

## Promoting Transport for Victoria: Creating accessible bus journeys for mobility aid users.

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### Overview and objective:

The Disability Standards for Accessible Public Transport (DSAPT) and new Technical Standard 3695.3:2018 (Blue Label scheme) require buses and powered mobility aids to comply to ensure that mobility aid users can access public buses. However, little is known about the compatibility of the standards. That is, if a mobility aid that meets the Blue Label standard will fit a bus that meets DSAPT standards. The objective of this study was to investigate bus accessibility for powered mobility aids (wheelchairs and scooters) with considerations to DSAPT and the Blue Label scheme, using 3D measures and computer simulations.

### Methods:

Three main tasks were undertaken in this study:

- 1) **Determine how many of 35 different powered mobility aids comply with the Blue Label scheme.** Four Test Rigs were built according to the Blue Label scheme specifications and the powered mobility aids were driven through them. Three Test Rigs (Swept Path, Narrow Access and Allocated Space) represent a typical low-floor bus from the entrance to the allocated space for travel, as shown in Figure 1.



Figure 1: Plan view of a typical bus layout from entrance to allocated space

The majority of the mobility aids were tested by a research team member and we also had powered mobility aid users test a wide range of powered mobility aids (as shown in Figure 2).



Figure 2: Left to right – Swept Path Test, Narrow Access Path Test, Allocated Space Test, Pavement Gap Test

- 2) **Determine how many of 21 different low-floor route buses are DSAPT compliant.** This was achieved by taking 3D measures of the 21 different low-floor route buses using 3D scanning. We then undertook 3D scans of the 35 powered mobility aids and the Test Rigs (as shown in Figure 3).

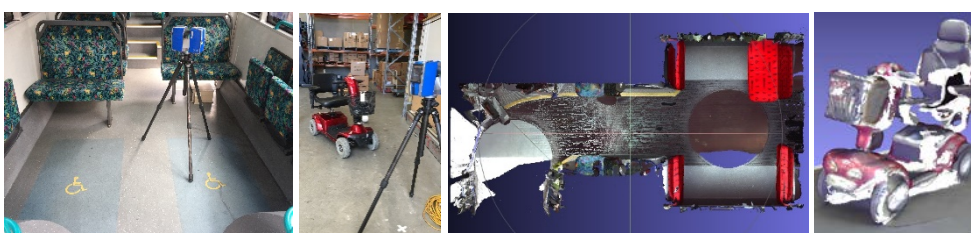


Figure 3: Left to right – 3D scanning a bus, 3D scanning a powered mobility aid, Plan view of a scanned bus 3D model, Scanned scooter 3D model

3) Determine how many of the 35 powered mobility aids are compatible (fit) the 21 buses and if they are not compatible, in which sections of the bus did they get stuck (called the stuck point). This was achieved by running simulations using 3D scanned models of the buses and powered mobility aids (as shown in Figure 4).

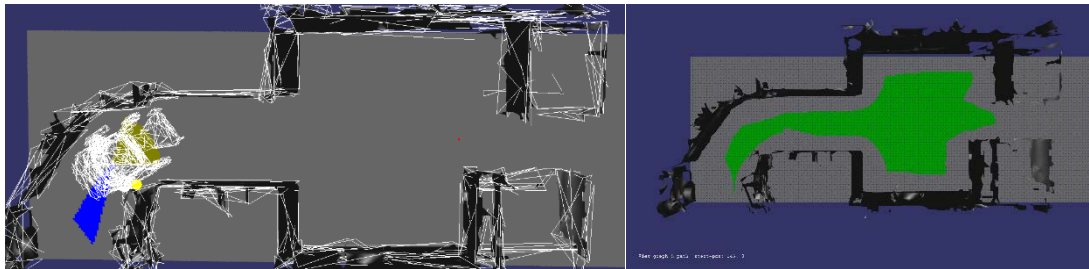


Figure 4: Left – Example of a 3D simulation with stuck point indicated by yellow dot, Right – Example of a successful Find Path simulation where a mobility aid could navigate through a bus.

