

CATENA-X
STANDARD



CX - 0034 Data Model Battery Pass

BUSINESS DOMAIN: SUSTAINABILITY

USE CASE: CIRCULAR ECONOMY

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Note: Please specify the platform capability in the email subject line.

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ABOUT THIS DOCUMENT & MOTIVATION

Catena-X is the first open and collaborative data ecosystem. The goal is to provide an environment for the creation, operation, and joint use of end-to-end data chains along the entire automotive value chain. All partners are on an equal ground, have sovereign control over their data and no lock-in effects occur. This situation provides a sustainable solution for the digitalization of supply chains, especially for medium-sized and small companies, and supports the cooperation and collaboration of market participants and competitors.

The ever-growing Catena-X ecosystem will enable enormous amounts of data to be integrated and collaboratively harnessed. To ensure that these complex data volumes can be sent, received, and processed smoothly across all stages of the value chain, one language for all players: common standards.

The standards of the Catena-X data ecosystem define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

Common standards create added value for all partners: Within our network, data flows more smoothly through interfaces. In addition, we avoid cumbersome individual IT solutions for sharing data with other partners. In the field of international standardization, Catena-X follows the proven international standardization institutions: ISO/IEC/ITU and CEN-CENELEC/ETSI

For users and data providers, implementation of standards will reduce the costs that would arise from adapting different systems. In addition, no important data is lost. On the contrary, it even becomes easier to collect data across companies. For operators and developers, standards will create a framework that provides reliable orientation and planning security.

The following document describes one of the reference implementations used in the Catena-X ecosystem and the requirements needed to implement it. Here, it serves as main resource to illustrate the following data model. It contains information starting from the format of the model, up to the conceptual and physical model. Defining the data model as a reference implementation enables faster information exchange and homogeneity across the Catena-X ecosystem.

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¹ https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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¹ <https://catena-x.net/de/standardisierung/catena-x-einfuehren-umsetzen/standardisierung/standard-library>

MANAGEMENT SUMMARY

The Battery Passport is a key instrument to develop a sustainable and circular battery value chain delivering on ten principles by monitoring the sustainability performance based on data. They are Understandable, Standardized, Accurate, Differentiating, Auditable, Comprehensive and providing the insights to trigger improvement action. The Battery Passport will be the cornerstone for the Digital Product Passport.

The Passport itself is defined by the usage of Catena-X shared services, a standardized data model and an application which will enable stakeholders to access the relevant data.

The first version of the battery passport model consists out of the following information:

- Battery Identity in the network
- Composition
- Track and Trace data

Circularity parameters will contribute to a more transparent and circular economy within the European Union. In this context, the EU Battery Regulation Drafts set the mandatory basis for circularity parameters for the battery passport without providing many details. A more detailed description is given in the Ecodesign for Sustainable Products Regulation Proposal (ESPR). From these regulations, content clusters for circularity were identified, and concrete circularity parameters for the battery passport derived. The data sets also contain information, which are relevant for closed and open loop business models. It is important to note that the data model contains information / data fields, which are optional and mandatory for regulation fulfillment.

It is also worth mentioning that sharing information within the network is based on decentral technologies and is always based on the individual decision by each partner.

1 INTRODUCTION

The battery accounts for about 40% of the added value in electric cars. It is therefore very important for sustainability and working standards in the automotive industry. The “Battery Passport” project by partners from industry and research therefore wants to design content and technical standards for a battery pass and show them in a pilot project. In this way, consumers can see at a glance what kind of batteries are installed, how they were manufactured and how sustainable they are.

2 PURPOSE OF THE DOCUMENT

The purpose of this document is the description of the Asset Administration Shell submodel Battery Pass. It defines the battery identity and all relevant attributes. The presented data model is described and illustrated in the following with the entities and properties and their interrelationships.

3 SCOPE OF THE IMPLEMENTATION

This chapter serves to situate the given reference implementation, to outline its prerequisites and to point out its limitations.

3.1 PRECONDITIONS AND DEPENDENCIES

Like all Catena-X data models, this model will be available in a machine-readable format on GitHub¹.

This aspect model is written in BAMM 2.0 as a modeling language, which is a separate industry standard from the open manufacturing platform, see Open Manufacturing².

The data contained in this Catena-X data model is requested and exchanged via Catena-X using an Eclipse Dataspace Connector (EDC), which is a separate Catena-X standard and an implementation of the IDSA standard.

3.2 CONSTRAINTS AND LIMITATIONS

There are no constraints and limitations to this reference implementation document.

¹ <https://github.com/eclipse-tractusx/sldt-semantic-models>.

² <https://openmanufacturingplatform.github.io/>

4 DATA MODEL

The data model is described in BAMB and is available in the semantic hub from which the following description originates.

4.1 OVERVIEW

This chapter provides information about the structure of the BAMB Model. It provides information about the properties, entities, characteristics and units of the data model. Each data model references a concrete Aspect Model.

The Meta Model is specified using the Resource Description Format (RDF) and the Terse RDF Triple Language syntax (TTL), together with validation rules in the Shapes Constraint Language (SHACL). Aspect models are likewise specified in RDF/Turtle, following BAMB semantics. The graphical representation of the BatteryPass data model can be found in the annex.

The graphical representation of the battery pass data model can be found in the annex.

Battery Pass	
Name	BatteryPass
Description	The battery pass describes information collected during the lifecycle of a battery.

4.2 PROPERTIES

A property of a BAMB Aspect Meta Model represents a named value. The following are the properties that refer to the aspect of the model.

CO2 footprint total	
Description	The total carbon footprint of the battery, calculated as kg of carbon dioxide equivalent, describes a regulatory requirement.
Name	cO2FootprintTotal
Characteristic	Measurement The total carbon footprint of the battery, calculated as kg of carbon dioxide equivalent, describes a regulatory requirement. Unit kilogram Symbol kg Code KGM

	Type http://www.w3.org/2001/XMLSchema#double
Example	DefaultScalarValue[value=124.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#double']']
Optional	No
In Payload	Yes
Payload Key	cO2FootprintTotal

battery cycle life

Description	Property describing the cycle life of a battery
Name	batteryCycleLife
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryCycleLifeEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	batteryCycleLife

battery identification

Description	Information to identify a specific battery
Name	batteryIdentification
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryIdentificationEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	batteryIdentification

cell chemistry

Description	Information about the cell chemistry of a battery cell
Name	cellChemistry
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#CellChemistryEntity
Example	n/a

Optional	No
In Payload	Yes
Payload Key	cellChemistry

composition	
Description	Information about the composition of a battery and the combination of materials describes a business requirement
Name	composition
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#CompositionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	composition

date placed on market	
Description	Date on which vehicle is produced i.e. when battery is put on the market or production date of the vehicle. Describes a regulatory requirement.
Name	datePlacedOnMarket
Characteristic	Type http://www.w3.org/2001/XMLSchema#date
Example	n/a
Optional	No
In Payload	Yes
Payload Key	datePlacedOnMarket

document	
Description	Set of documents containing the description of battery components
Name	document
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#DocumentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	document

electrochemical properties	
Description	Electrochemical properties of an electrochemical energy storage
Name	electrochemicalProperties
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ElectrochemicalPropertiesEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	electrochemicalProperties

manufacturer	
Description	Legal entity which sells and invoices the battery
Name	manufacturer
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ManufacturerEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	manufacturer

manufacturing	
Description	Information about the manufacturing process of a battery
Name	manufacturing
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ManufacturingEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	manufacturing

physical dimensions	
Description	Geometrical properties of the battery
Name	physicalDimensions

Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#PhysicalDimensionsEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	physicalDimensions

state of battery

Description	The condition of the battery at the end-of-life stage i.e. when entering the recycling scheme
Name	stateOfBattery
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#StateOfBatteryEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	stateOfBattery

temperature range idle state

Description	The range of temperatures the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangeldleState
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#TemperatureRangeldleStateEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	temperatureRangeldleState

warranty period

Description	Commercial warranty period of the battery describes a regulatory requirement.
Name	warrantyPeriod
Characteristic	Measurement Commercial warranty period of the battery describes a regulatory requirement.

	Unit month Symbol mo Code MON Conversion factor 2.629800×10^6 s Type http://www.w3.org/2001/XMLSchema#positiveInteger
Example	DefaultScalarValue[value=60, typeUri= 'DefaultScalar[metaModelVersion=BAMM_2_0_0, urn= 'http://www.w3.org/2001/XMLSchema#positiveInteger']']
Optional	No
In Payload	Yes
Payload Key	warrantyPeriod

4.3 ENTITIES

An entity is a logical encapsulation of multiple values. It has a number of properties, which are described in the following, starting with the entity, followed by its properties.

4.3.1 Address Entity

Address Entity	
Name	Address Entity
Description	Entity of an address. Model follows specification of BPDM (Business Partner Data Management).

