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**Road vehicles — Child seat presence and  
orientation detection system (CPOD) —**

**Part 1:  
Specifications and test methods**

*Véhicules routiers — Système de détection de la présence d'un siège  
enfant et de son orientation (CPOD) —*

*Partie 1: Spécifications et méthodes d'essai*



Reference number  
ISO/TS 22239-1:2009(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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.

ISO/TS 22239-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 12, *Passive safety crash protection systems*.

ISO/TS 22239 consists of the following parts, under the general title *Road vehicles — Child seat presence and orientation detection system (CPOD)*:

- *Part 1: Specifications and test methods*
- *Part 2: Resonator specification*
- *Part 3: Labelling*

## Introduction

This part of ISO/TS 22239 specifies a detection system for the automatic recognition of child seat presence and orientation detection system (CPOD) child seats placed on CPOD passenger seats.

The purpose of this detection system is to improve the overall safety performance of passenger restraint systems, particularly by reducing the risk of an airbag being deployed against a child seat placed on a passenger seat.

The CPOD system is not intended to encourage the placing of children on the front passenger seats of cars. However, in view of the fact that the following scenarios do occur in real life, children can be placed on front passenger seats in these cases:

- in 2-seater vehicles, which have no rear seats;
- when there are more than 2 or 3 children in one vehicle;
- when back seats are folded down for the transport of cargo;
- when the installation of a rearward-facing child restraint system (CRS), and the placing of the child in the CRS on the rear seats, is very difficult or impossible (e.g. in 2-door vehicles);
- when the driver wants to see the baby and have easy access to it.

There might be benefit to be gained by encouraging the use of airbags on rear seats.

For the cases cited above, CPOD technology offers a reliable automatic solution for the protection of children against any possible risk caused by non-deactivated airbags.



# Road vehicles — Child seat presence and orientation detection system (CPOD) —

## Part 1: Specifications and test methods

### 1 Scope

This part of ISO/TS 22239 specifies a child seat presence detection system that enables child seats placed on any passenger seats to be automatically detected where a child is at risk from an active airbag. The system provides the option of using additional information about the orientation of the child seat.

This part of ISO/TS 22239 describes the main system functionality, and provides design recommendations and requirements, compatibility measurements and labelling requirements.

Compliance with the requirements of this part of ISO/TS 22239 ensures compatibility between child seat presence and orientation detection system (CPOD) child seats and CPOD passenger seats.

ISO/TS 22239 applies only to child restraint systems in which the child is orientated in the forward or rearward driving direction.

NOTE 1 Throughout this part of ISO/TS 22239, the term “child seat” is used as an abbreviation of “CPOD child seat”.

NOTE 2 Throughout this part of ISO/TS 22239, the term “passenger seat” is used as an abbreviation of “CPOD-equipped passenger seat”.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 22239-2:2009, *Road vehicles — Child seat presence and orientation detection system (CPOD) — Part 2: Resonator specification*

ISO/TS 22239-3, *Road vehicles — Child seat presence and orientation detection system (CPOD) — Part 3: Labelling*

ISO 6549:1999, *Road vehicles — Procedure for H- and R-point determination*

UNECE Regulation No.14, *Uniform provisions concerning the approval of vehicles with regard to safety-belt anchorages, ISOFIX anchorages systems and isofix top tether anchorages*

UNECE Regulation No.16 (2005), *Uniform provisions concerning the approval of safety belts, restraint systems, child restraint systems and ISOFIX child restraint systems for occupants of power-driven vehicles*

UNECE Regulation No.44 (2008), *Uniform provisions concerning the approval of restraining devices for child occupants of power-driven vehicles (“child restraint system”)*

### 3 Terms and definitions

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

#### 3.1

##### **child seat presence and orientation detection system**

###### **CPOD**

radio frequency identification (RFID) system delivering information on the presence, orientation and type of a child seat

#### 3.2

##### **passenger seat reference point**

###### **CRP**

point located on the centre line of the passenger seat, determined by the procedure in Annex A

#### 3.3

##### **child seat reference point**

###### **CRC**

point identical to the intersection of the centre plane of the child restraint system and the CR axis defined in UNECE Regulation No.44

#### 3.4

##### **resonator reference point**

###### **RRP**

point located in the geometrical centre of the base surface of the resonator

#### 3.5

##### **resonator pair reference point**

###### **RPRP**

point located in the centre between two resonator reference points

#### 3.6

##### **reference co-ordinate system**

Cartesian coordinate system associated with the passenger seat and the compatibility test bench, having its origin in the passenger seat reference point, as shown in Figure B.4

#### 3.7

##### **CPOD detection area**

3-dimensional area above the passenger seat cushion, where all relevant child seat information needed to adapt the airbag deployment are transmitted to the restraint control module, provided that the resonator pair reference point is located within this area

#### 3.8

##### **CPOD failsafe area**

3-dimensional area above the passenger seat cushion, where either all relevant child seat information needed to adapt the airbag deployment or information indicating an incorrect positioning of the child seat is transmitted to the restraint control module, provided that the resonator pair reference point is located within this area

#### 3.9

##### **ISOFIX**

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

[ISO 13216-1:1999]

## 4 Abbreviated terms

|       |                                                                                              |
|-------|----------------------------------------------------------------------------------------------|
| CPOD  | Child seat presence and orientation detection system                                         |
| CRC   | Child seat reference point                                                                   |
| CRP   | Passenger seat reference point                                                               |
| CRS   | Child restraint system                                                                       |
| CTB   | Compatibility test bench                                                                     |
| ECU   | Electronic control unit                                                                      |
| FFCS  | Forward facing child seat                                                                    |
| PSCTD | Passenger seat compatibility test device                                                     |
| RCM   | Restraint control module (electronic unit controlling deployment of supplemental restraints) |
| RFCS  | Rearward facing child seat                                                                   |
| RFID  | Radio frequency identification                                                               |
| RMI   | Restraint system malfunction indicator (vehicle-manufacturer-specific)                       |
| RPRP  | Resonator pair reference point                                                               |
| RRP   | Resonator reference point                                                                    |

