

# 1. Considerations for CSRS: Seating Space

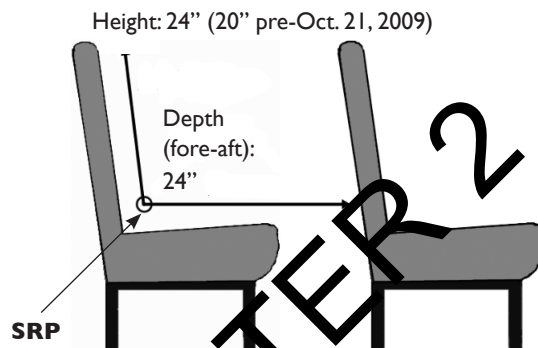
## ■ Space between rows

Per FMVSS 222, the maximum allowable spacing between rows of school bus seats is 24 inches, measured from the seating reference point, or SRP (pictured right), to the back of the seat ahead. Through testing, NHTSA has found that this is the maximum spacing that will provide the benefits of compartmentalization. The *minimum* distance between seating rows is not specified in federal regulations, but is about 18 to 20 inches in practice.

NHTSA recommends that buses used to transport preschoolers be ordered with maximum allowable spacing between all or some rows so that there is adequate room for CSRS. Track seating or other seat types that allow spacing to be adjusted, as needed, are options to consider.

Note: If maximum allowable spacing is desired, it must be *specified* when ordering a bus. When CSRS are not considered, the default goal is to maximize the number of rows on the bus in order to maximize capacity. This makes it virtually impossible to install rear-facing CSRS or large CSRS for children with special needs.

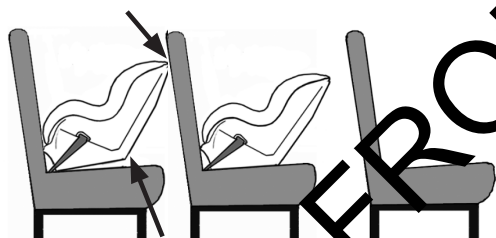
### FMVSS 222: maximum allowable spacing



### Wondering if your bus has maximum row spacing? Here's how to tell:

Per FMVSS 222, the maximum space allowed between rows (24 inches) is measured from a point that represents a crash dummy's hip joint (the seating reference point, or SRP shown above). To get a rough idea of how bus rows are spaced, measure horizontally from about 2 inches above the lower cushions from one seat back to the other. Push the end of the measuring tape into the back of the seat ahead until it hits the foam pad underneath the cover. This measurement will be approximately 28 inches if rows are at maximum allowed spacing (also called maximum knee spacing) and less if not (maximum capacity spacing).

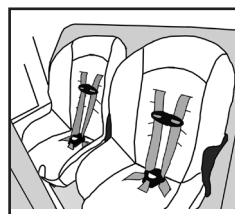
To confirm any bus feature with certainty, contact the manufacturer, and provide the bus's vehicle identification number (VIN).



Arrows point to incorrect use of the CSRS on the left. The close row spacing prevents the CSRS from resting on the seat cushion. The other CSRS fits properly between rows set at maximum spacing.

## ■ Seat cushion width

NHTSA guidelines allow the use of bus seats for multiple passengers, provided "the combined width of CSRS and/or other passengers on a single seat does not exceed the width of the seat" (NHTSA, 1999). See the images (right) for guidance by CSRS type.



NHTSA says only two conventional CSRS fit on a seat that's 39 inches or wider; only one fits if the seat is less than 39 inches wide.

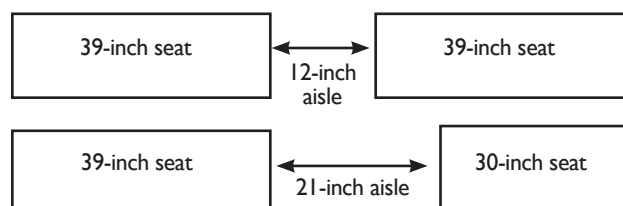


Three CSRS that attach using cam wraps can usually fit on one bus seat that is 39 inches wide or more.

