



ICAO

Doc 10049

Manual on the Approval and Use of Child Restraint Systems

Second Edition, 2019



Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION



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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

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FOREWORD

The safest way to secure an infant or child on board an aircraft is in a State-approved child restraint system (CRS), in a dedicated seat, appropriate for that infant or child. Therefore, States and industry should encourage the use of CRS by passengers travelling by air with infants or children.

Proper use of restraints is one of the most basic and important factors in surviving an accident. It is not possible for a parent¹ to physically restrain an infant or child, especially during a sudden acceleration or deceleration, unanticipated or severe turbulence, or impact. The use of CRS provides an equivalent level of safety to infants and children as that afforded to adult passengers wearing seat belts. ICAO developed the *Manual on the Approval and Use of Child Restraint Systems* (Doc 10049) in order to facilitate widespread use of CRS at an international level. It provides guidance on provisions in Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport* — *Aeroplanes* related to seats and restraints.

This manual contains guidance for States to develop the regulations and approval processes to enable the use of CRS. It also provides guidance for operators in the form of recommended content for relevant policies, procedures and training programmes as well as guidelines for managing change through their safety management systems to allow the use of CRS on board their aircraft.

The second edition of this manual has been expanded to include detailed guidance for the mutual acceptance of CRS between States, to promote their use at the global level. This additional guidance facilitates seamless international operations for persons travelling with CRS. The approach presented in this manual provides a means to verify that an equivalent level of safety is achieved when a State accepts devices approved by another State. The mutual acceptance of CRS between States facilitates the passenger experience when interlining between domestic and foreign operators.

The content of this manual was developed with input from experts from civil aviation authorities, operators, aircraft manufacturers, training organizations and international organizations, and thereafter submitted for extensive peer review to take into account comments from the expert community.

ICAO gratefully acknowledges the contributions of the ICAO Cabin Safety Group and individual experts who provided support, advice and input for this manual.

1. For the purpose of this manual, the term “parent” refers to the parent or guardian responsible for the infant or child.

GLOSSARY

DEFINITIONS

Adult. For purposes of accompanying an infant or child as a guardian, an adult is considered as any such person of an age as defined by the State of the Operator.

Bassinet. A device for accommodating an infant, which may attach to existing fittings on bulkheads, and is intended for use in flight but not during taxi, take-off and landing. Certain such devices may be certified for use in turbulence. Use of the device is restricted by infant size and weight.

Booster seat. A device that contains no built-in harness. The principal aim of the device is to enhance the positioning of a motor vehicle safety harness on a child. It may include a base, back and side wings.

Cabin crew member. A crew member who performs, in the interest of safety of passengers, duties assigned by the operator or the pilot-in-command of the aircraft, but who shall not act as a flight crew member.

Change management. A formal process to manage changes within an organization in a systematic manner, so that changes which may impact identified hazards and risk mitigation strategies are accounted for, before the implementation of such changes.

Child. A passenger who has reached their second birthday but not their twelfth birthday.

Child restraint system. Any device, other than a seat belt, that is designed specifically to protect and restrain an infant or child during all phases of flight. It typically has an internal harness and belt combination. The device needs to interface with the aircraft seat. This includes devices that are secured using the aircraft seat belt as well as systems that secure the device to the aircraft seat. The device needs to meet minimum performance standards, as specified by the State of the Operator.

Classroom training. In-person, instructor-led training which may include group exercises and interactive instructional sessions.

Computer-based training. Training involving instructional aids, such as computers and tablets. Computer-based training may encompass the use of CD-ROMs as well as web-based training (commonly referred to as eLearning).

Crew member. A person assigned by an operator to duty on an aircraft during a flight duty period.

Critical phases of flight. The period of high workload on the flight deck, normally being the periods between the beginning of taxiing until the aircraft is on the route climb phase and between the final part of descent to aircraft parking.

Direct access. A direct route or passage from a seat to an exit from which a passenger can proceed without entering an aisle or passing around an obstruction.

Emergency exit. Door, window exit, or any other type of exit (e.g. hatch in the flight deck, tail cone exit) used as an egress point to allow maximum opportunity for cabin evacuation within an appropriate time period.

Emergency exit row seating. Each seat in a row of seats located at an emergency exit, having direct access to the exit.

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Forward-facing seats. Seats installed within eighteen degrees of the longitudinal axis of the aircraft.