## 5 Principle

### 5.1 General

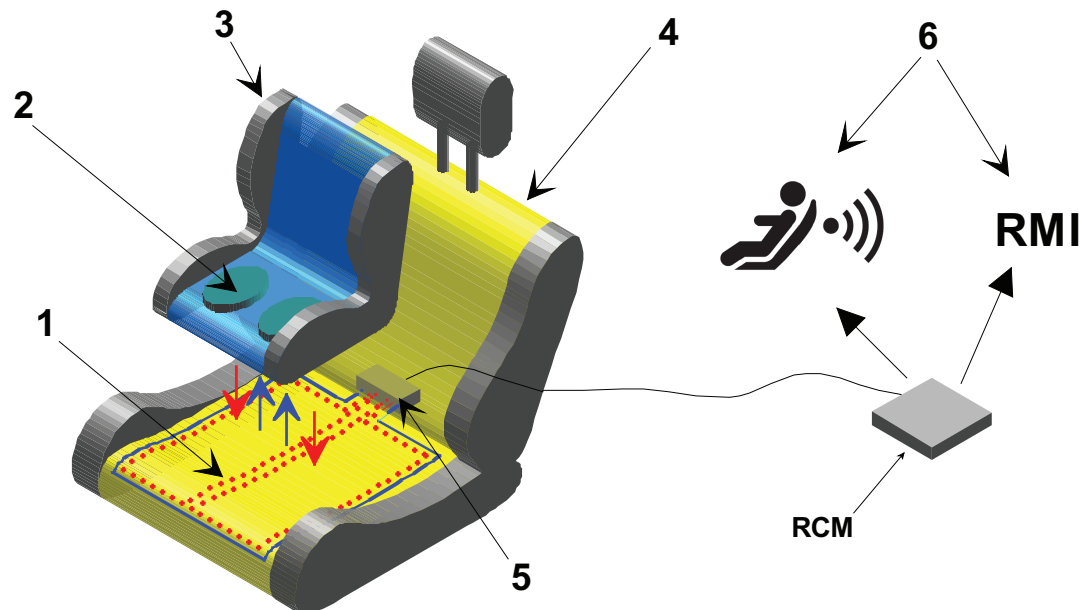
CPOD is an RFID sensing system which is capable of determining the presence and orientation of a CRS placed on a passenger seat. Depending on the positioning of the CRS, different types of information are transmitted to the RCM.

If the CRS is correctly placed on the passenger seat such that its RPRP is located within the CPOD detection area (see 3.7), the CRS is detected by the system.

If the CRS is placed outside of the CPOD detection area but within the CPOD failsafe area (see 3.8), the system either detects the CRS or recognizes an incorrect CRS positioning.

The gathered information is sent to the central RCM, which enables the adaptation of the airbag deployment specific to the occupancy situation.

NOTE The specifications of this part of ISO/TS 22239 are in compliance with Reference [6].



#### Key

- 1 CPOD sensor consisting of
  - one transmitting antenna
  - ..... two receiving antennas
- 2 CPOD resonators
- 3 CPOD child seat
- 4 passenger seat
- 5 CPOD electronics
- 6 in-vehicle information

Figure 1 — CPOD system topology

## 5.2 Compatibility

The compatibility of the system is given if the CPOD component compatibility checks have been passed. These compatibility checks consist of the following parts:

- a) CRS compatibility check to verify the performance of the CRS design;
- b) resonator compatibility check to verify the electrical performance of the resonators;
- c) passenger seat compatibility check to verify the performance of passenger seat and CPOD sensor design.

The flow chart in Figure 2 shows how these compatibility checks fit together to assure CPOD compatibility of the entire system.

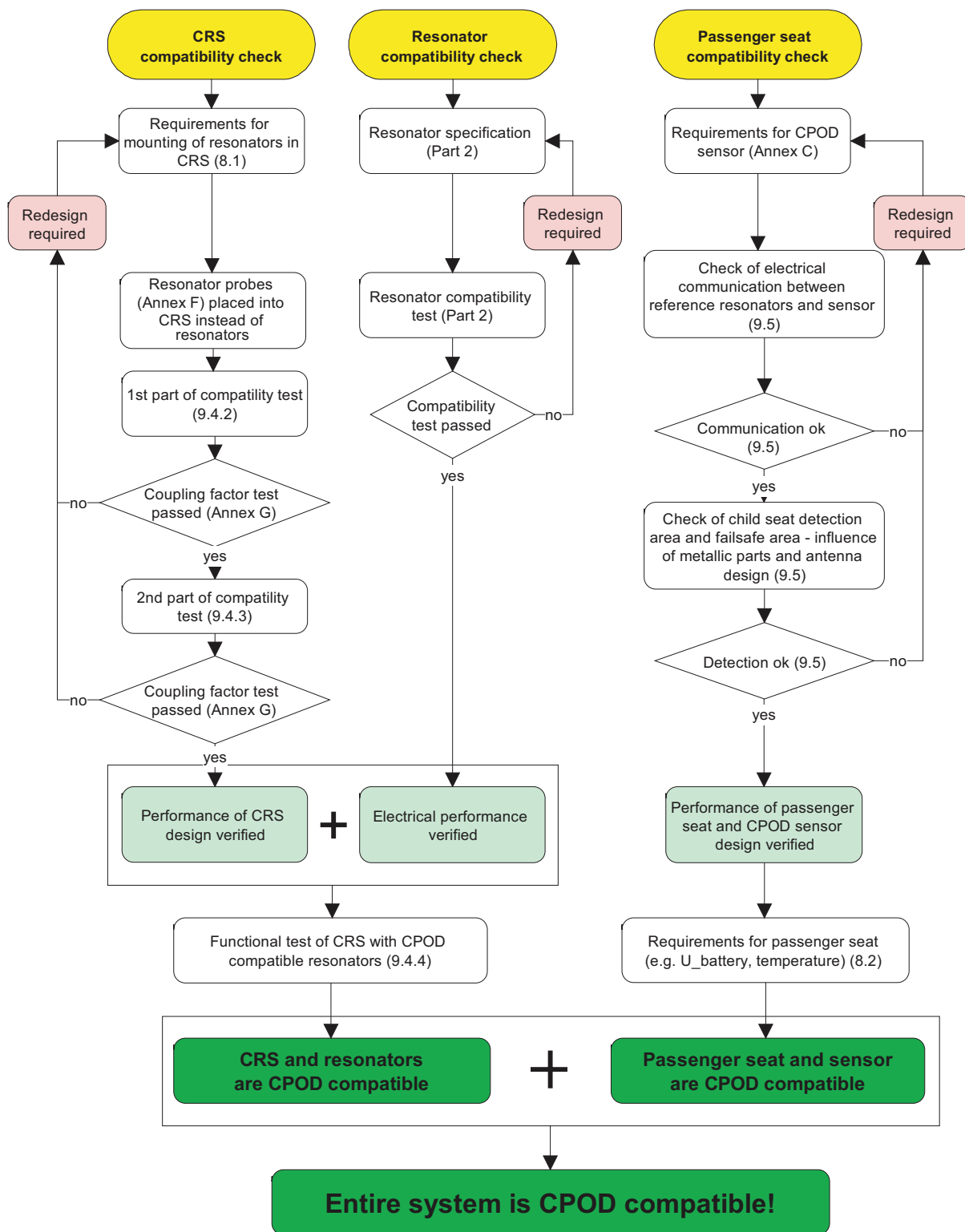


Figure 2 — Main steps for obtaining CPOD compatibility of the entire system

## 6 System functionality

In order to achieve its performance and, in addition, to provide failsafe behaviour in case of an error, the following features are implemented in the CPOD system:

