White Paper Summarizing Existing Battery Labeling Requirements and Standards

U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery

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Contents

Abbreviations

ANSI	American National Standards Institute
ARA	Automotive Recyclers Association
BCI	Battery Council International
BIL	Bipartisan Infrastructure Law
Cd	cadmium
CPSC	U.S. Consumer Product Safety Commission
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EOL	end-of-life
EPA	U.S. Environmental Protection Agency
EPR	extended producer responsibility
EU	European Union
EV	electric vehicle
HEV	hybrid electric vehicle
IEC	International Electrotechnical Commission
ISO	International Organization for Standards
LMT	light means of transport
LIB	lithium-ion battery
NFPA	National Fire Protection Association
Ni-Cd	nickel-cadmium
NSVRP	National Salvage Vehicle Reporting Program
Pb	lead
PHEV	plug-in hybrid electric vehicles
QR	quick response
RFI	request for information
RFID	radio frequency identification
SAE	Society of Automotive Engineers
SSLA	small sealed lead-acid
SLI	starting, lighting, and ignition
UL	Underwriters Laboratories
ZEV	zero-emission vehicle

1 Introduction

A clean energy transformation is underway. As the United States rapidly transitions away from fossil fuels, renewable energy sources are seeing unprecedented growth. Batteries play a central role in this transformation. They power everything from cars and trucks to electric bikes (e-bikes) and consumer electronics. They are also used in many industrial applications, from powering construction and agricultural equipment to providing backup power for critical infrastructure and storing energy for renewable power generation. As battery use increases globally, so does the demand for critical materials needed to manufacture single-use and rechargeable batteries. To reduce global reliance on the mining of virgin raw materials, including cobalt and lithium, the United States will need to increase the recovery of these critical materials from end-of-life (EOL) batteries. However, increasing these recovery rates will require overcoming the current technological, economic, regulatory, and social barriers to the safe collection and recycling of batteries. Today, many batteries are disposed of in municipal solid waste or recycling because consumers lack information on how or where to properly manage them. Products containing embedded batteries are often disposed of in municipal solid waste because consumers are unaware of the presence of a battery.

Sections 70401 and 40207 of the Bipartisan Infrastructure Law (BIL) direct the U.S. Environmental Protection Agency (EPA) to address these challenges along the battery life cycle through the development of voluntary battery labeling guidelines, battery collection best practices, consumer education materials, and a national extended producer responsibility (EPR) framework for batteries drafted in close coordination with the U.S. Department of Energy (DOE).[1] Together, these efforts will help state, local, and Tribal governments establish and improve battery collection programs and help consumers more easily participate in proper battery EOL management, reducing the frequency of safety incidents from improper battery disposal (e.g., fires at waste management facilities).

By developing new voluntary battery labeling guidelines, EPA seeks to increase consumer awareness of the presence of batteries in products and to empower consumers to properly dispose of them, depending on their local collection programs. Additionally, EPA aims to increase the proper identification and handling of batteries in battery collection, sorting, and processing facilities, which should improve the safety of facility staff and also increase the recovery of critical materials within the developing U.S. battery recycling infrastructure. These activities are essential to advancing the circular economy for batteries and strengthening the U.S. supply chain for critical materials.

The information in this white paper serves as foundational research to inform the development of the forthcoming voluntary battery labeling guidelines as mandated by the BIL. This white paper synthesizes the key findings from existing battery labeling guidelines to identify key information needs for EPA's voluntary battery labeling guidelines and ensure alignment with U.S. and international battery-related mandates, including:

- U.S. federal battery labeling requirements, including those in the 1996 Mercury-Containing and Rechargeable Battery Management Act (Battery Act).
- U.S. state EPR laws that include battery marking or labeling requirements.
- International battery labeling laws from the European Union (EU) and Japan.
- Voluntary battery labeling recommendations and guidelines.

This white paper is not a policy declaration by EPA, nor does it set forth any voluntary or required labeling standards, recommendations, or guidelines. This white paper is intended as a reference material only. Inclusion of any standard in this paper does not constitute an endorsement from EPA. The findings from EPA's research activities are not intended as a comprehensive overview of all existing battery labeling standards and mandates;

rather, they are meant to provide the necessary context to develop consistent voluntary battery labeling guidelines and education on safe use, handling, storage, disposal, and EOL management for all battery types.

2 Considerations for Battery Labeling

BIL Section 70401 requires EPA to develop voluntary battery labeling guidelines consistent with existing U.S. federal battery labeling requirements in the 1996 Battery Act and with international battery labeling standards. Because the BIL does not specify the types of information that should be included in the forthcoming voluntary battery labeling guidelines, EPA first compiled a breakdown of the types of information that are often included in existing labeling guidelines, as shown in Table 1.

Table 1: Information in Existing Battery Labeling Requirements and Labeling Guidelines

Type of Information	Description
Applicability	Battery types, uses, or chemistries covered by the existing labeling requirement or voluntary standard.
Production	General product information such as the product name; manufacturer name and contact information; packer, distributor, importer, or seller; country of origin; and production date.
Battery-specific	Details about the battery, including the battery chemistry (e.g., color coding, chemical symbols); cathode and anode identifiers (for lithium-ion batteries [LIBs] only); voltage; capacity; model number; polarity; and non-spillable markings.
EOL management	Information or instructions on how to properly dispose of the battery. This may include recycling symbols (e.g., the "chasing arrows" symbol, the crossed-out wheeled bin) and/or disposal and recycling instructions for consumers.
Safety	Information aimed at reducing safety risks during use, storage, and/or disposal of batteries or battery-containing products. This may include general warnings, handling recommendations, and cautionary statements, as well as symbols, markings, or warnings for dangerous goods and hazardous materials.
Transportation	Information about the safe transport of batteries and battery-containing products. This may include references to U.S. Department of Transportation (DOT) requirements for shipments of new, used, and EOL batteries.
Refurbishment and recycled content	Information used to signal that a battery may contain a certain percentage of recycled material or that a product may contain a refurbished battery.
Physical placement and size of the label	Instructions on the placement and size of a physical label and on the use of virtual information collection. Label placement depends on the battery's size; where it is located within the product, vehicle, or equipment; and whether it is embedded (i.e., one that has been placed permanently into a product and is not intended to be removed by the consumer).
Label design	Design elements including the color of the label font and/or background, as well as the font type and size. Design elements are often tied to specific label content, including safety warnings, battery chemistry, and EOL management.
Label durability	Specifications about the durability of the label, which may include a specification that the label should last the entire life cycle of a battery or product.

