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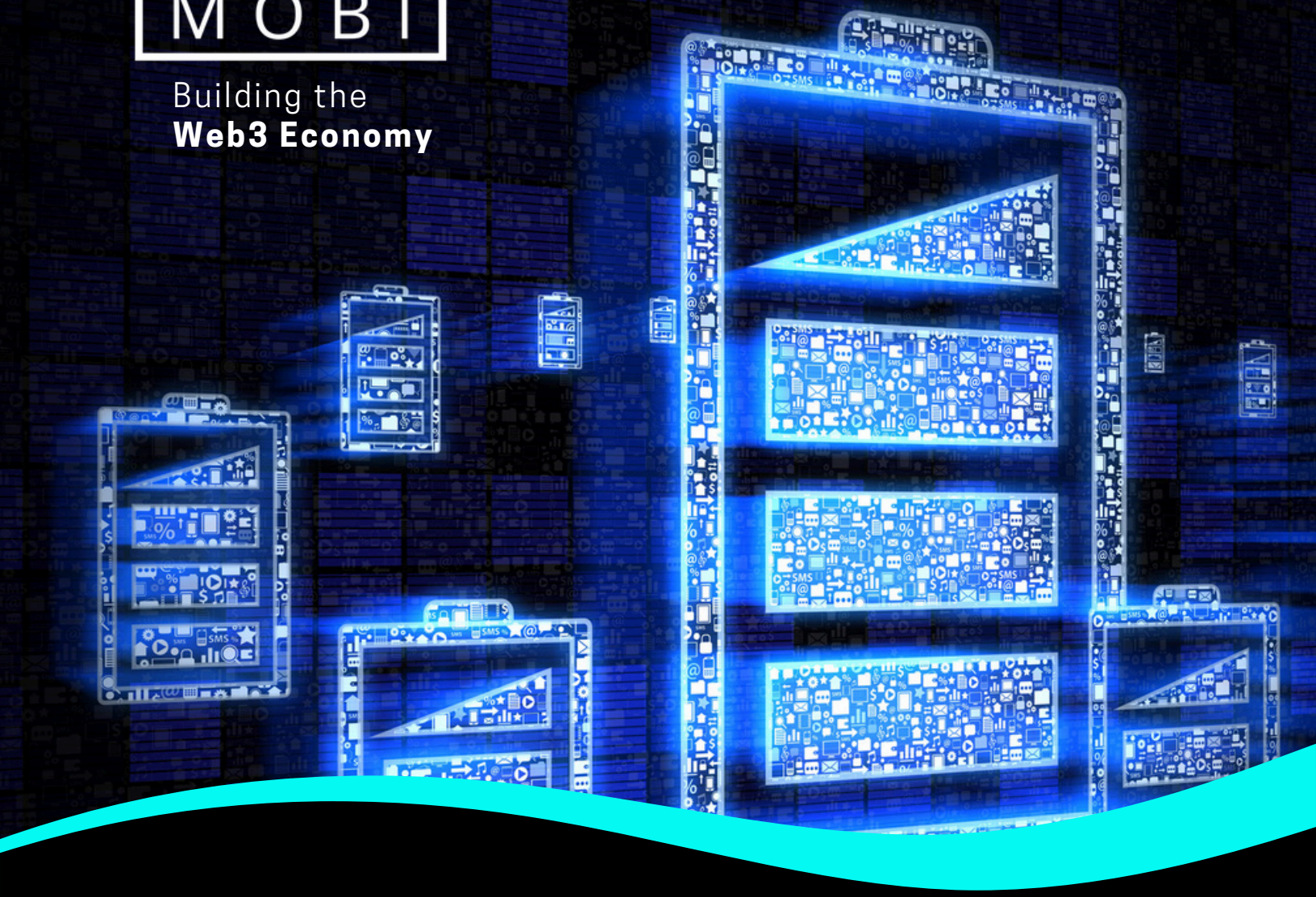

