



American Association of
Motor Vehicle Administrators

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Automated Delivery Vehicles and Devices *Whitepaper*



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Contents

Chapter 1	Background	3
Chapter 2	Guidelines for Testing PDDs	5
Chapter 3	Guidelines for Deployed PDDs	7
Chapter 4	Benefits of Implementing the Recommendations	8
Chapter 5	Challenges to Implementing the Recommendations	9
Chapter 6	Conclusion	10
Chapter 7	Definitions and Acronyms	11
Chapter 8	Additional Recommended Resources	12
<i>Appendix A</i>	<i>Examples of Automated Delivery Vehicles and Devices</i>	<i>13</i>
<i>Appendix B</i>	<i>Members</i>	<i>14</i>

Chapter 1 Background

The convenience economy is significantly altering the way business is conducted across virtually all sectors of our society. More than ever before, consumers are demanding the immediate, efficient delivery of products and services to their front door. The COVID-19 pandemic further modified consumer behavior to minimize personal interaction and has changed traditional shopping habits, thus accelerating an existing trend toward the convenience economy and e-commerce. On February 19, 2021, the US Department of Commerce announced that in the fourth quarter of 2020, the e-commerce estimate increased 32.1 percent ($\pm 2.1\%$) from the fourth quarter of 2019, while total retail sales increased 6.9 percent ($\pm 0.5\%$) in the same period. E-commerce sales in the fourth quarter of 2020 accounted for 14.0 percent of total sales.

As a result of these trends, interest and investment are rapidly increasing in the development of automated delivery vehicles and personal delivery devices (PDDs). For purposes of this whitepaper, an **automated delivery vehicle** is a motor vehicle designed for the purpose of delivering goods or cargo, does not carry people, is operated by an automated driving system (ADS), and meets the definition of a motor vehicle or a low-speed vehicle (LSV).

A **personal delivery device** is a ground-based delivery device that is manufactured for transporting cargo or goods, does not meet the definition of a motor vehicle, and is operated by a driving system that allows for automated and/or remote operations.

Automated delivery vehicles that meet the jurisdictional definition of a motor vehicle or LSV should be considered motor vehicles and therefore



The Nuro R2 zero-occupant autonomous delivery vehicle, designed to carry goods on public roads. It fits the federal low-speed vehicle classification and has received a US Department of Transportation and the National Highway Traffic Safety Administration regulatory exemption from some Federal Motor Vehicle Safety Standards regulations for usage on public roads.



A personal delivery device does not meet the definition of a motor vehicle or a low-speed vehicle. It is designed to operate in pedestrian and bicycle spaces.

should be regulated as motor vehicles. Guidance for automated motor vehicles is available in the [AAMVA Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, Edition 2, September 2020](#). These automated delivery vehicles may be designed for longer distance, on-road journeys and often resemble conventional automated vehicles, with cargo compartments replacing space reserved for human passengers.

PDDs are equipped with automated driving technology, operate in pedestrian and bicycle spaces, and transport small cargo to homes or businesses but do not meet the jurisdictional definition and requirements of a motor vehicle. Therefore, PDDs present a unique challenge to federal and state, provincial, territorial, and local government regulators.

PDDs aim to fill existing gaps in last-mile product delivery and courier services, promise to make product delivery more efficient and convenient for consumers, and save time and money for businesses. PDDs, as they are being developed today, come in various sizes and dimensions, with diverse potential applications. PDDs are designed for shorter distance off-road trips along trails and sidewalks, may be half the size of a standard public mailbox, and can transport small items, such as groceries and packages, in dense urban centers.

The purpose of this whitepaper is to provide clarity and guidance on developing a common policy

framework for the regulation of PDDs. Regulators will need to grapple with a myriad of questions related to PDDs. For instance:

- How can jurisdictions ensure that these devices are safe?
- What operational parameters should govern the use of these devices?
- What type of design conditions should be put in place?
- Where and when can these devices be used?
- How many devices should be permitted for use in a given area?
- Do these devices require registration, insurance, and external identifiers?
- Are some or all local ordinances or regulations preempted by state or provincial laws and regulations?
- Will PDDs ever be operated remotely?

