

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

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Page 1 of 11

FOREWORD

This document is addressed to Battery Manufacturers and Original Equipment Manufacturers as well as to those professionals who are storing, handling and transporting Li-Ion batteries.

- *This Battery Information Factsheet (BIF) is intended to provide information for the safe handling , storage and transport of lithium batteries by professionals. It offers Good Practice Guidance and Emergency Response Guidance while considering the hazards offered by Lithium-ion batteries.*
- *Original Equipment Manufacturers (OEMs) may use this information to communicate further down the supply chain. It is not targeting the end user of equipments where batteries are integrated. Usually the information for end-users is supplied by OEMs in their users manual.*
- *Other actors of the Battery Value Chain may also use this information.*
- *The BIF has been simplified in order to avoid any confusion with a Safety Data Sheet (SDS) which is mandatory for a chemical substance (according to REACH -Regulation (EC) No 1907/2006). According to this Regulation, Batteries are identified as “articles with no intended release of the substances they contain” therefore they do not require a specific SDS.*
- *This document can be used as a BIF template for companies manufacturing or placing Lithium –Ion batteries on the market. It’s content can be used to prepare Good Practice Guidance or Emergency Response Guidance for those who will be handling such batteries.*

Warning.

The reader will find at the end of the document a Table with correspondences between the Chapters of this BIF and a Safety Data Sheet. This document is not legally binding. It is prepared with the best information available to the authors at the time of its preparation. The information contained in this BIF may be updated without notice.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 2 of 11

BIF CONTENT SUMMARY

PART 1- Good Practice Guidance:

A Li-ion battery cell is a sealed article, with a typical voltage of 3.6V DC per cell. Its handling and storage shall respect the following key principles:

- **protect from short circuits and unadapted charging**
- **protect from heat sources (including sunlight).**
- **protect from water and humidity.**
- **protect from mechanical damage.**

Look for more information in Part 1.

PART 2- Emergency Response Guidance

- This part provide guidance for appropriate response to the possible hazards offered by a Li-ion battery:
- case of **High Voltage hazard** (modules and full battery > 36 Volts).The presence of the High Voltage warning sign requires dedicated intervention equipment: refer to Part 2-3.
- case of abusive conditions, damaged and defective batteries:
- **Release of electrolyte** containing a corrosive salt. Protect operators from inhalation of volatile organic substances. Reaction of the electrolyte with water/humidity may generate hydrofluoric acid. Refer to the hazard identification and protection in Part 2-2.
- **Fire.** Protect operators from inhalation of fumes. Refer to fire fighting measures in Part 2-4 for the First Responders.



PART 3- REGULATORY and LEGISLATIVE INFORMATION

Requirements for Lithium –Ion batteries placed on the European Union market in accordance with the Batteries Directive 2006/66/EC, and corresponding national laws. The batteries have to be marked with the crossed wheeled bin symbol. and may be subject to specific local/regional/national conditions for collection and recycling.

Lithium-ion batteries which contain electronic modules are subject to the EMC directive 93/97/EEC and must be certified and wear the CE marking.

Look for more information in Part 3.

PART 4- TRANSPORT INFORMATION

Li-ion batteries are classified as Dangerous Goods for transport according to the UN Model regulation for the Transport of Dangerous Goods.They are classified under CLASS 9 , **UN 3480 : Lithium-Ion Batteries**, and **UN 3481 : Lithium-Ion Batteries contained in equipment or packed with equipment.**

Prior to any shipment, the compliance with the following requirements points must be fulfilled:

-The Transport of Li-ion batteries (Dangerous Goods) is organized by appropriately trained persons and/or the shipment is accompanied by corresponding experts or qualified companies.

-The Lithium-Ion battery is of the type proved to meet the tests requirements of the UN Manual of Tests and Criteria, Part III, sub-section 38.3 ; A summary report of the tests shall be available on request.

-In accordance with the requirements of the UN Model Regulation, Chapter 2.9.4, the manufacturer of the battery or the battery pack shall make available on request of the Competent Authority the **evidences that a Quality Certification program is in place** in its manufacturing facility for Lithium-ion batteries.

In addition, Specific legislations apply to each mode of transportation:**ADR/RID** (road transport), **IMO** (maritime transport) and **IATA-DGR** (air transport).