BATTERY BIRTH CERTIFICATE

MOBI BBC0001/TS/2024 Version 0.9

Specifications for the Creation of Battery Birth Certificates

April 2024

MOBI
Circular Economy & the Global Battery Passport Working Group

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1. About MOBI BBC Tech Specs

This document delineates the foundational standards for the MOBI Battery Birth Certificate (MOBI-BBC or BBC), a pivotal component in fostering traceability and interoperability across the global battery value chain. The MOBI BBC encapsulates essential digital battery data recorded at the inception of its service life, whether as a new unit, remanufactured entity, or repurposed resource. Access to BBC information is restricted to permissioned parties based on their roles in the value chain. This ensures data privacy, security, and compliance with regulatory mandates while facilitating seamless information exchange among authorized stakeholders.

By defining the attributes of the BBC, this document begins to establish a framework for compliance with various regulations and industry norms governing battery lifecycle management.

In an era marked by the proliferation of electric vehicles (EVs) and the increasing adoption of batteries for sustainable energy solutions, the BBC emerges as a cornerstone for achieving comprehensive battery lifecycle traceability. As batteries evolve from passive energy storage units to autonomous devices capable of communication and transaction, the BBC serves as the foundational dataset within the Global Battery Passport, facilitating seamless tracking and management throughout its lifecycle.

The transition towards a more connected, circular, and resilient global battery value chain is hindered by a myriad of challenges, including trusted identity and data issues, information sharing gaps, and permissioned-traceability hurdles. Widespread adoption of the BBC — and, by extension, the Global Battery Passport — is set to enable countless new applications rooted in trusted battery data, including use cases centered around enhanced lifecycle management, EV diagnostics, carbon credit tracking, and charging optimization.

The MOBI BBC Technical Specifications document represents a significant milestone in advancing permissioned-traceability, efficiency, and sustainability within the global battery ecosystem. By defining attributes for the BBC, this standard sets the stage for more seamless data management, cross-industry interoperability, and innovation.

2. Scope of MOBI BBC Tech Specs

MOBI-BBC includes static data attributes about battery packs. These attributes describe the manufacturer's information, carbon footprint, durability, performance, etc. The static data remains the same once recorded. This is unlike dynamic data, which will change after the initial recording. In the context of batteries, static data value remains the same throughout the battery's intended life cycle stage. For example, the number of cells or modules in a pack is classified as static data since this is unlikely to change during the first use of the battery.

Note: There are no official or standardized methodologies of how a battery attribute is categorized as static or dynamic. At MOBI, the Working Groups decide which attributes are labeled static or dynamic.

3. Glossary of Terms

BBC: Battery Birth Certificate

BIN: Battery Identification Number

B-SSDT™: Battery Self-Sovereign Digital Twin™

C-rate: A measure of the rate at which a battery is discharged relative to its maximum capacity

DLT: Distributed Ledger Technology

DID: Decentralized Identifier

EC: European Commission

EO: Economic Operator

EU: European Union

EV: Electric Vehicle

ITN: Integrated Trust Network

IMDS: International Material Data System

LMT: Light Means of Transport

SSI: Self-Sovereign Identity

SSDT™: Self-Sovereign Digital Twin™

SOCE: State of Certified Energy

VC: Verifiable Credential

VIN: Vehicle Identification Number

VP: Verifiable Presentation

W3C: World Wide Web Consortium

4. Using BBC as a Verifiable Credential

BBCs are implemented as World Wide Web Consortium (W3C) Verifiable Credentials (VCs), which consist of credential metadata, claim(s), and proof(s)[1]. Attributes listed in Section 8 are included as part of the claims in the VC pertaining to the battery pack as a subject. Holders can then use data (included in claims) from various VCs in Verifiable Presentations (VPs). BBC credentials are one type of many credentials in the battery passport.

5. Attribute Structure of a BBC

The BBC includes the following attributes.

ID: Unique identifying number assigned by MOBI to individual attributes.