Chapter 2 Guidelines for Testing PDDs

A few jurisdictions have enacted laws to define and address PDDs, and it is anticipated that additional jurisdictions will consider proposals over the next few years. Therefore, it is recommended that state, provincial, and local government officials work with law enforcement agencies to develop a plan to ensure PDDs are safely tested to minimize risks to people and property. This paper should be shared with all jurisdictional agencies, including the Departments of Transportation and Public Safety, as well as other stakeholders, as laws and implementation plans are developed to oversee the testing of PDDs.

Recommendations for Jurisdictions

- 2.1 Define PDDs in statutes and ordinances to distinguish them from motor vehicles.
- 2.2 Develop an oversight process to allow manufacturers and other entities to test on bike lanes, paved or unpaved shoulders, other dedicated pedestrian or bicycle facilities such as sidewalks or recreational paths, and select public roadways to support safe testing. The process should include the manufacturers providing at least annual reports on the progression of the testing.
- 2.3 The development of an oversight process should be a collaborative effort between jurisdictional, local officials, and enforcement agencies.
- 2.4 Provide clear guidance on how PDDs should operate on sidewalks and roadways. For example, a PDD operating on a sidewalk should not operate at speeds higher than what pedestrians will expect; pedestrians should feel safe in proximity of PDDs. On roadways, drivers expect vehicles, such as bicycles, that operate in the same direction to travel at higher speeds. A PDD traveling on the same side of the road but in the opposite direction at higher speeds will likely create unexpected and distracting situations for drivers.
- 2.5 Limit the testing of PDDs to its specific operational design domain (ODD).
- 2.6 Require each device to be equipped with a braking system that enables the device to come to a controlled stop.
- 2.7 Require the device to yield to traffic and pedestrians. However, intentional interference or obstruction of PDDs should be prohibited.
- 2.8 Give consideration to requiring an audible alert for visually impaired pedestrians.
- 2.9 Require the PDD to respond appropriately in emergency situations, including but not limited to appropriate response to audio or visual emergency equipment (lights, sirens).

- 2.10 Require PDDs to be seen in daytime and nighttime from all directions. The jurisdiction's current regulations should be evaluated to determine if they are adequate for and apply to PDDs to ensure optimum visibility.

A good example for consideration: each PDD should be equipped with a lamp that emits a beam of white light intended to illuminate the PDD's path, be visible from a distance of at least 300 feet to the front, and have a lamp emitting a red flashing light, light-emitting diode, or other device visible from a distance of 300 feet to the rear. An authorized entity may supplement the required front lamp with a white flashing lamp, light-emitting diode, or similar device to enhance its visibility to other traffic. A bright projecting strobe should not be used.

- 2.11 If the PDD operates on a roadway, require a slow-moving vehicle emblem or placard as described by American Society of Agricultural Engineers standard S276.8 APR2016 (R2020) to indicate a slow-moving vehicle. If a placard is not practical on a small PDD used exclusively on sidewalks, require small reflectors mounted on all sides of the PDD.
- 2.12 Require each device to be specifically identified and require the name and contact information of the testing entity to be prominently displayed on the outside of the PDD along with a marking to indicate if the vehicle may be operated remotely.
- 2.13 Require PDDs to be accompanied by an employee of the testing entity until supervising or remote monitoring can be done safely.
- 2.14 Prohibit hazardous materials as defined in 49 U.S.C. Section 5103 or other relevant jurisdictional statutes to be transported by a PDD.