Infant. A passenger who has not reached their second birthday.

Infant sling. A device consisting of a pouch which holds an infant close to the wearer's body. It is also referred to as a vest.

Oblique-facing seats. Seats installed in the aircraft where the occupant angle relative to the aircraft longitudinal axis is other than those described for forward-facing, rearward-facing or side-facing seats.

Operations manual. A manual containing procedures, instructions and guidance for use by operational personnel in the execution of their duties.

Operator. The person, organization or enterprise engaged in or offering to engage in an aircraft operation.

Passenger. A person who is not an operating crew member.

Rearward-facing seats. Seats installed within eighteen degrees of the longitudinal axis of the aircraft, facing aft.

Restraint. A device designed to safely restrain an occupant in his/her seat to prevent injuries resulting from inertia forces or other in-flight forces such as turbulence. A restraint may be a seat belt, safety harness or approved child restraint system.

Safety harness. A webbing based restraint consisting of at least three anchor points restraining both the pelvis and upper torso.

Seat belt. A webbing based restraint consisting of two anchor points restraining the pelvis. It is also referred to as a lap belt.

Side-facing seats. Seats installed into the aircraft where the occupant angle θ relative to the aircraft longitudinal axis is $\theta = 90.0$ degrees, or $\theta = 270.0$ degrees.¹

State of the Operator. The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

Supplemental loop belt. A belt for infant use that is attached to an adult seat belt by inserting the adult's segment through a loop in the infant's belt. The infant is restrained by an abdominal belt attached to the adult's seat belt. It is also referred to as a belly or loop belt, or infant seat belt.

1. SAE ARP6316 — *Performance Standards for Oblique Facing Seats in Transport Aircraft*

ABBREVIATIONS AND ACRONYMS

ADREP	Accident/Incident Data Reporting System
AS	Aerospace Standard
ATD	Anthropomorphic test dummy
ATSB	Australian Transport Safety Bureau
CAMI	Civil Aerospace Medical Institute (FAA)
CASA	Civil Aviation Safety Authority
CMVSS	Canadian Motor Vehicle Safety Standard
CRS	Child restraint system
EASA	European Aviation Safety Agency
ETSO	European technical standard order
FAA	Federal Aviation Administration
FMVSS	Federal Motor Vehicle Safety Standard
ISOFIX	International standard for attachment points for child safety seats in cars
LATCH	Lower anchors and tethers for children
LODA	Letter of design approval
MPS	Minimum performance standards
MTOW	Maximum take-off weight
SAE	Society of Automotive Engineers
SARPS	Standards and Recommended Practices
SMS	Safety management system
STC	Supplemental type certificate
TC	Type certificate
TSO	Technical standard order
TSOA	Technical standard order authorization

Chapter 1

INTRODUCTION

1.1 BACKGROUND

1.1.1 Proper use of restraints is one of the most basic and important factors in surviving an accident, whether it is in a motor vehicle or on board an aircraft. Accident investigations and scientific dynamic testing have indicated that it is not possible for a parent to physically restrain an infant or child, especially during sudden acceleration or deceleration, unanticipated or severe turbulence, or impact. In such scenarios, an infant or child who is not restrained in a child restraint system (CRS) may suffer serious or fatal injury.

1.1.2 Research on CRS has concluded that infants and children are at higher risk of sustaining injuries if they are not properly secured in a suitable device that has been approved for use on board the aircraft. The use of certain types of devices, not specifically designed for use with an aircraft seat, is detrimental to an infant/child's safety (see Chapter 2, 2.3). Such devices do not provide the same level of safety as CRS approved for use on board aircraft, or that provided to other passengers who occupy their own seats. Studies to note on this subject include, but are not limited to:

- a) Federal Aviation Administration (FAA) — *The Performance of Child Restraint Devices in Transport Airplane Passenger Seats* (conducted by the Civil Aeromedical Institute (CAMI) and published in 1994);
- b) Australian Transport Safety Bureau (ATSB) — *Child Restraint in Australian Commercial Aircraft* (conducted by Human Impact Engineering and Britax Childcare Pty Ltd. and published in 2006); and
- c) European Aviation Safety Agency (EASA) — *Study on Child Restraint Systems* (conducted by TÜV Rheinland Kraftfahrt GmbH and published in 2008).

Note.— Copies of these studies can be obtained from the ICAO Cabin Safety Library at <http://www.icao.int/cabinsafety>.