**Findings:**

When trialed in the Test Rigs, it was found that 10 out of the 35 powered mobility aids we sampled would not achieve Blue Label standards. All 10 failed the Allocated Space Test and 3 of them also failed the Swept Path Test.

Table 1: List of powered mobility aids that failed the tests (+ briefly touched Swept Path wall but went through)

Make/Model	Length (mm)	Width (mm)	Measured Turn radius (mm)	Allocated Space	Swept Path	Narrow Access	Pavement Gap Tests	180° turn test
Monarch Hybrid 4	1170	565	753	Fail: Cannot get into space	Pass	Pass	Pass	Pass
Monarch GC440	1187	600	755	Fail: Cannot get into space	Pass <sup>+</sup>	Pass	Pass	Fail
Monarch Zener	1190	600	1070	Fail: Cannot get into space	Pass <sup>+</sup>	Pass	Pass	Fail
Shoprider GK4	1030	510	850	Fail: took longer than 5 minutes	Pass	Pass	Pass	Fail
Shoprider 889SL	1300	640	955	Fail: Cannot get into space	Pass <sup>+</sup>	Pass	Pass	Fail
Afikim Breeze C3	1300	670	765	Fail: Cannot get into space	Pass <sup>+</sup>	Pass	Pass	Fail
Trek Evolution	1270	620	1170	Fail: Cannot get into space	Fail	Pass	Pass	Fail
Invacare Metro	1270	660	845	Fail: Cannot get into space	Fail	Pass	Pass	Fail
Shoprider 888SE	1280	600	1125	Fail: Cannot get into space	Fail	Pass	Pass	Fail
Heartway Puzzle 15	1040	610	35	Fail: took longer than 5 minutes	Pass	Pass	Pass	Pass

In general, the powered mobility aids that passed and had good manoeuvrability had the following specifications: an overall length of 1110mm or less, a diagonal length less than 1280mm and a turning radius less than 760mm. However, certain rear-drive powered wheelchairs that meet the above specifications may still fail due to poor swivel wheel design or lengthy response times between joystick activation and motor response which affects their manoeuvrability.

When reviewing the 3D measures of the buses, we found that while some aspects of the buses were compliant with DSAPT, other aspects were not. Eleven buses did not achieve the minimum width requirement of 800mm

(850mm for newer buses), none of the 21 buses met the Allocated Space requirement of 1300x800mm and 19 of the buses did not have a manoeuvring area of 2070x1540mm.

However, despite non-compliance with these aspects of the DSAPT, the 3D simulations undertaken demonstrated that many powered mobility aids could still successfully access most of the buses. Specifically, 13 of the buses could accommodate at least 22 of the 35 powered mobility aids. We also found that two of the powered mobility aids that failed Blue Label testing could successfully access 12 and 13 buses respectively. However, 4 of the 25 powered mobility aids that do achieve a Blue Label cannot access 11 or more buses. 67% of the stuck points were in the Swept Path area of the buses. Table 2 provides a summary of the powered wheelchairs (blue) and scooters (green) that fit at least 20 of the buses we tested. Table 3 provides details on all 35 mobility aids we tested, whether they would achieve a Blue Label and the number of buses each could board from our sample.

