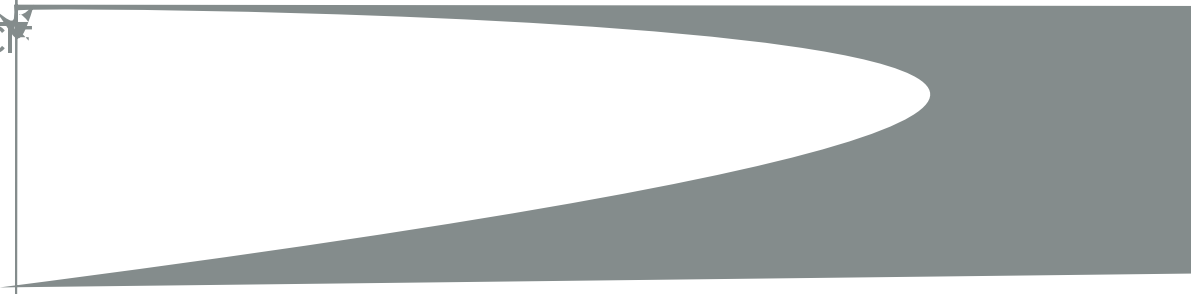




OCIR



About the RSC

The Royal Society of Chemistry (RSC) is the UK professional body for chemical scientists and an international learned society for advancing the chemical sciences. Supported by a network of over 43 000 members worldwide and an internationally acclaimed publishing business, its activities span education and training, conferences and science policy, and the promotion of the chemical sciences to the public.

If you require further information on the contents of this report, please contact us at our Cambridge office (refer to back cover for details).

About CLEAPSS and SSERC

CLEAPSS®

2. Simple rules

These simple rules have been drawn up knowing the chemicals likely to be transported for lecture

3. Status of the volunteer

The status of the individual transporting the chemicals is important because:

- private individuals are exempt from some of the regulations governing the transport of chemicals by road; and
- the insurance cover of the driver may also be affected.

A retired volunteer will not be in employment and thus can be regarded as a private individual. However if volunteers accept fees, as opposed to expenses, then they may be considered in employment. In any case, a private individual would not be able to obtain some chemicals. In that situation, a school or university might supply them (free of charge) but it does raise questions about the status of the individual.

A university lecturer, for example, may be encouraged by her/his department to give lectures to feeder schools, may be supplied at no cost with the relevant chemicals but may still be regarded as a private individual working in her/his own time. Similarly, some teachers in secondary schools may be encouraged, or even required, to liaise with feeder primary schools. Needless to say, few of these distinctions have been tested in court.

4. Motor insurance considerations

Some of the more popular private motor insurance policies do not appear to have any specific restrictions with regard to the carriage of chemicals (although radioactive materials may be treated differently). There is a general duty to take reasonable care to prevent loss or damage. Therefore, if chemicals were transported in an inappropriate manner then a claim might be rejected. The Simple Rules in Section 2 give guidance on good practice.

The car insurance held by most school teachers will cover them for business use as a teacher (but this needs to be stated on the certificate of insurance). Named drivers on another person's insurance policy (eg, spouses) are unlikely to be insured for business use unless this is explicitly stated. Primary school liaison is an important part of the job of some teachers in secondary schools and hence occasionally moving a few chemicals to a neighbouring feeder school should be covered by their insurance. University staff may also be covered for undefined business use, although most universities will have vans routinely employed for transporting chemicals between sites which it may be possible to use. In some cases different rules apply when employers are transporting chemicals between their own sites, even if public roads are involved.

When insurance cover is being arranged, questions are asked relating to the occupation of the proposer and the requirement for cover. The policy is then framed around this. Therefore, someone without a paid job, who stays at home to care for children or others, is likely to have a policy that restricts cover to Social, Domestic and Pleasure purposes only and this may be similar for a retired person. Beyond that there is a range of uses allowing for Social, Domestic and Pleasure purposes together with commuting and / or full business use. Sometimes "commuting" is restricted to a permanent place of work, therefore travel to alternative sites is not always allowed for. It could be argued that an unpaid volunteer travelling to a lecture / demonstration would be Social, Domestic and Pleasure purposes as there is no payment involved, whereas a paid volunteer is acting in a business capacity. Note, however, that some Social, Domestic and Pleasure policies do not cover a volunteer working unpaid for a charity.

