



INVESTORS
IN CYCLING

BA GUIDE:

Electric Bike Batteries



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The Bicycle Association of Great Britain



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Welcome

The BA Guides are a series of concise documents aiming to offer definitive information on matters of interest to the UK cycle industry. BA Guides are available as free downloads on the Bicycle Association website for reference by the wider industry, media and general public, while more detailed and specific material is reserved for Bicycle Association member companies.

This Guide was produced by the Bicycle Association Technical Service. Please note that the Bicycle Association Technical Service cannot give formal legal, financial or insurance advice. Any business or technical decision you may take based on our advice is entirely at your own risk. All information given, especially that related to regulations, laws etc., is a summary of our best understanding of what the law requires, but ultimately the interpretation of the law is a matter for the courts based on the individual facts of any particular case. You are therefore advised to consult the relevant legislation yourself and, if necessary, to seek independent advice on specific legal questions.



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Introduction

The fast-growing e-bike industry in the UK handles large numbers of relatively high-capacity lithium batteries, and there is a need for clarity about the regulations and best practice involved in their procurement, transport, handling and, eventually, disposal and recycling.

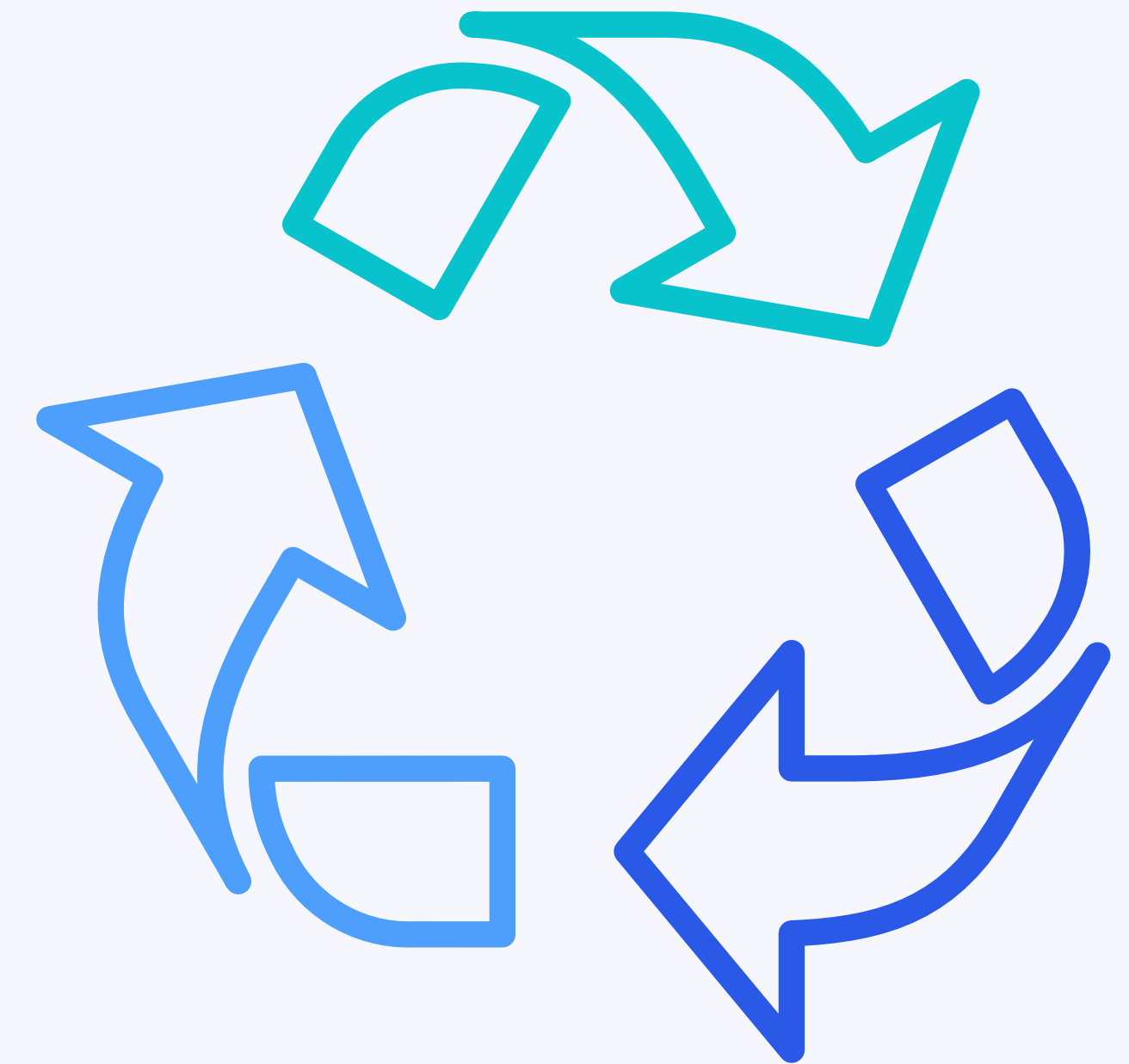
We will first look at “producer obligations”, which mainly affect importers but have implications for retailers.

Then we provide some guidance on storage and handling best practice, which will be relevant to all levels of the supply chain.

Finally we examine the requirements for safe transport of both separate batteries and e-bikes under the Dangerous Goods regulations. As part of this we will explain some common transport scenarios relevant to the e-bike industry.