- generation of a sinusoidal signal in the 130 kHz band for contact-less energy and information transmission;
- adaptation of the transmitting signal to different environmental conditions by variation of frequency and amplitude;
- demodulation of the signal phase modulated by the CRS resonators;
- monitoring of the power and demodulation circuits of the system via integrated self-diagnosis;
- interface to RCM for transmission of CPOD data;
- monitoring of transmitting and receiving antennas for disconnections and short circuits;
- detection of presence of CRS which are compliant with this part of ISO/TS 22239;
- detection of the orientation of CRS which are compliant with this part of ISO/TS 22239 in vehicles where the orientation of the CRS impacts the airbag deployment.

Examples of CRS orientations are given in Figures 3 to 5.

Compliance with the detailed system functionality specifications of Annex C shall be provided.



**Figure 3 — CRS in forward facing position**



**Figure 4 — CRS in rearward facing position**



**Figure 5 — Example of CRS wrongly positioned**

Depending on the positioning of the CRS, the CPOD system delivers the information to the RCM as shown in Figure 6, provided that the RPRP is located within the CPOD detection area.

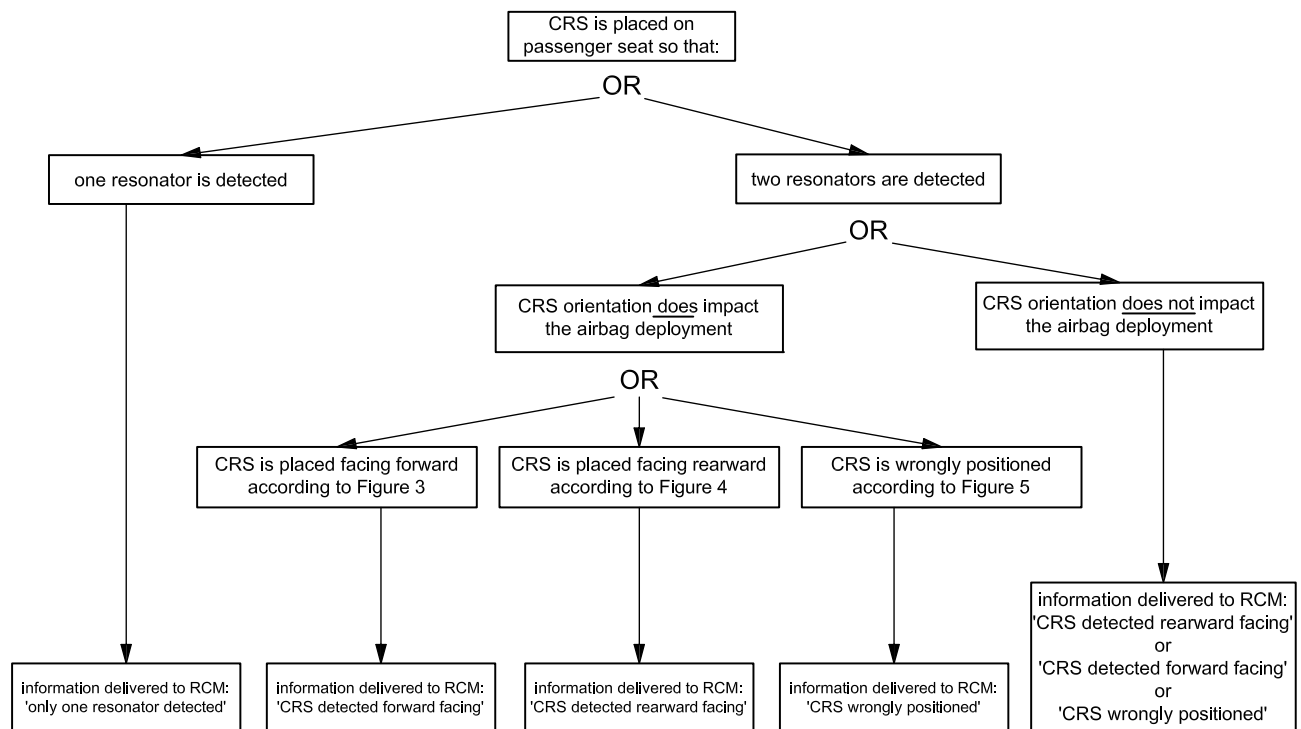


Figure 6 — Information to be submitted to RCM

## 7 Design recommendations

### 7.1 General

In order to maximize the chance of passing the compatibility measurements successfully, the following recommendations should be respected during the design of CRSs and passenger seats fitted with CPOD.

### 7.2 Installation of CPOD resonators into CRS

**7.2.1** Electroconductive materials might have an influence on the resonator detection in the CRS. Therefore, the distance between large electroconductive materials and the resonators in the CRS should be maximized during the design of the CRS.

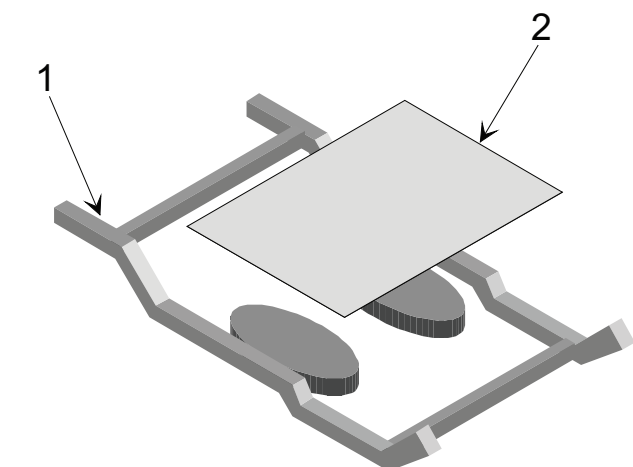
The detection capability of the system is very sensitive to electroconductive materials above the resonator pair or directly between the resonator pair and the CPOD passenger seat. Possible problems can be avoided by replacing these materials by non-electroconductive materials, as shown in Figure 8.