Category: Categories include general battery and manufacturer information, compliance, labels and certifications, battery materials and composition, carbon footprint, circularity and resource efficiency, performance, and durability. Categories of attributes were derived from the Battery Pass project's Content Guidance.[2]

Name: Name of the attribute for the battery birth certificate.

Data Type: The list of data types includes Decimal, Integer, URL, Date, String, and Array.

Description: Short description of the attribute.

Unit: Measurement unit of the attribute in %, Kilogram, Kilowatt Hour, etc.

[1] https://www.w3.org/TR/vc-data-model-2.0/#dfn-subjects.

[2] Battery Passport Content Guidance, https://thebatterypass.eu/assets/images/content-guidance/pdf/2023_Battery_Passport_Content_Guidance.pdf, Version 1.1, December 2023.

6. Standardized BBC Attributes

Because different regulations require different static battery attributes, MOBI has created standardized lists of attributes that should be part of the claims portion of BBC credentials to comply with various regulations and use cases.

6.1. To Comply with EU Regulations – Article 77/Annex XIII/Section 1 for Public - (BBC-EU-1)

ID	Category	Name	Data Type	Description	Unit
C1-1	General battery and manufacturer information	batteryId	String	Battery DID - ITN DID Method or other comparable DID Methods.	-
C1-2	General battery and manufacturer information	packUniqueId	String	Unique identifier allowing for the unambiguous identification of each battery pack - use MOBI BIN Standard.[3]	-
C1-3	General battery and manufacturer information	manufacturersId	String	Unambiguous identification of the manufacturer of the battery - use of GS1 Company Prefix.	-
C1-4	General battery and manufacturer information	manufacturingDate	Date	Manufacturing date - use YYYY-MM-DD -- ISO 8601 UTC format.	-
C1-5	General battery and manufacturer information	manufacturingLocation	String	Location of the final assembly plant of the pack - use full address of the plant.	-
C1-6	General battery and manufacturer information	intendedUse	String	Intended use of the battery. Choose from - LMT Battery, Electric Vehicle Battery or Industrial Battery.	-
C1-7	General battery and manufacturer information	packWeight	Integer	Weight of the entire battery pack.	Kilogram
C1-9	General battery and manufacturer information	cellType	String	Battery cell type used in the battery. Choose from - Lithium-ion, Nickel-metal hydride, Solid States, Lead Acid, Ultra-capacitors.	-
C1-10	General battery and	cellManufacturerId	String	Unambiguous identification of the cell manufacturer - use GS1 Company Prefix. [4]	-

[3] "First Open Battery Identity Standard Enables Web3 Supply Chain Efficiency – Mobi: The New Economy of Movement." MOBI, September 7, 2023. https://dlt.mobi/bin-release/.

	manufacturer information				
C1-11	General battery and manufacturer information	mobileOrStationary	String	Describes battery usage. Choose from Mobility or Stationary.	-
C1-13	General battery and manufacturer information	finalQualityTestDate	Date	Quality test date - use YYYY-MM-DD -- ISO 8601 UTC format. [5]	-
C1-14	General battery and manufacturer information	finalQualityTesterName	String	The name of the company that performed the final quality test.	-
C1-15	General battery and manufacturer information	packSerialNumber	String	A unique identifier assigned incrementally or sequentially to the battery by the OEM.	-
C1-17	General battery and manufacturer information	packDimensions	String	Dimensions of battery pack final assembly. Width (shorter side) x Length (longer side) x Depth or Height	Centimeter
C2-1	Compliance, labels and certifications	EUConformityDeclarationDocument	URI	URI of the EU declaration of conformity signed by responsible economic operators to declare compliance with the regulatory requirements in the context of the market conformity assessment procedure and assume full responsibility.	-
C2-2	Compliance, labels and certifications	EUConformityDeclarationID	String	Identification number of the EU declaration of conformity of the battery, linked to the Battery Carbon Footprint Declaration.	-
C2-4	Compliance, labels and certifications	separateCollectionSymbol	URI	URI to the separate collection' or 'WEEE label' indicating that a product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.	-
C2-5	Compliance, labels and certifications	labelsSymbolsMeaning	String	Explanation of the meaning of all symbols and labels	-
C2-6	Compliance, labels and certifications	cadmiumLeadSymbols	URI	Image of Cadmium and lead symbols indicating the metal is contained in the battery above a defined threshold.	-
C3-1	Performance and durability	certifiedUsableBatteryEnergy	Integer	The energy supplied by the battery from the beginning of the test procedure used for certification until the applicable break-off criterion of the test procedure used for certification is reached.	Kilowatt-Hour

