Transport for NSW

Bus Door Safety Systems

Technical Specification (TS) 160 | December 2021

Contents

1 Scope

1.1 This Technical Specification (TS) 160 sets the criteria for the design of a bus *door safety system* which is intended to prevent persons from being injured, potentially fatally, by a passenger door in a bus.

1.2. A *door safety system* meeting the criteria in this TS 160 will incorporate:

- A door sensor system to detect a door obstruction.
- A driver warning system with visual and audible alarm.
- A door brake system to stop the bus from moving or stop it if already moving.
- An acceleration control system that controls the supply of energy to vehicle drive system, in specific circumstances.

1.3. The *door safety system* will limit the opening and closing forces applied by *driver controlled passenger door* and, it will control the movement of the bus and warn the driver in the event that an object is detected, with the intention of preventing injury to minimise harm.

2 Application

2.1 This TS 160 is approved under clause 20 of the Road Transport (General) Regulation 2021 and applies to all motor vehicles built mainly to carry people that seats over 12 persons (including the driver) which:

- Are used by an accredited service operator to operate any regular passenger service * within the meaning of the *Passenger Transport Act 1990.*
- Are first registered in NSW on, or after, 1 January 2023.
- Are fitted with a driver controlled passenger door.

Note *: A regular passenger service means a public passenger service conducted according to regular routes and timetables, but does not include a tourist service, charter service or a long-distance service.

3 Definitions and Interpretation

Accelerator control system – means the subsystem of the *door safety system* that controls the supply of energy to the *vehicle drive system* in accordance with section 8 – Accelerator Control System.

Bus – means a motor vehicle covered under this TS 160 in accordance with section 2 - Applications.

Bus is stationary – means that the *bus* is stopped as determined by the respective chassis *speed sensor system*.

Chassis speed sensor system – means the system used to monitor vehicle road movement and speed.

Door brake system – means the subsystem of the *door safety system* that stops the *bus* from moving.

Door controls– means all buttons, switches and/or devices, other than *driver door controls*, that may be used to operate any *driver controlled passenger door*.

Door safety system – means the overall system that controls the safe operation and features of a *driver controlled passenger door*.

Door safety system manufacturer – means the company or entity integrating all the components comprising the *door safety system* in a *bus* to ensure its effective operation.

Door sensor system – means the subsystem of the *door safety system* used to detect a door obstruction.

Driver controlled passenger door – means any passenger door, provided for the entry and exit of passengers during normal operation of a *bus* that is operated by the driver in the driver's cabin.

Driver door controls – means all buttons and/or switches used by the driver in the driver's cabin to operate a *driver controlled passenger door*.

Driver door control lock- prevents all *driver controlled passenger doors*, other than the front door, being operated.

Driver warning system – means the visual and audible means of alerting a driver to an abnormal condition or a system fault affecting the *door safety system.*

Electronic Braking System (EBS) – means an electronically controlled braking system.

Front door – means the forward *driver controlled passenger door* which is located no further back than the seating row immediately behind the driver and which is in clear view of the driver.

Fully closed – is defined as the point where the door is sealed against the door aperture and any entrapment would have been detected. For *small buses,* fitted with a single leaf plug door, that have a secondary locking process where the door moves upwards or downwards to lock. The completion of the secondary locking process is the point where the door is sealed.

Hydraulic brake system – means a system that uses hydraulic fluid as a medium for transmitting force in any part of the system from the control to the friction elements, as defined in the Australian Design Rules vehicle definitions.

Maximum door opening or closing force – means the steady state opening and closing force that the door can exert on an object.

Mechanical handbrake – means a sub-system that applies restraining force to two or more road wheels and is part of a *hydraulic brake system*.

Non-reopening door system – means a door system that is not designed to reopen the doors in the event a door obstruction is detected.