Look for more information in Part 4.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 3 of 11

WARNING: According to REACH (Regulation (EC) No 1907/2006) batteries are identified as articles with no intended release of the substances they contain. Therefore providing a Safety Data Sheet in Europe is not mandatory for articles. This document provides some relevant information for Good Practice Guidance and Emergency Response Guidance as well as some complementary information regarding the Transport & Environnement Protection Legislation. The information contained in this document is not legally binding.

PRODUCT AND COMPANY REFERENCES

Product name Lithium-Ion Battery / example: 18650 cell of the LCO type = Cathode type is made of Lithiated Cobalt Oxide (LCO)
Product code N°: XXXXXXXXXX
Company reference Name: YYYYYYYYYY
Address: YYYYYYYY
Telephone: YYYYYYYY
E-mail: YYYYYYYYYY

Emergency contact: ZZZZZZZZ

PART 1. GOOD PRACTICE GUIDANCE

1. GOOD PRACTICE GUIDANCE

A Li-ion battery cell is a sealed article, with a typical voltage of 3.6V DC per cell.

A Li-ion battery is an article with no intended release of its substances.

Under normal conditions of use, the battery does not release its content as it is sealed. In case of accidental release of the batteries components, please refer to the emergency response guidance (PART 2 below)

In case of large electrical serial assembly, modules and full battery may offer high Voltage hazard (> 36 Volts). The presence of the High Voltage warning sign requires dedicated intervention equipment: see PART 2.2. below.



1.1. Handling.

- Safe handling advice

When handling the batteries (cells), use personal protective equipment (gloves), specifically to avoid short-circuits between the battery poles.

- Technical measures/precautions.

- Follow the instructions reported in the users manual prepared by the manufacturer.
- Do not short (+) or (-) battery terminals with conductors, do not allow battery terminals to contact each others.
- Do not use unadapted chargig systems.
- Do not reverse the polarity,
- Do not mix different types of batteries or mix new and old ones together e.g. in a power pack,
- Do not open the battery system or modules,
- Do not use the unit without its electronic management system,
- Do not submit to static electricity risks to avoid damages to the protecting electronic circuit,
- Do not submit to excessive mechanical stress,
- Do not expose the battery to water or humidity (avoid water condensation),
- Do not expose to heat, solder or throw into fire. Such unsuitable use can cause leakage or evacuate through a safety valve gaseous electrolyte fumes that may cause fire,
- Immediately disconnect the batteries and isolate in a safe place if, during operation, they emit an unusual smell, develop heat, change shape/geometry, or behave anormally. Contact the manufacturer if any of these problems are observed.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 4 of 11

1.2. Storage

- Keep in a dry, cool and well-ventilated place, check the recommended storage temperature usually reported in the users manual prepared by the manufacturer, (e.g. 35°C),
- Keep away from heat sources (max 60°C) and sources of ignition. Prortect from direct exposure to sunlight.
- Keep away from water and condensation.
- Store in closed container and packaging, in such a way to prevent short circuits and damages during storage or transportation. Packaging qualified for transport is generally suitable for storage.
- In case of risk of thermal runaway during storage or transport, it is necessary to use strong outer packaging as recommended by the UN Special Provision 376 in order to restrict the potential ejection of cells constituents and battery parts during fire.
- In case of mixed storage of goods and articles, organize seprate storage area for lithium-ion batteries.E..g. by maintaining a distance of 2.5 meters between the Lithium-ion batteries storage area and other goods.
- Store in limited quantities and in isolated area under external surveillance, unless specifically designed storage building (detectors and/or sprinklers protection systems).
- Infra-Red cameras may be used to detect any excessive temperature raise in stored quantites, e.g. > 85°C

It may be advisable to store limited quantities in a given area, such as for a 60 m2 area, the quantity should not be larger than 6 euro palets or an equivalent of 6.0 m3 of batteries or equipment containing batteries. The storage of the palets should not be higher than 2 meters, except in specifically designed storage building. Similar measures may be applied to storage of equipment containing batteries, particularly when the mass of the contained batteries represents a large part of the equipment weight.

Safety measures for storage shall be organized with the relevant safety team at the plant. It shall be adapted to the local Emergency Response Capacity (see PARA 3 below).