Thoroughfare	
Description	Street or thorough road name
Name	thoroughfare
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#ThoroughfareEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	thoroughfare

Locality	
Description	Locality belonging to an address
Name	locality

Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#LocalityEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	locality

Premise	
Description	Premise of an address, e.g. a specific "BUILDING", but can also be used for naming a particular site
Name	premise
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PremiseEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	premise

Postal Delivery Point	
Description	Delivery point, e.g. designation of a gate
Name	postalDeliveryPoint
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PostalDeliveryPointEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	postalDeliveryPoint

Country	
Description	Country of an address
Name	country
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#CountryEntity
Optional	No

In Payload	Yes
Payload Key	country

Post Code	
Description	n/a
Name	postCode
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PostCodeEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	postCode

4.3.2 AttachmentEntity

AttachmentEntity	
Name	AttachmentEntity
Description	Entity encapsulating the details of an attachment for the battery

file location	
Description	Location of the file
Name	fileLocation
Characteristic	Type http://www.w3.org/2001/XMLSchema#anyURI
Example	n/a
Optional	No
In Payload	Yes
Payload Key	fileLocation

Title	
Description	Title of the attached file
Name	title
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	No
In Payload	Yes
Payload Key	title

4.3.3 Contact Entity

Contact Entity	
Name	Contact Entity
Description	Entity to bundle the properties for the information on how to contact an organization

website	
Description	Website of the contact
Name	website
Characteristic	Type http://www.w3.org/2001/XMLSchema#anyURI
Example	DefaultScalarValue[value=https://www.samsung.com, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#anyURI']']
Optional	Yes
In Payload	Yes
Payload Key	website

phone number	
Description	Phone number with country and area code
Name	phoneNumber
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=+49 89 1234567890, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	Yes
In Payload	Yes
Payload Key	phoneNumber
Constraints	Description: Constraint to allow only numbers, whitespaces and an optional leading + sign. Regular expression: <code>^[+]?[0-9]+\$</code>

email	
Description	An email address
Name	email
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=test.mail@example.com, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	Yes
In Payload	Yes
Payload Key	email
Constraints	Description: Regular expression for mail address as defined in W3C (see https://html.spec.whatwg.org/multipage/input.html#valid-e-mail-address) Regular expression: <code>^[a-zA-Z0-9.!#\$%&'*+\\/=/?^_`{ }~-]+@[a-zA-Z0-9-]+(?:\\.[a-zA-Z0-9-]+)*\$</code>

faxNumber	
Description	Fax number with country and area code
Name	faxNumber
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	faxNumber
Constraints	Description: Constraint to allow only numbers, whitespaces and an optional leading + sign. Regular expression: <code>^[+]?[0-9]+\$</code>

4.3.4 Country Entity

Country Entity	
Name	Country Entity
Description	Entity definition for a country

Country Short Name	
Description	n/a
Name	countryShortName
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	No
In Payload	Yes
Payload Key	shortName
Constraints	Description: Regular expression for designation of a short name of a country as defined in ISO 3166-2 Regular expression: ([A-Z]{2}-[A-Z0-9]{1,3})

4.3.5 Postcode Entity

PostCode Entity	
Name	PostCode Entity
Description	Entity for a postcode which consists of a type plus a value

Post Code Value	
Description	The value of a post code
Name	postCodeValue
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=68161\12, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value
Constraints	Description:

	Regular expression for post codes Regular expression: <code>^[a-z0-9][a-z0-9\ -]{0,10}\$</code>
--	---

Post Code Technical Key	
Description	The technical key of a post code
Name	postCodeTechnicalKey
Characteristic	Enumeration Values CEDEX LARGE_MAIL_USER OTHER POST_BOX REGULAR Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	No
In Payload	Yes
Payload Key	technicalKey

4.3.6 Postal Delivery Point Entity

Postal Delivery Point Entity	
Name	Postal Delivery Point Entity
Description	Entity for a postal delivery point which consists of a technical key and a value.

Postal Delivery Point Technical Key	
Description	Technical key of a postal delivery point
Name	postalDeliveryPointTechnicalKey
Characteristic	Enumeration Values INTERURBAN_DELIVERY_POINT MAIL_STATION MAILBOX OTHER POST_OFFICE_BOX Type http://www.w3.org/2001/XMLSchema#string

Example	DefaultScalarValue[value=OTHER, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	technicalKey

Postal Delivery Point Value	
Description	Value of a postal delivery point, e.g. designation of a gate
Name	postalDeliveryPointValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Tor 1, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value

4.3.7 Premise Entity

Premise Entity	
Name	Premise Entity
Description	Entity for a premise which consists of a type (technical key) and a value

Premise Technical Key	
Description	Technical key of a premise
Name	premiseTechnicalKey
Characteristic	Enumeration Values BUILDING HARBOUR LEVEL OTHER ROOM SUITE UNIT WAREHOUSE Type http://www.w3.org/2001/XMLSchema#string

Example	DefaultScalarValue[value=OTHER, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	technicalKey

Premise Value	
Description	Value of a premise, e.g. name or designation of a particular site
Name	premiseValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Werk 1, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value

4.3.8 Thoroughfare Entity

Thoroughfare Entity	
Name	Thoroughfare Entity
Description	Entity for a thoroughfare which consists of a type, value and number

Thoroughfare Technical Key	
Description	Technical key of a thoroughfare. As specified by BPDM, this can be a "STREET" or a different type.
Name	thoroughfareTechnicalKey
Characteristic	Enumeration Values STREET INDUSTRIAL_ZONE OTHER RIVER SQUARE Type http://www.w3.org/2001/XMLSchema#string

Example	DefaultScalarValue[value=STREET, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	technicalKey

Value Thoroughfare	
Description	Value of a thoroughfare, e.g. name of a street
Name	thoroughfareValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Bernstraße, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value

Thoroughfare Number	
Description	Number of a thoroughfare. As used differently in international context, this number can contain both numerical and alphanumerical values
Name	thoroughfareNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=45, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	number

4.3.9 Thoroughfare Entity

Thoroughfare Entity	
Name	Thoroughfare Entity
Description	Entity for a thoroughfare which consists of a type, value and number

Locality Technical Key	
Description	Technical key of a locality
Name	localityTechnicalKey
Characteristic	Enumeration Values BLOCK CITY DISTRICT OTHER POST_OFFICE_CITY QUARTER Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=CITY, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	technicalKey

Locality Value	
Description	Value of a locality, e.g. name of a city ("Mannheim")
Name	localityValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Mannheim, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value

4.3.10 Battery Cycle Life Entity

battery cycle life entity	
Name	battery cycle life entity
Description	Entity to bundle the characteristics describing the cycle life of a battery

cycle life test c-rate	
Description	C-rate of relevant cycle-life test describes a regulatory requirement.
Name	cycleLifeTestCRate
Characteristic	Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=45, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	cycleLifeTestCRate

cycle-life test depth of discharge	
Description	Depth of discharge in the cycle-life test describes a regulatory requirement.
Name	cycleLifeTestDepthOfDischarge
Characteristic	Measurement Depth of discharge in the cycle-life test describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=23, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	cycleLifeTestDepthOfDischarge

expected lifetime	
Description	Expected battery lifetime, expressed in cycles, and reference test used describes a regulatory requirement.
Name	expectedLifetime
Characteristic	Measurement Expected battery lifetime expressed in cycles, and reference test used describes a regulatory requirement. Unit piece

	Code H87 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=456, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	expectedLifetime

4.3.11 Battery Energy Entity

battery energy entity	
Name	battery energy entity
Description	Entity to bundle the energy properties of a battery.

maximum allowed battery energy	
Description	Maximum allowed battery energy (Wh) of the battery describes a regulatory requirement.
Name	maximumAllowedBatteryEnergy
Characteristic	Measurement Characteristic to describe the energy (Wh) properties of the battery describes a regulatory requirement. Unit watt hour Symbol W·h Code WHR Conversion factor 3.6×10^3 J Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value= 90000.0, typeUri= 'DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	maximumAllowedBatteryEnergy
Reference	file:///service/https%3A%2F%2Feur-lex.europa.eu%2Flegal-content%2FEN%2FTXT%2F%3Furi%3DCELEX%3A52020PC0798

energy roundtrip efficiency	
Description	Round-trip efficiency is the percentage of electricity put into storage. Describes a regulatory requirement.
Name	energyRoundtripEfficiency
Characteristic	Measurement Round-trip efficiency is the percentage of electricity put into storage describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=56, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	energyRoundtripEfficiency

energy roundtrip efficiency	
Description	Round-trip efficiency is the percentage of electricity put into storage. Describes a regulatory requirement.
Name	energyRoundtripEfficiencyChange
Characteristic	Measurement Round-trip efficiency is the percentage of electricity put into storage after 50% of life of the battery. Describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=67, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	energyRoundtripEfficiencyChange

4.3.12 Battery Identification Entity

battery identification entity	
Name	battery identification entity
Description	Entity to bundle the characteristics describing the identification of a battery

battery type	
Description	Battery type as described by the contents of the battery e.g. cell chemistry describes a regulatory requirement.
Name	batteryType
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=LFP, Natrium, Li-Ion, NMC, NCA, Solid-State, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	batteryType

battery model	
Description	Battery model as described by the contents of the battery e.g. cell chemistry. Describes a regulatory requirement.
Name	batteryModel
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=LFP, Natrium, Li-Ion, NMC, NCA, Solid-State, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	batteryModel

battery ID DMC code	
Description	Digital Matrix Code (DMC) of the battery i.e. serial number allowing for unequivocal identification of a battery. Describing a regulatory requirement.
Name	batteryIDDMCCode
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=X123456789012X12345678901234567, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	batteryIDDMCCode

4.3.13 Battery Power Entity

battery power entity	
Name	battery power entity
Description	Entity to bundle the power properties of a battery

maximum allowed battery power	
Description	Maximum allowed battery power (kW) of the battery describes a business requirement.
Name	maximumAllowedBatteryPower
Characteristic	Measurement Power capability in kilowatts Unit kilowatt Symbol kW Code WTT Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=55000.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	maximumAllowedBatteryPower
Reference	file:///service/https%3A%2F%2Feur-lex.europa.eu%2Flegal-content%2FEN%2FTXT%2F%3Furi%3DCELEX%3A52020PC0798

maximum allowed battery power	
Description	Maximum allowed battery power (W) of the battery describes a business requirement.
Name	powerFade
Characteristic	Measurement The decrease over time and upon usage in the amount of power that a battery can deliver at the rated voltage describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=23.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	powerFade
Reference	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0798

power capability at 20 charge	
Description	Power (capability) at 20% state of charge. Description from the regulation describes a regulatory requirement.
Name	powerCapabilityAt20Charge
Characteristic	Measurement Power capability in kilowatts Unit kilowatt Symbol kW Code WTT Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=643.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes

Payload Key	powerCapabilityAt20Charge
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power capability at 80 charge

Description	Power (capability) at 80% state of charge. Description from the regulation describes a regulatory requirement.
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Name	powerCapabilityAt80Charge
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Characteristic	Measurement Power capability in kilowatts Unit kilowatt Symbol kW Code WTT Type http://www.w3.org/2001/XMLSchema#float
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Example	DefaultScalarValue[value=47.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
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Optional	No
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In Payload	Yes
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Payload Key	powerCapabilityAt80Charge
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original power capability	
Description	Performance ability of the high voltage battery i.e. the amount of energy that a battery is capable to provide over a given period of time describes a regulatory requirement.
Name	originalPowerCapability
Characteristic	Measurement A measurement for the power of the battery Unit kilowatt Symbol kW Code KWT Conversion factor 10^3 W Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=123, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	originalPowerCapability

original power capability limits	
Description	Performance ability of the high voltage battery according to limits i.e. how much power it can provide within given limits. Describes a regulatory requirement.
Name	originalPowerCapabilityLimits
Characteristic	Measurement A measurement for the power of the battery Unit kilowatt Symbol kW Code KWT Conversion factor 10^3 W Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=123, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	originalPowerCapabilityLimits

4.3.14 Battery Voltage Entity

battery voltage entity	
Name	battery voltage entity
Description	Entity to bundle the voltage properties of a battery

min voltage	
Description	Value of the minimal voltage the battery is rated for. Describes a regulatory requirement.
Name	minVoltage
Characteristic	Measurement Value of the voltage the battery is rated for Unit volt Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=2.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	minVoltage

nominal voltage	
Description	Value of the nominal voltage the battery is rated for. Describes a regulatory requirement.
Name	nominalVoltage
Characteristic	Measurement Value of the voltage the battery is rated for: Unit volt Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=4.3, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	nominalVoltage

max voltage	
Description	Value of the maximum voltage the battery is rated for. Describes a regulatory requirement.
Name	maxVoltage
Characteristic	Measurement Value of the voltage the battery is rated for Unit volt Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=6.0, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	maxVoltage

4.3.15 Cell Chemistry Entity

cell chemistry	
Name	cell chemistry
Description	Entity to bundle the characteristics describing a battery's cell chemistry

cathode active materials	
Description	The total amount of valuable materials contained in CAM material: Nickel, Cobalt, Lithium.
Name	cathodeActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#MaterialNameAnd WeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes

Payload Key	cathodeActiveMaterials
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recyclate content active materials	
Description	List of recovered Recyclate Content in Active Material Recycled describes a regulatory requirement. The following materials have to be reported on as a minimum: Cobalt, Lithium, Nickel, Lead
Name	recyclateContentActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	recyclateContentActiveMaterials

anode active materials	
Description	The total amount of valuable materials contained in anode: graphite
Name	anodeActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	anodeActiveMaterials

cathode composition other	
Description	The composition or materials contained in the Cathode describes a regulatory requirement.
Name	cathodeCompositionOther

Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#MaterialNameAnd WeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	cathodeCompositionOther

anode composition other

Description	The composition or materials contained in the anode describes a regulatory requirement.
Name	anodeCompositionOther
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#MaterialNameAnd WeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	anodeCompositionOther

electrolyte composition

Description	List of materials contained in the electrolyte. Describes a regulatory requirement.
Name	electrolyteComposition
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#MaterialNameAnd WeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes

Payload Key	electrolyteComposition
Reference	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0474

4.3.16 Components

components	
Name	components
Description	Entity to bundle the components properties of a battery.

components supplier	
Description	Contact details of the suppliers of replacement parts / spare parts describes a regulatory requirement. Available fields should be like: Name - Street - Number - ZIP Code - City - State - Country - Phone - Fax - Email - Website
Name	componentsSupplier
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#ComponentsSupplierEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	componentsSupplier

components part number	
Description	The unique serial numbers of the different parts of a battery describes a regulatory requirement.
Name	componentsPartNumber
Characteristic	Collection Has no order, Duplicates allowed Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Case xxxxxxxx/xx; Controller xxxxxxxx/xx, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	componentsPartNumber

4.3.17 Components Supplier Entity

components supplier	
Name	components supplier
Description	Entity encapsulating the details of a component supplier

address	
Description	An postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#AddressEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	address

contact	
Description	Contact details of the manufacturer
Name	contact
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. contact_information:1.0.0#ContactEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	contact

components supplier name	
Description	Name of the component supplier
Name	componentsSupplierName
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=XY Corporation, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	componentsSupplierName

4.3.18 Composition Entity

composition	
Name	composition
Description	Entity to bundle the characteristics describing a battery's composition

components	
Description	Properties of the batterie's components
Name	components
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#CompomenentsEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	components

composition of battery	
Description	Full composition of battery describes a business requirement.
Name	compositionOfBattery
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	compositionOfBattery

critical raw materials	
Description	List of critical raw materials (CRM) as specified by EU in a battery describes a regulatory requirement.
Name	criticalRawMaterials
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	No

In Payload	Yes
Payload Key	criticalRawMaterials

4.3.19 Document Entity

document entity	
Name	document entity
Description	Entity encapsulating the details of an attachment for the battery

packaging instructions	
Description	Instructions for safely packaging batteries describes a business requirement.
Name	packagingInstructions
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	packagingInstructions

transportation instructions	
Description	Instructions for safely transporting batteries describes a business requirement.
Name	transportationInstructions
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	transportationInstructions

vehicle dismantling procedure

Description	Document containing the vehicle dismantling procedure describes a regulatory requirement.
Name	vehicleDismantlingProcedure
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	vehicleDismantlingProcedure

battery dismantling procedure

Description	Document containing the battery dismantling procedure describes a regulatory requirement.
Name	batteryDismantlingProcedure
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	batteryDismantlingProcedure

safety measures

Description	Safety measure document(s) describes a regulatory requirement.
Name	safetyMeasures
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes

Payload Key	safetyMeasures
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test reports results	
Description	Results of test reports which prove that the battery fulfills this regulation, and its delegated regulations. Describes a regulatory requirement.
Name	testReportsResults
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	testReportsResults

declaration of conformity	
Description	Declaration of conformity (CE) describes a regulatory requirement.
Name	declarationOfConformity
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	declarationOfConformity

responsible sourcing	
Description	Document/Certificates on organizations compliance to ethical business practices
Name	responsibleSourcing
Characteristic	Set Has no order Duplicates not allowed

	Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Example	n/a
Optional	Yes
In Payload	Yes
Payload Key	responsibleSourcing

4.3.20 Electrochemical Properties Entity

electrochemical properties entity	
Name	electrochemical properties entity
Description	Entity encapsulating the electrochemical details of a battery

attachment	
Description	Characteristic to describe the power (W) properties of the battery
Name	batteryPower
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#BatteryPowerEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	batteryPower

battery voltage	
Description	Voltage (V) of the battery
Name	batteryVoltage
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#BatteryVoltageEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	batteryVoltage

rated capacity	
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Description	The total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under specific conditions. Describes a regulatory requirement.
Name	ratedCapacity
Characteristic	Measurement The total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under specific conditions describes a regulatory requirement. Unit ampere Symbol A Code AMP Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=210, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	ratedCapacity

capacity fade	
Description	The decrease over time and upon usage in the amount of charge that a battery can deliver at the rated voltage, with respect to the original rated capacity declared by the manufacturer. Describes a regulatory requirement.
Name	capacityFade
Characteristic	Measurement The decrease over time and upon usage in the amount of charge that a battery can deliver at the rated voltage, with respect to the original rated capacity declared by the manufacturer. Describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=34, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No

In Payload	Yes
Payload Key	capacityFade

internal resistance	
Description	Internal resistance in a battery cell or pack describes a regulatory requirement.
Name	internalResistance
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#InternalResistanceEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	internalResistance

Capacity threshold exhaustion	
Description	Capacity threshold for exhaustion as percentage value describes a regulatory requirement.
Name	capacityThresholdExhaustion
Characteristic	Measurement Capacity threshold for exhaustion as percentage value describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=23, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	capacityThresholdExhaustion

battery energy	
Description	Characteristics to describe the energy (kWh) properties of the battery
Name	batteryEnergy

Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryEnergyEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	batteryEnergy

ratio maximum allowed battery power and maximum allowed battery energy

Description	Ratio between maximum allowed battery power (W) and battery energy (Wh). Describes a regulatory requirement.
Name	ratioMaximumAllowedBatteryPowerAndMaximumAllowedBatteryEnergy
Characteristic	Type http://www.w3.org/2001/XMLSchema#float
Example	DefaultScalarValue[value=0.611, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#float']']
Optional	No
In Payload	Yes
Payload Key	ratioMaximumAllowedBatteryPowerAndMaximumAllowedBatteryEnergy

4.3.21 Internal Resistance

internal resistance

Name	internal resistance
Description	Entity to bundle the internal resistance properties of a battery

cell internal resistance

Description	The resistance offered by the cell in the flow of the current
Name	cellInternalResistance
Characteristic	Measurement The resistance offered by the cell in the flow of the current Unit milliohm Symbol mΩ Code E45 Conversion factor 10 ³

	Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=45, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	cellInternalResistance

pack internal resistance

Description	Total internal resistance in a battery pack. Describes a regulatory requirement.
Name	packInternalResistance
Characteristic	Measurement Total internal resistance in a battery pack Unit ohm Symbol Ω Code OHM Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=67, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	packInternalResistance

pack internal resistanceIncrease

Description	Increase in internal resistance of a battery pack over a period of time. Describes a regulatory requirement.
Name	packInternalResistanceIncrease
Characteristic	Measurement Increase in internal resistance of a battery pack over a period of time Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal

Example	DefaultScalarValue[value=23, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	packInternalResistanceIncrease

4.3.22 Manufacturer Entity

manufacturer	
Name	manufacturer
Description	Entity encapsulating the details of a manufacturer of goods

Name	
Description	Name of the manufacturer describes a regulatory requirement.
Name	name
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=Samsung, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	name

contact	
Description	Contact details of the manufacturer
Name	contact
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. contact_information:1.0.0#ContactEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	contact

address	
Description	A postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#AddressEntity
Example	n/a
Optional	No
In Payload	Yes
Payload Key	address

4.3.23 Manufacturing Entity

manufacturing entity	
Name	manufacturing entity
Description	Entity to bundle the characteristics describing the manufacturing (place and date of manufacturing)

date of manufacturing	
Description	Manufacturing date of the battery describes a regulatory requirement.
Name	dateOfManufacturing
Characteristic	Type http://www.w3.org/2001/XMLSchema#date
Example	DefaultScalarValue[value=2022-03-07, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#date']']
Optional	No
In Payload	Yes
Payload Key	dateOfManufacturing

Address	
Description	An postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#AddressEntity
Example	n/a
Optional	No
In Payload	Yes

Payload Key	address
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4.3.24 Material Name and Weight and Percent Entity

material name and weight and percent

Name	material name and weight and percent
Description	Entity to bundle a material's name, weight and percentage of mass

material percentage mass fraction

Description	Percentage mass fraction of a material
Name	materialPercentageMassFraction
Characteristic	Measurement Percentage mass fraction of a material Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=19, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	Yes
In Payload	Yes
Payload Key	materialPercentageMassFraction

material weight

Description	Weight of the material (in gram)
Name	materialWeight
Characteristic	Measurement Weight of the material (in gram) Unit gram Symbol g Code GRM Conversion factor 10^3 kg Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=2.5, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	Yes
In Payload	Yes

Payload Key	materialWeight
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material name	
Description	Name of the material
Name	materialName
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	n/a
Optional	No
In Payload	Yes
Payload Key	materialName

4.3.25 Physical Dimensions Entity

physical dimensions entity	
Name	physical dimensions entity
Description	Entity to bundle the characteristics describing the physical dimensions

length	
Description	Length of the item describes a business requirement.
Name	length
Characteristic	Measurement A measurement for the length/width/height of an item. Unit Millimeter Symbol mm Code MMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#integer
Example	DefaultScalarValue[value=20000, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']
Optional	No
In Payload	Yes
Payload Key	length

Width	
Description	Width of the item describes a business requirement.
Name	width

Characteristic	<p>Measurement</p> <p>A measurement for the length/width/height of an item.</p> <p>Unit Millimeter</p> <p>Symbol mm</p> <p>Code MMT</p> <p>Conversion factor 10^3 m</p> <p>Type http://www.w3.org/2001/XMLSchema#integer</p>
Example	<pre>DefaultScalarValue[value=1000, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']</pre>
Optional	No
In Payload	Yes
Payload Key	width

Height	
Description	Height of the item describes a business requirement
Name	height
Characteristic	<p>Measurement</p> <p>A measurement for the length/width/height of an item.</p> <p>Unit Millimeter</p> <p>Symbol mm</p> <p>Code MMT</p> <p>Conversion factor 10^3 m</p> <p>Type http://www.w3.org/2001/XMLSchema#integer</p>
Example	<pre>DefaultScalarValue[value=1, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']</pre>
Optional	No
In Payload	Yes
Payload Key	height

diameter	
Description	Diameter of the item.
Name	diameter
Characteristic	<p>Measurement</p> <p>A measurement for the length/width/height of an item.</p> <p>Unit Millimeter</p> <p>Symbol mm</p> <p>Code MMT</p> <p>Conversion factor 10^3 m</p>

	Type <code>http://www.w3.org/2001/XMLSchema#integer</code>
Example	<code>DefaultScalarValue[value=3, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']</code>
Optional	No
In Payload	Yes
Payload Key	diameter

Weight	
Description	Weight of the item describes a regulatory requirement.
Name	weight
Characteristic	Measurement A measurement for the weight of an item. UnitKilogram Symbol kg Code KGM Type <code>http://www.w3.org/2001/XMLSchema#integer</code>
Example	<code>DefaultScalarValue[value=1007, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']</code>
Optional	No
In Payload	Yes
Payload Key	weight

4.3.26 State of Battery Entity

state of battery entity	
Name	state of battery entity
Description	Entity to bundle the characteristics describing the state of a battery

state of health	
Description	Evidence/Certificate of the health evaluation of a battery for its use following repurposing or remanufacturing operations. Describes a business requirement.
Name	stateOfHealth
Characteristic	Measurement

	Evidence/Certificate of the health evaluation of a battery for its use following repurposing or remanufacturing operations. Describes a business requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#integer
Example	DefaultScalarValue[value=12, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']
Optional	No
In Payload	Yes
Payload Key	stateOfHealth

state of charge	
Description	The value of the state of charge of the battery at the end of life i.e. when entering recycling scheme describes a business requirement.
Name	stateOfCharge
Characteristic	Measurement The value of the state of charge of the battery at the end of life i.e. when entering recycling scheme describes a business requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#integer
Example	DefaultScalarValue[value=23, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#integer']']
Optional	No
In Payload	Yes
Payload Key	stateOfCharge

status battery	
Description	Status of the battery describes a regulatory requirement. Value list provided by the regulators.
Name	statusBattery
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Example	DefaultScalarValue[value=first life/ waste/ repaired/ repurposed/ recycled, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	statusBattery

4.3.27 Temperature Range Idle State Entity

temperature range idle state	
Name	temperature range idle state
Description	Entity to bundle the characteristics describing the battery's temperature range

temperature range idle state lower limit	
Description	The lower range of temperature the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangIdleStateLowerLimit
Characteristic	Measurement The lower range of temperature the battery can withstand when not in use describes a regulatory requirement. Unit degree Celsius Symbol °C Code CEL Conversion factor 1 × K Type http://www.w3.org/2001/XMLSchema#decimal
Example	DefaultScalarValue[value=67, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']
Optional	No
In Payload	Yes
Payload Key	temperatureRangIdleStateLowerLimit

temperature rangIdle state upper limit	
Description	The upper range of temperature the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangIdleStateUpperLimit
Characteristic	Measurement

	<p>The lower range of temperature the battery can withstand when not in use describes a regulatory requirement.</p> <p>Unit degree Celsius</p> <p>Symbol °C</p> <p>Code CEL</p> <p>Conversion factor 1 × K</p> <p>Type http://www.w3.org/2001/XMLSchema#decimal</p>
Example	<pre>DefaultScalarValue[value=67, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#decimal']']</pre>
Optional	No
In Payload	Yes
Payload Key	temperatureRangeldleStateUpperLimit

5 NORMATIVE REFERENCES

The following references refer to related Catena-X reference implementations and external standards. This is intended to place the present reference implementation in the context of existing references.

5.1 CATENA-X REFERENCE IMPLEMENTATIONS

CATENA-X REFERENCE IMPLEMENTATIONS	
SC-009	Catena-X standardized models
CX - 0003	BAMM Aspect Meta Model
CX - 0010	Business Partner Number
SC-002	Catena-X Eclipse Dataspace Connector (EDC)
SC-012	Semantic Hub

5.2 COMMON STANDARDS

Common Standards	
IDSA	International Data Spaces Association ¹

¹ <https://internationaldataspaces.org/we/the-association/>

GLOSSARY

TERMS & DEFINITIONS

Term	Description
R-strategy	R-strategies serve to change the companies' business models in the context of the circular economy.

ABBREVIATIONS

Abbreviations	Description
EoL	End of life
OEM	Original Equipment Manufacturer
BOM	Bill of material
EDC	Eclipse Dataspace Connector
IDSA	International Data Spaces Association

ADDENDUM FOR CONFORMITY ASSESSMENT

DISCLAIMER

The following pages are not part of the standard documentation.

CATENA-X

ADDENDUM FOR CONFORMITY
ASSESSMENT



CX – 0034 DATA MODEL BATTERY PASS

BUSINESS DOMAIN: SUSTAINABILITY
USE CASE: CIRCULAR ECONOMY

Contact: standardisierung@catena-x.net

Note: Please specify the platform capability in the subject line.

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ABOUT THIS DOCUMENT & MOTIVATION

The **standards of the Catena-X data ecosystem** define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

The addendum for conformity assessment clarifies the requirements and scope for each standard. It contains conformity assessment criteria (CAC) that specify how a participant can receive a certificate for the correct application of the standard.

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¹ https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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¹ <https://catena-x.net/de/standard-library>

MANAGEMENT SUMMARY

The Battery Passport is a key instrument to develop a sustainable and circular battery value chain delivering on ten principles by monitoring the sustainability performance based on data. They are Understandable, Standardized, Accurate, Differentiating, Auditable, Comprehensive and providing the insights to trigger improvement action. The Battery Passport will be the cornerstone for the Digital Product Passport.

The Passport itself is defined by the usage of Catena-X shared services, a standardized data model and an application which will enable stakeholders to access the relevant data.

The first version of the battery passport model consists out of the following information:

- Battery Identity in the network
- Composition
- Track and Trace data

Circularity parameters will contribute to a more transparent and circular economy within the European Union. In this context, the EU Battery Regulation Drafts set the mandatory basis for circularity parameters for the battery passport without providing many details. A more detailed description is given in the Ecodesign for Sustainable Products Regulation Proposal (ESPR). From these regulations, content clusters for circularity were identified, and concrete circularity parameters for the battery passport derived. The data sets also contain information, which are relevant for closed and open loop business models. It is important to note that the data model contains information / data fields, which are optional and mandatory for regulation fulfillment.

