



Office of Transport Safety Investigations

BUS SAFETY INVESTIGATION REPORT

UNINTENTIONAL OPENING OF BUS REAR DOORS

RYDE

3 APRIL 2014



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EXECUTIVE SUMMARY

On 3 April 2014, whilst travelling home on a State Transit Authority (STA) school bus service, two students standing in the rear vestibule area fell against the rear doors of the bus. The force of the students falling against the doors caused the doors to swing open and they fell onto the road sustaining minor injuries. The circumstances of a similar incident that occurred on 14 June 2012 were also reviewed in conjunction with the investigation.

The investigation determined that, in both incidents, the doors were able to open unintentionally because the design of the door operating mechanism permitted the mechanism to separate when lateral force was applied to the doors. It was reasonable to expect that the bus doors would not have opened in such circumstances.

Contributing to the incident was the flexibility of a polymer insert in the upper door guide bracket which allowed the pivot pin to change its angle when placed under load. It was found that Australian Design Rule 2/01 that specifies strength requirements for side door latches and hinges does not apply to buses. There were no other design rules or requirements specifying strength requirements for doors.

A temporary modification to the door system was implemented almost immediately after the 2014 incident and a program of permanent modification commenced in June.

It is recommended that NSW Roads and Maritime Services alert all bus operators in NSW to this issue.

It is also recommended that the State Transit Authority reinforces the requirement for bus drivers to monitor passenger compliance with designated 'No Standing Areas'.

Full details of the Findings and Recommendations of this bus safety investigation are contained in Parts 3 and 4 respectively.

PART 1 FACTUAL INFORMATION

Introduction

- 1.1 At 1510¹ on Thursday 3 April 2014, a State Transit Authority (STA) school bus service was transporting students home from Ryde Secondary College when two students fell against the rear doors of the bus. This caused the upper door mechanism to come apart allowing the doors to open. The students fell onto the road sustaining minor injuries.

Location

- 1.2 The incident occurred at the corner of Buffalo Rd and Malvina St, Ryde (see *Figure 1*). The bus stop outside Ryde Secondary College is about 200 m from this corner. The Sydney suburb of Ryde is 12 km north-west from the CBD.

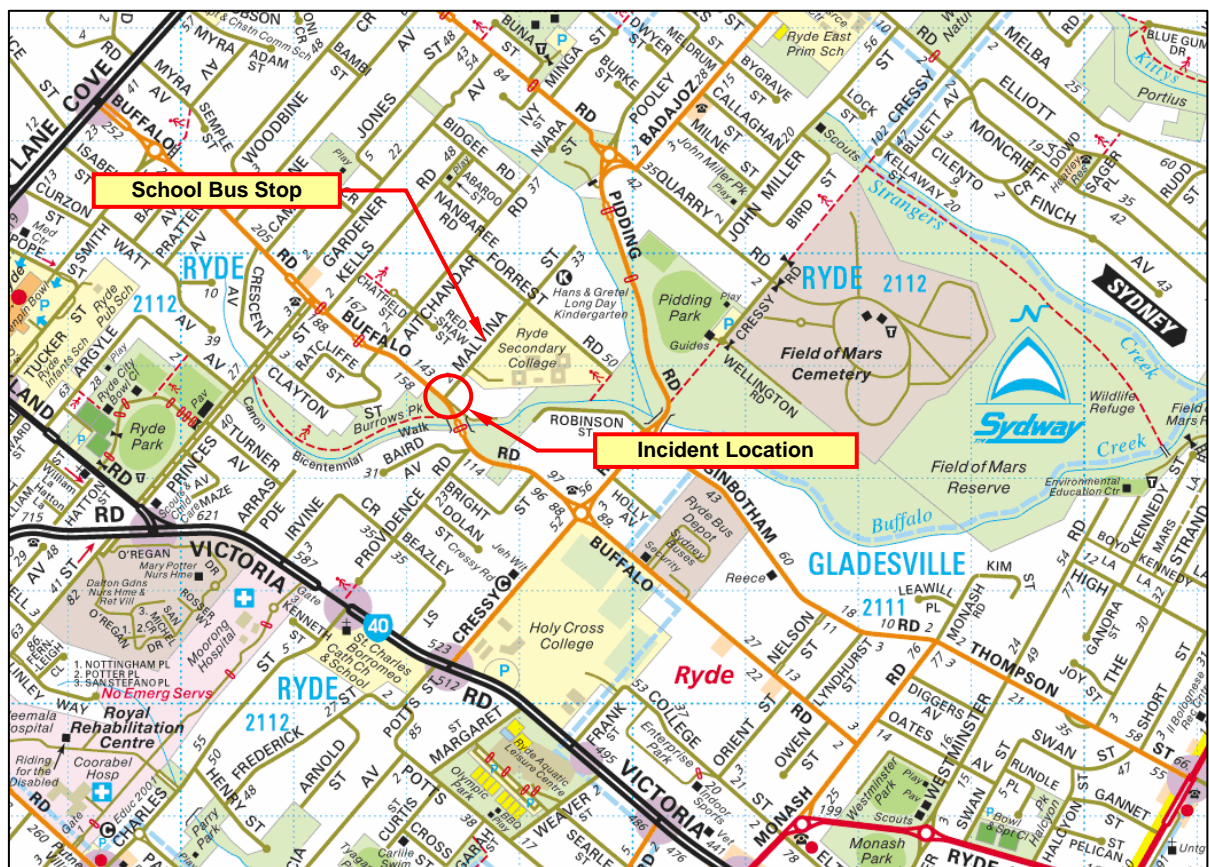


Figure 1: Locality Map

¹ Times in this report are in 24-hour clock form in Australian Eastern Daylight Time.

Environmental information

- 1.3 The afternoon of 3 April 2014 was dry and sunny. A temperature of 28.2°C was recorded by the Bureau of Meteorology at 1500 at Sydney Olympic Park about 8 km to the south-west of Ryde. It was determined that the environmental conditions played no part in the incident.