[4] What is a Company Prefix | GS1 US, accessed April 11, 2024, https://www.gs1us.org/upcs-barcodes-prefixes/what-is-a-prefix#:~:text=A%20GS1%20Company%20Prefix%20is,to%20your%20retail%20growth%20plan

[5] "ISO 8601 - Date and Time Format." ISO, March 11, 2020. https://www.iso.org/iso-8601-date-and-time-format.html.

C3-3	Performance and durability	ratedCapacity	Integer	The total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under specific conditions;	Ampere-Hour
C3-4	Performance and durability	nominalVoltage	Integer	The voltage value assigned to an electric circuit or system to designate its voltage class.	Volts
C3-5	Performance and durability	minimumVoltage	Integer	Minimum voltage the battery is rated for.	Volts
C3-6	Performance and durability	maximumVoltage	Integer	Maximum voltage the battery is rated for.	Volts
C3-7	Performance and durability	originalPowerCapability	Integer	Original power capability (in Watts) and limits, with temperature range when relevant.	Watts
C3-8	Performance and durability	maxPermittedBatteryPower	Integer	Maximum permitted power the battery is rated for, includes the data relevant to 'power limits'.	Watts
C3-9	Performance and durability	ratioNominalAllowedPower	Integer	Ratio between nominal allowed battery power (W) and battery energy (Wh).	Watts per Hour
C3-11	Performance and durability	roundTripEnergyEfficiency50pCycleLife	Integer	Round trip energy efficiency at 50% of cycle-life; measured at 50% of cycle life as determined in a pre-use standardized measurement.	%
C3-12	Performance and durability	initialInternalResistanceCellLevel	Integer	Initial (pre-use) internal resistance on battery cell level.	Milliohm
C3-13	Performance and durability	maxInitialInternalResistancePackLevel	Integer	Initial (pre-use) internal resistance on battery pack level.	Milliohm
C3-14	Performance and durability	maxInitialInternalResistanceModuleLevel	Integer	Initial (pre-use) internal resistance on battery module level.	Milliohm
C3-15	Performance and durability	expectedLifetime	Integer	Expected battery lifetime expressed in cycles, and reference test used.	Number of Cycles
C3-16	Performance and durability	cycleLifeReferenceTest	String	Specification of the applied cycle-life test.	-
C3-17	Performance and durability	cRateRelevantCycleLifeTest	Decimal	Measurement parameter: Applied charge and discharge rate (C-rate) of relevant cycle-life test.	-
C3-18	Performance and durability	thresholdCapacityExhaustion	Integer	Capacity threshold for exhaustion.	%
C3-19	Performance and durability	SOCEExhaustionThreshold	Integer	Minimum percentage of SOCE[6], above which the battery is still considered operational as an EV battery in its current life.	%
C3-20	Performance and durability	batteryWarrantyPeriod	Integer	Warranty period of the battery.	Years
C3-22	Performance and durability	idleStateTemperatureRangeLB	Integer	Lower boundary of the surrounding temperature range, which the battery can	Celsius

[6] Battery Passport Content Guidance, https://thebatterypass.eu/assets/images/content-guidance/pdf/2023_Battery_Passport_Content_Guidance.pdf, Version 1.1, December 2023.

