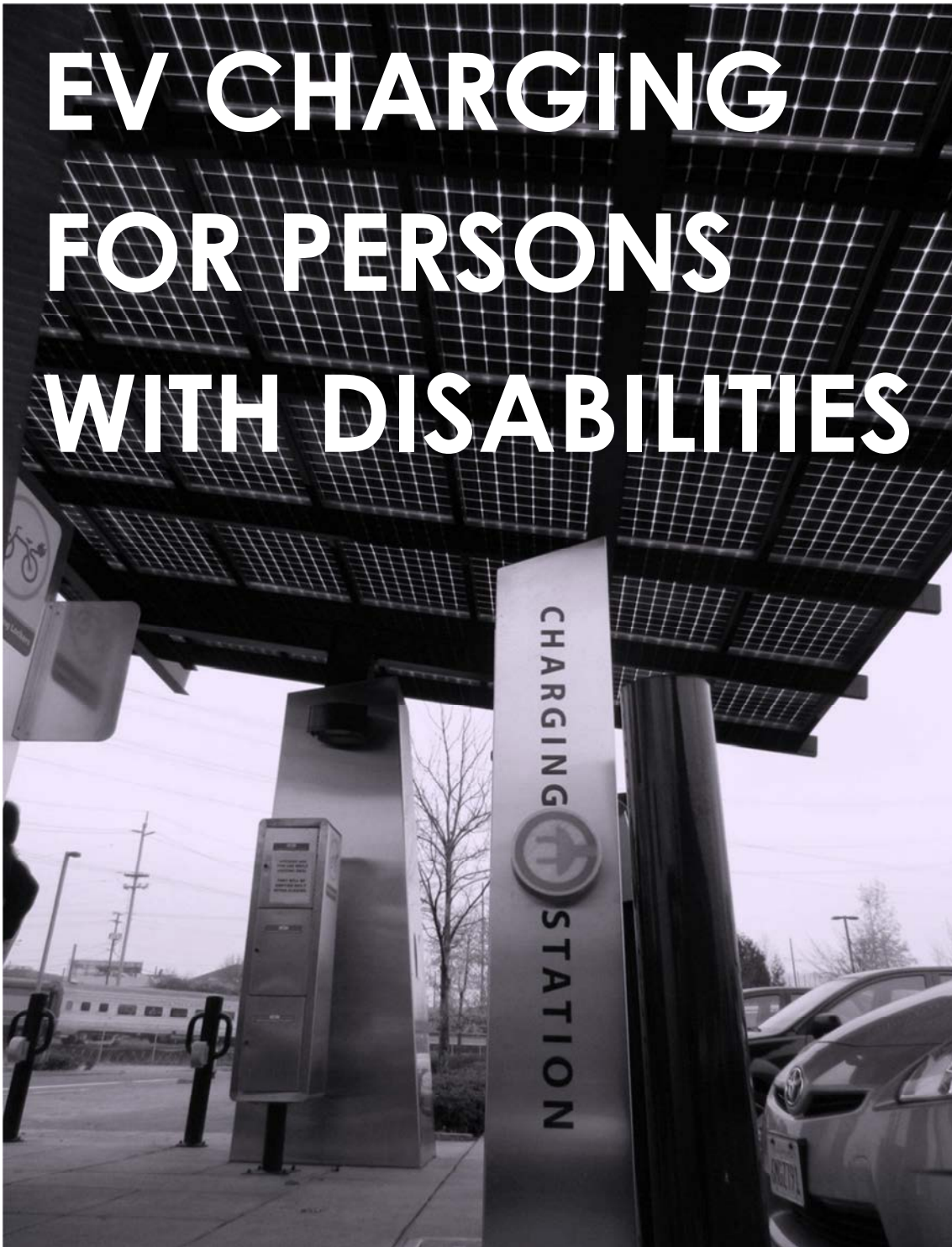


EV CHARGING FOR PERSONS WITH DISABILITIES



Prepared by:

Sustainable Transportation Strategies

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ELECTRIC VEHICLE CHARGING FOR PERSONS WITH DISABILITIES

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Prepared by: **Sustainable Transportation Strategies**

Author: David Mayfield

Editor: Carlotta Collette

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ELECTRIC VEHICLE CHARGING FOR PERSONS WITH DISABILITIES

INTRODUCTION

Plug-in electric vehicles 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. The next few years will be a critical period for installing publicly available EV charging stations to help foster this new technology.

