

**TRANSPORT, STORAGE AND HANDLING OF
BIOMASS DERIVED FAST PYROLYSIS LIQUIDS**

COMPLIANCE WITH ALL INTERNATIONAL MODES OF TRANSPORT

REPORT TO:

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SUMMARY

Biomass derived fast pyrolysis liquids are being researched, developed and produced for fuel applications in boilers, engines and turbines. As these developments proceed, liquids are increasingly being transported by air, water, rail and road. To this end, this report addresses the legislative requirements and regulations for the safe transport of pyrolysis liquids.

Pyrolysis liquids are not listed on the UN approved carriage list for dangerous or hazardous goods; however, there are several classifications for not otherwise specified [N.O.S.] classification which may be appropriate, depending on the composition and properties of the liquid. The four most appropriate N.O.S codes for biomass derived pyrolysis liquids are UN 1992, UN1993, UN2924 and UN3286, the selection of which depends on the three key properties: flash point, corrosivity and toxicity.

It is important that pyrolysis liquid producers utilise the code most appropriate to the properties of the liquids being shipped. Producers may therefore need to carry out extensive toxicological testing of the liquids to determine the exact nature of any hazard posed by the liquids, to shippers and end users.

If the properties of the liquids are not known, they will be treated in the class of highest risk, i.e. Group I or X, which will severely restrict the amount which can be transported by all modes. There are severe limitations on air transport of flammable liquids and only small samples are acceptable for both passenger and cargo aircraft.

Labelling and packaging are vital requirements of transportation of all quantities of pyrolysis liquids. Protocols for the labelling of packages and containers of all sizes are given with the aim of compliance with transport regulations world-wide. In conjunction with the requirements for packaging and labelling, guidance on the details to be enclosed on the transportation documents are given. Guidance on the handling of pyrolysis liquids and storage are given and preliminary procedures for the treatment of spills.

Further work is required to determine procedures for dealing with spills and how spill areas can be remediated, in particular, by inoculation with suitable bacteria to degrade the liquids. Detailed toxicological data on the exposure levels to the liquids also needs to be researched. Further work on the variety of properties of slow, fast pyrolysis and derivatives of liquids is required. Experiences from commercial producers needs to be assessed and incorporated into MSDS.

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1. INTRODUCTION

Pyrolysis liquids are now being actively produced for research, testing and evaluation purposes, for use as a chemical feedstock, source of individual chemicals and as an alternative fuel for use in boilers, engines and turbines.

As pyrolysis technologies advance and utilisation of the liquids increases, there will be a greater demand for the transportation of the liquids, by all possible routes – air, road, rail and water, or a combination of routes. To ensure that the liquids are transported in a safe and environmentally secure manner, all due care and attention must be taken to ensure that the appropriate national and international regulations pertaining to the transport of the pyrolysis liquids are met. To this end, it is likely that pyrolysis liquids will be classed as "dangerous" or a "hazardous" substance for transportation purposes.

The tasks, which CARE Ltd. would carry out, were:

- Derive an appropriate transportation code for pyrolysis liquids,
- Derive procedures for the treatment of spills [small and large],
- Produce a guide for the preparation of samples for shipment from a few grams to tonnes, with protocols for labelling, packaging and shipment.

The structure of the report to fulfil these tasks is:

- | | |
|---|-----------|
| • International regulations on transport | Section 2 |
| • Properties of pyrolysis liquids and UN classification | Section 3 |
| • Packaging and labelling protocols | Section 4 |
| • Handling and storage of pyrolysis liquids | Section 5 |
| • Treatment of spills | Section 6 |

The Department of Transport, Environment and Regions [Transport of Dangerous Goods Division] and the UK Health and Safety Executive had previously been consulted initially to discuss the classification of liquids for transportation purposes. (1). Based on discussions with these organisations, their opinion was that pyrolysis liquids would be classed as a "dangerous good" [or hazardous material], due to the chemical composition and its flammable properties.

The biomass pyrolysis community may feel that the classification of pyrolysis liquids as "dangerous" material does not reflect the true nature of the liquids. However, due to the variability of liquids produced by different processes, using variable feedstocks, the chemical composition of the liquids is variable and physical properties are significantly different. This variability in properties has been taken into account in classifying the liquids. This report focuses on whole fast pyrolysis liquids and not derived fractions or products thereof. Treated liquids, e.g. hydrotreated, fractionated, etc. or liquids produced in other pyrolysis processes may require a separate classification, which is outside the scope of this work.

2. INTERNATIONAL REGULATIONS ON THE TRANSPORTATION OF DANGEROUS GOODS

The scope of this legislative review pertains to the transport of goods in the EU for all modes. This report cannot cover all the national regulations in force, however, most national transportation regulation are based on, or use the UN Regulations, as described below [see Section 2.1].

2.1 Role of the United Nations

The international agreement on which all other dangerous goods controls are grounded is the United Nations Recommendations on the Transport of Dangerous Goods (UNRTDG, known as the "Orange Book") (2). There is a number of other agreements dealing specifically with the carriage of dangerous goods, as well as agreements (covering other matters) that touch on dangerous goods.

These Recommendations, prepared by the United Nations Economic and Social Council, were first published in 1956, and set out recommendations for the classification and labelling dangerous goods and requirements for packaging, tanks and containers. Although they have no legal force in themselves, they present a basic scheme of provisions that allows uniform development of national and international regulations. Only when the Recommendations are adopted into modal (mode-specific) agreements or domestic legislation do they have any legal force. Modal agreements and domestic legislation can go further than UNRTDG, by including additional mode-specific and domestic requirements.

The United Nations Manual of Tests and Criteria (UNMTC) sets out appropriate test methods and criteria to assist national competent authorities and consignors to reach accurate classifications of dangerous goods. It does not set out any duties, merely technical information on testing, the results of which aid determination of correct classifications. As with UNRTDG, the UNMTC only gains legal force through being referred to by modal agreements and domestic legislation.

International work on the Transport of Dangerous Goods is focused on the United Nations Committee of Experts and various ad hoc specialist groups. The way in which the Departmental specialists with safety responsibilities for different modes of transport link in with those UN groups is described in the appropriate sections below.

2.2 Carriage by Road

Europe is unique as being the only region of the world to be regulated for the carriage of dangerous goods by road internationally as well as nationally. This applies not only within the European Union but also to a total of 39 European (and adjoining) countries. The current Contracting Parties to the Agreement are: Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Morocco, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, the former Yugoslav Republic of Macedonia, Serbia and Montenegro, and the United Kingdom.

Regulation is via the European Agreement Concerning the International Carriage of Dangerous Goods by Road, which was drawn up by the United Nations Economic Commission for Europe (UNECE) in Geneva. It is more commonly known as "ADR" (from Accord Européen Relatif au Transport International des Marchandises Dangereuses par Route). International carriage by road between non-ADR signatories would mean compliance with the individual domestic requirements.

The provisions of ADR set out how producers/consignors and carriers should classify, package, label and transport dangerous goods (3). Also included are specific vehicle and tank requirements and various other operational requirements such as driver training. A body of international experts, known as WP.15, meets twice a year at the UN in Geneva to discuss and update these regulations. ADR is updated every two years: the current version is 2005.

2.3 Carriage by Rail

The international carriage of dangerous goods by rail within Europe is governed by Annex I of the Convention concerning International Carriage by Rail (COTIF, from Convention de l'Organisation Intergouvernementale pour les Transports Internationaux Ferroviaires). The Contracting Parties to the Convention are as for ADR; with the addition of Albania, Algeria, Iraq, Iran, Republic of Ireland, Lebanon, Monaco, Syria, Tunisia, and Turkey; and with the omission of Azerbaijan, Belarus, Estonia, Kazakhstan, Republic of Moldova, Russian Federation, and Ukraine. Annex I is the Regulations Concerning the International Carriage of Dangerous Goods by Rail. It is more commonly known as "RID" (from Règlement Concernant le Transport International Ferroviaire des Marchandises Dangereuses). It is published by OCTI (the Central Office for International Carriage by Rail, or Office Central des Transports Internationaux Ferroviaires), and updated every two years (current version 2005). Any amendments to the Regulations are discussed and agreed by the RID Committee of Experts (sometimes known as the Fachausschuss, from its German name). An unofficial DfT English translation of RID (English is not one of the official languages of RID) is available (4).

2.4 Harmonisation of ADR and RID, and Multilateral Agreements (MAs)

For many years efforts have been made to harmonise the provisions of ADR and RID with each other, and to align these regulations with the main provisions of the International Maritime Dangerous Goods [IMDG] Code for sea transport, which are based on the UN Model Regulations. The task of updating and harmonising the regulations is a continuing one. New developments in both products and transport may require amendments, some of which may be less easily applied to one transport mode than to another. There is growing international awareness of a need to avoid new differences arising in these requirements and to continue to seek means of removing those that remain.

The purpose of the ADR MAs is to allow a temporary derogation of up to 5 years from the provisions of ADR. In other words, carriers or consignors may follow the specifications set out in the MA rather than in the corresponding text of ADR. A MA may also be appropriate in situations where WP.15 has agreed but not yet formally adopted changes, which countries may wish to implement more quickly. Carriage of

dangerous goods under the terms of a MA can only be undertaken between and on the territory of those Contracting Parties that have countersigned the Agreement.

The procedures for RID MAs are broadly similar to those for ADR, and likewise the purpose of an Agreement is to allow a temporary derogation from the regulations of up to five years. MAs are downloadable from the UNECE website.

2.5 The European Union

The European Parliament has, on a number of occasions, considered reports concerning the transport of dangerous goods. The European Commission in response produced a detailed report in 1987 identifying a number of areas where they felt Directives might be appropriate. Two of the most important are:

- EC Directive 94/55/EC required Member States to align their domestic legislation concerning the transport of dangerous goods by road with ADR from 1 January 1997.
- EC Directive 96/49/EC required Member States to align their domestic legislation concerning the transport of dangerous goods by rail with RID from 1 January 1997.

Other Directives are issued to reflect, for example, safety provisions for transportable pressure equipment.

ECE subsidiary bodies deal with the transport of dangerous goods. These bodies are subsidiary bodies of the Inland Transport Committee, and therefore they are concerned only with inland transport, i.e. road, rail and inland waterway. These bodies are The Working Party on the Transport of Dangerous Goods [known as WP.15], which is responsible for:

- The European Agreement concerning the International Carriage of Dangerous Goods by Road [ADR] and;
- The European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterways [ADN] and;
- The Joint Meeting of the Working Party on the Transport of Dangerous Goods and the RID Safety Committee also called the RID/ADR/ADN Joint Meeting.

The RID/ADR/ADN Joint Meeting is serviced jointly by the ECE secretariat and the secretariat of the Intergovernmental Organisation for International Carriage by Rail [OTIF]; it is responsible for ensuring harmonisation between ADR, RID [Regulations concerning the international carriage of dangerous goods by rail) and ADN.

2.6 Transport by Inland Waterway

A UN specialist working party is developing rules for the international traffic of dangerous goods by inland waterway (ADN, from Accord Européen Relative au Transport International des Marchandises Dangereuses par Voies de Navigation Intérieures). The European Commission has proposed an ADN Framework Directive to enter into force once ADN is adopted (5).

2.7 Transport by Sea

143 countries are party to the International Maritime Organisation's (IMO) Maritime Safety Convention (Safety of Life at Sea SOLAS) 1974, and 103 parties to the Convention on Maritime Pollution (MARPOL). The principal international rules for the carriage of packaged dangerous goods by sea are published in the International Maritime Dangerous Goods (IMDG) Code which closely reflects the UN Model Regulations (6). The momentum for developing and up-dating the IMDG Code arises from the international seafaring community, maritime trading interests and governments of maritime nations. Amendments to the IMDG Code are the responsibility of IMO sub-committees. The carriage of goods in bulk in ships is covered by separate codes such as the International Bulk Chemical Code and the International Gas Carrier Code. These Codes are developed outside the UN Recommendations and International Atomic Energy Authority (IAEA) requirements.

2.8 Transport by Air

Until 1983 the carriage of dangerous goods by air was subject to the Restricted Articles Regulations of the International Air Transport Association (IATA), which was a system operated on airlines, largely based on domestic practice in the USA. In response to a need expressed by Contracting States of the International Civil Aviation Organisation (ICAO) for an internationally agreed set of provisions governing the safe transport of dangerous goods by air, Annex 18 to the Convention on International Civil Aviation was developed. The Annex became applicable on 1 January 1984. Its broad provisions are amplified by the detailed specifications of ICAO's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO Technical Instructions), which are closely aligned with the UN Model Regulations.

The ICAO Technical Instructions cover the following: classification of substances and articles; their packing (including specifications and tests for packaging); the marking and labelling of packages; the documentation of consignments; the acceptance procedures to be used by air operators (including the inspection of packages for leakage or damage) and the loading of dangerous goods on aircraft and the training of personnel involved in the transport of dangerous goods by air (7).