Based on feedback from EPA's virtual working sessions and responses to the request for information (RFI) that EPA issued in 2022, EPA focused its labeling research on battery-specific information, safety, and EOL management, as well as label design and durability. These pieces of information are needed to meet the stated purpose of the guidelines, which is to increase battery recycling and reduce safety incidents. EPA reviewed U.S. federal and state labeling requirements, international requirements, voluntary labeling standards, and other relevant standards with this key information in mind. The next several sections summarize EPA's findings on how existing requirements and standards address the need for communicating battery-specific information and information on safety and EOL management via battery labeling. These findings also provide insights into how current standards may align or conflict.

3 U.S. Federal Battery Labeling Requirements

This section reviews U.S. federal requirements for battery labeling. EPA did not attempt to cover all labeling requirements for batteries and battery-containing products but focused its research on reviewing labels that might be relevant for alignment with the BIL mandates. In the United States, lead-acid, nickel-cadmium (Ni-Cd), and LIB chemistries are currently subject to national labeling requirements. Additionally, button cell and coin batteries and products that contain these batteries are subject to warning labels for child safety.

3.1 The Mercury-Containing and Rechargeable Battery Management Act (1996)

The 1996 Battery Act phased out the use of mercury-containing batteries and aimed to improve the collection, recycling, and labeling of Ni-Cd and lead-acid batteries. Under the Act, manufacturers are required to include a label on removeable batteries and on battery-containing products with non-removeable batteries if they are regulated by the Act. Specifically, the Battery Act requires that labels for Ni-Cd and small sealed lead-acid (SSLA) batteries display the following: the chasing arrows, the chemical name (for regulated batteries), and certain phrases for proper disposal such as "BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY." For mercuric-oxide batteries, the label must direct consumers to a collection site and provide a phone number for consumers to call for information about proper disposal. The Battery Act has a provision that gives EPA the authority to determine through rulemaking if additional battery chemistries are covered by the Act. The requirements in the Battery Act specifically target retailers, manufacturers, and battery handlers, and are further summarized in Table 3 in Section 8.[2]

3.2 Call2Recycle Recycling Labels (1998)

Although the 1996 Battery Act was a major milestone in battery recycling, it did not include key labeling information for consumers and battery consolidators that would help facilitate recovery (e.g., information on the cathode, anode, and electrolyte, and EOL management information). To address this concern, in 1998 EPA partnered with the Rechargeable Battery Recycling Corporation (now Call2Recycle) and announced the certification of a new label for rechargeable batteries and their packaging to reduce consumer confusion around proper disposal of EOL rechargeable batteries. As presented in Figure 1, the labels provided a toll-free number

that consumers could call for more information on how to dispose of the battery properly.[3]

Figure 1: Call2Recycle recycling labels. *Source: Call2Recycle, 1998.*[4]

3.3 Reese's Law (2022)

Passed in 2022, Reese's Law provides standards related to human safety. Specifically, Reese's Law aims to prevent the ingestion of button cell or coin batteries and products containing these batteries.[6] Reese's Law required the U.S. Consumer Product Safety Commission (CPSC) to promulgate a rule for safety performance and labeling of products and packaging.[6] In the final rule, 88 FR 65296, effective September 21, 2024, CPSC required warning labels on the packaging of all button cell and coin batteries; on the packaging of all products containing button cell or coin batteries; in accompanying literature (including user manuals) with relevant batteries and products; and directly on products containing button cell or coin batteries where practical (see Figure 2). Reese's Law and the final rule promulgated by CPSC do not require the label to include battery-specific information or information on production, EOL management, or transportation. However, the warning symbol is intended to help alert consumers to the presence of a battery, which could assist with recycling or EOL management options once consumers identify the battery that needs to be managed.

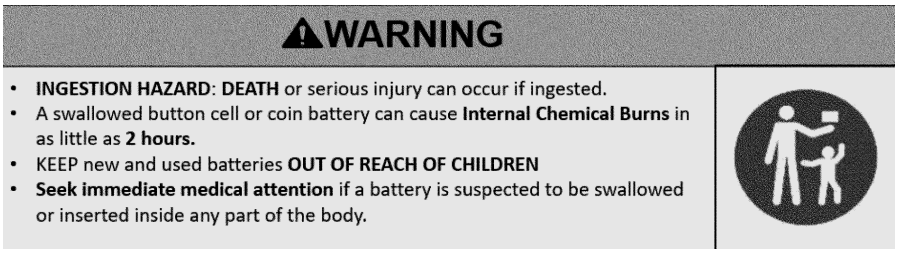

Figure 2: Label for button cell and coin batteries, warning of ingestion hazards. *Source: CPSC, 2023.*[5]

3.4 Transportation Labeling for Lithium-ion Batteries

Transportation labeling is not a key focus of this white paper because labeling requirements for international transportation of batteries are established by the International Civil Aviation Organization's Technical Instructions, by the International Air Transport Association's Dangerous Goods Regulations, and by the International Maritime Dangerous Goods Code. Additionally, country-specific regulations are enforced by the country that enacted them. The U.S. DOT regulates domestic shipments of lithium-ion cells and batteries and enforces international shipping requirements and U.S. laws on movements of hazardous materials, including LIBs and lead-acid batteries.[7,8] DOT developed a guide for shippers of LIBs, which provides instructions and examples of labels needed for shipping LIBs and products packed with or containing batteries. The DOT guide includes information on exceptions for batteries being shipped for disposal or recycling. It also helps shippers identify correct packaging for LIBs.

Some battery collectors like Call2Recycle have worked with DOT to ensure that LIBs shipped for recycling are properly labeled. Call2Recycle was issued a DOT special permit that allows the organization and its partners to ship batteries via a specialized collection box.[9] The Call2Recycle battery collection partnership programs ensure proper handling and recycling of batteries by equipping partner locations with materials for collection and shipping, including the label seen in Figure 3.[9] Call2Recycle's shipping label focuses on safety by identifying that a battery is present and should be handled properly.