It is also worth mentioning that sharing information within the network is based on decentral technologies and is always based on the individual decision by each partner.

1 INTRODUCTION

This document describes one semantic model used in the Catena-X network.

1.1 AUDIENCE & SCOPE

This section is non-normative

The purpose of this document is the description of the Asset Administration Shell submodel Battery Pass. It defines the battery identity and all relevant attributes. The presented data model is described and illustrated in the following with the entities and properties and their interrelationships

List for which roles the standard is relevant:

- Data Provider / Consumer
- Business Application Provider

1.2 CONTEXT

This section is non-normative

The Battery Pass provides foundations for digital infrastructures for its documentation, the exchange of basic information and update-relevant technical data – in particular, data that comprehensively describes supply-chain accountability, such as greenhouse gas footprint, working conditions in raw material extraction, or the determination of battery conditions.

1.3 ARCHITECTURE OVERVIEW

This aspect model is written in BAMM 2.0 as a modeling language, which is a separate industry standard from the open manufacturing platform, see Open Manufacturing3F.

The data contained in this Catena-X data model is requested and exchanged via Catena-X using an Eclipse Dataspace Connector (EDC), which is a separate Catena-X standard and an implementation of the IDSA standard.

1.4 CONFORMANCE

As well as sections marked as non-normative, all authoring guidelines, diagrams, examples, and notes in this specification are non-normative. Everything else in this specification is normative.

The key words MAY, MUST, MUST NOT, OPTIONAL, RECOMMENDED, REQUIRED, SHOULD and SHOULD NOT in this document are to be interpreted as described

in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

1.5 PROOF OF CONFORMITY

This section is non-normative

All participants and their solutions will need to prove they conform with the Catena-X standards. To validate that the standards are applied correctly, Catena-X employs Conformity Assessment Bodies (CABs).

A model validator MUST to be created, to prove the correctness of the data model. A generic test set created for the model MUST to prove the expected results.

1.6 EXAMPLES

```
1_ManufacturerCharacteristic":{"type":"object","properties":{"name":{"$ref":"#/components/schemas/urn_bamm_io.openmanufacturing_characteristic_2.0.0_Text"},"contact":{"$ref":"#/components/schemas/urn_bamm_io.catenax.shared.contact_information_1.0.0_ContactCharacteristic"},"address":{"$ref":"#/components/schemas/urn_bamm_io.catenax.shared.address_characteristic_1.0.1_PostalAddress"}}, "required":["name","contact","address"],"urn_bamm_io.catenax.battery.battery_pass_3.0.1_PowerCharacteristic":{"type":"number"},"urn_bamm_io.catenax.battery.battery_pass_3.0.
```

1.7 TERMINOLOGY

This section is non-normative

EoL: End of life

OEM: Original Equipment Manufacturer

BOM: Bill of material

EDC: Eclipse Dataspace Connector

IDSA: International Data Spaces Association

Business Partner Number (BPN)

A BPN is the unique identifier of a partner within Catena-x.

Aspect Model

a formal, machine-readable semantic description (expressed with RDF/turtle) of data accessible from an Aspect.

Additional terminology used in this standard can be looked up in the glossary on the association homepage.

2 ASPECT MODEL “BATTERY PASS”

2.1 INTRODUCTION

The battery accounts for about 40% of the added value in electric cars. It is therefore very important for sustainability and working standards in the automotive industry. The “Battery Passport” project by partners from industry and research therefore wants to design content and technical standards for a battery pass and show them in a pilot project. In this way, consumers can see at a glance what kind of batteries are installed, how they were manufactured and how sustainable they are.

The purpose of this document is the description of the Asset Administration Shell submodel Battery Pass. It defines the battery identity and all relevant attributes. The presented data model is described and illustrated in the following with the entities and properties and their interrelationships.

2.2 NORMATIVE CRITERIA

Every data provider of BatteryPass data MUST provide the data conformant to the semantic model specified in this document.

The unique identifier of the semantic model specified in this document MUST be used by the data provider to define the semantics of the data being transferred.

Every certified business application relying on the BatteryPass data MUST be able to consume data conformant to the semantic model specified in this document.

This semantic model MUST be made available in the central Semantic Hub.

Data consumers and data provider MUST comply with the license of the semantic model.

In the Catena-X data space the BatteryPass data MUST be requested and exchanged via Eclipse Dataspace Connector (EDC) conformant to **Error! Reference source not found.** and **Error! Reference source not found.**

2.3 SPECIFICATION ARTIFACTS

The modeling of the semantic model specified in this document was done in accordance to the "semantic driven workflow" to create a submodel template specification [SMT].

This aspect model is written in SAMM 2.0.0 as a modeling language conformant to **Error! Reference source not found.** as input for the semantic derived workflow.

Like all Catena-X data models, this model is available in a machine-readable format on GitHub.¹ conformant to **Error! Reference source not found.**

2.4 LICENSE

This Catena-X data model is an outcome of Catena-X use case group Live Quality Loops (QAX). This Catena-X data model is made available under the terms of the Creative Commons Attribution 4.0 International (CC-BY-4.0) license, which is available at Creative Commons².

The license information is available in github.

In case of doubt the license, copyright and authors information in github overwrites the information in this specification document.

2.5 IDENTIFER OF SEMANTIC MODEL

The semantic model has the unique identifier
urn:bamm:io.catenax.battery.battery_pass:3.0.0

2.6 FORMATS OF SEMANTIC MODEL

2.6.1 RDF Turtle

The rdf turtle file, an instance of the Semantic Aspect Meta Model, is the master for generating additional file formats and serializations.

It can be found at:

https://github.com/eclipse-tractusx/sldt-semantic-models/blob/main/io.catenax.battery.battery_pass/3.0.0/BatteryPass.ttl

¹ <https://github.com/eclipse-tractusx/sldt-semantic-models>.

² <https://creativecommons.org/licenses/by/4.0/legalcode>

The open source command line tool of the Eclipse Semantic Modeling Framework¹ is used for generation of other file formats like for example a JSON Schema, aasx for Asset Administration Shell Submodel Template or a HTML documentation.

2.6.2 JSON Schema

A JSON Schema can be generated from the RDF Turtle file. The JSON Schema defines the Value-Only payload of the Asset Administration Shell for the API operation "GetSubmodel".

2.6.3 aasx

A AASX file can be generated from the RDF Turtle file. The AASX file defines one of the requested artifacts for a Submodel Template Specification conformant to [SMT].

Note: As soon as the specification V3.0 of the Asset Administration Shell specification is available and update will be provided.

2.7 SEMANTIC MODEL

The data model is described in SAMM². A html documentation can be generated from the rdf turtle file from which the following description originates.

2.7.1 Overview

This chapter provides information about the structure of the BAMB Model. It provides information about the properties, entities, characteristics and units of the data model. Each data model references a concrete Aspect Model.

The Meta Model is specified using the Resource Description Format (RDF) and the Terse RDF Triple Language syntax (TTL), together with validation rules in the Shapes Constraint Language (SHACL). Aspect models are likewise specified in RDF/Turtle, following BAMB semantics.

Battery Pass

Name	BatteryPass
-------------	-------------

¹ <https://github.com/eclipse-esmf/esmf-sdk>

² SAMM was named BAMB until end of year 2022.

Description	The battery pass describes information collected during the lifecycle of a battery.
--------------------	---

2.7.2 Properties

A property of a Bamm Aspect Meta Model represents a named value. The following are the properties that refer to the aspect of the model.

CO2 footprint total	
Description	The total carbon footprint of the battery, calculated as kg of carbon dioxide equivalent, describes a regulatory requirement.
Name	cO2FootprintTotal
Characteristic	Measurement The total carbon footprint of the battery, calculated as kg of carbon dioxide equivalent, describes a regulatory requirement. Unit kilogram Symbol kg Code KGM Type http://www.w3.org/2001/XMLSchema#double
Optional	No
In Payload	Yes
Payload Key	cO2FootprintTotal

battery cycle life	
Description	Property describing the cycle life of a battery
Name	batteryCycleLife
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#BatteryCycleLifeEntity
Optional	No
In Payload	Yes
Payload Key	batteryCycleLife

battery identification	
Description	Information to identify a specific battery
Name	batteryIdentification

Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryIdentificationEntity
Optional	No
In Payload	Yes
Payload Key	batteryIdentification

cell chemistry	
Description	Information about the cell chemistry of a battery cell
Name	cellChemistry
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#CellChemistryEntity
Optional	No
In Payload	Yes
Payload Key	cellChemistry

composition	
Description	Information about the composition of a battery and the combination of materials describes a business requirement
Name	composition
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#CompositionEntity
Optional	No
In Payload	Yes
Payload Key	composition

date placed on market	
Description	Date on which vehicle is produced i.e. when battery is put on the market or production date of the vehicle. Describes a regulatory requirement.
Name	datePlacedOnMarket
Characteristic	Type http://www.w3.org/2001/XMLSchema#date
Optional	No
In Payload	Yes
Payload Key	datePlacedOnMarket

document

Description	Set of documents containing the description of battery components
Name	document
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#DocumentEntity
Optional	Yes
In Payload	Yes
Payload Key	document

electrochemical properties

Description	Electrochemical properties of an electrochemical energy storage
Name	electrochemicalProperties
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ElectrochemicalPropertiesEntity
Optional	No
In Payload	Yes
Payload Key	electrochemicalProperties

manufacturer

Description	Legal entity which sells and invoices the battery
Name	manufacturer
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ManufacturerEntity
Optional	No
In Payload	Yes
Payload Key	manufacturer

manufacturing

Description	Information about the manufacturing process of a battery
Name	manufacturing
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#ManufacturingEntity
Optional	No
In Payload	Yes

