



Transport of Lithium Batteries

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Seminar on Lithium Batteries

Karlstein, November 2005



- ▶ Incidents (Air Transport)
- ▶ Major Players
- ▶ UN 3090 - Overview
- ▶ Definitions, Exemption limits
- ▶ Transport regulations and exemptions
- ▶ Packaging, marking and documents
- ▶ Transport tests
- ▶ More information sources.

Incidents (Air Transport) 1996 - 2004



When?	Where?	Type of battery	Damage
11 x 1996 - 1999	14 x Cargo	10 x Lead acid	15 x Fire
10 x 2000-2004	2 x Passenger	2 x Alkaline	1 x Explosion ¹⁾
	5 x Ground	3 x NiCad	4 x Heat
		4 x Lithium	1 x Unknown
		2 x Unknown	

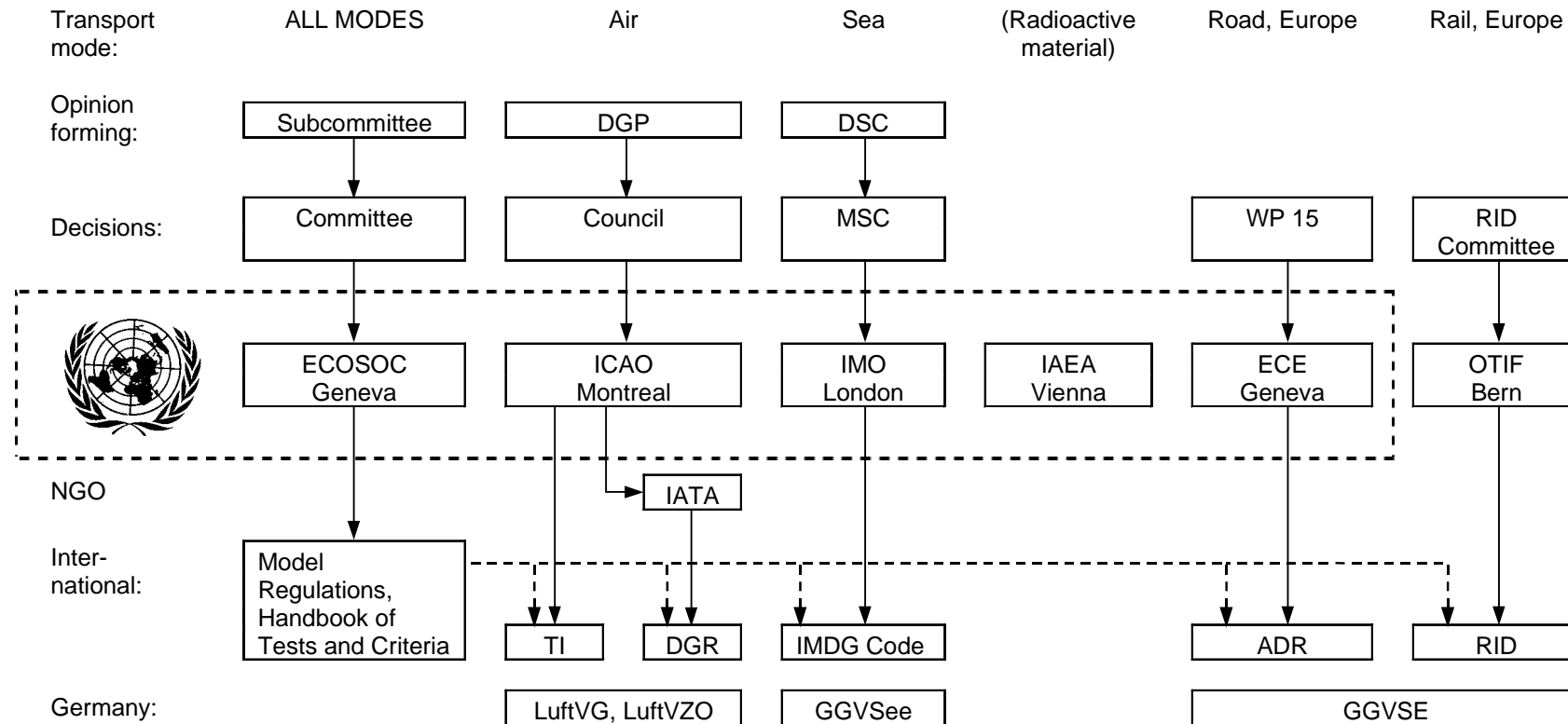
¹⁾ Alkaline in Flashlight

Source: ICAO DGP-WG/04-IP/9, Abu Dhabi, Oct 2004 (by R. Richard)



- ▶ Lithium batteries are classified as Dangerous Goods
 - Class 9, Miscellaneous
 - UN No. 3090 Lithium batteries
 - UN No. 3091 Lithium batteries packed in/with equipment
- ▶ Transport of Dangerous Goods is regulated by law
- ▶ National laws are harmonized on different levels by International Governmental Organizations.

Transport of Dangerous Goods International Context



UN No. 3090 - Lithium Batteries Overview (ADR)



			see chapter (ADR 2001)
Class	9	Miscellaneous	2.2
Classification code	M4	Lithium batteries	2.2.9.1.7
Packing group	II	Medium danger	2.1.13
Labels	9	Class 9 label	5.2.2
Special provisions	188	Exempted if ...	3.3
	230	Class 9 if ...	
	310	Small lots	
	636	Used batteries	
Limited quantities	LQ0	No	3.4.6
Packing instruction	P903	Lithium batteries	4.1.4
Transport category	2	Exemptions under 333 kg	1.1.3.6
Special provisions for carriage	V1	Closed or sheeted vehicles/containers	7.2.4