The Dangerous Goods Panel of ICAO recommends to the ICAO Air Navigation Commission (ANC) what amendments to the Technical Instructions are required. The ANC, in turn, recommends the changes to the Council, which gives approval to the publication of revised Instructions. They are published every two years. Any country which is a Contracting State of ICAO, is required to take the necessary measures to achieve compliance with the ICAO Technical Instructions. It should also be noted that airline operators also require compliance with their own IATA 'Dangerous Goods Regulations'.

2.9 Note on Transport Regulations

It should be noted that the requirements of Annexes A and B of ADR have been annexed to the European Union Council Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods, and

therefore these requirements have become applicable not only to international transport of dangerous goods but also to domestic traffic in all countries of the European Union as from 1 January 1997 (8, 9). It is therefore incumbent on those transporting pyrolysis liquids to ensure compliance with the UN Regulations, ADR, RID and ADN. In North America, in particular the USA, there is still usage of older codes and frequently containers may have "NA" [North America] rather than "UN" on the packages.

Within the context of the contract, the legal requirements of consignors, and transportation companies were not covered. Consignors and transportation companies must comply with an extensive set of codes, guides, regulations that are beyond the scope of this work.

2.10 How To Use This Guide

If the liquids are to be shipped by one mode of transport, then the user is recommended to use the appropriate Annex as indicated. Due to harmonisation between RID/ADN/ADR, then if the shipment is to go by several modes of transport a multimodal transport form can be used, which is supplied by the shipping company. Following on from the selection of package for the liquids, then the choice of labels and their requirements are specified in Sections 4 and 5.

3. PROPERTIES OF PYROLYSIS LIQUIDS AND UN CLASSIFICATION

The nature of pyrolysis liquids means that there is no "generic" analyses to cover the wide spectrum of liquids producible from biomass. In the UN or EU regulations, there is no classification for pyrolysis liquids or its derivatives, fractions or by-products. It is assumed in the course of this work that the liquids to be transported are all derived from fast pyrolysis processes.

As noted in Section 2, a submission to the EU to have pyrolysis liquids listed in ADR, RID and ADN could take several years, therefore a self assessment of the substance must be made, using the methods described in the UN Model Regulations (2). It is also likely that the outcome of a submission would be that pyrolysis liquids would be classed as a "dangerous substance" or "hazardous material" due to its flammability and the fact that very limited toxicological data exists for the liquids and the highly variable nature of their composition and physical properties. The assessment of a substance as a dangerous good considers the chemical and physical properties of pyrolysis liquids are summarised below.

3.1 Physical Properties of Pyrolysis Liquids

Specific physical properties, if not known, can be determined to UN test methods (10) and also to any method given for each transportation guide, although the trend is now that each transportation method is adopting the UN methods to ensure compatibility and compliance for goods which may be subject to several modes of transportation.

As pyrolysis liquids are not listed as a substance in their own right in the UN Regulations, the liquids can be categorised with a N.O.S. classification. The physical properties of the fast pyrolysis liquids used are given in Table 1, based upon typical values in the literature [see Appendix I for references used]. Detailed chemical analysis is required as discussed in Section 3.2 below.

Table 1: Applicable physical properties of fast pyrolysis liquids (11)

<u>Physical property</u>	<u>Fast pyrolysis liquid</u>
Moisture content	~20-40wt%
pH	~2-3
Specific gravity	~1.2
Dynamic Viscosity [cp @ 40°C]	~50 cp
Kinematic viscosity [cSt]	20-1000 @ 25°C 15-500 @ 40°C
Flash point [°C]	50-70
Pour point [°C]	-23

From these properties, pyrolysis liquids may be generally classed a Class 3 substance- Flammable Liquid. The exact specification is then related to its chemical composition to determine its level of hazard, as described in Section 3.2.

3.2 Chemical composition of biomass fast pyrolysis liquids

There are numerous references in the literature with chemical analyses of pyrolysis liquids from a variety of sources, including slow pyrolysis tars (12), fast pyrolysis liquids (13) and fractions of the liquids (14). As fast pyrolysis liquids may be raw, treated, filtered, and derived from a variety of biomass feedstocks, a "worst case" must be taken for the liquids composition, i.e. high chemical variability and significant levels of harmful chemicals. The classes of compounds which those found in fast pyrolysis liquids in the UN Manual are mainly in Class 3, but some are also Class 6.1 – Toxic substances [phenols, etc.] which are in concentrations > 0.1 wt%. Detailed GC-MS analysis of the Biotox liquids were made by IWC-BFH and are given in Annex XIII of the first progress report.

Due to the presence of Class 6.1 compounds in concentrations greater than 0.1 wt%, pyrolysis liquids are classed as 3(a) overall classification, using a cross classification to derive the most appropriate classification for complex mixtures. If the concentration of acetic acid is below 10wt%, there is no need to add additional labelling to highlight corrosiveness in the liquids. Each pyrolysis liquid needs therefore to be analysed by the producer and its class determined. As noted, if a "worst case" is assumed, then the producer could ship all liquids as Class 3(a), but the limitations on the transport of significant quantities of this class of liquids are severe. Using the chemical and physical data, further requirements relating to the hazard level posed by the liquids can be assessed and these are presented in Appendices II and III and are discussed later.

3.3 Toxicology of Pyrolysis Liquids – BIOTOX

As this part of the work is dependent on the testwork done with the BIOTOX contract, the main conclusions concerning the toxicity of the pyrolysis liquids are:

- The Algal growth inhibition tests reveal that bio-oils don't inhibit and don't influence the growth rate of algae (ErL50 > 1200mg/L loading rate). Concerning the growth inhibition (EbL50) pyrolysis oils appeared to have an atypical behaviour: in most cases with low concentrations pyrolysis oils increase the algae growth and with high concentrations they have an inhibiting effect on the algae growth. Further tests are on going in order to assess if the inhibition effect at high concentration is due to light absorption (necessary for algae growth) or/and to a toxicological effect.
- The acute toxicity tests on *Daphnia magna* did not show immobilisation of the animals after 48 hours at the highest loading rate.
- The final test results of the geno-toxicological tests revealed that according to the production parameters all pyrolysis liquids tested are mutagenic, at high dosage levels of 5000 µg. Temperature appeared to be the most important parameters influencing the mutagenicity of bio-oils.

Unfortunately, no LD₅₀ data has been obtained during the project to assess exactly which packing group(s) pyrolysis liquids should be characterised by, so all three packing groups are presented for each UN N.O.S. classification in this report. The fact that pyrolysis liquids are mutagenic would probably lead to a Group I or II

packing classification, depending on the LD₅₀ dose rate. To date, this data does not exist.

3.4 UN Code(s) for Pyrolysis Liquids

The only other assessment of the transportation requirements for fast pyrolysis liquids was a report produced by Conversion And Resource Evaluation Ltd. in 1999 for the IEA pyrolysis activity, a summary of the results were published (15). Since that time, and utilising the results from the Biotox contract, the classification of fast pyrolysis liquids was re-assessed using the most current model regulations from the UN and then slight variations in the nature of packaging and classification were assessed with the regulations for each transport mode.

This report is written with the aim of assisting competent authorities specify the correct limits and packing methods for shipment by all modes. It is therefore aimed primarily at producers who are not experienced in shipping liquids, but need to provide sufficient information to competent authorities that liquids can be safely shipped. In some cases, the producer may also need specific training for preparation of some shipments, notably by air or sea. Guidance on the testing of packages and training are provided in the model regulations for each mode of transport and are beyond the scope of this work.

3.5 UN Classification of pyrolysis liquids

Based on the physical properties noted above in Sections 3.1-3.3, pyrolysis liquids will be categorised as Class 3 – flammable liquids. From the UN Model Regulations [13th Edition] (2), a flammable liquid is defined as:

"Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or not more than 65.6°C, open-cup test, normally referred to as the flash point.

This class also includes:

- (a) Liquids offered for transport at temperatures at or above their flash point; and
- (b) Substances that are transported or offered for transport at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum transport temperature.

NOTE: Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition."

The issue of the flammability of pyrolysis liquids has been subject to some debate, as the presence of water in the liquids can cause the ignition of the liquids to be delayed and in some cases, extinguish the flame. However, determined values by modified methods have shown that the liquids are flammable in the range of ~ 40-70°C, thus rendering them subject to the dangerous goods regulations. In some cases, the producer may be able to justify a case where the liquids are not subject to dangerous goods requirements for shipment, i.e.:

"Liquids meeting the definition in 2.3.1.2 (2) with a flash point of more than 35°C which do not sustain combustion need not be considered as flammable liquids for the purposes of these Regulations. Liquids are considered to be unable to sustain combustion for the purposes of these Regulations (i.e. they do not sustain combustion under defined test conditions) if:

- (a) They have passed a suitable combustibility test (see SUSTAINED COMBUSTIBILITY TEST prescribed in the Manual of Tests and Criteria, Part III, sub-section 3.2.5.2;
- (b) Their fire point according to ISO 2592:2000 is greater than 100°C;
or
- (c) They are water miscible solutions with a water content of more than 90% by mass."

If the liquids do not fall within Class 3 – Flammable Liquids, they may however, be subject to Class 6- Toxic substances or Class 8 – Corrosive as noted above. The exact nature of the chemical composition and the toxicity of the liquids will determine the applicable classes and subsidiary classes, which are applicable. The four closest not otherwise specified [N.O.S.] classifications that fit pyrolysis liquids are given in Table 2 overleaf. The definition of each code in the table follows the Table and a similar format is used for all the other modes of transport. With the drive to harmonise the regulations for each transport code, the general headings are the same, however each mode of transport also has its specific requirements.

For each mode of transport, reference to any sections made is for the regulations pertaining to that shipping mode, not the UN regulations. Where appropriate, the section referred to in the regulations is quoted or paraphrased.

Table 2. UN NOS Classifications applicable to pyrolysis liquids

UN No.	Name and Description	Class or Division	Subsidiary Risk	UN Packing Group	Special Provisions	Limited Quantities	Packaging and IBCS		Portable Tanks and Bulk Containers	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	6.1	I	274	None	P001		T14	TP2 TP6 TP13
	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	6.1	II	274	1 L	P001 IBC02		T7	TP2 TP13
	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	6.1	III	223 274	5 L	P001 IBC03		T7	TP1 TP28
1993	FLAMMABLE LIQUID, N.O.S.	3		I	274	None	P001		T11	TP1 TP9 TP27
	FLAMMABLE LIQUID, N.O.S.	3		II	274	1 L	P001 IBC02		T7	TP1 TP8 TP28
	FLAMMABLE LIQUID, N.O.S.	3		III	223 274	5 L	P001 IBC03 LP01		T4	TP1 TP29
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	8	I	274	NONE	P001		T7	TP1 TP28
	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	8	II	274	1 L	P001 IBC002		T11	TP2 TP27
	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	8	III	223 274	5 L	P001 IBC03		T7	TP1 TP28
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE N.O.S.	3	6.1 + 8	I	274	NONE	P001		T14	TP2 TP9 TP13 TP27
	FLAMMABLE LIQUID, TOXIC, CORROSIVE N.O.S.	3	6.1 + 8	II	274	1 L	P001 IBC99		T11	TP2 TP13 TP27

3.6 Interpretation of the Un Regulations and application to pyrolysis liquids

The Dangerous Goods List is divided into 11 columns and the definition and interpretation of these is given in Table 3, Table 4 and Table 5.

