

# Guidelines for accessible EV charging stations – consultation document

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## Summary report of accessible public charging stations

### Introduction

Electric vehicles (EVs) hold the promise of cutting petroleum use and improving air quality, including reducing greenhouse gas emissions. EVs also can efficiently use homegrown, renewable energy resources rather than depending on fuel imports from other nations [1]. Compared to 2020, sales of new electric vehicles more than doubled in 2021, with an increase of 51.8%. This brought EV sales to about 5% of global passenger car sales in 2021. Unit sales of electric vehicles exceeded 6.5 million cars, and the market realized a total revenue of US\$350 billion. Hence, it is estimated that the compound annual growth rate (CAGR) of the revenue between 2017 and 2027 will reach 28.9% [2].

The ongoing increase in EVs must be accompanied by an increase in available public charging infrastructure (CI) [3]. The CI can be divided into two groups, the fast-charging, mostly DC network, and the slow-charging AC network. The former is necessary to enable long-distance highway traveling generally, and drivers stay near the vehicle during the short charging periods. The latter is the key enabler for everyday mobility and can be further differentiated into private and public charging. Private charging takes place in households or workplaces. Public charging occurs at openly accessible charging stations (CS) in parking areas, while the EV drivers are usually engaged in other activities such as shopping, sports, etc. Due to the generally longer charging times, it is important to place the CSs at attractive locations so that the users can integrate the charging process into their daily life. Further, to make the CSs worthwhile for the operators, a high frequency of usage is important. Failing to do so could mean that the expensive and often publicly supported CSs may remain unused.

Austroroads has developed guidelines to cover the installation of charging infrastructure for Low and Zero Emission Vehicles (LZEVs), including requirements, location, usability, and design. The guidelines are designed to aid road managers and prompt consideration of planning and design issues. The document draws on work and guidance from across the member states and New Zealand and international insights. As this is a relatively fast-moving area of interest, Austroroads will continue to monitor and research developments, to update these guidelines regularly.

As Australia develops a network of EV charging stations, we must include access for persons with disabilities and comply with the Disability Discrimination Act 1992 (DDA) [4]. DDA requires non-discriminatory access to places that accommodate the general public. Commercial facilities that do not directly serve the public – like office facilities and warehouses also must meet DDA requirements for new construction and alterations. Therefore, the Electric Vehicle (EV) charging experience should be a positive one for all users, including people with disabilities and older people. Austroroads would like to understand what opportunities and challenges LZEV charging infrastructure represent for people with disability (PWD). Based on that understanding, the current Austroroads' LZEV charging infrastructure guidelines can be updated or refined if required so that the guidelines also facilitate accessibility and inclusiveness.

## Charging Infrastructure

Charging infrastructure in Australia is experiencing ongoing expansion, with a notable growth in charging locations. According to [5], there has been a 15% increase in the number of charging sites over the past year, as shown in Figure 1. In each station, multiple charging bays are in place to support multiple cars charging simultaneously.



Figure 1 A record of the number of charging locations over various years [5]

**Public charging locations by region and power level, as at 30 June 2022:**

State/territory	Regular (below 24kW, AC and DC)	Fast (24kW - 99kW DC)	Ultrafast (100kW DC and above)	Grand Total
ACT	35	4	1	40
NSW	529	85	33	647
NT	22	1	0	23
QLD	301	57	10	368
SA	178	26	6	210
TAS	91	14	5	110
VIC	383	51	21	455
WA	252	36	6	294
<b>Grand Total</b>	<b>1,791</b>	<b>274</b>	<b>82</b>	<b>2,147</b>

*The data included above is drawn from Plugshare, a publicly available crowd-sourced platform designed to enable drivers to find public charging stations. The Electric Vehicle Council has made efforts to cleanse the data to provide a reasonably accurate snapshot of the current state of play, but we have not independently verified every location.*

Figure 2 Public charging locations by region and power level as of 30 June 2022 [1]

## Inclusive design principles

In this report, we have applied inclusive design principles. Inclusive design principles are a set of guiding principles that aim to guide the design of products, services, environments and communications to be accessible and usable by the widest possible range of users, including those with disabilities or diverse abilities [6]. These principles were developed in 1997 by a working group of architects, product designers, engineers, and environmental design researchers, guided by the late Ronald Mace at the North Carolina State University [7].