				safely withstand.	
C3-23	Performance and durability	idleStateTemperatureRangeUB	Integer	Upper boundary of the surrounding temperature range, which the battery can safely withstand.	Celsius
C3-24	Performance and durability	totalEnergy	Integer	Total amount of energy when charged to 100%.	Kilowatt-Hour
C3-25	Performance and durability	maxChargeRate	Integer	The highest sustainable amount of power the battery is capable of capturing.	Kilowatt
C3-26	Performance and durability	maxDischargeRate	Integer	The maximum power at which the battery can be discharged continuously.	Kilowatt
C3-27	Performance and durability	operationalTempUB	Integer	Upper boundary of the surrounding temperature range, which the battery can safely operate.	Celsius
C3-28	Performance and durability	operationalTempLB	Integer	Lower boundary of the surrounding temperature range, which the battery can safely operate.	Celsius
C3-29	Performance and durability	materialSource	Array	Sources of the raw material used.	-
C3-30	Performance and durability	DODCycleLifeTest	Integer	The percentage of battery capacity that has been discharged, expressed as a percentage of maximum capacity.	%
C4-1	Battery materials and composition	criticalRawMaterials	Array	Critical raw materials contained in the battery above a concentration of 0.1 % weight by weight = {critical material 1, critical material 2, ...}	-
C4-2	Battery materials and composition	batteryChemistry	Array	Composition of a battery in general terms by specifying the cathode and anode active material as well as electrolyte.	-
C4-6	Battery materials and composition	hazardousSubstancesNames	Array	Name of hazardous substances other than mercury, cadmium or lead = {substance 1, substance 2, ... }	-
C4-7	Battery materials and composition	hazardSubstancesClasses	Array	The class hazardous substances other than mercury, cadmium or lead = {class 1, class 2, ... }	-
C4-8	Battery materials and composition	relatedIDHazardousSubstances	Array	The identifier hazardous substances other than mercury, cadmium or lead = {identier 1, identifier 2, ...}	-
C4-9	Battery materials and composition	locationHazardousSubstances	Array	The location of hazardous substances other than mercury, cadmium or lead on the battery = {substance 1: location 1, substance 2: location 2, ... }	-
C4-10	Battery materials and composition	concentrationRangeHazardousSubstances	String	The concentration range of hazardous substances other than mercury, cadmium or lead = substance 1{lower bound, upperbound}, substance 2{lowerbound, upperbound}, ...	%
C4-11	Battery materials and composition	substancesImpactDescriptions	String	Description of the impact of substances on environment, health, etc.	-
C5-1	Carbon footprint	carbonFootprint	Decimal	The carbon footprint of the battery over its expected service life.	kg/kWh

C5-2	Carbon footprint	carbonFootprintShareRawMaterialAcquisitionPreprocessing	Decimal	The carbon footprint of the battery over its expected service life in raw material acquisition and pre-processing stage.	%
C5-3	Carbon footprint	carbonFootprintShareMainProduction	Decimal	The carbon footprint of the battery over its expected service life in the main production stage.	%
C5-4	Carbon footprint	carbonFootprintShareDistribution	Decimal	The carbon footprint of the battery over its expected service life in the distribution stage.	%
C5-5	Carbon footprint	carbonFootprintShareEndOfLifeRecycling	Decimal	The carbon footprint of the battery over its expected service life in the end-of-life and recycling stage.	%
C5-6	Carbon footprint	carbonFootprintPerformanceClassDoc	URI	URI to carbon footprint performance class document based on carbon footprint life cycle impact.	-
C5-7	Carbon footprint	publicVerCarbonFootprintStudy	URI	A URI to a public version of the study supporting the carbon footprint values.	-
C6-1	Supply chain due diligence	dueDiligenceReport	URI	Link to the supply chain due diligence report.	-
C6-2	Supply chain due diligence	thirdPartySupplyChainAssurances	URI	URI to the third-party supply chain assurance document.	-
C6-3	Supply chain due diligence	EUTaxonomyDisclosureStatement	URI	URI to Taxonomy disclosure statements.	-
C6-4	Supply chain due diligence	sustainabilityReport	URI	URI to the EU Corporate Sustainability Reporting Directive (CSRD) requires EU companies to draft a sustainability report.	-

