



SURFACE VEHICLE INFORMATION REPORT

J3071™

APR2016

Issued

2016-04

Automotive Battery Recycling Identification and Cross Contamination Prevention

RATIONALE

Automotive manufacturers and other industries are increasingly reliant on energy storage technologies other than lead acid batteries. The introduction of these other energy storage technologies into the existing used lead acid battery (ULAB) waste and recycling stream presents challenges to recyclers that will require development of universal mechanisms for sorting the different technologies to prevent safety and environmental hazards, cross contamination, regulatory noncompliance, and negative economic impact to manufacturers and recyclers. To complicate the situation, some of these batteries may be packaged in similar or identical form factors and may even contain multiple technologies/chemistries within a single package. It is also recognised that batteries entering the waste stream may be partly dismantled or whole, presenting the recycler with a wide variety of forms of battery casings, parts, and combinations of chemistries. Methods developed for addressing these issues will also need to consider legacy energy storage systems that may end up in the waste and recycling stream.

1. SCOPE

This SAE Battery Identification and Cross Contamination Prevention document is intended to provide information that may be applicable to all types of Rechargeable Energy Storage System (RESS) devices. It is important to develop a system that can facilitate sorting by chemistry. The recycler is interested in the chemistry of the RESS. This is true for the recyclers of Lead Acid, Lithium Ion, Nickel Cadmium etc.

Thus recyclers of RESS will receive RESS from automotive, commercial, and industrial applications. These RESS have the potential to be contaminated with a RESS of an incompatible chemistry. It is recognized that mitigation methods to reduce or eliminate the introduction of incompatible chemistries into a given recycling stream would also benefit safety and the environment.

1.1 Purpose

The purpose of this document is to provide both a background and comprehensive summary of the various facets of automotive recycling identification and cross-contamination prevention. It serves as a repository of information, and a useful guide to any future decisions taken by the industry. It does not advocate a specific solution, but strives to inform.

The information herein is to aid in the development of a solution that could be applied to energy storage systems. Motive power, stationary, and SLI type batteries are thought to have the highest risk of being intermixed. Other battery systems such as non-rechargeable batteries and batteries contained in electronics are not considered in the development of this document. This document considers identification of legacy RESS as well as future systems to eliminate cross-contamination of recycling streams.

In order to address energy storage system segregation, identification of the system and subcomponent chemistry is critical for both currently existing and future systems. In order to be effective, the identification system must be universally applied to all RESS's in a safe, cost effective manner.

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Documents

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A common approach to chemistry identification is needed and must be agreed upon by the battery manufacturers to reduce the contamination risk during battery recycling operations on a global level. Agreed upon consensus of identification technology and tools must also be applicable throughout the life cycle, to reduce costs and risk.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2936 SAE Electrical Energy Storage Device Labeling Recommended Practice

SAE J11715/2 Battery Terminology

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

SAE J2984 Identification of Transportation Battery Systems for Recycling Recommended Practice

2.2 Related Publications

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

Leiby, R., "Lead Smelter Sorting," presented at The Battery Show, USA , Sept 18, 2014.

Pelletier, C., "SAE Battery Recycling Committee: Battery recycling approaches for the 21st century," presented at The Battery Show, USA , Sept 18, 2014.

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>

NTC Recyclable rechargeable batteries EPA Website [online] 1998 [cited September 24, 2015] <http://yosemite.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/ba8450d1cd3696e785256665007073eb?opendocument>

RTCA/DO-311A, *Minimum Operational Performance Standards for Rechargeable Lithium Battery Systems*

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.

United States Public Law 104–142, "Mercury containing and Rechargeable Battery Management act" (the Battery Act)

Steve Binks. "Viewpoint: ILA Lead, lithium recycling mix: a clear and present danger." *Batteries International* Spring 2015: 12-13.

3. DEFINITIONS

3.1 RECHARGEABLE ENERGY STORAGE SYSTEM (RESS)

Any energy storage system that has the capability to be charged and discharged. (Examples: batteries, capacitors, and electro-mechanical flywheels) (SAE J1715/2)

3.2 ENERGY STORAGE SYSTEM (Battery System)

One or more packs connected in parallel and/or series configuration and associated electronics. (SAE J1715/2)

4. DOCUMENT CONTENT

4.1 Background

There is currently no known comprehensive battery labeling standard in existence that requires battery manufacturers to mark their products for ease of segregation in recycling, but several organizations have guidance documents attempting to address this issue. Due to the number of batteries on the market and the number of applications using these batteries, communication of chemistry requirements varies globally and label markings vary by regulatory authority. Recyclers have various technologies which they can employ, but the manufacturers of batteries must be willing to apply a standard identification mark or technology to ease the sorting process for the recycler, just as recyclers must agree to support the agreed strategies adopted by the manufacturers. Sections 4.1.1 through 4.1.11 present a collection of position summaries, recommended practices, and labeling strategies published by various organizations and consortia on this topic.

