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Legal regime for Lithium battery transport in UN Model Regulations, RID and ADR

Riga, 11/12/2024

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Why it is important ?

- Lithium (and Sodium ion) batteries are the most powerful batteries available today

- They are used in multiple applications, for example :

  - In small portable equipments (drills, lawnmovers …)
  - In industrial equipments (forklifts …)
  - As energy storage for renewable sources
  - As power storage for electric cars and trucks …

- However, when misused, for example :

  - In case of short circuits
  - When dropped or crushed
  - When too rapdily charged or discharged …

- They can produce violent reactions possibly leading to fire, particle and flammable/toxic gas emission

- Therefore, these articles are dangerous goods and must be regulated

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In this presentation, I will briefly

- Outline the general structure of the legal frame for transport of Lithium batteries in UN Model Regulations

- Give some indications of the legal frame in ADR (Road transport) and RID (rail transport)

- Present rapidly the ongoing work concerning the Lithium batteries in UN Model Regulations

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The provisions for Lithium Batteries in UN Model Regulations

- Un Model Regulations are a frame which is a base for the TDG regulations of every mode,
  - Air mode (ICAO), Sea mode (IMDG)
  - Land modes (ADR : Road, RID : Rail, ADN : Inland waterways)
  - I will first present the provisions of UN Model Regulations,
    - then some aspects of the ADR and the RID

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The provisions for Lithium Batteries in UN Model Regulations

- Lithium (or Sodium ion) batteries can be classified under the following UN Numbers :

- UN 3090 : LITHIUM METAL BATTERIES
- UN 3091 : LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT
  or LITHIUM METAL BATTERIES PACHED WITH EQUIPMENT

- UN 3480 : LITHIUM ION BATTERIES
- UN 3481 : LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT
  or LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT

- UN 3551 : SODIUM ION BATTERIES
- UN 3552 : SODIUM ION BATTERIES CONTAINED IN EQUIPMENT
  or LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT

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The provisions for Lithium Batteries in UN Model Regulations

- Lithium (or Sodium ion) batteries when used for energy storage or energy source are also classified, for instance under following UN Numbers :

- UN 3536 : LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT
  lithium ion batteries or lithium metal batteries

- UN 3556 : VEHICLE, LITHIUM ION BATTERY POWERED

- UN 3557 : VEHICLE, LITHIUM METAL BATTERY POWERED

- UN 3558 : VEHICLE, SODIUM ION BATTERY POWERED

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The provisions for Lithium Batteries in UN Model Regulations

- For each UN Number, there are Special Provisions and Packing Instructions :

UN N°	Name and Description	Class or Division	Subsi-diary Hazard	UN packing group	Special pro-visions	Limited and excepted quantities		Packagings and IBC's		Portable tanks and bulk containers	
								Packing instruction	Special packing provisions	Instruc-tions	Special provisions
(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
-	3.1.2	2.0	2.0	2.0.1.3	3.3	3.4	3.5	4.1.4	4.1.4	4.2.5/4.3.2	4.2.5
3090	LITHIUM METAL BATTERIES (including lithium alloy batteries)	9			188 230 310 376 377 384 387	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			
3091	LITHIUM METAL BATTERIES CONTAINED IN EQUIPMENT or LITHIUM METAL BATTERIES PACKED WITH EQUIPMENT (including lithium alloy batteries	9			188 230 310 360 376 377 384 387 390	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			

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(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
-	3.1.2	2.0	2.0	2.0.1.3	3.3	3.4	3.5	4.1.4	4.1.4	4.2.5/4.3.2	4.2.5
3480	LITHIUM ION BATTERIES (including lithium ion polymer batteries)	9			188 230 310 348 376 377 384 387	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			
3481	LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT or LITHIUM ION BATTERIES PACKED WITH EQUIPMENT (including lithium ion polymer batteries)	9			188 230 310 348 360 376 377 384 387 390	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			

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								Packing instruction	Special packing provisions	Instruc-tions	Special provisions
(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
-	3.1.2	2.0	2.0	2.0.1.3	3.3	3.4	3.5	4.1.4	4.1.4	4.2.5/4.3.2	4.2.5
3551	SODIUM ION BATTERIES with organic electrolyte	9			188 230 310 348 376 377 384 400 401	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			
3552	SODIUM ION BATTERIES CONTAINED IN EQUIPMENT or SODIUM ION BATTERIES PACKED WITH EQUIPMENT, with organic electrolyte	9			188 230 310 348 376 377 384 400 401	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906			