Table 3. Structure of the UN Dangerous Goods List

UN code	Description and/or interpretation
Column (1) "UN No."	This column contains the serial number assigned to the article or substance under the United Nations system.
Column 2 "Name and description"	This column contains the proper shipping names in uppercase characters, which may be followed by additional descriptive text presented in lowercase characters (see 3.1.2). An explanation of some of the terms used appears in Appendix B. Proper shipping names may be shown in the plural where isomers of similar classification exist. Hydrates may be included under the proper shipping name for the anhydrous substance, as appropriate. Unless otherwise indicated for an entry in the dangerous goods list, the word "solution" in a proper shipping name means one or more named dangerous goods dissolved in a liquid that is not otherwise subject to these Regulations.
Column 3 "Class or division"	This column contains the class or division and in the case of Class 1, the compatibility group assigned to the article or substance according to the classification system described in Chapter 2.1.
Column 4 "Subsidiary risk"	This column contains the class or division number of any important subsidiary risks which have been identified by applying the classification system described in Part 2.
Column 5 "UN packing group"	This column contains the UN packing group number (i.e. I, II or III) assigned to the article or substance. If more than one packing group is indicated for the entry, the packing group of the substance or formulation to be transported shall be determined, based on its properties, through application of the hazard grouping criteria as provided in Part 2.
Column 6 "Special provisions"	This column contains a number referring to any special provision(s) indicated in 3.3.1 that are relevant to the article or substance. Special provisions apply to all the packing groups permitted for a particular substance or article unless the wording makes it otherwise apparent.
Column 7 "Limited quantities"	This column provides the maximum quantity per inner packaging authorized for transport of the substance concerned according to the provisions for limited quantities in Chapter 3.4. The word "None" in this column means that the article or substance is not permitted to be transported under the provisions of Chapter 3.4.
Column 8 "Packing instruction"	This column contains alpha numeric codes which refer to the relevant packing instructions specified in section 4.1.4. The packing instructions indicate the packaging (including IBCs and large packagings), which may be used for the transport of substances and articles. • A code including the letter "P" refers to packing instructions for the use of packagings described in Chapters 6.1, 6.2 or 6.3. • A code including the letters "IBC" refers to packing instructions for the use of IBCs described in Chapter 6.5. • A code including the letters "LP" refers to packing instructions for the use of large packagings described in Chapter 6.6. When a particular code is not provided, it means the substance is not authorized in the type of packaging that may be used according to the packing instructions bearing that code. When N/A is included in the column it means that the substance or article need not be packaged. • The packing instructions are listed in numerical order in section 4.1.4 as follows: • Sub-section 4.1.4.1: Packing instructions concerning the use of

	packagings (except IBCs and large packagings) (P); • Sub-section 4.1.4.2: Packing instructions concerning the use of IBCs (IBC); • Sub-section 4.1.4.3: Packing instructions concerning the use of large packagings (LP).
Column 9 "Special packing provisions"	This column contains alpha numeric codes which refer to the relevant special packing provisions specified in section 4.1.4. The special packing provisions indicate the special provisions for packaging (including IBCs and large packagings). • A special packing provision including the letters "PP" refers to special packing provision applicable to the use of packing instructions bearing the Code "P" in 4.1.4.1. • A special packing provision including the letter "B" refers to special packing provision applicable to the use of packing instructions bearing the code "IBC" in 4.1.4.2. • A special provision including the letter "L" refers to special packing provision applicable to packing instructions bearing the code "LP" in 4.1.4.3.
Column 10 "Portable tank and bulk containers/Instructions"	This column contains a number preceded by the letter "T" which refers to the relevant instruction in 4.2.5 specifying the tank type(s) required for the transport of the substance in portable tanks. A code including the letters "BK" refers to types of bulk containers used for the transport of bulk goods described in Chapter 6.8.
Column 11 " Portable tank and bulk containers/Special provisions"	This column contains a number preceded by the letters "TP" referring to any special provisions indicated in 4.2.5.3 that apply to the transport of the substance in portable tanks.

The following abbreviations or symbols are used in the Dangerous Goods List and have the meanings shown in Table 4.

Table 4. Abbreviations used in UN transportation guidance

Abbreviation	Column	Meaning
N.O.S.	2	Not otherwise specified.

For Columns 6-11, further explanation is given below in Section 3.6.1 for those codes applicable to pyrolysis liquids.

3.6.1 UN Special Provisions

The explanation for the codes in Table 2 are given in Table 5 overleaf.

Table 5. Codes for Portable tanks and Containers

Code	Description
223	If the chemical or physical properties of a substance covered by this description are such that when tested it does not meet the established defining criteria for the class or division listed in column (3), or any other class or division, it is not subject to these Regulations.
274	For the purposes of documentation and package marking, the proper shipping name shall be supplemented with the technical name (see 3.1.2.8). 3.1.2.8 Generic or "not otherwise specified" (N.O.S.) names 3.1.2.8.1 Generic and "not otherwise specified" proper shipping names that are assigned to special provision 274 in Column 6 of the Dangerous Goods List shall be supplemented with the technical or chemical group names unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of Class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical and chemical group names shall be entered in brackets immediately following the proper shipping name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc. and the percentage of the technical constituent may also be used. For example: "UN 1993 Flammable liquid, n.o.s. (contains acetic acid), 3, PG II". 3.1.2.8.1.1 The technical name shall be a recognized chemical or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the World Health Organisation (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used. 3.1.2.8.1.2 When a mixture of dangerous goods is described by one of the "N.O.S." or "generic" entries to which special provision 274 has been allocated in the Dangerous Goods List, not more than the two constituents which most predominantly contribute to the hazard or hazards of a mixture need to be shown, excluding controlled substances when their disclosure is prohibited by national law or international convention. If a package containing a mixture is labelled with any subsidiary risk label, one of the two technical names shown in brackets shall be the name of the constituent which compels the use of the subsidiary risk label.

3.6.2 UN Limited Quantities

For limited quantities, if "NONE" is written, then this class of liquid is not permitted for transport. All other values are given with the appropriate units.

3.6.3 UN Packaging and IBCs

The requirements indicated for packaging and IBCs is given below in Table 6.

Table 6. Packing instructions for IBCs [IBC02,03, 99]

IBC02	PACKING INSTRUCTION	IBC02
The following IBCs are authorized, provided the general provisions of 4.1.1, 4.1.2 and 4.1.3 are met:		
(1) Metal (31A, 31B and 31N);		
(2) Rigid plastics (31H1 and 31H2);		
(3) Composite (31HZ1).		
Additional requirement:		
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.		
Special packing provisions:		
B5	For UN Nos. 1791, 2014 and 3149, IBCs shall be provided with a device to allow venting during transport. The inlet to the venting device shall be sited in the vapour space of the IBC under maximum filling conditions during transport.	
B7	For UN Nos. 1222 and 1865, IBCs with a capacity greater than 450 litres are not permitted due to the substance's potential for explosion when transported in large volumes.	
B8	The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.	
IBC03	PACKING INSTRUCTION	IBC03
The following IBCs are authorized, provided the general provisions of 4.1.1, 4.1.2 and 4.1.3 are met:		
(1) Metal (31A, 31B and 31N);		
(2) Rigid plastics (31H1 and 31H2);		
(3) Composite (31HZ1 and 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2).		
Additional requirement:		
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized, other than UN 2672 (See B11).		
Special packing provision:		
B8	The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.	
B11	UN 2672 ammonia solution in concentrations not exceeding 25% may be transported in rigid or composite plastics IBCs (31H1, 31H2 and 31HZ1).	
IBC99	PACKING INSTRUCTION	IBC99
Only IBCs which are approved by the competent authority may be used (see 4.1.3.7).		

P001 PACKING INSTRUCTION (LIQUIDS) (cont'd)		P001	
		Maximum capacity/Net mass (see 4.1.3.3.)	
Single packagings (cont'd)	Packing group I	Packing group II	Packing group III
Jerricans			
steel, non-removable head (3A1)	60 l	60 l	60 l
steel, removable head (3A2)	60 l ^a	60 l	60 l
aluminium, non-removable head (3B1)	60 l	60 l	60 l
aluminium, removable head (3B2)	60 l ^a	60 l	60 l
plastics, non-removable head (3H1)	60 l	60 l	60 l
plastics, removable head (3H2)	60 l ^a	60 l	60 l
Composite packagings			
plastics receptacle in steel or aluminium drum (6HA1, 6HB1)	250 l	250 l	250 l
plastics receptacle in fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)	120 l	250 l	250 l
plastics receptacle in steel or aluminium crate or box or plastic receptacle in wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)	60 l	60 l	60 l
glass receptacle in steel, aluminium, fibre, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or in steel, aluminium, wooden or fibreboard box or in a wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)	60 l	60 l	60 l

P001		PACKING INSTRUCTION (LIQUIDS)			P001
The following packagings are authorized provided the general provisions of 4.1.1 and 4.1.3 are met:					
Combination packagings		Maximum capacity/Net mass (see 4.1.3.3)			
Inner packagings	Outer packagings	Packing group I	Packing group II	Packing group III	
Glass 10 l	Drums steel (1A2) aluminium (1B2) other metal (1N2) plastics (1H2) plywood (1D) fibre (1G) Boxes steel (4A) aluminium (4B) natural wood (4C1, 4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) expanded plastics (4H1) solid plastics (4H2) Jerricans steel (3A2) aluminium (3B2) plastics (3H2)	250 kg	400 kg	400 kg	
Plastics 30 l		250 kg	400 kg	400 kg	
Metal 40 l		250 kg	400 kg	400 kg	
		250 kg	400 kg	400 kg	
		250 kg	400 kg	400 kg	
		150 kg	400 kg	400 kg	
		75 kg	400 kg	400 kg	
		250 kg	400 kg	400 kg	
		250 kg	400 kg	400 kg	
		150 kg	400 kg	400 kg	
		150 kg	400 kg	400 kg	
		75 kg	400 kg	400 kg	
		75 kg	400 kg	400 kg	
		60 kg	60 kg	60 kg	
		150 kg	400 kg	400 kg	
		120 kg	120 kg	120 kg	
		120 kg	120 kg	120 kg	
		120 kg	120 kg	120 kg	
Single packagings					
Drums					
steel, non-removable head (1A1)		250 l	450 l	450 l	
steel, removable head (1A2)		250 l*	450 l	450 l	
aluminium, non-removable head (1B1)		250 l	450 l	450 l	
aluminium, removable head (1B2)		250 l*	450 l	450 l	
other metal, non-removable head (1N1)		250 l	450 l	450 l	
other metal, removable head (1N2)		250 l*	450 l	450 l	
plastics, non-removable head (1H1)		250 l	450 l	450 l	
plastics, removable head (1H2)		250 l*	450 l	450 l	

^a Only substances with a viscosity more than 200 mm²/s are permitted.

LP01	PACKING INSTRUCTION (LIQUIDS)				LP01
The following large packagings are authorized provided the general provision of 4.1.1 and 4.1.3 are met:					
Inner packagings		Large outer packagings	Packing group I	Packing group II	Packing group III
Glass 10 litre Plastics 30 litre Metal 40 litre		steel (50A) aluminium (50B) metal other than steel or aluminium (50N) rigid plastics (50H) natural wood (50C) plywood (50D) reconstituted wood (50F) rigid fibreboard (50G)	Not allowed	Not allowed	Maximum capacity: 3 m ³

3.6.4 UN Portable tank and bulk container instructions

The instructions pertaining to portable tanks are given in Table 7.

Table 7. Portable Tank Instructions

PORTABLE TANK INSTRUCTIONS				
<i>These portable tank instructions apply to liquid and solid substances of Classes 3 to 9. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met.</i>				
Portable tank instruction	Minimum test pressure (bar)	Minimum shell thickness (in mm reference steel) (see 6.7.2.4)	Pressure-relief requirements^a (see 6.7.2.8)	Bottom opening requirements (see 6.7.2.6)
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T14	6	6mm	See 6.7.2.8.3	Not allowed

Notes referred to in Table 7 and detailed in Table 8.

Table 8. UN Code Explanation for Table 7

Note number	Description
6.7.2.4.2	The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of Packing Group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.
6.7.2.6.3	Every bottom discharge outlet, except as provided in 6.7.2.6.2, shall be equipped with three serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and include: (a) A self-closing internal stop-valve, that is a stop-valve within the shell or within a welded flange or its companion flange, such that: (i) The control devices for the operation of the valve are designed so as to prevent any unintended opening through impact or other inadvertent act; (ii) The valve may be operable from above or below; (iii) If possible, the setting of the valve (open or closed) shall be capable of being verified from the ground; (iv) Except for portable tanks having a capacity of not more than 1,000 litres, it shall be possible to close the valve from an accessible position of the portable tank that is remote from the valve itself; and (v) The valve shall continue to be effective in the event of damage to the external device for controlling the operation of the valve; (b) An external stop-valve fitted as close to the shell as reasonably practicable; and (c) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.

6.7.2.8.3	When required for certain substances by the applicable portable tank instruction identified in Column 10 of the Dangerous Goods List and described in 4.2.5.2.6, portable tanks shall have a pressure-relief device approved by the competent authority. Unless a portable tank in dedicated service is fitted with an approved relief device constructed of materials compatible with the load, the relief device shall comprise a frangible disc preceding a spring-loaded pressure-relief device. When a frangible disc is inserted in series with the required pressure-relief device, the space between the frangible disc and the pressure-relief device shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure-relief system. The frangible disc shall rupture at a nominal pressure 10% above the start to discharge pressure of the relief device.
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Portable tank special provisions are assigned to certain substances to indicate provisions which are in addition to or in lieu of those provided by the portable tank instructions or the requirements in Chapter 6.7. Portable tank special provisions are identified by an alphanumeric designation beginning with the letters "TP" (tank provision) and are assigned to specific substances in Column 11 of the Dangerous Goods List in Chapter 3.2. The following is a list of the portable tank special provisions applicable to pyrolysis liquid as given in Table 9.

Table 9. UN TP code descriptions

Code	Description
TP1	The degree of filling prescribed in 4.2.1.9.2 shall not be exceeded $\text{Degree of filling} = \frac{97}{1 + \alpha(t_r - t_f)}$
TP2	The degree of filling prescribed in 4.2.1.9.3 shall not be exceeded $\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$
	In these formulae, α is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transport (t_r) (both in °C). For liquids transported under ambient conditions α could be calculated by the formula: $\alpha = \frac{d_{15} - d_{50}}{35d_{50}}$ in which d_{15} and d_{50} are the densities of the liquid at 15°C and 50°C, respectively.
TP8	The test pressure for the portable tank may be reduced to 1.5 bar when the flash point of the substances transported is greater than 0°C.
TP9	A substance under this description shall only be transported in a portable tank under an approval granted by the competent authority.
TP13	Self-contained breathing apparatus shall be provided when this substance is transported.
TP27	A portable tank having a minimum test pressure of 4 bar may be used if it is shown that a test pressure of 4 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP28	A portable tank having a minimum test pressure of 2.65 bar may be used if it is shown that a test pressure of 2.65 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP29	A portable tank having a minimum test pressure of 1.5 bar may be used if it is shown that a test pressure of 1.5 bar or less is acceptable according to the test pressure definition in

6.7.2.1.

