Transport and Storage of Lithium Batteries:

A Multi Modal Guide

How to find the applicable UN number for Lithium Batteries?

How to find the applicable provision for the transport?

Mode of Transport:
- ADR/RID/ADN
- IMDG Code
- IATA DGR

Storage:
- Regulations for sprinkler protection

This guide is intended to help you to find your way through the jungle of legal requirements for the various modes of transport and includes standards for the sprinkler protection to get an impression about what is expected by the insurance industry.

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Transport and Storage of Lithium Batteries: A Multi Modal Guide

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Content

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Introduction

Lithium batteries have become the most popular energy storage system. They need to be transported

- stand alone
- contained in equipment and vehicles
- packed with equipment and vehicles
- contained in and packed with equipment and vehicles.

Lithium batteries are dangerous goods without any exemption. As a result their transport is subject to dangerous goods regulations.

This guide will help you to find a path through the jungle of dangerous goods regulations to identify the correct applicable provision for the corresponding transportation case.

Recommendation: check first the flow chart “How to find the applicable UN number” of this guide to identify the applicable regulation for all modes of transport.

Storage is very often an unavoidable necessity in the supply chain. The provisions for the storage of lithium batteries are differing from country to country. The European Association of Insurance Companies Associations and FM Global have set individual standards for the sprinkler protection of warehouses containing lithium (ion) batteries, stand alone and in equipment. This guide includes these standards to get an impression about what is expected by the insurance industry.

Companies which

- pack and/or mark and/or label packages and/or over-packages
- load
- consign
- transport
- unload

lithium batteries, stand-alone and/or contained in equipment and/or packed with equipment have to take care that their respective employees, including the drivers, have undergone an appropriate training; in Air transport the training (and examination) is regulated by the CBTA.

In countries, which are contract parties of the ADR, RID and/or ADN, companies which

- pack and/or mark and/or label packages and/or over-packages
- load
- consign
- transport
- unload

lithium batteries, stand-alone and/or contained in equipment and/or packed with equipment have to appoint a Dangerous Goods Safety Adviser (DGSA) if the weight of the load on a cargo transport unit (road vehicle, rail wagon, container) is more than 333 kg of such batteries. Except for lithium batteries which are critically damaged or defective according to Special Provision 376 of ADR/RID/ADN: In this case a DGSA has to be appointed independent of the weight of the load.

The 2nd edition of this Guide

- reflects the provisions as from 1st of January 2025, as published in November 2023 - for aviation regulations from 1st of January 2024.

- contains some corrections and amendments to the 1st edition.

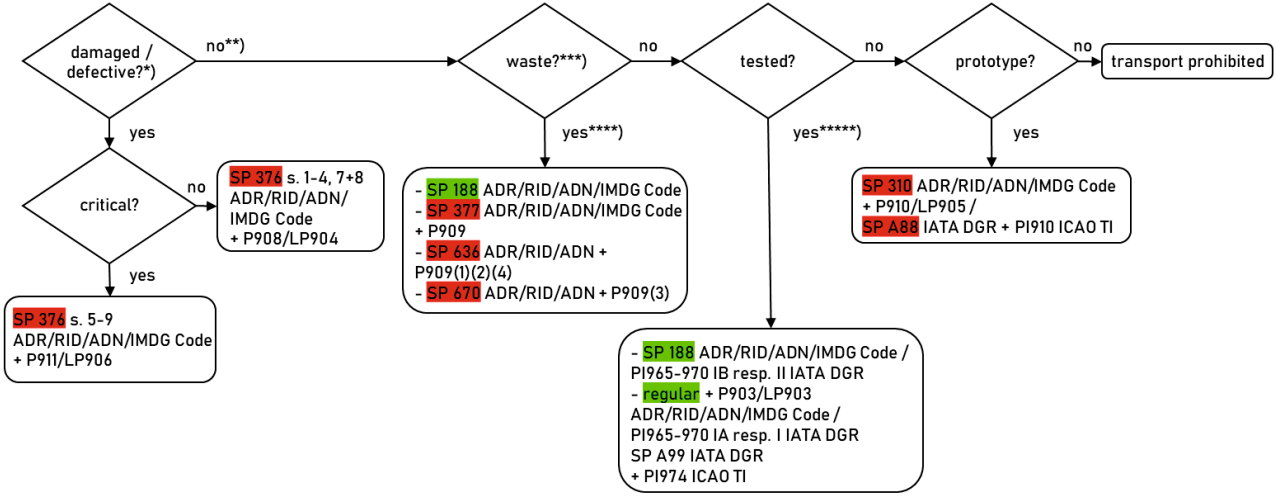
All changes to the 1st edition are highlighted in red color for easy identification.