Bus information

- 1.4 The bus was an articulated Volvo B12BLEA model. It had three door openings; all on the near side of the bus (see *Photograph 1*).²



Photograph 1: Side of 2319 ST

- 1.5 The bus, registration 2319 ST, entered service with STA on 20 June 2011 and operated from the STA Ryde Depot. There are 150 articulated Volvo B12BLEA models in the STA fleet with this door system. There are another 33 STA buses, based in Newcastle, which use the same door system.
- 1.6 The bus was operating a school route from Ryde Secondary College. This was an express service to Eastwood railway station with no stopping scheduled to occur en route.
- 1.7 It was the rear door that opened during the incident. Each door opening incorporates a double leaf outward opening door. The rear door aperture measures approximately 1350 mm wide by 2180 mm high.
- 1.8 All door systems on this model bus were designed and manufactured by a Swiss company, FBT Fahrzeugbau (FBT). Volgren Australia Pty Ltd (Volgren) supplied and fitted them to Australian built buses. The design of this system

² The left side when looking forward in the bus is the near side. The right side is the off side.

relies on the door slide pivot block pin being retained by the upper door bracket (see *Photograph 2*). Due to the movement of the bus frame the pivot block pin needs to move vertically and laterally while it is being retained by the door bracket. The design of the FBT door system meant that there was no mechanical restriction to prevent the pin disengaging from the bracket recess. The pivot block pins were found to have disengaged from the brackets of door leaves 5 and 6.³



Photograph 2: Rear door opening of 2319 ST

- 1.9 The bus service history showed that 2319 ST was regularly serviced and maintained. The most recent general service took place on 25 March 2014. An annual door system service took place on 17 June 2013.

³ The door leaves are numbered 1 to 6 from the front to the rear of the bus.

Development of the occurrence

- 1.10 The bus driver started his afternoon shift at Ryde Bus Depot at approximately 1456. He drove to Ryde Secondary College, arriving at 1500, parked his bus on Malvina St and waited in line for other buses to finish loading students. At 1507 the driver moved his bus forward to the College entrance.
- 1.11 At the school gate a teacher was supervising the students as they queued outside the bus. The students started boarding the bus at 1507 via the front door. The students started boarding the bus at 1507 via the front door. At 1508, after 80 students were loaded, the teacher stepped on board the bus to check the positioning and number of students. She allowed another seven students to board. When the bus started its journey at 1509 there were 87 students on the bus. The bus is authorised to carry 115 persons, 52 seated and 63 standing.
- 1.12 In the vestibule area next to the rear doors there were 12 students. Eight students were standing in this area and two were standing fully on the marked 'No Standing Area' (see *Photographs 3 and 4*). Four students were sharing the three single seats adjacent to the vestibule on the off side of the bus.



Photograph 3: Vestibule area next to rear doors (empty)



Photograph 4: Vestibule area next to rear doors (before incident)

- 1.13 At 1509:15 the bus started moving away from the school along Malvina St. The vestibule area next to the rear doors was crowded. Most students were standing talking to each other. There were two boys in the vestibule area who used the overhead steel grab rail above the single seats to do chin-ups. They completed this exercise just before the bus turned the corner.
- 1.14 The bus travelled approximately 200 m southbound along Malvina St, reaching a top speed of 29 km/h. It reached the T- intersection at Buffalo Rd at 1509:39. The bus driver waited for traffic to clear before making the turn. Another STA bus on Buffalo Rd, on the left of 2319 ST, paused to allow this bus to enter Buffalo Rd. At 1509:47 the bus started the right hand turn into Buffalo Rd (see *Photograph 5*).
- 1.15 There is a steep decline for the last 40 m of Malvina St approaching Buffalo Rd. Also, Buffalo Rd has a camber which accentuated the lean of the bus to the left as it made the right hand turn from Malvina St into Buffalo Rd. This incline and camber may have caused instability for the standing students.
- 1.16 Buffalo Rd and Malvina St are fully asphalted from kerb to kerb; there were no potholes or damage to the road surface that affected the passage of the bus.



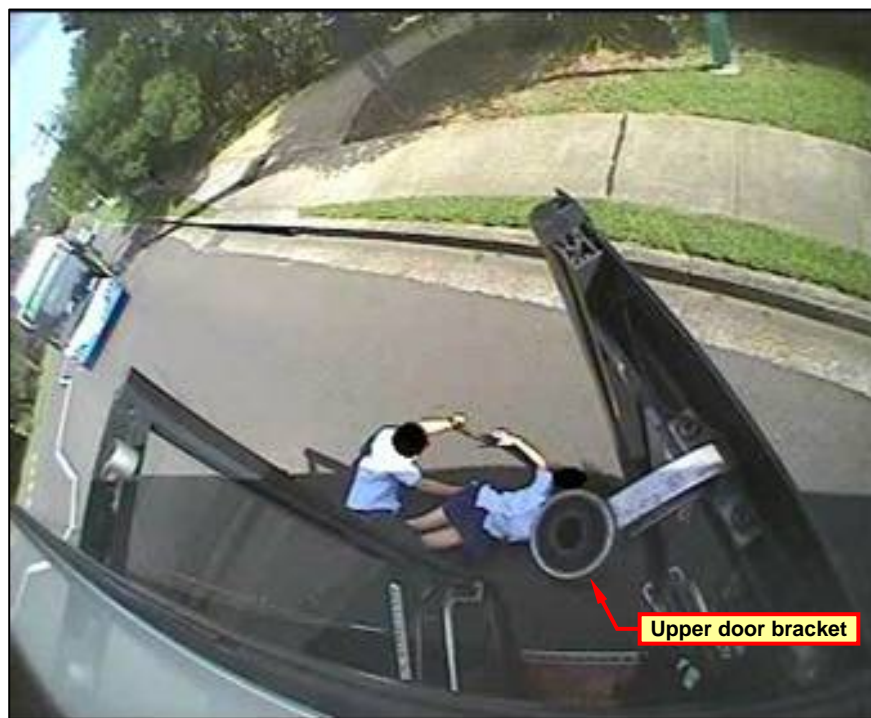
Photograph 5: Malvina St and Buffalo Rd intersection

The incident

- 1.17 As the bus was making the turn, a schoolgirl, standing in the vestibule area, stumbled and fell against a schoolboy (see *Photograph 6*). This was the initiating event. The schoolgirl was not holding on and had just finished talking with the schoolboys doing chin-ups. The schoolboy she fell against was standing unsupported facing away from the doors and talking on his mobile phone.
- 1.18 At 1509:52 both students fell against the rear doors. The initial impact from the schoolboy was mainly against number six door leaf and from the schoolgirl against number five door leaf. The combined force of the students falling against the doors caused the door slide pivot block pins to disengage from the door brackets. This meant that both doors were unrestrained and free to open. Both doors opened outwards and the two students fell out of the bus onto Buffalo Rd (see *Photograph 7*).



Photograph 6: Schoolgirl stumbles against schoolboy



Photograph 7: Students fall out of bus (2319 ST)

- 1.19 After the students fell out of the bus, the rear doors continued to swing open and closed without restraint. The students who remained in the vestibule area attempted to hold the doors closed as the bus continued its journey. The bus at this time was travelling at approximately 31 km/h. The remaining students

were also in danger of falling out. In particular one schoolboy held the door closed with one hand while not holding on to anything else.