Figure 3: Call2Recycle shipping label.
Source: Call2Recycle, n.d.[9]

4 State-Level Battery Labeling Requirements

In the United States, state-level battery labeling requirements are emerging. The EPR laws and accompanying rulemakings that create labeling requirements differ across states, producing variations in state requirements. For example, states may include different information on the label or use various means to communicate the required information (e.g., use of different symbols for management). Adopted in 2022, California's Advanced Clean Cars II New Vehicle Battery Labeling Requirements are the most comprehensive labeling mandates in terms of the information required, but they only apply to large format vehicle batteries.[10] Other California battery-related laws—the California Responsible Battery Recycling Act of 2022 and the California Electronic Waste Recycling Act of 2003—apply to small format batteries and battery-containing products.[11,12] Recent legislation from Washington and Illinois extends labeling requirements to a combination of small, mid-, and large format batteries and embedded batteries as described in Table 2.[13] Many other states have passed laws related to retail collection of used batteries and required signage to educate consumers about EOL battery management, but these laws do not address labeling.

The Advanced Clean Cars II, Title 13, Section 1962.6 outlines battery label requirements for zero-emission vehicles (ZEVs), plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs) for sale in California.[10] The regulation requires battery labels to contain the following: a chemistry identifier, the minimum voltage of the battery pack, the battery capacity, and a digital identifier. Additionally, the regulation requires labels in the following locations: (1) the exterior of the battery or each portion of the battery pack, and (2) a visible location in the engine compartment, powertrain, or cargo compartment, or on the driver's side doorjamb.

As of November 2024, 11 states and the District of Columbia have battery EPR laws applicable to primary and/or rechargeable batteries.[14] These EPR laws focus on establishing stewardship programs to increase the recycling and collection of batteries. Three state-level battery EPR laws—those in California (2022), Washington (2023), and Illinois (2024)—include labeling or marking requirements. Consistent across all three EPR laws is the

requirement that batteries sold within the state include the battery chemistry on the label, as well as symbols or indicators signaling that consumers should not dispose of the batteries as household waste. However, labels are not required to provide information for consumers on where to recycle their batteries. The Washington and Illinois laws note that the state rulemaking agencies may amend the labeling requirements to remain consistent with any labeling requirements or voluntary standards established by federal law.[11,13,15]

Table 2 presents select examples of state laws that require battery labeling.

Table 2: Examples of U.S. State Laws Requiring Battery Labeling

State Law	Applicability	Label Content and Placement Requirements
California Advanced Clean Cars II New Vehicle Battery Labeling Requirements[10]	Applies to large format vehicle batteries for electric vehicles (EVs), ZEVs, HEVs, and PHEVs.	Battery chemistry; cathode and anode; and manufacturer and date of manufacture, as stated in the Society of Automotive Engineers (SAE) standard J2984. The label must be on the exterior of the battery to be clearly visible and accessible when the battery is removed from the vehicle.
California Responsible Battery Recycling Act of 2022[11] (EPR)	Applies to small format primary batteries only.	Battery chemistry; language indicating that the battery should not be placed in household waste. The law does not specify where to place the label.
California Electronic Waste Recycling Act of 2003,[12] amended by Senate Bill 1215	Applies to all battery-containing products.	Battery chemistry (information can be presented either on the product label or on the manufacturer's website). The law states that the label must be clearly visible.
Washington Battery Stewardship Law[13] (EPR)	Applies to primary and rechargeable small, medium-, and large format batteries and battery-containing products.	Producer information, as size allows. Starting in 2030, all new applicable batteries must be labeled to ensure collection and recycling. Labels must identify the chemistry of the battery and an indication that the battery should not be disposed of as household waste. The law does not specify where to place the label.
Illinois Portable and Medium-Format Battery Stewardship Act[15] (EPR)	Applies to primary and rechargeable small and medium-format batteries and battery-containing products.	Starting in January 2029, producers and retailers may only sell small and medium-format batteries and battery-containing products if the battery is marked with a label that identifies battery chemistry and indicates that the battery should not be placed in household trash or recycling.

New York's Rechargeable Battery Recycling Law, passed in 2010, requires manufacturers to provide retailers with information on how to safely handle and store rechargeable batteries, but it does not include specific battery labeling requirements.[16] Retailers are required to post point-of-sale signs in their stores notifying consumers about the state's disposal ban and advising consumers to recycle batteries at the retailer's location.[17] Forty-five states have implemented similar laws requiring lead-acid battery retailers to accept lead-acid batteries from consumers and deliver them to recycling facilities. Of these states, 30 require retailers to post an educational sign at the point-of-sale location, informing consumers about the proper disposal method for lead-acid batteries. In some states, the chasing arrows symbol is required. The required language for this educational sign varies among states, but the message that producers and retailers are responsible for lead-acid battery recycling remains consistent.[18]

5 International Battery Labeling Requirements

This section reviews battery labeling requirements from the EU and Japan, in consideration of the BIL's mandate to develop voluntary U.S. battery labeling guidelines that align with existing international standards. Several key features of the labeling requirements from these countries could serve as examples for EPA's development of voluntary guidelines for the United States.

5.1 European Union Batteries Regulation (2023)

In 2006, the EU adopted a Batteries Directive, applicable to all member states, that regulates battery production and disposal and requires the use of a symbol for the separate collection of batteries (see Figure 4). The EU enacted the 2023 Batteries Regulation that will repeal the 2006 Batteries Directive as of 2025. The 2023 EU Batteries Regulation does the following:

- Provides additional requirements regarding sustainability, EPR, safety, markings, information, and labeling.[19,20]
- Updates the 2006 labeling requirements to include additional details on capacity, battery chemical composition, carbon footprint values, and handling instructions.[19,20] These new labeling requirements, outlined in Annex VI of the regulation and summarized in Table 3 at the end of this document, go into effect between 2025 and 2026.[20]
- Requires that every EV battery and industrial battery with a capacity of over 2 kilowatt-hours should have an EU "battery passport," an official document that will accompany the battery throughout its entire life cycle, from production to disposal.[21] The battery passport will contain vital information about the battery, including its composition, capacity, voltage, and other specifications. The EU battery passport is one example of how labels can be used to share information along a product's value chain.