The following are key principles of inclusive design:

1. **Equitable Use:** This principle emphasises the design to be useful and marketable to people with diverse abilities.

Guidelines:

- a. Providing the same services for all users identically whenever possible, equivalent when not.
- b. Promote inclusion and avoid isolating or marginalizing any users.
- c. Ensure that provisions for privacy, security, and safety are equally accessible to all users.
- d. Aim to create a design that appeals to a diverse range of users.

In the context of EV charging stations, implementing the equitable use design principle involves considerations such as providing obstacle-free and even surfaces, ensuring optimal ground conditions and visibility, as well as addressing parking space occupancy.

2. **Flexibility in Use:** This principle focuses on providing options and features that accommodate a wide range of user preferences and abilities.

Guidelines:

- a. Offer users a range of options for methods of use.
- b. Accommodate access and use for both right-handed and left-handed individuals.
- c. Optimise for the user's accuracy and precision during operation.
- d. Allow for adaptability to accommodate the user's preferred pace.

In the context of EV charging stations, when implementing this principle, it is essential to provide users with the ability to choose between different charging methods (where possible), offering flexibility in charging port types available at the station and further allowing more accessible decisions for a broad range of users to pick from.

3. **Simple and Intuitive Use:** This principle advocates for designs that are easy to understand and use without the need for extensive training or complex instructions.

Guidelines:

- a. Minimize unnecessary complexity.
- b. Align with user expectations and intuition for consistency.
- c. Cater to diverse literacy and language skills.
- d. Organize information based on its importance.
- e. Offer effective prompts and feedback throughout and after task completion.

To apply this principle in the context of EV charging, several examples can be implemented, such as clear signage, intuitive charging station display screen, step-by-step visual instructions to guide users throughout the charging process, etc.

4. **Perceptible Information:** This principle emphasizes the importance of presenting information in a clear and perceivable manner regardless of ambient conditions or the user's sensory

abilities. It involves utilizing multiple sensory modalities (such as visual, auditory, and tactile) to convey information effectively, ensuring that users can comprehend and interpret it regardless of their sensory abilities.

Guidelines:

- a. Utilizing multiple sensory modalities (such as visual, auditory, and tactile) to convey information effectively.
- b. Ensure sufficient contrast between essential information and its surroundings.
- c. Optimize the "legibility" of essential information.
- d. Differentiate elements in a way that facilitates clear instructions or directions.
- e. Support compatibility with devices or techniques that are commonly utilized by individuals with sensory limitations.

In the context of EV charging stations, achieving this principle requires careful considerations, such as providing clear signage and visible markers at the station. Additionally, it entails the offer of easily perceivable visual and audible information regarding payment methods and other relevant details.

5. **Tolerance for Error:** The design mitigates hazards and reduces the negative impacts of accidental or unintended actions.

Guidelines:

- a. Organize elements to minimize hazards and errors (i.e., prioritize frequently used elements for easy accessibility, eliminate, isolate, or shield hazardous elements).
- b. Provide error feedback whenever faults or hazards may occur.
- c. Incorporate fail-safe features.
- d. Ensure the user is alerted to significant decisions and tasks.

In the context of EV charging stations, an example of implementing this principle could involve the assistance of workers or automated systems if errors occur, extending the time required to make payment or undergo charging processes, or generally ensuring a more user-friendly and accommodating experience.

6. **Low Physical Effort:** This principle aims to reduce physical exertion and fatigue for users by minimizing the effort required to operate or access a design.

Guidelines:

- a. Enable users to maintain a neutral body position while performing tasks.
- b. Actions use the minimum reasonable force for operation.
- c. Minimize repetitive actions.
- d. Reduce sustained physical exertion.

In the context of EV charging stations, this principle can be applied through considerations such as efficient cable management to facilitate easy handling, the reduction of effort needed to unplug charging connectors or use the charging station.

7. **Size and Space for Approach and Use:** This principle addresses the importance of providing adequate space and size for all users to approach, reach, manipulate, and use equipment, regardless of user's body size, posture, or mobility.

