Shipping Guidelines for Lithium Ion Batteries

Content

1. Introduction .................................................................................................................. 2
2. Provisions for Lithium Batteries carried by Passengers on Aircrafts ......................... 2
3. Transport regulations for Dangerous Goods ................................................................. 3
4. UN Transportation Testing (UN DOT 38.3) for Lithium Batteries .................................. 3
5. Shipping Guidelines ......................................................................................................... 4
   5.1. Shipment of Lithium Ion Batteries ≤ 100 Wh by Truck / Rail (ADR/RID), Sea Freight (IMDG) ................ 4
   5.1.1. Example: Packaging containing batteries ≤ 100 Wh, SP188 ............................................. 4
   5.2. Shipment of Lithium Ion Batteries > 100 Wh by Truck / Rail (ADR/RID), Sea Freight (IMDG) ................ 5
   5.2.1. Example: Packaging containing batteries > 100 Wh, UN3480, P903 .................................. 6
   5.2.2. Example: Packaging containing batteries > 100 Wh, UN3480, P903, overpack used .................. 6
   5.3. Shipment of Lithium Ion Batteries ≤ 100 Wh by Air Freight (IATA) ............................... 7
   5.3.1. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC II ............................... 8
   5.3.2. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC IB ............................... 8
   5.3.3. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC IB, overpack used ............. 8
   5.4. Shipment of Lithium Ion Batteries > 100 Wh by Air Freight (IATA) ............................... 9
   5.4.1. Example: Packaging containing batteries > 100 Wh, PI 965, SEC IA ............................... 10
   5.4.2. Example: Packaging containing batteries > 100 Wh, PI 965, SEC IA, overpack used .......... 10
   5.5. Shipment of Lithium Ion Battery Prototypes ............................................................. 11
   5.5.1. Example: Packaging containing Lithium Ion Battery Prototypes ................................. 11
   5.6. Shipment of damaged or defective Lithium Ion Batteries ........................................... 12
   5.7. Shipment of Lithium Ion Batteries for Disposal or Recycling ...................................... 13
6. Useful Websites ............................................................................................................. 13
1. Introduction

Transport of lithium ion batteries is in the scope of Dangerous Goods Transport Regulations. Therefore many specific requirements have to be respected for their transport. The following recommendations have been created to provide initial practical guidance to the regulations of the transport of lithium ion batteries.

It refers to the commercial transport by
- Road / Rail (ADR/RID)
- Seafreight (IMDG)
- Airfreight (IATA)

Lithium ion batteries are classified as follows:
- UN3480 Lithium Ion batteries
- UN3481 Lithium Ion batteries contained in equipment
- UN3481 Lithium Ion batteries packed with equipment

Especially the watt-hour rating and other conditions classify which dangerous goods regulations must be taken into account for the transport of lithium ion batteries. Please refer to the product data sheet.

For all shipments, it is required that all personnel involved in the preparation and transport of lithium ion cells or batteries receive adequate instruction on these requirements or Dangerous Goods training.

In individual cases, a dangerous goods expert should be consulted. Local authorities are responsible for the interpretation and implementation of the relevant regulations. They can make decisions differing from this guidelines. Therefore, no liability can be assumed for the content and the completeness of this document.

2. Provisions for Lithium Batteries carried by Passengers on Aircrafts

Certain restrictions apply to the carriage of lithium metal and lithium ion batteries even when carried by passengers as baggage. Only batteries that have successfully passed the Tests outlined in Part III, Sub Section 38.3 of the UN Manual of tests and criteria may be carried.

IATA Table 2.3.A Provisions for Dangerous Goods Carried by Passengers or Crew (Subsection 2.3):
3. Transport regulations for Dangerous Goods

Please refer to the listed regulations for further and detailed information:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road,

49 CFR: Code of Federal Regulations, DOT, PHMSA is responsible for regulating movement of hazardous materials by all modes of transportation within the US.