Therefore, it is important that individuals check their policies (and certificates of motor insurance) to ensure they have the correct cover for their activities. For example a retired person might add the term, "volunteer lecturer in chemistry" to his "occupation".

5. Exemptions from ADR

The rules governing the transport of chemicals by road are extremely complex and not always entirely logical to the chemist's mind. In general, carriage must conform to the requirements of ADR as implemented by the Carriage Regulations⁴.

Terminology can be very complicated. A partial Glossary is given in Appendix 1. Labelling and packaging which must conform to Part 4 of ADR. Table A [3.2.1] of ADR⁵ is known as the Dangerous Goods List. It runs to 266 pages!

There are exemptions from ADR (section 1.1.3) under several categories, of which the most relevant in the context of this document are as follows.

- Private individual
- Ancillary to main activity
- Limited quantities
- Excepted quantity
- Small loads

The issues are discussed in more detail below, but the above list is given in order of preference for demonstrators needing to transport chemicals by road. As you descend the list, the legal requirements become more onerous.

5.1 Private individuals

Whilst there are limits on the total quantity that may be carried under this exemption, private individuals are exempt from ADR [ADR 1.1.3.1(a)] if carrying **dangerous goods packed for retail sale and intended for personal, domestic and leisure use**, provided steps have been taken to prevent leakage. This should cover individuals carrying out lectures and similar activities as a hobby as long as the original containers are used but obviously some chemicals are not available for retail sale to private individuals. If a university, for example, provided the chemicals for a former lecturer, that lecturer might be regarded as working (unpaid) for the university.

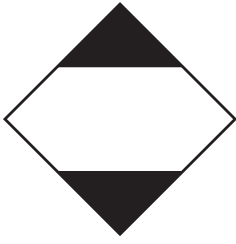
In addition, private individuals are allowed to carry up to 50 kg of fireworks (or a combination of 30 kg of fireworks and other explosives) [Carriage Regulations 3(9)].

5.2 Ancillary to main activity

Carriage by organisations which is "ancillary to their main activity" [ADR 1.1.3.1(c)] is also exempt from ADR, providing quantities are restricted. Thus if the main activities of a university are research and degree-level teaching, a lecture for school students could be seen as ancillary to their main activity. However, there is no clear definition of "ancillary to their main activity" and, for example, outreach work might be seen as part of the recruitment process of a university.

⁴ The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 can be downloaded from http://www.opsi.gov.uk/si/si2007/uksi_20071573_en.pdf

⁵ <http://www.unece.org/fileadmin/DAM/trans/danger/publi/adr/adr2011/English/Part3.pdf>



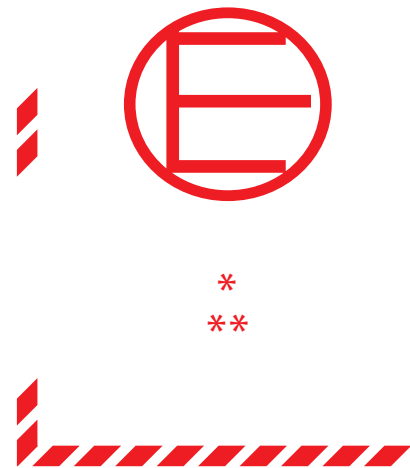
5.3 Limited quantities

Limited quantities (LQ) of most substances are exempt from the provisions of ADR providing they are well-packaged and labelled in a specified way. The previous system of 28 different categories has now been simplified to a limited list of quantities (in g or kg, ml or l). Unfortunately, for a few substances, the quantity is 0 g and this category includes some that demonstrators might want to transport. Examples include the alkali metals and compressed gases such as hydrogen.

The total allowed in any one box is also restricted but unlikely to be an issue in the context of this guidance. The Limited Quantity amount of the chemicals reported to be used by demonstrators is given in Appendix 2. It is generally preferable to use the LQ exemption if possible as fewer regulations would then apply. For example, the hazard warning diamond is not required on the outside of the vehicle. However, each package should have on its outside a warning diamond, 100 mm x 100 mm⁶. The line defining the outside of the diamond must be at least 2 mm thick. Note that this is a different design to that shown in the previous edition of this publication (which can continue in use only until June 2015).