Figure 4: EU symbol for separate collection of batteries. ***Source: EU Battery Regulation 2023/1542, 2023.***[20]

5.2 Battery Association of Japan Labeling Requirements (2000)

Japan established the Law for the Promotion of the Effective Utilization of Resources in 2000. The law required manufacturers to indicate on labels how to properly recycle applicable batteries.[22] To meet the requirements of the law, the Battery Association of Japan specified labeling requirements for batteries to improve recycling; however, there are limited studies on the impact of the labeling requirements on recycling rate. Labels provide information for EOL management, identify battery chemistry through color coding, and identify toxic or hazardous substances. The color scheme for identifying chemistry aligns with the following voluntary standards, which are discussed in Sections 6.1 and 7.

6 Voluntary Battery Labeling Standards

This section provides an overview of voluntary battery labeling standards, including globally recognized industry standards from organizations such as SAE International, Battery Council International (BCI), and the Automotive Recyclers Association (ARA).

6.1 Society of Automotive Engineers International Standards

SAE International is a global association of engineers and technical experts that develops voluntary consensus standards. For the automotive industry or ground vehicle category, SAE has developed over 8,000 standards applicable to various components of cars, including batteries. EPA reviewed SAE standards J2936 and J2984 because these provide a consistent recommendation for identifying the battery chemistry and including color coding, the chasing arrows, and safety information in alignment with U.S. and international requirements. However, industry experts participating in EPA's battery collection and recycling working sessions noted that the SAE recommendations have not yet been widely implemented. SAE J2936 and J2984 are summarized in Table 3 at the end of this document.

SAE J2936-201212 Electrical Energy Storage Device Labeling Recommended Practice[23] is a comprehensive reference guideline for labeling any device used for energy storage, including "cell, battery and pack level products used in mobility, stationary and secondary use applications." The information in these labeling recommendations is intended for the automotive sector but is written for "anyone working in the field of energy storage devices." The guideline recommends including the chasing arrows symbol and a chemistry identifier on the label, with the chemistry denoted using the practice described in J2984. The recommended practices also note other labeling information required by country, as well as practices recommended by the industry.

SAE J2984-202109 Chemical Identification of Transportation Batteries for Recycling[24] is referenced in the J2936 guideline and offers a standardized way for rechargeable transportation battery manufacturers to denote chemical composition using the system chemistry, cathode material identifiers and sub identifiers, anode active material identifier, and miscellaneous information (e.g., flammable liquid, rare earths). The standard includes: (1) battery definitions citing SAE J1715/2 and other relevant SAE definitions; (2) identification codes for the battery chemistry and production referencing International Electrotechnical Commission (IEC) 62902, which identifies electrochemical storage technologies (batteries and others) according to their chemistry; and (3) recommendations for the physical placement of the identifier. The standard also includes examples of battery chemistry identification. This standard does not include specific information on the label design and label durability or other battery information (e.g., voltage, recycling instructions, safety information, handling, storage, or transportation).

6.2 Battery Council International Recommended Practices Battery Labeling Manual

BCI promotes the responsible manufacture, use, and recycling of batteries for energy storage applications. BCI's *Recommended Practices Battery Labeling Manual*, last revised in 2020, summarizes labeling requirements for lead-acid batteries from the United States, Canada, the EU, China, and Japan, as well as BCI-recommended (but not legally required) labeling practices that are based on industry standards.[25] The manual includes definitions of common label terms, a table of labeling requirements, explanations of typical battery labels (including sample

labels), and an appendix of reference materials. The labeling recommendations reflect major nationally and internationally adopted laws and standards governing health, safety, and the environment, as of January 2020.

In the manual, elements of label contents and design are displayed on sample labels, as shown in Figure 5 and Figure 6. The sample labels in the manual include descriptions and references to applicable U.S. or foreign laws and other applicable standards. Letters in the symbols are further explained in the manual.

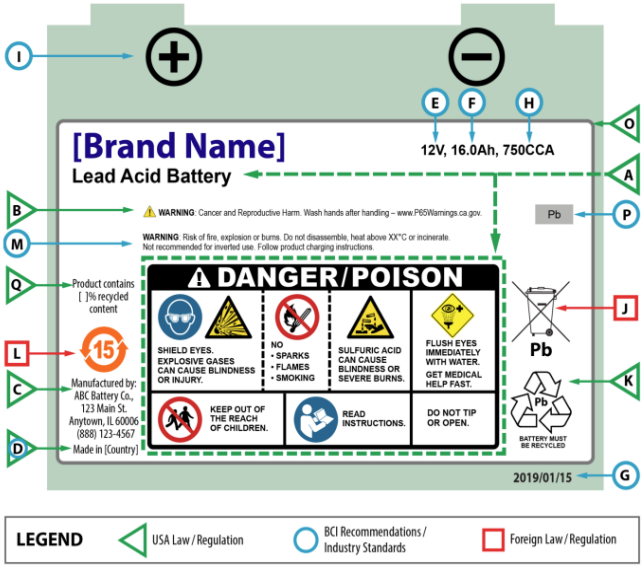

Figure 5: BCI recommended label for consumer starting, lighting, and ignition batteries. *Source: BCI, 2020.*[25]

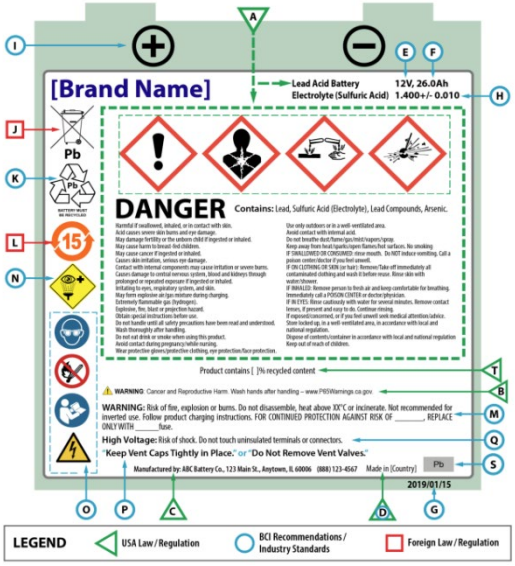

Figure 6: BCI recommended label for workplace, industrial, and non-consumer batteries. *Source: BCI, 2020.*[25]

