



SURFACE VEHICLE RECOMMENDED PRACTICE

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Identification of Transportation Battery Systems for Recycling Recommended Practice

RATIONALE

Electrification of the transportation industry is increasing rapidly. The battery chemistry used to electrify the vehicle may not be easily identifiable at the end of life and therefore an identification system to assist in the proper recycling is required. There are many combinations of materials designated as lithium-ion. Thus, the identification code will assist in identifying the battery system and provide more details on the particular lithium ion chemistry for lithium ion battery systems.

1. SCOPE

The chemistry identification system is intended to support the proper and efficient recycling of rechargeable battery systems used in transportation applications with a maximum voltage greater than 12V (including SLI batteries). Other battery systems such as non-rechargeable batteries, batteries contained in electronics, and telecom/utility batteries are not considered in the development of this specification. This does not preclude these systems from adapting the format proposed if they so choose.

1.1 Purpose

A simple common identifier is required to allow consumers, service and waste management personnel to direct unknown battery types to appropriate recyclers. Recyclers also benefit from this identifier as it allows them to segregate, screen for potential contamination to existing process streams, and identify the manufacturer so they may contact them to find detailed information about the battery to ensure proper and safe recycling. At a minimum, recyclers should obtain the MSDS and/or PSDS from the manufacturer.

This code is not intended to replace regulatory reporting requirements, nor provide intricate details of the chemistry involved in the Battery System. The method and specific location for applying this code is not defined in this specification.

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2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.1.1 European Union. Directive 2006/66/EC of the European Parliament and of the Council of the 6 September 2006 on batteries and accumulators and repealing Directive 91/157/EEC. s.1.: Europa, 2006. Directive 2006/66/EC.

2.1.2 Battery Association of Japan (BAJ). Program to make the portable secondary battery recycle mark an international standard. BAJ Website [Online] BAJ, 2010 [Cited: October 10, 2011] <http://www.baj.or.jp/e/recycle/recycle10.html> & <http://www.baj.or.jp/e/recycle/recycle11.html>

2.2 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1715 Hybrid Electric Vehicle (HEV) & Electric Vehicle (EV) Terminology

SAE J2464 Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing

SAE J2950 Recommended Practices (RP) for Shipping Transport and Handling of Automotive-Type Battery System - Lithium Ion

3. DEFINITIONS

3.1 BATTERY

Electrochemical cells electrically connected in a series and/ or parallel arrangement. REF SAE J1715

3.2 BATTERY SYSTEM

A completely functional energy storage system consisting of the pack(s), necessary ancillary subsystems for physical support, thermal management, and electronic control (See Figure 1.a). REF SAE J1715

3.3 BATTERY PACK

Interconnected battery modules that have been configured for a specific energy storage application (See Figure 1.b). REF SAE J1715

3.4 BATTERY MODULE

A grouping of interconnected cells in a single mechanical and electrical unit. Also known as battery monoblock (See Figure 1.c). REF SAE J1715

3.5 CELL

An assembly of at least one positive electrode, one negative electrode, and other necessary electrochemical and structural components. A cell is a self-contained energy conversion device whose function is to deliver electrical energy to an external circuit via an internal chemical process (See Figure 1.d). REF SAE J1715.