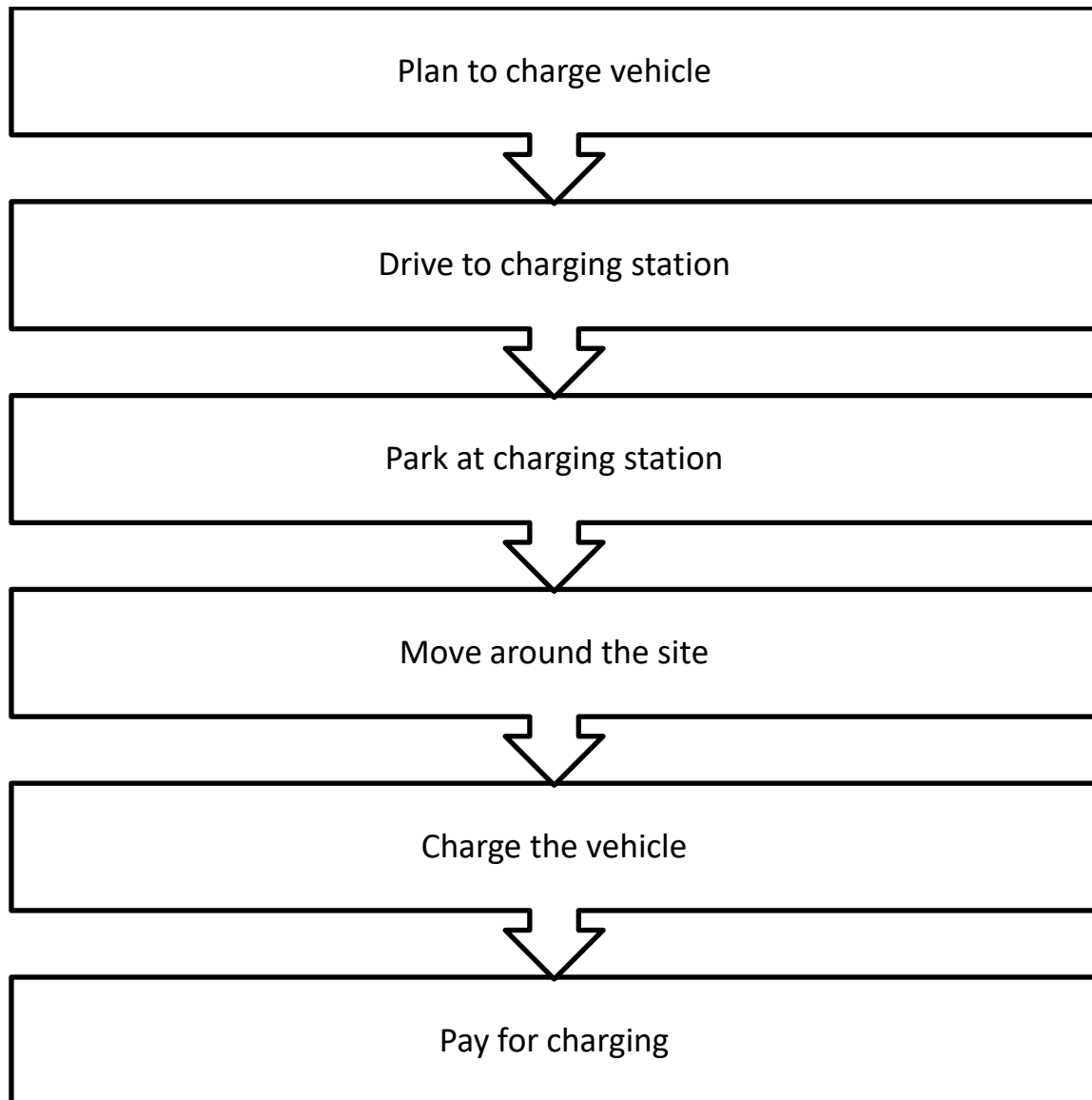
Guidelines:

- a. Ensure important elements are visible to both seated and standing users.
- b. Make sure components are comfortable to reach for both seated and standing users.
- c. Accommodate variations in hand and grip size.
- d. Provide sufficient space for the use of assistive devices or personal assistance.

Implementing this principle involves providing an adequate parking space and an adjoining aisle between charging points to facilitate easy and comfortable movement for people with disabilities. These considerations ensure that users can access the charging infrastructure without encountering physical barriers or restrictions.