6.3 National Salvage Vehicle Reporting Program

Established in 2008 at the request of the U.S. Department of Justice, the National Salvage Vehicle Reporting Program (NSVRP) is a nonprofit, dedicated to reducing auto theft and controlling criminal activities related to exporting stolen or fraudulently procured vehicles.[26] NSVRP oversees a battery registry focused on batteries that have been removed from EVs but may have enough life for a second use. NSVRP generates labels for EV batteries and provides them to facilities that have been certified by ARA as high-voltage vehicle recyclers. The labels have an embedded unique quick response (QR) code, which includes a coded battery registry URL and coded label ID. When a battery recycler scans a label, they are directed to the NSVRP portal for quick registration. NSVRP facilitates used battery purchases by providing second-life battery storage companies access to browse available batteries in the registry. These companies can then reach out directly to an automobile recycler to make a purchase.

6.4 Automotive Recyclers Association

ARA advances the automotive recycling industry and supports professional automotive recycling businesses by increasing awareness of the industry's role in environmental stewardship, promoting the value of recycled original equipment, and providing professional standards, education, and information on safety, best practices, and other topics.[24] ARA has developed several resources to keep auto recyclers safe, including an EV readiness checklist, a high-voltage vehicle checklist, and a high-voltage vehicle handling and dismantling protocol. In

addition to documents, ARA also developed two stickers to place on vehicles to improve worker safety during the dismantling and recycling processes, as shown in Figure 7 and Figure 8.[25]

Figure 7: ARA high-voltage "battery intact" sticker. *Source: ARA, 2020.*[28]

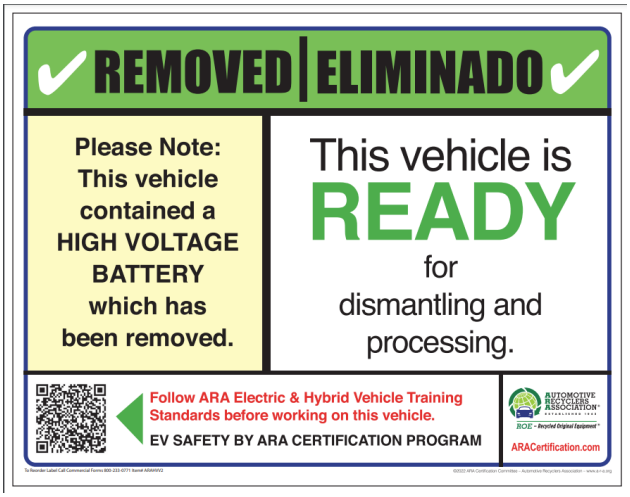

Figure 8: ARA high-voltage "battery removed" sticker. *Source: ARA, 2020.*[28]

7 Other Battery Safety and Labeling Standards

This section lists additional international standards relevant for both battery safety and labeling for EPA to consider when developing the labeling guidelines. The list is non-exhaustive but represents standards identified during research and through discussions with interested parties engaged with EPA's ongoing battery collection and labeling working sessions. Certain standards could be incorporated into labeling legislation or rulemakings—for example, Reese's Law prompted CPSC to adopt UL 4200A: Battery Testing and Labeling Services as a response to the law's rulemaking mandate for button cell and coin battery safety.[6,29] The list below demonstrates that batteries are subject to many standards and requirements, making labeling a challenge due to limited space and the various standards that may apply.

- The IEC is a nonprofit organization that develops and publishes international standards for all electrical, electronic, and related technologies.
    - IEC 62902: Secondary Cells and Batteries—Marking Symbols for Identification of Their Chemistry.
    - IEC 61429: Marking of Secondary Cells and Batteries with the International Recycling Symbol ISO 7000-1135.
    - IEC/ISO TR 24729: Information Technology—Radio Frequency Identification for Item Management—Implementation Guidelines, Part 2: Recycling and RFID Tags.
- The International Code Council's 2024 International Fire Code includes "regulations to safeguard life and property from fires and explosion hazards." The 2024 version includes tools to manage LIB collection, a section on the hazards of powered micromobility devices, a section on lithium-ion and lithium metal batteries, and guidance on battery markings for fire and explosion hazards.

- The American National Standards Institute (ANSI) is a nonprofit organization that coordinates U.S. voluntary standards, including testing and safety standards for various types of batteries. ANSI has published standards for safety alerts (not battery-specific), as well as general and safety standards for portable batteries.
    - ANSI Z535: Safety Alerting Standards.
    - ANSI C18.1 Part 1: American National Standard for Portable Primary Cells and Batteries with Aqueous Electrolyte—General and Specifications.
    - ANSI C18.1 Part 2: American National Standard for Portable Primary Cells and Batteries with Aqueous Electrolyte—Safety Standard.
    - ANSI C18.2 Part 1: American National Standard for Portable Rechargeable Cells and Batteries—General and Specifications.
    - ANSI C18.2 Part 2: American National Standard for Portable Rechargeable Cells and Batteries—Safety Standard.
    - ANSI C18.3 Part 1: American National Standard for Portable Lithium Primary Cells and Batteries—General and Specifications.
    - ANSI C18.3 Part 2: American National Standard for Portable Lithium Primary Cells and Batteries—Safety Standard.
    - ANSI C18.5M Part 1: Portable Lithium Rechargeable Cells and Batteries.
- UL Solutions offers globally recognized safety standards for batteries used for energy storage, EVs, and micromobility.[28]
    - UL 1642: Standard for Lithium Batteries.
    - UL 1974: Creating a Safe Second Life for Electric Vehicle Batteries.
    - UL 2054: Standard for Household and Commercial Batteries.
    - UL 2271: Standard for Batteries for Use in Light Electric Vehicle Applications.
    - UL 2272: Standard for Electrical Systems for Personal E-Mobility Devices.
    - UL 2849: Standard for Electrical Systems for E-Bikes.
    - UL 4200A: Battery Testing and Labeling Services for Reese's Law.
    - UL 60086-4: Standard for Safety for Primary Batteries—Part 4: Safety of Lithium Batteries.
    - UL 9540: Energy Storage System Requirements.
- The National Fire Protection Association (NFPA) is a nonprofit organization offering over 300 codes and standards, as well as professional training, education, and advocacy. Relevant NFPA safety standards apply primarily to large format stationary energy storage batteries. These standards help ensure the safety of those installing and working with the batteries. The standards do not specifically address labeling for recycling.
    - NFPA 855: Standard for the Installation of Stationary Energy Storage Systems.
    - NFPA 70: National Electrical Code.

