

**Committee of Experts on the Transport of Dangerous Goods
and on the Globally Harmonized System of Classification
and Labelling of Chemicals**

5 December 2022

Sub-Committee of Experts on the Transport of Dangerous Goods

Sixty first session

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Item 4.(f) of the provisional agenda

Electric storage systems:

miscellaneous

Reuse and repurpose of lithium ion cells and batteries

**Submitted by PRBA – The Rechargeable Battery Association and
RECHARGE the Advanced Rechargeable & Lithium Batteries
Association**

Reuse and Repurpose of Lithium ion Cells and Batteries

UN Sub-Committee of Experts on the Transport of
Dangerous Goods, November 2022

George A. Kerchner

PRBA – The Rechargeable Battery Association
Washington, DC 20036
gkerchner@wiley.law
+1 202.719.4109



Dr. Claude Chanson

RECHARGE
The Advanced Rechargeable & Lithium Batteries Association
Brussels, Belgium
+32 2 777 05 67
cchanson@rechargebatteries.org



Agenda

- Terms of reference agreed to by TDG Sub-Committee
- Definitions
- What is being repurposed and reused?
- Industry voluntary standards for “repurpose” and “reuse” of lithium ion batteries
- What applications are conducive for repurposed cells and batteries
- UN38.3 cell and battery testing requirements
- Safety concerns associated with repurposed and reused lithium ion cells and batteries



Terms of Reference Approved by TDG Sub-Committee

- ▶ Identify current industry standards and regulations associated with the terms, definitions, design, manufacturing, and certification of reused, repurposed, repair, refurbished, and recycled lithium ion cells and batteries.
- ▶ Identify different examples and practices associated with reuse and repurposing lithium ion cells and batteries.
- ▶ Distinguish the different examples where the design type conformity is still valid or is compromised and list criteria to assess it. This should include identification of acceptable and unacceptable practices.
- ▶ Develop a program for future work to be validated by the Sub-Committee that may include, but not be limited to, proposals to amend the applicable provisions of the UN38.3 lithium-ion cell and battery tests and UN Model Regulations to ensure compliance and the safe transport of reused and repurposed cells and batteries.

Definitions

- ▶ **Reuse:** A lithium ion cell, or battery are used again for the same purpose/application/function it was initially designed. Other term often used to describe such a scenario include “refurbish.”
- ▶ **Repurpose:** A lithium ion cell, or battery are used for a different purpose/application/function than initially designed. Other terms used to describe such a scenario include “secondary use” and “second life.”
- ▶ **Repair:** Changes are made to the original battery, which shows a malfunction, in order to have a fully-functioning battery again. No change in design results from repair.
- ▶ **Remanufacturing:** Changes are made to a battery that alter its functionality. This includes any changes that involve replacement of safety components. It also includes any procedures carried out on the battery that are not approved by the original manufacturer.



Government Agencies Advocating Reuse, Repurpose of Lithium ion Batteries

- ▶ European Commission's "roadmap" for batteries promotes the need for battery designs that provide for "maximum longevity," "refurbishing," and "second life"
- ▶ U.S. Department of Energy's "National Blueprint for Lithium Batteries" includes extensive references to reuse of lithium ion batteries and how "a resilient market should be developed for the reuse of battery cells from retired electric vehicles for secondary applications, including grid storage."



Automotive Companies Promoting Reuse/Repurpose

[Home](#) > [Releases](#)

NEWSROOM: Volkswagen shows off a new way to recycle and reuse EV batteries

Mar 9, 2021

Transforming the world to run on electric vehicles will take millions of batteries, and even though the EV revolution has just kicked off, there's growing questions about how to handle batteries at the end of their useful lives, and where all the materials needed to build new batteries will come from.

Earlier this year, the Volkswagen Group provided one answer to both these challenges, opening its first EV battery recycling plant in Salzgitter, Germany, the result of more than a decade of research. Designed to be more energy efficient than current battery recycling techniques, the pilot plant has a goal of being able to recapture up to 95 percent of the materials in an EV battery pack for potential reuse – including rare metals that store electricity.

