = wrong shoulder height adjustment

**G3** = straps incorrectly routed in back

**G4** = adjuster(s) wrongly threaded

**G5** = fittings/hardware into contact with skin

## 8 Final steps

If deemed to be necessary, the examiner shall provide additional explanations or details. Finally, the examiner shall sign and date the MMEA form.

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**Annex A**  
(normative)

**Misuse Mode and Effect Analysis (MMEA) — Assessment sheet**

Product name/number: No:

Supplier(s) name(s): Sheet:

Part/ func- tion	Poten- tial misuse mode	Misuse code or N/A	Effects of mis- use	Cause(s) of mis- use	Initial assessment			Ac- tions taken	Revised assessment			Fur- ther actions re- quired
					Occur- rence	Sever- ity	R P N		Occur- rence	Sever- ity	R P N	

**Likelihood of occurrence:**

no misuse	0
misuse rather unlikely	1
relatively little misuse	2 – 3
occasional misuse	4 – 6
repeated misuse	7 – 8
misuse almost inevitable	9 – 10

**Severity (effect on safety):**

no effect on safety	0
hardly noticeable effects	1
insignificant failure	2 – 3
moderate failure	4 – 6
severe failure	7 – 8
very high severity failure	9 – 10

**Date:**

**Signature:**

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## Annex B (informative)

### Guideline for examiners using the MMEA method

#### B.1 Example case of potential misuse

##### B.1.1 General

A case of potential misuse on a CRS is predicted and assessed.

NOTE The case is purely fictional and for illustration of MMEA method application.

##### B.1.2 Design feature

It is a CRS with a detachable ISOFIX base, intended to be positioned rearward-facing only, in the car. The interface to the base fits smoothly when connecting it as intended.

##### B.1.3 Assessment

###### B.1.3.1 Occurrence

The design was assessed in an installation workshop using a panel of caregivers (in accordance with ISO 13215-2). It was found that a few participants incorrectly installed the child seat shell forward-facing by applying excessive force on the interface. See [Figure B.1](#).

Checking the occurrence, it was established that this condition could occur in 5 % of the installations.

###### B.1.3.2 Severity

This wrongly oriented child seat shell would have an unsecure attachment, which would cause the child seat shell to disengage completely from the base, resulting in a very high severity failure scoring.

###### B.1.3.3 Action taken

The interface between child seat shell and base was redesigned by relocating one set of male connectors from the child seat shell to the base. This would make it impossible to force the interface to connect if the child seat shell is installed in the non-intended direction. Additional actions were taken to ensure that the interface parts could not match any other holes or cavities in the base. See [Figure B.2](#).

In a revised assessment none of the panel participants were able to install the child seat shell in the wrong orientation.