Please indicate any question related to the application of the guide to the publisher.

Prof. Dr. Norbert Müller

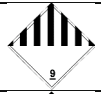
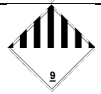
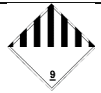
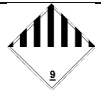
How to find the applicable provision for the transport of a lithium cell / battery?

- stand alone (UN 3090, UN 3480)
- contained in equipment or packed with equipment or contained in & packed with equipment (UN 3091, UN 3481)

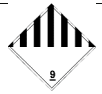
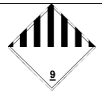
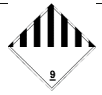


*) according to SP 376 ADR/RID/IMDG Code resp. SP A154 IATA DGR;
**) battery would pass all applicable tests according to chapter 38.3 of the UN Manual of Tests and Criteria;
***) for recycling (recovery, not reuse) or for disposal (elimination);
****) additionally regulations for the transport of waste apply;
*****) inclusive used batteries.
Test summary (section 38.3.5 of the UN Manual of Tests & Criteria) required
Test summary not required

Mode of Transport Road/Rail/Inland Navigation Vessels – ADR/RID/AND

ADR / RID / ADN								
UN 3090 LITHIUM METAL BATTERIES								
Special Provision		Test Summary?	Package			Container		Transport document
			Packaging	Marking	Labeling	Marking	Placarding	
(1a)	(1b)	(2)	(3a)	(3b)	(3c)	(4a)	(4b)	(5)
188	≤ 1 g per cell, ≤ 2 g per battery	Yes SP188(c)	SP188(d),(g),(h)		-	-	-	-
-	> 1 g per cell, > 2 g per battery	Yes 2.2.9.1.7.1(g)	P903(1),(2) LP903	UN 3090		-		UN 3090 LITHIUM METAL BATTERIES, 9, (E)
310	pre-production prototypes or production runs ≤ 100 cells or batteries	No	P910(1),(3) LP905(1)	UN 3090		-		UN 3090 LITHIUM METAL BATTERIES, 9, (E), CARRIAGE IN ACCORDANCE WITH SPECIAL PROVISION 310
376	damaged / defective, non critical	No	P908 LP904	UN 3090 DAMAGED / DEFECTIVE LITHIUM METAL BATTERIES		-		UN 3090 LITHIUM METAL BATTERIES, 9, (E), CARRIAGE IN ACCORDANCE WITH SPECIAL PROVISION 376
376 677	damaged / defective, critical	No	P911 LP906	UN 3090 DAMAGED / DEFECTIVE LITHIUM METAL BATTERIES		-		UN 3090 LITHIUM METAL BATTERIES, 9, (E), CARRIAGE IN ACCORDANCE WITH SPECIAL PROVISION 376, TRANSPORT CATEGORY 0

Mode of Transport Ocean – IMDG Code

IMDG Code								
UN 3090 LITHIUM METAL BATTERIES								
Special Provision		Test Summary?	Package			Container		Transport document
			Packaging	Marking	Labeling	Marking	Placarding	
(1a)	(1b)	(2)	(3a)	(3b)	(3c)	(4a)	(4b)	(5)
188	≤ 1 g per cell, ≤ 2 g per battery	Yes SP188.3	SP188.4,.7,.8	 *)	-	-	-	- (unless required by carrier)
-	> 1 g per cell, > 2 g per battery	Yes 2.9.4.7	P903(1),(2) LP903	UN 3090 LITHIUM METAL BATTERIES		3090 if > 4 tons		UN 3090 LITHIUM METAL BATTERIES, 9
310	pre-production prototypes or production runs ≤ 100 cells or batteries	No	P910(1),(3) LP905(1)	UN 3090 LITHIUM METAL BATTERIES		3090 if > 4 tons		UN 3090 LITHIUM METAL BATTERIES, 9, TRANSPORT IN ACCORDANCE WITH SPECIAL PROVISION 310
376	damaged / defective, non critical	No	P908 LP904	UN 3090 DAMAGED / DEFECTIVE LITHIUM METAL BATTERIES		3090 if > 4 tons		UN 3090 LITHIUM METAL BATTERIES, 9, TRANSPORT IN ACCORDANCE WITH SPECIAL PROVISION 376
	damaged / defective, critical	No	P911 LP906	UN 3090 DAMAGED / DEFECTIVE LITHIUM METAL BATTERIES		3090 if > 4 tons		UN 3090 LITHIUM METAL BATTERIES, 9, TRANSPORT IN ACCORDANCE WITH SPECIAL PROVISION 376
	*) if export to the U.S.A. (U.S. CFR 49, §171.25(b)(3))							