## ■ Aisle width

A narrow aisle can make carrying a CSRS on/off the bus difficult and also hinder evacuation. A bus aisle must be at least 12 inches at its narrowest width between cushions. By equipping one side of the bus with seating that is less than 39 inches wide, the aisle can be more accommodating to CSRS. (Some 12-inch aisles are wider at hip width because the seatbacks taper at the top.)

### Aisle width affects CSRS ease of use and evacuation



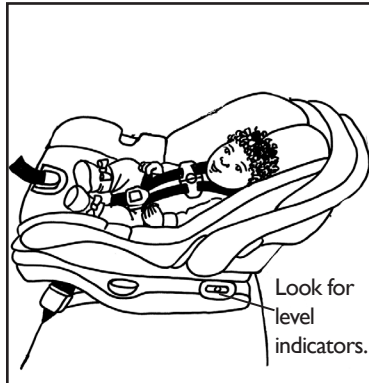
## Step 3: Angle: Set the CSRS to Be Reclined or Upright

**Rear-Facing CSRS:** Instructions will outline how to install a rear-facing CSRS in a way that balances:

**Reclined enough**, so that gravity will help keep the child's head upright and his or her airway open while riding. A baby's CSRS is too upright if the head flops forward (chin to chest). This could cause breathing difficulties.



**Upright enough**, so force will be spread over a child's entire back in a crash. If a CSRS is over-reclined, too much crash force will be placed on the child's weak shoulders, which could cause injury and allow ejection from the harness.



### How to tell when the appropriate angle is achieved

Carefully read and follow CSRS instructions. Most CSRS must be placed so that the child's back reclines at a 30- to 45-degree angle from fully upright. (See illustration, below.) Look for these types of angle indicators on the CSRS:

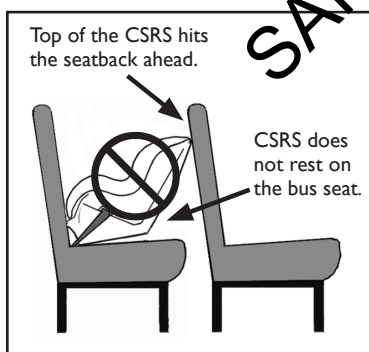
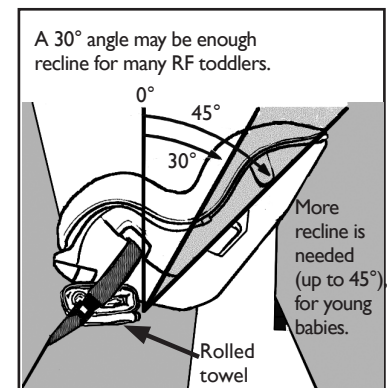
- **Level-to-ground lines.** Set the CSRS so the line is parallel to the ground. The line may be on a label or molded into the plastic shell.
- **Gravity-based indicators.** Various styles use such indicators as dials, air bubbles, or balls that must fall within a specified range. For this type to work properly, the bus must be on level ground.

Each of these indicator types may have instructions that allow older babies with better head control to sit more upright.

### How to adjust the angle of a rear-facing CSRS

If a CSRS is too reclined or (more likely) too upright, see the instructions for approved ways to make angle adjustments. Techniques might include:

- **Use a recline foot.** If a foot is present (usually on a RF-only CSRS; separate base), lower it to increase recline; stow it to make the CSRS more upright.
- **Use a rolled towel or piece of Styrofoam pool noodle** (illustrated, at right). Place this under the front of the CSRS to prop it to a more-reclined position. (However, this method is rarely needed on a bus, due to the flat seat cushions. *Never* use this technique to make a CSRS more upright.)
- **Further tighten the installation strap.** The CSRS will become more upright.
- **Use a RF-only CSRS without its base.** Most instructions allow this option.