- 1.20 The students fell as the bus was travelling at approximately 20 km/h. The schoolgirl, aged 13, hit her head in the fall and the school boy, aged 14, grazed his left knee and elbow.
- 1.21 It was fortunate that the other STA bus, which had stopped to allow this bus to enter onto Buffalo Rd, was blocking the flow of traffic behind this bus. This meant that there was a gap between buses when the students fell onto the road. They were able to move themselves off the road before any traffic approached.
- 1.22 The bus driver of 2319 ST was unaware of the incident and continued driving. Because it was an articulated bus turning right, the rear doors were hidden from the driver's view and the driver did not see the students as they fell from the bus. At 1510:34 a schoolgirl made her way to the front of the bus and informed the driver of what happened. The bus driver stopped the bus about 500 m away from the incident site near the corner of Gardener Ave and Buffalo Rd.
- 1.23 The driver of the trailing bus witnessed the students falling from the bus ahead and stopped and rendered assistance to the students. He reported the incident to the STA network control centre who then called 000 and requested NSW Ambulance attend.
- 1.24 Police from Eastwood police station and an ambulance attended the scene. After the two children had been administered first aid the girl was transported by ambulance to Royal North Shore hospital for treatment for neck pain. She was discharged from hospital later that afternoon.
- 1.25 The Office of Transport Safety Investigations (OTSI) received notification of the incident at 1540. The bus was driven to an STA bus depot at Leichhardt where an inspection was undertaken by two OTSI investigators the following morning.
- 1.26 Following this inspection the Chief Investigator determined that OTSI would conduct an investigation into the incident. As part of the process OTSI

examined electronically recorded CCTV footage from the bus, maintenance records, internal reports, bus timetables and door adjustment manuals.

PART 2 ANALYSIS

Introduction

- 2.1 The investigation focussed principally on the factors that contributed to the unintentional opening of the doors. This included the design of the door mechanism, the safety mechanisms in place to prevent unintentional door openings, compliance with existing design standards, and the service and repair histories. The positioning of students on the bus and their actions were also reviewed.
- 2.2 A previous incident that occurred on 14 June 2012 was also reviewed during the course of this investigation. This occurrence took place on the same model STA bus which was coincidentally also transporting students home from Ryde Secondary College. During this incident five students fell against the rear doors of the bus, which again opened and they fell onto the road sustaining minor injuries. The cause of this incident was the same as the incident on 3 April 2014.
- 2.3 After the 2012 incident the bus body supplier, Volgren, instigated a program to adjust all doors to ensure proper alignment with door pivots. STA also recommended that Volgren redesign the door bracket to eliminate any risk of future incidents. The fitment of a modified bracket had not been finalised at the time of this 2014 incident.

Bus door incident 3 April 2014

- 2.4 The inspection of the bus by OTSI investigators on 4 April 2014 found the rear doors (door leaves 5 and 6) unrestrained and able to be moved freely. It was observed that the pivot block pins had disengaged from the door brackets (see *Figure 2 and Photograph 8*). There were no breakages of any parts and the electrical and hydraulic systems were fully operational. All warning and door alarm systems were functional.

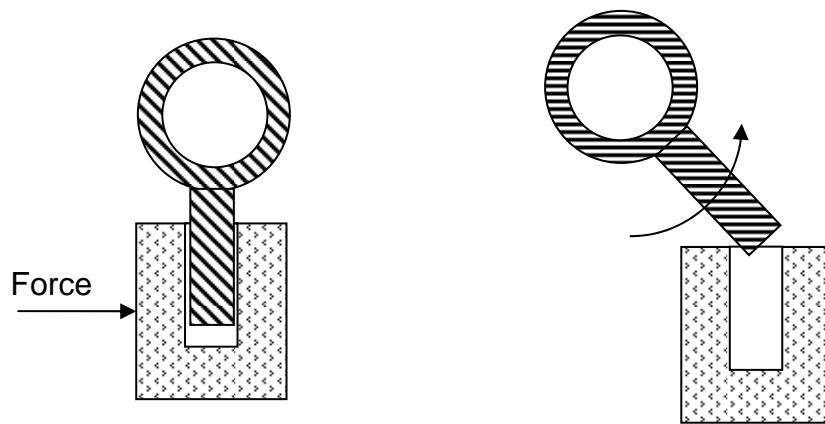
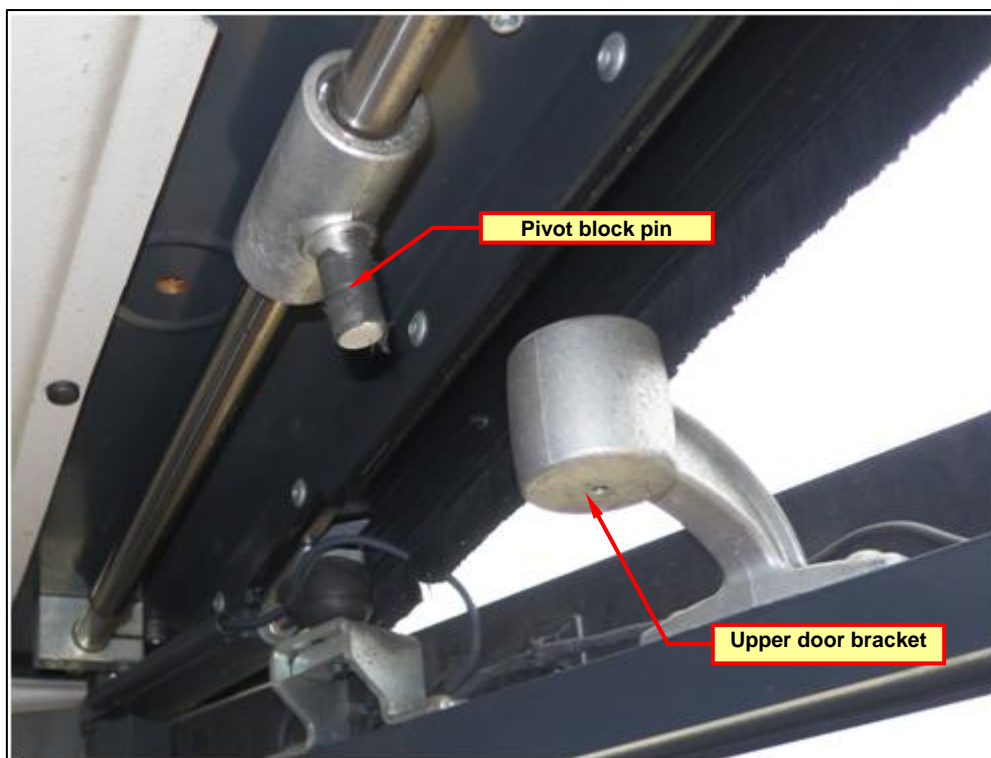
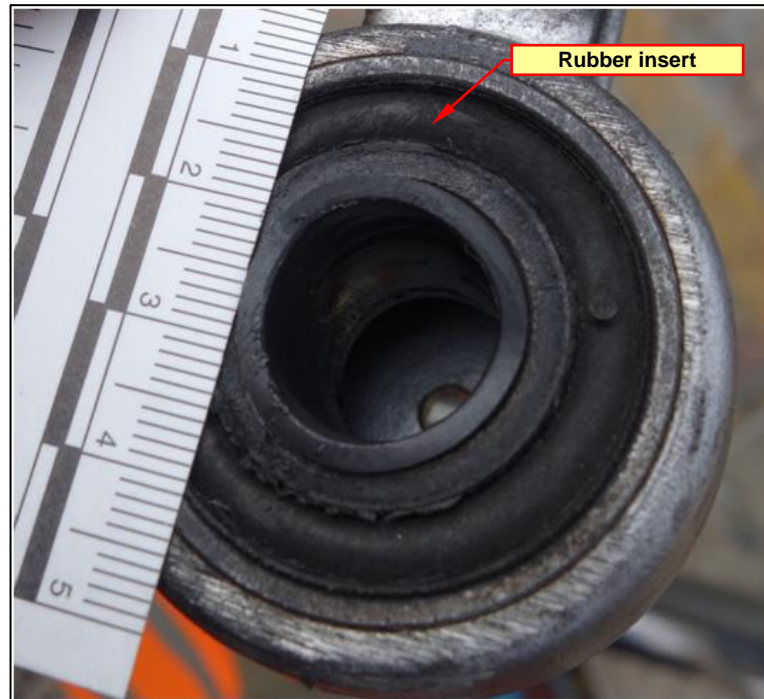