## Report organisation: The charging journey

This report considers seven steps of the end user experience that will determine the overall outcome. Within each of these steps, we will explore various challenges that people with disabilities may encounter. Subsequently, each challenge will be categorized according to the corresponding inclusive design principle, drawing recommendations will be presented for each challenge, considering the standards and guidelines.



## Plan to charge vehicle:

### Summary of the challenges

When planning for vehicle charging in public charging stations, a person with a disability may encounter several challenges:

1. Inadequate available information – Lack of information and awareness about the availability and accessibility of public charging stations can pose challenges with regards to how users will access those stations. People with disabilities may struggle to find up-to-date online information about the locations, accessibility features and operation details of the charging infrastructure, leading to confusion about which stations are usable or unusable.
2. Long distances between stations – If there is a long distance or travel time for a user to get to the nearest public charging station, they may face significant challenges. This could lead to increasing difficulties for people with disabilities that have to travel long distances to access them, especially if they are located far from residential areas, places of interest, or far apart from one another (especially if a charging station is not operational).
3. Isolated charging stations – Charging stations that lack proximity to amenities and other services may pose issues for some users, making it difficult to complete some tasks that they were expecting to be able to do (such as shopping or using the restroom). Additionally, service areas may not be easily accessible from the charging station, depriving users of the convenience of accessing necessary services while their vehicles charge.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Equitable Use	Inadequate available information	Provide clear and accessible information online (or otherwise available, e.g., through route planners) about the availability, geographical location, and operational status of charging stations to ensure that it is easily perceivable, including for those with disabilities. This should also include what amenities and charging port types of the station has.	Designability UK [8]
	Long distances between stations	Ensuring that the charging stations are located at convenient distances, allowing users to easily find an accessible charging station. This could include rural and city areas.	Australian Standards for Disability Discrimination Act 1992 [9]
	Isolated charging stations	Building charging stations in convenient locations, near amenities and services, and ensuring easy accessibility to these facilities from the charging area, allows individuals with disabilities to access necessary services and amenities while their vehicles charge, enhancing their overall experience.	Designability UK- page 21 [8]

## Drive to charging station:

### Summary of the challenges

When driving to charging station, people with disability may encounter several challenges:

1. Travel time – Users that do have to travel large distance to get to the nearest applicable charging station may experience difficulty with driving for that long. This could lead to potential issues with discomfort or fatigue, especially to users with disabilities.
2. Unclear signage or directions – The lack of proper signage and visible markers surrounding charging stations could create challenges for people with disability. This could also lead to increased anxiety or stress if a user is struggling to locate the facility.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Low physical effort	Travel time	Designing charging stations that are located within reasonable distances from residential areas and places of interest can help minimize the challenges faced by people with disabilities, especially in terms of fatigue and discomfort.	Australian Standards for Disability Discrimination Act 1992 [9]
Perceptible Information	Unclear signage or directions	Providing clear, consistent navigation signage from a site entrance to the charging points information on signage to help people with disabilities easily locate and identify the charging points. This ensures that they can navigate the charging area effectively, reducing any challenges related to physical disabilities.	Refer to Designability UK [8] (Designability Information signage)

## Park at charging station:

### Summary of the challenges

When parking at public EV charging station, several challenges can occur for people with disabilities which could lead to unsafe and inaccessible parking experience:

1. Lack of unoccupied accessible parking spaces – This challenge could occur if there is an insufficient number of parking spaces with accessibility features (e.g., adjoining isle/wider clearances), or if those that are accessible are occupied by those that do not need them. This could lead to disabled person being unable to park in a location that meets their needs, and thus being unable to charge their vehicle [9, 10].
2. Inadequate signage and markings – The lack of clear signage and visible markings to and around accessible parking spaces may lead to confusion and difficulty in identifying designated spots for disabled individuals as they approach to park.
3. Inadequate protection barrier – The charging station should have a protection barrier to prevent cars from driving too far forward, ensuring safety and proper alignment. Adequate space should be provided between the protection barriers and the public charging point to enable smooth movement and avoid congestion.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Equitable Use	Lack of unoccupied accessible parking spaces	<p>Austroroads guidelines state as follows:</p> <ul style="list-style-type: none"> <li>- 2 charging points → 1 accessible</li> <li>- 5 charging points → 2 accessible</li> <li>- 26+ charging points → 3 accessible</li> </ul> <p>This needs further clarification (e.g., “one – four”, “five – 25”, “26+”).</p> <p>Based on the current number of general EV chargers, implementing a “use last” policy is in Australia would be a better approach to ensuring that accessible parking spaces prioritise for disabled people. There should also be non-charging parking spaces available if all the charging bays are full.</p> <p>U.S. guidelines state that accessible parking spaces should have an adjoining aisle at least 5 feet wide, while <b>California recommends 2.5 – 3 feet.</b></p>	<p>Austroroads [11]</p> <p>U.S. Access Board [12], pg. 36</p> <p>U.S. Access Board [12], pg. 7</p> <p>California plug-in EV collaborative [13], pg. 13</p>
Perceptible Information	Inadequate signage and markings	<p>Provide clear, consistent navigation signage from a site entrance to the charging points.</p> <p>Parking bays inside the charging station should also be close to accessible parking spaces and entrances, so that they are easily identifiable and locatable.</p> <p>Improve visual contrast between signage colour and the background and create visual</p>	<p>Designability UK [8], pg. 19</p> <p>PAS 1899:2022 [13]</p> <p>PAS 1899:2022 [13], pg. 5</p>