### How to deal with seating area incompatibility

Sometimes a CSRS is too upright because the space between rows does not allow it to rest on the seat cushion (illustration, left). Try these potential solutions:

- **Use a RF-only CSRS without its base.** Most instructions allow this option, which tends to require less fore-aft space.
- **Move the CSRS handle to upright.** If the handle of a RF-only CSRS is interacting with the seatback, see if instructions allow a different handle position.
- **Install the CSRS in a different row.** Some rows may have wider spacing. If the front seat barrier is upright, there will be more space in the front row.
- **Use a different CSRS.** Some models are shorter, so they require less space.

**Forward-Facing CSRS:** Most forward-facing CSRS types must be used in an upright position. However, when a convertible CSRS is used forward facing, confirm that the angle has been properly adjusted for use in that mode. Follow instructions; never place padding under a forward-facing CSRS to adjust the angle.

Some forward-facing CSRS may be used upright or in a semi-reclined position. However, unless there is a valid

reason for the child to be reclined, on a school bus it is better to install a convertible CSRS in its upright position, as that is more likely to leave space for the child's legs.

#### What would you do?

A forward-facing convertible CSRS overhangs the seat cushion and presses against the seatback ahead. What can you check/adjust to try to fix this problem?



## Using a Cam Wrap to Anchor Safety Vests

The type of cam wrap used for anchoring a safety vest is often called a “seat mount” or “portable seat mount” by manufacturers. It is a separate device with hardware that connects to rings, loops, or slots on a vest. The connection to the vest, at shoulders and hips, is made while the child wears the vest, which has already been adjusted for proper fit (usually while off the bus). (See Chapter 5 for vest fit details.)

Follow the basic anchoring process outlined on the previous page. Make sure that the attachment points can be connected to the vest while the child is seated properly, with his/her back against the seatback. Adjust the seat mount’s hip and shoulder straps so that they connect to the vest in a way that holds the child securely in place (no slack), while not altering proper vest fit.