Figure 2: Pivot block pin disengaging from upper door bracket



Photograph 8: Pivot block pin disengaged from upper door bracket

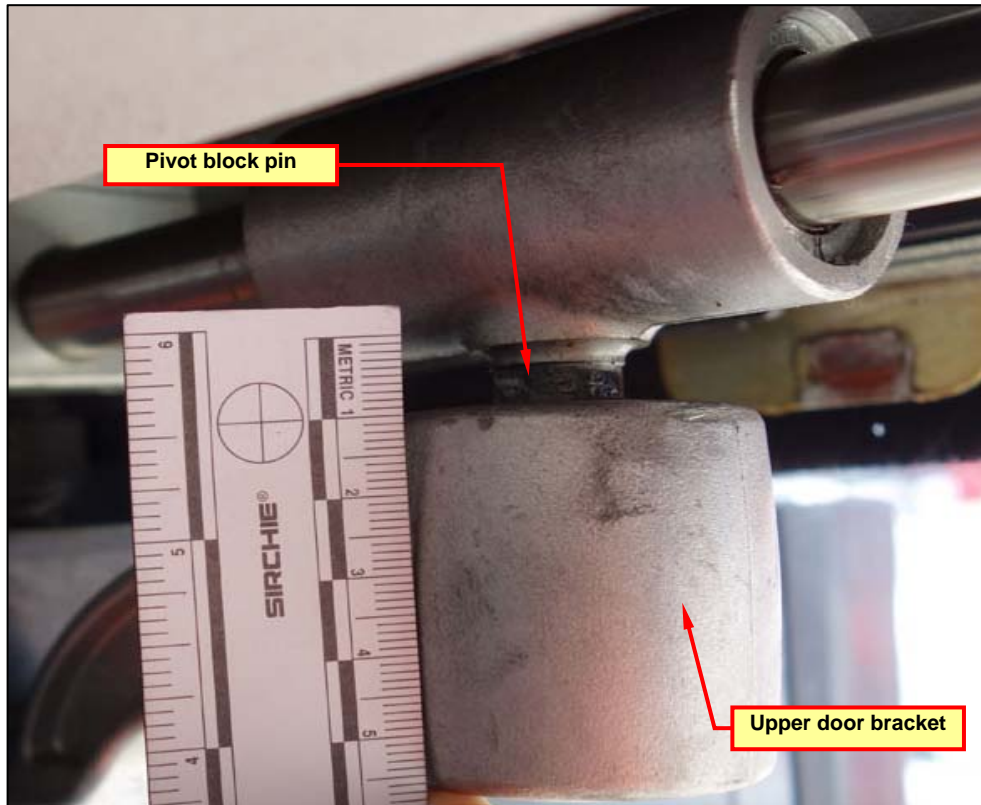
- 2.5 There were signs of deformation of the internal bushes of the door bracket (see *Photograph 9*). This was consistent with horizontal force having been applied to the doors. The force was sufficient to cause the pin to rotate out of the bush.



Photograph 9: Upper door bracket bush (door leaf 6)

- 2.6 Following the inspection by OTSI investigators, the doors were re-assembled by STA personnel so that the doors were once again functioning. The reassembly of the upper door bracket with the pivot block pin revealed a number of problems with the door assembly. A STA inspection found that the number 6 door was visibly out of alignment with door 5. This was caused by the lower door post arm moving on its locating taper. This allowed the door to move out of alignment from its normal closed position.
- 2.7 It was also found that on door leaves 5 and 6 there was a difference in the length of pin engagement into the upper door bracket bush. According to the manual⁴ the pin clearance for the upper door guide bracket should not exceed 6 mm when the door is in the closed position (see *Photograph 10*). However, the inspection of the reassembled door following the incident found the pin clearance on both door brackets was within specification.

⁴ Volgren Australia - Installation and adjustment manual for STA 2009/2010 Door System v1.7 17 May 2013.