UN Nr. 3090 - Lithium batteries Overview (IATA)



			see Chapter
Class	9	Miscellaneous dangerous goods	3.9
Sub risk	–		
Packing group	II	Medium danger	3.0.3
Packing instructions	P903 P912, P918	Lithium batteries Lithium batteries in/ with equipment	5.9
Hazard label	9	Class 9	7.3.17
Limited quantity	–	No	
Max. gross mass	5 kg		
Cargo aircraft	Max. gross mass	35 kg	
	Handling label	Yes	Cargo aircraft only 7.4.2
Special provisions	A45	Exemptions	4.4
	A88	Prototypes	
	A99	over 35 kg	

UN Model Regulations Definition of cell



- ▶ Cell:
 - Single encased electrochemical unit
- ▶ Small cell:
 - Cell with not more than 12 g Li
- ▶ Large cell:
 - Cell with more than 12 g Li.

UN Model Regulations

Definition of battery



- ▶ **Battery:**
 - One or more cells which are electrically connected together, including case, terminals, and markings
- ▶ **Small battery:**
 - Battery with not more than 500 g Li, composed of small cells
- ▶ **Large battery:**
 - Battery with more than 500 g Li.



- ▶ *System*
 - lithium metal
 - lithium ion

- ▶ *Assembly status*
 - cell
 - battery

- ▶ *Lithium content*
 - mass.

Exemption limits



	<i>Li per cell</i>	<i>Li per battery</i> ¹⁾	<i>subject to regulations</i>	<i>UN tests required</i>
Li-Metal	$\leq 1 \text{ g}$	$\leq 2 \text{ g}$	<i>No</i> ²⁾	<i>Yes</i>
	$> 1 \text{ g}$	$> 2 \text{ g}$	<i>Yes</i>	<i>Yes</i>
Li-Ion	$\leq 1,5 \text{ g}^{3)}$	$\leq 8 \text{ g}^{3)}$	<i>No</i> ²⁾	<i>Yes</i>
	$> 1,5 \text{ g}^{3)}$	$> 8 \text{ g}^{3)}$	<i>Yes</i>	<i>Yes</i>

1) Battery contains one or more cells

2) Under certain conditions (see Special Provision 188)

3) Equivalent content: 3 Ah correspond to 1 g Li (per cell).