Table 2: Powered mobility aids that fit at least 20 of the buses tested

Mobility Devices	Length (mm)	Width (mm)	Height (mm)	Diagonal (mm)	Turn radius (mm)	Class	No of Buses that fit
MonarchBuzz3	1010	550	<1500	1150	650	B	21
LuggieStd	982	450	<1500	1080	805	B	21
LuggieElite	982	455	<1500	1082	940	B	21
MeritsYoga	980	435	<1500	1072	950	B	21
PrideGogoUltraX	1041	521	<1500	1125	995	B	20
ShopriderVenice	725	545	<1500	907	300	A	20
ShopriderComo	870	580	851	1046	310	A	20
TrekSupachair	870	600	840	1057	305	B	21
LuggieChair	950	610	<1500	1129	300	A	20

Table 3: Summary of results

No	Powered mobility aids (PMA)	Achieves a Blue Label	No. of Buses PMA could board	
Scooters	1	Afikim Breeze	No	0
	2	Monarch Hybrid4	No	13
	3	Monarch GC440	No	1
	4	Monarch Zener	No	0
	5	Shoprider 889SL	No	0
	6	Trek Evolution	No	0
	7	Invacare Metro	No	0
	8	Shoprider 888	No	0
	9	Shoprider GK4	No	12
	10	Monarch Buzz3	Yes	21
	11	Luggie Std	Yes	21
	12	Luggie Elite	Yes	21
	13	Pride Gogo LX	Yes	12
	14	Merits Yoga	Yes	21
	15	Shoprider GK93	Yes	14
	16	Invacare Colibri	Yes	19
	17	Trek SupaScootaSS	Yes	18
	18	Pride Gogo UltraX	Yes	20
	19	Trek SupaScoota Sumo	Yes	17

No	Powered mobility aids (PMA)	Achieves a Blue Label	No. of Buses PMA could board	
Wheelchairs	20	Heartway Puzzle	No	12
	21	Heartway P3D	Yes	10
	22	Luggie Chair	Yes	20
	23	Merits Maverick	Yes	13
	24	Monarch GP650	Yes	10
	25	Pride JazzyAir	Yes	15
	26	Shoprider Puma14HD	Yes	9
	27	Shoprider CougarTilt	Yes	16
	28	Heartway P3DX	Yes	11
	29	Monarch Literider	Yes	17
	30	Shoprider Venice	Yes	20
	31	Shoprider Como	Yes	20
	32	Pride Gochair	Yes	16
	33	Invacare ProntoAir	Yes	14
	34	Pride R40Fusion	Yes	5
	35	Trek Supachair	Yes	21

**Conclusion:**

The findings demonstrated that being awarded a Blue Label is not sufficient to determine if a powered mobility aid will be able to access a bus. Furthermore, although none of the 21 buses in our study were fully compliant with all elements of the DSAPT using 3D measures, many powered mobility aids were able to successfully access these buses. This suggests that consumers, professionals who prescribe mobility aids, transport operators as well as bus commissioning teams cannot rely on the Blue Label scheme nor DSAPT to provide assurance of access for people who use powered mobility aids on buses. The compatibility of the 35 powered mobility aids and 21 buses scanned (735 combinations) will be available soon for users, health professionals and bus companies through a dedicated website and mobile app.

Since the Swept Path area of buses is a major source of incompatibility, bus design in the future should investigate boarding people using powered mobility aids from double doors in the middle of the bus to a large allocated space in front of the entrance as depicted in Figure 5.

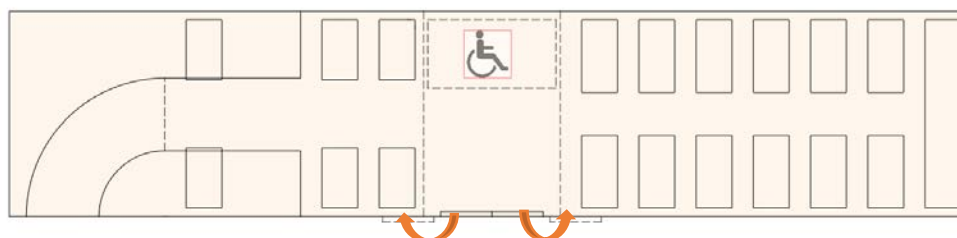


Figure 5: Conceptual drawing of a 12.5m bus showing mid-entry with double outward opening doors and allocated space in front of the entrance.