Safety Concerns Associated with Micromobility Products

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1 EXECUTIVE SUMMARY

Use of micromobility products, including electric scooters, electric bicycles, and self-balancing scooters, has increased in recent years with the advancements in battery technology and the advent of commercial ride-sharing services. Consumers may also purchase their own micromobility products. These products are popular with consumers because, among other benefits, they are convenient for short-distance travel.[1]

Internet access is needed to activate some consumer micromobility products, and it is required for many commercial ride-sharing products. These products can have the same data security vulnerabilities that could affect product safety as any other connected products.

The hazards associated with micromobility products, such as e-scooters, primarily fall into three broad areas: (1) mechanical, (2) electrical, and (3) human factors. The mechanical hazards consist of falls, including rider ejections due to frame or structural failures, and braking problems and collisions with motor vehicles, objects, and pedestrians. The electrical hazards include: fire and explosions due to battery failures, and mechanical battery-mounting issues, and falls and rider ejections due to electronic control (hardware and firmware) problems. The human factors hazards include, but are not limited to, the abovementioned risks associated with user expectations and reasonably foreseeable use cases, such as pertaining to user positioning (*e.g.*, probable forward body positioning due to handle placement and width of foot area) and the location and operation of emergency controls (*e.g.*, brakes), which affect the user's ability to respond safely in a dangerous situation.

These product hazards, in conjunction with riders unfamiliar with the products and local laws, contribute to consumer injuries. For example, consumers have reported variability in operation and performance across ride-sharing products, limited warnings and instructions, and poor maintenance. Riders also may be unfamiliar with local laws. Additionally, riders may be unfamiliar with how to ride the products and may lose their balance and fall off. Motorists may not yield to riders – just as we see with conventional bikes and scooters – leading to collisions.

To address the hazards associated with micromobility products, staff continues to work with ASTM International and Underwriters Laboratories (UL) to develop standards to address the hazards. Staff is planning a Micromobility Stakeholder Forum to take place later this fiscal year. A report from the Directorate of Epidemiology on injury data associated with micromobility products is also expected this fiscal year.

[1] See https://www.bcg.com/publications/2019/promise-pitfalls-e-scooter-sharing.aspx

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2 WHAT ARE MICROMOBILITY PRODUCTS?

In January 2017, the Commission published a staff report, *Potential Hazards Associated with Emerging and Future Technologies*,[2] which identified micromobility products, along with a number of emerging consumer products and technologies, as an area to analyze, prioritize, and possibly, manage for potential safety issues.

The Society of Automotive Engineers (SAE)[3] defines "micromobility products" as motorized, low-speed, small-size transportation products for roadways, sidewalks, and paths. Micromobility products, including electric scooters (e-scooters), electric bikes (e-bikes), and self-balancing scooters, use electric motors as a power source made viable by advancements in rechargeable battery technology. These products are popular with consumers because they are convenient for short-distance travel.

Micromobility products, such as e-scooters, e-bikes, and self-balancing scooters are also used in commercial ride-sharing programs in cities, towns, and universities across the United States. Each micromobility product that is part of a ride-sharing program can be used by many different riders, multiple times a day.[4] Some ride-sharing programs offer micromobility products that connect into docking stations for drop-off and pickup. Other programs use smartphone applications ("apps") that allow micromobility products to be dropped off and picked up anywhere within a defined area.