Not subject to regulations - Conditions:




- ▶ Transport tests must have been passed
- ▶ Cells and batteries must be separated so as to prevent short circuit
- ▶ Cells and batteries must be packed in strong packaging
- ▶ For packages with more than 24 cells / 12 batteries:
 - Hazard communication on package and in document
 - Package withstands 1.2 m drop, no shifting, no contact
 - Not more than 30 kg gross mass per package.



Shipment not subject to regulations

Package:

	<u>CAUTION!</u>
	Lithium Batteries inside
IF DAMAGED	Handle with care
	Flammable if damaged
	If package is damaged, batteries must be quarantined, inspected and repacked.
	For emergency information, call: xyz

Document:

“This shipment contains lithium batteries.
Handle with care. Flammable if damaged.
If package is damaged, batteries must be
quarantined, inspected and repacked.
For emergency information, call: xyz”

Subject to regulations means:



- ▶ Limited mass per package, depending on transport mode and packaging type approval
 - max. 5 kg passenger aircraft
 - other modes: max. gross mass of package per approval
- ▶ Authorized packaging: Packing group II
- ▶ Packaging must prevent short circuit
- ▶ Special labelling: Class 9 label
- ▶ Special documents
 - Shipper's declaration
 - Instructions in writing (road transport).

Transport of cells and batteries without testing (“SP 310”)



- ▶ Without transport testing:
- ▶ Special provision 310 (ADR, IMDG Code)
- ▶ Lots up to 100 batteries (pilot production, small production runs)
- ▶ Air transport: ≤ 24 cells, ≤ 12 batteries + DOT authorisation
- ▶ Subject to dangerous goods regulations
- ▶ Packing group I (SOLi: “Utz - Poolbox”)
- ▶ Packaging must be DOT authorised
- ▶ Each cell and battery individually packed in an inner packaging
- ▶ Cushioning material to be non-combustible and non-conductive.



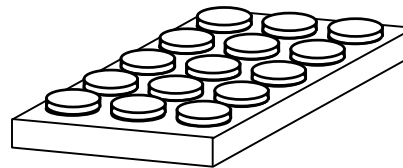


- ▶ **TRUCK**
 - ADR Special provision 636
 - Package marking „USED LITHIUM BATTERIES“
- ▶ **AIRCRAFT**
 - IATA Packing instruction 903
 - Batteries forbidden from transport if below 2 Volts
- ▶ **GENERAL**
 - Must fulfill all other Dangerous Goods Regulations same as unused batteries
- ▶ **CONCLUSION**
 - Ship batteries for disposal by truck and ship.

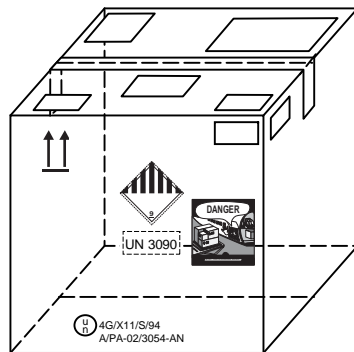
Dangerous Goods Regulations Packaging - Definitions