As our nation develops a network of EV charging stations, we must include access for persons with disabilities and comply with the Americans with Disabilities Act (ADA). ADA requires nondiscriminatory 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 ADA requirements for new construction and alterations.

Persons with disabilities currently use a variety of equipment including canes and walkers, non-motorized wheelchairs, power chairs and electric scooters. This report primarily addresses access for persons that drive EVs and also use wheelchairs.

Over the past few years, companies have begun installing Level 1 and Level 2 charging stations in parking facilities. Level 2 stations are currently the most popular for public parking. As seen in Figure 1, Level 2 charging equipment has an attached cable and connector that plugs into the EV.



FIGURE 1: LEVEL 2 EV CHARGING EQUIPMENT

The EV may need to connect to Level 1 or Level 2 equipment for several hours, depending on the EV's battery size and state of charge. After charging is initiated, the vehicle's occupants leave the parking area to conduct business, shop, dine, go to school, or engage in other activities.

Some communities are beginning to install DC fast chargers – heavy duty equipment that will charge an EV in minutes instead of hours. Due to the short waiting period associated with DC fast chargers, the vehicle's occupants conduct a more limited set of activities and stay relatively near the charging station.

State and local governments are developing code language appropriate to EV charging stations. This report provides background to help develop functional design standards that address the particular needs of persons with disabilities. How will they use the EV charging stations currently being installed, and what design factors will make this use safer and easier?

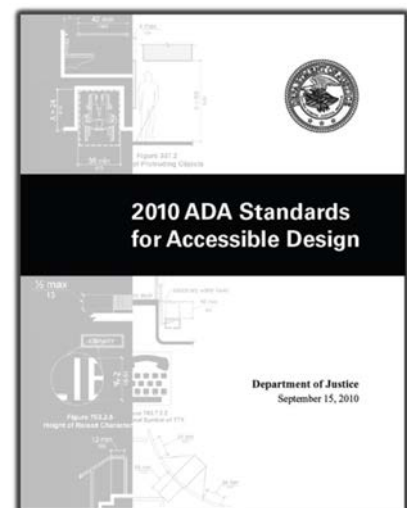
Many current EV charging station installations attempt to include ADA accessibility, but have design features that impede, or make actual use unsafe. Better designed installations often can avoid these impediments. Still, retrofitting existing parking sites is challenging, potentially expensive, and achieving full accessibility in some locations will not be feasible.

In 2010, the US Department of Justice issued new standards for accessible design¹ that will become effective March 2012 (Figure 2). The standards address accessible parking and pedestrian routes, parking space design, and access to equipment.

While the Department of Justice has not issued federal guidance specifically pertaining to EV charging stations, this report uses the latest national standards to help address station design recommendations. Many states have additional guidelines for accessible design. Readers are advised to check how their state's guidelines may influence EV charging station design.

FIGURE 2: NEW ADA STANDARDS FOR ACCESSIBLE DESIGN

¹U.S. Department of Justice. (2010). ADA Standards for Accessible Design.



ACCESSIBLE PARKING

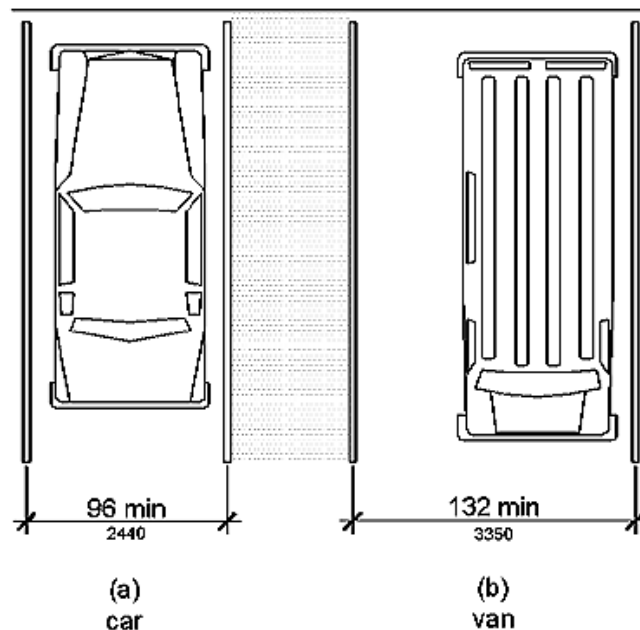
The Americans with Disabilities Act requires designated, accessible parking spaces in most public and commercial parking facilities. These are for the exclusive use of persons with disabilities. Accessible parking space design depicted in the 2010 ADA Standards for Accessible Design is shown in Figure 3.