5.4 Excepted quantity exemptions

Excepted quantities (EQ) is a new concept [ADR 3.5] which did not appear in earlier versions of the regulations. It assumes chemicals will be in combination packages (e.g. a bottle in a box). A new code (E0 to E5) appears in column 7(b) of table A (see Appendix 1.5). This links to paragraph 3.5.1.2 where what is allowed by the codes is set out. For example code E0 means that no EQ provisions are applicable. Code E1 means that the substance may be carried in inner packagings up to 30g or 30ml in outer packagings with a maximum net contents of 1000g or 1000ml – and so on for the other codes. It seems that this new category is unlikely to offer any great advantage to those at whom this document is aimed, unless they are carrying really quite small containers (less than 30 ml or 30 g) in large numbers. The packages have to be marked with the “EQ Symbol” (which can be black or red) and documents (where carried) must state “dangerous goods in excepted quantities” and indicate the number of packages.



* The first or only label number shown in column (5) of Table A of Chapter 3.2 shall be shown here.

** The name of the consignor or of the consignee shall be shown here if not shown elsewhere on the package.

5.5 Small loads

There are also exemptions for small loads, i.e. where the total quantity of dangerous goods carried is restricted [ADR 1.1.3.6.2]. It is the transport category of each substance, listed in ADR Table A (see Appendix 1.4), which determines what is regarded as a small load. There is a weighting system to deal with a mixed load having substances in different categories. For the situations covered in this document the Small Load Exemption will almost certainly apply (see Appendices 1 and 2). This means that many of the requirements of ADR do not apply. However, some of the requirements do apply which is why it is generally preferable to use the Limited Quantity Exemption if possible. **The following requirements of ADR must be followed even for small loads unless the private individual or other exemptions apply.**

- The driver must have awareness training [ADR 8.2.3] and a record of this should be kept [ADR 1.3.3]. The legislation assumes that that driver is in employment. Awareness involves both an understanding of transport legislation and of the hazards of the goods being transported. Familiarity with the joint Department for Transport / HSE publication⁷ Working with ADR. An introduction to the carriage of dangerous goods by road should suffice for the former. As far as the latter is concerned, since the driver will be using the goods her- or himself in demonstrations or similar, s/he should self-evidently be fully aware of the hazards.
- The vehicle should carry one 2 kg dry powder fire extinguisher or equivalent [ADR 8.1.4.2].
- The goods should be stowed properly [ADR 7.5.7], i.e. to prevent sliding etc.
- For some categories of chemicals the full ADR packaging requirements must be met, irrespective of the quantities carried. This includes UN approved containers, combination packaging, hermetic seals, etc. It is very unlikely this could be satisfied except by use of the original packaging in which the chemicals were supplied. Chemicals likely to be used by demonstrators etc for which the full packaging requirements would apply include sodium, potassium and bromine⁸.

6 Use of specialist contractors or carriers

In many cases the lecturer will transport her/his own chemicals and equipment. This obviates most of the need for driver training as the lecturer will certainly know the properties of the chemicals very well, including how to handle them and deal with emergencies. However, this will NOT be the case if a carrier is used. Some chemical suppliers do have trained drivers but some suppliers have ceased supplying particular chemicals because they do not have trained drivers. Trained drivers are not required for all chemicals and so in principle a carrier could be used. However, there may be difficulties in persuading the carrier that this is the case. It may be possible to pay a carrier to move chemicals between sites. Firms specialising in waste disposal, especially the smaller ones⁹, are sometimes willing to do so.

⁷ http://adlib.eversite.co.uk/resources/000/157/714/working_with_adr.pdf

⁸ <http://www.unece.org/fileadmin/DAM/trans/danger/publi/adr/adr2011/English/Part3.pdf>. Look for the Limited Quantities code 0 in column 7(a).

⁹ For example, Chemgo, tel: 07739 415061; fax: 0121 453 7887; web site: www.chemgo.org; e-mail: enquiry@chemgo.com.

8 Special cases

8.1 Fireworks and explosives

Under section 9(4) of the Carriage Regulations private individuals are allowed to carry up to 50 kg of fireworks or 30 kg of other explosives (or mixed loads), ie they are covered by exemption 1.1.3.1(a) of ADR. They must be loaded, stowed, carried and unloaded in a manner which does not significantly increase the risk to any person. Unauthorised access must be prevented and there should be no smoking and naked flames in and near the vehicle.