Operating and Maintenance (O&M) Documentation – means all written or electronic instructions, manuals, training materials and other documentation recommended by the *door safety system* manufacturer to enable safe operation and maintenance of each *bus*. O&M documentation, as it applies to *door safety system* manufacturers, includes, but is not necessarily limited to:

- Recommended maintenance, servicing, inspection and adjustment instructions, servicing and inspection schedules and intervals, and detailed certification and in-service compliance test procedures and methods.
- Required inventory catalogue and specialised test equipment.

Pre-set speed – is the speed set (nominally up to 10 km/h) that influences the control of various subsystem functions of the *door safety system*.

Reopening door system – means a door system designed to automatically reopen the doors in the event a door obstruction is detected.

Small bus - means a motor vehicle built mainly to carry people that seats over 12 and up to 25 persons including the driver.

Safe state of operation – a design state where, in the event of any failure in a system or one of its components, the system or component or other inter-related systems or components will operate in a way that prevents or mitigates unsafe or intolerable consequences of the failure.

Vehicle drive system – means the system that powers the *bus* such as the engine, motor or other drive system.

4 General Requirements

4.1 Each *driver controlled passenger door* will be incorporated into a *door safety system* as described in this TS 160.

4.2 A sticker (or stickers) will be affixed to the side window next to the driver similar to the example below. The text must be **visible** from the outside of the *bus* and will read, “Do Not Access Bus Through Window”.

5 Door Safety System

5.1 The operation of the *door safety system* will not affect the compliance of the *bus* with any Australian Design Rule or applicable regulation.

5.2 The *door safety system* will not prevent any internal emergency *door controls* from opening any passenger door when the *bus* is travelling below the *pre-set speed*.

5.3 All components of a *door safety system* will be located or designed so that the risk of them being tampered with is minimised.

5.4 The *door safety system* will be designed to (in the event of any abnormal condition, system fault or failure) default to a *safe state of operation*.

5.5 The *door safety system* will operate:

5.5.1. Without any driver intervention.

5.5.2. Whenever the engine ignition (or equivalent activation system) is in the 'ON' position.

5.5.3. Whenever there is sufficient energy available to enable any door to be operated.

5.6 The *door safety system* will deactivate the *door sensor system* when the *bus* is travelling above the *pre-set speed*. For *small buses* fitted with a single plug door configuration and where the doors go through a secondary locking process where the door moves upwards or downwards to lock, the *door safety system* shall remain active until the door is *fully closed*.

5.7 The *door safety system* must incorporate a 'maintenance isolation' switch to enable the system to be deactivated and allow a vehicle to be driven, under controlled conditions, to a place of repair;

5.7.1. The maintenance isolation switch must be concealed behind a panel that is not accessible from the driving position.

5.7.2. The *door safety system* will provide a means of recording and storing, for a minimum of 7 days, data relating to the application of the maintenance isolation switch.

5.8 The *door safety system* must also feature a tamper-resistant 'emergency override' switch that allows a vehicle to be driven to a safe location in the event of an emergency occurring when the *door brake system* or the *accelerator control system* are active.

5.8.1. The emergency override switch must be accessible from the driving position and must return immediately to the off position on release to deactivate the override function.

5.8.2. Activation of the emergency override switch will produce a visible and audible alert to the driver.

5.8.3. The *door safety system* will provide a means of recording and storing, for a minimum of 7 days, data relating to the application of the emergency override switch.

5.8.4. Where a *small bus* is fitted with a *hydraulic brake system* and uses a *mechanical handbrake* as the *door brake system*, the function of the emergency override can be replaced by the manual release of this handbrake. The release of the handbrake in this situation must produce a visible and audible alert to the driver.

5.9 When the *door sensor system* activates, the *door safety system* will only be capable of being reset by:

- A reapplication of the driver door controls or,
- A secondary door reset button.

A further application of the *driver door controls* would then be required to close the doors.

5.10 The *maximum door closing force* applied to an object located at any vertical position between closing doors, or the leading edge of a single closing door and any part of the *bus*, will not exceed 200 N for a *reopening door system* and 150 N for a *non-reopening door system*, when measured from 20 mm to 300 mm from the *fully closed* position, as demonstrated in Appendix A – Typical one and two leaf door configuration closing force test methodology.