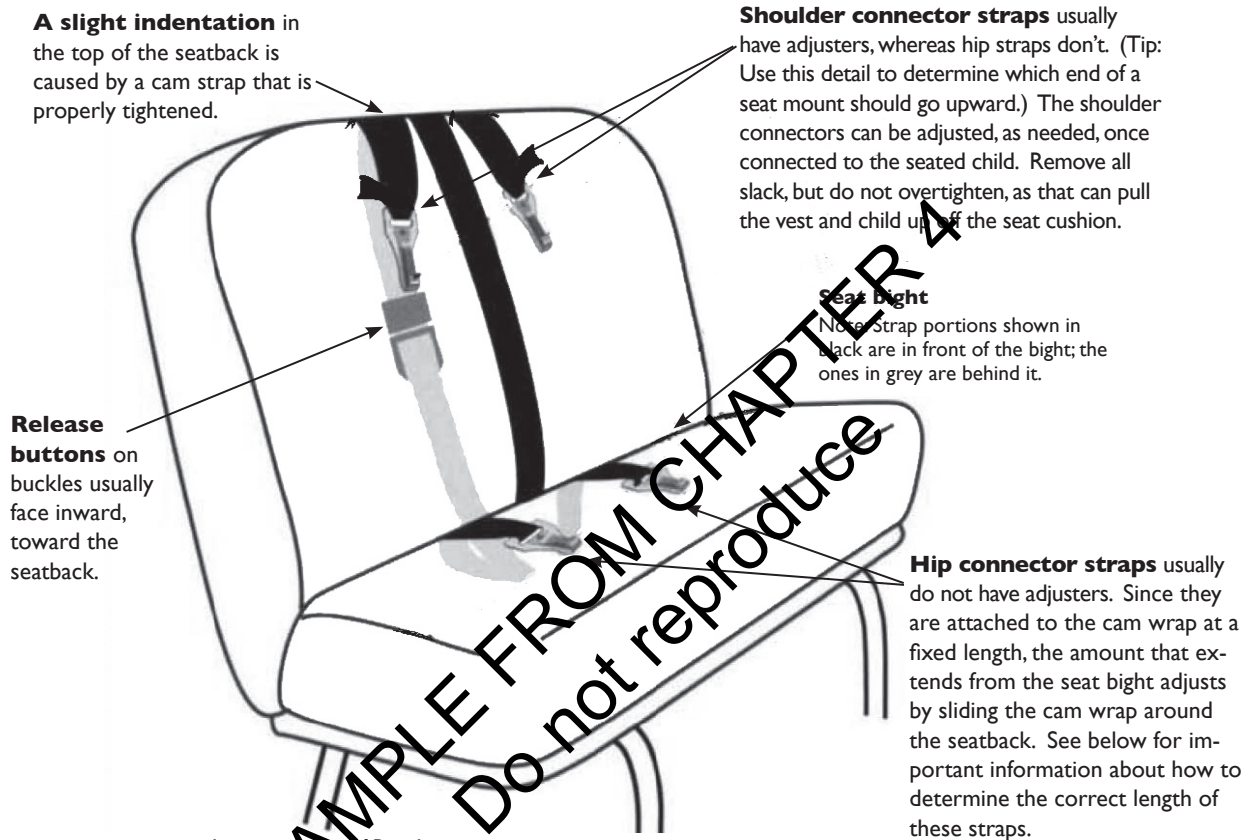
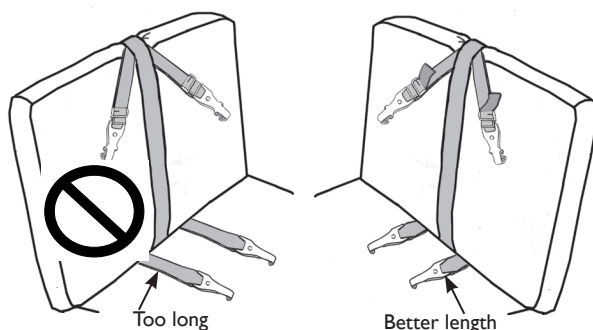
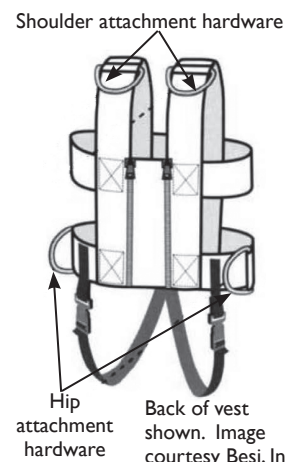


Image courtesy of Besi, Inc.



**The hip connector straps** attach to the child’s safety vest and should hold the child’s hips firmly against the lower seatback. A common mistake is to leave the hip connector straps too long (left), which allows the straps to be slack when attached to the vest. For most children, only about an inch or two of webbing extending from the seat bight is needed, as further explained at right. Set the length during the cam wrap anchoring process, described above.

**Hip and shoulder connector straps must align with a properly worn safety vest.** Since the bottom of the vest must touch the top of the seated child’s thighs (never higher), the hip connector strap must be rather short—just long enough to reach the attachment hardware on the safety vest. Attach and adjust the shoulder straps last. (See Chapter 5 for more on vest fit.)



### What would you do?

A preschooler who wears a safety vest is able to slide forward on the seat cushion several inches. How can you fix this positioning problem?



## Step 4: Protect the Wheelchair-Seated Occupant

Whenever possible, transfer a child who uses a WC to bus seating (with a CSRS, as needed), following the instructions in his/her ITP. (See page 83.) However, if circumstances require a child to ride in a WC during transport, it is essential that he/she wears an occupant restraint system.