2.1 CATEGORIES OF MICROMOBILITY PRODUCTS

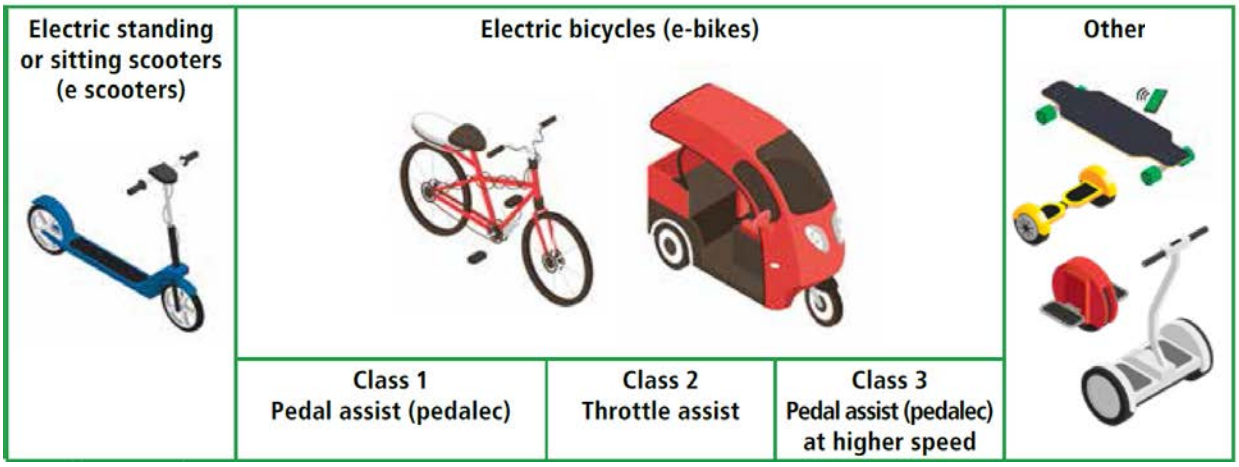
Micromobility products are categorized as standing or sitting e-scooters, e-bikes, and e-skateboards, self-balancing scooters, including single and three to four-wheel products and variations.

E-bikes, are further categorized into three classes:

- Class 1: pedal assisted, with speeds less than 20 mph and less than 750 watts of power
- Class 2: throttle assisted, with speeds less than 20 mph and less than 750 watts of power
- Class 3: pedal assisted with speeds less than 28 mph and less than 750 watts of power

E-skateboards, self-balancing scooters and their variations, are typically limited to less than 20 mph; however, some of these products go to 30 mph.

[2] *See* https://www.cpsc.gov/s3fs-public/Report%20on%20Emerging%20Consumer%20Products%20and%20Technologies_FINAL.pdf
[3] *See* https://www.sae.org/ for additional information on SAE and micromobility products.
[4] Micromobility in Cities. A History and Policy Overview. National League of Cities (NLC).



Sandt, L., Pedestrian and Bicycle Information Center, Chapel Hill, NC.
http://pedbikeinfo.org/cms/downloads/PBIC_Brief_MicromobilityTypology.pdf

2.2 CPSC's Jurisdiction Over Micromobility Products

CPSC has jurisdiction over consumer products, which include micromobility products that the National Highway Traffic Safety Administration (NHTSA) does not consider to be a "motor vehicle" under its jurisdiction.[5] NHTSA guidance advises that the following micromobility products are not considered "motor vehicles": (1) scooters lacking seats that are operated in a stand-up mode; (2) scooters that are incapable of a top speed of 20 mph or greater; and (3) electric bicycles with operable pedals, and an electric motor of 750 watts or less, whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph.[6] Accordingly, these micromobility products fall within CPSC's jurisdiction. Additionally, by statute, CPSC has jurisdiction over low-speed bicycles, which is codified in CPSC's bicycle regulations. 15 U.S. Code § 2085; 16 CFR § 1512.2(a)(2). Pedal-assisted micromobility products, even if they can exceed 20 mph, that are not capable of continued self-propulsion, fall within CPSC's jurisdiction.[7] CPSC staff will continue to work with NHTSA on jurisdictional issues as they arise.

Another micromobility product that is not considered to be a consumer product within the CPSC's jurisdiction is a mobility scooter for medical use, which is under the jurisdiction of the U.S. Food and

[5] By statute, a "motor vehicle" under NHTSA's jurisdiction is "a vehicle driven or drawn by mechanical power and manufactured for use on public streets, roads, and highways, but does not include a vehicle operated only on a rail line." 49 U.S.C. 30102. NHTSA's jurisdictional analysis focuses on a product's on-road capabilities. Accordingly, mopeds, scooters, and motorcycles that are intended for on-road use, having a top speed greater than 20 mph and at least one other street-ready component, such as head lights, side mirrors, or brake lights, are under NHTSA's jurisdiction.
[6] *See* https://www.nhtsa.gov/importing-vehicle/importation-and-certification-faqs-0.
[7] *See, for example,* NHTSA's guidance at: https://www.nhtsa.gov/interpretations/07-001825as.