8.2 Gas cylinders

To avoid potential problems it is much simpler if lecturers use the very small non-refillable canisters (sometimes called "disposable cylinders" in catalogues). For example, a standard 50 litre water capacity refillable cylinder filled to 200 bar will yield 10 000 litres of gas when released as against the mid-range non-refillable canister containing 34 litres of gas from a company such as Cryoserve¹⁰.

The British Compressed Gas Association (BCGA) produces a number of Codes of Practice¹¹. These industry codes are non-statutory but a court would probably decide that they represent good practice. However, there may well be alternative, and equally safe, ways of complying with the actual requirements of the Regulations, which in the end is what matters. One of the main requirements is that gas cylinders should be transported in open vehicles, or, if that is not possible, only in a well ventilated vehicle. Small canisters obviously require much less ventilation than larger cylinders.

8.3 Liquid nitrogen

Under the Carriage Regulations, liquid nitrogen must only be transported in vessels which are suitable for this purpose. Open vessels are **not** suitable, because of the risk of splashing and spills. Equally, ordinary vacuum flasks ('thermos' flasks) are **not** suitable. 2 litres of liquid nitrogen will become 1366 litres of gaseous nitrogen. In an enclosed vessel this will give rise to a huge increase in pressure. Because liquid nitrogen is cold, it will condense any moisture in the atmosphere, possibly forming a water-ice plug which may seal an open vessel, causing the pressure to build up. To our knowledge this has caused at least two explosions in schools/colleges. Liquid nitrogen therefore must be transported, kept and used only in a vented Dewar flask, specially designed for cryogenic work with a pressure relief valve.

If liquid nitrogen is transported by road, the Carriage Regulations require that the driver shall have had special training. The BCGA Code of Practice CP30 The Safe Use of Liquid Nitrogen Dewars up to 50 litres¹² states that Dewars must be transported separately from driver or passengers. Flat-back pick-ups, or vehicles fitaraot5886 Tm rara. 5. (f

8.4 Radioactive materials

The legislation concerning the transportation of radioactive substances (UN Class 7, see Appendix 1.1) has now been merged with that discussed elsewhere in this document, ie the Carriage Regulations [ADR 1.6.6]. All the sources needed in the context of this document are likely to be regarded as an "Excepted Package" under the Regulations. Because the effective dose is so low and the quantities so small, no special driver training is required. Even so, the driver should be responsible for the safety and security of the sources throughout, ensuring that they are stored properly when they reach their destination.

Regulations require the package to retain its contents under conditions likely to be found in routine transport. Also, the dose rate at any point on the external surface of the package must not exceed a specified limit (5 $\mu\text{Sv/h}$). If the guidance in Appendix 3 is followed, these requirements will be met.

9 Summary of Options

This flow diagram summarises the options for transporting chemicals. It has been adapted, with permission, from a document produced by SSERC¹³.

For many substances, the classification is given in Appendix 2. For those not listed, the most accessible source of information is the (English-language) version of the (German) GESTIS Substances Database, <http://gestis-en.itrust.de/nxt/gateway.dll?f=templates&fn=default.htm&vid=gestiseng:sdbeng>. This is useful as it gives both the new GHS (CLP) hazard classification as well as the old CHIP classification, in addition to much other useful information.

¹³ SSERC, 2 Pitreavie Court, Pitreavie Business Park, Dunfermline, Fife. KY11 8UB. Tel: 01383 626070; fax: 01383 842793; web site: www.sserc.org.uk; e-mail: sts@sserc.org.uk. SSERC fulfils a similar role in Scotland to CLEAPSS in the rest of the UK.

Carriage of substances for personal use or transport which is ancillary to the main activity may be exempt from ADR. These options may often be unavailable. See sections 5.1 and 5.2 of this document.

If not for personal use nor ancillary to the main activity

Look up the chemical in alphabetical index of the Dangerous Goods List in Table B in ADR 3.2.2 and obtain its UN number. See Appendix 1.2 of this document.

Go to Dangerous Goods List in Table A in ADR 3.2.1 which contains chemicals in order of their UN number and consult column 7 ("*Limited quantities*"). See section 5.3 and Appendix 1.3 of this document.

If the entry in column 7 is zero

It will be exempt from the provisions of ADR provided:

- it is packed in "Limited quantities" with the quantities in table ADR 3.4.6 not being exceeded for both inner packaging and the outer package;
- the packaging is stout and suitable;
- the outer package is clearly labelled with the LQ diamond.