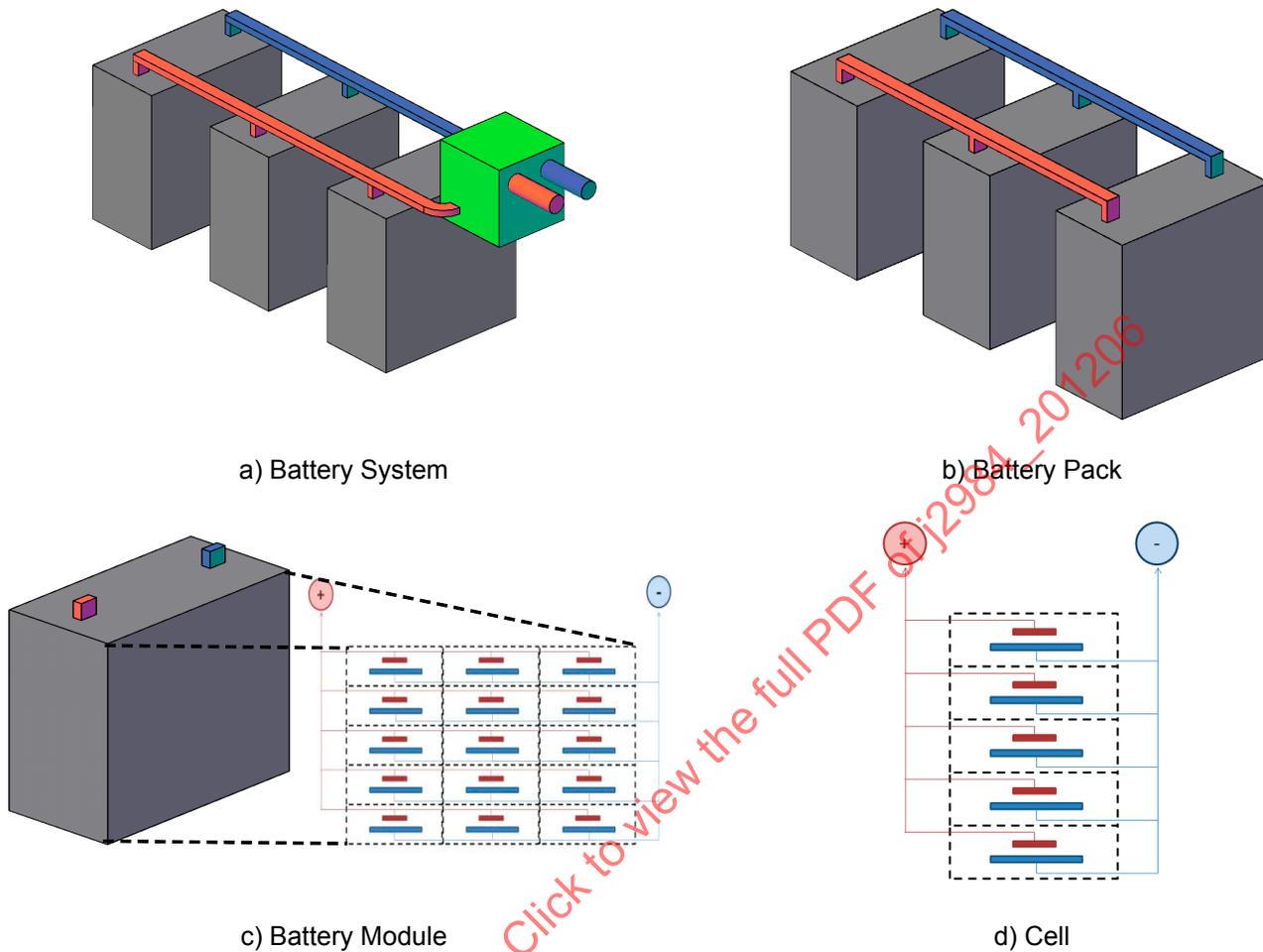


FIGURE 1 - SCHEMATICS OF BATTERY TERMINOLOGY FOR A) BATTERY SYSTEM B) BATTERY PACK C) BATTERY MODULE D) CELL

3.6 FLAMMABLE LIQUID

A flammable liquid has a flash point below 100 °F (38 °C). A combustible liquid has a flash point between 100 °F – 200 °F (37.8 °C - 93.3 °C); REF SAE J2464.

3.7 FLASH POINT

Flash point is defined in OSHA's 29 CFR 1910.106 as the minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. REF SAE J2464.

3.8 LI-ION

Lithium Ion

3.9 MODULE

See Battery Module

3.10 MSDS

Material Safety Data Sheet

3.11 PSDS

Product Safety Data Sheet

3.12 NiCd

Nickel Cadmium

3.13 NiMH

Nickel Metal Hydride

3.14 NON-SERVICEABLE

A device or component that cannot be quickly and/or safely and/or easily removed and replaced by the user without having to send the entire product or system to a repair facility. The defective or failed device or component is not found by standard troubleshooting procedures and is, removed and replaced using non-standard, or specialized tools.

3.15 PB-ACID

Lead Acid

3.16 PHOSPHATE

A phosphorous content greater than 1 wt percent in their respective cathode or anode active material, (e.g., LiFePO₄, LiMnPO₄)

3.17 RARE EARTHS

A chemistry in which any of the lanthanide elements as well as scandium and yttrium are added in total greater than 1 wt percent in their respective cathode or anode active material.

3.18 RECYCLING

Transformation of end of life batteries or scrap into usable products.