Drug Administration (FDA). Finally, some consumer mobility products that are generally within CPSC's jurisdiction are not considered micromobility products within the scope of this report, including golf carts, battery-powered ride-on toys, and go-carts.

2.3 NEW PRODUCT TRENDS

Micromobility products have grown in popularity over the past several years. New developments in battery technologies, such as higher energy density lithium-ion batteries, have made micromobility products more affordable, more powerful, easier to charge, and lighter weight. With the advent of the "sharing economy," commercial ride-sharing programs have expanded in cities, towns, and universities.

This trend has led to more micromobility products and their riders co-existing with motor vehicles on streets and with pedestrians on sidewalks. Although this access has improved transportation options available to many people, injuries have also occurred, due to impacts, falls, and other hazards.

3 MICROMOBILITY PRODUCTS AND THE INTERNET OF THINGS (IOT)

Internet access is needed to activate some consumer micromobility products, and it is required for many ride-sharing products. These products can have the same data security vulnerabilities that may affect product safety as any other connected products.

Using ride-sharing products can be convenient for many consumers. The consumer downloads the company's "app" on a mobile device, enters their payment information into the app, locates a nearby product, and unlocks the product for use. The consumer can then ride anywhere within the geo-fence area establish by the rideshare company. When the rider is finished using the product, the rider returns the product to a dock, if applicable, or leaves the product where they finish using it, closing out the use in the app.

As with other connected products, staff is concerned that consumer safety may be compromised through poor software and firmware design or maintenance, remote updating, or loss of communications, resulting in operational control (*e.g.*, braking/acceleration) or battery-management problems that could be hazardous to riders. Staff also recognizes that product safety could be impacted by malicious attack. Therefore, it is important for these products to have robust cybersecurity protection. On the positive side, staff also recognizes that software updates can be used to improve product safety, instructions, and alerts.

Data Security and the concept of product hazardization is described more fully in the recent staff report: *Status Report to the Commission on the Internet of Things and Consumer Product Safety*.[8]

4 HAZARDS ASSOCIATED WITH MICROMOBILITY PRODUCTS

Hazards associated with micromobility products generally fall into three broad hazard areas: (1) mechanical, (2) electrical, and (3) human factors. In general, the mechanical hazards include falls; collisions with motor vehicles, objects, and pedestrians; frame or structural failures; and braking issues. The electrical hazards include battery-charging issues, fires from mechanical battery mounting issues (battery short-circuiting), and braking issues due to problems with software. The human factors hazards include, but are not limited to, the abovementioned risks, associated with user expectations and reasonably foreseeable use cases, such as those pertaining to user positioning (*e.g.,* probable forward body positioning due to handle placement and width of foot area) and the location or operation of emergency controls (*e.g.,* brakes), which affect the user's ability to respond safely in a crisis situation.

The mechanical, electrical, and human factors considerations are paramount to understanding and addressing hazards associated with micromobility products and preventing injuries involving these products. For example, staff has reviewed numerous incident reports involving problems with e-scooter brakes, such as mechanical, electrical, and usage-error-based brake failure, unexpected braking, and variability in operation of brakes and braking distance/response. Often, these issues can be attributed to problematic product-design features, resolved via design changes, safeguarding measures, and, in some cases, through safety information. Riders, particularly new or intermittent riders, such as those using rideshare devices, may be unfamiliar with the specific product's controls and capabilities, contributing to collisions with objects, pedestrians, and other motorists. Micromobility products can be designed to help increase response time and limit mistakes and consequences of mistakes, such as secondary braking mechanisms and intuitive interfaces. Other concerns include riders potentially being unfamiliar with local laws and riders choosing to forego helmets and other safety equipment. Safety information pertaining to these issues can be included with the products and in efforts to raise public awareness, and again, design properties can help to reduce or prevent injury.