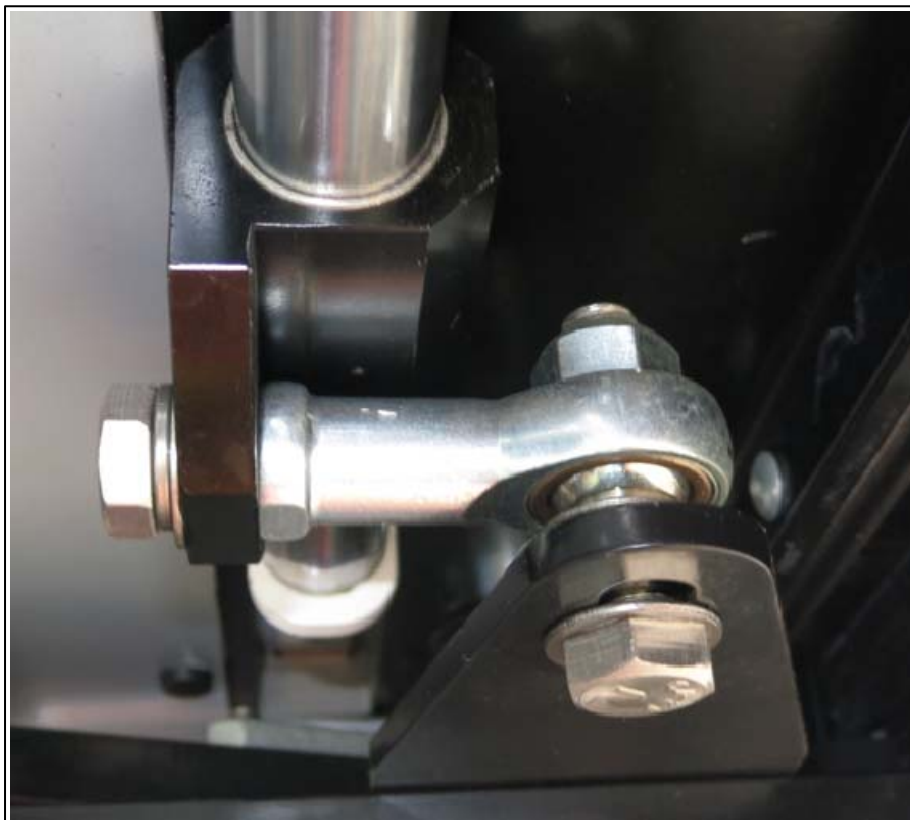
Photograph 10: Readjusted pivot block pin inserted into upper door bracket

- 2.8 A separate OTSI inspection was conducted on 7 April 2014. On this occasion the doors on the bus were in the assembled position. A test was conducted to determine the amount of force required to open the doors. An adult male applied lateral impact force to the centre of door leaves 5 and 6 with his shoulder. While the force was not quantified, the door required repeated impacts before the pivot block pins disengaged from the door bracket. The disengagement of the pin from the bracket can be seen in the sequence of photographs (see *Photographs 11 a, b and c*). It should be noted that this test was conducted while the bus was stationary.



Photographs 11 a, b and c: Pivot block pin disengaging from upper door bracket

- 2.9 The FBT door system installed on these Volvo B12BLEA model buses differed in its operation from door systems in place on other STA buses. There are a number of types of mechanisms installed across the STA fleet. An example of another door opening mechanism is shown below (see *Photograph 12*). This mechanism consists of a secure connection between the upper door bracket and the door slide pivot block. There are no reported incidents with this or other types of door mechanisms being unintentionally forced open by passengers.



Photograph 12: Alternative door opening mechanism

Bus door safety mechanisms

2.10 Passenger buses have several safety mechanisms in place to prevent doors opening during travel and also to prevent the doors closing as passengers get on and off. The opening of the doors is controlled by the driver from a dashboard control at the front of the bus. On this dashboard is a warning light which is accompanied by an audible alarm (see *Photograph 13*). This was fully functioning on 2319 ST.



Photograph 13: Bus door controls

2.11 At no stage did the alarm indicate that the rear doors had opened. This is because the alarm only activates under two conditions. Firstly, if the door sensor detects pressure on the edge of the door panel, such as an arm caught between the doors as they close. Secondly, if the doors do not close or are opened when the vehicle's road speed is under 5 km/h. Under both of these conditions the brakes of the bus will be applied and the throttle will shut

down. Both of these conditions were not met as the bus was travelling over 5 km/h and the pressure sensor on the edge was not involved.

- 2.12 A hydraulic mechanism is responsible for opening and closing the doors. This mechanism is located above the doors inside a locked recess and only operates when the bus is stationary. This was examined following the incident and was found to be functioning normally. Because the hydraulic ram did not move during the incident, the sensor did not detect that the doors were in the open position. There is no sensor attached to the door leaves themselves, nor is one required.

Compliance with standards

- 2.13 The door safety system complied with all current standards. The current standard that applies to bus doors in NSW is Technical Specification 146.⁵ This sets the criteria for the design of a bus door safety system.
- 2.14 This safety system has the primary intention of preventing passengers from being caught and trapped by a closing door system and then potentially being dragged by a moving bus. The system also seeks to ensure the bus does not move when the doors are in the open position. Neither this specification nor the Australian Design Rules concern themselves with the lateral force required to force open a closed door on buses.
- 2.15 It is reasonable to expect that bus doors would not open when subjected to the forces such as those occurring in this incident.
- 2.16 Technical Specification 146 includes a number of requirements. It specifies that the door safety system shall detect a 20 mm diameter rod (simulating the thickness of a child's wrist). Once such an intrusion is detected the vehicle should be immobilised and an audible and/or visual alarm shall be given to alert the driver that an interlock function has operated. It also specifies that the door closing force not exceed 150 N. This relates to the crushing force between door leaves to prevent passenger injury.

⁵ Bus door safety systems issued by NSW Roads and Traffic Authority 16 July 1997 (see Appendix 2).

Bus door incident 14 June 2012

- 2.17 A similar incident occurred at 1510 on 14 June 2012 at the corner of Princes St and Blaxland Rd about 1.2 km from Ryde Secondary College (see *Photograph 14*).



Photograph 14: Intersection of Princes St and Blaxland Rd

(A turning bus at approximate location of incident, not the bus involved in the incident.)

- 2.18 On this occasion five students fell from the rear doors of the bus. The bus involved, 2318ST, entered service with STA on 29 June 2011. It was the same model bus as the one from which the two students fell on 3 April 2014.
- 2.19 The bus departed Ryde Secondary College at 1507 with approximately 85 students. Three students were standing in the 'No Standing Area' at the front of the bus near the driver. The rear vestibule area was crowded, with approximately 12 students in this area. Three students were seated and three other students were standing in the red-coloured 'No Standing Area' (see *Photograph 15*).