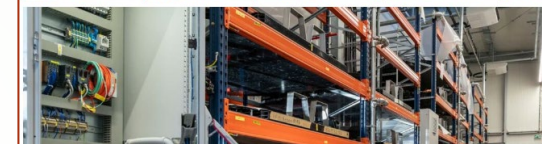
Decommissioned Audi EV batteries used in 4.5MWh stationary energy storage system in Germany

By [Andy Colthorpe](#)

January 4, 2022

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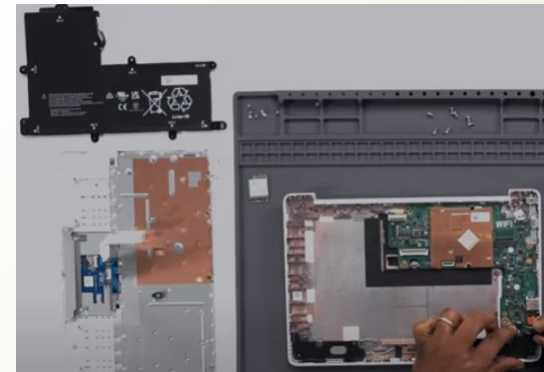
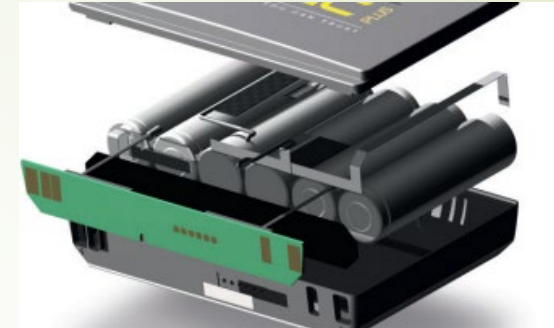
Toyota to Collaborate with Redwood Materials on a Sustainable, Closed-Loop Electrified Vehicle Battery Ecosystem

June 21, 2022



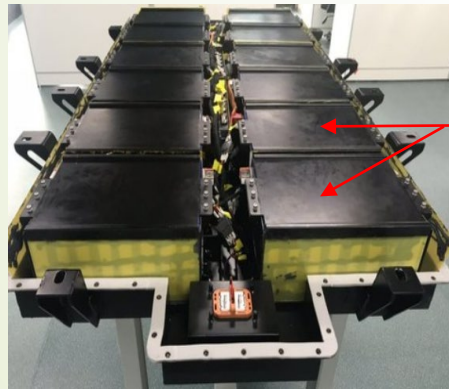
What is Being Reused and Repurposed?

- ▶ **Cells:** Lithium ion cylindrical and pouch (polymer) cells removed from batteries or equipment for reuse in single-cell or multi-cell battery applications (e.g., power banks, vaping devices)
- ▶ Significant safety and dangerous goods compliance concerns



What is Being Reused and Repurposed?

- ▶ **Battery Modules:** Pouch or cylindrical cells electrically connected to form a “battery” subject to UN38.3 testing requirements
- ▶ Often found in hybrid and electric vehicles and other large format battery applications
- ▶ Modules often repurposed for stationary storage applications



Electric vehicle lithium ion battery (assembly) design with battery modules
Modules may be repurposed or reused