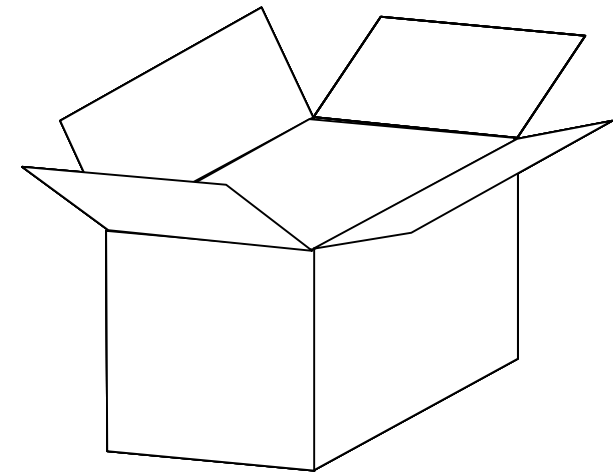
1. Battery



2. Inner packaging



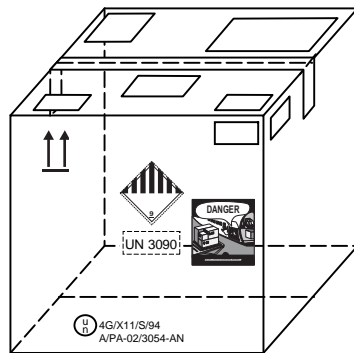
4. Package



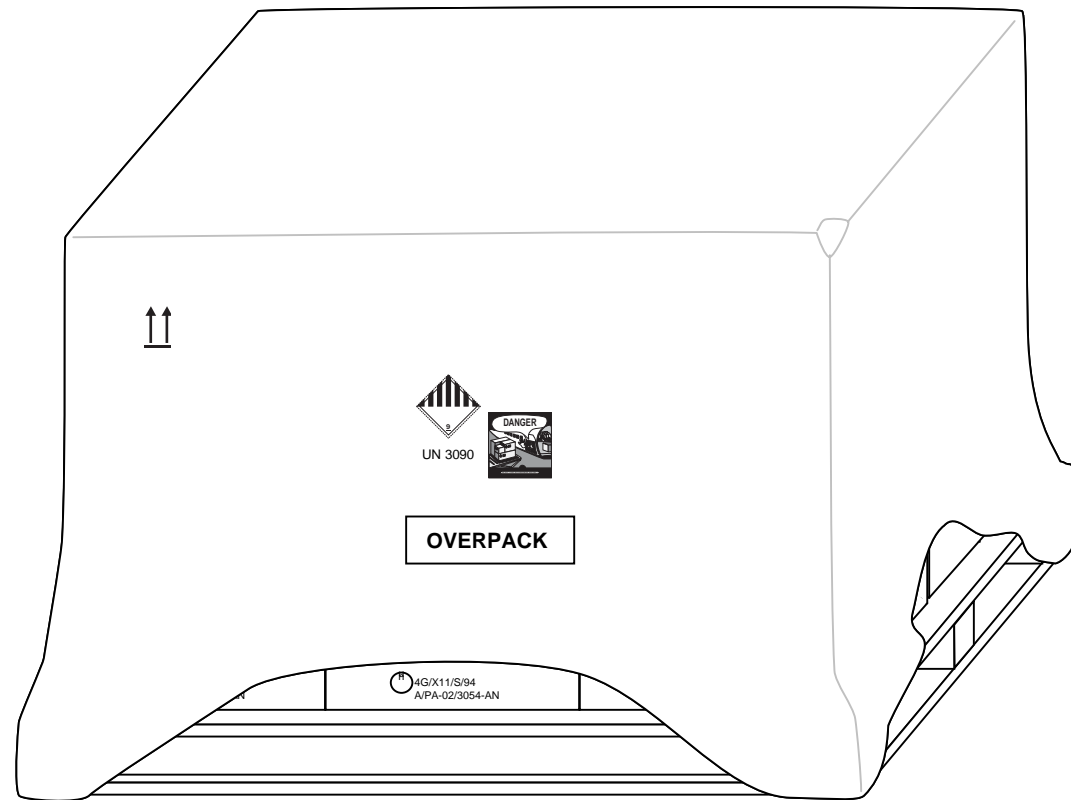
3. Outer packaging



5. Overpack



4. Package