Federal standards generally call for a 1:25 parking ratio (4 percent) of parking places to be set aside for qualified persons. Standards require that the first such parking space be van accessible; that is, the space must account for operation of a wheelchair lift or ramp attached to a van.

After designating the first ADA parking space as van accessible, federal guidelines state that additional van-accessible parking spaces follow a ratio of 1 per 6 ADA-designated parking spaces.²

The State of Washington adopted guidance that the first of any EV charging parking spaces be ADA accessible and other ADA-accessible spaces be provided at a 1:50 ratio.³

FIGURE 3: ADA-ACCESSIBLE PARKING SPACE DESIGN



² U.S. Department of Justice. (2010) ADA Standards for Accessible Design, Section 208.2.

³ Puget Sound Regional Council. (2010, July). Electric Vehicle Infrastructure, A Guide for Local Governments in Washington State.

The federally funded EV Project, which is planning and deploying charging stations in several states, sets a higher bar with a 1:25 ratio.⁴ In both cases, the charging station spaces are accessible, but not exclusively for use by persons with disabilities.

Designers have modified several types of commercially available vans that enable persons with disabilities to drive solo. EVs will be adapted as well. Specialized vans sport automatic lifts or ramps that move the wheelchair in and out of the vehicle and enable the operator to utilize the wheelchair as the driver's seat. Most lifts operate from the passenger side of a van.

Some persons with disabilities that use wheelchairs drive vehicles not outfitted with specialized equipment. These drivers must have the body strength to lift themselves and move the wheelchair into the vehicle. First they enter the vehicle from the driver's side door using upper body strength to lift out of the wheelchair and move into the driver's seat. They next lean outside to dismantle or fold the wheelchair and then swivel to transfer the wheelchair (or its parts) over to the passenger seat or behind the driver's seat.

To account for these movements, important disability-related parking space design elements include:

- Minimum parking space width of 8 feet for a car and 11 feet for a van.
- Five-foot wide minimum access aisle. Two accessible parking spaces can share an aisle between them.
- Vertical clearance of at least 98 inches for a van.
- Nearly level (less than 2% slope in any direction) and firm ground surface.
- Accessible curb cut if needed to reach and operate the charging station.

As an exception, both ANSI 2009 guidelines and the 2010 federal standards allow reducing the width of the van space from 11 feet to 8 feet if the access aisle between two adjacent spaces is widened from 5 feet to 8 feet. However, this is not recommended for charging station parking spaces meant to be accessible. Standard vehicles have a width of 6 feet or more, and drivers might need access to both sides of the vehicle in order to recharge.

Parallel parking, while feasible, creates greater safety issues compared to angled or perpendicular parking – including greater exposure of persons to traffic. The curb would need to be inset to create an access aisle. A person with disabilities would need to move around the vehicle and still be protected from the adjacent traffic flow.

⁴ Ecotality NA. (2011, August). Lessons Learned – EV Project: Accessibility at Public EV Charging Locations. Prepared for US Department of Energy.

Once adoption of EVs reaches higher levels, designers will likely include EV charging stations at ADA-exclusive parking spaces. One current approach provides effective accessibility by locating non-exclusive EV charging stations near an existing ADA access route as shown in Figure 4.



FIGURE 4: EV CHARGING ADJACENT TO EXCLUSIVE ADA PARKING

ACCESS FROM VEHICLE TO CHARGING EQUIPMENT

After a driver parks, he or she will need to exit the vehicle, access and start the charging station, return to the vehicle, insert the connector, and then go to the planned destination. Depending on the vehicle, a driver with disabilities might leave by way of the driver's door, a door on the passenger side (most common for lifts), or a rear door.