It is important to note that much of the other advice available online about transport of lithium batteries (for power tools, laptops, etc.) concerns different rules, which apply to smaller batteries with a capacity below 100 Wh.

As far as we are aware, all current e-bike batteries exceed this capacity (300 to 700 Wh is more typical). Also, note that no ‘limited quantity’ or ‘excepted’ rules apply to e-bike batteries, as they do for some smaller batteries.



Reporting, take-back and recycling obligations

An e-bike battery 'producer' (i.e. the company who first places a battery on the UK market, which would normally be the importer, typically an e-bike brand or distributor) has obligations to report, take back and properly dispose of batteries.

These obligations would not normally apply to retailers or others in the distribution chain unless they are also the importer.

Under these regulations, e-bike batteries are classed as "Industrial", and full Government guidance is here:

<https://www.gov.uk/guidance/waste-batteries-producer-responsibility#industrial-battery-producer-register>

- **Producers must register within 28 days of first placing batteries on the UK market. Registration is via the National Packaging Waste Database:**
<http://npwd.environment-agency.gov.uk/>

- **Producers must provide the total tonnage, chemistry and brand name of industrial batteries placed on the market by 31 March in the following year.**

PRODUCERS ALSO HAVE A DUTY TO:

- **Take back waste industrial batteries free of charge from any end-user, if they supply them with new batteries, if they're the same chemistry as batteries you place on the market or if they cannot be returned to another producer**
- **Tell end users how they can return waste industrial batteries, for example through information on their website**
- **Ensure that waste batteries go to an Approved Battery Treatment Operator (ABTO) or an Approved Battery Exporter (ABE) for treatment and recycling.**

Because of the reference to 'end users', the 'take back' obligation is widely understood to apply through retailers: if a retailer sells an importer's e-bikes, then the importer should make arrangements (at their cost) to take back end of life batteries from that retailer..

This would normally be handled by a third party battery collection company commissioned by the producer (importer), who would provide suitable packaging and receptacles, give training to the dealers in proper handling, and arrange collections when required.

A commercial offering for ad hoc collections is identified below.

Reporting, take-back and recycling obligations

2.1 Portable batteries

Propulsion batteries for e-bikes are classed as “Industrial” - as explicitly stated here:

<https://www.gov.uk/guidance/waste-batteries-and-accumulators-technical-guidance#battery-types>

But other batteries that are handled within the cycle industry - for e.g. gear change systems, lights or computers, will be classed as “portable”, for which different requirements apply at producer, distributor and retailer levels.

We will not consider these further in this document, but guidance on obligations re portable batteries is:

- Here for producers
<https://www.gov.uk/guidance/waste-batteries-producer-responsibility>
- Here for distributors and retailers:
<https://www.gov.uk/battery-waste-supplier-reponsibilities>



Storage and general safety advice

Other than general catch-all 'duty of care' provisions, we are not aware of any legal requirements or official regulations for storage of lithium batteries. E-bike batteries from reputable suppliers do generally have a high level of safety, unless mistreated, but there always remains some risk, and the consequences of a lithium battery fire can be very serious. Several such incidents involving e-bike batteries, and the total loss of buildings, have been reported. So it is worth taking practical measures to further minimise any fire risk.

We would note that used battery packs (which end users may have mis-treated) and battery packs from unknown suppliers where it is harder to be confident of good design and proper testing, could potentially pose somewhat higher fire risks.

So all companies dealing with e-bikes and their batteries should make a risk assessment of their storage arrangements and make appropriate provision to minimise risks.

Also, we suggest that you consult and inform your insurers and the local emergency services if you store significant numbers of e-bike batteries.



Storage and general safety advice

KEY POINTS FROM OUR UNDERSTANDING INCLUDE:

- If possible, obtain dummy batteries from suppliers for display purposes and keep all ‘real’ batteries in a secure store until needed for test rides or sale. This also allows display bikes to be placed in direct sunlight - which might otherwise damage the batteries over time.
- Lithium batteries should be stored in a well ventilated and cool place well away from other flammable and combustible materials.
- Only charge lithium batteries when the premises are attended.
- Keep a Class D extinguisher nearby, and/or dry sand, as in the event of a fire, it should be smothered with dry sand or covered with contents from a Class “D” fire extinguisher. The use of a Class “D” fire extinguisher is the preferred extinguishing method.
- Avoid contact with water unless a lot of water is available. If large amounts are available it may slow down the reaction and can prevent burning cells from igniting neighbouring cells. Usually it will not completely extinguish the fire.
- Do not use Halon extinguishers as toxic gases will be generated.
- Even when the material has apparently burned and cooled, be prepared as it may re-ignite.

Storage and general safety advice

3.1 Commercial solutions

At the time of writing we are aware of the following commercial offerings which may be of assistance to companies in the e-bike industry. Additional proposals or suggestions are welcome: please contact the BA so they can be added for future editions.

- **Madison can supply a fire safe battery storage cabinet solution for your electric bike batteries from Asecos. Some details are here:**
<https://cyclingindustry.news/asecos-sculpts-its-battery-storage-case-for-e-bike-shop-needs/>
Contact your Madison representative for more information.
- **Bosch has issued guidance on the handling and storage of its electric bike batteries to approved dealers, and as a part of its ongoing training programme.**

- **Recycling operator Ecolamp has a solution available for retailers who may have a stockpile of faulty or end-of-life batteries within their business. Ecolamp can dispatch a waste battery storage drum (either 30 litre or 60 litre) to the individual store. The store can then safely store batteries in this drum until such time they want a collection. Both the 30 litre and 60 litre drums have a weight limit of maximum 40 kg.**

Once a collection has been arranged and completed, Ecolamp will make a visual inspection to check the contents and weigh the drum for completion of a hazardous waste note. Indicative pricing for a 60 litre drum (40 kg) is £179+VAT (as at October 2021). A specification for the drum can be found [here](#).