Photograph 15: Students in rear door vestibule just prior to incident

- 2.20 As the bus travelled along Princes St, towards the corner with Blaxland Rd, the movement of the bus caused some students to bump into each other in the crowded rear vestibule. Then, at 1510, as the bus started its right hand turn into Blaxland Rd there was a disturbance in the vestibule area. Three schoolboys were behaving in an unruly manner which caused them to lose their balance. Together the three schoolboys fell backwards towards the rear doors. This action forced two other schoolgirls against the doors.
- 2.21 The combined force of five students falling against the doors caused the upper door bracket to separate from the pivot pin of door leaf six. The first two schoolgirls fell out of the bus facing forwards, the next two schoolboys fell out of the bus facing backwards, and the last schoolboy fell forward onto the road (see *Photograph 16*). The students sustained minor injuries.



Photograph 16: Students fall out of bus (2318 ST)

- 2.22 In this incident only one door opened fully, door leaf six. This is because the first student struck the centre section of this door first. The adjacent door, door leaf five, partially opened but the pin remained in the bracket and it returned to its closed position.
- 2.23 The bus driver was unaware of the students falling from the bus and it took about 45 seconds for him to be aware of the incident at 1510:45. He pulled up at a bus stop about 15 seconds later at the corner of Blaxland Rd and Church St. He notified the network control centre of the incident and, after all passengers were disembarked, was instructed to return to Ryde depot.

Positioning of students

- 2.24 The number of students on board both buses was below the authorised maximum. The CCTV footage shows that the standing space in the aisles was occupied. There were no students in the front red-coloured 'No Standing Area' near the driver. However, in both incidents, there were students in the rear 'No Standing Area'.

- 2.25 With the aid of the overhead cameras it is possible for the driver to see if these areas are clear, but it is difficult for bus drivers to monitor the position of passengers once the bus is underway and their focus is on driving. The ideal time for checking if anyone is in the 'No Standing Area' is while the bus is stationary. No request was made by the driver for the students to comply with requirements in either incident.
- 2.26 The STA issued a Safety Alert in June 2012 reminding bus drivers to monitor passenger compliance with the designated 'No Standing Areas' (see *Appendix 3*). It is an important safety requirement that these areas are kept clear.
- 2.27 While not mandatory, due to the nature of bus travel, it is prudent for standing passengers to assist stability by holding onto a handrail or overhead strap. The students that fell from the bus were standing but not using any hand hold.

Safety actions taken

- 2.28 Following the 14 June 2012 incident investigating officers from both OTSI and NSW Police Forensic Services Group inspected the bus and CCTV of the incident. On the initial examination of the circumstances, the unruly behaviour of the students was determined to have substantially contributed to the unintentional opening of the doors. The mechanical separation of the pin from the upper door bracket was identified as the mechanism of the doors opening, but was thought to be a result of an overwhelming lateral force which was unlikely to be replicated. Consequently, it was decided that STA should conduct its own investigation and implement a solution. OTSI requested to review the STA report on its completion.
- 2.29 The internal investigation was completed by STA and forwarded to OTSI on 3 July 2012.⁶ The technical investigation report contained a number of key findings as to the cause of the incident. It found:

'A combination of distortion of the door leaf frame, deflection in the upper door bracket bushing, and in the case of number five door leaf, movement of

⁶ Technical Investigation Report / 2318ST Rear Passenger Door Incident STA 21 June 2012.

the lower number five door pivot taper with the subjected lateral force applied allowed the door slide pivot blocks to separate from the upper door brackets.'

2.30 One recommendation in the report was:

'...installation and service documentation to be revised to clarify the correct door slide pivot block pin / upper door bracket mating depth.'

A modified service program for all 150 Volgren B12BLEA bus door sets commenced in July 2012. The technical documentation supplied by Volgren was altered to incorporate recommendations by STA in relation to door adjustments and settings.

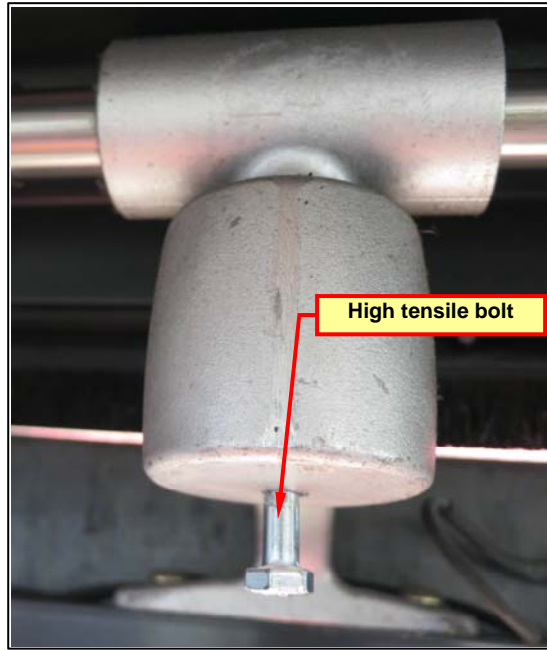
2.31 The key recommendation from the report was:

'Consideration for improvements in design by the OEM (Original Equipment Manufacturer) of the upper door bracket and door slide pivot block assembly to reduce the risk of similar incidences reoccurring.'

2.32 OTSI reviewed the report and determined that the proposed safety actions, if implemented, would prevent a recurrence of this incident. Action that STA could undertake independently such as issuing a Safety Alert and conducting a door adjustment program were completed.

2.33 Volgren, after being alerted to the 2012 incident, requested that FBT commence a redesign of the door system. In December 2013 Volgren proposed an upgrade to these FBT door systems fitted on STA buses. The new system included a retaining bolt that would not allow the upper door bracket to separate from the pivot block pin. It also included other modifications to prevent door pole movement. Volgren was delayed in installing this improved bracket due to reliance on the European OEM, FBT, having to manufacture and supply the brackets to Australia. No door systems had been modified by the time of the second incident on 3 April 2014.

2.34 Following the incident on 3 April 2014 Volgren and FBT proposed an interim fix to prevent the door bracket separation. Installation of this solution began almost immediately and was completed within a week. This involved screwing a high tensile bolt through the bottom of the upper door bracket and into the pivot block pin (see *Photograph 17*).



Photograph 17: Interim modification to upper door bracket

- 2.35 A review by NSW Roads and Maritime Services (RMS) found one other operator in NSW using the FBT door system. Both companies were visited by RMS Bus Safety Officers who confirmed that all affected buses had undergone the interim modification.
- 2.36 Outside of NSW, there are only two companies each with two buses using the FBT system, one in Queensland and one in Victoria. Volgren is working with these companies to institute the upgraded solution. According to Volgren there have been no instances of similar failures reported to FBT from any other users of the original door system.
- 2.37 The permanent modification to the FBT door system on STA buses was commenced in June 2014 and had a completion time frame of six months (see *Figure 3*).