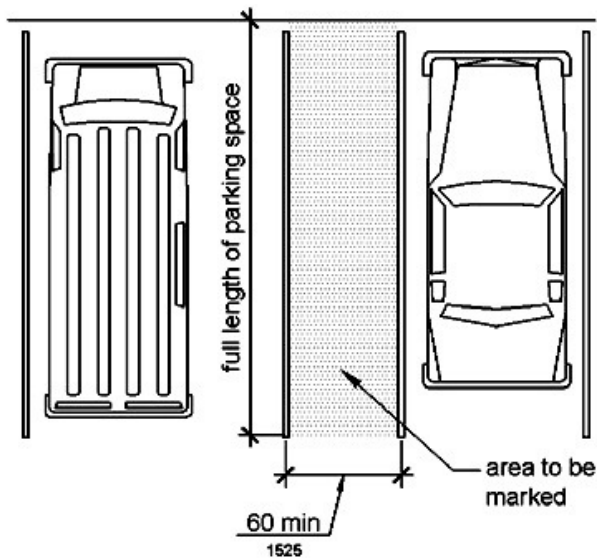


FIGURE 5: ACCESS AISLE

The access aisle serves as space for reassembling and moving into a wheelchair, or operating a lift or ramp. Figure 5 shows an access aisle located between two ADA-compliant parking spaces.

Drivers may need to back into a parking space to properly utilize a lift or ramp at the access aisle.

Numerous existing installations have no access aisles to reach the charging equipment. Space for wheelchair movements next to the vehicle must account for closing car doors, turning to approach the EV charging station, and plugging in the connector.

Manufacturers have not standardized where on the car the charging inlet is located, so charging station site designers should consider that a person using a wheelchair may need access to charging equipment from the front or either side of the vehicle.

If feasible, provide an access aisle on the driver's side and at least 36 inches of clear width (pinching to 32 inches) on the passenger side as shown in Figure 6.⁵

⁵U.S. Department of Justice. (2010). ADA Standards for Accessible Design, Section 403.

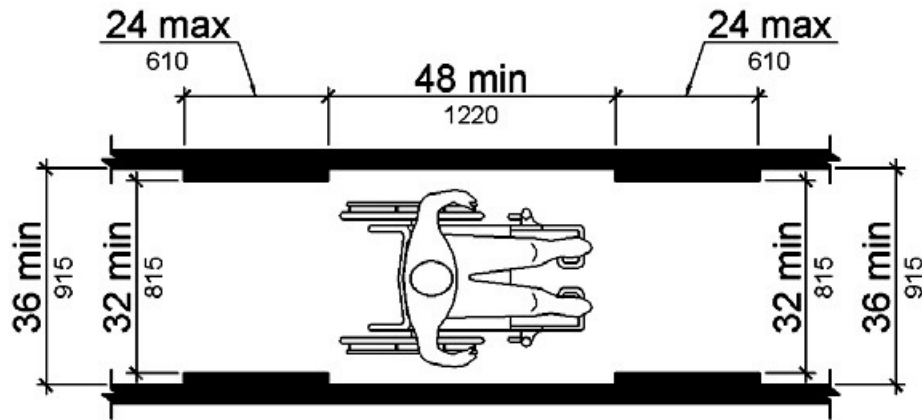


FIGURE 6: CLEAR WIDTH OF ACCESSIBLE ROUTE

EV charging station installations evaluated for this report utilized curbs, wheel stops and/or bollards to protect the charging equipment from being hit by vehicles. However, successful access needs a way for a wheelchair to approach the charging equipment. Figure 7 demonstrates how obstacles can block wheelchair access.



FIGURE 7: BOLLARDS, WHEEL STOPS, AND CURB BLOCK ACCESS

USING THE EV CHARGING STATION

EV charging equipment requires activation and removal/replacement of the cable and connector. Poor site design at parking facilities can lead to out-of-reach equipment. Most pedestal style installations are set back from curbs or other barriers from 1 foot to 3 feet. A person in a wheelchair can reach up to 48 inches to operate the equipment if no barrier keeps the wheelchair more than 10 inches away (see Figure 8).