1.1.3 ICAO's primary indicator of safety in the global air transport sector is the accident rate based on scheduled commercial operations involving aircraft having a maximum take-off weight (MTOW) above 5 700 kg. Statistically, the global accident rate is significantly low, which while affirming the safety of aviation as a mode of transport, makes the collection of sufficient data on infant and child safety in accidents challenging. Additionally, historical data in the ICAO Accident/Incident Data Reporting System (ADREP) does not contain a significant number of reported occurrences resulting in serious or fatal injuries to infants or children in scheduled commercial operations. Therefore, data from research, including scientific dynamic testing, is the most widely available source of information used to understand the issues surrounding infant and child safety.

1.1.4 Infants and children differ significantly from adults in terms of size and weight, body proportions and anatomy. Current seats on passenger aircraft are designed and tailored to the anatomical structure of an adult; they are not specifically designed to accommodate infants or children under a certain weight and/or height. To enhance their safety, infants and children should be restrained in an approved CRS that is appropriate to their weight and/or height which can safely accommodate their body structure and is designed for use on board an aircraft or with an aircraft seat.

1.1.5 At the time of publication, there was no internationally harmonized approach to the approval, acceptability and use of CRS on board aircraft. Certain States have regulations on CRS; others have recommendations on their use. Most States recommend that all occupants be restrained. However, there are variations in the types of CRS that may be used on board aircraft and in their effectiveness. Ultimately, the State is responsible for determining which CRS are suitable for use on board its operators' aircraft. Prior to allowing the use of CRS on board, the State should develop a clear process for the approval of changes in policy and procedures by operators, and determine actions that should be undertaken to maintain or enhance the expected levels of safety performance while implementing any changes. Information on the types of CRS approved by the State should be communicated to the travelling public via the State's relevant website or through other means (e.g. the operator's website).

1.2 PURPOSE

1.2.1 The purpose of this manual is to encourage the widespread use of CRS at an international level by presenting an internationally harmonized approach to the approval and use of CRS on board aircraft. In order to promote such harmonization, States are encouraged to incorporate the content of this manual into their guidance material and make use of it in the development or amendment of regulations.

1.2.2 This manual is intended to provide guidance for States to develop regulations and approval processes for the use of CRS on board aircraft. It provides guidance on provisions in Annex 6 — *Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes* related to seats and restraints. The manual presents a series of considerations that the State should integrate into the approval process, including modifications to regulations and changes which should be required of operators to allow the use of CRS. For the purpose of this manual, "State" refers to State of the Operator, unless specified otherwise.

1.2.3 Guidance is also provided for operators to develop a process to allow the use of CRS on board their aircraft, including the recommended content of relevant policies, procedures and training programmes, as well as guidelines for managing changes through their safety management system. Furthermore, the manual contains guidance for post-implementation activities related to continued surveillance by the State and safety assurance processes by the operator in relation to the use of CRS.

1.2.4 This manual also provides guidance for the mutual acceptance of CRS between States. (see Chapter 2, Appendix B)

1.3 SCOPE

The content of this manual is presented as guidance material. The approach outlined was developed as an acceptable means, but not the sole means, to allow the use of CRS on board aircraft. States may also use guidance material issued by other States to assist with the implementation process. Operators should consult with their respective States on specific requirements for the approval and use of CRS and comply with national regulations where applicable.

Chapter 2

CHILD RESTRAINT SYSTEMS

2.1 TYPES OF CRS

2.1.1 Certain CRS are suitable for use on board aircraft while others are not. Data from research, including scientific dynamic testing, is the most widely available source of information that can be used to understand the issues surrounding infant and child safety. Results from internationally recognized research studies on the effectiveness of CRS were utilized to determine the suitability of types of devices for use on board aircraft. (See Appendix A to this chapter for additional information on these studies.)

2.1.2 Section 2.2 presents the types of devices considered suitable for use as CRS on board aircraft; section 2.3 presents the types of devices deemed not suitable for use as CRS on board aircraft. Prior to allowing the use of a CRS on board, the device should go through the State's approval process as noted in section 2.6.