For any collections over and above 40Kgs Ecolamp can send their own ADR driver to collect, to obtain a quotation for this service please contact info@ecolamp.co.uk or telephone 01925 230825 (www.ecolamp.co.uk)



Storage and general safety advice

3.1 Commercial solutions

We have identified the following sources of further advice:

- Many brands and drive system suppliers will provide advice to retailers on the safe handling and storage of lithium batteries. We recommend retailers request this information from e-bike and drive system suppliers when being on-boarded with the brand, or ASAP if they have not already.
- Human Powered Solutions from the USA has proposed a cycle industry specific best practice document detailing storage, charging and handling procedures, for retailers who wish to minimise risks by using a secure battery store. It is a free download here:
<https://humanpowersolutions.com/safe-lithium-ion-battery-storage-and-charging-procedures-for-the-ebike-shop/>
- The UK's Fire Industry Association has a detailed but general-purpose guidance document (January 2021) available here:
<https://www.fia.uk.com/news/guidance-on-li-ion-battery-fires.html>



Transporting batteries and e-bikes: Dangerous Goods regulations

Lithium batteries with a capacity of above 100 Wh, as used on all e-bikes, are classed internationally as “Class 9 Dangerous Goods”.

Understanding the resultant legal obligations for transportation is complicated by the existence of separate regulations for shipping by air (IATA and IACO), road (ADR) and sea (IMDG). Individual courier companies sometimes also seem to have their own requirements and interpretations.

This document will focus mainly on in-country transport, principally by road. It uses information from the latest ADR version, ADR 2021. The full text can be downloaded here, in two volumes:

<https://unece.org/transportdangerous-goods/adr-2021-files>

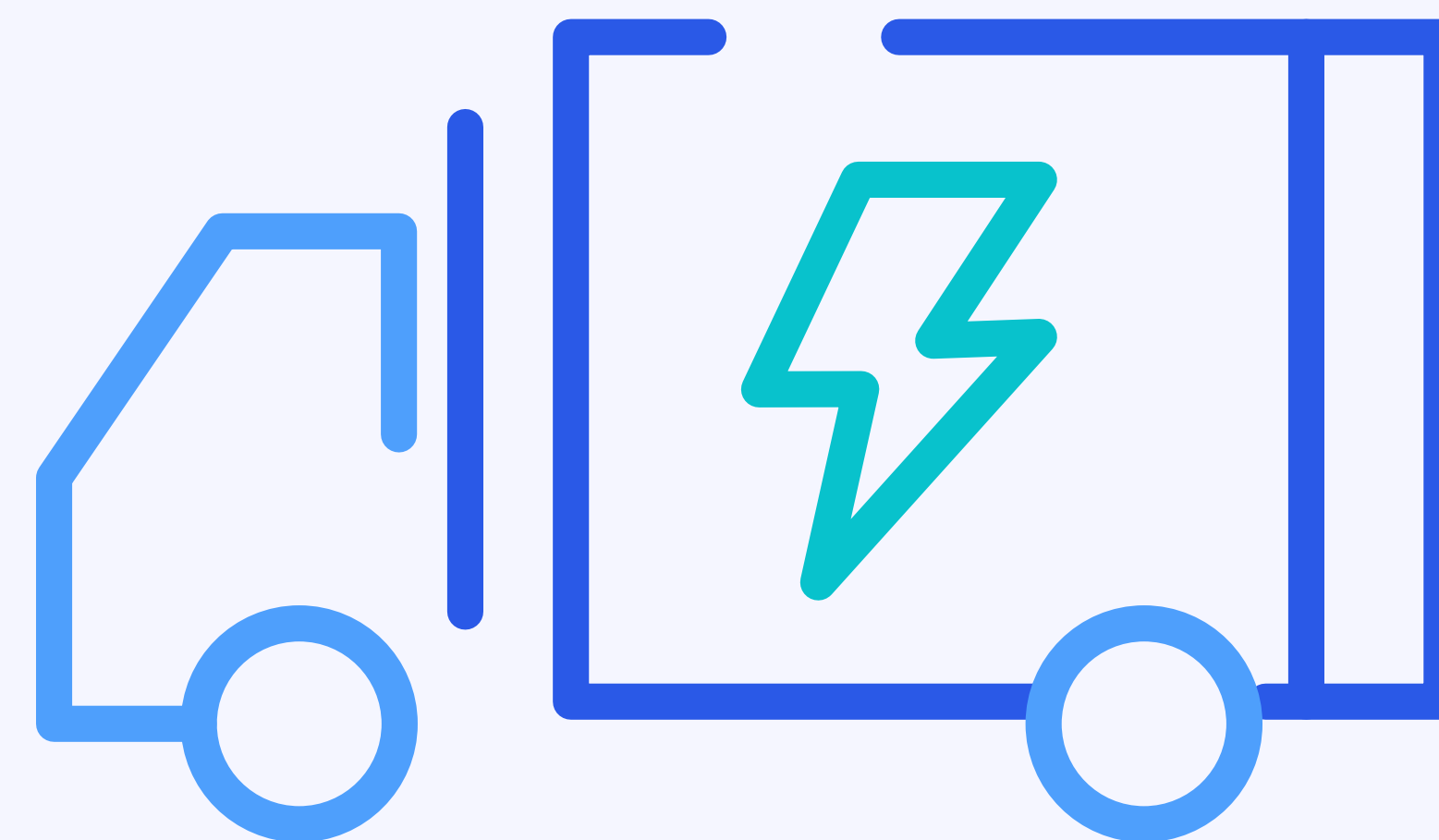
These regulations are aimed at protecting the vehicle drivers, other road users, and the general public and wider environment from damage which could potentially be caused by the dangerous goods which are being transported.