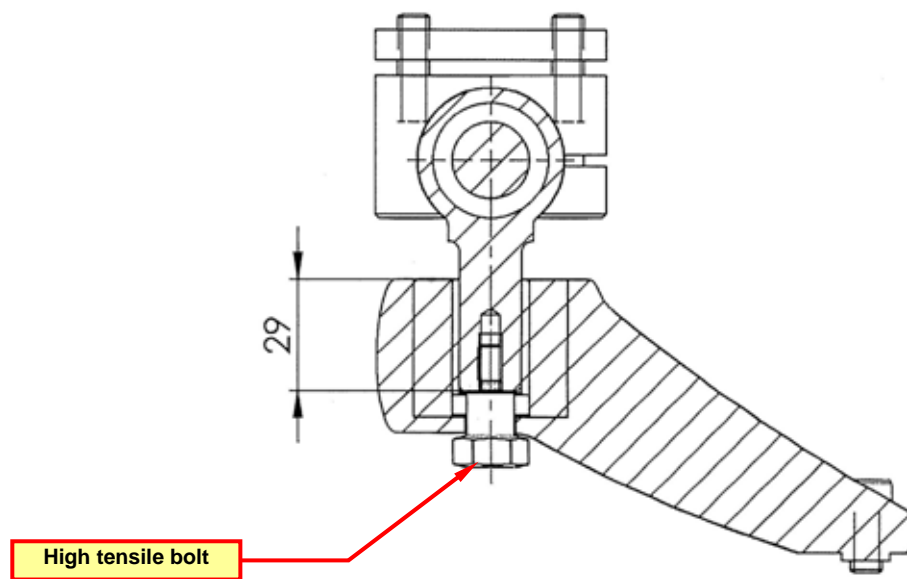


Figure 3: Modification to FBT door system

PART 3 FINDINGS

Causation

- 3.1 The rear doors opened unintentionally when the lateral force caused by two students falling against them caused parts of the upper door guide mechanism to separate.

Contributory Factors

- 3.2 The flexible bush in the upper door bracket allowed movement of the pivot pin relative to the bracket when placed under load.
- 3.3 Students standing, and being allowed to remain standing, in clearly defined 'No Standing Areas' increased their risk of falling against the door.
- 3.4 The students that fell from the bus were not holding on to any means of support when standing in the rear vestibule area.

Other Safety Factors

- 3.5 There is no design specification or rule specifying lateral burst force requirements for bus doors.

PART 4 RECOMMENDATIONS

Noting that remedial safety action has been implemented, it is recommended that the following additional safety actions be undertaken by the specified responsible entities.

State Transit Authority

- 4.1 Reinforces the requirement for bus drivers to monitor passenger compliance with designated 'No Standing Areas'.

Roads and Maritime Services

- 4.2 Alerts all bus operators in NSW to the issues identified in this report involving the unintentional opening of bus doors.

PART 5 APPENDICES

Appendix 1: Sources, Submissions and Acknowledgements

Sources of Information

- State Transit Authority
- Transport for NSW
- Volgren Australia Pty Ltd;

References

- Australian Design Rules
- RTA Technical Specifications

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Roads and Maritime Services
- Ryde Secondary College
- State Transit Authority
- Transport for NSW
- Volgren Australia Pty Ltd

Submissions were received from all the DIPs. The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.

Appendix 2: Technical Specification 146



Roads and Traffic Authority of New South Wales

TECHNICAL SPECIFICATION 146

Bus Door Safety Systems

1 Scope

- 1.1 This Specification sets the criteria for the design of a bus door safety system which is intended to prevent passengers from being trapped by a door system in a moving bus.
- 1.2 A door safety system meeting the criteria in this Specification will prevent the bus from moving or stop it, if already moving, which in turn will minimise any chance of injury to a passenger. The door safety system will also limit the door closing force in some positions of the door.
- 1.3 This Specification applies only to buses fitted with a driver controlled door.

2 General Requirements

- 2.1 Each passenger access door shall be fitted with a door safety system as described in this Specification.
- 2.2 The door safety system shall operate:
 - (i) without any driver intervention,
 - (ii) whenever the engine ignition key is in the "on" position,
 - (iii) in the case of a stored energy system, whenever there is sufficient energy to operate the door (see Clause 2.8).
- 2.3 The door system may or may not automatically reopen when the door safety system is activated.
- 2.4 The door safety system shall be capable of detecting a 20 mm diameter rod. Note: the rod is intended to simulate the thickness of the wrist of a child.
- 2.5 The door safety system shall detect the rod at all vertical positions of the rod when placed on the door step up to 1500 mm from the door step.

ISSUED: 16 July 1997

- 2.6 When the rod is detected, the door safety system shall prevent movement of the bus or stop it, if already moving, by:
 - (i) mechanically or electronically securing the engine in idle mode and,
 - (ii) applying the brakes on at least one axle or by locking the driveline.
- 2.7 The control of the braking or driveline system shall be designed so that it will not cause the brakes or driveline mechanism to apply while the bus is in motion if there is no controlled operation of the door system. Note: This can be achieved by disarming the brake or driveline control once a preset speed (nominally 10 km/h) has been reached.
- 2.8 The operation of the door safety system shall not affect the compliance of the bus with any Australian Design Rule in particular, any braking rule. If the braking system uses stored energy, the brake system shall be preferentially supplied.
- 2.9 When the door is being closed, the steady force applied to an object which is located at any position up to 1500 mm above the door step shall not exceed 150N when measured from 20 mm to 300 mm from the fully closed position (see Appendix A).
- 2.10 An audible warning and/or visual warning shall be given to alert the driver that the door safety system has activated. If a visual warning device only is installed, it shall be located in the area of the driver's normal driving controls and be marked with or display the word "DOOR FAULT". An audible warning device which reproduces a recorded message shall say in English "DOOR FAULT".
- 2.11 When activated, the door safety system shall only be capable of being deactivated by a reapplication of the door control.
- 2.12 Any emergency door release control or other device fitted to a door system shall not be rendered ineffective by the installation of a door safety system.
- 2.13 The correct operation of the door safety system shall be capable of being readily checked without the use of special tools or dismantling any component. In the case of components which have "normally open" circuits, there shall be a method of automatically checking the integrity of the circuit.
- 2.14 The door safety system shall be capable of operating reliably under the full range of environments likely to be encountered during bus operation. This includes extremes of temperature and cleaning with pressurised water. Note: rubber or plastic components might perform differently over a range of temperatures such as, the flexibility of a door seal.
- 2.15 All components shall be located or designed to minimise the risk of passengers tampering with their operation.