In reviewing incident data, staff is aware of three deaths from two battery-related incidents with self-balancing scooters and two deaths due to falls. From 2015 through March 2019, there were more than 330 fire-related incidents associated with charging and riding self-balancing scooters,

[8] Status Report to the Commission on the Internet of Things and Consumer Product Safety. September 2019. https://www.cpsc.gov/s3fs-public/Status-Report-to-the-Commission-on-the-Internet-of-Things-and-Consumer-Product-Safety.pdf

leading to more than $9 million in property damage. In addition, consumer use of self-balancing scooters led to more than 70,000 emergency room visits from 2015 through 2018, with approximately 90 percent from falls (*e.g.*, unspecified falls, loss of balance or sudden stops/starts), and approximately 13 percent of these injuries categorized as head injuries, about 40 percent arm injuries, 38 percent fractures, 18 percent contusions, and 16 percent sprains or strains.

The vast majority of these fire and fall incidents from consumer products are associated with products manufactured prior to the development of voluntary standards for e-micromobility products. The electrical voluntary standard, UL 2272 (see section 5), along with CPSC's letter urging manufacturers, importers, distributors, and retailers of self-balancing scooters to certify their product to the voluntary standard, has shown to be effective, based on no known substantial fires associated with products certified to the voluntary standard.[9]

The estimated number of annual e-bike incidents is about 20,000, based on reports identified with the e-bike code for NEISS.[10] Additionally, staff believes that some of the estimated 457,000 annual bicycle injuries and more than 1000 deaths may include e-bikes, depending on how the incident was reported.

E-bikes, e-scooters, and self-balancing scooters are used in roadways and on sidewalks, and they may be used in potentially more congested areas, if used for commuting. Helmet use is limited, which likely increases the severity of some head-injury incidents when they occur. The Directorate for Epidemiology will complete a report on micromobility product incident data in FY2020.

5 REGULATIONS AND VOLUNTARY STANDARDS

The local rules for use of commercial micromobility products are not always clear to consumers. As shared-riding services – like those for e-bikes and e-scooters – have grown in cities, towns, and universities, many local jurisdictions have established their own rules. For example, some localities permit street use and prohibit use on sidewalks; other localities prescribe just the opposite. The difference in usage requirements may cause confusion for consumers who are using these ride-sharing services in multiple localities.

[9] *See* CPSC letter to manufacturers, importers, distributors, and retailers of self-balancing scooters: https://www.cpsc.gov/s3fs-public/Hoverboard-Letter_Kaye_signed_2.22.18.pdf.

[10] The National Electronic Injury Surveillance System (NEISS) is a data-collection system. Data are collected from approximately 100 hospitals across the United States and then weighted to provide consumer injury estimates nationwide. https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data

The CPSC has a regulation that covers the mechanical requirements for bicycles and e-bicycles (less than 20 mph) at 16 CFR part 1512, *Requirements for Bicycles*. However, this regulation does not include electrical requirements, other than to limit the speed of the e-bicycle for mechanical structure and safety requirements.

Similarly, many ASTM International, European Committee for Standardization (CEN), and International Organization for Standardization (ISO) voluntary standards for bicycle types and conditions provide requirements for mechanical safety. Some of these voluntary standards also include limited electrical requirements for e-bicycles.

To address the mechanical hazards associated with micromobility products, staff participates in the following voluntary standards activities:

- ASTM F2641-08 (reapproved 2015). *Standard consumer safety specification for recreational powered scooter and pocket bikes,*
- ASTM F2642-08 (reapproved 2015) *Standard consumer safety specification for safety instructions and labeling for recreational powered scooters and pocket bikes,*
- ASTM F15.58 *Draft Standard consumer safety specification for self-balancing scooters (hoverboards),* and
- ASTM F15.58 *Draft Standard commercial electric-powered scooters for adults (commercial ride-sharing).*

Staff also actively participated in developing the following Underwriters Laboratories (UL) standards:

- UL 2272 *Standard for electrical systems for personal e-mobility devices*. (Staff notes this standard needs to be revised to include commercial ride-sharing products), and
- UL 2849 *Standard for electrical systems for e-bikes* (Staff notes this standard needs to be revised to include commercial ride-sharing products).

In addition, staff is aware of two other international standards for e-bikes:

- EN 15194: EPAC – Electrically power-assisted cycles (2017), and
- ISO 4210-10 Safety standard for e-bikes (draft).

6 STAFF ACTIVITIES ON MICROMOBILITY PRODUCTS

Staff has conducted and continues to engage in a range of activities focusing on micromobility products. The following is a brief summary of staff efforts.