In the UK, ADR is implemented as The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009. The Health and Safety Executive has further guidance on these regulations here:

<https://www.hse.gov.uk/cdg/index.htm>

The UK regulations reference an earlier edition of ADR, ADR 2017, but to the best of our knowledge all requirements detailed in this document are essentially unchanged between the 2017 and 2021 regulations.

Private end users are exempted from all of these requirements.



Transporting batteries and e-bikes: Dangerous Goods regulations

4.1 Coding and categories

All of the air, sea and road regulations use a common coding for Dangerous Goods. For e-bike batteries, the most relevant codes are:



- UN 3480 Lithium ion batteries



- UN 3171 Battery Powered Vehicle

(applies when e-bikes are transported with batteries installed – see section 4.5 below)

Transporting batteries and e-bikes: Dangerous Goods regulations

4.2 Battery testing

Almost all of the regulations insist that for legal transport batteries must be of a type which has passed UN 38.3 type testing (strictly, Part III, Sub-Section 38.3.1 of the UN Manual of Tests and Criteria, available here: <https://unece.org/transport/dangerous-goods/rev7-files>) and also some other basic requirements such as short circuit protection and manufacture under a quality management programme. These are detailed in para 2.2.9.1.7 of ADR 2021 (page 242).

All reputable battery suppliers will provide proof of UN 38.3 type testing and related requirements, and it is advisable for importers and suppliers to retain documentation of this in the product's Technical File, and they must make this evidence available to e.g. retailers on request.

The situation for batteries which have not passed UN 38.3 (etc) is more difficult. They cannot be shipped by air. If you discover such batteries (third party copies, perhaps) they would need to be shipped as defective/damaged, with stricter packaging rules (see below) as this does not require UN 38.3 compliance. But there are provisions for small batch (<100) or prototype batteries - see below..



Transporting batteries and e-bikes: Dangerous Goods regulations

4.3 Packing instructions

The ADR regulations specify a wide range of “packing instructions” (PIs) which specify requirements for packaging – specifying both the materials used and the performance (leak proof, etc.) of the packaging. See the Appendix for the most commonly relevant ones for e-bike batteries.

Also often specified is the maximum weight per consignment and per ‘overpack’ – typically meaning pallet load. Only one overpack per ‘transport unit’ (truck and trailer) is permitted in normal circumstances.

Where “Packing Group II” is mentioned, this means that packaging to a UN-specified performance level must be used. Group II is for “substances presenting medium danger”

Packaging can be purchased which complies with whichever requirements apply, with the types listed at the top of each packing code. e.g. UN/4G/Y30 for a max 30 kg package. Courier companies will often also supply suitable packaging.

For the PIs relevant to e-bike batteries, they specify that the batteries must be prevented from moving within the packaging, must be completely enclosed, and protected against short circuit. For the PIs to be used with damaged/defective batteries, the requirements are rather more extensive, including heat resistance, venting for gases and more.



Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

When batteries are transported separately (i.e. not installed in a bike) then the UN 3480 rules apply:

4.4.1. Normal e-bike batteries, UN83.3 compliant

- Use packing instructions P903.
Max per consignment 30 kg.
- Label with Class 9A diamond and mark
“UN 3480 LITHIUM ION BATTERIES”

4.4.2. Damaged / Defective batteries

- ADR Provision 376 specifies the ‘non-critical’ damaged/defective batteries that may be transported. This includes batteries identified as defective for safety reasons, cells leaked or vented, cells or batteries that cannot be diagnosed prior to carriage, and cells which have sustained physical or mechanical damage.
- Label with Class 9A diamond and mark “UN 3480 DAMAGED/DEFECTIVE LITHIUM ION BATTERIES” and use packing instructions P908.
THIS IS VERY RIGOROUS!
- The transport document shall include the following statement: “Carriage in accordance with special provision 376”.
- This excludes ‘critical’ batteries liable to imminently explode, react or emit fumes etc., which may NOT be carried.
FOR THESE, CALL A SPECIALIST!

Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

4.4.3. For disposal or recycling

- This is detailed in ADR Provision 377
- Label with Class 9A diamond and mark “UN 3480 LITHIUM BATTERIES FOR DISPOSAL” or “UN 3480 LITHIUM BATTERIES FOR RECYCLING”
- Use packing instructions P909.
**NOT QUITE AS RIGOROUS AS P908,
BUT STILL PRETTY STRICT!**