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(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
-	3.1.2	2.0	2.0	2.0.1.3	3.3	3.4	3.5	4.1.4	4.1.4	4.2.5/4.3.2	4.2.5
3536	LITHIUM BATTERIES INSTALLED IN CARGO TRANSPORT UNIT lithium ion batteries or lithium metal batteries	9			389	0	E0				
3556	VEHICLE, LITHIUM ION BATTERY POWERED	9			384 388 405	0	E0	P912			
3557	VEHICLE, LITHIUM METAL BATTERY POWERED	9			384 388 405	0	E0	P912			
3558	VEHICLE, SODIUM ION BATTERY POWERED	9			384 388 404 405	0	E0	P912			

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The provisions for Lithium Batteries in UN Model Regulations

- What are the special provisions about ? Some examples for batteries :

SP	Provisions
188	• Conditions for exemption (maximum lithium content or watt-hour rating, batteries are of a type which pass the tests in MTC, manufactured under quality control, packing conditions, short circuit protection, package marked with the lithium battery mark, package resistant to drop test, package not exceeding 30 kg gross mass
310	• Relaxed provisions for small series or prototype batteries transported for testing – P910 or LP905 packing instructions applicable – provisions not applicable for damaged or defective batteries (see SP 376), or transported for disposal (see SP 377)
376	• Definition of damaged or defective batteries (= which do not conform to the type tested) – Packing instructions P908 or LP904 are applicable. If the batteries are liable to rapidly dissassemble, use P911 or LP906
377	• Batteries transported for recycling or disposal may be packaged according to P909. The compliance to tests are not required. Modal regulations may define additional conditions for exemptions.

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The packing instructions for Lithium Batteries in UN Model Regulations

- From less severe to more severe :

P.I.	Description
P903	• Standard packing instructions for batteries of a tested type
P908	• Packing instructions for damaged or defective batteries
P909	• Packing instructions for batteries transported for recycling or disposal
P910	• Packing instructions for untested prototype batteries.
P911	• Packing instructions for batteries liable to rapidly disassemble

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From UN Model Regulations to ADR / RID : some differences

- Some new definitions are used, compared to UN Model Regulations :
  - Alphanumerical classification code of DG, according to its hazard classification : ADR : 2F = flammable gas, Tx = toxic, TCx = toxic corrosive, M4 = Lithium batteries
  - Provisions for labels to be affixed on packings and transport units
  - Provisions for mixed packing
  - Provisions for RID/ADR tanks
  - ADR : Provisions concerning vehicles for tank carriage, for tunnel restrictions
  - RID/ADR : provisions for loading and unloading
- However, in the case of lithium batteries, there is not much change compared to UN Model Regulations

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From UN Model Regulations to ADR / RID : some differences

UN N°	Name and Description	Class	Classification code	Packing group	Labels	Special provisions	Limited and excepted quantities		Packaging			Portable tanks and bulk containers		RID tanks		Transport category	Special provisions for carriage			Colis express (express parcels)	Hazard identification N°
									Packing instructions	Special packing provisions	Mixed packing provisions	Instruc-tions	Special provisions	Tank code	Special provisions		Packages	Bulk	Loading, unloading and handling		
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9a)	(9b)	(10)	(11)	(12)	(13)	(15)	(16)	(17)	(18)	(19)	(20)
-	**3.1.2**	**2.2**	**2.2**	**2.1.1.3**	**5.2.2**	**3.3**	**3.4**	**3.5. 1.2**	**4.1.4**	**4.1.4**	**4.1.10**	**4.2.5.2 7.3.2**	**4.2.5.3**	**4.3**	**4.3.5 6.8.4**	**1.1.3.1(c)**	**7.2.4**	**7.3.3**	**7.5.11**	**7.6**	**5.3.2.3**
3480	LITHIUM ION BATTERIES (including lithium ion polymer batteries)	9	M4		9A	188 230 310 348 376 377 384 387 636	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906							2				CE2	90
3481	LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT or LITHIUM ION BATTERIES PACKED WITH EQUIPMENT (including lithium ion polymer batteries)	9	M4		9A	188 230 310 348 360 376 377 384 387 390 670	0	E0	P903 P908 P909 P910 P911 LP903 LP904 LP905 LP906							2				CE2	90

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Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- So far the current regulations are globally OK : the vast majority of cells and batteries, which are of a tested type, are successfully transported, with only a minimal occurrence of accidents

- But the different types of batteries may have different sensibilities to thermal abuse can behave differently :

    - Batteries transported at low state of charge (typically about 30 % of max charge) usually react less than those transported at full charge

    - On the other hand, some very reactive batteries could in some case lead to worse effects than expected, and perhaps the most severe transport conditions may not be sufficient to deal with the risk.