8 Summary of Select Battery Labeling Requirements and Guidelines

Table 3 summarizes select existing battery labeling requirements and voluntary standards from the United States, the EU, BCI, and SAE International.

Table 3: Summary of Select Requirements and Voluntary Standards

	U.S. Battery Act of 1996[2]	EU Batteries Regulation[20]	BCI Battery Labeling Manual[25]	SAE J2936 and SAE J2984 (aligns with IEC 62902)[23,24]
Applicability	The Act applies to Ni-Cd and lead-acid batteries.	The 2023 Batteries Regulation updates the definitions of covered batteries to include the following categories: portable, industrial, automotive, EV, and light means of transport (LMT).	The recommended practices apply to SSLA batteries; starting, lighting, and ignition (SLI) lead-acid batteries; and their packaging.	SAE J2936 could apply to any device used for energy storage, including "cell, battery and pack level products used in mobility, stationary and secondary use applications."[23]
Chemical Symbol or Identification	The Act requires chemical identification of regulated Ni-Cd or lead (Pb) batteries.	All batteries must include general information on their category, chemistry, and whether they are rechargeable. All batteries containing more than 0.002% Cd or 0.004% Pb must be marked with the chemical symbol for the metal concerned.	The manual recommends compliance with the U.S. Battery Act of 1996 requirement to include a Ni-Cd or Pb label. The manual recommends having a chemical symbol on the battery label.	Color coding: • Ni-Cd: Yellow green • Nickel–metal hydride: Orange • Lithium-ion: Cobalt blue • Pb: Silver • Nickel-zinc: Green
Placement and Legibility of Statements	Label must be on each individual battery or battery-containing product, in addition to the product packaging unless the label on the battery or battery-containing product is visible through the packaging.	A QR code must be in high contrast to the background color and large enough to be easily readable by a common QR code reader.	Required label elements should be "clear and conspicuous, separated from other text and graphics, and not placed on the bottom of the product."	Information must be displayed on the largest panel or side of the product. The label copy should be clean and free of any dirt or excess print. It should have a lower gloss reflection to ensure readability. The label should be on a background of sharp contrasting color to ensure it stands out to the user. The label should be durable and remain intact for the entire life of the product.
Recycling Symbol or Label	The chasing arrows symbol (or a comparable recycling symbol) is required for all regulated batteries. Label for Ni-Cd batteries: "nickel-cadmium" or "Ni-Cd," with the	Batteries must display the crossed-out wheeled bin (see Figure 4), which is the EU symbol for separate collection.[31]	The manual recommends compliance with the U.S. Battery Act of 1996 and EU requirements.	Batteries should display the chasing arrows symbol.

	U.S. Battery Act of 1996[2]	EU Batteries Regulation[20]	BCI Battery Labeling Manual[25]	SAE J2936 and SAE J2984 (aligns with IEC 62902)[23,24]
	phrase “Battery must be recycled or disposed of properly.” Label for rechargeable consumer products containing nonremovable Ni-Cd batteries: “Contains nickel-cadmium battery. Battery must be recycled or disposed of properly.” Label for regulated lead-acid batteries: “Pb” or the words “lead,” “return,” and “recycle.” Label for rechargeable consumer products containing nonremovable regulated lead-acid batteries: “Contains sealed lead battery. Battery must be recycled.” Labels must be in all capital letters.			

9 Key Findings

This review of U.S. and international battery labeling requirements and voluntary standards focuses on three of the key information needs identified by EPA for the development of voluntary battery labeling guidelines: EOL management information, battery specifications (including chemistry), and safety information. At present, a single comprehensive standard requiring battery producers and manufacturers to label batteries and battery-containing products for improved collection and safe recycling does not exist. Box 1 summarizes key findings from the review of existing labeling requirements and voluntary standards that will help EPA focus on the types of information needed to achieve the purpose of the voluntary battery labeling guidelines and align them with existing requirements and standards.

Box 1: Key Findings from EPA's Review of Existing Labeling Requirements and Voluntary Guidelines

EOL management information labels are a work in progress, and there is limited evidence of their impact on recycling.

- Existing labeling requirements in the United States, the EU, and Japan include messaging and/or symbols indicating that batteries and battery-containing products should be recycled, but battery labels do not provide clear instructions for users to determine where or how batteries should be collected.
- New labeling requirements that aim to improve information on EOL management have been adopted in the EU, Washington State, and California in recent years, but not all are fully in effect as of November 2024. As such, governing bodies cannot evaluate the efficacy of these new labeling requirements in improving recycling.
- Recycling symbols vary by region. The EU uses a crossed-out wheeled bin, whereas standards and regulations in the United States and other regions reference the Mobius loop (i.e., chasing arrows symbol).

Battery chemistry identification and rated capacity can help aid safe recycling, but these label elements are not internationally standardized.

- SAE International provides a recommended chemistry identifier with anode and cathode information for LIBs.
- Standardized color coding by chemistry is referenced in some regulatory requirements and voluntary standards but is not widely adopted.
- Labeling guidelines for chemistry should be adaptable to new battery chemistries and new sorting technologies.

Safety labeling or markings included in existing safety standards could be incorporated into law.

- Standards organizations have developed several safety standards applicable to specific battery formats, including standards for safe use, storage, repair, reuse, and recycling. These safety standards could be incorporated into federal or state law by reference.
- For small format consumer electric and portable batteries, U.S. federal law requires safety information on the battery packaging to reduce the risk of ingestion (Reese's Law). Washington and California state laws will require labeling to ensure proper EOL management; these labeling requirements are under development as of January 2025.
- For micromobility or mid-format batteries, safety standards aim to tackle emerging safety issues and reduce fire risks. For example, New York State incorporated safety standards into new laws on e-mobility. Washington State will require labeling for EOL management; these labeling requirements are under development as of January 2025.