4.4.4. Small batches or prototype batteries

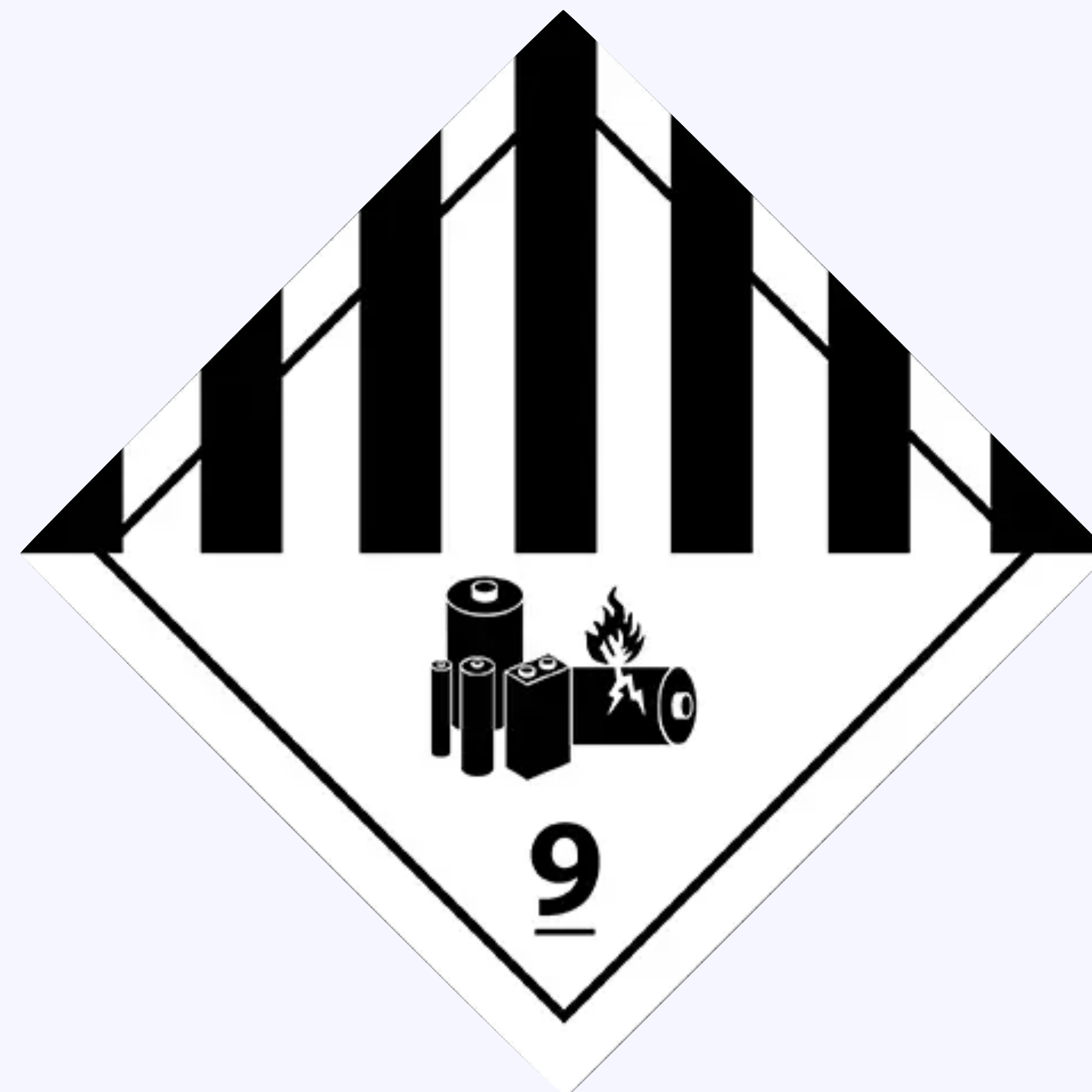
- These are detailed in ADR Provision 310
- Applies for <100 productions runs or pre-production prototypes when carried for testing.
- Label with Class 9A diamond and mark “UN 3480 LITHIUM ION BATTERIES”
- Use packing instruction P910.
- The transport document shall include the following statement: “Carriage in accordance with special provision 310”.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

4.4.5. Labelling

- All shipments of batteries under the UN 3480 code need the Class 9A Dangerous Goods label, sized 10 cm square. The label should also be marked “UN 3480 LITHIUM BATTERIES” or appropriately as above if defective, a prototype, or for disposal or recycling.



Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

4.4.6. Transport document

- The transport document is also a requirement for all shipments. Usually a template / form will be supplied by your shipping company.

FOR STANDARD UN 3480 BATTERIES
THE MINIMUM NECESSARY INFO IS:

- UN 3480 LITHIUM BATTERIES, 9, (E)
- NUMBER OF PACKAGES, PACKAGING TYPE
- BATTERY WEIGHT (KG)
- TRANSPORT CATEGORY: 2
(shipper and consignee addresses)

IN THE FIRST LINE, 9 IS THE DANGEROUS GOODS CLASS, AND “E” IS THE ‘TUNNEL CLASS’.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

4.4.7. Placarding, driver and vehicle requirements

If you are using your own company van to transport e-bikes or e-bike batteries then there are indeed some requirements, but as long as the total weight of batteries is under 333 kg, a 'small load' exemption applies (detailed here: <http://www.hse.gov.uk/cdg/manual/exemptions.htm>) which considerably reduces the burden compared to 'full' ADR. The remaining requirements are:

- **General training for driver (ADR 1.3.2).**
A record should be kept (ADR 1.3.3)
- **Carry one 2 kg dry powder fire extinguisher or equivalent (ADR 8.1.4.2).**
- **Stow the dangerous goods properly (ADR 7.5.7).**

There is no requirement for external vehicle marking, but it is also not prohibited, and could help emergency responders assess risk in the event of an accident (although some dispute this, suggesting that for small loads especially, it may cause unnecessary escalation of a response). Magnetic 100 mm diamond-shaped hazard signs (Class 9A, as pictured above) would be (optionally) appropriate for a vehicle carrying e-bike batteries. Any such signs **MUST** be removed when no dangerous goods are being carried.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.4 E-bike batteries - transported separately

4.4.8. Document retention

- Transport documents: 3 months
- Training records: one year after employee's last employment
- DGSA annual reports
(see below): 5 years.