The UN transportation guidance is used as the basis for most other modes of transport and each of these will be described in a similar format with code descriptions and explanations in a separate Annex for each transportation mode.

4. PACKAGING OF PYROLYSIS LIQUIDS

The most crucial aspect of transport of dangerous goods is packaging. Appendix II gives the fuller details of packaging codes and weight restrictions for specific UN approved packaging types. Pyrolysis liquids are shipped in small samples of the order of a few mg to tonne quantities, in a variety of receptacles [single package or combination packaging] and for different purposes. This section highlights the following:

- | | |
|--|-------------|
| 1. Receptacle requirements to comply with UN regulations | Section 4.1 |
| 2. Labelling of and packaging for all sizes of shipments | Section 4.2 |
| 3. Empty packages and mixed packaging | Section 4.3 |

4.1 Receptacle requirements to comply with UN regulations

Consignments of fast pyrolysis liquids are acceptable for international transport provided they meet the specifications of packaging described in the UN regulations (). Packaging relates to samples of liquids of all sizes, however, depending on the classification of the substance as a hazardous material, there are limitations to the quantities, which may be shipped per package. Packages may also be single, e.g. drums, or combination packages, e.g. plastic bottles inside a cardboard box. In summary, the physical requirements for packaging are in Table 10.

Table 10. Minimum Package requirements for Pyrolysis Liquids

Packing group	I or "X" is used on UN approved packaging
Receptacle required minimum test pressure	250kPa g
Degree of filling of receptacle [at 15°C]:	90%
Hazard symbols	models 3, 6.2 and 8 as appropriate
Other comments	acid resistant material must be used

There are also particular volume and weight limits, depending on the package, materials of construction and type. The wide range of combinations is discussed in Appendix II, but a summary of the limits for inner packages is given in Table 11.

Table 11. Limitations on inner packages

Type of inner packaging	Maximum permissible capacity [l]
Glass, porcelain or stoneware packaging	5
Plastic packaging	30
Metal packaging	40
Other types of small packaging, e.g. tubes	1

Inner packages are the containers with the liquids inside; outer packages are for the containment of the sample and prevention of damage to the inner package.

4.2 Packaging requirements

Pyrolysis liquids can be transported in varying quantities, from mg to tonnes. Due to the hazardous nature of pyrolysis liquids, it is possible that shipment quantities will be limited to 10,000 l per tank, although this would need to be clarified during classification by the relevant authorities. Some general guidance is given on the package specification for a range of shipment sizes.

4.2.1 Very small quantities [< 1 l]

For small samples, it is recommended that polypropylene [or Nalgene™] bottles be used with a cap insert inside the neck. This type of plastic packaging is extremely resilient to compression and damage. Glass bottles and sample vials should be avoided where possible, unless satisfactorily packed with adsorbent and a support material to reduce the potential for breakage. All very small quantities should be shipped as a combination package- an inner package in a cardboard box to UN standard with a suitable fabric adsorbent in the package.

4.2.2 Small quantities [1-10 l]

For larger quantities, individual 1 l containers should be used, either with a cap insert, or small plastic drums with non-removable heads. A stockist of UN approved packaging can provide a suitable receptacle and it is recommended that for quantities of less than 10 l, an outer package is used, e.g. a cardboard or a wooden box filled with adsorbent. If for example a 10 l plastic drum was used, it would be preferable to place it for shipment in an outer package, e.g. a steel drum or wooden box filled with adsorbent. Such small drums can also be shipped as a single package with the appropriate transport requirements.

4.2.3 Moderate quantities [10-450 l [max 400 kg]]

For moderate quantities, the UN limitations mean that maximum volumes are only 30 l for plastic packages [drums] or 40 l for metal drums [see Table 11]. Metal drums should be stainless steel, or a PTFE lined mild steel drum if used as an inner package. Mild steel drums will be attacked by the pyrolysis liquids and this could lead to drum failure. For single packages, e.g. drums, the maximum weight is 400 kg; therefore, standard drums/barrels can be used, provided they are stainless steel or polypropylene plastic barrels [or lined mild steel drums] and are appropriately filled. Drums with non-removable heads are recommended.

In addition to the packaging types noted above, the other type of packaging, which is occasionally used for pyrolysis liquids, is the Intermediate Bulk Container [IBC]. An IBC is a rigid, or flexible portable packaging, other than those specified in Appendix A.5 of the UN guide (2). According to the requirements of ADR, IBCs are not to be used for Packing Group I liquids.

4.2.4 Large quantities [> 400 kg]

Large samples need to be transported in larger containers or tanks. Containers are defined quite specifically in the ADR regulations [in decreasing volume] as:

Large container	internal volume more than 3 m ³
Small container	> 1 m ³ , but less than 3 m ³ .
Tank [alone]	means a tank-container, or a fixed tank or a demountable tank, or an element of a battery vehicle having a capacity more than 1 m ³ .
Fixed tank	capacity more than 1 m ³ , which is structurally attached to a vehicle, or is an integral part of the frame of such vehicle.
Tank-container	means an article of transport equipment [inc. tank swap bodies] conforming to the definition of the term container [marginal 10014] and built to contain liquids, gaseous, powdery or granular substances but having a capacity of more than 0.45m ³ .
Demountable tank	tank, other than a fixed tank, a tank-container or an element of a battery vehicle, which has a capacity not more than 0.45 m ³ , is not designed for carriage of goods without breakage of load, and normally can only be handled when empty.

The additional requirement for tank/containers is the use of a placard on road containers, displayed the appropriate UN code of 1993 on the bottom and 33X on the top [see Section 4.3.2]. Containers and tanks will be the preferred method with time for larger quantities for land transport. Again, acid resistant containers and tanks are required.

4.3 Labelling of Packages

4.3.1 Marking

Each package shall be clearly marked with the substance identification number of the goods to be entered in the transport document, preceded by the letters "UN". For pyrolysis liquids, this classification is 1993.

4.3.2 Danger labels

Packages containing substances or articles of this class shall bear a label conforming to model No. 3 [Class 3 – Flammable liquids] as shown in Figure 1 below:



Figure 1. Label model No. 3 [Class 3 – Flammable liquids]

Packages containing substance of 11° to 19°, 32° and 41° shall in addition bear a label conforming to model No. 6.1 [Class 6 – Toxic substances], as shown in Figure 2:



Figure 2. Label model No. 6.1 [Class 6 – Toxic substances]

There is a requirement for label model no. 6.1, due to the presence of phenols in the liquids. Labels No. 3 and No. 6.1 shall be diamond shaped and measure at least 100 x 100 mm. They have a line of the same colour as the symbol appearing on the label 5 mm inside the edge and running parallel to it. If the size of the package so requires, the dimensions of the label may be reduced, if they remain clearly visible [see Table 12]. Labels to be affixed to vehicles, to tanks of more than 3 m³ or to large containers shall measure not less than 250 x 250 mm.

Packages containing receptacles, the closures of which are not visible from the outside and packages containing vented receptacles or vented receptacles without outer packaging shall in addition bear on two opposite sides a label conforming to model 11, as shown in **Erreur ! Source du renvoi introuvable.** The label size should be 148mm x 210 mm high, or reduced sizes in this ratio depending on the package size.

If the liquids are highly acidic, then an additional label for Class 8 substances is required as shown in **Erreur ! Source du renvoi introuvable.**



Figure 3. Label model No. 8 [Class 8 – Corrosive substances]



Figure 4. Label model no. 11 – This way up

Any label required to be carried on a package shall be securely fixed to the package with its entire surface in contact with it and the label shall be clearly and indelibly printed. The colour and nature of the marking shall be such that the symbol [if any] and wording stand out from the background to be readily noticeable and the wording shall be of such a size and spacing as to be easily read. The package shall be so labelled that the particulars can be read horizontally when the package is set down normally. The dimensions of the labels required for packages are given in Table 12.

Table 12. Label model no. 11 Size Requirements for Packages

Capacity of Package	Dimensions of label
Not exceeding 3 litres if possible	at least 52 x 74 mm
Exceeding 3 litres but not exceeding 50 litres	at least 74 x 105 mm
Exceeding 50 litres but not 500 litres	at least 105 x 148 mm
Exceeding 500 litres	at least 148 x 210 mm

In addition, for tankers, or other large bulk transport, placards are typically used for road and rail transport. The placard dimensions are typically a minimum of 30 cm high by 40 cm wide, numerals to be a minimum of 10 cm high. The requisite codes for a placard are:

Substance Identification No. [Lower part]	Name of Substance	Hazard Identification No. [Upper part]
1993	Flammable Liquid [Fast Pyrolysis Liquid]	33

A placard for large quantities [> 500 l] is shown in Figure 5 below, with the appropriate transportation codes for UN 1993 liquids, Transport category 1.

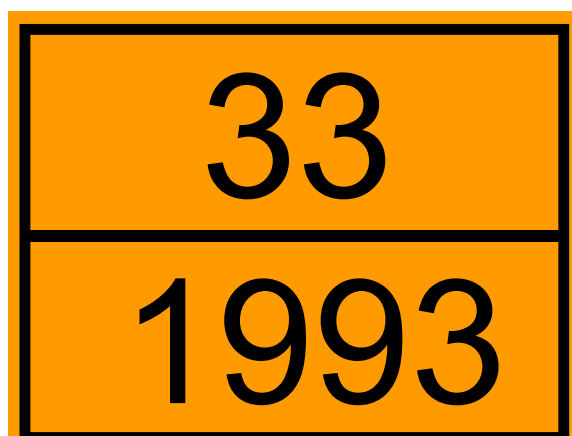


Figure 5. Placard for transportation in containers and bulk carriage [> 500 l]

4.4 Mixed and Empty packaging

4.4.1 Mixed packaging

Fast pyrolysis liquids should not be shipped with other dangerous goods. Up to 5 litres [inner packaging] may be shipped with goods not subject to the provisions of ADR, provided they do not react dangerously with each other. Pyrolysis liquids shall not be packed together with substances and articles of classes 1 and 5.2 [explosives substances and articles and organic peroxides respectively, other than hardeners and compound systems] and class 7 material [radioactive material].

Only 0.5 l of fast pyrolysis liquids per inner packaging and 1 litre per package, which are classed under hazard group (a), may be shipped with up to 5 litres of Class 3 substance not exceeding 5 litres if they classified under (b) or (c). This is provided that mixed packaging is also permitted for substances or articles of these classes, and/or with goods, which are not subject to the provisions of ADR, provided they do not react dangerously with each other. Dangerous reactions are classed as:

1. Combustion and/or giving off considerable heat,
2. Emission of flammable and/or toxic gases,
3. Formation of corrosive liquids,
4. Formation of unstable compounds.

If wooden or fibreboard boxes are used, a package shall not weigh more than 100 kg [provided marginals 2002 (6) and 2002 (7) relating to the inclusion of adsorbent packaging and the provision of a leak proof outer package and that all individual packages are clearly singly labelled (2)].

4.4.2 Empty packaging

In the case of empty tank vehicles, empty demountable tanks and empty tank containers, uncleaned, this description shall be completed by adding the words, "Last load", together with the name and item number of the goods last loaded:

Last load XXXX Flammable liquid [Fast pyrolysis liquids], 1°(a)

Where 'XXXX' is the appropriate UN N.O.S. number. This should help to reduce misuse of empty containers for other incompatible liquids.

5. HANDLING AND STORAGE OF PYROLYSIS LIQUIDS

Handling of fast pyrolysis liquids is taken in this context to apply to the usage of the material and the precautions that should be adhered to minimise harm or risks from exposure to the liquids. The legal requirements for the bulk handling of materials is not discussed here, as this is again subject to national guidance. MSDS sheets, which are required to accompany the transportation document. Careful consideration must be given to site layout and the loading and unloading of the liquids to minimise spills and potentially harmful releases to the environment.

5.1 Handling of Pyrolysis Liquids

Handling and storage activities are a common feature of the majority of workplaces. They are also one of the principal causes of death and injury due to this interface between people and the wide range of materials handled. This section sets out the measures necessary on the part of employers, employees, manufacturers, designers, importers and suppliers of pyrolysis liquids used at work to ensure safety and the absence of risks to health in connection with the use, handling, storage and transport of pyrolysis liquids. Handling and storage covers a very broad range of areas, including:

1. The use of fixed and mobile handling equipment;
2. Manual handling operations;
3. Design of the workplace;
4. The provision of a suitable working environment;
5. Specific requirements for the handling and storage of identified hazardous substances;
6. Controls on the use of hazardous materials;
7. Specific requirements for labelling of hazardous substances; and
8. The selection, provision and use of personal protective equipment.