**7.2.2** Closed electroconductive loops as indicated by Figure 7 might have an influence on the resonator detection in CRS. Therefore, the distance between closed electroconductive loops and the resonators in the CRS should be maximized during the design of the CRS.

Closed electroconductive loops, which surround the volume above or below the resonator pair, should be avoided. This can be achieved by cutting closed loops using non-electroconductive materials, as shown in Figure 8.

**7.2.3** The distance between the bottom of the resonators inside the CRS and the surface of the CRS compatibility test bench should not exceed 30 mm when the CRS is placed correctly on the CTB in

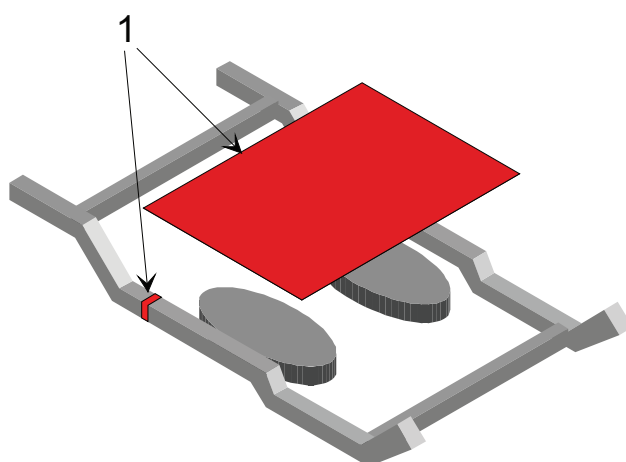
accordance with Annex D (see Figure 9). In addition, in that position, the bottom of the resonator should be parallel with the corresponding seat surface below it. An inclination of  $\pm 15^\circ$  should not be exceeded (see Figure 9).



**Key**

- 1 electroconductive loop
- 2 electroconductive surface

**Figure 7 — Closed electroconductive loop or surface close to the resonators**



**Key**

- 1 non-electroconductive

**Figure 8 — Closed conducting loop opened using a non-electroconductive connection**

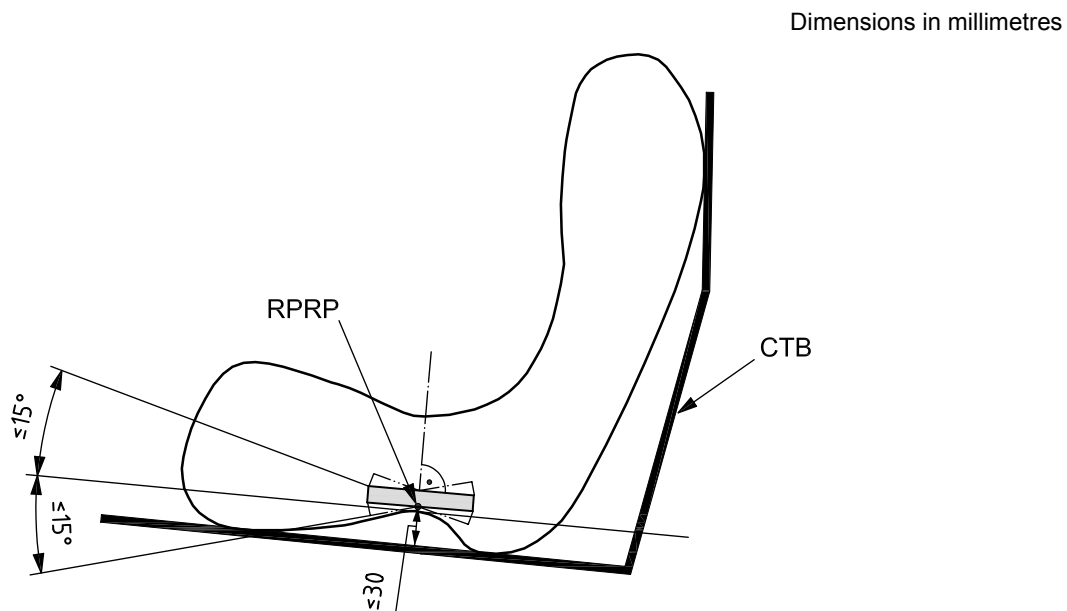
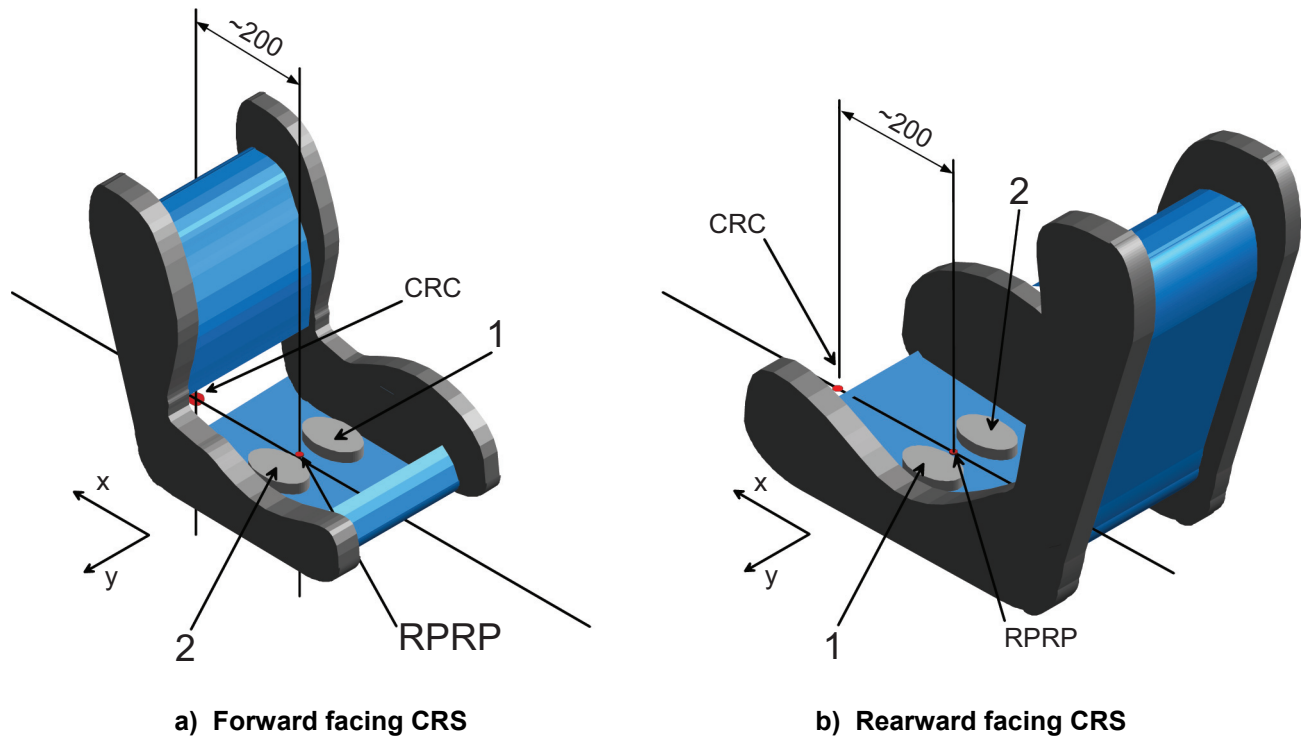