Transporting batteries and e-bikes: Dangerous Goods regulations

4.5 E-bikes with batteries installed: a special case

Special Provision 666 says that vehicles assigned to code UN3171 "battery powered vehicle" are not subject to any other provisions of ADR, providing certain conditions are met, including the UN38.3 type approval requirements as noted above.

SP 388 clarifies the difference between battery powered equipment and battery powered vehicles. "Pedal cycles with a motor" are specifically mentioned as being within UN3171 as vehicles. It also states that the vehicles must be "carried with the batteries installed".

SP667 on page 621 adds provisions for prototype, small production run or damaged batteries.

The upshot is that there are NO special packaging requirements for transporting e-bikes with the batteries installed, so they can be shipped in a normal bike box without any special labelling. This assumes that the battery type has been UN38.3 approved and manufactured.

NO TRANSPORT DOCUMENT IS REQUIRED.

HOWEVER it is recommended that the code "UN3171 BATTERY POWERED VEHICLE" be entered on the shipping docket so that the carrier is informed of the nature of the load (mainly because some UK couriers may, without your knowledge, use air or rail transport as part of their UK networks - not just road, which is what ADR covers).

Transporting batteries and e-bikes: Dangerous Goods regulations

4.6 Other aspects of shipping batteries

4.6.1. Dangerous Goods Safety Advisor

There is a requirement in ADR that if you ship batteries regularly from your premises then you must have a “Dangerous Goods Safety Advisor” (DGSA) to do the shipping and complete the transport documentation.

However, there are certain exemptions from this requirement, some of them UK specific. Government guidance here: <https://www.hse.gov.uk/cdg/manual/adrcarriage.htm> indicates that for carriage activities related to ‘small loads’ (in this case, 333 kg or less) this requirement does NOT apply.

However, ADR (1.3.1) does still require “training commensurate with the duties and responsibilities” of the roles involved, and if shipping batteries is a major role in your business, having a member of staff qualified as a DGSA is recommended.

4.6.2. Incident reporting obligations

You are obliged to report any incidents to the Environment Agency in the first instance – and to the police if appropriate in a traffic situation.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.7 Transport and shipping scenarios

DISTRIBUTOR SHIPS A COMPLETE E-BIKE WITHIN THE UK, BATTERY INSTALLED ON THE BIKE

Exempt from ADR requirements as a 'battery powered vehicle' so no external labelling is required. This assumes that you are sure the parcel will go by road only – it has been suggested that some UK couriers may use airfreight for domestic journeys.

So it is advisable to mention "UN3171 BATTERY POWERED VEHICLE" on the waybill.

DISTRIBUTOR SENDS MULTIPLE SPARE E-BIKE BATTERIES TO A UK DEALER

The sender will need the UN approved packaging for PI 903, need the Class 9 label, and to provide the shipper with a transport document. Max consignment weight 30 kg. If 'overpacked' with other consignments, max weight per truckload is 333 kg before extra measures need be taken. Note that particular couriers may have their own additional requirements - always confirm with the particular company used!

Note also that the person handling the shipment should have (documented) "training commensurate with the duties and responsibilities" involved in this shipment, or be a qualified DGSA.

RETAILER SENDS A SPARE E-BIKE BATTERY TO A CUSTOMER IN THE UK

The retailer will need the UN approved packaging for PI 903, need the Class 9A label, and to complete a transport document.

Note also that the person handling the shipment should have (documented) "training commensurate with the duties and responsibilities" involved in this shipment, or be a qualified DGSA.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.7 Transport and shipping scenarios

RETAILER TAKES AN E-BIKE IN HIS VAN TO A LOCAL EVENT FOR DEMOS, WITH BATTERY INSTALLED

No requirements for the bike (or box, if it is in one), so long as the battery is UN83.3 compliant and total battery weight is less than 333 kg.

The driver needs to be appropriately trained, must have a 2 kg dry powder fire extinguisher with them, and the bikes must be stowed securely.

RETAILER TAKES AN E-BIKE AND SPARE BATTERIES IN HIS VAN TO A LOCAL EVENT FOR DEMOS

No requirement for the e-bike with battery installed – it can just go in the van, so long as the battery is definitely UN83.3 compliant.

For the batteries, despite the retailer carrying out the role of both consigner and shipper, we understand that a Transport Document should still be carried with the vehicle. The batteries should also be packaged according to the P903 requirements.

As the dealer will be under the small load threshold of 333 kg, the only remaining requirements are that the driver needs to be trained, must have a 2 kg dry powder fire extinguisher with them, and the bikes and batteries must be stowed securely.

CUSTOMER BRINGS A DAMAGED OR DEFECTIVE BATTERY TO A RETAILER, WHO WISHES TO SHIP IT BACK TO THE DISTRIBUTOR FOR DIAGNOSIS.

Collection should normally be arranged by the distributor or importer who originally placed the battery on the UK market, under their take-back and proper disposal obligations. They will generally employ a specialist carrier.