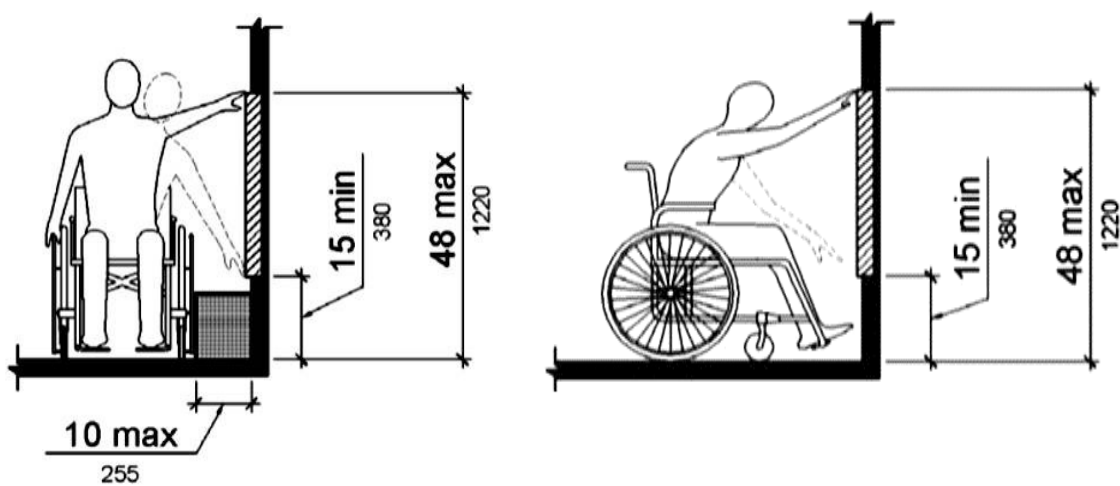


FIGURE 8: REACH RANGE WHERE BARRIER IS LESS THAN 10 INCHES

If this barrier is greater than 10 inches but less than 24 inches deep, the reach range drops to 46 inches.⁶ Many persons using wheelchairs will not have access if the charging equipment is blocked by a barrier more than 24 inches deep. Some connectors require a lifting motion that cannot be accomplished from a sitting position if the handle is situated on the charging equipment near the 46-inch or 48-inch upper limit.

Several brands of EV charging equipment show operational status on a display screen. Consistent with machines like ATMs, these screens should be readable for a person sitting in a wheelchair (eyes at 40 inches above the ground floor in front of the machine).

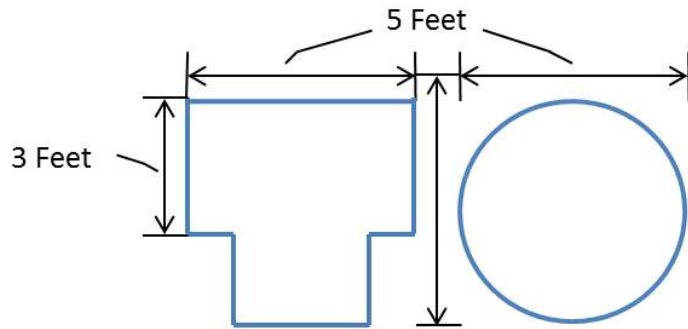
Buyers of Level 2 EV charging equipment for public facilities should select ones that do not require undue strength to pull, lift, or operate the handle. Relying on similar federal guidelines, the required pulling or lifting strength should be less than 5-pound force.

⁶ American National Standards Institute. (2009). A117.1 Standard on Accessible and Usable Buildings and Facilities, Section 308.3.2.

RETURNING TO RECHARGE THE VEHICLE

Once the charging equipment has started, the wheelchair user will return to the vehicle carrying the connector and cable. Wheelchairs will need a turnaround at or near the charging equipment and also near the port on the vehicle. Figure 9 shows two examples of turning patterns with adequate dimensions for a wheelchair.⁷

FIGURE 9: TURNING PATTERN OPTIONS



The turning area can be near rather than directly fronting the charging equipment. If the EV charging station is located near the front of the curb, the turning space can be provided where the access aisle meets the curb line. Note that some mobility devices (like motorized scooters) cannot pivot in place and require more turnaround room than 5 feet.

Bollards and wheel stops can block turnaround space, yet without strategic placement of these barriers – or at least painted striping – parked vehicles will intrude into the clear floor space needed for a wheelchair. Providing adequate space in front of the parked vehicle may mean lengthening the parking space. Site layout needs to account for potential placement of the cable while charging occurs (see Figure 10). These cables can represent a tripping hazard especially when they straddle and block access aisles. For ADA, the aisles are supposed to be free of barriers over $\frac{1}{4}$ -inch high. Level-2 charging equipment cables are about $\frac{3}{4}$ inches in diameter.



FIGURE 10: POTENTIAL TRIPPING HAZARD

⁷ U.S. Department of Justice. (2010). ADA Standards for Accessible Design, Section 304.3.

ACCESSING THE DESTINATION

EV drivers typically park to charge their vehicles at public locations for more than an hour when using Level 1 and Level 2 equipment. Few people choose to sit in their car while charging. Planners siting charging stations seek attractive destinations where people want to park for extended periods.