IATA DGR: International Air Transport Association, Dangerous Goods Regulations,

ICAO: International Civil Aviation Organization, Technical Instructions for the Safe Transport of Dangerous Goods by Air,

IMDG Code: International Maritime Dangerous Goods Code,

RID: International Statutory Order on the Conveyance of Dangerous Goods by Rail,

UN: United Nations Recommendations on the Transport of Dangerous Goods

4. UN Transportation Testing (UN DOT 38.3) for Lithium Batteries

Nearly all lithium batteries are required to pass section 38.3 of the UN Manual of Tests and Criteria (UN Transportation Testing) with the following procedure:

T1 – Altitude Simulation (Primary and Secondary Cells and Batteries)
T2 – Thermal Test (Primary and Secondary Cells and Batteries)
T3 – Vibration (Primary and Secondary Cells and Batteries)
T4 – Shock (Primary and Secondary Cells and Batteries)
T5 – External Short Circuit (Primary and Secondary Cells and Batteries)
T6 – Impact (Primary and Secondary Cells)
T7 – Overcharge (Secondary Batteries)
T8 – Forced Discharge (Primary and Secondary Cells)
5. Shipping Guidelines

5.1. Shipment of Lithium Ion Batteries ≤ 100 Wh by Truck / Rail (ADR/RID), Sea Freight (IMDG)

A passed transportation test according section 38.3 of the UN Manual of Tests and Criteria is required!

<table>
<thead>
<tr>
<th>Truck / Rail (ADR/RID), Sea Freight (IMDG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packagings: ADR/RID SP188, RIDG SP188</td>
</tr>
</tbody>
</table>

**Transportation Mode:**
- Batteries (without equipment)
- Batteries packed with equipment
- Batteries contained in equipment

**Max. Quantity:**
- none

**Weight Limit:**
- 30 kg gross weight per packaging

**Packaging:**
- Batteries must be placed in inner packagings that completely enclose the battery, batteries must be protected so as to prevent short circuits.
- Strong outer packaging, e.g. fibreglass box (drop test passed; content shall not be damaged or shifted).
- Protection against unintentional activation
- Short circuit protection

**Marking:**
- Minimum dimensions: 120 x 110 mm
- UN 3480

**Sea Freight:**
- Container-Marking: none
- Transport Document: none

**Miscellaneous:**
- Work instruction of involved staff

5.1.1. Example: Packaging containing batteries ≤ 100 Wh, SP188

Max. content: 30 Kg G (G = gross weight) per packaging
### 5.2. Shipment of Lithium Ion Batteries > 100 Wh by Truck / Rail (ADR/RID), Sea Freight (IMDG)

A passed transportation test according section 38.3 of the UN Manual of Tests and Criteria is required!

<table>
<thead>
<tr>
<th>Truck / Rail (ADR/RID), Sea Freight (IMDG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For lithium ion cell the Watt-hour rating is more than 20 Wh.</td>
</tr>
<tr>
<td>For lithium ion battery the Watt-hour rating is more than 100 Wh.</td>
</tr>
</tbody>
</table>

#### Packing Instructions
- ADR (RID P903)
- IMDG (P903)

#### Transportation Mode
- Batteries (without equipment)
- Batteries packed with equipment
- Batteries contained in equipment

#### Max. Quantity
- none

#### Weight Limit
- ADR 1.1.3.6: max. 333 kg / per transport unit (truck incl. trailer)
- If exceeding weight limit, additional requirements to the carrier required

#### Packaging
- Batteries must be placed in inner packages that completely enclose the battery.
- Batteries must be protected against short circuit.
- Batteries must be secured against movement within the outer packaging.
- UN approved packaging (Packing Group II: e.g. UN4507/UN7052/)

#### String outer packaging
- Protection against unintentional activation
- Short circuit protection

#### In addition for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, and assemblies of such cells or batteries:
- String outer packaging;
- Protective envelope (e.g. in fully enclosed or wooden skidded container);
- Or pallets or other handling devices.

#### Cells or batteries shall be secured to prevent inadvertent movement, and the terminals shall not support the weight of other superposed elements.

#### Marking
- Label (10x10 cm)
- UN 3480
- IMDG 4980 LITHIUM ION BATTERIES
- UN 3481
- IMDG 4981 LITHIUM ION BATTERIES PACKED WITH EQUIPMENT
- UN 3480 LITHIUM ION BATTERIES PACKED WITH EQUIPMENT, 2 (C)
- UN 3481 LITHIUM ION BATTERIES PACKED WITH EQUIPMENT, 2 (C)

#### Sea Freight Container-Marking
- CONTAINER-PLACARDS (min. 25x25 cm)

#### Transport Document
- UN 3480, LITHIUM ION BATTERIES, 9, (E)
- Number of packages and packaging type (e.g. 1 Fibreboard box)
- Battery weight (e.g. 12 kg)
- Transport category 2, 9, (E)
- Shipment & consignee’s address
- See Freight (IMO): (language English)
- IMDG DANGEROUS GOODS DECLARATION
- SOLAS 74, CAP. V, REG 5, MARPOL 73/78, ANNEX III REG 4 OF IMO CODE