Mode of Transport Air – IATA DGR

IATA DGR						
UN 3090 LITHIUM METAL BATTERIES						
Special Provision		Test Summary?	Package			Transport document
			Packaging	Marking	Labeling	
(1a)	(1b)	(2)	(3a)	(3b)	(3c)	(4)
-	≤ 1 g per cell, ≤ 2 g per battery, ≤ 2,5 kg net mass per cell or battery	Yes 3.9.2.6.1.1(g)	PI 968 IB	UN 3090 LITHIUM METAL BATTERIES 		UN 3090 LITHIUM METAL BATTERIES, 9, PI 968 IB
-	> 1 g per cell, > 2 g per battery, ≤ 35 kg net mass per cell or battery	Yes 3.9.2.6.1.1(g)	PI 968 IA	UN 3090 LITHIUM METAL BATTERIES 		UN 3090 LITHIUM METAL BATTERIES, 9, PI 968
A99	> 1 g per cell, > 2 g per battery, > 35 kg net mass per cell or battery	Yes 3.9.2.6.1.1(g)	PI 974(1) of ICAO TI	UN 3090 LITHIUM METAL BATTERIES 		UN 3090 LITHIUM METAL BATTERIES, 9, PI 974, SP A99
A88	pre-production prototypes or production runs ≤ 100 cells or batteries	No	PI 910(1) of ICAO TI	UN 3090 LITHIUM METAL BATTERIES 		UN 3090 LITHIUM METAL BATTERIES, 9, PI 910, SP A88
A154	damaged / defective, non critical	Forbidden				
	damaged / defective, critical	Forbidden				

Appendix 3: Restrictions of IATA Airlines

Airline		UN 3480		UN 3481				UN 3090		UN 3091				UN 3556
				with		in				with		in		
		PI965		PI966		PI967		PI968		PI969		PI970		PI952
		IA	IB	I	II	I	II	IA	IB	I	II	I	II	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Aerolineas Argentinas	AR				A		A							
Aeromexico	AM													
AeroUnion	6R	shipper must be registered								shipper must be registered				if self balancing with additional provisions only
											A		A	
Air Atlanta Europe	CT													CAO
Air Atlanta Icelandic	CC													CAO
Air Baltic	BT													
Air Bridge Cargo	RO	with approval only		with approval only	A	with approval only	A	with approval only		with approval only	A	with approval only	A	
Air Canada	AC				A		A				A		A	
Air Canada Rouge	RV				A		A				A		A	
Air China	CA													
Air Europa	UX													
Air Europa Express	X5													
Air France	AF			≤ 1,6 m						≤ 1,6 m				
Air Hong Kong	LD													
Air Mauritius	MK													

FM Global Data Sheet "Commodity Classification" (DS 8-1, January 2023)

https://www.fmglobal.com/research-and-resources/fm-global-data-sheets

<table>
<tr><th>UN 3480
SoC</th><th>ceiling
height</th><th>storage
height</th><th>storage
arrangement</th><th>packaging</th><th>ceiling protection
(Quick Response
sprinklers only)</th><th>in-rack
protection</th></tr>
<tr><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td><td>(5)</td><td>(6)</td><td>(7)</td></tr>
<tr><td rowspan="4">≤ 60 %</td><td rowspan="3">≤ 12 m</td><td rowspan="3">≤ 3 levels,
≤ 4.5 m</td><td rowspan="3">on-floor
+
in-rack</td><td>wood, metal or corrugated carton with cellulose and/or unexpanded plastic internal packaging only</td><td>K320 or K360,
12 sprinklers,
2.4 bar</td><td rowspan="3">-</td></tr>
<tr><td>corrugated carton with expanded plastic internal packaging</td><td>CEP *)
according to DS 8-9</td></tr>
<tr><td>plastic external packaging</td><td>UUP **)
according to DS 8-9</td></tr>
<tr><td rowspan="2">> 12 m</td><td rowspan="3">-</td><td rowspan="3">in-rack</td><td>uncartonated</td><td rowspan="3">per surrounding
occupancy</td><td rowspan="3">see section
2.4.2.2 of DS 8-1
(each second
level).</td></tr>
<tr><td rowspan="2">> 60 %</td><td rowspan="2">cartonated or uncartonated</td></tr>
<tr><td>-</td></tr>
<tr><td colspan="7">*) = Cartonated Expanded Plastic; **) = Uncartonated Unexpanded Plastic.</td></tr>
</table>

UN 3481 SoC	ceiling height	storage height	storage arrangement	packaging	ceiling protection (Quick Response sprinklers only)	in-rack protection
(1)	(2)	(3)	(4)	(5)	(6)	(7)
≤ 60 %	According to the product commodity classification.					
> 60 %					per surrounding occupancy	see section 2.4.2.2 of DS 8-1 (each second level).