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Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- The idea is then to create a new classification of the lithium batteries, based on their actual hazard when forced into thermal runaway :
    - A cell of a battery is forced in thermal runaway by an appropriate test
    - The induced effects (propagation to the battery, propagation to the nearby batteries …) are measured and a classification is made

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Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- An experts working group, which reports to the UN SubCommittee of Experts for TDG is working on that subject.

- In that WG, there is now an agreement on the following points :

  - On the principle of testing the battery types for thermal runaway by an appropriate test and on defining a classification based on the hazard

  - On the parameters to consider : propagation of thermal runaway to adjacent cells or batteries, emission of heat, emission of toxic/explosive gas

  - On the principle of defining packing instructions according to each class of the hazard based classification

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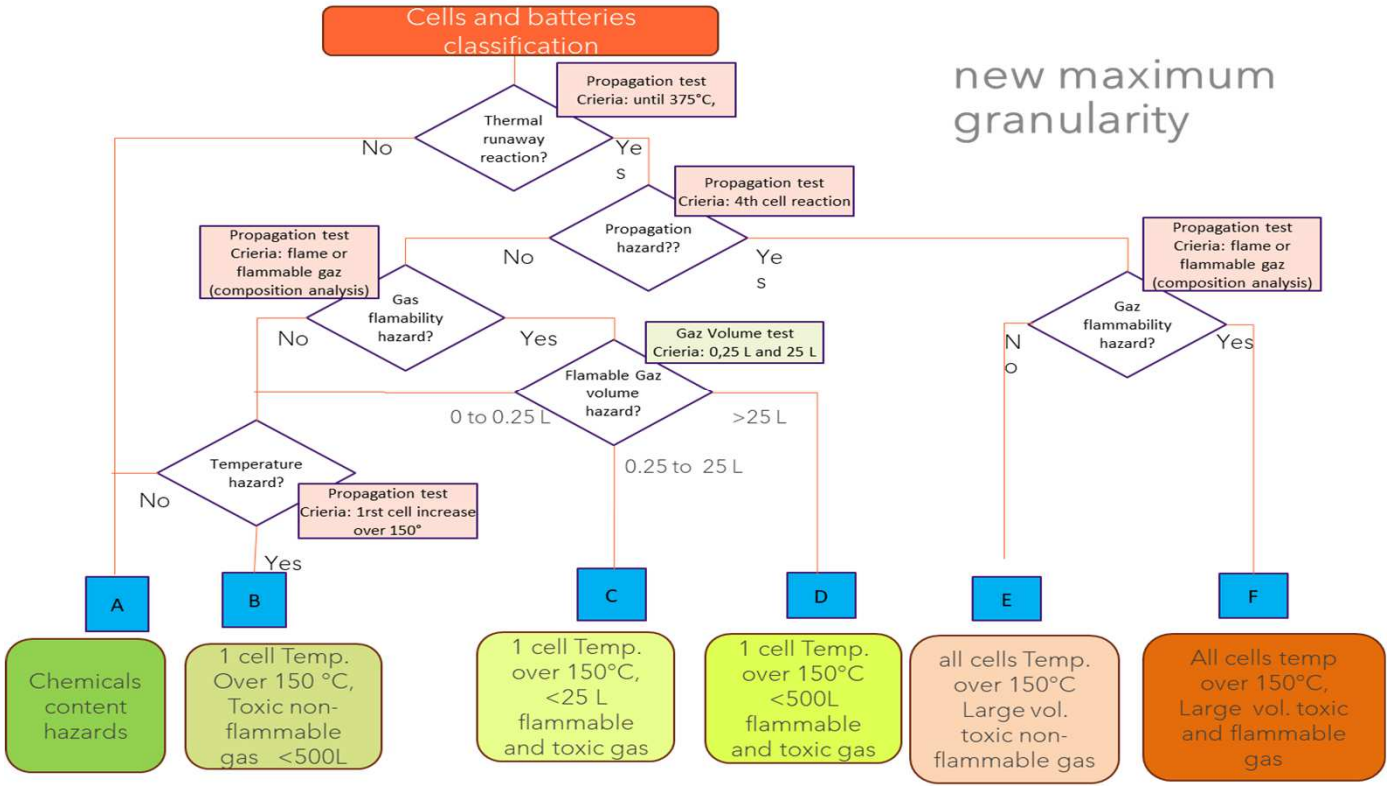
Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- First step is the definition of an optimal granularity for the classes (number of classes, associated limit values) : high granularity