#### Miscellaneous
- Work instruction of involved staff
- UN 3481, LITHIUM ION BATTERIES PACKED WITH EQUIPMENT, 9, (E)
- Number of packages and packaging type (e.g. 1 Fibreboard box)
- Battery weight (e.g. 12 kg)
- Transport category 2, 9, (E)
- Shipment & consignee’s address
- See Freight (IMO): (language English)
- IMDG DANGEROUS GOODS DECLARATION
- SOLAS 74, CAP. V, REG 5, MARPOL 73/78, ANNEX III REG 4 OF IMO CODE

Gültig ab [Valid from]: 15. April 2019
5.2.1. Example: Packaging containing batteries > 100 Wh, UN3480, P903

Max. content: as per UN packaging (e.g. Y30 = 30 Kg G)

5.2.2. Example: Packaging containing batteries > 100 Wh, UN3480, P903, overpack used

Max. content: 333 Kg G / shipment (Truck), if exceeding, additional requirements to the carrier will be needed
5.3. Shipment of Lithium Ion Batteries ≤ 100 Wh by Air Freight (IATA)

A passed transportation test according section 38.3 of the UN Manual of Tests and Criteria is required!

For IATA PI965 SEC IB and II only: Lithium ion cells and batteries must be offered for transport at a state of charge (SoC) not exceeding 30% of their rated design capacity!
5.3.1. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC II

Max. content: 2 batteries per packaging

5.3.2. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC IB

Max. content: 10 Kg net per packaging

5.3.3. Example: Packaging containing batteries ≤ 100 Wh, PI 965, SEC IB, overpack used

Max. content: none per overpack (from 01. Jan. 2016 min. size of “OVERPACK” 12mm)
## 5.4. Shipment of Lithium Ion Batteries > 100 Wh by Air Freight (IATA)

A passed transportation test according section 38.3 of the UN Manual of Tests and Criteria is required!

For IATA **PI965** SEC IA only: Lithium ion cells and batteries must be offered for transport at a state of charge (SoC) not exceeding 30% of their rated design capacity!

### Airfreight (IATA)

<table>
<thead>
<tr>
<th>Packing Instructions</th>
<th>Transportation Mode</th>
<th>Max. Quantity</th>
<th>Weight Limit PAX</th>
<th>Weight Limit CAD</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>IATA PI965 Section IA</td>
<td>Batteries (without equipment)</td>
<td>none</td>
<td>prohibited</td>
<td>16 kg net battery weight per packaging</td>
<td>Batteries must be placed in inner packaging that completely encloses the battery, batteries must be protected to prevent short circuits. UN approved packaging (Packing Group II: e.g. UN 4G/Y09...).</td>
</tr>
<tr>
<td>IATA PI965 Section I</td>
<td>Batteries packed with equipment</td>
<td>number required for equipment plus 5 spare</td>
<td></td>
<td></td>
<td>Batteries must be placed in inner packaging that completely encloses the battery, batteries must be protected so as to prevent short circuits. UN approved packaging (Packing Group II: e.g. UN 4G/Y09...).</td>
</tr>
<tr>
<td>IATA SP A68</td>
<td>Batteries contained in equipment</td>
<td>none</td>
<td></td>
<td></td>
<td>Equipment containing batteries must be secured and packed to prevent unintended operation during transport. Batteries must be protected to prevent short circuits due to contact to further conductive materials within the same packaging. String outer packaging (e.g. cardboard boxes). UN approved packaging not required (UN A68).</td>
</tr>
</tbody>
</table>

### Marking

<table>
<thead>
<tr>
<th>UN 3480, Lithium ion batteries</th>
<th>UN 3481, Lithium ion batteries packed with equipment</th>
<th>UN 3481, Lithium ion batteries contained in equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net weight (NET QTY)</td>
<td>Net weight (NET QTY)</td>
<td>Net weight (NET QTY)</td>
</tr>
<tr>
<td>Shipper/Consignee’s address</td>
<td>Shipper/Consignee’s address</td>
<td>Shipper/Consignee’s address</td>
</tr>
</tbody>
</table>

### Transport Document

- **UN 3480 Lithium ion batteries**: 9 // 965, delete the "PASSENGER AND CARGO AIRCRAFT" box.
- **UN 3481 Lithium ion batteries packed with equipment**: 9 // 966
- **UN 3481 Lithium ion batteries contained in equipment**: 9 // 967