**Figure 9 — Distance between resonator reference point and CTB surface**

**7.2.4** The distance between the CRC and RPRP (see Figure 10) should be chosen in such a way that the resonator pair reference point remains within the CRS detection area when varying the CRS compatibility test bench adjustments in accordance with 9.4.2 and 9.4.3. A value as close as possible to 200 mm is recommended for this distance.

Dimensions in millimetres

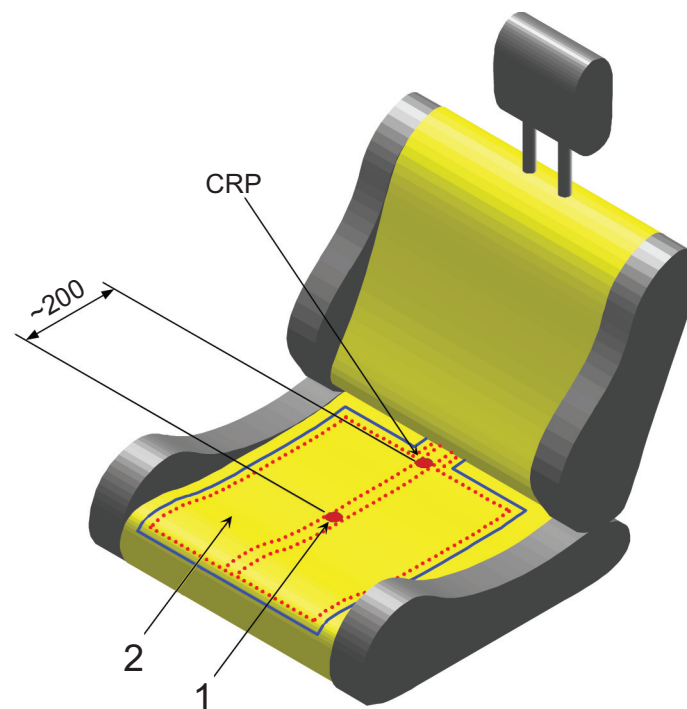
**Key**

- 1 left resonator
- 2 right resonator

**Figure 10 — Assembly of resonators in CRS****7.3 Installation of CPOD sensors into passenger seats**

With respect to the installation of CPOD sensors into passenger seats:

- it is recommended to position the CPOD sensors directly under the seat cover instead of foaming them;
- the maximum distance between CPOD sensor and surface of the seat cover should not exceed 20 mm;
- the seat area should be designed to be as flat as possible (see Clause A.2, Note);
- for non-adjustable seat cushions, the distance between CPOD sensor and the passenger's seat metal shell should be maximized;
- the distance between the seat's CRP and the centre of the CPOD sensor should be as close as possible to 200 mm, as indicated by Figure 11;
- during CPOD sensor design, account should be taken of any possible seat adjustment and/or feature that could affect the performance of the system; in order to improve the detection performance of a CRS, the two receiving antennas should overlap (see Figure 11).

**Key**

- 1 centre of CPOD sensor
- 2 CPOD sensor consisting of
  - one transmitting antenna
  - ..... two receiving antennas

**Figure 11 — Assembly of CPOD antennas into passenger seat****8 Design requirements****8.1 Requirements for CPOD child seats**

- 8.1.1** Only resonators that are CPOD compatible in accordance with ISO/TS 22239-2 shall be used.
- 8.1.2** CRS shall be equipped with two CPOD resonators.
- 8.1.3** Easy removal of the resonators without special tools shall be avoided by CRS design.
- 8.1.4** The distance between both resonator reference points shall be  $140 \text{ mm} \pm 2 \text{ mm}$ , as indicated in Figure B.1.
- 8.1.5** The resonator pair shall be positioned symmetrically in the CRS in accordance with Figure 10, such that the right resonator is assembled into the CRS right side and the left resonator in the CRS left side (CRS left and right side referenced on the child's line of sight).
  - **Exception for CRS types 4** (see ISO/TS 22239-2:2009, Table 2): The resonators shall be assembled symmetrically in the CRS such that, if the CRS is mounted on the passenger seat, the left resonator is positioned above the left side and the right resonator is placed above the right side of the passenger seat (passenger seat's left and right side referenced on the driving direction).
  - **For all CRS types:** The resonator pair reference point shall be part of the x-z plane of the passenger seat if the CRS is mounted correctly on the passenger seat.

## 8.2 Requirements for CPOD passenger seats

### 8.2.1 Passenger seat design

Passenger seats shall be designed to allow the installation of the fixture (Gabarit) in accordance with Annex A.

### 8.2.2 CPOD sensor

CPOD passenger seats shall be equipped with a CPOD sensor consisting of one transmitting and two receiving antennas. The CPOD sensor shall meet the requirements defined in Annex C. In addition, it shall meet the manufacturer's seat and electronic requirements.

It shall be assured that the CPOD sensor maintains its function during the entire life cycle (e.g. position of the antennas in the seat cushion, environmental stability), as specified by the seat/vehicle manufacturer.

### 8.2.3 Operating range for CPOD passenger seats

The CPOD system shall meet its functionality in accordance with Clause 6 within the limits specified in Table 1.

**Table 1 — CPOD operating range**

| Parameter                                              | min. | max. |
|--------------------------------------------------------|------|------|
| Operating temperature<br>$T_{OP}$<br>°C                | −35  | 85   |
| Operating voltage (12 V power net)<br>$V_{OP,12}$<br>V | 10   | 16   |
| Operating voltage (24 V power net)<br>$V_{OP,24}$<br>V | 20   | 32   |

## 9 Compatibility measurements

### 9.1 General specification

In order to ensure the performance of the CPOD system, the CRS manufacturers and the vehicle manufacturers shall perform compatibility measurements for introducing new CRS respectively new CPOD passenger seats. By means of these compatibility measurement procedures, it is ensured that all released CRS and all released CPOD passenger seats feature CPOD performance, which is characterized as described below.