If shipping it themselves, the retailer will need the UN approved packaging for PI 908 and follow its requirements, need the Class 9A label, and a transport document. The person handling the shipment should have (documented) “training commensurate with the duties and responsibilities” involved in this shipment, or be a qualified DGSA.

Transporting batteries and e-bikes: Dangerous Goods regulations

4.7 Transport and shipping scenarios

CUSTOMER BRINGS A FAULTY OR END OF LIFE BATTERY TO A RETAILER, WHO NEEDS TO DISPOSE OF IT PROPERLY.

Collection should normally be arranged by the distributor or importer who originally placed the battery on the UK market, under their take-back and proper disposal obligations. They will generally employ a specialist carrier.

If shipping it themselves, the retailer will need the UN approved packaging for PI 909 and follow its requirements, need the Class 9A label, and a transport document. The person handling the shipment should have (documented) “training commensurate with the duties and responsibilities” involved in this shipment, or be a qualified DGSA.

Appendix - Packing Instructions

The following are copies of the Packaging Instructions (PIs) in ADR 2021, reproduced here for convenience. The originals can be found in Volume 2 of the regs, downloadable here:

<https://unece.org/transportdangerous-goods/adr-2021-files>



Appendix - Packing Instructions

5.1.1. P903

This instruction applies to UN Nos. 3090 , 3091, 3480 and 3481.

For the purpose of this packing instruction, “equipment” means apparatus for which the lithium cells or batteries will provide electrical power for its operation. The following packagings are authorized provided that the general provisions of 4.1.1 and 4.1.3 are met:

(1) For cells and batteries:

- Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);
- Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);
- Jerricans (3A2, 3B2, 3H2).

Cells or batteries shall be packed in packagings so that the cells or batteries are protected against damage that may be caused by the movement or placement of the cells or batteries within the packaging. Packagings shall conform to the packing group II performance level.

(2) 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:

- (a) Strong outer packagings;
- (b) Protective enclosures (e.g., fully enclosed or wooden slatted crates); or
- (c) 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 superimposed elements.

Packagings need not meet the requirements of 4.1.1.3.

(3) For cells or batteries packed with equipment:

Packagings conforming to the requirements in paragraph (1) of this packing instruction, then placed with the equipment in an outer packaging; or Packagings that completely enclose the cells or batteries, then placed with equipment in a packaging conforming to the requirements in paragraph (1) of this packing instruction. The equipment shall be secured against movement within the outer packaging.

(4) For cells or batteries contained in equipment:

Strong outer packagings constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use. They shall be constructed in such a manner as to prevent accidental operation during carriage. Packagings need not meet the requirements of 4.1.1.3.

Large equipment can be offered for carriage unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.

Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be carried when intentionally active in strong outer packagings.

NOTE: For carriage in a transport chain including air carriage, these devices, when active, shall meet defined standards for electromagnetic radiation to ensure that the operation of the devices does not interfere with aircraft systems.

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Appendix - Packing Instructions

5.1.1. P903

(5) For packagings containing both cells or batteries packed with equipment and contained in equipment:

- (a) For cells and batteries, packagings that completely enclose the cells or batteries, then placed with equipment in a packaging conforming to the requirements in paragraph (1) of this packing instruction; or
- (b) Packagings conforming to the requirements in paragraph (1) of this packing instruction, then placed with the equipment in a strong outer packaging constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use. The outer packaging shall be constructed in such a manner as to prevent accidental operation during carriage and need not meet the requirements of 4.1.1.3.

The equipment shall be secured against movement within the outer packaging.

Devices such as radio frequency identification (RFID) tags, watches and temperature loggers, which are not capable of generating a dangerous evolution of heat, may be carried when intentionally active in strong outer packagings.

NOTE: For carriage in a transport chain including air carriage, these devices, when active, shall meet defined standards for electromagnetic radiation to ensure that the operation of the devices does not interfere with aircraft systems.

Additional requirement:

Cells or batteries shall be protected against short circuit.

Appendix - Packing Instructions

5.1.2. P908

This instruction applies to damaged or defective lithium ion cells and batteries and damaged or defective lithium metal cells and batteries, including those contained in equipment, of UN Nos. 3090, 3091, 3480 and 3481.

The following packagings are authorized provided the general provisions of 4.1.1 and 4.1.3 are met:

For cells and batteries and equipment containing cells and batteries:

- Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G)
- Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2)
- Jerricans (3A2, 3B2, 3H2)

Packagings shall conform to the packing group II performance level.

1. Each damaged or defective cell or battery or equipment containing such cells or batteries shall be individually packed in inner packaging and placed inside an outer packaging. The inner packaging or outer packaging shall be leak-proof to prevent the potential release of electrolyte.

2. Each inner packaging shall be surrounded by sufficient non-combustible and electrically non-conductive thermal insulation material to protect against a dangerous evolution of heat.

3. Sealed packagings shall be fitted with a venting device when appropriate.

4. Appropriate measures shall be taken to minimize the effects of vibrations and shocks, prevent movement of the cells or batteries within the package that may lead to further damage and a dangerous condition during carriage. Cushioning material that is non-combustible and electrically non-conductive may also be used to meet this requirement.

5. Non combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.

For leaking cells or batteries, sufficient inert absorbent material shall be added to the inner or outer packaging to absorb any release of electrolyte.

A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.

Additional requirement:

Cells or batteries shall be protected against short circuit.

Appendix - Packing Instructions

5.1.3. P909

This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 carried for disposal or recycling, either packed together with or packed without non-lithium batteries.