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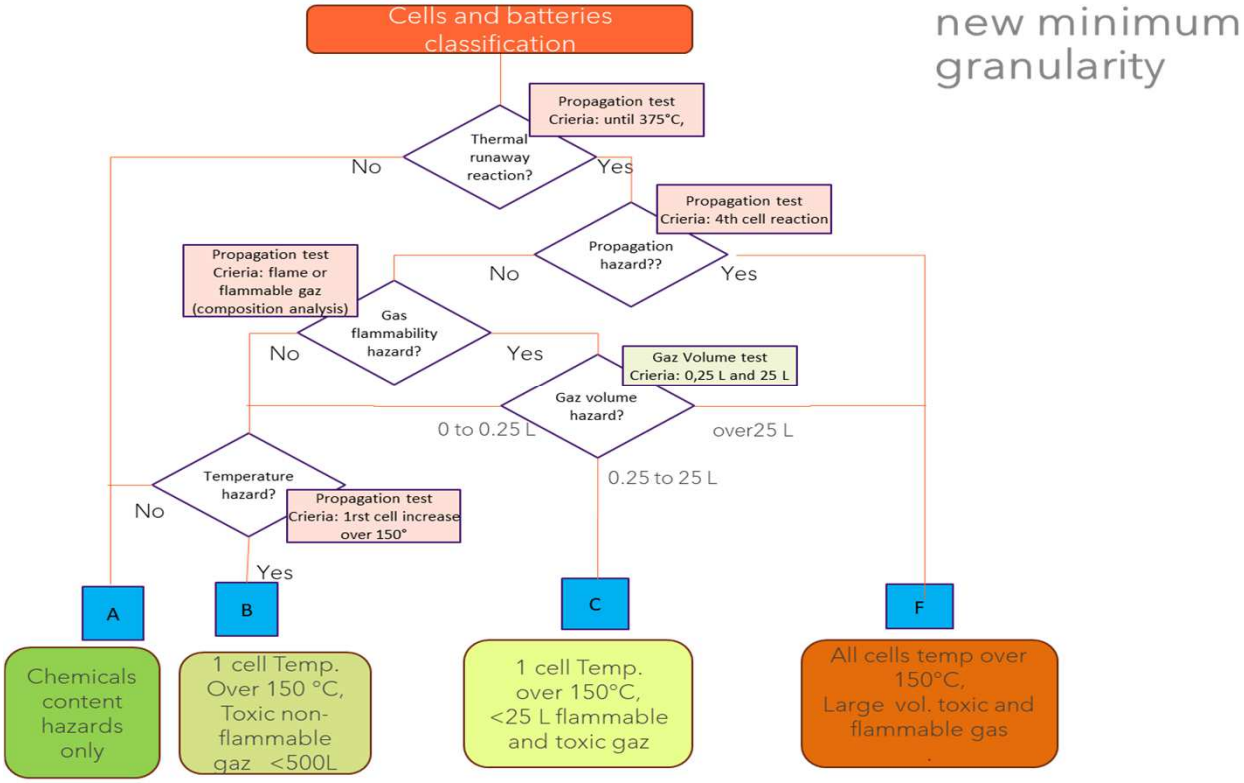
Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- By regrouping some of the classes, we get a minimum granularity



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Partial conclusion and further work on transport provisions for Lithium batteries at UN Model Regulations level

- Beside the classification , the WG already works on the following points :
    - Definition of the propagation test
    - Definition of new packing instructions for each class according to the hazard

- Then, further topics are to be adressed :
    - Aged batteries, damaged or defective batteries
    - Repair, refurbishment of batteries

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Thank you for your attention

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