5.11 The *door safety system* must have a means to minimise the risk of the door being forced or blown open in operation above the *pre-set speed*. For this purpose the door holding force may increase, as required, above the 150 N closing force after the *bus* has reached the *pre-set speed* or for *small buses* after the doors are *fully closed*.

5.12 The *maximum door opening force* for inward opening doors must not exceed 150 N at a distance from 20 mm up to 300 mm from any *bus* body fixture that could cause passenger entrapment. For systems incorporating a *door sensor system* on the door opening cycle, the opening force won't exceed 200 N at a distance from 20 mm up to 300 mm from any *bus* body fixture that could cause passenger entrapment. In the case of doors with passenger handles, these forces can be exceeded to aid stability. This can only be done when the door is stationary and in the fully open position.

5.13 The correct operation of the *door safety system* must be readily checked without dismantling any component.

5.14 The *door safety system* will be capable of operating reliably under the full range of likely conditions encountered during *bus* operation such as road camber and inclines. This includes extremes of temperature and cleaning with pressurised water. For example, rubber or plastic components might perform differently over a range of temperatures affecting the flexibility of a door seal.

6 Door Sensor System

6.1 A *driver controlled passenger door* may or may not automatically reopen when the *door sensor system* detects an obstruction.

6.2 The *door sensor system* will be capable of detecting a 35 mm diameter section of rod when placed horizontally on the door step and a 20 mm diameter rod at all other heights up to 1500 mm above the door step.

Note: The 20 mm rod is intended to simulate the thickness of the wrist of a child and the 35 mm diameter section, a child's ankle.

6.3 The *door sensor system* must activate when the *driver door controls* are activated and must remain active until the *driver controlled passenger doors* are closed and the *bus* moves off and reaches the *pre-set speed*, or for *small buses* after the doors are *fully closed*.

6.4 The *door sensor system* will conform to the requirements contained in Appendix B – Typical one and two leaf door configuration sensor system test methodology of this TS 160.

6.5 The *door sensor system* will be capable of detecting a solid rod used to obstruct the doors in accordance with Appendix B – Typical one and two leaf door configuration sensor system test methodology of this TS 160.

7 Door Brake System

7.1 When any *driver door control* has been activated to open any *driver controlled passenger door*, and until all *driver controlled passenger doors* have closed without the *door sensor system* detecting an object, the *door brake system* will prevent movement of the *bus* by:

- Ensuring that the *accelerator control system* is active in accordance with Section 8.
- Applying the brakes on at least one axle or by locking the driveline.
- Or for *small buses* with a *hydraulic brake system*, the *driver door controls* shall only function in conjunction with the activation of the *mechanical handbrake*.

7.2 The *door safety system* will only release the *door brake system*, if no object has been detected, after:

- The doors have *fully closed*.
- The handbrake is released.
- A secondary activation of either the foot brake or the engine accelerator is applied.
- For *small buses* with a *hydraulic brake system*, if the handbrake is released prior to the door being *fully closed*, then the system shall alarm and the throttle be limited to idle.

7.3 The *door brake system* used to control the *bus* brakes or driveline retarding device will be designed so it does not activate while the *bus* is travelling in excess of the *pre-set speed*.

7.4 The *door brake system* will be designed to hold a stationary *bus* on a 12 per cent gradient while fully laden.

7.5 The *door brake system* should be capable of stopping a *bus* travelling under the *pre-set speed* smoothly without locking the wheels and within a reasonable distance.

7.6 To avoid *bus* rollaway the *door brake system* must only operate when the engine ignition (or equivalent activation system) is in the 'ON' position.

7.7 For *small buses* that use *hydraulic brake system*, the *mechanical handbrake* can be used as the *door brake system*. The *mechanical handbrake* can be applied either manually or via electronic activation.

8 Accelerator Control System

8.1 The *door safety system* will only activate the *accelerator control system* whenever the *door brake system* is active, or if the *door safety system* activates the *driver warning system* above the *pre-set speed*.