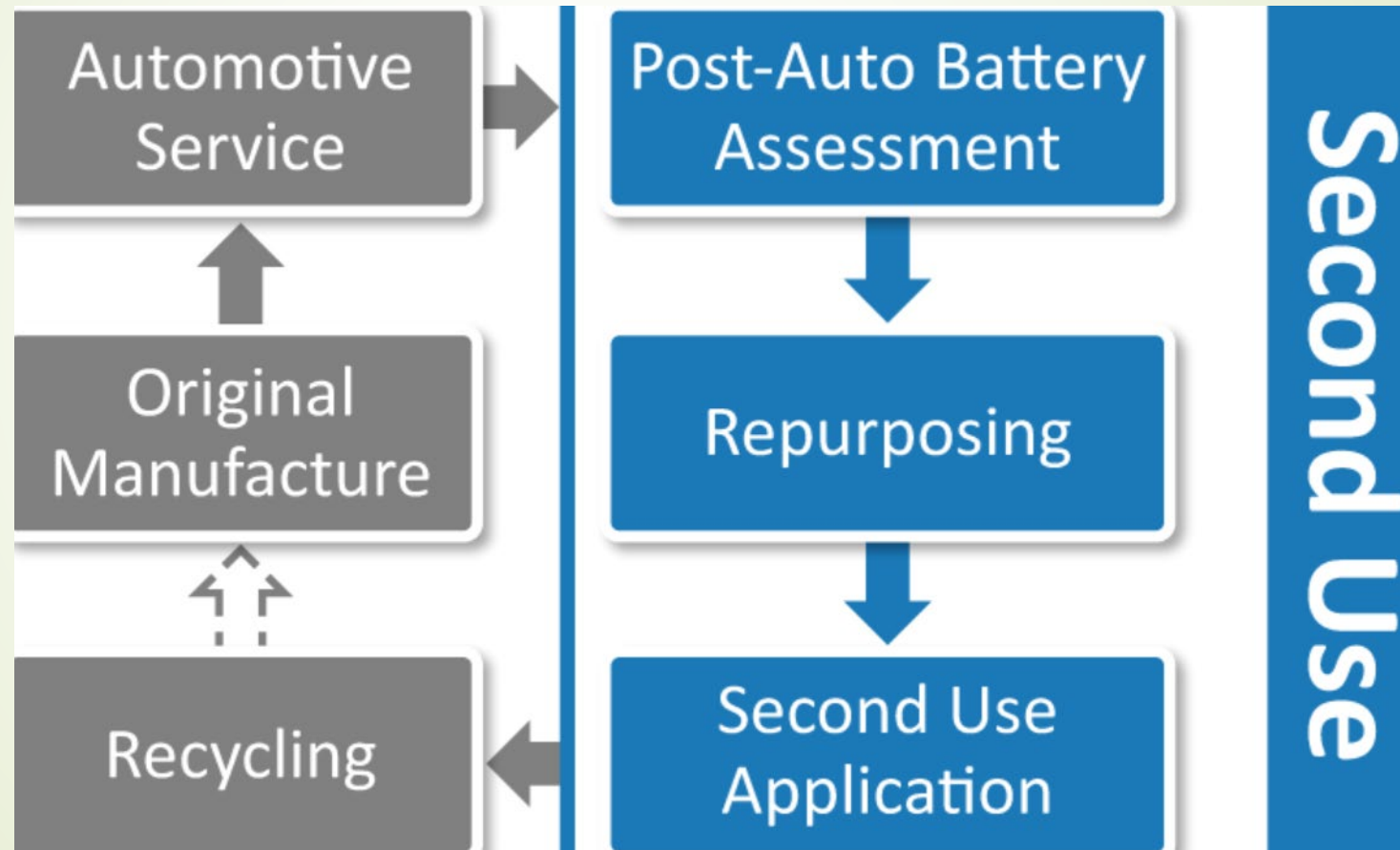


What is Being Reused and Repurposed?

- ▶ **Complete EV/HEV batteries (e.g., battery packs/systems).** Use of whole EV/HEV batteries without reconfiguration in large scale energy storage.
- ▶ Battery modules remain in original configuration
- ▶ See: <https://www.b2uco.com/technology>



Possible Repurpose/Secondary Use Cycle for EV/HEV Lithium ion Battery*



Industry Standards, Regulations

- ▶ **ANSI/CAN/UL 1974: Standard for Evaluation for Repurposing Batteries**
 - Voluntary industry standard
 - Covers sorting and grading process of batteries, modules and cells intended for a repurposed use applications
 - Standard also covers application specific requirements for repurposed batteries and batteries utilizing repurposed modules, cells and other components
- ▶ **IEC TC 21: IEC 63330 ED1 Requirements for reuse of secondary batteries**
 - Status: CDV finished, up for vote
- ▶ **IEC/SC21A: 63338 ED1 General guidance for reuse of secondary cells and batteries**
 - Very early stages of developing standard



Industry Standards, Regulations

38.3.2.2 Lithium metal and lithium ion cells and batteries shall be subjected to the tests, as required by special provisions 188 and 230 of Chapter 3.3 of the Model Regulations prior to the transport of a particular cell or battery type. Cells or batteries which differ from a tested type by:

- (a) For primary cells and batteries, a change of more than 0.1 g or 20 % by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte;
- (b) For rechargeable cells and batteries, a change in nominal energy in Watt-hours of more than 20 % or an increase in nominal voltage of more than 20 %; or
- (c) A change that would lead to failure of any of the tests,

shall be considered a new type and shall be subjected to the required tests.

NOTE: The type of change that might be considered to differ from a tested type, such that it might lead to failure of any of the test results, may include, but is not limited to:

- (a) A change in the material of the anode, the cathode, the separator or the electrolyte;
- (b) A change of protective devices, including hardware and software;
- (c) A change of safety design in cells or batteries, such as a venting valve;
- (d) A change in the number of component cells;
- (e) A change in connecting mode of component cells; and
- (f) For batteries which are to be tested according to T.4 with a peak acceleration less than 150 g_n, a change in the mass which could adversely impact the result of the T.4 test and lead to a failure.

In the event that a cell or battery type does not meet one or more of the test requirements, steps shall be taken to correct the deficiency or deficiencies that caused the failure before such cell or battery type is retested.