### Information on Air Waybill

- Dangerous goods as per attached (DG) - Cargo aircraft only
- When a shipment contains both dangerous goods and non-dangerous goods, the number of packages containing dangerous goods shall be added in the "Handling Information" box

### Miscellaneous

- **Official IATA Training by authorized trainer required. If not available, please contact IATA authorized expert**

- **Special Precautions**: A98, A99, A154, A156, A161, A162, A163, A165, A201, A256, A331
Shipping Guidelines for Lithium Ion Batteries

5.4.1. Example: Packaging containing batteries > 100 Wh, PI 965, SEC IA

Max. content: 35 Kg net per packaging (CAO)

5.4.2. Example: Packaging containing batteries > 100 Wh, PI 965, SEC IA, overpack used

Weight limit CAO (cargo aircraft only): 35 kg net battery weight per packaging, none for overpack
### 5.5. Shipment of Lithium Ion Battery Prototypes

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Prototypes Truck/Rail/Sea Freight</th>
<th>Prototypes Airfreight</th>
</tr>
</thead>
</table>
|                     | Prototypes: Batteries not tested according UN Test 38.3  
                     Only for transport of  
                     • small production series of max. 100 batteries (IATA: p.a.)  
                     • prototypes for testing reasons only |

#### Packing Instructions
- **ADR/RID/IMDG Code:** SP 310, P910
- **IATA SP ABB, P910:** Approval required from the Competent Authority of the state of origin  
  **Note:** To/against/through USA additional approval required from  
  US Authority (DOT)
- **Max. Quantity:** n/a  
  **Weight Limit:** as defined in approval

#### Packaging
- UN approved packaging: e.g. fibreboard box  
  (Packaging Group II: e.g. UN 4G/Y30/…)
- Each battery shall be individually packed in an inner packaging, e.g. in a plastic bag  
  • Non-combustible, non-conductive thermal insulation material,  
    e.g. Vermiculite  
  • Must be secured against movement within the outer packaging  
  **as defined in approval**

#### Marking
- **ADR/RID:** UN 3480  
  **IMDG:** UN 3480 LITHIUM ION BATTERIES  
  (100 x 100 mm)
  **as defined in approval**

#### Transport Document
- Shipper’s & consignee’s address  
  UN 3480 LITHIUM ION BATTERIES, 9, (E)  
  Number of packages and packaging type (e.g. 1 fibreboard box)  
  Battery weight (e.g. xx kg)  
  “CARRIAGE IN ACCORDANCE WITH SPECIAL PROVISION 310”  
  **as defined in approval**

#### Miscellaneous
- Work Instruction of involved staff  
  **as defined in approval**

---

**5.5.1. Example: Packaging containing Lithium Ion Battery Prototypes**
### 5.6. Shipment of damaged or defective Lithium Ion Batteries

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Damaged or Defective Batteries</th>
<th>Air Transport of Damaged or Defective Batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Truck/Rail/Sea</strong></td>
<td>(not comply to UN Test 38.3 anymore)</td>
<td>Batteries, that have been identified as defective for safety reasons by the manufacturer, or that have been damaged, that have the potential of producing a dangerous evolution of heat, fire or short circuit, are forbidden for transport (e.g., those being returned to the manufacturer for safety reasons) (IATA A154).</td>
</tr>
<tr>
<td><strong>Packing Instructions</strong></td>
<td>SP376 P908</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Criteria for &quot;Damaged or Defective&quot;</strong></td>
<td>&quot;Non-critical&quot; (no possible danger during transport) Batteries such that they do not conform to the tested type according to the applicable provisions of the UN Manual of Tests and Criteria, 38.3 This includes: • Batteries identified as being defective for safety reasons; • Batteries that have leaked or vented; • Batteries that cannot be diagnosed prior to carriage; or • Batteries that have sustained physical or mechanical damage. The following provisions (below) apply to batteries not liable to rapidly disassemble, dangerously react, produce a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours. &quot;Critical&quot; (possible danger during transport) Batteries liable to rapidly disassemble, dangerously react, produce a flame or a dangerous evolution of heat or a dangerous emission of toxic, corrosive or flammable gases or vapours. Note: In order to assess the type of battery, its previous use and misuse shall be taken into account. Transport only with approval from the Competent Authority (In Germany: Federal Institute for Materials Research and Testing (BAM)); detailed requirements as stated in the approval.</td>
<td>n/a</td>
</tr>
</tbody>
</table>