- a) If the CRS is placed on the passenger seat, such that the RPRP (see Annex B) remains within the detection area, the CRS is detected by the CPOD sensor in the seat:
  - for vehicles where the airbag deployment is influenced by the orientation of the CRS on the seat, CPOD performance means that the presence and orientation is detected by the CPOD sensor;
  - for vehicles where the airbag deployment is not influenced by the orientation of the CRS on the seat (e.g. the airbag is switched off in any case when a CRS is detected, independent of its orientation), CPOD performance means that only the presence of the CRS is detected by the CPOD system.
- b) If the CRS is placed on the passenger seat, such that the RPRP in the CRS remains within the failsafe area, at least one resonator is detected by the CPOD sensor in the seat.

## 9.2 Compatibility test parameters range

The test temperature,  $T_{\text{test}}$ , and test voltage (vehicle),  $V_{\text{test}}$ , shall be as defined in Table 2 when performing the compatibility measurements:

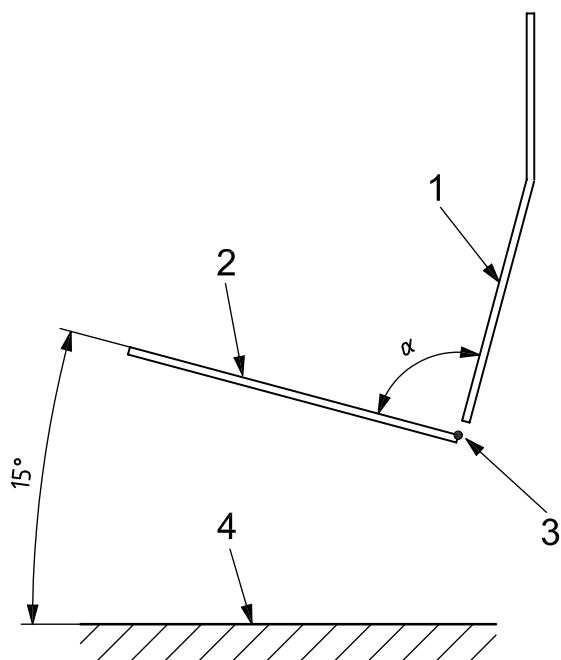
**Table 2 — Compatibility test parameters**

| Parameter                                        | min.                      | max. |
|--------------------------------------------------|---------------------------|------|
| Test temperature<br>$T_{\text{test}}$<br>°C      | 18                        | 28   |
| Test voltage (vehicle)<br>$V_{\text{test}}$<br>V | nominal voltage $\pm 2\%$ |      |

## 9.3 Adjustment of backrest inclination

### 9.3.1 Adjustment of CTB backrest angle, $\alpha$

The CTB backrest angle,  $\alpha$ , is defined as the angle between the seat plane of the CTB and the lower part of the CTB backrest, as indicated in Figure 12.



#### Key

- 1 backrest (lower part)
- 2 seat plane
- 3 rotation centre
- 4 bottom

**Figure 12 — Definition of CTB backrest angle,  $\alpha$**

### 9.3.2 Adjustment of passenger seat backrest angle, $\varphi$

#### 9.3.2.1 General

The passenger seat backrest angle,  $\varphi$ , is defined as the angle between the passenger seat surface and the backrest of the seat. To determine the target backrest angle,  $\varphi$ , the H-point machine as specified in ISO 6549 shall be used without using the lower leg segments.

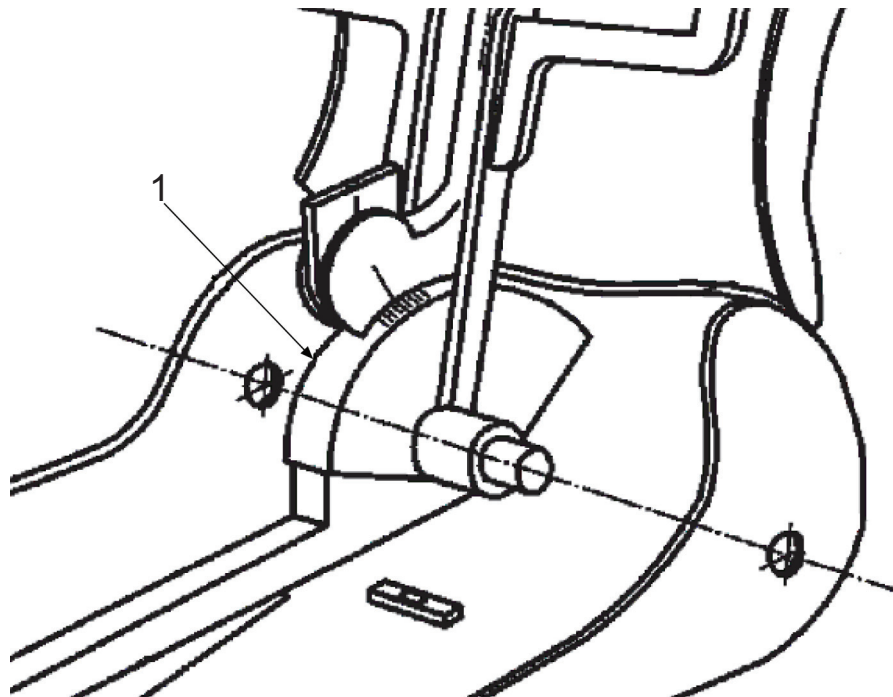
#### 9.3.2.2 Installation procedure for the three-dimensional H-point machine

The installation procedure for the three-dimensional H-point machine is as follows.

- Place muslin cotton tightly over the seat area to be checked.
- Place the seat and torso assembly of the three-dimensional H-point machine (ISO 6549), such that the centre plane of the occupant coincides with the centre plane of the H-point machine.

NOTE In vehicles with individual seats, the centre plane of the seat represents the centre plane of the occupant. On bench seats, the centre plane of the occupant is specified by the manufacturer.

- Position the H-point machine on the seat as specified in ISO 6549:1999, 5.9 to 5.13.2.
- After the H-point machine is correctly positioned, rotate the headroom probe to its fully rearward position. The actual backrest angle,  $\varphi$ , can be read from the hip angle quadrant of the H-point machine (see Figure 13).