The law on handling and storage is diverse, and each country has its own legislation and guidance for the handling of goods and therefore national information should be used where possible. The handling and storage of materials has, in many cases, great potential for pollution incidents, particularly in the case of hazardous materials that may be discharged by natural seepage to water and land resulting in groundwater pollution in particular. Within the EU, this issue is tasked within the Integrated Pollution Prevention and Control [IPPC] regulations, which came into force on 1st August 2000.

Most national regulations apply, in the case of the handling and storage of materials, with particular reference to:

- (a) Risk assessments;
- (b) Implementation of management systems for the effective planning, organising, controlling, monitoring and review of any preventive and protective measures arising from a risk assessment;
- (c) Appointment of competent persons;
- (d) Establishment of emergency procedures to be followed in the event of serious or imminent danger;

- (e) Provision of comprehensible and relevant information;
 - (f) Consideration of human capability;
 - (g) Provision of health and safety training; and
 - (h) Consultation with safety representatives.
- III.2 Storage of hazardous substances

Before storing and handling pyrolysis liquids, it is imperative to consult sources of hazard data, typically the MSDS or other available sources (16). The chemical compatibility of hazardous materials must be given particular consideration. Potentially reactive material must be stored separately [mixing may occur due to spillage, leakage or accident e.g. during a fire]. The following precautions are necessary to ensure the safe handling and storage of dangerous goods and/or chemical substances with pyrolysis liquids:

1. Meticulous standards of housekeeping should be maintained at all times;
2. Smoking and the consumption of food or drink should be prohibited in any area in which substances are used or stored e.g. laboratory, bulk chemical store;
3. Staff must be reminded regularly of the need for good personal hygiene, in particular washing of hands after handling chemical substances;
4. The minimum quantities only should be stored in the working area; extra bulk storage may be required separately and well away from the work area;
5. Containers and transfer containers should be clearly and accurately marked;
6. Chemical substances should always be handled with care and carriers used for Winchester and other large containers;
7. Fume cupboards should operate with a minimum face velocity of approximately 0.4 m/sec when measured with the sash opening set at 300 mm maximum, and performance should be checked frequently in accordance with the COSHH Regulations;
8. Staff should always wear personal protective clothing and equipment e.g. eye protection, face protection, aprons, gloves, wellington boots, whenever handling or using dangerous chemical substances;
9. Any injury should be treated promptly, particularly skin wounds and abrasions; and
10. Responsibility for safe working should be identified at senior management level, and written procedures published and used in the training of staff.

5.2 Bulk chemical storage [drums, barrels, tanks and similar containers]

In the design and use of bulk storage facilities, the following aspects need attention:

1. The range and quantities of substances to be stored;
2. Dependent upon (1) above, the degree of segregation by distance of:
 - a. The store from any other building; and
 - b. Certain chemical substances within the store from other chemical substances stored.

Purpose-built chemical stores should be of the detached single-storey brick built type or constructed in other suitable materials, such as concrete panels, with a sloping

roof of weatherproof construction. The structure should have a notional period of fire resistance of at least one hour.

Other features include:

- (a) Permanent ventilation by high and low level air bricks set in all elevations, except in those forming a boundary wall; low-level air bricks should be sited above door sill level;
- (b) Access doors constructed from material with at least one hour notional period of fire resistance; doorways should be large enough to provide access for fork lift trucks, with ramps on each side of the door sill (also to contain any internal spillage); separate pedestrian access, which also serves as a secondary means of escape, should be provided;
- (c) An impervious chemical-resistant finish to walls, floors and other surfaces;
- (d) Artificial lighting by sealed bulkhead or fluorescent fittings, to provide an overall luminance level of 300 lux;
- (e) Provision of adequate space, with physical separation and containment for incompatible substances, each area to be marked with the permitted contents, the hazards and the necessary precautions, and incorporating an area for the storage of empty containers;
- (f) Fire separation of individual areas sufficient to prevent fire spreading;
- (g) Provision of the following equipment in a protected area outside the store:
 - 1. Fire appliances (dry powder and/or foam extinguishers);
 - 2. Fixed hose reel appliance;
 - 3. Emergency shower and eyewash station with water heating facility to prevent freezing;
 - 4. Personal protective equipment i.e. safety helmet with visor, impervious gloves, disposable chemical-resistant overall, with storage facilities for same; and
 - 5. Respirator and breathing apparatus in a marked enclosure;
- (h) A total prohibition on the use of naked flames and smoking, appropriate warning signs should be displayed;
- (i) A prohibition on the use of the store for storage of other items or for any other purpose; and
- (j) Provision of racking or pallets to enable goods to be stored clear of the floor.

The producers of pyrolysis liquids therefore need to give careful consideration to the bulk storage of liquids and the exposure of workers to them and the vapours which may be given off.

5.3 External drum storage

Drums, barrels, carbuoys and other similar containers of pyrolysis liquids should be stored in the external air on an impervious and durable surface, which is in excess of 4 m to any risk area, bund or open boundary. The area should be protected by a bund wall, dished or ramped to contain spillages, with the walls and floor impervious to the materials stored. The bunded area should contain no drains or valves. Vehicular access to such areas should be protected by a ramp or a channel ensuring, of course, that the ramp itself does not cause regular spillages.

Generally, no container should be stored within 2 m of any window, escape route or door. Much will depend on the nature of the substances stored and the design of the storage area. Where a storage area is constructed with fire resistant walls, these distances can be reduced.

Ensure that overflow pipes on all tanks discharge within the bunded area. Remember any tank situated on a roof may drain to the surface water system via the guttering therefore avoid roof storage wherever possible. Flammable liquids should be stored in a purpose-built external flammable materials store and not in a warehouse. Much will depend upon the quantities to be stored. Small quantities should be stored in a lockable metal cupboard, suitably marked.

Consider the storage of chemical drums too. These must be within a bunded area to contain any spillages. Ensure vehicular access to such areas is protected too, by a ramp or a channel, but ensure the use of the ramp does not itself cause regular spillages! Have automatic cut-offs on all delivery pipes to prevent spillage due to overfilling.

5.4 Underground storage tanks

A wide range of flammable liquids are stored in underground tanks, although at present there is no requirement for underground storage of pyrolysis liquids. The following general precautions are necessary:

- (a) The tank should be subject to regular examination and test by a competent person;
- (b) The tank should be located in an area free from vehicular traffic as far as possible; where this is not possible, the tank compartment will need extra reinforcement and protection;
- (c) Permanent venting should be provided to allow for the release of waste gases and to prevent excessive pressure in the tank;
- (d) The tank should be located away from buildings to prevent subsidence; the distance from buildings will depend on the nature of the substance stored;
- (e) Operators should be trained in safe entry procedures, emergency rescue procedures and in the use of breathing apparatus;
- (f) Operators should, where atmospheric testing identifies a risk, wear breathing apparatus, together with rescue harness with lifeline attached; and
- (g) Someone should be stationed outside the tank to keep watch and communicate with people inside and, if necessary, take charge of rescue procedures.

Access to underground storage tanks and work in confined spaces has always been a high risk activity due to the possibility of dangerous gas or vapour concentrations, rust, which consumes oxygen, and oxygen-deficient atmospheres. For example, the Confined Spaces Regulations 1997 [UK] require employers to:

- (h) Avoid entry to confined spaces, for example, by doing the work from outside;
- (i) Follow a safe system of work, e.g. a Permit to Work system, if entry to a confined space, such as an underground tank, is unavoidable; and
- (j) Put in place adequate emergency arrangements before work starts, which will

also safeguard rescuers.

Underground tanks used for the storage of oils, solvents and effluents are a common source of groundwater pollution. Such tanks require regular examination, maintenance and testing. Pressure testing of the tanks should be undertaken to identify leaks. Where possible, new underground tanks should be double skinned or be 'housed' in a concrete structure (to reduce corrosion and provide secondary containment). Particular attention should be paid to the location of underground connecting pipework. Where possible, underground pipework should be located within impervious ductwork.

5.5 Health risk assessments

Employers must, where employees may be exposed to substances hazardous to health, make a suitable and sufficient assessment of the risks (a health risk assessment) created by that work to employees and the steps that need to be taken. The assessment must be reviewed if it is no longer valid or there has been a significant change in the work to which the assessment relates, and any changes, as a result of the review, must be made.

5.5.1 Prevention or control of exposure to substances hazardous to health:

Exposure to pyrolysis liquids and vapours must either be prevented or, where this is not reasonably practicable, controlled. Except in the case of a carcinogen or biological agent, prevention or adequate control shall be by means other than the provision of personal protective equipment.

5.5.2 Use of control measures, etc:

Every employer shall take all reasonable steps to ensure that any control measure is properly used or applied. Every employee shall make full and proper use of any control measures, return PPE to any accommodation provided, and report defects in control measures to his employer.

5.5.3 Maintenance, examination and test of control measures, etc:

Employers must ensure that any control measure is maintained in efficient state, in efficient working order and in good repair and, in the case of PPE, in a clean condition.

5.5.4 Monitoring exposure at the workplace:

Where appropriate, the employer shall ensure that there is a suitable procedure for monitoring the exposure of employees, including the keeping of records of such monitoring procedures.

5.5.5 Health surveillance:

Where appropriate, the employer shall ensure that employees who are liable to be exposed are under suitable health surveillance. As there is no suitable data on the

exposure of workers to pyrolysis liquids produced by fast pyrolysis, then the liquids should be treated as being hazardous given that the liquids do exhibit mutagenic properties.

5.5.6 Information, instruction and training etc:

Where employees are exposed to the risk of exposure, those employees must be provided with such information, instruction and training as is suitable and sufficient for them to know the risks of such exposure and the precautions that should be taken. The provision of appropriate safety equipment is required under national and EU legislation and is discussed in Section 5.5.9.

5.5.7 Prevention and control strategies

Every employer shall ensure that the exposure of his employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled.

So far as is reasonably practicable, the prevention or adequate control of exposure of employees to a substance hazardous to health, except to a carcinogen or biological agent, shall be secured by measures other than the provision of personal protective equipment.

Control strategies include:

1. Enclosure/containment: can the materials be handled so that individuals never need come into contact with them? Total enclosure or containment of the process may be possible by the use of bulk tanks and pipework to deliver a liquid directly into a closed production vessel. Complete enclosure is practicable if the substances are in liquid form, used in large quantities, and if the range of substances is small.
2. Isolation/separation: can the process be put somewhere else? The isolation of a process may simply mean putting it into a small locked room, thereby separating the workforce from the risk, or could involve the construction of a chemical plant in a remote geographical area. The system of isolation is required to prevent access effectively, or certainly restrict access only to those who need to be there.
3. Ventilation systems: ventilation is an important control strategy [see also Section 5.2.1]. Here it is necessary to distinguish between natural ventilation and mechanical ventilation systems.

Handling of pyrolysis liquids can lead to the release of vapours and gases during use, either in production, transfer or monitoring, therefore consideration must be given to exposure to the gases, due to a variety of means. Local exhaust ventilation may therefore be required. Local exhaust ventilation [LEV] systems these take two principal forms, receptor systems and captor systems:

1. Receptor systems: in a receptor system, the contaminant enters the system without inducement. The fan in the system is used to provide airflow to transport the contaminant from the hood/enclosure through the ducting to a collection system. The hood may form a total enclosure around the source, for example, a

laboratory fume cupboard. Receptor hoods receive contaminants as they flow from their origin under the influence of thermal currents.

2. Captor systems: with a captor system, the air which flows into the hood captures the contaminant at some point outside the hood and induces its flow into the system. The rate of flow of air into the hood must be sufficient to capture the contaminant at the furthestmost point of origin, and the air velocity induced at this point must be high enough to overcome any tendency the contaminant may have to go in any direction other than into the hood.

Contaminants emitted with high energy (large particles with high velocities) will require high velocities in the capturing stream.

5.5.8 Dilution ventilation

In certain cases, it may not be possible to extract a contaminant close to the point of origin. If the quantity of contaminant is small, uniformly evolved and of low toxicity, it may be possible to dilute the contaminant by inducing large volumes of air to flow through the contaminated region. Dilution ventilation is most successfully used to control vapours, for example, organic vapours from pyrolysis liquids.

5.5.8 Personal protective equipment [PPE]

The use of various forms of PPE, including respiratory protective equipment [RPE] is never a perfect solution to preventing exposure to hazardous substances. As a control strategy, it relies heavily on the operator wearing the correct PPE/RPE all the time he is exposed to the risk and people simply will not do this. In the majority of cases, the provision and use of PPE should be seen as an extra form of protection where other forms of protection, as indicated above, are operating. Recommended PPE for using pyrolysis liquids are:

1. Safety boots or shoes with protective steel toecaps,
2. Acid and solvent resistant gloves,
3. Coveralls,
4. Safety glasses or goggles,
5. Breathing apparatus if dealing with spills [organic vapour filter mask for short term exposure]

There is requirement by those handling pyrolysis liquids to carry out appropriate risk assessments for the exposure of workers to the liquids and all suitable precautions taken to minimise exposure to the liquids and the product vapours.