Payload Key	manufacturing
--------------------	---------------

physical dimensions	
Description	Geometrical properties of the battery
Name	physicalDimensions
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#PhysicalDimensionsEntity
Optional	No
In Payload	Yes
Payload Key	physicalDimensions

state of battery	
Description	The condition of the battery at the end-of-life stage i.e. when entering the recycling scheme
Name	stateOfBattery
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#StateOfBatteryEntity
Optional	No
In Payload	Yes
Payload Key	stateOfBattery

temperature range idle state	
Description	The range of temperatures the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangeldleState
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#TemperatureRangeldleStateEntity
Optional	No
In Payload	Yes
Payload Key	temperatureRangeldleState

warranty period	
Description	Commercial warranty period of the battery describes a regulatory requirement.
Name	warrantyPeriod

Characteristic	Measurement Commercial warranty period of the battery describes a regulatory requirement. Unit month Symbol mo Code MON Conversion factor 2.629800×10^6 s Type http://www.w3.org/2001/XMLSchema#positiveInteger
Optional	No
In Payload	Yes
Payload Key	warrantyPeriod

2.7.3 Entities

An entity is a logical encapsulation of multiple values. It has a number of properties, which are described in the following, starting with the entity, followed by its properties.

2.7.3.1 Address Entity

Address Entity	
Name	Address Entity
Description	Entity of an address. Model follows specification of BPDM (Business Partner Data Management).

Thoroughfare	
Description	Street or thorough road name
Name	thoroughfare
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared.address_characteristic:1.0.1#ThoroughfareEntity
Optional	No
In Payload	Yes
Payload Key	thoroughfare

Locality	
Description	Locality belonging to an address
Name	locality

Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#LocalityEntity
Optional	No
In Payload	Yes
Payload Key	locality

Premise	
Description	Premise of an address, e.g. a specific "BUILDING", but can also be used for naming a particular site
Name	premise
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PremiseEntity
Optional	Yes
In Payload	Yes
Payload Key	premise

Postal Delivery Point	
Description	Delivery point, e.g. designation of a gate
Name	postalDeliveryPoint
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PostalDeliveryPointEntity
In Payload	Yes
Payload Key	postalDeliveryPoint

Country	
Description	Country of an address
Name	country
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#CountryEntity
Optional	No
In Payload	Yes
Payload Key	country

Post Code	
Description	n/a

Name	postCode
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#PostCodeEntity
Optional	No
In Payload	Yes
Payload Key	postCode

2.7.3.2 Attachment Entity

AttachmentEntity	
Name	AttachmentEntity
Description	Entity encapsulating the details of an attachment for the battery

file location	
Description	Location of the file
Name	fileLocation
Characteristic	Type http://www.w3.org/2001/XMLSchema#anyURI
Optional	No
In Payload	Yes
Payload Key	fileLocation

Title	
Description	Title of the attached file
Name	title
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	title

2.7.3.3 Contact Entity

Contact Entity	
Name	Contact Entity
Description	Entity to bundle the properties for the information on how to contact an organization

website	
Description	Website of the contact

Name	website
Characteristic	Type http://www.w3.org/2001/XMLSchema#anyURI
Optional	Yes
In Payload	Yes
Payload Key	website

phone number	
Description	Phone number with country and area code
Name	phoneNumber
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Optional	Yes
In Payload	Yes
Payload Key	phoneNumber
Constraints	Description: Constraint to allow only numbers, whitespaces and an optional leading + sign. Regular expression: <code>^[+]?[0-9]+\$</code>

email	
Description	An email address
Name	email
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Optional	Yes
In Payload	Yes
Payload Key	email
Constraints	Description: Regular expression for mail address as defined in W3C (see https://html.spec.whatwg.org/multipage/input.html#valid-e-mail-address) Regular expression: <code>^[a-zA-Z0-9.!#\$%&'*+\\/=/?^_`{ }~-]+@[a-zA-Z0-9-]+(?:\\.[a-zA-Z0-9-]+)*\$</code>

faxNumber	
Description	Fax number with country and area code
Name	faxNumber

Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Optional	Yes
In Payload	Yes
Payload Key	faxNumber
Constraints	Description: Constraint to allow only numbers, whitespaces and an optional leading + sign. Regular expression: ^[+]?[0-9]+\$

2.7.3.4 Country Entity

Country Entity	
Name	Country Entity
Description	Entity definition for a country

Country Short Name	
Description	n/a
Name	countryShortName
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	shortName
Constraints	Description: Regular expression for designation of a short name of a country as defined in ISO 3166-2 Regular expression: ([A-Z]{2}-[A-Z0-9]{1,3})

2.7.3.5 Postcode Entity

PostCode Entity	
Name	PostCode Entity
Description	Entity for a postcode which consists of a type plus a value

Post Code Value	
Description	The value of a post code
Name	postCodeValue

Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	value
Constraints	Description: Regular expression for post codes Regular expression: <code>^[a-z0-9][a-z0-9\ -]{0,10}\$</code>

Post Code Technical Key	
Description	The technical key of a post code
Name	postCodeTechnicalKey
Characteristic	Enumeration Values CEDEX LARGE_MAIL_USER OTHER POST_BOX REGULAR Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	technicalKey

2.7.3.6 Postal Delivery Point Entity

Postal Delivery Point Entity	
Name	Postal Delivery Point Entity
Description	Entity for a postal delivery point which consists of a technical key and a value.

Postal Delivery Point Technical Key	
Description	Technical key of a postal delivery point
Name	postalDeliveryPointTechnicalKey
Characteristic	Enumeration Values INTERURBAN_DELIVERY_POINT MAIL_STATION MAILBOX OTHER

	POST_OFFICE_BOX Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	technicalKey

Postal Delivery Point Value	
Description	Value of a postal delivery point, e.g. designation of a gate
Name	postalDeliveryPointValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	value

2.7.3.7 Premise Entity

Premise Entity	
Name	Premise Entity
Description	Entity for a premise which consists of a type (technical key) and a value

Premise Technical Key	
Description	Technical key of a premise
Name	premiseTechnicalKey
Characteristic	Enumeration Values BUILDING HARBOUR LEVEL OTHER ROOM SUITE UNIT WAREHOUSE Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	technicalKey

Premise Value

Description	Value of a premise, e.g. name or designation of a particular site
Name	premiseValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	value

2.7.3.8 Thoroughfare Entity

Thoroughfare Entity	
Name	Thoroughfare Entity
Description	Entity for a thoroughfare which consists of a type, value and number

Thoroughfare Technical Key	
Description	Technical key of a thoroughfare. As specified by BPDM, this can be a "STREET" or a different type.
Name	thoroughfareTechnicalKey
Characteristic	Enumeration Values STREET INDUSTRIAL_ZONE OTHER RIVER SQUARE Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	technicalKey

Value Thoroughfare	
Description	Value of a thoroughfare, e.g. name of a street
Name	thoroughfareValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	value

Thoroughfare Number

Description	Number of a thoroughfare. As used differently in international context, this number can contain both numerical and alphanumerical values
Name	thoroughfareNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	Number

2.7.3.9 Thoroughfare Entity

Locality Entity	
Name	Thoroughfare Entity
Description	Entity for a thoroughfare which consists of a type, value and number

Locality Technical Key	
Description	Technical key of a locality
Name	localityTechnicalKey
Characteristic	Enumeration Values BLOCK CITY DISTRICT OTHER POST_OFFICE_CITY QUARTER Type http://www.w3.org/2001/XMLSchema#string
Example	DefaultScalarValue[value=CITY, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	technicalKey

Locality Value	
Description	Value of a locality, e.g. name of a city ("Mannheim")
Name	localityValue
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Example	DefaultScalarValue[value=Mannheim, typeUri='DefaultScalar[metaModelVersion=BAMM_2_0_0, urn='http://www.w3.org/2001/XMLSchema#string']']
Optional	No
In Payload	Yes
Payload Key	value

2.7.3.10 Battery Cycle Life Entity

battery cycle life entity	
Name	battery cycle life entity
Description	Entity to bundle the characteristics describing the cycle life of a battery

cycle life test c-rate	
Description	C-rate of relevant cycle-life test describes a regulatory requirement.
Name	cycleLifeTestCRate
Characteristic	Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	cycleLifeTestCRate

cycle-life test depth of discharge	
Description	Depth of discharge in the cycle-life test describes a regulatory requirement.
Name	cycleLifeTestDepthOfDischarge
Characteristic	Measurement Depth of discharge in the cycle-life test describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	cycleLifeTestDepthOfDischarge

expected lifetime	
--------------------------	--

Description	Expected battery lifetime, expressed in cycles, and reference test used describes a regulatory requirement.
Name	expectedLifetime
Characteristic	Measurement Expected battery lifetime expressed in cycles, and reference test used describes a regulatory requirement. Unit piece Code H87 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	expectedLifetime

2.7.3.11 Battery Energy Entity

battery energy entity	
Name	battery energy entity
Description	Entity to bundle the energy properties of a battery.

maximum allowed battery energy	
Description	Maximum allowed battery energy (Wh) of the battery describes a regulatory requirement.
Name	maximumAllowedBatteryEnergy
Characteristic	Measurement Characteristic to describe the energy (Wh) properties of the battery describes a regulatory requirement. Unit watt hour Symbol W·h Code WHR Conversion factor 3.6×10^3 J Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	maximumAllowedBatteryEnergy

energy roundtrip efficiency	
Description	Round-trip efficiency is the percentage of electricity put into storage. Describes a regulatory requirement.
Name	energyRoundtripEfficiency