8.2 When the *accelerator control system* is active it will prevent the accelerator supplying energy to the *vehicle drive system* (i.e. the accelerator will be inactive).

8.3 When the *driver controlled passenger doors* are closed, the a*ccelerator control system* will release when the doors have *fully closed* and after a secondary activation of either the foot brake or the accelerator.

8.4 For *small buses* with a *hydraulic brake system*, the *accelerator control system* will only release after the door is *fully closed* and the *mechanical handbrake* is released. If the *mechanical handbrake* is released prior to the door closing, the *accelerator control system* must remain active and the system must alarm to alert the driver to the door not being closed.

9 Driver Door Controls

9.1 The *driver door controls* will not operate unless the *bus is stationary* or for *small buses* with a *hydraulic brake system*, the *mechanical handbrake* is applied.

9.2 The *driver door controls* will only close the doors if the handbrake is applied or the foot brake is depressed.

9.3 If a *driver door control lock* is provided to prevent all *driver controlled passenger doors*, other than the front door, being operated (for example, school special) it will be located adjacent to the driver *door controls.*

9.3.1. When the *driver door control lock* has been activated a light adjacent to the driver door controls lock will illuminate to inform the driver the lock is activated

9.3.2. With the *driver door control lock* activated it should be possible to close any open rear or centre passenger door. It must not be possible to open these doors with the driver *door controls.*

9.3.3. Activation of the *driver door control lock* should not affect the operation of the front passenger door.

10 Door Controls

10.1. For *driver controlled passenger doors* that can be closed via an external door control, operation of these door controls will not close any door or deactivate the *door brake system* unless the handbrake is applied.

10.2. Where a bus has a mechanism that allows the *driver controlled passenger doors* to be manually shut, the *door brake system* will not deactivate unless the handbrake is applied.

10.3. If any *driver controlled passenger door* fitted with a wheelchair ramp is open, and the ramp is deployed, the *driver door controls* must not be able to close the doors.

11 Driver Warning System

11.1 The *bus* must also be fitted with a *driver warning system* comprising of an audible and visual alarm activating if the driver turns the vehicle off or removes the ignition key without the handbrake applied.

11.2 The *driver warning system* will be activated by the *door safety system* when an abnormal condition is detected, such as the system not complying with this TS 160.

11.2.1. If a bus is fitted with an *Electronic Braking System* (EBS), any active fault in the EBS that inhibits the operation of the *door safety system* or any of its sub-systems must activate the *driver warning system*.

11.2.2. The visual indicator for the *driver warning system* will be located in the area of the driver's normal controls and be marked with or display the words 'DOOR ALARM'.

11.2.3. Any audible warning device, as part of the *driver warning system*, which produces a recorded voice message will repeat, 'DOOR ALARM' in clear English until the system is reset.

11.3 The *door safety system* will also continually monitor its own state of operation and, if a fault does occur, must provide an audible and visual warning to alert the driver a fault has occurred.

12 Certification

12.1 The *door safety system* manufacturer will retain a certification confirming compliance of the system with this standard. This will be completed by an appropriately competent person who is authorised by the *door safety system* manufacturer to confirm compliant manufacture of any *bus*. This will also be provided to the accredited service operator or owner of the vehicle.

12.2 The *door safety system* manufacturer must provide operating and maintenance documentation applicable to the *door safety system* to the accredited service operator or owner of each *bus.*

12.3 The *door safety system* will utilise the chassis Original Equipment Manufacturers (OEM) supplied *door brake system* and *accelerator control system* whenever possible. The activation and use of these systems must always be in accordance with the OEM's recommendations, ADR compliance requirements and any applicable regulations.

12.4 Where the *door safety system* is not in compliance with part 12.3 of this TS 160, certification is required by a person accredited as a licensed certifier and authorised to assess within their particular area of expertise under the *Vehicle Safety Compliance Certification Scheme (VSCCS)* – see VSCCS Bulletin No. 1 'Licensed Certifiers'.