		difference by referencing the surface light reflectance values (LRV).	
Tolerance for Error	Inadequate protection barrier	Low-level barriers of maximum 600 mm height and less than 200 mm width placed immediately in front of or surrounding a charging point to protect against vehicle impact by BS 8300-1:2018	PAS 1899:2022 [11], pg. 17

## Move around the site

### Summary of the challenges

People with disabilities may face different kind of challenge when they try to get off or move around their car at the charging bay.

1. Lack of sufficient space or accessible pathways – The physical layout of the parking area may lack sufficient clearances and accessible pathways, making it difficult for disabled individuals to manoeuvre their vehicles or comfortably use mobility aids. This is particularly relevant when exiting the vehicle, moving between charging points and vehicles/parking spaces, or visiting amenities, as wheelchair or disabled users are more vulnerable to being struck by traffic.
2. Congestion and crowding – Charging bays can become congested with multiple vehicles queuing at once, resulting in highly crowded areas. This can make it challenging for people with disabilities to navigate around their vehicle and safely move to and from the charging equipment.
3. Obstacles and uneven surfaces – Uneven surfaces, curbs, or other obstacles in the vicinity of the charging bay can pose barriers for people with disabilities. Such obstacles can impede movement and increase the risk of trips or falls. This also extends to poor ground conditions (i.e., wet, slippery, or unstable terrain), which can pose significant hazards for people with disabilities, increasing the risk of accidents and compromising their safety.
4. Insufficient lighting – Poor lighting in the charging bay area can impact visibility and safety, particularly during night-time or low-light conditions and for those with visual impairments. Also, photosensitive users may struggle to look at information if there are flashing or strobing lights, which could potentially cause seizures or other sensory-based problems.
5. Lack of close amenities – The absence of amenities such as reception, seating areas, or restrooms near the charging bay can make it challenging for people with disabilities who wish to rest or seek support while using the charging facility.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Size and Space for Approach and Use	Lack of sufficient space or accessible pathways	The space must be available for single-sided wheelchair accessible vehicle, but double-sided wheelchair accessible vehicle will not be a requirement.	Designability UK [8] PAS 1899:2022 [11]

		<p>Accommodate the safe loading/deployment of any adaptations such as ramps, hoists, and lifts from the boot of a vehicle, with 1.2 m spacing as a minimum, but ideally 1.6 m.</p> <p>Using a rubber frame on the ground to help a person with disability to park their car in the right position. This will give them the right space to move around their vehicle.</p> <p>Currently, there are a low number of EV chargers per site. However, if this number increases, there should be an accessible route for wheelchair users between these chargers.</p>	U.S. Access Board [12], pg. 36
Tolerance for Error	Congestion and crowding	Disabled parking spots require proof of disability (e.g., disabled parking sticker), thus reducing the amount of traffic around these designated spots.	PAS 1899:2022 [11] Designability UK [8]
Equitable Use	Obstacles and uneven surfaces	<p>Provide appropriate tactile paving and ensure the ground surface below and around the public charging point is smooth (but not slippery in normal or wet conditions) and stable (without grass, mud, gravel or other potholes or surface deformities). There should also not be a running slope steeper than 1:20, or a cross slope steeper than 1:48.</p> <p>Not signals or components should be positioned where they can cause an obstruction or risk of injury to the user or people passing by.</p>	PAS 1899:2022 [11], pg. 32, 37 U.S. Access Board [12] Designability UK [8], pg. 19
Equitable Use	Insufficient lighting	<p>It is recommended to provide adequate lighting around the site, especially around the charging point.</p> <p>Minimise flashing lights and adhere to accessibility guidelines regarding visual stimuli. This is especially important for users with sensory processing disorders or photosensitive epilepsy.</p>	PAS 1899:2022 [11]
Low Physical Effort	Lack of close amenities	<p>People may need or want to be close to shops, toilets, cafes or other amenities while they charge their vehicle. These should be at a close distance and in a visible location.</p> <p>Additional assistance must be available for disabled people who are unable to use and operate the charging points without such assistance.</p>	Designability UK [8], pg. 21 PAS 1899:2022 [11], pg. 17