- 2.15 Require the manufacturer or operator to provide a Law Enforcement Interaction Plan (LEIP).
- 2.16 For law enforcement agencies: Develop protocols and training for interacting with PDDs.
- 2.17 A jurisdictional vehicle registration is not recommended for PDDs. However, support a local registration if the local government chooses to do so. A local registration can be used as a tool for statistical information.
- 2.18 Develop a reporting process and threshold specific to PDDs to require incidents that include personal injury or property damage to be reported to local and jurisdictional agencies. Helpful data to collect in these incident reports include the PDD owner and operator; the date, time, and location of the incident; a summary of the incident; and the known severity of any injuries.
- 2.19 Consider creating a local opt-in framework to allow local governments to determine whether to allow the operation of PDDs within their communities and to create additional ordinances on the uses of PDDs (e.g., that govern where devices can be used, which companies are eligible, and how many PDDs are permitted).
- 2.20 Require the operation of PDDs to comply with all local ordinances.

Recommendations for Manufacturers and Other Entities (MOEs)

- MOE 1 MOEs should work with government regulators and stakeholders, such as retailers and customers, before testing and deploying PDDs.
- MOE 2 MOEs should provide an LEIP that contains all elements for safe interaction with a PDD.

Chapter 3 Guidelines for Deployed PDDs

Although PDDs may be a potential solution for last-mile deliveries and may provide consumer choice and convenience, there may also be impacts on the pedestrian environment. More information and observation through testing and piloting is needed before the full-scale deployment of PDDs. Therefore, it is premature to provide guidance on the actual deployment of the devices. Next are a few considerations for jurisdictions and local government agencies that can assist in preparing for the future deployment of PDDs.

Considerations for Jurisdictions

- 3.1 If a definition for PDD was adopted during the testing phase, review it to determine if any amendments are needed.
- 3.2 If a testing oversight process was developed, results should be reviewed to determine if new local ordinances or adjustments to current ordinances need to be adopted.
- 3.3 Based on lessons learned during testing on a widespread, operations scale, consider updating regulations on operating PDDs on sidewalks and roadways.
- 3.4 Review statutes to determine if any amendments or exceptions are needed to allow for the deployment of PDDs.
- 3.5 Consider potential opportunities for use of PDDs by government agencies such as law enforcement and first responders and work with the appropriate stakeholders to develop jurisdictional guidance for this type of operation.

Chapter 4

Benefits of Implementing the Recommendations

Jurisdiction and local officials will have an increased awareness of PDDs through collaborative oversight of testing and piloting PDDs. A documented process to permit the testing of PDDs that includes where, when, and by whom testing was conducted as well as the number and types of PDDs tested and if there were any incidents or crashes will allow jurisdictional and enforcement agencies to be well informed and to better ensure safety during testing and appropriate response to incidents. This will also allow officials to provide useful information to business owners, institutions, and the public to help to address safety and security concerns. A better-informed public is more likely to accept the technology, which will ultimately encourage innovation in last-mile delivery solutions that has the

potential to reduce traffic congestion, emissions, and costs and bring efficiency and reliability improvements for both businesses and consumers.

These recommendations support a collaborative approach to testing and piloting PDDs that includes all impacted and interested entities. This guidance takes into consideration many of the lessons learned when scooters were deployed by companies without advance notice to government officials.

Additionally, the use of universal definitions of terms will facilitate communication, understanding, and standardization of government oversight of the testing and deployment of PDDs.

Chapter 5

Challenges to Implementing the Recommendations

Finding the right balance between ensuring safety while supporting technological advancements through the development and testing phases of PDDs is a challenge. Ensuring the safe interaction between PDDs, vehicles, pedestrians (including those using mobility devices), and bicyclists will be difficult during testing. It will be difficult for the public to know what to expect and how to interact with a variety of delivery devices that are being developed in many sizes, shapes, dimensions, weights, and technical abilities.

As with any fast-developing field, regulators will need to keep pace with technological advancements, both to ensure road safety and to encourage innovation. More data and observation will be necessary to evaluate

issues such as liability, interaction with other road users, and vehicle oversight parameters. Jurisdictions will also need to be nimble to ensure regulations do not stifle development of the evolving designs of these delivery devices and to ensure emerging concerns are covered when appropriate.