2.2 TYPES OF DEVICES SUITABLE FOR USE AS CRS ON BOARD AIRCRAFT

2.2.1 The suitability of a particular type of CRS is based on the infant/child's weight and/or height. Additionally, the parent or crew member should comply with manufacturer specifications and instructions. Children whose weight is less than 26 kg (60 lbs.) and whose height is less than 125 cm (49 in) should occupy an approved CRS. Weight restrictions presented in this section are provided as examples and may be subject to variations.

2.2.2 *Aft-facing CRS.* An aft-facing (rearward-facing) CRS is typically intended for an occupant who is unable to walk unassisted and weighing less than 10 kg (22 lbs.). However, some aft-facing CRS can accommodate occupants of a greater weight. Weight restrictions are specified on the device and may vary from one CRS to another. Figure 2-1 presents an example of an aft-facing CRS.

2.2.3 *Forward-facing CRS.* A forward-facing CRS is typically intended for an occupant weighing 10 to 30 kg (22 to 66 lbs.). However, some forward-facing CRS can accommodate occupants of a greater weight. Weight restrictions are specified on the device and may vary from one CRS to another. Figure 2-2 presents an example of a forward-facing CRS.

2.2.4 *CRS specific to aviation.* A CRS that has been designed and approved by the State specifically for use on board an aircraft.



Figure 2-1. Example of an aft-facing CRS



Figure 2-2. Example of a forward-facing CRS

2.3 TYPES OF DEVICES NOT SUITABLE FOR USE AS CRS ON BOARD AIRCRAFT

2.3.1 *Booster seat.* A device that contains no built-in harness. The principal aim of the device is to enhance the positioning of a motor vehicle safety harness on a child. It may include a base, back and side wings. This type of device is not suitable for use as a CRS on board aircraft.¹ Figure 2-3 presents an example of a booster seat.

2.3.2 *Infant sling.* A device consisting of a pouch which holds an infant close to the wearer's body. It is not suitable for use as a CRS on board an aircraft. Figure 2-4 presents an example of an infant sling.



Figure 2-3. Example of a booster seat



Figure 2-4. Example of an infant sling

1. Some high-backed booster seats may be approved by the State for use on board aircraft if the devices meet specific requirements and testing.

2.4 THE USE OF MOTOR VEHICLE CRS ON BOARD AIRCRAFT

2.4.1 A CRS designed for a motor vehicle may or may not be compatible, in fit or function, with aircraft seats. Therefore, in some cases, the CRS cannot be installed properly and may not perform as intended on board an aircraft. The lack of available space between armrests (width of seat base) and the lack of space between two rows of seats (seat pitch) are two reasons why a motor vehicle CRS may not fit on board a particular aircraft. Furthermore, these devices are not configured to be fully compatible with an aircraft seat (break-forward seat backs, no attachment point for a tether strap, etc.), nor are they fully tested with the aircraft seats in mind. (See Chapter 6 for guidance on information for passengers regarding suitable CRS.)

2.4.2 The width between the armrests of an aircraft seat depends on the location and style of the armrests. Some motor vehicle CRS do not fit between the armrests, particularly on seats with seat trays stowed in the armrests. In addition, the dimensions of the available seat base (on which the CRS rests) may differ between motor vehicles and aircraft. The typical seat pan of an aircraft is smaller and narrower than that of a motor vehicle.

2.4.3 The seat pitch or the available space between two rows of seats may also be an issue and particularly significant for aft-facing CRS as they are further reclined and take up more horizontal space. The inability to be effectively installed using existing aircraft seat belts may also render motor vehicle CRS ineffective on board. The location of anchor points can also be problematic. This includes the location of the aircraft seat belt attachment to the aircraft seat, as a CRS must translate forward until the belt path angle allows for belt tension forces to restrain the device.

2.4.4 The installation method and the available maneuvering space for installing a CRS in aircraft differ from the motor vehicle environment. Parents usually stand outside the motor vehicle and can position themselves on either side of the CRS to attain the best possible position for installing the device.

2.4.5 CRS installation frequency may pose a problem. In motor vehicles, the CRS is usually installed and left in the same position for several months, or the base remains installed when the rest of the device is removed. In an aircraft, the CRS is only installed for a particular flight segment.