6.1 PUBLIC BRIEFING TO THE COMMISSION

On February 26, 2020, staff briefed the Commission on the potential hazards and risks associated with micromobility products.

6.2 VOLUNTARY STANDARDS ACTIVITIES

Staff participates in standards development for the safety of micromobility products, as discussed in section 5 of this report. Staff is participating in ASTM work item, WK 70724, *New Specification for Commercial Electric-Powered Scooters for Adults*, to develop performance requirements specific to commercial e-scooters for use in ride-sharing applications. In a recent letter to the ASTM F15.58 Subcommittee on Powered Scooters and Skateboards, staff asked ASTM to consider addressing the following topics for this new standard: brake failures, electrical and thermal-related events, software issues, durability (fatigue testing), dynamic and static load testing, environmental conditions, and warning labels and instructions. Additionally, staff provided data that was presently available to support the review of these topics.

Staff will continue work on work item WK 57360 to complete ASTM F15.58 *Draft Standard Consumer Safety Specification for Self-Balancing Scooters (Hoverboards).* Staff will also work with ASTM F15.58 to revise ASTM F2641-08 (reapproved 2015) and ASTM F2642-08 (reapproved 2015) to address new lithium-ion battery products and other hazards associated with children's e-scooters.

Staff will also work with UL or other electrical voluntary standards developers to improve electrical system standards for micromobility products. Specifically, staff will work with industry to address hazards associated with shared-use products.

6.3 STAKEHOLDER OUTREACH

The CPSC will hold a stakeholder forum on micromobility products later this fiscal year. The goal of the forum is to provide staff with information on the micromobility product market, hazards, risks, and risk reduction efforts that will assist staff in making recommendations for improving consumer safety of these products.

6.4 COLLABORATIONS WITH FEDERAL AGENCIES

Staff continues to collaborate with micromobility product federal agency stakeholders. For example:

- Staff is coordinating with the U.S. DOT, including the National Highway Traffic Safety Administration (NHTSA), and the National Transportation Safety Board (NTSB), to review jurisdictional issues and to manage specific agency activities to address safety of these products when used on streets and public areas.

- Through an interagency agreement (IAA), staff has been collaborating with the Naval Surface Warfare Center Carderock Division, leveraging their battery expertise with CPSC staff product safety knowledge to address hazards. The IAA supports compliance activity, voluntary standards, and participation in federal working groups.

To address potential electrical hazards, including battery charging, use, storage, and transportation issues, staff is participating in two federal working groups regarding lithium battery safety:

- The first is the Lithium Battery Safety Working Group, established by the Secretary of the Department of Transportation under Section 333(c) of the FAA Reauthorization Act of 2018 (Public Law No. 115-254) (the Act). This working group consists of two participants each from DOT, National Institute for Standards and Technology (NIST), the U.S. Food and Drug Administration (FDA), and CPSC.

  The working group is tasked to identify, assess, and report to Congress on:

  1. additional ways to decrease the risk of fires and explosions from lithium batteries and cells;
  2. additional ways to ensure uniform transportation requirements for bulk and individual batteries; and
  3. new or existing technologies that may reduce the fire and explosion risk of lithium batteries and cells.

- The second working group, the Lithium Battery Interagency Coordination Group, consists of 19 federal agencies, whose mission is to offset the threat associated with the transportation, use, and remediation of lithium batteries. This group operates as a forum for federal stakeholders to coordinate on policy development, enforcement, information-sharing, research, and education.

7 SUMMARY

Consumer use of micromobility products has grown in recent years, due, in part, to the proliferation of commercial ride-sharing services. Among other benefits, micromobility products offer consumers options for short-distance travel. Staff has identified potential mechanical, electrical, and human factors hazards associated with this product category. Combining these identified product hazards with riders potentially unfamiliar with the product and local laws contributes to consumer injuries.

Staff is working to advance micromobility consumer product safety through development of, and improvements to, voluntary standards, and collaborations with our federal partners and industry stakeholders. A stakeholder forum on micromobility products is planned for later this fiscal year, as well as an epidemiology report on injury data. These activities will help to inform voluntary standards work.