(1) Cells and batteries shall be packed in accordance with the following:

(a) The following packagings are authorized, provided that the general provisions of 4.1.1 and 4.1.3, are met:

- Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);
- Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H2);
- Jerricans (3A2, 3B2, 3H2).

(b) Packagings shall conform to the packing group II performance level.

(c) Metal packagings shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.

(2) However, lithium ion cells with a Watt-hour rating of not more than 20 Wh, lithium ion batteries with a Watt-hour rating of not more than 100 Wh, lithium metal cells with a lithium content of not more than 1 g and lithium metal batteries with an aggregate lithium content of not more than 2 g may be packed in accordance with the following:

(a) In strong outer packaging up to 30 kg gross mass meeting the general provisions of 4.1.1, except 4.1.1.3, and 4.1.3.

(b) Metal packagings shall be fitted with an electrically non-conductive lining material (e.g. plastics) of adequate strength for the intended use.

(3) For cells or batteries contained in equipment, strong outer packagings constructed of suitable material, and of adequate strength and design in relation to the packaging capacity and its intended use, may be used. Packagings need not meet the requirements of 4.1.1.3. Equipment may also be offered for carriage unpackaged or on pallets when the cells or batteries are afforded equivalent protection by the equipment in which they are contained.

(4) In addition, for cells or batteries with a gross mass of 12 kg or more employing a strong, impact resistant outer casing, strong outer packagings constructed of suitable material and of adequate strength and design in relation to the packaging's capacity and its intended use, may be used. Packagings need not meet the requirements of 4.1.1.3.

Additional requirement:

1. Cells and batteries shall be designed or packed to prevent short circuits and the dangerous evolution of heat.
2. Protection against short circuits and the dangerous evolution of heat includes, but is not limited to:
 - individual protection of the battery terminals,
 - inner packaging to prevent contact between cells and batteries,
 - batteries with recessed terminals designed to protect against short circuits, or
 - the use of an electrically non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.
3. Cells and batteries shall be secured within the outer packaging to prevent excessive movement during carriage (e.g. by using a non-combustible and electrically non-conductive cushioning material or through the use of a tightly closed plastics bag).

Appendix - Packing Instructions

5.1.4. P910

This instruction applies to UN Nos. 3090, 3091, 3480 and 3481 production runs consisting of not more than 100 cells or batteries and to pre-production prototypes of cells or batteries when these prototypes are carried for testing.

The following packagings are authorized provided that the general provisions of **4.1.1** and **4.1.3** are met:

(1) For cells and batteries, including when packed with equipment:

- Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);
- Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2); -
- Jerricans (3A2, 3B2, 3H2).

Packagings shall conform to the packing group II performance level and shall meet the following requirements:

(a) Batteries and cells, including equipment, of different sizes, shapes or masses shall be packaged in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;

(b) Each cell or battery shall be individually packed in an inner packaging and placed inside an outer packaging;

(c) Each inner packaging shall be completely surrounded by sufficient non-combustible and electrically non- conductive thermal insulation material to protect against a dangerous evolution of heat;

(d) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the cells or batteries within the package that may lead to damage and a dangerous condition during carriage. Cushioning material that is non-combustible and electrically non- conductive may be used to meet this requirement;

(e) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured;

(f) A cell or battery with a net mass of more than 30 kg shall be limited to one cell or battery per outer packaging.

(2) For cells and batteries contained in equipment:

- Drums (1A2, 1B2, 1N2, 1H2, 1D, 1G);
- Boxes (4A, 4B, 4N, 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2);
- Jerricans (3A2, 3B2, 3H2).

Packagings shall conform to the packing group II performance level and shall meet the following requirements:

(a) Equipment of different sizes, shapes or masses shall be packaged in an outer packaging of a tested design type listed above provided the total gross mass of the package does not exceed the gross mass for which the design type has been tested;

(b) The equipment shall be constructed or packaged in such a manner as to prevent accidental operation during carriage;

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Appendix - Packing Instructions

5.1.4. P910

(c) Appropriate measures shall be taken to minimize the effects of vibration and shocks and prevent movement of the equipment within the package that may lead to damage and a dangerous condition during carriage. When cushioning material is used to meet this requirement it shall be non-combustible and electrically non-conductive; and

(d) Non-combustibility shall be assessed according to a standard recognized in the country where the packaging is designed or manufactured.

(3) The equipment or the batteries may be carried unpackaged under conditions specified by the competent authority of any Contracting Party to ADR, which may also recognize an approval granted by the competent authority of a country which is not a Contracting Party to ADR, provided that this approval has been granted in accordance with the procedures applicable according to RID, ADR, ADN, the IMDG Code or the ICAO Technical Instructions. Additional conditions that may be considered in the approval process include, but are not limited to:

(a) The equipment or the battery shall be strong enough to withstand the shocks and loadings normally encountered during carriage, including trans-shipment between cargo transport units and between cargo transport units and warehouses as well as any removal from a pallet for subsequent manual or mechanical handling; and

(b) The equipment or the battery shall be fixed in cradles or crates or other handling devices in such a way that it will not become loose during normal conditions of carriage.

Additional requirement:

The cells and batteries shall be protected against short circuit; Protection against short circuits includes, but is not limited to,

- individual protection of the battery terminals,
- inner packaging to prevent contact between cells and batteries,
- batteries with recessed terminals designed to protect against short circuits, or
- the use of a electrically non-conductive and non-combustible cushioning material to fill empty space between the cells or batteries in the packaging.



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