3.19 SERVICEABLE

A device or component that can be quickly and safely and easily removed and replaced by the user without having to send the entire product or system to a repair facility. The defective device or component is found by standard troubleshooting procedures and is, removed and replaced using standard non-specialized tools. REF SAE J2950

3.20 TRACE ELEMENTS

Elements that are not a major constituent added to the cathode or anode active material and are below 1 wt percent in their respective cathode or anode material.

3.21 SYMBOLS

Not Applicable

4. DOCUMENT CONTENT

4.1 Chemistry Identifier Requirements:

Special attention has been given to identifying lithium-ion batteries as these are expected to play a large role in the electrification of the transport industry. Unlike Pb-acid, NiMH, or NiCd battery systems, Li-ion batteries have many different potential combinations of anode and cathode materials. These materials affect the value and effectiveness of the recycling process and need to be clearly identified prior to recycling to sort the batteries and prevent cross-contamination of the recycler process streams. Lithium ion batteries are typically designated by their cathode (e.g., Lithium cobaltate) or anode (e.g., Lithium titanate) depending on its chemical makeup. The identification code provides more details for the lithium ion battery system to address the different combinations of anode and cathode materials.

Materials / elements intentionally added to a cell should be considered in classifying the cathode or anode type or miscellaneous categories. Unintentional or trace materials should not be included. When determining anode and cathode type for Lithium Ion battery systems, materials should have a minimum of 1 wt percent content by mass of the cathode or anode. Materials falling below this threshold should be treated as trace elements and not considered in classifying the cathode or anode type.

A miscellaneous properties place holder was created in the identification code to address known and future properties of concern for recyclers.

The manufacturer identification and manufacture date is also included to assist the recyclers in contacting manufacturers to find out detailed information on the specific chemistries of the particular cells. This information may be too detailed and possibly too proprietary to include in the identification code, or MSDS.

The Battery Association of Japan (BAJ) has issued Guidelines for Recycle Label on batteries which include a color code system for identifying the major battery systems: Pb-acid, NiCd, NiMH, and Li-Ion. We have recommended remaining consistent with the BAJ color code standards in our identification code to further assist in sorting of the battery types.

The identification code shall be applied in a visible location on the outer-most non-serviceable cover(s) of the battery system and/or its components.

The identifier code shall be formatted as follows:

SC-A.M / MFG.YYMM ^{1, 2, 3}

Where,

| Letter | Description |
|--------|---|
| S | System ID |
| C | Cathode for Li-ion chemistries only |
| A | Anode for Li-ion chemistries only |
| M | Miscellaneous hazard(s) identifier selected from Table 2. Multiple hazards may be selected. |
| MFG | Manufacturer 2-4 digit alpha numeric descriptor ² |
| YYMM | Year and month of manufacture |

- 1 Cathode and anode identifiers must be separated by a dash. Anode and Miscellaneous identifiers must be separated by a period. The miscellaneous and manufacturing identifiers must be separated by a slash(/). The manufacturer identifier and the manufacturing date must be separated by a period.
- 2 If manufacturer's name or logo appears elsewhere on the non-serviceable unit(s), the manufacturer descriptor is not a required portion of the mark. Manufacturers will determine their own unique two to four digit identification based on their company name.
- 3 For battery systems that do not specify Cathode and/or Anode, an "X" should be used as a place holder.

Table 1 lists the proper characters to identify the battery System, Cathode, and Anode and the code background color reference consistent with the BAJ recommendations.

Table 2 lists the proper character(s) for the miscellaneous properties.

TABLE 1 - SYSTEM, CATHODE, AND ANODE IDENTIFIERS

| System (S=) Pantone Color Reference (CR=) | Type | Cathode (C=) | Type | Anode (A=) | Type |
|--|----------------|--------------|----------------|------------|------------------------|
| Li CR = Blue PMS312 | Lithium Ion | Fe | Iron | C | Graphitic/Carbonaceous |
| | | Co | Cobalt | Si | Silicon |
| | | Mn | Manganese | Ti | Titanium |
| | | S | Sulfur | Sn | Tin |
| | | Ni | Nickel | Li | Lithium |
| | | Al | Aluminum | | |
| | | MM | Mixed Metal | | |
| NiMH CR = Orange PMS151 | NiMH | X | Not Applicable | X | Not Applicable |
| NiCd CR = Green PMS367 | NiCd | X | Not Applicable | X | Not Applicable |
| Pb-Acid CR = Silver PMS871 | Pb-Acid | X | Not Applicable | X | Not Applicable |