6. TREATMENT OF SPILLS

Spills can range in size and their prevention, the problems associated with spillages can be minimised by good handling, storage practices, and preventative measures. Spillages of hazardous substances can arise as a result of poor storage systems, the use of unsuitable or defective containers, during refilling of tanks and other containers, or as a result of human error. Measures to deal with spillages will depend upon:

- (a) The hazard of the substance;
- (b) The quantities involved;
- (c) The location of the spillage; and
- (d) The potential for occupational ill health and/or pollution of ground, water and/or air arising from the spillage.

Procedures for dealing with both small and large spillages should be outlined in the supplier's safety data sheet for the substance concerned and, where the substance is classified as a "substance hazardous to health", in a health risk assessment. For pyrolysis liquids, there is extremely limited data or trials on the treatment of spillages of pyrolysis liquids.

In most cases, small spillages can be dealt with immediately by absorption in sand, sawdust or proprietary absorbent granules and subsequent disposal to a waste container. Vermiculite is a particularly useful adsorbent for pyrolysis liquids as it is non-reactive and a good adsorber of liquids. Large spillages will need a considerable degree of attention to ensure, in particular, that substances do not enter a drainage system or natural watercourse in concentrated form. This may entail containment of the spillage using drain cones, sand bags, polythene sheeting and a range of other materials, so that it can eventually be pumped into a disposal container. Never wash spillages of fast pyrolysis liquids to surface water drains as this will only exacerbate the problem and require secondary remediation of the spill. It should be noted that a material used to clean up a spillage of fast pyrolysis liquids must be disposed of as a special waste.

The potential for water and ground pollution because of spillages very much depends upon the handling systems operated on site. The following recommendations with regard to materials handling are made:

1. All loading and discharge points should be designated, marked and isolated from the surface water drainage system.
2. Routes of transfer for all materials should be identified and the complete route should be protected against spillages to the surface water system.
3. Avoid underground pipework where possible, as faults are more difficult to detect and can lead to groundwater contamination.
4. Avoid manual handling where possible to reduce the risk of human error and accidents.
5. Yard areas used for materials handling or materials handling processes must be isolated from the surface water drainage system by bunding. Roofing such an area is an advantage to prevent the accumulation of rainwater, fire regulations permitting.

6. Always use appropriate containers for different materials. They should be sturdy, in good condition, clearly labelled and not liable to leak.
7. Minimise the necessity for materials handling and transfer where possible to reduce the risk.

To handle spills, the following preliminary procedures are proposed in Sections 6.1 and 6.2.

6.1 Small Quantities[<1000ml]

The suggested actions for such spillages are:

1. Wear rubber gloves and suitable eye and face protection. If there is inadequate ventilation, a suitable organic vapour filter mask or NIOSH/MSHA approved respirator must be worn.
2. Cover contaminated area with sawdust, or other suitable inert adsorbent, e.g. vermiculite or montmorillonite. Sawdust and vermiculite are the preferred choices.
3. Take up used adsorbent and place in a sealable container.
4. Transport, or arrange for transport, to approved landfill or incinerator for disposal.

6.2 Large Quantities [>1000ml]

The suggested actions for spillages of significant quantities of pyrolysis liquids are:

1. Evacuate area.
2. Wear rubber boots, rubber gloves, suitable eye/face protection and NIOSH/MSHA approved respirator.
3. Cover contaminated area with sawdust, or other suitable inert adsorbent, e.g. sawdust, vermiculite or montmorillonite
4. Take up used adsorbent and place in closed container. Transport to approved landfill or incinerator.
5. Where necessary, contain large spills with sandbags and other appropriate containment, e.g. adsorbent socks as found in emergency spill kits.

Where possible for large spills, a spill kit is advised to contain the spill and prevent its incursion to local watercourses. The recovery of pyrolysis liquids as an adsorbed waste may mean that they must be treated as "special waste" for disposal. Where possible, adsorbent should be recovered and stored in sealed containers for subsequent disposal.

Some remediation of the contaminated area may be required. If the spillage is on a concrete, or other non-adsorbent surface, then the liquids can be cleaned off with a weak NaOH solution [5wt%]. This will remove the majority of the liquid, however for forestry residue derived liquids, this action may not be effective, due to the non-polar nature of some of the components of the liquids. In this case, specialist advice is required on local remediation. If the spillage is on an adsorbent surface, e.g. soil, tarmac, then removal of the contaminated material may be the best course of action with removal for specialist disposal.

As noted in the third year BIOTOX report, some work on the bio-degradability of the liquids has been performed. Prior to this, only very limited work had been carried out by RTI Ltd. in Canada in 1997, which demonstrated that the liquids were biodegradable and had properties better than conventional diesel. The work in this contract has shown that the liquids from fast pyrolysis are generally bio-degradable, as summarised by CIRAD:

- Pyrolysis oils are readily biodegradable and the curves have similar shapes. Bio-oil biodegradations start immediately and no lag phase was observed at the beginning of the tests carried out by CIRAD. The lag phase lag values are short, half that of conventional diesel.
- Fast pyrolysis bio-oils are partially degraded to 43-50 % in 28 days and can be classified as biodegradable. A slow pyrolysis sample [Biotox 8] could be classified as readily biodegradable but without meeting the 10-day window.
- Bio-oils with biodegradation percentages between 43 and 60% are slightly more biodegradable than diesel (below 40 %) and have a higher biodegradable potential than heavy fuel oil (11%).

No other work has been done on the bio-degradation of biomass derived pyrolysis liquids.

7. CONCLUSIONS

Fast pyrolysis liquids may be classed as a flammable liquid for the purposes of transport by any mode. The use of the UN manual for the assessment of pyrolysis liquids has allowed four applicable N.O.S. classifications to be used to ensure that liquids, when shipped in UN approved packaging, or packaging conforming to UN requirements is meeting the relevant international transportation regulations. The use of the UN code will allow samples to be shipped in a manner complying with the regulations currently in force world-wide.

Consignors must provide MSDS and a transportation document containing certain basic requirements, which have been summarised in this report. Due to the nature of pyrolysis liquids, producers need to supply their own MSDS. The use of a supplier of UN approved packaging will assist in the compliance of suppliers of liquids with packaging requirements and in some cases avoid the additional costs of specially trained and approved staff for the preparation of shipping documentation and packaging. In conclusion:

1. Four appropriate UN N.O.S. codes can be used for the shipment of pyrolysis liquids, conforming to international transportation regulations, primarily by road, depending on the exact nature of the hazard posed by the liquids.
2. Labelling requirements have been summarised to ensure compliance with transportation regulations for all sizes of shipments by all modes of transport.
3. Volume and weight limitations on a range of shipment sizes have been specified.
4. Transportation documentation requirements have been specified and the required information applicable to pyrolysis liquids detailed.
5. Procedures for the treatment of spills have been made.

By using one of the four proposed Un N.O.S. codes, pyrolysis liquids can be shipped by most modes of transport, however, as indicated in Section 12 for air transport, this is only a viable option for very small samples of liquids.

8. RECOMMENDATIONS

The following recommendations are made:

1. A detailed toxicological assessment is required on animal specimens to determine the LD₅₀ [mg/kg] levels for the pyrolysis liquids.
2. A full MSDS for pyrolysis liquids needs to be produced and agreed with pyrolysis liquids producers.

9. GLOSSARY

ADN	The European Provisions concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	EU Agreement on the Carriage of Dangerous Goods by Road
CAA	Civil Aviation Authority
COSHH (UK)	Control of Substances Hazardous to Health Regulations 1994
DETR (UK)	Department of the Environment, Transport and Regions, UK
ECE	Economic Commission for Europe
ECOSOC	Economic and Social Council Committee of Experts
FAA (USA)	Federal Aviation Administration
FHWA (USA)	Federal Highway Administration
IATA	International Air Transport Association
IBC	Intermediate Bulk Container
ICAO	International Civil Aviation Organisation
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration, USA
NIOSH	National Institute of Occupational and Safety Hazards, USA
OTIF	Organisation for International Carriage by Rail
RID	EU Agreement on the Carriage of Dangerous Goods by Rail
RID/ADR/ADN	The Joint Meeting of the Working Party on the Transport of Dangerous Goods and the RID Safety Committee

APPENDIX I: TRANSPORT DOCUMENT FOR PYROLYSIS LIQUIDS

I.1 EU Transportation requirements

The transport document must contain the following information for any dangerous goods; however, the information relevant to pyrolysis liquids is included for future reference [assumed in this case initially for road transport]:

A description of the goods including the substance identification no. [where available]	UN 1993 Flammable Liquid, N.O.S., (Fast pyrolysis Liquid) Biomass derived liquid produced by fast pyrolysis. Flash point 50-70°C.
The class	3
The item number together with any letter	1°(a), 2°(a), 2°(b), 3°(b), 5°(c), 17°(a), 17°(b), 19°(a), 31°(c), 32°(c)
The initials ADR or RID, ADN	ADR, RID as appropriate
The number and description of the packages	As applicable
The total quantity of the dangerous goods [as a volume or gross mass or as a net mass]	As applicable
The name and address of the consignor	As applicable
The name and address of the consignee(s)	As applicable
A declaration as required by the terms of any special agreement	Not applicable
Instructions to be implemented in the case of an accident	See below

I.2 Instructions in Case of Accidents or Spills

No specific procedures have been adequately developed for pyrolysis liquids, however, the unusual properties of the liquids allows some general comments to be made to assist in the minimising of any hazard to the environment, or personnel involved with dealing with an accident. Advice on dealing with spills is given in Section 6.

Instruction must be provided in writing for the driver of a vehicle, or other transporter by the consignor. As a precaution against any accident or emergency that may occur or arise during carriage, the transporter shall be given instructions in writing, specifying concisely for each dangerous substance or article carried for each group of dangerous goods presenting the same dangers to which the substance(s) or article(s) carried belong(s):

1. The name of the substance or article or group of goods, the class and the identification number or for a group of goods, the identification numbers of the goods for which these instructions are intended or applicable;

2. The nature of the danger inherent in these goods as well as the measures and personal protection to be applied by the driver;
3. The general actions, e.g. to warn road users and passers-by and call the fire brigade/police, etc.
4. The additional actions to deal with minor leakages or spillages to prevent their escalation, if this can be achieved without personal risk;
5. The special actions for special products, if applicable;
6. The necessary equipment for general and if applicable additional and/or special actions.

I.3 Instruction to be provided to the Transporter [Provisional]

I Load

Pyrolysis liquids, class 3, UN 1993 [package identification numbers to be added here].

Hazard Identification number: 336, 338, 33 or 33X, depending on the mode of transport.

II Nature of Danger

- Harmful by inhalation, in contact with skin and if swallowed.
- Do not breathe vapours or fume from combusting or heated liquids.
- Irritating to eyes, respiratory system and skin.
- Corrosive [pH 1.5-3].
- Flash point of 50-70°C for the raw liquids.
- Possible mutagen, contains potentially carcinogenic compounds.
- Avoid continuous exposure.

II Personal Protection

Wear gloves, full eye protection [goggles] and organic vapour filter mask if a significant spillage occurs. Wear coveralls if dealing with a spill.

III General Actions by transporter

1. Stop engine
2. No naked light, no smoking
3. Cordon off area if land release occurs and warn others nearby
4. Notify appropriate fire and police authorities as soon as possible

IV Additional And/or Special Actions by the transporter

To handle spills, the following equipment is recommended:

Small Quantities [<1 l]

- Wear rubber gloves and suitable eye and face protection.
- Cover contaminated area with a suitable inert adsorbent preferably, e.g.

- vermiculite, or montmorillonite.
- Take up adsorbent and place in closed container.
- Transport to approved landfill or incinerator.

Large Quantities [>1 l]

1. Evacuate area.
2. Wear rubber boots, rubber gloves, suitable eye/face protection and NIOSH/MSHA approved respirator.
3. Cover contaminated area with a suitable inert adsorbent preferably, e.g. vermiculite, or montmorillonite. Take up adsorbent and place in closed container. Transport to approved landfill or incinerator.

V Special Action - Fire

Extinguishing Media: Water, Carbon Dioxide, Foam, Powder

Special Fire fighting Precautions:

1. Wear self-contained breathing apparatus and protective clothing to prevent contact with eyes and skin.
2. Do not inhale smoke from fire.
3. Use water spray to cool fire exposed containers.

First Aid

1. In case of contact with eyes, flush with copious amounts of water for 15 minutes. Remove contaminated clothing and seek medical assistance.
2. In case of contact with skin, flush with copious amounts of water. Remove contaminated clothing.
3. If inhaled remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration and call for medical assistance.
4. If swallowed, wash out mouth with water. Consume water to dilute. Call for medical assistance immediately.

Additional information

Carriage of a suitable adsorbent is recommended, i.e. dry sawdust or an inert adsorbent such as vermiculite. It is recommended to carry approx. 0.5-kg adsorbent/kg pyrolysis liquids.