## Charge the vehicle

### Summary of the challenges

To start charging your vehicle, people with disability could face several challenges:

1. High tension/force to use – Disabled individuals may face challenges when plugging or unplugging their vehicle due to physical limitations. Factors such as the force required to insert or take out the plug, and the design of the storage for the connector or dust caps may pose difficulties for individuals with limited dexterity or strength.
2. Unergonomic – The ergonomic design of the charging port connector grip or handle may not adequately accommodate the needs of people with disabilities. If the design does not prioritize user comfort and accessibility, it can create challenges during the charging process.
3. Insufficient cable length – The type and length of the cable can pose challenges for people with disabilities. If the cable is heavy or difficult to handle, or the length is insufficient, it can make it challenging or impossible to connect the vehicle to the charging station comfortably.
4. Limited Assistance – Some people with disabilities may require assistance and it could be possible at certain stations to provide that on request. If this support is unavailable, some users may be unable to charge their vehicle. Specifically, charging at higher-powered charge points may require additional assistance or specialized equipment to handle the increased power safely. This can create challenges for people with disabilities who may require assistance or face limitations in accessing the necessary support.
5. Unsupported charger types – Charging port types may not match to what a user needs for their specific vehicle. This also extends to wireless or inductive charging, and while it is still uncommon in Australia, people with disabilities may face challenges if their vehicle or charging station does not support this technology, especially as it becomes more available. Compatibility issues or the need for additional equipment may hinder their ability to utilize wireless charging.
6. Physical accessibility of charging point – Various physical challenges can impede the accessibility of individuals with disabilities at EV charging stations. One key challenge involves providing conspicuous and well-lit indicators to effectively guide users to the charging points. Additionally, it is crucial to achieve visual contrast on the surfaces surrounding the charging points without causing glare, as this enhances visibility for users. In addition, the lack of charging point placement could pose a challenge for people on wheelchair.
7. Lack of accessible information – The spacing and lighting of the charging point components, particularly the screen, may not be optimized for accessibility. Issues such as insufficient spacing and text (e.g., size or typeface), poor lighting, flashing lights, or glare on the touch interface screen can make it difficult for people with disabilities such as people with visual impairments or sensitivity to interact with the charging station effectively. This also includes hearing aid compatibility and control over volume levels.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Low Physical Effort	High tension/force to use	Ensuring plug-in force is as small as possible, <60N (upward force and lateral pull force).  If there will be a dust cap, the maximum force will be better at 15N, with restricted value of 30N.	PAS 1899:2022 [11], pg. 24, 26