12.5 A plate or label made of durable material must be fitted adjacent to the vehicle manufacturer's compliance plate. The plate or label display the following information:

- The name of the *door safety system* manufacturer and the statement:
- "The door safety system fitted to this bus has been manufactured and installed to comply with Transport for NSW Technical Specification 160 Bus Door Safety Systems".

13 Further Information

Transport for NSW Technical Enquiries

PO Box 1120, Parramatta NSW 2124
T: 1300 137 302
F: 02 8837 0037
E: technical.enquiries@transport.nsw.gov.au

- Vehicle construction and registration requirements in NSW

Transport for NSW Technical Specifications

https://www.nsw.gov.au/topics/vehicle-registration/how-to/vehicle-standards/technical-specifications-for-buses

Transport for NSW Vehicle Safety Compliance Certification Scheme (VSCCS)

www.rms.nsw.gov.au/vsccs T: 1300 336 206
E: vsccs@transport.nsw.gov.au
VSCCS Bulletin No.1'Licensed certifiers'.

14 Appendix A - Typical one and two leaf door configuration closing force test methodology

Certification Testing

Overview

The door closing force is determined by placing a force measuring device in the doorway so the door edges close onto the device.

For single panel doors, the closing force is to be measured by placing the measuring device between the door edge and the fixed door aperture so that the door edge closes onto the device.

Equipment

The force measuring device will be capable of measuring a compression force between two surfaces. The device will measure force up to at least 500 N.

Typical test procedure

1. Close the door(s) onto the device (as shown in Figure 1). Use spacers when necessary to set the required test gap between the door edge(s).
2. Observe and record the force reading.
3. Repeat steps one and two for required test heights above the doorstep.

Note: In order to assess the correct closing force exerted by the door(s) it might be necessary to disarm, override or bypass some of the automatic functions of the *door safety system*, such as the *door sensor system*. The force to be measured is the steady force generated by the closing door(s). The test is designed to confirm that, even if the *door sensor system* is not operating, the specified door closing forces are not exceeded.

4. The force readings are to be taken in at least the following situations:

    a) With the *door safety system* fully functional and in normal operation.

    b) When the *door safety system* is isolated via the maintenance isolation switch which is detailed in clause 5.7.

    c) Or if there is any fault in the *door safety system* including when the *door sensor system*(s) are deactivated due to a system fault.

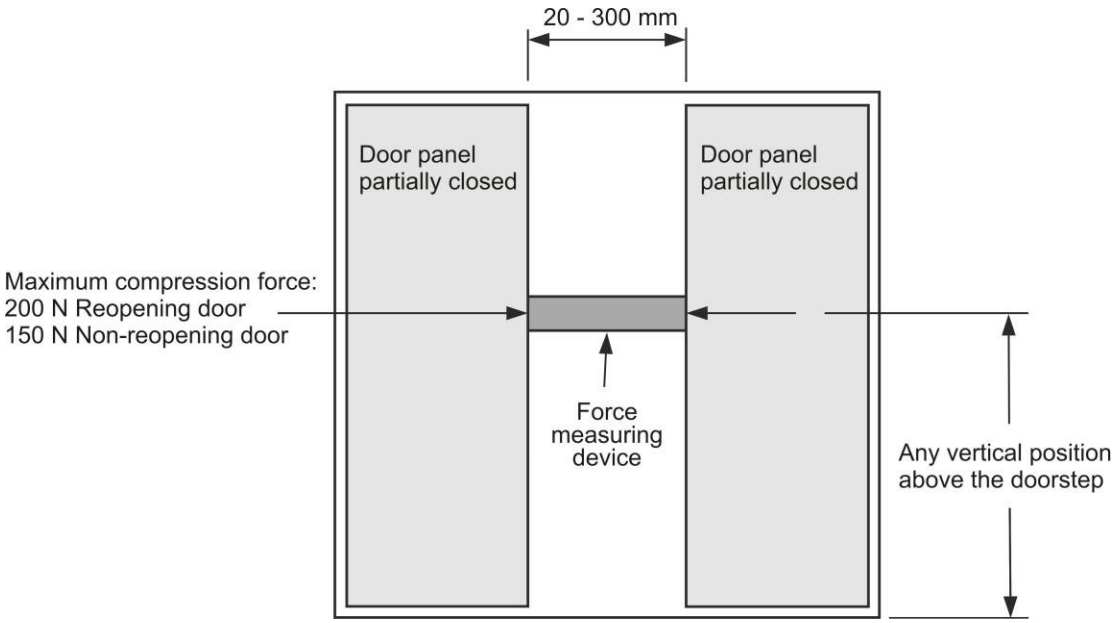
When testing door systems that use multiple air pressures, or electrical doors that use variable power settings to control the doors, test 4 c) must be undertaken with the doors at the system default pressure or power setting. That is the pressure or power setting that the system defaults too if a failure does occur.