ADA requires exclusive, accessible parking on the shortest accessible route of travel to an accessible facility entrance. Some EV-related guidance states that parking spaces associated with Level 1 and Level 2 charging do not need to be near the parking facility's destination. The reason given is that the primary activity at the parking space is recharging. However, consider these practical matters:

- Disabilities prevent many people from walking or rolling long distances. They might need to conserve strength to conduct activities within the destination.
- Average time for a person with disabilities to move from parking to destination is often longer than for the general population, increasing exposure during extreme weather events.
- Motorized wheelchairs can be damaged from moisture (such as a heavy rainstorm). Longer exposure to moisture means more risk.

A person with disabilities will find safety and convenience by parking on the shortest accessible route nearest the destination for which the parking was built (Figure 11). Access aisles next to the parking should directly connect via an accessible route to the destination (except for parking not oriented to a particular destination). The route should have a maximum cross slope of 2% and up to a 5% running slope (parallel to travel) except at ramps where the running slope can steepen. The access route should minimize exposure to traveling vehicles.



FIGURE 11: SHORTEST ACCESSIBLE ROUTE TO DESTINATION

DC FAST CHARGER CONSIDERATIONS

As of February 2012, only Nissan and Mitsubishi sell vehicles in the United States that can use DC fast chargers (see Figure 12). Unlike Level 1 and Level 2 charging equipment, no standard connector exists for DC fast chargers. A widely accepted standard will spur deployment of DC fast chargers. DC fast chargers provide a substantial charge in 10 to 30 minutes. These charging stations will function more akin to a gas pump than will the Level 1 and Level 2 charging equipment.



FIGURE 12: DC FAST CHARGER

While charging, some people wait with their vehicles after starting the DC fast charger. However, retailers and infrastructure developers will seek to benefit convenience stores and other commercial outlets by placing DC fast chargers nearby. This is not unlike the service model provided at most modern gas stations and truck stops.

The first generation of DC fast chargers will not be usable for many persons with disabilities without assistance because of size and weight. Figure 13 shows the large size of the handle and connector of a DC fast charger.



FIGURE 13: SIZE OF DC FAST CHARGER CONNECTOR

The connector and cable will far exceed the 5-pound maximum force found in ADA standards associated with similar lifting and pulling actions. As an example, the connector and cable of the Blink DC fast charger is about 19 pounds.⁸ Furthermore, the stiffness of the thicker cable will impede carrying via wheelchair.

Federal standards offer several exceptions regarding accessibility when applied to fuel dispensers and similar exceptions would probably apply to charging EVs. Selection of sites with staff to assist and adequate notification methods will benefit persons with disabilities.

In addition to angled and perpendicular parking, designers are likely to place DC fast chargers on fueling islands similar to existing gas station designs. If there is a destination (for instance, a convenience store) associated with the charging station, designers should strive to provide an accessible aisle adjacent to the parking space connected to an accessible path that leads to the destination. Vertical clearance associated with EV charging islands should accommodate accessible vans by being higher than 9.5 feet.

⁸ Ecotality NA. (2011, August). Lessons Learned – EV Project: Accessibility at Public EV Charging Locations. Prepared for US Department of Energy.

SUMMARY

Key elements of providing access at charging stations for persons with disabilities include:

- Adequate space to move a wheelchair or other equipment in and out of the vehicle.
- Placing operable parts of the charging equipment within unobstructed reach from a wheelchair.
- Space for turning around a wheelchair near the charging equipment and inlet on the vehicle.
- Charging stations on accessible paths and near the destination for which the parking was developed.

While not all EV charging station installations in existing facilities can achieve full accessibility for persons with disabilities, most can facilitate greater access. A number of existing installations can fix minor problems to substantially raise the level of accessibility. Some professionals propose that a high proportional cost of ADA-related improvements should factor into the decision whether to make the equipment accessible.⁹ Future policies need to address this issue. Design of new facilities will be able to better integrate accessibility-related needs into their facilities without extraordinary cost.

ADDITIONAL INFORMATION

For assistance with additional information, please contact:

David Mayfield, Principal, Sustainable Transportation Strategies, via
www.sustainabletransportationstrategies.com

Cynthia Maves, Director of Grant Administration, Clean Fuels Ohio at (614) 884-7336.

Alleyn Harned, Executive Director, Virginia Clean Cities at (540) 568-8896.

⁹ Ecotality NA. (2011, August). Lessons Learned – EV Project: Accessibility at Public EV Charging Locations. Prepared for US Department of Energy.