Manufacturers may view any testing permit process as an impediment to their ability to test and develop PDDs. They may also view the need to comply with multiple local ordinances inconvenient. Additionally, jurisdictions and local government agencies may lack the resources to monitor and enforce provisions of a permitting process.

Chapter 6 Conclusion

Automated vehicle and robotics technologies continue to develop rapidly. It is anticipated that new and emerging applications of these technologies—for example, to assist in sidewalk maintenance, snow removal, and waste removal—will become increasingly widespread. Recommendations provided in this guidance document may serve as a framework to assist jurisdictions in regulating these new and emerging technologies. In developing regulatory approaches for these devices, jurisdictions should carefully account for factors such as vehicle design and intended usage. Parameters applied to private and commercial

applications may, for instance, differ dramatically from government or public applications.

As discussed in this document, it is imperative that industry and government entities work closely together to purposefully test and pilot the technology to reduce risks and increase the value to society.

The Automated Vehicle Subcommittee will continue to monitor the development, testing, and piloting of automated devices and provide additional guidance in the future.

Chapter 7 Definitions and Acronyms

The following is an explanation of terminology used in this document. AAMVA is not necessarily recommending jurisdictions adopt these terms for use in their statutes or administrative rules; they are provided to help readers understand their use in this document.

Automated driving system (ADS) – the hardware and software that are collectively capable of performing the entire dynamic driving task (DDT) on a sustained basis, regardless of whether it is limited to a specific ODD; this term is used specifically to describe a level 3, 4, or 5 driving automation system

Deploy, deployment, deployed – the operation of an ADS-equipped vehicle or a personal delivery device on public roads or sidewalks by members of the public or for use by the public who are not employees, contractors, or designees of a manufacturer or other testing entity or for purposes of sale, lease, providing transportation or delivery services for a fee, or otherwise making commercially available outside of a testing program

Jurisdiction – any state, district, territory, or province of the United States or Canada

Low Speed Vehicle – as defined by US federal law 49 CFR 571.3(a)

Low-speed vehicle means a motor vehicle,

- 1) That is 4-wheeled,
- 2) Whose speed attainable in 1.6 km (1 mile) is more than 32 kilometers per hour (20 miles per

hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface, and

- 3) Whose GVWR is less than 1,361 kilograms (3,000 pounds).

Operational design domain (ODD) – the specific conditions under which a given driving automation system or feature is designed to function, including, but not limited to, driving modes. An ODD may include geographic, roadway, environmental, traffic, speed, and temporal limitations.

Personal delivery device (PDD) – a ground-based delivery device manufactured for transporting cargo or goods, does not meet the definition of a motor vehicle, and is operated by a driving system that allows for automated or remote operations.

Testing – the operation of an ADS-equipped vehicle or PDD on public roads or sidewalks by employees, contractors, or designees of a manufacturer or other entities for the purpose of assessing, demonstrating, and validating the ADS or PDD capabilities

Acronyms

kpm – kilometers per hour

MOE – manufacturers and other entities

mph – miles per hour

PDD – personal delivery device

Chapter 8 Additional Recommended Resources

Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, Edition 2, September 2020 Developed by the AAMVA Automated Vehicles Subcommittee

Emerging Automated Urban Freight Delivery Concepts: State of Practice Scan, November 2020
Developed by the US Department of Transportation Volpe National Transportation Systems Center

Appendix A Examples of Automated Delivery Vehicles and Devices



Automated delivery vehicle.



Personal delivery device.



Personal delivery device.



Personal delivery device.

Appendix B Members

The following members of the 2021 AAMVA Automated Vehicle Subcommittee developed this paper.

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A more complete list of companies developing automated delivery vehicles and devices can be found in Tables 4 and 5 in *Emerging Automated Urban Freight Delivery Concepts: State of the Practice Scan* developed by the US Department of Transportation Volpe National Transportation Systems Center.

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