1.3. Transport.

Lithium Ion batteries are classified as Dangerous Goods for the Transport by Road/Rail, Sea and Air. It is important to conform to the requirements of the UN Regulation on the Transport of Dangerous Goods. Some of these are detailed in PART 4 of this BIF.

1.3.1. Inside a plant.

Internal transfer of Lithium-Ion batteries should follow the minimum safety rules imposed by the local legislation/regulation regarding the handling of Dangerous Goods (See PART 4).

1.3.2. Shipment outside a plant.

The shippers of lithium batteries, and lithium batteries packed with Equipment, to an outside facility should be aware that these batteries before being offered for transport have to be tested according to UN Tests and Manual Requirements Chapter 38.4..

In case of damaged and defective batteries, or waste, allways protect the battery from short circuits. The transport of such product is also submitted to UN regulation.

The Shipper is responsible for the implementation of the UN Regulation and may be subject to heavy penalty in case of infringement to the UN Transport Regulation. Please refer to PART 4 of this BIF.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 5 of 11

PART 2 EMERGENCY RESPONSE GUIDANCE

2. EMERGENCY RESPONSE GUIDANCE

In normal conditions of use, the Lithium-Ion battery is a sealed article.

Lithium-ion Batteries are manufactured in accordance with very strict quality and safety standards. Access to these quality standards can be obtained by contacting directly the battery manufacturer.

The information below is aiming at delivering guidance to respond to an emergency situation in case of ,

- Accidental release of the battery content,
- Exposure to high voltage,
- Exposure to a fire.

This may happen in case of damage to the battery or in case of not-foreseeable use or misuse of the battery or of the equipment containing the battery.

2.1. Lithium-ion Battery main components.

In case of accidental release of the battery content, the operator may be exposed to one or more of the battery constituents. A list of generic constituents of a Lithium-Ion battery is presented below.

Components	CAS Number	Content (wt. %)
Lithiated Metal Oxide	12190-70-13	10-25
Organic Electrolyte	96-49-1/108-32-7/..	10-35
Inorganic salt in the electrolyte	21324-40-3	1-5
Carbon, as Graphite	7440-44-0	10-25
Copper	7440-50-8	1-10
Aluminium	7429-90-5	1-10

NB. This composition may vary significantly between manufacturers. Please address your inquiry for more specific compositions to the manufacturer.

2.2. Measures in case of accidental release of the battery content (spillage in absence of fire)



The potential hazard offered by damaged lithium batteries in absence of fire is mainly the release of an electrolyte containing a corrosive salt. Measures should also be taken to protect operators from inhalation of volatile organic substances. Reaction of the electrolyte with water/humidity may generate hydrofluoric acid and irritate the eyes, nose, throat and skin.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 6 of 11

Personal precautions

Use personal protective equipment. Avoid contact with skin and eyes. Ventilate the area. Position yourself in the wind direction. The information below refers to exposure to the substances contained in the battery.

- Respiratory track protection

Protective mask for acidic vapours or Self Contained Breathing Apparatus (SCBA).

- Hand protection

Neoprene gloves (EN 374) or equivalent.

- Eye protection

Safety glasses with side-shields conforming to EN166 or equivalent.

- Skin and body protection

Boots, apron, long sleeved clothing.

- Hygiene measures

General industrial hygiene practice.

Human intervention: first aid and measures.

- Inhalation of vapours (in non fire situations).

Immediate medical attention is required. Move to fresh air. If symptoms persist, call a physician.

- Skin contact

Immediate medical attention is required. Wash off immediately with plenty of water for at least 15-20 minutes, as necessary. Remove and wash contaminated clothing before re-use. If skin irritation persists, visit a physician.

- Eye contact

Immediate medical attention is required. Remove contact lenses. Rinse immediately with plenty of water for at least 15-20 minutes, as necessary.

- Ingestion

Immediate medical attention is required. Gently wipe or rinse the inside of the mouth with water. Do not induce vomiting. Never give anything by mouth to an unconscious person. Call a physician or a Poison Control Centre immediately.

Environmental precautions

Eliminate all possible sources of heat or ignition.

Prevent further leakage or spillage if safe to do so (use absorbent cloth or other inert absorbent non-conductive mineral such as sand, sodium bicarbonate, alumina or vermiculite).