Characteristic	Measurement Round-trip efficiency is the percentage of electricity put into storage describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	energyRoundtripEfficiency

energy roundtrip efficiency	
Description	Round-trip efficiency is the percentage of electricity put into storage. Describes a regulatory requirement.
Name	energyRoundtripEfficiencyChange
Characteristic	Measurement Round-trip efficiency is the percentage of electricity put into storage after 50% of life of the battery. Describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	energyRoundtripEfficiencyChange

2.7.3.12 Battery Identification Entity

battery identification entity	
Name	battery identification entity
Description	Entity to bundle the characteristics describing the identification of a battery

battery type	
Description	Battery type as described by the contents of the battery e.g. cell chemistry describes a regulatory requirement.
Name	batteryType
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Optional	No
In Payload	Yes
Payload Key	batteryType

battery model	
Description	Battery model as described by the contents of the battery e.g. cell chemistry. Describes a regulatory requirement.
Name	batteryModel
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	batteryModel

battery ID DMC code	
Description	Digital Matrix Code (DMC) of the battery i.e. serial number allowing for unequivocal identification of a battery. Describing a regulatory requirement.
Name	batteryIDDMCCode
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	batteryIDDMCCode

2.7.3.13 Battery Power Entity

battery power entity	
Name	battery power entity
Description	Entity to bundle the power properties of a battery

maximum allowed battery power	
Description	Maximum allowed battery power (kW) of the battery describes a business requirement.
Name	maximumAllowedBatteryPower
Characteristic	Measurement Power capability in kilowatts Unit kilowatt Symbol kW Code WTT Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	maximumAllowedBatteryPower
Reference	file:///service/https%3A%2F%2Feur-lex.europa.eu%2Flegal-content%2FEN%2FTXT%2F%3Furi%3DCELEX%3A52020PC0798

maximum allowed battery power	
Description	Maximum allowed battery power (W) of the battery describes a business requirement.
Name	powerFade

Characteristic	<p>Measurement</p> <p>The decrease over time and upon usage in the amount of power that a battery can deliver at the rated voltage describes a regulatory requirement.</p> <p>Unit</p> <p>percent</p> <p>Symbol %</p> <p>Code P1</p> <p>Type http://www.w3.org/2001/XMLSchema#float</p>
Optional	No
In Payload	Yes
Payload Key	powerFade
Reference	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0798

power capability at 20 charge

Description	Power (capability) at 20% state of charge. Description from the regulation describes a regulatory requirement.
Name	powerCapabilityAt20Charge
Characteristic	<p>Measurement</p> <p>Power capability in kilowatts</p> <p>Unit</p> <p>kilowatt</p> <p>Symbol kW</p> <p>Code WTT</p> <p>Type http://www.w3.org/2001/XMLSchema#float</p>
Optional	No
In Payload	Yes
Payload Key	powerCapabilityAt20Charge

power capability at 80 charge

Description	Power (capability) at 80% state of charge. Description from the regulation describes a regulatory requirement.
Name	powerCapabilityAt80Charge
Characteristic	<p>Measurement</p> <p>Power capability in kilowatts</p> <p>Unit</p> <p>kilowatt</p> <p>Symbol kW</p> <p>Code WTT</p> <p>Type http://www.w3.org/2001/XMLSchema#float</p>

Optional	No
In Payload	Yes
Payload Key	powerCapabilityAt80Charge

original power capability

Description	Performance ability of the high voltage battery i.e. the amount of energy that a battery is capable to provide over a given period of time describes a regulatory requirement.
Name	originalPowerCapability
Characteristic	Measurement A measurement for the power of the battery Unit kilowatt Symbol kW Code KWT Conversion factor 10^3 W Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	originalPowerCapability

original power capability limits

Description	Performance ability of the high voltage battery according to limits i.e. how much power it can provide within given limits. Describes a regulatory requirement.
Name	originalPowerCapabilityLimits
Characteristic	Measurement A measurement for the power of the battery Unit kilowatt Symbol kW Code KWT Conversion factor 10^3 W Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	originalPowerCapabilityLimits

2.7.3.14 Battery Voltage Entity

battery voltage entity

Name	battery voltage entity
Description	Entity to bundle the voltage properties of a battery

min voltage	
Description	Value of the minimal voltage the battery is rated for. Describes a regulatory requirement.
Name	minVoltage
Characteristic	Measurement Value of the voltage the battery is rated for Unit volt Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	minVoltage

nominal voltage	
Description	Value of the nominal voltage the battery is rated for. Describes a regulatory requirement.
Name	nominalVoltage
Characteristic	Measurement Value of the voltage the battery is rated for: Unit volt Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	nominalVoltage

max voltage	
Description	Value of the maximum voltage the battery is rated for. Describes a regulatory requirement.
Name	maxVoltage
Characteristic	Measurement Value of the voltage the battery is rated for Unit volt

	Symbol V Code VLT Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	maxVoltage

2.7.3.15 Cell Chemistry Entity

cell chemistry	
Name	cell chemistry
Description	Entity to bundle the characteristics describing a battery's cell chemistry

cathode active materials	
Description	The total amount of valuable materials contained in CAM material: Nickel, Cobalt, Lithium.
Name	cathodeActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	cathodeActiveMaterials

recyclate content active materials	
Description	List of recovered Recyclate Content in Active Material Recycled describes a regulatory requirement. The following materials have to be reported on as a minimum: Cobalt, Lithium, Nickel, Lead
Name	recyclateContentActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No

In Payload	Yes
Payload Key	recycleContentActiveMaterials

anode active materials

Description	The total amount of valuable materials contained in anode: graphite
Name	anodeActiveMaterials
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	anodeActiveMaterials

cathode composition other

Description	The composition or materials contained in the Cathode describes a regulatory requirement.
Name	cathodeCompositionOther
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	cathodeCompositionOther

anode composition other

Description	The composition or materials contained in the anode describes a regulatory requirement.
Name	anodeCompositionOther
Characteristic	Set Has no order Duplicates not allowed

	Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	anodeCompositionOther

electrolyte composition	
Description	List of materials contained in the electrolyte. Describes a regulatory requirement.
Name	electrolyteComposition
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#MaterialNameAndWeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	electrolyteComposition
Reference	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0474

2.7.3.16 Components Entity

components	
Name	components
Description	Entity to bundle the components properties of a battery.

components supplier	
Description	Contact details of the suppliers of replacement parts / spare parts describes a regulatory requirement. Available fields should be like: Name - Street - Number - ZIP Code - City - State - Country - Phone - Fax - Email - Website
Name	componentsSupplier
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#ComponentsSupplierEntity
Optional	No

In Payload	Yes
Payload Key	componentsSupplier

components part number

Description	The unique serial numbers of the different parts of a battery describes a regulatory requirement.
Name	componentsPartNumber
Characteristic	Collection Has no order, Duplicates allowed Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	componentsPartNumber

2.7.3.17 Component Supplier Entity

components supplier

Name	components supplier
Description	Entity encapsulating the details of a component supplier

address

Description	An postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared.address_characteristic:1.0.1#AddressEntity
Optional	No
In Payload	Yes
Payload Key	address

contact

Description	Contact details of the manufacturer
Name	contact
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared.contact_information:1.0.0#ContactEntity
Optional	No
In Payload	Yes
Payload Key	contact

components supplier name	
Description	Name of the component supplier
Name	componentsSupplierName
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	componentsSupplierName

2.7.3.18 Composition Entity

composition	
Name	composition
Description	Entity to bundle the characteristics describing a battery's composition

components	
Description	Properties of the batterie's components
Name	components
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#CompomenentsEntity
Optional	No
In Payload	Yes
Payload Key	components

composition of battery	
Description	Full composition of battery describes a business requirement.
Name	compositionOfBattery
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#MaterialNameAnd WeightAndPercentageMassFractionEntity
Optional	No
In Payload	Yes
Payload Key	compositionOfBattery

critical raw materials

Description	List of critical raw materials (CRM) as specified by EU in a battery describes a regulatory requirement.
Name	criticalRawMaterials
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	criticalRawMaterials

2.7.3.19 Document Entity

document entity	
Name	document entity
Description	Entity encapsulating the details of an attachment for the battery

packaging instructions	
Description	Instructions for safely packaging batteries describes a business requirement.
Name	packagingInstructions
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	packagingInstructions

transportation instructions	
Description	Instructions for safely transporting batteries describes a business requirement.
Name	transportationInstructions
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	transportationInstructions

vehicle dismantling procedure

Description	Document containing the vehicle dismantling procedure describes a regulatory requirement.
Name	vehicleDismantlingProcedure
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	vehicleDismantlingProcedure

battery dismantling procedure

Description	Document containing the battery dismantling procedure describes a regulatory requirement.
Name	batteryDismantlingProcedure
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	batteryDismantlingProcedure

safety measures

Description	Safety measure document(s) describes a regulatory requirement.
Name	safetyMeasures
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	safetyMeasures

test reports results

Description	Results of test reports which prove that the battery fulfills this regulation, and its delegated regulations. Describes a regulatory requirement.
Name	testReportsResults
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	testReportsResults

declaration of conformity

Description	Declaration of conformity (CE) describes a regulatory requirement.
Name	declarationOfConformity
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	declarationOfConformity

responsible sourcing

Description	Document/Certificates on organizations compliance to ethical business practices
Name	responsibleSourcing
Characteristic	Set Has no order Duplicates not allowed Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#AttachmentEntity
Optional	Yes
In Payload	Yes
Payload Key	responsibleSourcing