6.2. To Comply with EU Regulations– Article 77/Annex XIII Sections 2 and 3 for Regulators – (BBC-EU-2)

In addition to the attributes listed in Section 5.1, the regulators require the following ones:

ID	Category	Name	Data Type	Description	Unit
C2-3	Compliance, labels and certifications	EUComplianceTestResultsReport	URI	URI to the results of tests reports proving compliance in the market conformity assessment procedure with the requirements as per the technical documentation.	-
C4-3	Battery materials and composition	cathodeAnodeElectrolyteNames	Array	Name of the materials = {cathode material, anode material, electrolyte material} in this order.	-
C4-4	Battery materials and composition	relatedIDsCathodeAnodeElectrolytes	Array	Related identifiers of the cathode, anode, electrolyte materials = {identier of cathode, an identifier of anode, identifier of electrolyte}	-
C4-5	Battery materials and composition	weightCathodeAnodeElectrolytes	Array	Total weights of the cathode, anode, and electrolyte materials in the pack = {cathode weight in kg, anode weight in kg, electrolyte weight in kg}	Grams

C7-1	Circularity and resource efficiency	manualBatteryRemoval	URI	URI to the manual for removal of the battery from the appliance.	-
C7-2	Circularity and resource efficiency	manualBatteryDisassemblyDismantling	URI	URI to the manual for the dismantling of the battery pack.	-
C7-3	Circularity and resource efficiency	postalAddressSparePartsSources	Array	Postal address of sources for replacement spares.	-
C7-4	Circularity and resource efficiency	emailsSparePartsSources	Array	E-mail address of supplier for spare parts.	-
C7-5	Circularity and resource efficiency	spartPartsSources	Array	URI of supplier for spare parts.	-
C7-6	Circularity and resource efficiency	componentsPartNumbers	String	Part numbers for components.	-
C7-8	Circularity and resource efficiency	safetyMeasuresInstructions	URI	URI to Safety measures/instructions to handle waste batteries	-

6.3. To Comply with EU Regulations – Article 77/Annex XIII Sections 2 and 4 for Interested Parties– (BBC-EU-3)

In addition to the attributes listed in Section 5.1, the regulators require the following ones:

ID	Category	Name	Data Type	Description	Unit
C1-8	General battery and manufacturer information	lifeCycleStatus	String	Lifecycle status of the battery. Status defined from a list, with the options suggested as follows: 'Original', 'Repurposed', 'Reused', 'Remanufactured', 'Waste'. Definition of original, repurposed, reused, remanufactured, waste	-
C1-12	General battery and manufacturer information	bmsSoftwareVersion	String	Software version for the battery management system.	-
C1-16	General battery and manufacturer information	oemPartNumber	String	Part number used by OEM per its specification format.	-
C3-2	Performance and durability	initialSelfDischargingRate	Decimal	Initial self-discharge in % of capacity per unit of time in defined conditions (temperature range etc) as pre-use metric.	%
C3-21	Performance and durability	batteryPuttingIntoServiceDate	Date	Date of putting the battery into service - use YYYY-MM-DD -- ISO 8601 UTC formats	-
C3-31	Performance and durability	storageHumidity	Integer	Manufacturer recommended humidity for storing the battery.	%
C4-3	Battery materials	cathodeAnodeEl	Array	Name of the materials = {cathode material,	-