Dry clothes can also be used as a absorbent material in absence of fire.

Do not allow material to contaminate ground water system.

Treatment of Waste Water

Confine the effluent or the contaminated material and collect it for further as hazardous waste (water) for appropriate treatment.

Pick up and transfer to properly labelled containers.

Dispose of in accordance with local waste management legislation and emissions regulations (PART 3 below).

2-3 Exposure to High voltage.



Lithium-ion batteries used in Hybrid and full Electric Vehicles may have Voltage larger than 30V. Therefore the approach of a battery used in an EV should consider the hazard of Electrical Shock which characterizes these batteries.

The following prevention measures should be taken when approaching a high voltage battery or rescue a victim nearby.



Use insulating gloves or protections.

Turn off the source of electricity, if possible. If not, move the source away from you and the person (victim), using a dry, nonconducting object made of cardboard, plastic or wood.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 7 of 11

Check for signs of life (breathing, coughing or movement). If absent, begin cardiopulmonary recovery (CPR) immediately.

Prevent shock. Lay the person down and, if possible, position the head slightly lower than the body with the legs elevated.

After coming into contact with electricity, the person should see a doctor to check for internal injuries, even if he or she has no obvious signs or symptoms.



2-4 Fire fighting measures.

Call for emergency services. Consider and decide about the adapted intervention plan (ACTIVE/PASSIVE Response, proximity or distance response).

Ventilate the area. Position yourself upfront of the wind direction.

In case of intervention:

- Use personal protective equipment.
- Use Self Contained Breathing Apparatus (SCBA).

2.4.1 case of limited fire/smoke, decision of early intervention:

• Several possibilities to control a small fire are applicable according the circumstances: small batteries can be immersed in water, or placed in a drum covered with a non- flammable blanket, Carbon dioxide or an extinguishing foam can be used to extinguish small flames (but is insufficient to cool down the fire). This method is used to provide enough time to move a pallet in an isolated place, for use of further extinguishing systems in large quantities (sand, water,...).

Sprinkler located at short distance is advisable (rapid cooling can stop the fire propagation).

• In all cases, the intervention to control a fire should not be recommended if the intervention team safety is not trained in accordance at least with the following criteria, as a minimum:

- The intervention team has a general knowledge and understanding of the situation.
- The vision on the site is acceptable (smoke evacuation and ventilation can be helpful).
- The intervention team has self contained breathing apparatus.
- The first responders need to be informed that in case of fire there is a risk of ejection of projectiles from the battery.
- In case where a transport is needed, there is an available free area at short distance, where further actions, or visual control and monitoring will be possible.

2.4.2 case of large fires,

Manage ventilation:

- make sure the area is ventilated in order to avoid any accumulation of hydrogen or other explosive gas, particularly in case of mixed storage containing Li-metal batteries. In addition, good ventilation is recommended to evacuate fumes, allowing eventually an easier fire brigades intervention. The toxicity of fumes do not depend greatly on the type of Lithium batteries, Hydrogen fluoride can be produced in almost all cases. Specific care of flammable or explosive gazes should be taken in case of use of flame extinguishing systems: they can accumulate in a closed area even after the flames have been extinguished.

In active response,

- **Large flow of water can be used to reduce the temperature of the batteries and stop the fire reactions inside the batteries. Specific care should be taken for large and compact batteries, where cooling may require more time.**
- **Foam and specialized products can be used to reduce access of oxygen to the fire and stop flames, but are generally less efficient than cooling down the batteries. Be aware of the risk of re-ignition until the batteries have been cooled down below 100°C.**

In passive response, control extension of fire to neighbours materials and buildings

- Use abundant flow of water to cool down cells or batteries adjacent to the ones that have caught fire (maintain low temperature) whatever the type of batteries at the origin of the fire.
- The first responders need to be informed that in case of fire there is a risk of ejection of projectiles from the battery.

Suitable extinguishing media.

1. Water (see below)
2. Specialized products, liquid foam, carbon dioxide (CO2), sand, vermiculite,...

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 8 of 11

Warning for the use of water

- If water is used on active batteries, caution should be taken to avoid the electrical hazard that may be present (in case of high voltage battery, > 36 Volts).
- the decision to use large amount of water is depending on the local circumstances (water retentions systems, environment risks,...).
- In case of fire including large Lithium metal or Lithium metal polymer batteries, the use of water may increase the energy /heat release.
- In such case, stop the use of water and allow the energetic fire of the battery during 15 minutes.
- Protect or cool with water the surrounding to avoid propagation of the fire.