- ▶ Package (packaging group II) with labels and marking



Symbol „Keep upright“

Hazard label class 9

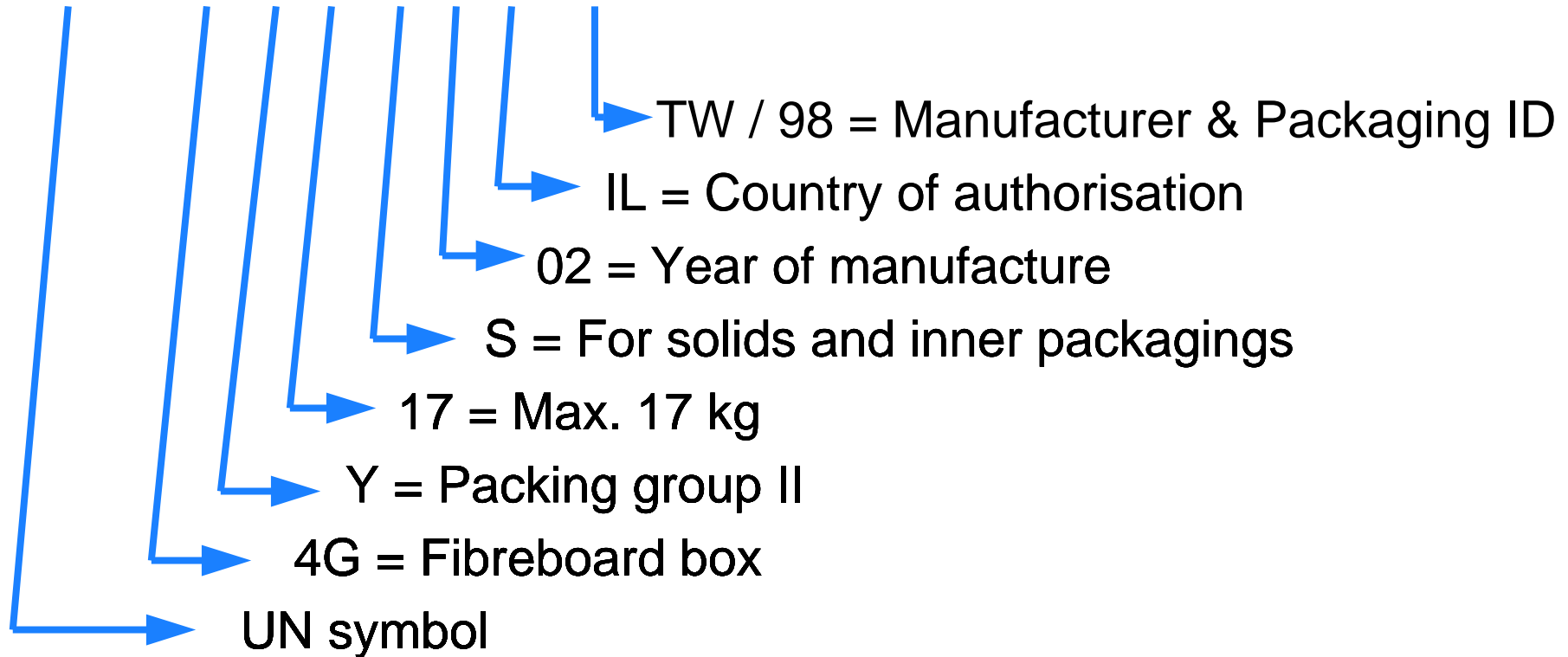
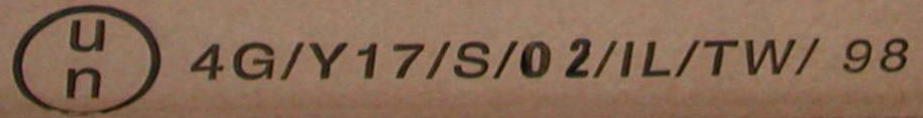
UN number and proper shipping name