	and composition	ectrolyteNames		anode material, electrolyte material} in this order	
C4-4	Battery materials and composition	relatedIDsCathodeAnodeElectrolytes	Array	Related identifiers of the cathode, anode, electrolyte materials = {identier of cathode, an identifier of anode, identifier of electrolyte}	-
C4-5	Battery materials and composition	weightCathodeAnodeElectrolytes	Array	Total weights of the cathode, anode, and electrolyte materials in the pack = {cathode weight in kg, anode weight in kg, electrolyte weight in kg}	Grams
C7-1	Circularity and resource efficiency	manualBatteryRemoval	URI	URI to the manual for removal of the battery from the appliance.	-
C7-2	Circularity and resource efficiency	manualBatteryDisassemblyDismantling	URI	URI to the manual for dismantling of a battery pack.	-
C7-3	Circularity and resource efficiency	postalAddressSparePartsSources	Array	Postal address of sources for replacement spares.	-
C7-4	Circularity and resource efficiency	emailsSparePartsSources	Array	E-mail address of supplier for spare parts.	-
C7-5	Circularity and resource efficiency	spartPartsSources	Array	URI of supplier for spare parts.	-
C7-6	Circularity and resource efficiency	componentsPartNumbers	String	Part numbers for components.	-

6.4. To Comply with CARB ACC-II Regulations - Article 2 Approval of Motor Vehicle Pollution Control Devices (New Vehicles) Section 1962.6. Battery Labeling Requirements (b)(1)(A) - (BBC-CARB-1)

ID	Category	Name	Data Type	Description	Unit
C8-1	Required Label Information	manufacturersId	String	Unambiguous identification of the manufacturer of the battery. Use of GS1 Company Prefix. The same attribute as ID #C1-3 - Manufacturer's Identification.	-
C8-2	Required Label Information	manufacturingDate	Date	Manufacturing date (YYYY-MM-DD -- ISO 8601 UTC formats). The same attribute as ID #1-4.	-
C8-3	Required Label Information	minimumVoltage	String	Minimum voltage the battery is rated for. The same attribute as ID #C3-5.	Volts
C8-4	Required Label Information	ratedCapacity	Integer	The energy supplied by the battery from the beginning of the test procedure used for certification until the applicable break-off criterion of the test procedure used for certification is reached. The same attribute as ID #C3-1.	Kilowatt-Hour
C8-5	Required Label	packUniqueId	String	Unique identifier allowing for the	-

	Information			unambiguous identification of each battery pack. Proposed use MOBI BIN Standard. The same attribute as ID #C1-2.	
C8-7	Required Label Information	manualBatteryDisassemblyDismantling	URI	URI to the manual for the dismantling of battery pack. The same attribute as ID #C7-2.	-

6.5. To Comply with CARB ACC-II Regulations - Article 2. Approval of Motor Vehicle Pollution Control Devices (New Vehicles) Section 1962.6. Battery Labeling Requirements (c)(1)(A) – (BBC-CARB-2)

ID	Category	Name	Data Type	Description	Unit
C9-1	Data Repository Website Requirements	numberOfCells	Integer	Total number of cells in the pack.	-
C9-2	Data Repository Website Requirements	hazardousSubstancesNames	Array	Name of hazardous substances other than mercury, cadmium or lead = {substance 1, substance 2, ... } The same attribute as ID #C4-6.	-
C9-3	Data Repository Website Requirements	safetyOrRecallInfo	URI	Product safety information or recall information.	-
C9-4	Data Repository Website Requirements	safeDisposalInformation	URI	Web link to a website that provide the following information related to the vehicle's traction battery: safe disposal information.	-

7. References

"Verifiable Credentials Data Model v2.0." W3C, www.w3.org/TR/vc-data-model-2.0/.

"Battery Passport Content Guidance." Battery Pass, thebatterypass.eu/assets/images/content-guidance/pdf/2023_Battery_Passport_Content_Guidance.pdf.

"First Open Battery Identity Standard Enables Web3 Supply Chain Efficiency – MOBI: The New Economy of Movement." MOBI, September 7, 2023. https://dlt.mobi/bin-release/.

"What is a Company Prefix." GS1 US, April 11, 2024, https://www.gs1us.org/upcs-barcodes-prefixes/what-is-a-prefix#:~:text=A%20GS1%20Company%20Prefix%20is,to%20your%20retail%20growth%20plan

"ISO 8601 - Date and Time Format." ISO, March 11, 2020. https://www.iso.org/iso-8601-date-and-time-format.html.