The *door safety system* Manufacturer Suppliers must show via a failure mode analysis that the operating pressure or power setting used for point 4 c), is the real default position.

In-Service Compliance Testing

Systems must be configured so that each scenario 4a), 4b) and 4c) can be tested in the field by a suitability trained and qualified tester/*bus* operator/*bus* maintainer.
Note: Test 4c) may not be able to be tested without disconnecting at least one or more operating safety sensors. Refer to maintenance processes.

For detailed instruction on test procedure refer to the *door safety system* manufacturer's operating and maintenance documentation.



(Figure 1 not to scale)

15 Appendix B- Typical one and two leaf door configuration sensor system test methodology

Overview

A short length of solid rod, intended to represent the ankle and wrist of a child, is held firmly in the way of the closing door panels to check that they function correctly.

Equipment

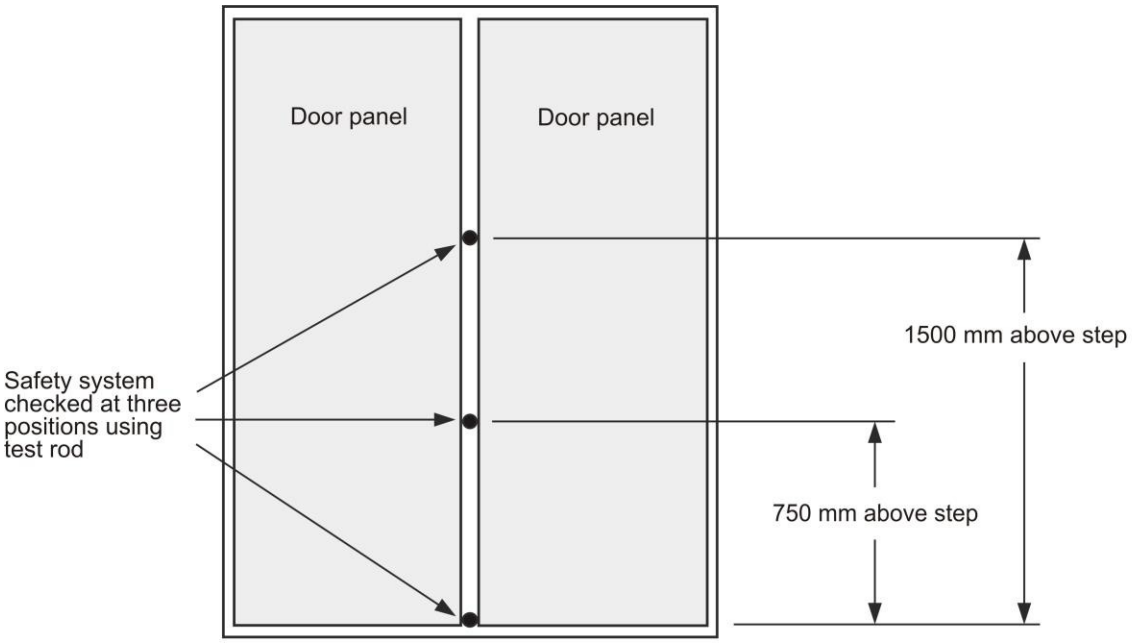
The test device consists of a multi-diameter rod as illustrated in the diagram (Figure 2). The 20 mm diameter section is representative of a child's wrist and the 35 mm diameter section, a child's ankle. At the lowest test height, the 35 mm diameter section of rod is placed horizontally on the door step and between the closing doors. At all other test heights above the step, the 20 mm diameter section of rod is placed between the closing doors.