Note:

These particulars to be entered in the document shall be drafted in an official language of the forwarding country, and also, if that language is not English, French or German, in English, French or German, unless international road transport tariffs, if any, or agreements concluded between the countries concerned in the transport operation, provide otherwise.

IV.3 North America Transportation Requirements

In North America, there are slightly different procedures for the transport of dangerous goods and the U.S. DOT has established a set of regulations that requires a series of warning signs, labels, package markings, and shipping documents, similar to the UN system. In Canada, an emergency response plan must be submitted to Transport Canada.

10. ANNEX I: ROAD - ADR

The provisions for transport by road are covered by ADR (3). The classifications for pyrolysis liquid are basically the same as UN Model Regulations, however there are minor differences in coding of the liquids depending on corrosivity and toxicity of the liquids. Class 3 liquids are defined as:

Having a vapour pressure less than 300 kPa at 50°C and are not gaseous at 20°C and at standard pressure of 101.325 kPa.

Liquids which are highly toxic on inhalation, having a flash point 23°C and toxic substances, having a flash point of 23°C or above are substances of Class 6.1.

The substances and articles of Class 3, which may be applicable to fast pyrolysis liquids, are sub-divided as follows:

- F Flammable liquids, without subsidiary risk:
 - F1 Flammable liquids having a flash point of or below 61°C;
 - F2 Flammable liquids having a flash point above 61°C, which are carried or handed over for carriage at, or above their flash point (elevated temperature substance)
- FT Flammable liquids, toxic:
 - FT1 Flammable liquids, toxic;
- FC Flammable liquids, corrosive:
- FTC Flammable liquids, toxic, corrosive:

10.1 ADR Dangerous Goods List

As a rule, each row of Table 14 of this Chapter deals with the substance(s) or article(s) covered by a specific UN number. However, when substances or articles belonging to the same UN number have different chemical properties, physical properties and/or carriage conditions, several consecutive rows may be used for that UN number. Each column of Table 14 is dedicated to a specific subject as indicated in the explanatory notes below. The intersection of columns and rows (cell) contains information concerning the subject treated in that column, for the substance(s) or article(s) of that row:

- The first four cells identify the substance(s) or article(s) belonging to that row (additional information in that respect may be given by the special provisions referred to in Column (6));
- The following cells give the applicable special provisions, either in the form of complete information or in coded form. The codes cross-refer to detailed information that is to be found in the Part, Chapter, Section and/or Sub-section indicated in the explanatory notes below. An empty cell means either that there is no special provision and that only the general requirements apply, or that the carriage restriction indicated in the explanatory notes is in force. The applicable general requirements are not referred to in the corresponding cells. The explanatory notes below indicate for every column the Part(s), Chapter(s), Section(s) and/or Sub-section(s) where these are to be found. For convenience, the relevant information is included here in Table 13.

Table 13. Structure of the ADR Dangerous Goods List

Column No. and Name	Description and explanatory notes
Column (1) "UN No."	Contains the UN number: – of the dangerous substance or article if the substance or article has been assigned its own specific UN number, or – of the generic or n.o.s. entry to which the dangerous substances or articles not mentioned by name shall be assigned in accordance with the criteria ("decision trees") of Part 2.
Column (2) "Name and description"	Contains, in upper case characters, the name of the substance or article, if the substance or article has been assigned its own specific UN number, or of the generic or n.o.s. entry to which it has been assigned in accordance with the criteria ("decision trees") of Part 2. This name shall be used as the proper shipping name or, when applicable, as part of the proper shipping name (see 3.1.2 for further details on the proper shipping name). A descriptive text in lower case characters is added after the proper shipping name to clarify the scope of the entry if the classification and/or carriage conditions of the substance or article may be different under certain conditions.
Column (3a) "Class"	Contains the number of the Class, whose heading covers the dangerous substance or article. This Class number is assigned in accordance with the procedures and criteria of Part 2.
Column (3b) "Classification code"	Contains the classification code of the dangerous substance or article. – For dangerous substances or articles of Class 1, the code consists of a division number and compatibility group letter, which are assigned in accordance with the procedures and criteria of 2.2.1.1.4; – For dangerous substances or articles of Class 2, the code consists of a number and hazardous property group, which are explained in 2.2.2.1.2 and 2.2.2.1.3; – For dangerous substances or articles of Classes 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 6.2, 8 and 9, the codes are explained in 2.2.x.1.2 1; – Dangerous substances or articles of Class 7 do not have a classification code.
Column (4) "Packing group"	Contains the packing group number(s) (I, II or III) assigned to the dangerous substance. These packing group numbers are assigned on the basis of the procedures and criteria of Part 2. Certain articles and substances are not assigned to packing groups.
Column (5) "Labels"	Contains the model number of the labels/placards (see 5.2.2.2 and 5.3.1.7) that have to be affixed to packages, containers, tank-containers, portable tanks, MEGCs and vehicles. However: – For substances or articles of Class 7, 7X means label model No.7A, 7B or 7C as appropriate according to the category (see 2.2.7.8.4 and 5.2.2.1.11.1) or placard No. 7D (see 5.3.1.1.3 and 5.3.1.7.2); – Labels of model number 11 are not indicated in this column; 5.2.2.1.12 is to be consulted in every case. The general provisions on labelling/placarding (e.g. number of labels, their location) are to be found in 5.2.2.1 for packages, and in 5.3.1, for containers, tank-containers, MEGCs, portable tanks and vehicles. NOTE: Special provisions, indicated in Column (6), may change the above labelling provisions.
Column (6) "Special provisions "	Contains the numeric codes of special provisions that have to be met. These provisions concern a wide array of subjects, mainly connected with the contents of Columns (1) to (5) (e.g. carriage prohibitions, exemptions from requirements, explanations concerning the classification of certain forms of the dangerous goods concerned and additional labelling or marking provisions), and are listed in Chapter 3.3 in numerical order. If Column (6) is empty, no special provisions apply to the contents of Columns (1) to (5) for the dangerous goods concerned.
Column (7) "Limited quantities"	Contains an alphanumeric code with the following meaning: – "LQ0" signifies that no exemption from the provisions of ADR exists for the dangerous goods packed in limited quantities;

	- All the other alphanumeric codes starting with the letters "LQ" signify that the provisions of ADR are not applicable if the conditions indicated in Chapter 3.4 are fulfilled (general conditions of 3.4.1 and conditions of 3.4.3, 3.4.4, 3.4.5 and 3.4.6, as appropriate, for the relevant code).
Column (8) "Packing instructions "	Contains the alphanumeric codes of the applicable packing instructions: - Alphanumeric codes starting with the letter "P", which refers to packing instructions for packagings and receptacles (except IBCs and large packagings), or "R", which refers to packing instructions for light gauge metal packagings. These are listed in 4.1.4.1 in numerical order, and specify the packagings and receptacles that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "P" or "R", the dangerous goods concerned may not be carried in packagings; - Alphanumeric codes starting with the letters "IBC" refer to packing instructions for IBCs. These are listed in 4.1.4.2 in numerical order, and specify the IBCs that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "IBC", the dangerous goods concerned may not be carried in IBCs; - Alphanumeric codes starting with the letters "LP" refer to packing instructions for large packagings. These are listed in 4.1.4.3 in numerical order, and specify the large packagings that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "LP", the dangerous goods concerned cannot be carried in large packagings; - Alphanumeric codes starting with letters "PR" refer to packing instructions for particular pressure receptacles. These are listed in 4.1.4.4 in numerical order, and specify the pressure receptacles that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. NOTE: Special packing provisions, indicated in Column (9a), may change the above packing instructions.
Column (9a) "Special packing provisions "	Contains the alphanumeric codes of the applicable special packing provisions: - Alphanumeric codes starting with the letters "PP" or "RR" refer to special packing provisions for packagings and receptacles (except IBCs and large packagings) that have additionally to be met. These are to be found in 4.1.4.1, at the end of the relevant packing instruction (with the letter "P" or "R") referred to in Column (8). If Column (9a) does not contain a code starting with the letters "PP" or "RR", none of the special packing provisions listed at the end of the relevant packing instruction apply; - Alphanumeric codes starting with the letter "B" or the letters "BB" refer to special packing provisions for IBCs that have additionally to be met. These are to be found in 4.1.4.2, at the end of the relevant packing instruction (with the letters "IBC") referred to in Column (8). If Column (9a) does not contain a code starting with the letter "B" or the letters "BB", none of the special packing provisions listed at the end of the relevant packing instruction apply; - Alphanumeric codes starting with the letter "L" refer to special packing provisions for large packagings that have additionally to be met. These are to be found in 4.1.4.3, at the end of the relevant packing instruction (with the letters "LP") referred to in Column (8). If Column (9a) does not contain a code starting with the letter "L", none of the special packing provisions listed at the end of the relevant packing instruction apply.
Column (9b)	Contains the alphanumeric codes starting with the letters "MP" of the applicable

"Mixed packing provisions"	mixed packing provisions. These are listed in 4.1.10 in numerical order. If Column (9b) does not contain a code starting with the letters "MP", only the general requirements apply (see 4.1.1.5 and 4.1.1.6).
Column (10) "Portable tank and bulk container instructions"	Contains an alphanumeric code assigned to a portable tank instruction, in accordance with 4.2.5.2.1 to 4.2.5.2.4 and 4.2.5.2.6. This portable tank instruction corresponds to the least stringent provisions that are acceptable for the carriage of the substance in portable tanks. The codes identifying the other portable tank instructions that are also permitted for the carriage of the substance are to be found in 4.2.5.2.5. If no code is given, carriage in portable tanks is not permitted unless a competent authority approval is granted as detailed in 6.7.1.3. The general requirements for the design, construction, equipment, type approval, testing and marking of portable tanks are to be found in Chapter 6.7. The general requirements for the use (e.g. filling) are to be found in 4.2.1 to 4.2.4. The indication of a "(M)" means that the substance may be carried in UN MEGCs. NOTE: <i>Special provisions, indicated in Column (11), may change the above requirements.</i> May also contain alphanumeric codes starting with the letters "BK" referring to types of bulk containers described in Chapter 6.11 which may be used for the carriage of bulk goods in accordance with 7.3.1.1 (a) and 7.3.2.
Column (11) "Portable tank and bulk container special provisions"	Contains the alphanumeric codes of the portable tank special provisions that have additionally to be met. These codes, starting with the letters "TP" refer to special provisions for the construction or use of these portable tanks. They are to be found in 4.2.5.3.
Column (12) "Tank codes for ADR tanks"	Contains an alphanumeric code describing a tank type, in accordance with 4.3.3.1.1 (for gases of Class 2) or 4.3.4.1.1 (for substances of Classes 3 to 9). This tank type corresponds to the least stringent tank provisions that are acceptable for the carriage of the relevant substance in ADR tanks. The codes describing the other permitted tank types are to be found in 4.3.3.1.2 (for gases of Class 2) or 4.3.4.1.2 (for substances of Classes 3 to 9). If no code is given, carriage in ADR tanks is not permitted. If in this column a tank code for solids (S) and for liquids (L) is indicated, this means that this substance may be offered for carriage in tanks in the solid or the liquid (molten) state. In general this provision is applicable to substances having melting points from 20 °C to 180 °C. If for a solid, only a tank code for liquids (L) is indicated in this column, this means that this substance is only offered for carriage in tanks in the liquid (molten) state. The general requirements for the construction, equipment, type approval, testing and marking that are not indicated in the tank code are to be found in 6.8.1, 6.8.2, 6.8.3 and 6.8.5. The general requirements for the use (e.g. maximum degree of filling, minimum test pressure) are to be found in 4.3.1 to 4.3.4. The indication of a "(M)" after the tank code means that the substance can also be carried in battery-vehicles or MEGCs. The indication of a (+) after the tank code means that the alternative use of the tanks is permitted only where this is specified in the certificate of type approval. For fibre-reinforced plastic tanks, see 4.4.1 and Chapter 6.9; for vacuum operated waste tanks, see 4.5.1 and Chapter 6.10. NOTE: <i>Special provisions, indicated in Column (13), may change the above requirements.</i>
Column (13) "Special provisions for ADR tanks "	Contains the alphanumeric codes of the special provisions for ADR tanks that have additionally to be met: - Alphanumeric codes starting with the letters "TU" refer to special provisions for the use of these tanks. These are to be found in 4.3.5; - Alphanumeric codes starting with the letters "TC" refer to special provisions for the construction of these tanks. These are to be found in 6.8.4 (a); - Alphanumeric codes starting with the letters "TE" refer to special provisions concerning the items of equipment of these tanks. These are to be found in 6.8.4 (b); - Alphanumeric codes starting with the letters "TA" refer to special provisions for the type approval of these tanks. These are to be found in 6.8.4 (c);