2.7.3.20 Electrochemical Properties Entity

electrochemical properties entity	
Name	electrochemical properties entity
Description	Entity encapsulating the electrochemical details of a battery

attachment	
Description	Characteristic to describe the power (W) properties of the battery
Name	batteryPower
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryPowerEntity
Optional	No
In Payload	Yes
Payload Key	batteryPower

battery voltage	
Description	Voltage (V) of the battery
Name	batteryVoltage
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#BatteryVoltageEntity
Optional	No
In Payload	Yes
Payload Key	batteryVoltage

rated capacity	
Description	The total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under specific conditions. Describes a regulatory requirement.
Name	ratedCapacity
Characteristic	Measurement The total number of ampere-hours (Ah) that can be withdrawn from a fully charged battery under specific conditions describes a regulatory requirement. Unit ampere Symbol A Code AMP Type http://www.w3.org/2001/XMLSchema#decimal

Optional	No
In Payload	Yes
Payload Key	ratedCapacity

capacity fade	
Description	The decrease over time and upon usage in the amount of charge that a battery can deliver at the rated voltage, with respect to the original rated capacity declared by the manufacturer. Describes a regulatory requirement.
Name	capacityFade
Characteristic	Measurement The decrease over time and upon usage in the amount of charge that a battery can deliver at the rated voltage, with respect to the original rated capacity declared by the manufacturer. Describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	capacityFade

internal resistance	
Description	Internal resistance in a battery cell or pack describes a regulatory requirement.
Name	internalResistance
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery. battery_pass:3.0.0#InternalResistanceEntity
Optional	No
In Payload	Yes
Payload Key	internalResistance

Capacity threshold exhaustion	
Description	Capacity threshold for exhaustion as percentage value describes a regulatory requirement.
Name	capacityThresholdExhaustion

Characteristic	Measurement Capacity threshold for exhaustion as percentage value describes a regulatory requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	capacityThresholdExhaustion

battery energy	
Description	Characteristics to describe the energy (kWh) properties of the battery
Name	batteryEnergy
Characteristic	SingleEntity Type urn:bamm:io.catenax.battery.battery_pass:3.0.0#BatteryEnergyEntity
Optional	No
In Payload	Yes
Payload Key	batteryEnergy

ratio maximum allowed battery power and maximum allowed battery energy	
Description	Ratio between maximum allowed battery power (W) and battery energy (Wh). Describes a regulatory requirement.
Name	ratioMaximumAllowedBatteryPowerAndMaximumAllowedBatteryEnergy
Characteristic	Type http://www.w3.org/2001/XMLSchema#float
Optional	No
In Payload	Yes
Payload Key	ratioMaximumAllowedBatteryPowerAndMaximumAllowedBatteryEnergy

2.7.3.21 Internal Resistance Entity

internal resistance	
Name	internal resistance
Description	Entity to bundle the internal resistance properties of a battery

cell internal resistance	
Description	The resistance offered by the cell in the flow of the current
Name	cellInternalResistance
Characteristic	Measurement The resistance offered by the cell in the flow of the current Unit milliohm Symbol $m\Omega$ Code E45 Conversion factor 10^{-3} Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	cellInternalResistance

pack internal resistance	
Description	Total internal resistance in a battery pack. Describes a regulatory requirement.
Name	packInternalResistance
Characteristic	Measurement Total internal resistance in a battery pack Unit ohm Symbol Ω Code OHM Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	packInternalResistance

pack internal resistanceIncrease	
Description	Increase in internal resistance of a battery pack over a period of time. Describes a regulatory requirement.
Name	packInternalResistanceIncrease
Characteristic	Measurement Increase in internal resistance of a battery pack over a period of time Unit percent

	Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	packInternalResistanceIncrease

2.7.3.22 Manufacturer Entity

manufacturer	
Name	manufacturer
Description	Entity encapsulating the details of a manufacturer of goods

Name	
Description	Name of the manufacturer describes a regulatory requirement.
Name	name
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	name

contact	
Description	Contact details of the manufacturer
Name	contact
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. contact_information:1.0.0#ContactEntity
Optional	No
In Payload	Yes
Payload Key	contact

address	
Description	A postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared. address_characteristic:1.0.1#AddressEntity
Optional	No

In Payload	Yes
Payload Key	address

2.7.3.23 Manufacturing Entity

manufacturing entity	
Name	manufacturing entity
Description	Entity to bundle the characteristics describing the manufacturing (place and date of manufacturing)

date of manufacturing	
Description	Manufacturing date of the battery describes a regulatory requirement.
Name	dateOfManufacturing
Characteristic	Type http://www.w3.org/2001/XMLSchema#date
Optional	No
In Payload	Yes
Payload Key	dateOfManufacturing

Address	
Description	An postal address
Name	address
Characteristic	SingleEntity Type urn:bamm:io.catenax.shared: address_characteristic:1.0.1#AddressEntity
Optional	No
In Payload	Yes
Payload Key	address

2.7.3.24 Material Name and Weight and Percent Entity

material name and weight and percent	
Name	material name and weight and percent
Description	Entity to bundle a material's name, weight and percentage of mass

material percentage mass fraction	
Description	Percentage mass fraction of a material
Name	materialPercentageMassFraction
Characteristic	Measurement Percentage mass fraction of a material

	Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#decimal
Optional	Yes
In Payload	Yes
Payload Key	materialPercentageMassFraction

material weight	
Description	Weight of the material (in gram)
Name	materialWeight
Characteristic	Measurement Weight of the material (in gram) Unit gram Symbol g Code GRM Conversion factor 10^3 kg Type http://www.w3.org/2001/XMLSchema#decimal
Optional	Yes
In Payload	Yes
Payload Key	materialWeight

material name	
Description	Name of the material
Name	materialName
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	materialName

2.7.3.25 Physical Dimensions Entity

physical dimensions entity	
Name	physical dimensions entity
Description	Entity to bundle the characteristics describing the physical dimensions

length	
Description	Length of the item describes a business requirement.
Name	length

Characteristic	Measurement A measurement for the length/width/height of an item. Unit Millimeter Symbol mm Code MMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	length

Width	
Description	Width of the item describes a business requirement.
Name	width
Characteristic	Measurement A measurement for the length/width/height of an item. Unit Millimeter Symbol mm Code MMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	width

Height	
Description	Height of the item describes a business requirement
Name	height
Characteristic	Measurement A measurement for the length/width/height of an item. Unit Millimeter Symbol mm Code MMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	height

diameter

Description	Diameter of the item.
Name	diameter
Characteristic	Measurement A measurement for the length/width/height of an item. Unit Millimeter Symbol mm Code MMT Conversion factor 10^3 m Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	diameter

Weight	
Description	Weight of the item describes a regulatory requirement.
Name	weight
Characteristic	Measurement A measurement for the weight of an item. Unit Kilogram Symbol kg Code KGM Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	weight

2.7.3.26 State of Battery Entity

state of battery entity	
Name	state of battery entity
Description	Entity to bundle the characteristics describing the state of a battery

state of health	
Description	Evidence/Certificate of the health evaluation of a battery for its use following repurposing or remanufacturing operations. Describes a business requirement.
Name	stateOfHealth
Characteristic	Measurement

	Evidence/Certificate of the health evaluation of a battery for its use following repurposing or remanufacturing operations. Describes a business requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	stateOfHealth

state of charge	
Description	The value of the state of charge of the battery at the end of life i.e. when entering recycling scheme describes a business requirement.
Name	stateOfCharge
Characteristic	Measurement The value of the state of charge of the battery at the end of life i.e. when entering recycling scheme describes a business requirement. Unit percent Symbol % Code P1 Type http://www.w3.org/2001/XMLSchema#integer
Optional	No
In Payload	Yes
Payload Key	stateOfCharge

status battery	
Description	Status of the battery describes a regulatory requirement. Value list provided by the regulators.
Name	statusBattery
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Optional	No
In Payload	Yes
Payload Key	statusBattery

2.7.3.27 Temperature Range Idle State Entity

temperature range idle state	
Name	temperature range idle state

Description	Entity to bundle the characteristics describing the battery's temperature range
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temperature range idle state lower limit

Description	The lower range of temperature the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangeldleStateLowerLimit
Characteristic	Measurement The lower range of temperature the battery can withstand when not in use describes a regulatory requirement. Unit degree Celsius Symbol °C Code CEL Conversion factor 1 × K Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	temperatureRangeldleStateLowerLimit

temperature rangeldle state upper limit

Description	The upper range of temperature the battery can withstand when not in use describes a regulatory requirement.
Name	temperatureRangeldleStateUpperLimit
Characteristic	Measurement The lower range of temperature the battery can withstand when not in use describes a regulatory requirement. Unit degree Celsius Symbol °C Code CEL Conversion factor 1 × K Type http://www.w3.org/2001/XMLSchema#decimal
Optional	No
In Payload	Yes
Payload Key	temperatureRangeldleStateUpperLimit

3 REFERENCES

3.1 NORMATIVE REFERENCES

The following references refer to related Catena-X reference implementations and external standards. This is intended to place the present reference implementation in the context of existing references.

- CX-0002 DIGITAL TWINS IN CATENA-X
- CX-0003 SEMANTIC ASPECT META MODEL
- CX-0004 GOVERNANCE PROCESS FOR SEMANTIC MODELS
- CX-0018 ECLIPSE DATA SPACE CONNECTOR (EDC)
- CX-0001 EDC DISCOVERY API

3.2 NON-NORMATIVE REFERENCES

This section is non-normative

- [IDSA] IDS Officially a Standard: DIN SPEC 27070 is Published - International Data Spaces
- [SMT] How to create a submodel template specification. Guideline. Download from: <https://industrialdigitaltwin.org/wp-content/uploads/2022/12/140-IDTA-WS-Process-How-to-write-a-SMT-FINAL-.pdf>