2.5 SPECIAL CONSIDERATIONS FOR OTHER DEVICES

Special consideration should be paid to the following:

- a) *Bassinets.* Bassinets are not considered CRS. They should not be used during critical phases of flight. These include taxi, take-off and landing. Unless the device has been approved for use during turbulence, an infant should be removed from a bassinet in the event of turbulence. Parents should be made aware of the need to remove and restrain the infant under these circumstances. Bassinets should be used in accordance with the manufacturer's instructions.
- b) *CRS for infants/children with special needs.* The CRS should still be weight and/or height appropriate and capable of supporting the infant/child without impeding accessibility to exits in an emergency situation.
- c) *Medical transportation.* In special operations, such as medical flights, the use of a restraint may conflict with the immediate medical needs of an infant/child. In these circumstances, alternate means, such as humidicribs/incubators (neonatal intensive care units), need to be considered. Any such non-compliance or alternative compliance with the relevant regulations should be granted with a specific exemption or approval of alternate procedures. The operator engaged in this type of flight should work in close cooperation with the State to address the specific requirements for each flight. Qualified medical personnel may need to accompany the infant/child.

2.6 APPROVAL OF CRS BY THE STATE

2.6.1 The State is responsible for determining which CRS may be used on board its operators' aircraft. An approved CRS needs to be compatible with the aircraft seat and meet minimum performance standards (MPS), as specified in this chapter.

2.6.2 The State's approval process should cover the following points:

- a) the use of existing CRS standards to establish MPS (see Appendix B to this chapter);
- b) acceptance of other States' CRS approvals (in line with Appendix B to this chapter);
- c) an approved CRS should be labelled indicating that the device can be used on board aircraft. The label attests that the device has been subjected to specific testing and has been certified for use on board aircraft in accordance with the applicable State regulation (see Chapter 4, 4.2.5); and
- d) a review of the latest research on restraining infants and children, including new products or safety studies.

2.6.3 As a first step in the process, the State should define what constitutes an acceptable CRS that may be approved for use on board aircraft, and determine restrictions on the use of CRS, if applicable.

2.6.4 When approving CRS for use on board aircraft, the State should ensure that the device meets applicable certification requirements, as outlined below:

- a) *Type certificate (TC) process.* A TC is an original design approval process in which an applicant applies for, and the certifying authority may issue, a TC or design approval of a product, or a major design change to a product. A product is an aircraft, an aircraft engine or an aircraft propeller. The process, if approved, results in the issue of a TC.
- b) *Supplemental type certificate (STC) process.* An STC is a TC issued when an applicant has received approval, by the certifying authority, to modify an aircraft from its original design. The STC, which incorporates by reference the related TC, approves not only the modification but also how that modification affects the original design.
- c) In both TC and STC processes, the application for use of a CRS in a specific type of aircraft constitutes a novel and unusual design feature not addressed by current regulations and safety standards. In this case, the State may publish special conditions. These conditions explain the additional safety standards that the State deems necessary for the CRS to comply with existing regulations. They also indicate the required performance of the CRS and the capability of the CRS to be installed and used without creating safety concerns.
- d) An applicant seeking approval for the design of a device should utilize the *technical standard order (TSO) process*. A specific TSO can have different names based on a State or region, such as Canadian technical standard order (CAN-TSO) or European technical standard order (ETSO) process, while maintaining the same technical content. A TSO is an MPS issued by the State for specified materials, parts, processes, and appliances used on aircraft. The MPS must be used for an applicant to receive TSO authorization (TSOA) or a letter of design approval (LODA). An example of an MPS is TSO C-100, which specifies the requirements that a CRS must meet. Clear markings on the CRS indicate that it conforms to the requirements of this TSO. These TSOs apply to equipment intended to provide proper restraint of infants/children in the aircraft environment and suitable for use during all phases of flight. The TSO process also requires the manufacturer to provide technical data, including operating instructions, equipment limitations, installation procedures and limitations, and instructions

for continued airworthiness and maintenance of the CRS. Receiving a TSOA means the applicant obtained an approval for design and production of a device. However, a TSO is not an approval to install and use the device on board aircraft. It means that the device meets the specific TSO and the applicant is authorized to manufacture it.

2.6.5 Typically, a CRS approved by the State for use on board aircraft through the TSO process will likely be similar in design and performance standards to a CRS meeting the requirements for motor vehicles. However, devices approved by the State through a TC or STC may contain novel and unique design features. The MPS for the air transport industry provide more realistic CRS testing regarding performance of CRS in an aviation environment.

2.6.6 Additional information related to the certification of CRS can be obtained from the ICAO Cabin Safety Library at <http://www.icao.int/cabinsafety>.