4.1.1 ABR

The Association of Battery Recyclers (ABR) issued a position paper in December 2013 stating Environmental, Health and Safety (EHS) problems encountered in Lead Acid (PbA) battery recycling. Safety incidents have been reported due to the introduction of Li-ion batteries and ultra-capacitors into the PbA recycling stream. These currently lack adequate identification of the chemistry to permit segregation of the battery/capacitor types. Fires and explosions at facilities in North America and Europe have resulted, and although no fatalities have occurred, these incidents are on the increase, and are driving the need to clearly identify and separate the batteries by chemistry to improve safety and health and limit environmental impact.

As alternative RESS technology applications increase in both size and number, cross-contamination of the PbA recycling stream will likely increase proportionally unless the identification issue is addressed in all applications.

The ABR proposed in its position paper that a multi-faceted action plan be developed to prevent/minimize the improper introduction of Li-ion batteries and other energy storage system into the PbA recycling chain. The proposal involves:

- The implementation of improved on-site sorting/screening technology and processes that meet the needs of the individual recycling facilities
- A globally harmonized and enforceable solution consisting of
 - Education of upstream manufacturers, distributors, and collectors e.g., retailers/scrap dealers, and municipalities about the health, safety, and environmental issues associated with cross-contamination and the lack of chemistry identification,
 - Collaborative efforts with international standards agencies to produce a global standard for energy storage system identification requirements,
- Coordination with legislative, policy bodies, and trade associations in all countries manufacturing and recycling energy storage systems to propose standardization and ensure enforcement, and
- Establishment of requirements for manufacturers of energy storage systems to provide chemistry identification to allow efficient sorting prior to shipment to any recycling operation and easy verification upon receipt and prior to processing.

4.1.2 ILA Survey Results Summary

ILA conducted a survey of ILA and ABR member companies in 2014 to assess the issue of lithium ion batteries entering used lead acid battery (ULAB) waste streams. They provided a summary to their members and published some of the information in Batteries International magazine. The survey focused only on collection of information on lithium ion batteries entering ULAB recyclers as opposed to other battery technologies. This was because information previously collected from ILA members identified that lithium ion batteries presented a very serious safety concern for workers within the lead recycling industry, whereas other batteries led to issues with effluents, emissions, and slag composition, but did not directly endanger workers.

Twenty-six companies were surveyed from a range of countries, covering a significant portion of the global lead recycling industry. All smelting furnaces used to process ULAB were covered by the survey. Twenty-five out of the twenty-six companies reported that they had an issue with Li-ion batteries entering their recycling facilities. The companies reported that Li-ion batteries can appear very similar to lead acid batteries making it very difficult to differentiate between the chemistries. The respondents stated that Li-ion batteries in ULAB waste stream were believed to cause fires and explosions during transport, storage, breaking and smelting operations. A significant increase was also seen in the rate of incidents (i.e. fires and explosions) reported; with relatively few incidents seen in 2010, 2 incidents reported, compared to 18 incidents in 2013.

Detailed information on the incidents was provided by respondents, stating in most cases, fires were initially seen. These fires produced significant smoke production, and in many cases could be put out. Sometimes explosion occurred from these incidences.

All companies indicated they have techniques to differentiate between batteries entering the recycling site, with most using visual identification and CCTV monitoring. In addition, most companies provided photographs and real examples of batteries to assist workers in differentiating among batteries. Companies reported that they were aware of more advanced technologies such as density and x-ray analysis, radio-frequency identification (RFID) and sonic evaluation, but these techniques were not currently in use by any respondents.

70 of the companies reported adding techniques to differentiate among batteries as a result of incidents involving Li-ion batteries. These included:

- More visual inspections
- Inspections at numerous stages once batteries arrive on site
- Increased training
- Photographs and example batteries shown to workers
- Sharing of information with other smelters and sites
- Checking and more information on companies delivering batteries
- Developing improved handing techniques