Handling label

Cargo aircraft only

Authorization number of packaging

Dangerous goods packaging – Authorisation number



Shipper's Declaration



SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper Sonnenschein Lithium GmbH Industriestraße 22 63654 Büdingen / Hessen Federal Republic of Germany		Air Waybill No. Page 1 of 1 Pages Shipper's Reference Number (optional)					
Consignee ROCCAS ICCP SRL SOS. PANTELIMON NO. 10-12 Et. 6, SECTOR 2 BUCHAREST 77104 / ROMANIA							
Two completed and signed copies of this Declaration must be handed to the operator.		WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.					
TRANSPORT DETAILS This shipment is within the limitations prescribed for: (delete non-applicable)							
Airport of Departure: Frankfurt		Shipment type: (delete non-applicable) NON-RADIOACTIVE RADIOACTIVE					
Airport of Destination: BUCHAREST							
NATURE AND QUANTITY OF DANGEROUS GOODS							
Dangerous Goods Identification							
Proper Shipping Name	Class or Division	UN or ID No.	Pack- ing Group	Subsidi- ary Risk	Quantity and type of packing	Packing Inst.	Authorization
LITHIUM BATTERIES, LIQUID CATHODE	9	UN 3090	II		1 x 4G-carton gr weight 2,3 kgs	903	
Additional Handling Information Emergency phone: (0049) 6042 / 81-284							
I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.				Name Title / Signature Barbel Hof Export Clerk Date Büdingen, this 29 th May 2002 Signature (see warning above) 			

Order No.: L 109 9/94

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WHEN:

“New” lithium cells or batteries need to be tested if there is

- ▶ a change of more than 0,1 g or 20 % by mass, whichever is greater, to the electrodes or to the electrolyte, or
- ▶ a change that would materially affect the test results

HOW:

Test methods are described in the UN Model Regulations, Handbook of tests and criteria (See also IEC 62281).



1. Altitude
2. Temperature
3. Vibration
4. Shock
5. Intentional short circuit
6. Impact (cells only)
7. Overcharge (rechargeable cells only)
8. Forced discharge (cells only).



- ▶ IEC 62281
Safety tests for primary and secondary lithium cells and batteries during transport
- ▶ IEC 60086-4
Primary batteries - Part 4: Safety of lithium batteries
- ▶ IEC 62133
Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications
- ▶ IEC 61960
Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications.



- ▶ Technical Notice Sonnenschein Lithium
www.sonnenschein-lithium.de >> Products >> Safety & transport
- ▶ ADR Dangerous Goods Regulations (Road / Railroad)
www.unece.org/trans/danger/publi/adr/adr_e.html
- ▶ IATA Dangerous Goods Regulations (Air transport)
e.g. ISBN 92-9195-318-0, by IATA, Montreal
- ▶ ZVEI Transport Brochure
(in German, unpublished, please refer to the speaker)
- ▶ UN Recommendations on the Transport of Dangerous Goods
www.unece.org/trans/danger/danger.htm
- ▶ UN Sub-Committee of Experts
www.unece.org/trans/main/dgdb/dgsubc/c3age.html .



- ▶ **EPBA**

European Portable Battery Association
www.epbaeurope.net

- ▶ **Eurobat**

Association of European Storage Battery Manufacturers
www.eurobat.org

- ▶ **Recharge**

The international association for the promotion and management of portable rechargeable batteries through their life cycle
www.rechargebatteries.org

- ▶ **ZVEI**

Zentralverband der Elektro-Industrie, Fachverband Batterien
www.zvei.org

- ▶ **PRBA**

Portable Rechargeable Batteries Association (USA)
www.prba.org

Transport to, from, and inside the USA



- ▶ Transport regulations in the USA are not harmonized with UN regulations
- ▶ Transport regulations in the USA are based on 49CFR
- ▶ Refer to www.gpoaccess.gov/cfr/index.html for details.