#### Key

- 1 hip angle quadrant

Figure 13 — Backrest angle indicator on ISO 6549 H-point machine

## 9.4 Compatibility measurements for CRS

### 9.4.1 General compatibility test description

In order to perform a CPOD compatibility check with a CRS, the CRS compatibility test bench (see Figure 14) shall be used. The CRS compatibility test bench is based on the UNECE Regulation No.44 test seat bench and is specified in Annex D. It consists of a seat surface, an adjustable backrest including removable cheeks, and an antenna structure under the seat surface used to measure the magnetic coupling between the antennas and the resonators in the CRS to be tested. Before the compatibility test can be performed, the correct functionality of the coupling factor measurement setup shall be confirmed by performing the functionality check described in Clause G.3 with the resonator probes defined in Annex F. After the functional test, the resonators in the CRS to be tested shall be replaced by the resonator probes that were used during the functional check.

The compatibility measurement is divided into two parts (see 9.4.2 and 9.4.3).

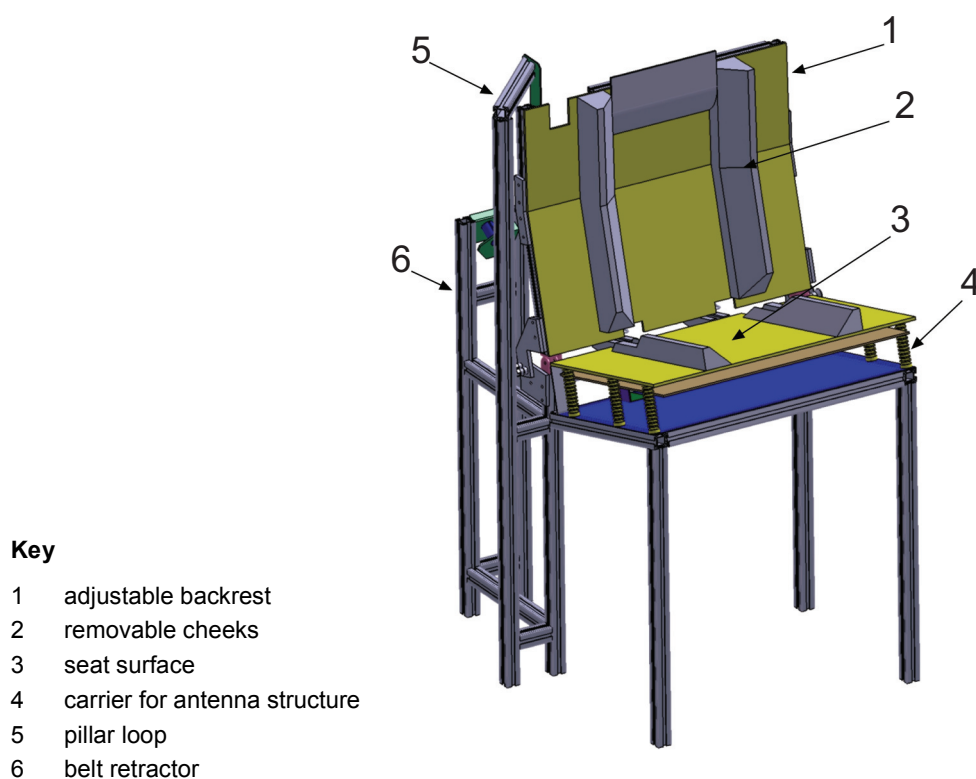


**Figure 14 — CPOD CRS compatibility test bench**

### 9.4.2 Compatibility test (Part 1)

#### 9.4.2.1 Compatibility test bench adjustment

The CTB backrest angle,  $\alpha$  (see Figure 12) shall be adjusted to  $90^\circ$  in accordance with 9.3.1 in order to simulate a worst case scenario. The tests shall be conducted with the cheeks of the backrest, the cheeks on the seat surface of the test bench in order to produce a maximum displacement of the CRS in the negative x-direction and a maximum possible distance in the z-direction between the CRS and the antennas.

For the test of ISOFIX CRS, the ISOFIX anchorages of the test bench shall be adjusted in their foremost position.

#### 9.4.2.2 Installation procedure for CRS without ISOFIX

The CRS shall be placed on the test bench in its designed orientations (forward or rearward facing) and as defined in the CRS owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, z-displacement, inclination), these features shall be additionally tested in all possible combinations. The CRS shall be pushed against the backrest of the test bench with a force of 50 N.

If adjustable devices of the CRS are changed under the force of 50 N, the CRS shall be pushed back with the maximum possible force up to 50 N that is feasible without changing the position of the adjustable devices.

Wherever this is feasible (normal conditions), the CRS shall be placed symmetrically to the test bench's centre y-plane.

The CRS shall be fastened to the test bench with the test bench restraint system, as defined in the CRS owner's manual for the installation on passenger seats. During the installation procedure, a lap belt tension and shoulder belt tension each of  $(50 \pm 5)$  N shall be reached.

If the CRS is equipped with an anti-rotation device, the CRS shall be tested in the following two positions without using this feature:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a way that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9.

#### 9.4.2.3 Installation procedure for CRS with ISOFIX

The CRS shall be placed on the test bench in its designed orientations (see 9.4.2.2) and as defined in the CRS owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, z-displacement, inclination), these features shall be additionally tested in all possible combinations.

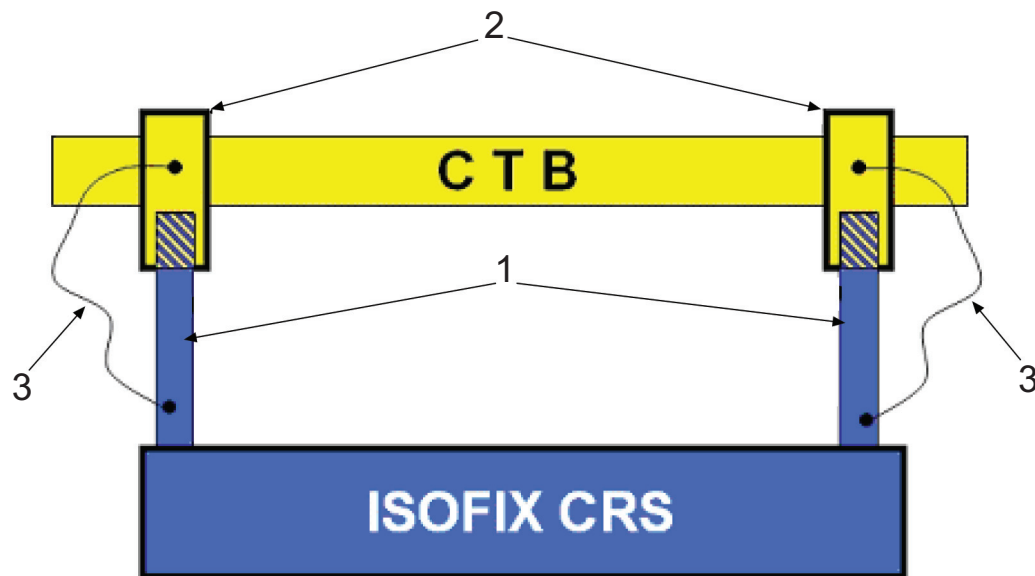
The ISOFIX connectors of the CRS shall be connected to the ISOFIX anchorages. In contrast to the definitions in its owner's manual, the connectors shall remain in their fully extended position.