Other general legislation always applies, eg Health & Safety at Work Act, including the duty of care, COSHH Regulations, Management Regulations.

It is not exempted from most provisions even for small quantities, unless specifically stated elsewhere for that chemical. But it may still attract some exemptions via the "Small Load" exemptions. See section 5.4 of this document.

Appendix 1: Glossary

A1.3 Limited quantities

The coding system for the maximum size of the innermost packaging of different categories has been abolished in the current version of ADR. Instead, column 7(a) of Table A [ADR 3.2.1] now simply lists the maximum mass or volume for each substance. It can be 5 kg, 1 kg, 500g, 5 litres, 1 litre, 500 ml, 120 ml, 100 ml – or 0. Generally, demonstrators should easily be able to keep within the limited quantity amounts,

A1.6 Packing group

The Packing Group for a chemical indicates the degree of hazard associated with its transportation. The highest group is Group I (great danger); Group II is next (medium danger), while Group III chemicals present the lowest hazard (minor danger). The Transport Category is nearly always the same as the Packing Group but the Packing Groups are often shown on safety data sheets for chemicals under the heading "Transport Information". Some chemicals can be in different packing groups, depending on the nature of the packaging used. This can also affect the Transport Category and the LQ Category.

A1.7 Substances not accepted for carriage

Chemically-unstable substances in UN Class 5.1

"shall not be accepted for carriage unless the necessary steps have been taken to prevent their dangerous decomposition or polymerisation during carriage. To this end it shall in particular be assured that receptacles and tanks do not contain any material likely to promote these reactions" [ADR 2.2.51.2.1].

ADR specifically lists the following substances and mixtures, although some would be of little relevance in the context of this document. Note that where mixtures are referred to, the components could be transported separately and mixed on site.

- Oxidizing solids, self-heating, assigned to UN No. 3100; oxidizing solids, water-reactive, assigned to UN No. 3121; and oxidizing solids, flammable, assigned to UN No. 3137, unless they meet the requirements for Class 1 (see also ADR 2.1.3.7).
- Hydrogen peroxide, not stabilized or hydrogen peroxide, aqueous solutions, not stabilized containing more than 60% hydrogen peroxide.
- Tetranitromethane not free from combustible impurities.
- Perchloric acid solutions containing more than 72% (mass) acid, or mixtures of perchloric acid with any liquid other than water.
- Chloric acid solution containing more than 10% chloric acid or mixtures of chloric acid with any liquid other than water.
- Halogenated fluor compounds other than UN Nos. 1745 bromine pentafluoride, 1746 bromine trifluoride and 2495 iodine pentafluoride of class 5.1 as well as UN nos. 1749 chlorine trifluoride and 2548 chlorine pentafluoride of Class 2.
- Ammonium chlorate and its aqueous solutions and mixtures of a chlorate with an ammonium salt.
- Ammonium chlorite and its aqueous solutions and mixtures of a chlorite with an ammonium salt.
- Mixtures of a hypochlorite with an ammonium salt.
- Ammonium bromate and its aqueous solutions and mixtures of a bromate with an ammonium salt.
- Ammonium permanganate and its aqueous solutions and mixtures of a permanganate with an ammonium salt.
- Ammonium nitrate containing more than 0.2% combustible substances (including any organic substance calculated as carbon) unless it is a constituent of a substance or article of Class 1.
- Fertilizers having an ammonium nitrate content (in determining the ammonium nitrate content, all nitrate ions for which a molecular equivalent of ammonium ions is present in the mixture shall be calculated as ammonium nitrate) or a content in combustible substances exceeding the values specified in special provision 307 except under the conditions applicable to Class 1.
- Ammonium nitrite and its aqueous solutions and mixtures of an inorganic nitrite with an ammonium salt.
- Mixtures of potassium nitrate, sodium nitrite and an ammonium salt.