The system may be fully or partially integrated into the WC, but typically a seat belt that is part of a WTORS must be added. It is the responsibility of transporters to ensure that a crashworthy occupant restraint system is used properly on each ride, as described on this page.

### Occupant Restraint System Types

There are three types of crashworthy occupant restraint systems for WC occupants:

1. A lap-shoulder seat belt, provided as part of a WTORS system. (An independent system.)
2. A load-bearing WC lap belt (marked with the logo shown on page 84) used with a WTORS shoulder belt connected to the school bus wall. (A partially integrated system.)
3. A load-bearing five-point harness for children who weigh 25 to 50 pounds, marked with the logo shown on page 84. (A fully integrated system, which, if present, should fit as described on page 62.)

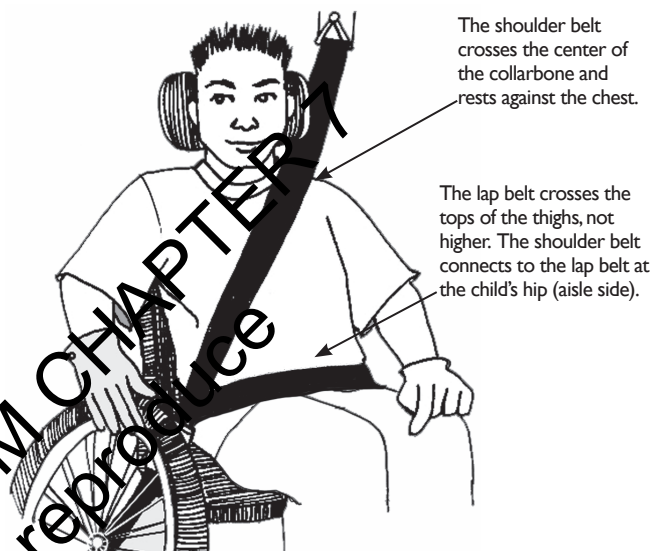
The most common type, by far, is the first type described above: the independent system that is part of a WTORS. As described on page 84, current WC19-compliant wheelchairs must have the *option* to be equipped with partially or fully integrated systems, but few WCs are actually equipped with this transit option. Therefore, even with WC19 wheelchairs, expect to use the full WTORS lap-shoulder seat belt unless absolutely certain that the integrated belts are marked as crashworthy.

### Wheelchair Seat Belt Fit

Lap-shoulder belts for WC occupants come in a variety of styles, as described on page 61. Follow manufacturer instructions for the particular system being used. Regardless of the style, strive to make the belt fit the way any other seat belt should. (See images, right, and pages 68–69.) The webbing should be flat and make snug contact with the body. The lap portion should cross the upper thighs, and the shoulder portion should contact the occupant as it crosses the center of the collarbone and run diagonally across the torso. The shoulder belt should not hover away from the body nor contact the neck or throat area. The lap belt should not sit above the thighs, crossing the child's abdomen.

Although protecting the occupant with the lap-shoulder belt is the last step in the process of safely transporting a child in a WC, it may be necessary to redo the work of earlier steps to make the lap-shoulder belt fit correctly. For instance, it may help to move the wheelchair's position, which would require repositioning and retightening the tiedowns. This type of trial and error should be done during a practice run-through before the child's first ride.

**Children who ride the bus while seated in a WC are not protected by compartmentalization. A WC-seated passenger must use a seat belt, even if other passengers do not.**



**Above: Good belt fit.** Proper positioning of the lap and shoulder belt is critical for protection. This shoulder belt properly crosses the center of the shoulder and diagonally across the torso. The lap belt is snug and low on the top of the thighs.

**Below: Poor belt fit.** There are many problems with the fit of this belt system. The lap belt rides up on the abdomen, and the shoulder belt does not contact the chest. These issues are worsened by an unfortunate lap-shoulder belt design, in which the shoulder belt connects to the lap belt in the middle of the child's lap, so the shoulder belt does not run across the entire torso and tends to pull the lap belt upward.