| Max. Quantity | n/a |
| Weight Limit | n/a - A battery with a net mass of more than 30 kg shall be limited to one battery per outer packaging |
| Packaging | • Each damaged or defective battery or equipment containing such batteries must be packed separately in leak-proof inner packaging to prevent release of electrolyte. • UN approved packaging required for all battery types (Packaging Group II), e.g., fibreboard box. • Must be secured against movement within the package. • Sealed packagings shall be fitted with a venting device. • Must be packed with non-combustible and non-conductive thermal insulation material, material class A1 or A2 (non-combustible, e.g., rockwool, glass wool, foamglass, Vermiculite). • Absorbing material to absorb leaking electrolyte from leaking batteries. • Batteries shall be protected against short circuit. "Critical batteries": as per approval. | n/a |
| Marking | UN 3480 DAMAGED/DEFECTIVE LITHIUM ION BATTERIES contained in equipment | n/a |

*"Critical batteries": as per approval.

| Transport Document | Shipper’s & consignee’s address UN 3480 LITHIUM ION BATTERIES, 9, (E) Number of packages and packaging type (e.g., 1 Alumimunm box) Battery weight (e.g., xx kg) | n/a |
| Miscellaneous | Work instruction of involved staff | n/a |
5.7. Shipment of Lithium Ion Batteries for Disposal or Recycling

<table>
<thead>
<tr>
<th>Transportation Mode</th>
<th>Batteries for Disposal &amp; Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck/Rail/Sea</td>
<td>(not comply to UN Test 38.3 anymore)</td>
</tr>
<tr>
<td></td>
<td>Waste batteries and batteries being shipped for recycling or disposal are prohibited from air transport unless approved by the appropriate national authority of the State of Origin and the State of the Operator.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>&lt; 100 Wh (per battery)</th>
<th>&gt; 100 Wh (per battery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packing Instructions</td>
<td>SP377 P909</td>
<td></td>
</tr>
<tr>
<td>Max. Quantity</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Weight Limit</td>
<td>30 kg per packaging</td>
<td>none</td>
</tr>
<tr>
<td>Packaging</td>
<td>For batteries &lt; 100 Wh UN-approved packaging required (Packing Group II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For batteries ≤ 100 Wh and for batteries contained in equipment, UN-approved packaging is not required. Strong outer packages constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Batteries shall be packed to prevent short-circuits and dangerous evolution of heat. Protection against short-circuits and dangerous evolution of heat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This can be achieved by:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• individual protection of the battery terminal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• inner packaging to prevent contact between batteries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• batteries with recessed terminals designed to protect against short-circuits or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• the use of non-conductive and non-combustible cushioning material to fill empty space between the batteries in the package or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• the use of a tightly closed plastic bag)</td>
<td></td>
</tr>
<tr>
<td>Marking</td>
<td>UN 3480 LITHIUM BATTERIES FOR DISPOSAL or LITHIUM BATTERIES FOR RECYCLING</td>
<td></td>
</tr>
</tbody>
</table>

![Marking Image]

<table>
<thead>
<tr>
<th>Transport Document</th>
<th>Shippers’ &amp; consignee’s address</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UN 3480, WASTE LITHIUM ION BATTERIES, 9, (E)</td>
</tr>
<tr>
<td></td>
<td>Number of packages and packaging type (e.g. 1 Fibreboard box (4G))</td>
</tr>
<tr>
<td></td>
<td>Battery weight (e.g. xx kg)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>Work instruction of involved staff</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Damaged / defective batteries</td>
</tr>
<tr>
<td></td>
<td>Batteries identified as being damaged or defective shall be carried in accordance with SP 376.</td>
</tr>
<tr>
<td></td>
<td>Batteries for Disposal &amp; Recycling</td>
</tr>
<tr>
<td></td>
<td>Alternatively, lithium batteries for disposal and recycling can also be carried (like unused lithium batteries) under ADR SP 230 and SP 188, as appropriate, or – up to the intermediate processing facility – under ADR SP 236 b).</td>
</tr>
</tbody>
</table>

6. Useful Websites

The following websites provide various sources of useful information:

- http://www.unece.org
- http://www.iata.org
- http://www.icao.int
- http://www.imo.org
- http://www.gpo.gov/
- http://phmsa.dot.gov/hazmat
- https://www.lithium-batterie-service.de/en/