Maximum quantity carried	Name	UN number	LQ	Transport category	Packing group
1000 ml	Solution: 500 ml 0.1 M potassium iodide, 200 ml 0.01 M sodium thiosulfate, 30 ml 1% starch solution, 30 ml ethanoic acid (glacial), 4.1 g anhydrous sodium ethanoate, water to make up to 1000 ml.	-	not subject to ADR		
1000 ml	Solution: 4 g soluble starch, 13.7 g sodium metabisulfite, water to make up to 1000 ml.	-	not subject to ADR		
2000 ml	Solution: hydrogen peroxide (3%), hydrochloric acid (1 M)	-	not subject to ADR		
4000 ml	Solution: 30 ml ethanoic acid, 4.1 g sodium ethanoate, 50 g potassium iodide, 9.4 g sodium thiosulfate in 4 000 ml water.				
	sparklers (commercial) (but see section 8.1)	0333 to 0337	0	1, 2 or 4	-
0.2 g	starch	-	not subject to ADR		
20 ml	starch solution				
10 g	strontium chloride-6-water	-	not subject to ADR		
50 ml	strontium chloride in methanol				
10 g	strontium nitrate(V)-4-water	1507	5 kg	3	III
100 g	sucrose (sugar)	-	not subject to ADR		
200 g	sulfur	1350	5 kg	3	III
75 ml	sulfuric(VI) acid (conc.)	1830	1 litre	2	II
800 ml	sulfuric(VI) acid (2.5M)	2796	1 litre	2	II
250 g	superglue (methyl 2-cyanoacrylate)	-	not subject to ADR		
40 ml	tetrachloromethane	1846	100 ml	2	II
100 mg	thymolphthalein	-	not subject to ADR		
12 g	thyodene iodine indicator	-	not subject to ADR		
?	tonic water (commercial)	-	not subject to ADR		
20 g	turmeric	-	not subject to ADR		
250 ml	trichloromethane	1888	5 litre	2	III
500 ml	universal indicator solution	1170	1 litre, 5 litre	2, 3	II, III
?	vitamin C tablets	-	not subject to ADR		
50 ml	washing up liquid (commercial)	-	not subject to ADR		
50 g	yeast	-	not subject to ADR		
4 g	zinc powder	1436	0	(1, 2), 3	(I, II), III
20 g	zinc sulfate(VI)-7-water	3077	5 kg	3	III

Appendix 3: Radioactive materials

Strontium-90, plutonium-239 and americium-241 cup sources, in their normal containers, can be transported in any outer container.

Radium-226 and almost new cobalt-60 sources will require shielding to bring the surface dose rate below specified limits. This can be achieved by using a large cardboard box, packed with smaller boxes, such that the wooden source box is at least 15 cm from the surface of the outer box.

A uranium or thorium compound (in an appropriate container) must be carried inside a robust container, usually metal (eg, a tool box) such that damage is extremely unlikely in event of a road accident.

Transportation of radioactive material in solution should be restricted to a 30 ml protactinium generator. This should be kept upright and surrounded by a mineral absorbent (eg, cat litter) sufficient to absorb twice the volume of liquid in the container, in a sturdy, water-tight outer container, inside a strong plastic bag. This is tied and securely packed in robust containers, usually metal (eg, a tool box) such that damage is extremely unlikely in event of a road accident.

All packages should be loaded securely, as far as possible from the occupants, and out of sight, in the boot of the vehicle. The vehicle must be locked whenever it is left unattended.

There should be a regular check of the packages used for transport of radioactive material to confirm that they have not become contaminated. Records must be kept for at least two years.

No external signs are required on the vehicle.

The outside of an excepted package should show the United Nations (UN) number and the name and address of the consignor and consignee, as below.

Name of consignor: School address: Telephone:
Excepted package, UN Class: 7, UN Number: UN 2910

Name of consignor: School address: Telephone:
Excepted package, UN Class: 7, UN Number: UN 2911



The UN number is:

UN2910 for sealed sources, protactinium generators, uranium and thorium compounds, cloud chamber sources or radioactive substances.

UN2911 for 'instruments and articles', eg, spinthariscopes, expansion cloud chambers with non-detachable radioactive material, clocks or instruments with radioluminescent paint.

The package itself must be marked 'Radioactive', with the standard radioactivity warning symbol on the internal surface, in such a way that a warning of radioactive material is visible when the package is opened. Each item inside the package should be suitably labelled.

A transport document must be prepared, and taken by the driver. A copy should be kept at the school and the driver must take one with the package. The only information legally required is the name and address of the consignor and consignee, and the UN number. However, it is good practice to sign and date the document and give a brief description of the contents of the package. See below for an example of a suitable document.