Note:

Request complementary information for firefighting tools to the battery manufacturer: see Fire fighters training manual for more detailed information.

Treatment of Waste Water.

Confine the effluent or the contaminated material and collect it for further as hazardous waste (water) for appropriate treatment.

Pick up and transfer to properly labelled containers.

Dispose of in accordance with local waste management legislation and emissions regulations (PART 3 below).

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021


template provided by RECHARGE aisbl

Page 9 of 11

PART 3. REGULATORY and LEGISLATIVE INFORMATION

3.1 Regulatory information

Requirements for Lithium –Ion batteries placed on the European Union market in accordance with the Batteries Directive 2006/66/EC, Regulation 1103/2010 and Directive 2023/56/EU, and corresponding national laws. Batteries may be classified as

hazardous waste in some EU countries. The batteries have to be marked with the crossed wheel bin symbol.  and may be submitted to specific conditions for collection and recycling.

According to the document “QUESTIONS AND ANSWERS ON THE BATTERIES DIRECTIVE (2006/66/EC) » published by the EU Commission (page 23), the Batteries Directive applies also to battery packs.

Lithium-ion batteries, which contain electronic modules as battery management units and which are subject to the EMC directive 2014/30/EU, must be approved and must wear the CE marking. The CE marking is also applicable to various equipments containing batteries, such as equipments submitted to the Ecodesign Directive 2009/125/EC or noise emissions Directive 2000/15/EC, systems for potentially explosive atmospheres (ATEX) Directive 2014/34/EU, low voltage equipments (75-1500 V DC) according Directive 2014/35/EU, ROHS, medical equipments, machineries, etc..see: https://ec.europa.eu/growth/single-market/ce-marking/manufacturers_en

Batteries that can be used by consumers should comply with the General Product Safety Directive (GPS) 2001/95/EC.

3.2 Environmental Legislation applicable.

Waste treatment.

Directive 2006/66/EC on batteries and accumulators, and waste batteries and accumulators, and Commission Regulation EU 493/2012 applies.

Dispose of waste batteries in accordance with national legislation. When collected waste batteries must undergo recycling to comply with national regulations. Batteries should not be disposed of into the environment.

Clean packing material may be recycled according to local and national regulations.

Further information

According to the European Waste Catalogue (EWC), Waste Codes are not product specific, but application specific. Waste codes should be assigned by the user, preferably in discussion with the waste disposal authorities.

Suggested EWC-codes according waste disposal are

N°: 16 06 05, other batteries & accumulators, and

N°: 20 01 34, unsorted batteries and accumulators containing these batteries

PART 4. TRANSPORT INFORMATION

Li-ion batteries are classified as Dangerous Goods for transport according to the UN Model regulation for the Transport of Dangerous Goods. They are classified under CLASS 9 Dangerous Goods due to their dual hazard properties associated with their chemical and electrical content

UN 3480 : Lithium-Ion Batteries

UN 3481 : Lithium-Ion Batteries contained in equipment or packed with equipment.

Prior to any shipment, the compliance with the following requirements points must be fulfilled:

-The Transport of Li-ion batteries (Dangerous Goods) is organized by appropriately trained persons and/or the shipment is accompanied by corresponding experts or qualified companies.

-The Lithium-Ion battery is of the type proved to meet the tests requirements of the UN Manual of Tests and Criteria, Part III, sub-section 38.3 ; <https://unece.org/rev7-files>

-In accordance with the requirements of the UN Model Regulation, Chapter 2.9.4, the manufacturer of the battery or the battery pack shall made available on request of the Competent Authority the evidences that a Quality Certification program is in place in its manufacturing facility for Lithium-ion batteries.

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 10 of 11

The following requirements applies according to the various modes of transportation.