UN38.3.2.2: Identifies changes in “tested type” that would trigger new testing



Table 38.3.3: Summary table of required tests for rechargeable cells and batteries

Rechargeable cells and batteries											
		T.1	T.2	T.3	T.4	T.5	T.6	T.7 ^a	T.8	Sum ^d	
Cells not transported separately from a battery	first cycle, 50 % charged state						5			30	
	25th cycle, 50 % charged state						5				
	first cycle, fully discharged state								10		
	25th cycle, fully discharged state								10		
Cells	first cycle, fully charged state	5									40
	25th cycle, fully charged state	5									
	first cycle, 50 % charged state						5				
	25th cycle, 50 % charged state						5				
	first cycle, fully discharged state								10		
	25th cycle, fully discharged state								10		
Single cell batteries ^b	first cycle, fully charged state	5							4		48
	25th cycle, fully charged state	5									
	first cycle, 50 % charged state						5				
	25th cycle, 50 % charged state						5				
	25th cycle, fully charged state								4		
	first cycle, fully discharged state								10		
	25th cycle, fully discharged state								10		
Small batteries	first cycle, fully charged state	4							4		16
	25th cycle, fully charged state	4							4		
Large batteries	first cycle, fully charged state	2							2		8
	25th cycle, fully charged state	2							2		
Batteries assembled with tested batteries ≤ 6 200 Wh or ≤ 500 g Li	fully charged state				1			1		2	
Batteries assembled with tested batteries > 6 200 Wh or > 500 g Li ^c										0	

Industry Standards, Regulations

Cells and batteries required for UN38.3 tests



- (b) When testing rechargeable cells and batteries under tests T.1 to T.5 the following shall be tested in the quantity indicated:
- (i) five cells at first cycle, in fully charged states;
 - (ii) five cells after 25 cycles ending in fully charged states;
 - (iii) four small batteries at first cycle, in fully charged states;
 - (iv) four small batteries after 25 cycles ending in fully charged states;
 - (v) two large batteries at first cycle, in fully charged states; and
 - (vi) two large batteries after 25 cycles ending in fully charged states.
- (c) When testing primary and rechargeable cells under test T.6, the following shall be tested in the quantity indicated:
- (i) for primary cells, five cells in undischarged states and five cells in fully discharged states;
 - (ii) for component cells of primary batteries, five cells in undischarged states and five cells in fully discharged states;
 - (iii) for rechargeable cells, five cells at first cycle at 50 % of the design rated capacity and five cells after 25 cycles ending at 50 % of the design rated capacity; and
 - (iv) for component cells of rechargeable batteries, five cells at first cycle at 50 % of the design rated capacity and five cells after 25 cycles ending at 50 % of the design rated capacity.
- (d) When testing rechargeable batteries or rechargeable single cell batteries under test T.7, the following shall be tested in the quantity indicated:
- (i) four small batteries at first cycle, in fully charged states;
 - (ii) four small batteries after 25 cycles ending in fully charged states;
 - (iii) two large batteries at first cycle, in fully charged states; and
 - (iv) two large batteries after 25 cycles ending in fully charged states.

Industry Standards, Regulations

- Cell and battery cycling requirements in UN38.3 tests
- Cycling requirements cannot be met with used cells/batteries that will be reused, repurposed and require resting
- Batteries comprised of used/repurposed cells cannot meet UN38.3 testing requirements



RECHARGE

Lithium Cell or Battery **Test Summary in Accordance
with Sub-Section 38.3 of UN Manual of Tests and Criteria**

The following information shall be provided in this test summary:

- (a) Name of cell, battery, or product manufacturer, as applicable;
- (b) Cell, battery, or product manufacturer's contact information to include address, phone number, email address and website for more information;
- (c) Name of the test laboratory to include address, phone number, email address and website for more information;
- (d) A unique test report identification number;
- (e) Date of test report;
- (f) Description of cell or battery to include at a minimum:
 - (i) Lithium ion or lithium metal cell or battery;
 - (ii) Mass of cell or battery;
 - (iii) Watt-hour rating, or lithium content;
 - (iv) Physical description of the cell/battery; and
 - (v) Model numbers.
- (g) List of tests conducted and results (i.e., pass/fail);
- (h) Reference to assembled battery testing requirements, if applicable (i.e., 38.3.3 (f) and 38.3.3 (g));
- (i) Reference to the revised edition of the Manual of Tests and Criteria used and to amendments thereto, if any; and
- (j) Name and title of responsible person as an indication of the validity of information provided.

UN38.3 Test Summary



Port of Long Beach, California – March 2022



- 10 containers found with used/waste lithium ion batteries being exported to Asia
- Batteries were undeclared
- Bill of lading identified batteries as “synthetic resins” and “computer parts”
- Investigation ongoing, batteries likely being exported for repurposing and recycling