	Unergonomic	<p>Applying ergonomic principles to the design of the charging port such as ergonomic design of the connector grip or handle is recommended and should be operatable with one hand.</p> <p>Ergonomic straps and loops on the cable that are optimized to require minimal force can address the challenges faced by disabled individuals with limited dexterity or strength.</p>	<p>PAS 1899:2022-[11]</p> <p>U.S. Access Board [12]</p>
	Insufficient cable length	<p>It should be at least 4m from charging point. Must be retractable.</p> <p>Cables should not sacrifice length and weight just to achieve faster charging, allowing users to charge their vehicle no matter the orientation.</p>	<p>U.S. Access Board [12], pg. 4, 20</p> <p>PAS 1899:2022 [11], pg. 23</p>
Flexibility in Use	Limited Assistance	<p>Support (e.g., in-person assistance or assistance through phone) should be available upon request at all operating hours of the charging station, possibly even available before a user's arrival on request.</p> <p>Ensure adequate space, accessibility, and assistance to address the challenges faced by people with disability during high-powered charging.</p>	<p>PAS 1899:2022-[11], pg. 39</p> <p>U.S. Access Board [10], pg. 37</p>
	Unsupported charger types	<p>Adapters between different charge point types must be included to accommodate all charger types.</p> <p>Wireless charging should be considered to ensure compatibility and availability of these options can address the challenges faced by disabled people who may rely on specific charging technologies.</p>	<p>PAS 1899:2022-[11]</p> <p>U.S. Access Board [12]</p>
Size and Space for Approach and Use	Physical accessibility of charging point	<p>There should always be a conspicuous, lit indicator for the charging point. Surfaces should be coloured to provide visual contrast, but without creating glare.</p> <p>Screen should be angled 0° to 20° upwards to provide visibility to lower-down users. It should also have an accessibility icon to lower the contents screen (reachability), along with high contrast mode, etc.</p> <p>Minimum requirement for charging point placement is specified in Appendix II.</p>	<p>PAS 1899:2022-[11], pg. 17</p> <p>Appendix II</p>

Perceptible Information	Lack of accessible information	<p>Charging terminal heights should refer to "Appendix I: components, height requirements, specifically UK".</p> <p>The text displayed on the charging station screen should follow accessibility guidelines to be easily readable, such as the Web Content Accessibility Guidelines (WCAG) (e.g., sans-serif font, minimum text size, etc.).</p> <p>Allow audio output or hearing aid compatibility to access information audibly. This should include text-to-speech and audio descriptions, along with adjustable volume controls and audio cues throughout the process.</p>	<p>PAS 1899:2022- [11], pg. 17, 26, 27, 43</p> <p>U.S. Access Board [12], pg. 23 – 26</p>
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## Pay for charging

### Summary of the challenges

In this stage, people with disabilities can face different kind of challenges:

1. Limited Electronic Payment Options – If the charging station does not offer electronic payment methods or alternative accessible payment options, people with disabilities may face challenges in completing the transaction. This can include difficulties in accessing or using traditional payment methods or lack of compatibility with assistive technologies.
2. Internet signal requirement –If the payment process relies on an internet signal, people with disabilities in areas with poor connectivity or limited internet access may encounter difficulties in completing the payment. This can result in delays or inability to finalize the transaction.
3. Identification of Payment Terminal – Locating and accessing the payment terminal can be a challenge for people with mobility impairments or those using mobility aids. If the terminal is not marked or positioned at an accessible height, it can create difficulties for people with disabilities to complete the payment transaction.
4. Time Constraints –If the payment process has a short time limit or "times out" quickly, people with disabilities who require additional time to complete the transaction may find it challenging to finalize the payment within the given timeframe.
5. Lack of Provisions for Disability Pass/Identification – If there are no provisions in place to recognize and facilitate smooth payment processes for people with disabilities, they may face challenges in availing themselves of any applicable discounts, benefits, or accessible payment methods specifically designed for disabled individuals.

### How can we do it?

Inclusive design principles	Possible challenges	Recommendation	References
Flexibility in Use	Limited Electronic Payment Options	Providing multiple payment options, including electronic methods, to cater to diverse user needs. Offering alternative accessible payment options, such as contactless payment or mobile payment apps, can address the challenges faced by people with disabilities in completing the transaction	PAS 1899:2022 [11] Designability UK [8]
	Internet Signal Requirement	The end user should have the ability to access the cellular/Wi-Fi connections that could be used for the payment process.  Design the payment process to work offline or having alternative methods of offline payment.	PAS 1899:2022 [11] U.S. Access Board [12]
Simple and Intuitive Use	Identification of Payment Terminal	Austroroads and international standards for EV charging stations advise to implement a payment system that supports contactless payment methods, such as credit or debit cards. Contactless payment offers convenience and ease of use for users, aligning with inclusive design principles.	Austroroads [10] PAS 1899:2022 [11] U.S. Access Board [12]

Tolerance for Error	Time Constraints	If time response is required, the user must be alerted visually and by sound (or touch) and allowing users to request additional time.	U.S. Access Board [12], pg. 24
Equitable Use	Lack of Provisions for Disability Pass/ Identification	Incorporate disability pass/identification for disabled parking spots (e.g., disabled parking sticker) to allow disability benefits.	PAS 1899:2022 [11]