3 Checking the door safety system performance.

- 3.1 Place a 20 mm diameter rod between adjacent door panels in a two piece door system or, in the case of a door closing to one side, between the edge of a door panel and the door frame.
- 3.2 The rod shall be perpendicular to the vertical edge of the door and the end of the rod shall protrude no more than 30 mm beyond the inside surface of the door (see Appendix B).
- 3.3 Close the door using the normal door closing control.
- 3.4 Hold the rod loosely so that when the door makes contact the rod will self-align with the door closing geometry.
- 3.5 Once the rod is detected:
 - (i) the door may or may not automatically reopen,
 - (ii) the engine shall remain at or go to idle speed and be incapable of increasing engine revolutions,
 - (iii) the vehicle shall be immobilised by locking the brakes on at least one axle or by locking the driveline,
 - (iv) an audible and/or visual warning shall be given to alert the driver that the interlock function has operated.
- 3.6 Open the door using the normal door control or in the case of an automatic opening door safety system, operate the door control to release the brakes or driveline lock and throttle control.
- 3.7 Operate the engine throttle and attempt to move the bus to ensure the brakes or driveline lock and throttle control have released.
- 3.8 Close and open the door again to ensure normal vehicle operation.
- 3.9 Check the rod sensing operation at all vertical positions from the rod sitting on the door step up to 1500 mm from the door step.
- 3.10 Using a suitable gauge, check the door closing force between 20 mm and 300 mm to ensure that it does not exceed 150 N at all vertical positions up to 1500 mm from the door step.

Note: In order to assess the correct performance of the door safety system it might be necessary to disarm or override some of the automatic functions.

4 Certification

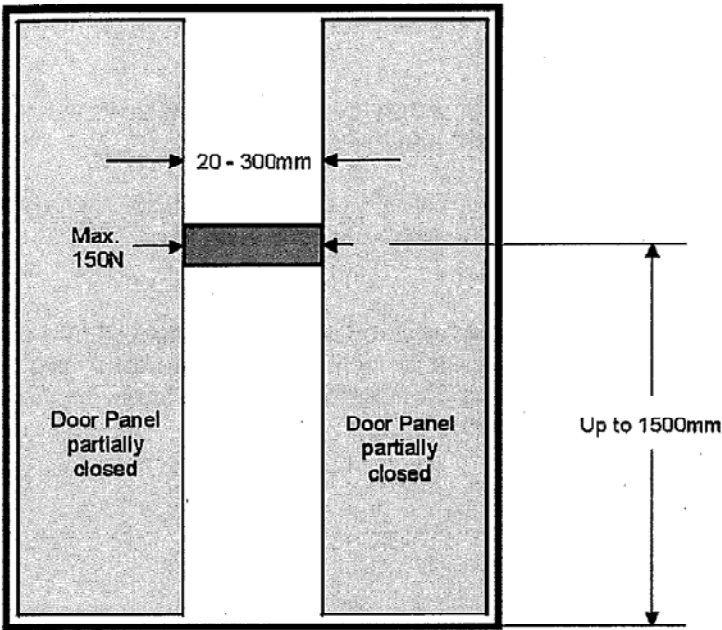
- 4.1 A plate or label made of durable material shall be fitted adjacent to the vehicle manufacturer's Compliance Plate. The plate or label shall display the following information:

The name of the door safety system manufacturer; the person who installed the door safety system and the statement,

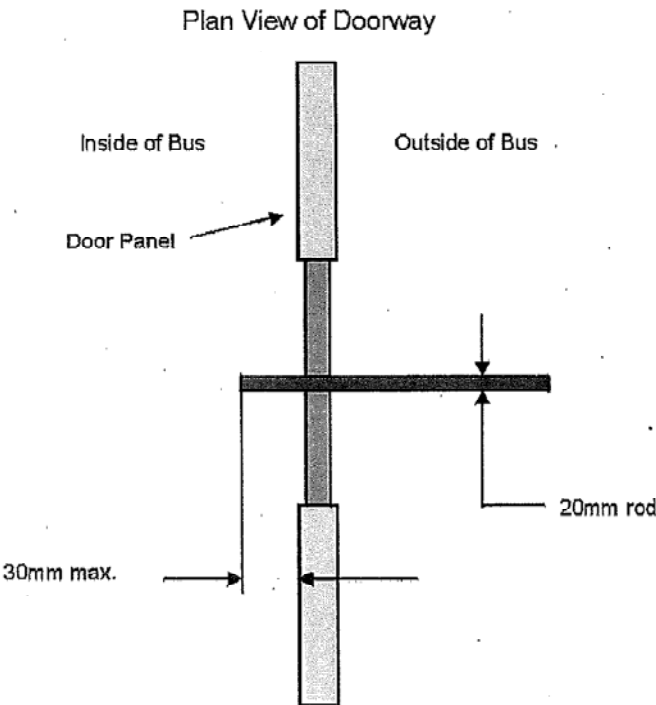
The door safety system fitted to this bus has been manufactured and installed to comply with RTA Technical Specification No. 146 "Bus Door Safety Systems"

- 4.2 Where the door safety system uses the braking system to immobilise the bus, a certification is required by an RTA approved recognised engineering signatory (see Vehicle Standards Information sheet 15, "Recognised Engineering Signatories").

Appendix A Closing force test





Appendix B Detection test




Appendix 3: Safety Alert – Monitoring marked ‘No Standing Areas’

WI 50.08.52 – Monitoring “No Standing Areas”

<h1 style="margin: 0;">SAFETY ALERT</h1>	
Title:	Monitoring marked “No Standing Areas”
Attention of:	Bus Operators
Date Issued:	June 2012
Safety Alert No:	WI 50.08.52
ISSUE	
<p>Bus Operators are reminded that it is critical that they monitor passenger compliance with the designated “No Standing Areas”.</p> <p>Bus Operators should continue to monitor passenger compliance in “No Standing Areas” whilst the bus is in operation with the aid of mirrors and or CCTV systems.</p>	
<div style="display: flex; justify-content: space-around;">   </div>	
INSTRUCTION	
<p>In the event that passengers do stand in a marked no standing area the Bus Operators should:</p> <ul style="list-style-type: none"> ✓ Stop and secure the bus ✓ Advise passengers that the vehicle can not operate whilst passengers stand in no standing areas ✓ Make a reasonable request of passengers to comply with the requirements ✓ Contact Network Control Centre in the event of any resistance ✓ If a passenger refuses to comply activate your CCTV system event button and await further advice from NCC ✓ Complete a TSIR on return to the depot for follow up by State Transit. 	

ISSUED BY STATE TRANSIT - SAFETY DIVISION

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