Box 1: Key Findings from EPA's Review of Existing Labeling Requirements and Voluntary Guidelines

- For large format vehicle batteries, motive equipment batteries, and stationary storage batteries, voluntary standards and example labels aim to improve safety for recyclers and for reuse.

Existing industry guidelines can serve as a model for labeling recommendations and content considerations.

- International standards organizations compile requirements and recommendations for label components—including content, design, placement, and durability—which can be used as a model for EPA's voluntary labeling guidelines.

10 Next Steps

Moving forward, EPA will continue engaging with parties across the battery life cycle to develop the voluntary battery labeling guidelines as required by the BIL. Specifically, in 2025, EPA will host working sessions on mid-format and large format batteries in partnership with other federal agencies, battery manufacturers, retailers, industry leaders, and state, local, and Tribal governments. The goal of these sessions is to build on feedback received on effective label content and design considerations from the small format battery engagement sessions. EPA will assess this feedback to inform the development and implementation of the guidelines. The guidelines will focus on standardizing necessary information for different audiences to identify batteries and battery-containing products and increase proper EOL management.

To bolster adoption of the voluntary battery labeling guidelines and increase their effectiveness, EPA will conduct additional research on consumer education and messaging based on feedback gathered from working session participants. EPA will develop and test messaging to ensure that the labeling guidelines resonate and meet the needs of priority audiences, including municipalities, consumers, and recyclers. Additionally, EPA will create a collection best practices toolkit to accompany the voluntary guidelines, which will help to improve EOL battery management by increasing access to collection sites. EPA will also, in coordination with DOE, develop a battery EPR framework that addresses battery recycling goals, cost structures for mandatory recycling, reporting requirements, product design, collection models, and transportation of collected materials.

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Appendix: Relevant Legislation

The following sections include excerpts from relevant state, federal, and international legislation that state requirements for battery labels.

Relevant Text from the Mercury-Containing and Rechargeable Battery Management Act (1996)

SEC. 102. PURPOSE.

The purpose of this title is to facilitate the efficient recycling or proper disposal of used nickel-cadmium rechargeable batteries, used small sealed lead-acid rechargeable batteries, other regulated batteries, and such rechargeable batteries in used consumer products, by—

(1) providing for uniform labeling requirements and streamlined regulatory requirements for regulated battery collection programs; and

(2) encouraging voluntary industry programs by eliminating barriers to funding the collection and recycling or proper disposal of used rechargeable batteries.

SEC. 103. RECHARGEABLE CONSUMER PRODUCTS AND LABELING.

b) LABELING.—Each regulated battery or rechargeable

consumer product without an easily removable battery manufactured on or after the date that is 1 year after the date of enactment of this Act, whether produced domestically or imported shall bear the following labels:

(1) 3 chasing arrows or a comparable recycling symbol.

(2)(A) On each regulated battery which is a nickel-cadmium battery, the chemical name or the abbreviation "Ni-Cd" and the phrase "BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY."

(B) On each regulated battery which is a lead-acid battery, "Pb" or the words "LEAD," "RETURN," and "RECYCLE" and if the regulated battery is sealed, the phrase "BATTERY MUST BE RECYCLED."

(3) On each rechargeable consumer product containing a regulated battery that is not easily removable, the phrase "CONTAINS NICKEL-CADMIUM BATTERY. BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY." Or "CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED," as applicable.

(4) On the packaging of each rechargeable consumer product, and the packaging of each regulated battery sold separately from such a product, unless the required label is clearly visible through the packaging, the phrase "CONTAINS NICKEL-CADMIUM BATTERY. BATTERY MUST BE RECYCLED OR DISPOSED OF PROPERLY." or "CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED," as applicable

Relevant Text from California AB-2440 Responsible Battery Recycling Act (2022)

Article 3. Stewardship Plans for Covered Batteries

42422.1. A stewardship plan for covered batteries shall include all of the following:

(p) Developing strategies in coordination with other program operators to develop and implement proper labeling of covered batteries to ensure proper collection and recycling, by identifying the chemistry of the covered battery and including an indication that the covered battery should not be disposed of as household waste

42424.1. A program operator shall annually submit to the department, in the form and manner, and by the date, determined by the department, an annual report, which the department shall make publicly available that includes all of the following information for the preceding calendar year:

(l) (1) A report on coordination activities with other program operators, including covered battery collection and recycling programs and electronic waste recyclers, with regard to the proper management or recycling of collected covered batteries, for purposes of providing the efficient delivery of services and avoiding unnecessary duplication of effort and expense.

(2) A description of efforts undertaken by a program operator to implement the required labeling of covered batteries pursuant to Section 42422.1.

Relevant Text from California SB-1215 Electronic Waste Recycling Act (2003)

42466.1.(a) On and after January 1, 2026, a person shall not sell or offer for sale in this state a new or refurbished covered electronic device, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, unless the item is labeled with the name of the manufacturer or the manufacturer's brand label so that it is readily visible.

(b) A new or refurbished covered electronic device, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, battery-embedded product shall either be labeled with information identifying the chemistry of the battery contained within the covered electronic devices sold by the manufacturer or include that information on the manufacturer's internet website.

42467. On or before July 1, 2027, and at least once annually thereafter, each manufacturer of a covered electronic device, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, sold in this state shall do both of the following:

(1) Submit to CalRecycle a report that includes all of the following information:

(A) An estimate of the number of covered electronic devices, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, sold by the manufacturer in the state during the previous year.

(B) The chemistry of the battery contained within the covered electronic devices, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, sold by the manufacturer.

(C) A baseline or set of baselines that show the total estimated amount of recycled materials contained in covered electronic devices, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, sold by the manufacturer in that year and the increase in the use of those recycled materials from the previous year.

(D) A list of those retailers, including, but not limited to, internet and catalog retailers, to which the manufacturer provided a notice in the prior 12 months pursuant to Section 42466.2.

(2) Make information available to consumers that describes where and how to return, recycle, and dispose of the covered electronic device, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463, and opportunities and locations for the collection or return of the device, through the use of a toll-free telephone number, internet website, information labeled on the device, information included in the packaging, or information accompanying the sale of the covered electronic device, as defined in subparagraph (B) of paragraph (1) of subdivision (g) of Section 42463.