ADR/RID

Class 9 Packing group II, tunnel category E ADR/RID-Labels 9
Proper shipping name Lithium-Ion batteries, UN 3480
ADR Special Provisions 188, 230,310, 348 will apply and Packing Instruction P903, LP903.
Damaged and defective batteries: Special Provision 376 and P908-LP904,or P911-LP906 or contact your National Competent Authority
Waste batteries: SP 636, Special provision 377 and P909.
Note: For ADR, see the following address <https://unece.org/transportdangerous-goods/adr-2021-files>

IMO

Class Packing group II IMO-Labels 9
Proper shipping name Lithium-Ion batteries, UN 3480
IMDG Code: Special provisions 188, 230, 310, and packing instructions P903
EmS: F-A, S-I
Stowage category A
Damaged and defective batteries: contact your National Competent Authority
Waste batteries: See new provision SP 377 applicable from January 2015 and contact your Competent Authority.

IATA-DGR

Class Packing group II ICAO-Labels 9
Proper shipping name Lithium-Ion batteries, UN 3480
IATA: Special provisions A88, A99, A154, A164, A181, A182, A183 packing instructions P965, P966, P967
Since April 1 2016, UN 3480, PI 965, Section IA and IB are forbidden for carriage as cargo on passenger aircraft. Damaged and defective batteries or waste batteries are not allowed for transport by air.
Note: For the IATA Guidance Document on lithium batteries, see the address:
<http://www.iata.org/whatwedo/cargo/dgr/Pages/lithium-batteries.aspx>

Please, keep updated on the Transport Regulation by contacting your National Competent Authority

WARNING / DISCLAIMER ON LIABILITY (to be adapted according company policy).

The information provided in this Battery Information Factsheet is indicative and only valid at the date of its publication. The information given is designed only as a **guidance for safe handling, storage and transportation of these batteries. It is not to be considered as a warranty or quality specification.**

It is the responsibility of each individual handling these batteries to obtain from the supplier of the batteries the most appropriate information in order to complement, adapt or correct the content of this BIF.

ADDITIONNAL SOURCE OF INFORMATION

Detailed chemical information is available separately from each individual Battery Manufacturer.
About safety: other source of information for safety measures in the large storage can be found by international organizations like the NFPA , where a large part of the requirements for Energy Storage Systems are applicable:
<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855>
"Sprinkler Protection Guidance for Lithium-Ion Based Energy Storage Systems". Fire Protection Research Foundation report: "Sprinkler Protection Guidance for Lithium-Ion Based Energy Storage Systems" Authors: R. Thomas Long, Jr., P.E., CFEI, Amy M. Misera, CFEI. Date of issue: June 2019.
<https://www.nfpa.org/News-and-Research/Data-research-and-tools/Suppression/Sprinkler-Protection-Guidance-for-Lithium-Ion-Based-Energy-Storage-Systems>
In 2020 was published the DNV-GL report about the ESS fire in Arizona, with relevant conclusions for batteries safety management, and review of some standards shortcomings.
<https://coaching.typepad.com/files/mcmicken.pdf>

BATTERY INFORMATION FACTSHEET : Lithium-Ion (Li-Ion) Batteries

Date 11/01/2021

template provided by RECHARGE aisbl

Page 11 of 11

BATTERY INFORMATION FACTSHEET – BIF.

1. Targeted Audiences

	Generic Information		Generic Information and additional Information
1	<i>Purchasing Department (OEM)</i>	7	<i>EHS officers</i>
2	<i>Battery assemblers and users in industrial environment (OEMs)</i>	8	<i>Collectors (waste batteries)</i>
3	<i>Warehouses</i>	9	<i>Recyclers</i>
4	<i>Carriers (new batteries)</i>	10	<i>Handling of damaged battery</i>
5	<i>Insurance Companies</i>	11	<i>Intervention Crew (Fire Brigade)</i>
6	<i>Customs agents</i>		

2. Type of Information (Equivalence between BIF Chapters and Chapters of an SDS)

	BIF	Equivalent paragraphs of a SDS
<i>PART 1</i>	<i>Good Practice Guidance</i>	<i>7;9</i>
<i>PART 2</i>	<i>Emergency Response Guidance</i>	<i>3;4;5;6;8</i>
<i>PART 3</i>	<i>Basic Regulatory and Legislative Information</i>	<i>13;15</i>
<i>PART 4</i>	<i>Transport</i>	<i>14</i>
<i>PART 5</i>	<i>Additional information</i>	<i>2</i>