## Citations

- [1] C. C. David Mayfield, "ELECTRIC VEHICLE CHARGING FOR PERSONS WITH DISABILITIES." [Online]. Available: <https://vacleancities.org/wp-content/uploads/EV-Charging-ADA-Version-1.0s.pdf>
- [2] "Number of public charging stations for electric vehicles in Australia from 2018 to 2021, by type", ed: Statista, 2022.
- [3] B. J. Mortimer, Hecht, Christopher, Goldbeck, Rafael, Sauer, Dirk Uwe, De Doncker, Rik W, "Electric vehicle public charging infrastructure planning using real-world charging data," *World Electric Vehicle Journal*, vol. 13, no. 2032-6653, p. 94, 2022.
- [4] F. R. o. Legislation, "Disability Discrimination Act ". [Online]. Available: <https://www.legislation.gov.au/details/c2013c00022>
- [5] B. Sievwright, "State of Electric Vehicles – March 2022," Electric Vehicle Council, Australia, 2022, vol. 2023. [Online]. Available: <https://electricvehiclecouncil.com.au/wp-content/uploads/2022/03/EVC-State-of-EVs-2022.pdf>
- [6] H. Persson, H. Åhman, A. A. Yngling, and J. Gulliksen, "Universal design, inclusive design, accessible design, design for all: different concepts—one goal? On the concept of accessibility—historical, methodological and philosophical aspects," *Universal Access in the Information Society*, vol. 14, pp. 505-526, 2015.
- [7] C. f. E. i. U. Design. "The 7 Principles." <https://universaldesign.ie/what-is-universal-design/the-7-principles/> (accessed 30/6, 2023).
- [8] (2022). *Design Guidance: Accessible EV charging*. [Online] Available: <https://accessibleevcharging.designability.org.uk/wp-content/uploads/2022/12/Design-Guidance-Accessible-EV-Charging-1.2-Nov2022.pdf>
- [9] ANGELIQUE. "Challenging behaviour that infuriates people accessing disabled parking." <https://thatsmyspot.com.au/challenging-behaviour-that-infuriates-people-accessing-disabled-parking-bays/> (accessed 18-7, 2023).
- [10] (2021). *INTERPRETIVE OPINION*. [Online] Available: <https://health.hawaii.gov/dcab/files/2021/07/DCAB-2012-01-EV-Charging-Stations-Ruling-03-11-21.pdf#:~:text=Where%20EV%20charging%20stations%20are%20provided%2C%205%25%2C%20but,Section%20302%3B%20changes%20in%20level%20are%20not%20permitted.>
- [11] *Guidelines for Low and Zero Emission Vehicle Charging Infrastructure Installation*, Austroads, 2022. [Online]. Available: <https://austroads.com.au/publications/low-and-zero-emission-vehicles/ap-g98-22>
- [12] (2022). *Design Recommendations for Accessible Electric Vehicle Charging Stations*. [Online] Available: <https://www.transportation.gov/grants/dot-navigator/design-recommendations-accessible-electric-vehicle-charging-stations>
- [13] *Electric vehicles – Accessible charging – Specification*, U. Standards, UK, 2022. [Online]. Available: <https://www.bsigroup.com/en-GB/standards/pas-1899/>

## Appendix I

	PAS (UK)		USA		California	
Height range for charge point components	Minimum (mm)	Maximum (mm)	Minimum (inch)	Maximum (inch)	Minimum (inch)	Minimum (inch)
Charge point socket-outlet	800	950				
Tethered charging cable connector handle when in holster	800	950				
Screen/visual interface (bottom and top interface)	800	1300				
Screen/visual interface (buttons / touchscreen)	800	1200		40		
Payment terminal (bottom edge)	800	1000		48		48
card reader						54

## Appendix II

minimum width between bollards	<u>1800 mm</u>
minimum straight-line access width from charge point	<u>1400 mm</u> <u>It could be less if the charger is not faced to the charging space.</u>
maximum protrusion forward of bollards from point charge point	<u>1200 mm</u>
maximum depth from the vertical plane to the charge point charge point	<u>300 mm</u>
forward reach (unobstructed/obstructed)	<u>220 mm</u>