In the event that an electrical connection between the CRS and the ISOFIX anchorages can be excluded over the lifetime of the CRS, the electrical connection between CRS and CTB is not requested during testing. If an electrical connection between the CRS and the ISOFIX anchorages cannot be excluded, the ISOFIX connectors of the CRS shall be electrically connected to the test bench, as shown in Figure 15.

If the CRS is equipped with anti-rotation devices, the CRS shall be tested in the following two positions without using these features:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a way that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9.



#### Key

- 1 ISOFIX connector (fully extended)
- 2 ISOFIX anchorages
- 3 electrical connection

**Figure 15 — Electrical connection between CRS ISOFIX connectors and test bench**

#### 9.4.2.4 Installation procedure for CRS with LATCH system

The CRS shall be placed on the test bench in its designed orientation and as defined in the owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, y-, z-displacement, inclination), these features shall be additionally tested in all possible combinations.

The lower attachments of the CRS shall be connected to the ISOFIX anchorages. The lower attachments shall be fastened in such a way that the CRS is pulled back to the backrest of the test bench until full contact to the backrest is reached without losing full contact between the CRS and the seat surface.

If the CRS is equipped with an anti-rotation device, the CRS shall be tested in the two following positions without using this feature:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a manner that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9

If electrical conductivity is likely to occur between the CRS and the test bench due to the materials used for the lower anchorages, these anchorages of the CRS shall be electrically connected to the test bench as shown in Figure 15.

### 9.4.3 Compatibility test (Part 2)

#### 9.4.3.1 Compatibility test bench adjustment

The CTB backrest angle,  $\alpha$  (see Figures 12 and 16) shall be adjusted to 120° in accordance with 9.3.1, in order to simulate a worst case scenario. The test shall be conducted without the cheeks of the backrest, but with the cheeks on the test bench's seat surface installed in order to produce a maximum possible distance between the CRS and the antennas.

For the testing of ISOFIX CRS, the ISOFIX anchorages of the test bench shall be adjusted in their rearmost position.

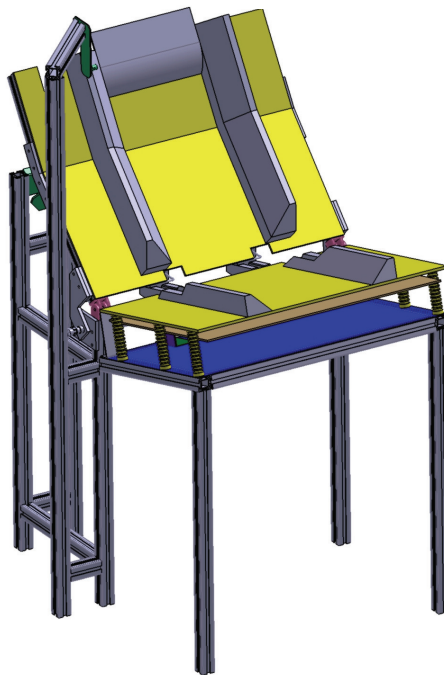


Figure 16 — CRS compatibility test — 2nd part (most reclined position)

#### 9.4.3.2 Installation procedure for CRS without ISOFIX

The CRS shall be placed on the test bench in its designed orientations and as defined in the owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, y-, z-displacement, inclination), these features shall be additionally tested in all possible combinations. The CRS shall be pushed against the backrest of the test bench with a force of 50 N.

The CRS shall be placed symmetrically to the test bench's centre y-plane.

The CRS shall be fastened to the test bench with the restraint system defined in the owner's manual for installation on passenger seats. During the installation procedure, a lap belt tension and shoulder belt tension each of  $(50 \pm 5)$  N shall be reached.

If the CRS is equipped with an anti-rotation device, the CRS shall be tested in the following two positions without using this feature:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a way that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9.

#### **9.4.3.3 Installation procedure for CRS with ISOFIX**

The CRS shall be placed on the test bench in its designed orientations and as defined in the owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, y-, z-displacement, inclination), these features shall be additionally tested in all possible combinations

The ISOFIX connectors of the CRS shall be connected to the ISOFIX anchorages.

In the event that an electrical connection between the CRS and the ISOFIX anchorages can be excluded over the lifetime of the CRS, an electrical connection between CRS and CTB is not requested during testing. If an electrical connection between the CRS and the ISOFIX anchorages cannot be excluded, the ISOFIX connectors of the CRS shall be electrically connected to the test bench, as shown in Figure 15.

If the CRS is equipped with an anti-rotation device, the CRS shall be tested in the following two positions without using this feature:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a way that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9.

#### **9.4.3.4 Installation procedure for CRS with LATCH system**

The CRS shall be placed on the test bench in its designed orientations and as defined in the owner's manual. If the CRS has adjustable or add-on features (e.g. footrest, adjustable backrest or angle of the cradle), which have an influence on the position of the CRS on the test bench (x-, y-, z-displacement, inclination), these features shall be additionally tested in all possible combinations.

The lower attachments of the CRS shall be connected to the ISOFIX anchorages and fastened until contact to the backrest of the test bench is reached.

If the CRS is equipped with an anti-rotation device, the CRS shall be tested in the two following positions without using this feature:

- a) in full contact with the seat surface of the test bench;
- b) with the wedge specified in Figure D.9.

The wedge shall be placed on the seat surface in such a manner that the front faces of both the wedge and the seat cushion are in one plane, as shown in Figure D.9.

If electrical conductivity is likely to occur between the CRS and the test bench due to the materials used for the lower anchorages, these connectors of the CRS shall be electrically connected to the test bench.

#### **9.4.3.5 Testing**

The CRS compatibility test shall be performed by conducting the magnetic coupling factor measurement in accordance with Annex G. The CRS is CPOD compatible if the pass/fail criteria defined in Annex G are met.