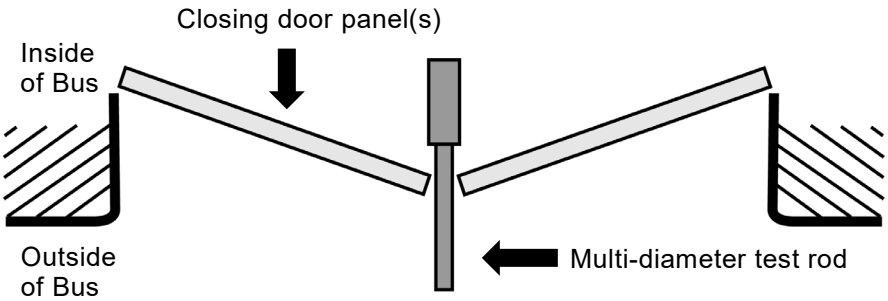
Typical test procedure

1. For twin panel doors, place the 35 mm diameter section of the rod on the door step so the door edges only contact the 35 mm diameter section. Ensure the rod is positioned at right angles, horizontally and vertically, to the closed position of the doors.
2. For a single panel door, place the 35 mm diameter section of the rod on the door step so the door edge and the fixed door aperture will only contact the 35 mm diameter section. Ensure the rod is positioned at right angles, horizontally and vertically, to the closed position of the doors.
3. Close the doors onto the rod.
4. Observe whether the doors reopen when the edges of the doors reach the rod (the reopening feature is optional).
5. Irrespective of whether the doors reopen, have the driver attempt to move the *bus* by selecting a forward gear, releasing the parking brake (if applied) and gently pressing the accelerator.
6. Observe whether the *bus* moves (Note: the *bus* should not move).
7. If the doors are still closed, open them.

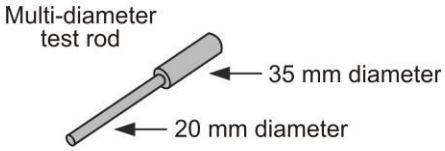
8. Remove the rod.
9. Close the doors and have the driver attempt to move the *bus* by gently pressing the accelerator. The *bus* should move, indicating that the safety system has deactivated.
10. Repeat steps one to nine for additional heights using the 20 mm diameter section of the rod (for example, approximately 750 mm and 1500 mm above the step). The actual test heights should be somewhat random to ensure that no system is only sensitive at defined test heights.

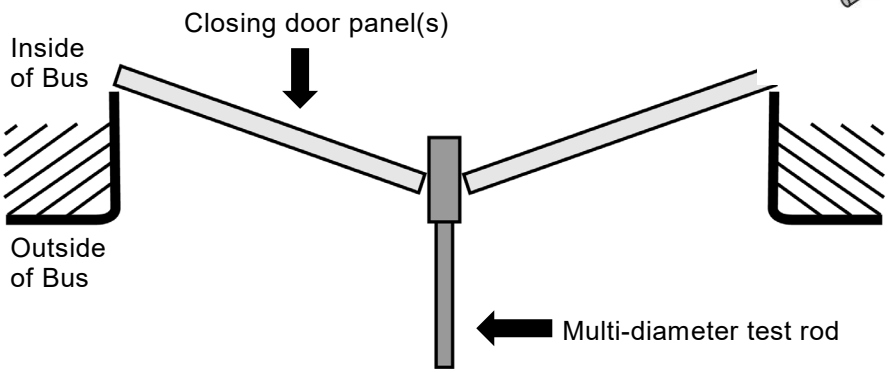
For detailed instruction on test procedure refer to the *door safety system* manufacturer's operating and maintenance documentation.





Test rod use, at example, 750mm and 1500mm above step





Test rod use on door step