Relevant Text from Washington State SB-5144—Providing for Responsible Environmental Management of Batteries (2023)

Marking requirements for batteries.

(1) Beginning January 1, 2028, a producer or retailer may only sell, distribute, or offer for sale in or into Washington a large format battery, covered battery, or battery-containing product that contains a battery that is designed or intended to be easily removable from the product, if the battery is:

(a) Marked with an identification of the producer of the battery, unless the battery is less than one-half inch in diameter or does not contain a surface whose length exceeds one-half inch; and

(b) Beginning January 1, 2030, marked with proper labeling to ensure proper collection and recycling, by identifying the chemistry of the battery and including an indication that the battery should not be disposed of as household waste.

(2) A producer shall certify to its customers, or to the retailer if the retailer is not the customer, that the requirements of this section have been met, as provided in RCW 70A.555.030.

(3) The department may amend, by rule, the requirements of subsection (1) of this section to maintain consistency with the labeling requirements or voluntary standards for batteries established in federal law.

[2023 c 434 § 14.]

Relevant Text from European Union (EU) Batteries Regulation (2023)*(44) Batteries should be labelled in order to provide end-users with transparent, reliable and clear information about batteries and waste batteries. That information would enable end-users to make informed decisions when buying and discarding batteries and waste operators to appropriately treat waste batteries.*

Batteries should be labelled with all the necessary information concerning their main characteristics, including their capacity and the amount of certain hazardous substances present. To ensure the availability of information over time, that information should also be made available by means of QR codes which are printed or engraved on batteries or are affixed to the packaging and to the documents accompanying the battery and should respect the guidelines of ISO/IEC Standard 18004:2015. The QR code should give access to a battery's product passport. Labels and QR codes should be accessible to persons with disabilities, in accordance with Directive (EU) 2019/882 of the European Parliament and of the Council (17).

CHAPTER III

Labelling, marking and information requirements

Article 13

1. *From 18 August 2026 or 18 months after the date of entry into force of the implementing act referred to in paragraph 10, whichever is the latest, batteries shall bear a label containing the general information on batteries set out in Part A of Annex VI.*
2. *From 18 August 2026 or 18 months after the date of entry into force of the implementing act referred to in paragraph 10, whichever is the latest, rechargeable portable batteries, LMT batteries and SLI batteries shall bear a label containing information on their capacity.*
3. *From 18 August 2026 or 18 months after the date of entry into force of the implementing act referred to in paragraph 10, whichever is the latest, non-rechargeable portable batteries shall bear a label containing information on their minimum average duration when used in specific applications and a label indicating 'non-rechargeable'.*
4. *From 18 August 2025, all batteries shall be marked with the symbol for separate collection of batteries ('separate collection symbol') as shown in Part B of Annex VI.*
    a. *The separate collection symbol shall cover at least 3 % of the area of the largest side of the battery up to a maximum size of 5 × 5 cm.*
    b. *In the case of cylindrical battery cells, the separate collection symbol shall cover at least 1,5 % of the surface area of the battery and shall have a maximum size of 5 × 5 cm.*
    c. *Where the size of the battery is such that the separate collection symbol would be smaller than 0,47 × 0,47 cm, the battery does not need to be marked with that symbol. Instead, a separate collection symbol measuring at least 1 × 1 cm shall be printed on the packaging.*
5. *All batteries containing more than 0,002 % cadmium or more than 0,004 % lead, shall be marked with the chemical symbol for the metal concerned: Cd or Pb.*
    a. *The relevant chemical symbol indicating the heavy metal content shall be printed beneath the separate collection symbol and shall cover an area of at least one-quarter the size of that symbol.*
6. *From 18 February 2027, all batteries shall be marked with a QR code as described in Part C of Annex VI. The QR code shall provide access to the following:*
    a. *(a) for LMT batteries, industrial batteries with a capacity greater than 2kWh and electric vehicles batteries, the battery passport in accordance with Article 77;*
    b. *(b) for other batteries, the applicable information referred to in paragraphs 1 to 5 of this Article, the declaration of conformity referred to in Article 18, the report referred to in Article 52(3) and*

the information regarding the prevention and management of waste batteries laid down in Article 74(1), points (a) to (f);

c. *(c) for SLI batteries, the amount of cobalt, lead, lithium or nickel recovered from waste and present in active materials in the battery, calculated in accordance with Article 8.*

This information shall be complete, up-to-date and accurate.

7. *The labels and the QR code referred to in paragraphs 1 to 6 shall be printed or engraved visibly, legibly and indelibly on the battery. Where this is not possible or not warranted on account of the nature and size of the battery, the labels and the QR code shall be affixed to the packaging and to the documents accompanying the battery.*
8. *The Commission is empowered to adopt delegated acts in accordance with Article 89 to amend this Regulation to provide for alternative types of smart labels for use instead of or in addition to the QR code, in view of technical and scientific progress.*
9. *Batteries that have been subject to preparation for re-use, preparation for repurposing, repurposing or remanufacturing shall bear new labels or shall be marked with markings in accordance with this Article and containing information on their change of status in accordance with point 4 of Annex XIII, which shall be accessible through the QR code.*
10. *The Commission shall, by 18 August 2025, adopt implementing acts to establish harmonised specifications for the labelling requirements referred to in paragraphs 1, 2 and 3 of this Article. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 90(3).*

Labelling and marking of batteries ANNEX VI LABELLING, MARKING AND INFORMATION REQUIREMENTS

Part A: General information on batteries

Information on the label of a battery shall comprise the following information regarding the battery:

1. *information identifying the manufacturer in accordance with Article 38(7);*
2. *the battery category and information identifying the battery in accordance with Article 38(6);*
3. *the place of manufacture (geographical location of a battery manufacturing plant);*
4. *the date of manufacture (month and year);*
5. *the weight;*
6. *the capacity;*
7. *the chemistry;*
8. *the hazardous substances present in the battery, other than mercury, cadmium or lead;*
9. *usable extinguishing agent;*
10. *critical raw materials present in the battery in a concentration of more than 0,1 % weight by weight.*

Part B: Symbol for separate collection of batteries

Part C: QR code

The QR code shall be in high contrast to the background colour and of a size that is easily readable by a commonly available QR reader, such as those integrated in hand-held communication devices.