	- Alphanumeric codes starting with the letters "TT" refer to special provisions for the testing of these tanks. These are to be found in 6.8.4 (d); - Alphanumeric codes starting with the letters "TM" refer to special provisions for the marking of these tanks. These are to be found in 6.8.4 (e).
Column (14) "Vehicle for tank carriage"	Contains a code designating the vehicle (see 9.1.1) to be used for the carriage of the substance in tank in accordance with 7.4.2. The requirements concerning the construction and approval of vehicles are to be found in Chapters 9.1, 9.2 and 9.7.
Column (15) "Transport category"	Contains a figure indicating the transport category to which the substance or article is assigned for the purposes of exemption related to quantities carried per transport unit (see 1.1.3.6).
Column (16) "Special provisions for carriage - Packages"	Contains the alphanumeric code(s), starting with letter "V", of the applicable special provisions (if any) for carriage in packages. These are listed in 7.2.4. General provisions concerning the carriage in packages are to be found in Chapters 7.1 and 7.2. NOTE: <i>In addition, special provisions indicated in Column (18), concerning loading, unloading and handling, shall be observed.</i>
Column (17) "Special provisions for carriage - Bulk"	Contains the alphanumeric code(s), starting with letters "VV", of the applicable special provisions for carriage in bulk. These are listed in 7.3.3. If no code is given, carriage in bulk is not permitted. General Provisions concerning the carriage in bulk are to be found in Chapters 7.1 and 7.3. NOTE: <i>In addition, special provisions indicated in Column (18), concerning loading, unloading and handling, shall be observed.</i>
Column (18) "Special provisions for carriage - Loading and unloading"	Contains the alphanumeric code(s), starting with letters "CV", of the applicable special provisions for loading, unloading and handling. These are listed in 7.5.11. If no code is given, only the general provisions apply (see 7.5.1 to 7.5.10).
Column (19) "Special provisions for carriage - Operation"	Contains the alphanumeric code(s), starting with letter "S", of the applicable special provisions for operation which are listed in Chapter 8.5. These provisions shall be applied in addition to the requirements of Chapters 8.1 to 8.4 but in the event of conflict with the requirements of Chapters 8.1 to 8.4, the special provisions shall take precedence.
Column (20) "Hazard identification number"	Contains a two or three figures number (in some cases prefixed by the letter "X") which shall appear on the upper part of the orange-coloured plate when required for carriage in tank or in bulk according to 5.3.2.1. The meaning of the hazard identification numbers is explained in 5.3.2.3.

Table 14. ADR Packaging and Transport Requirements – Part 1

UN No.	Name & Description	Class	Classification Code	Packing Group	Labels	Special Provisions 3.3	Limited quantities 3.4.6	Packaging			Portable Tanks and Bulk Containers	
								Packing Instructions 4.1.4	Special Packing Provisions	Mixed Packing Provisions	Instructions	Provisions
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(11)
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	I	3 + 6.1	274	LQ0	P001	-	MP7, MP17	T14	TP2 TP9 TP27
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	II	3 + 6.1	274	LQ0	P001 IBC02	-	MP19	T7	TP2
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	III	3 + 6.1	274	LQ7	P001 IBC03 R001	-	MP19	T7	TP1 TP28
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C > 175 kPa]	3	F1	I	3	274 640A	LQ3	P001	-	MP7, MP17	T11	TP1 TP9 TP27
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C < 100 kPa, < 175 kPa]	3	F1	I	3	274 640B	LQ3	P001	-	MP7, MP17	T11	TP1 TP9 TP27
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C < 100 kPa, < 175 kPa]	3	F1	II	3	274 640C	LQ4	P001	-	MP19	T7	TP1 TP8 TP28
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C < 110 kPa]	3	F1	II	3	274 640D	LQ4	P001 IBC03 R001	-	MP19	T7	TP1 TP8 TP28

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1993	FLAMMABLE LIQUID, N.O.S.	3	F1	III	3	274 640E	LQ7	P001 IBC03 LP01 R001	-	MP19	T4	TP1 TP29
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	I	3 + 8	274	LQ3	P001	-	MP7, MP17	T14	TP2 TP9
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	II	3 + 8	274	LQ4	P001 IBC02	--	MP19	T11	TP2 TP27
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	III	3 + 8	274	LQ7	P001 IBC02 LP01		MP19	T7	TP1 TP28
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	3	FTC	I	3 +6.1 + 8	274	LQ0	P001	-	MP7 MP17	-	TP2 TP9 TP27
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	3	FTC	II	3 +6.1 + 8	274	LQ0	P001 IBC02		MP19		TP2 TP27

Note: See code descriptions and qualifiers below

Table 15. ADR Packaging and Transport Requirements – Part 2

UN No.	Name and Description 3.1.2	ADR tank		Vehicle for tank carriage 9.1.1.2	Transport category 1.1.3.6	Special Provisions for carriage				Hazard identification No. 5.3.2.3	UN No.
		Tank Code 4.3.4	Special Provisions 4.3.5, 6.8.4			Package 7.2.4	Bulk 7.3.3	Loading, unloading and handling 7.5.11	Operation 8.5		
(1)	(2)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(1)
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	L10CH	TU14 TU15 TE21	FL	1			CV13 CV28	S2 S19	336	1992
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	L4BH	TU15 TE15	FL	2			CV13 CV28	S2 S19	336	1992
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	L4BH	TU15 TE15	FL	3			CV13 CV28	S2	36	1992
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C > 175 kPa]	L4BN		FL	1				S2 S20	33	1993
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C < 100 kPa, < 175 kPa]	L1 5BN		FL	1				S2 S20	33	1993
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C < 100 kPa, < 175 kPa]	L1 5BN		FL	2				S2 S20	33	1993
1993	FLAMMABLE LIQUID, N.O.S.[vapour pressure @50°C< 110 kPa]	LGBF		FL	2				S2 S20	33	1993
1993	FLAMMABLE LIQUID, N.O.S.	LGBF		FL	3				S2	30	1993
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	L10CH	TU14 TE21	FL	1				S2 S20	338	2924
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	L4BH	TE15	FL	2				S2 S20	338	2924

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2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	L4BH		FL	3				S2	38	2924
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	L10CH	TU14 TU15 TE21	FL	1			CV13 CV28	S2 S19	368	3286
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	L4BH	TU15 TE15	FL	2			CV13 CV28	S2 S19	368	3286

Note: See code descriptions and qualifiers below

10.2 ADR Classification Codes

10.2.1 ADR Column 6- Special Provisions

The specification of the ADR special provisions are given in Table 16.

Table 16. ADR Special Provisions on naming

ADR reference	Description
274	The provisions of 3.1.2.8 apply. 3.1.2.8 Generic or "not otherwise specified" (N.O.S.) names 3.1.2.8.1 Generic and "not otherwise specified" proper shipping names that are assigned to special provision 274 in Column (6) of Table A in Chapter 3.2 shall be supplemented with the technical name of the goods unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of Class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical names shall be entered in brackets immediately following the proper shipping name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc. and the percentage of the technical constituent may also be used. For example: "UN 1993 FLAMMABLE LIQUID, N.O.S. (CONTAINS XYLENE AND BENZENE), 3, II". 3.1.2.8.1.1 The technical name shall be a recognized chemical name, if relevant a biological name, or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used.
640	The physical and technical characteristics mentioned in column (2) of Table A of Chapter 3.2 determine different tank codes for the carriage of substances of the same packing group in RID tanks. In order to identify these physical and technical characteristics of the product carried in the tank, the following shall be added, to the particulars required in the consignment note, only in case of carriage in RID tanks: "Special provision 640X" where "X" is the applicable capital letter appearing after the reference to special provision 640 in column (6) of Table A of Chapter 3.2. These particulars may, however, be dispensed with in the case of carriage in the type of tank which, for substances of a specific packing group of a specific UN number, meets at least the most stringent requirements.

10.2.2 ADR Column 7 - Limited Quantities

ADR guidance and general requirements are given in Table 17 with the relevant ADR reference and code details in Table 18.

Table 17. ADR limited quantities guidance

ADR reference	Description
3.4.1.1	Packagings used in accordance with 3.4.3 to 3.4.6 below, need only to conform to the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8.
3.4.1.2	The maximum gross mass of a combination packaging shall not exceed 30 kg and for shrink and stretched wrapped trays shall not exceed 20 kg. NOTE: The limit for combination packagings does not apply when LQ5 is issued.
3.4.1.3	Subject to the maximum limits in 3.4.1.2 and individual limits in table 3.4.6, dangerous goods may be packed together with other articles or substances, provided they will not react dangerously in the event of leakage.
3.4.2	When the code "LQ0" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, that substance or article is not exempted from any of the applicable provisions of Annexes A and B when it is packed in limited quantities, unless otherwise specified in these Annexes.
3.4.3	Unless otherwise provided in this Chapter, when one of the codes "LQ1" or "LQ2" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, the provisions of other Chapters of ADR do not apply to the carriage of that substance or article, provided: (a) The provisions of 3.4.5 (a) to (c) are observed; with respect to these provisions, articles are considered to be inner packagings; (b) Inner packagings meet the conditions of 6.2.1.2 and 6.2.4.1 to 6.2.4.3.
3.4.4	Unless otherwise provided in this Chapter, when the code "LQ3" is shown in Column (7) of Table A in Chapter 3.2 for a given substance, the provisions of other Chapters of ADR do not apply to the carriage of that substance, provided: (a) The substance is carried in combination packagings, the following outer packagings being allowed: - steel or aluminium drums with removable head; - steel or aluminium jerricans with removable head; - plywood or fibre drums; - plastics drums or jerricans with removable head; - boxes of natural wood, plywood, reconstituted wood, fibreboard, plastics, steel or aluminium; and be so designed that they meet the relevant construction requirements of 6.1.4; (b) The maximum net quantities per inner packaging shown in columns (2) or (4) and per package in columns (3) or (5), where indicated, of table 3.4.6 are not exceeded; (c) Each package is clearly and durably marked with: (i) the UN number of the goods contained therein, as given in Column (1) of Table A in Chapter 3.2, preceded by the letters "UN"; (ii) in the case of different goods with different UN numbers within a single package: - the UN numbers of the goods contained therein, preceded by the letters "UN", or - the letters "LQ"¹. These markings shall be displayed within a diamond-shaped area surrounded by a line that measures at least 100 mm × 100 mm. The width of line forming the diamond shall be at least 2 mm; the number shall be at least 6 mm high. Where more than one substance assigned to different UN numbers are included

1. The letters "LQ" are an abbreviation of the English words "Limited Quantities". The letters "LQ" are not permitted by the IMDG Code or the ICAO Technical Instructions.

	in the package, the diamond shall be large enough to include each relevant UN number. If the size of the package so requires, the dimension may be reduced, provided the markings remain clearly visible.
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The packaging limits for limited quantities are given in Table 18.

Table 18. ADR limits on combination and inner packagings

ADR code	Combination packagings ^a Maximum net quantity		Inner packagings placed in shrink-wrapped or stretch-wrapped trays ^a Maximum net quantity	
	Per inner packaging	Per package ^b	Per inner packaging	Per package ^b
LQ0	No exemption under the conditions of 3.4.2.			
LQ3 ^c	500 ml	1 l	Not allowed	Not allowed
LQ4	3 l		1 l	
LQ7 ^c	5 l		5 l	

Notes:

^a See 3.4.1.2.

^b See 3.4.1.3.

^c In the case of homogenous mixtures of Class 3 containing water, the quantities specified relate only to the substance of Class 3 contained in those mixtures.

10.2.3 ADR Column 8 - Packing Instructions

Packing instructions are given in Table 19 below.

Table 19. ADR Packing instructions

IBC02 PACKING INSTRUCTION	
The following IBCs are authorized, provided the general provisions of 4.1.1 , 4.1.2 and 4.1.3 are met:	
(1) Metal (31A, 31B and 31N);	
(2) Rigid plastics (31H1 and 31H2);	
(3) Composite (31HZ1).	
Additional requirement:	
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.	
Special packing provisions:	
B5	For UN Nos. 1791, 2014, 2984 and 3149, IBCs shall be provided with a device to allow venting during carriage. The inlet to the venting device shall be sited in the vapour space of the IBC under maximum filling conditions during carriage.
B7	For UN Nos. 1222 and 1865, IBCs with a capacity greater than 450 litres are not permitted due to the substance's potential for explosion when carried in large volumes.
B8	The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.
IBC03 PACKING INSTRUCTION	
The following IBCs are authorized, provided the general provisions of 4.1.1 , 4.1.2 and	

4.1.3 are met:

- (1) Metal (31A, 31B and 31N);
- (2) Rigid plastics (31H1 and 31H2);
- (3) Composite (31HZ1, 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2).

Additional requirement:

Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.

Special packing provision:

B8 The pure form of this substance shall not be carried in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.

R001 PACKING INSTRUCTION

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

Light gauge metal packagings	Maximum capacity/maximum net mass		
	Packing group I	Packing group II	Packing group III
steel, non-removable head (0A1)	Not allowed	40 l / 50 kg	40 l / 50 kg
steel, removable head (0A2)	Not allowed	40 l / 50 kg	40 l / 50 kg

NOTE 1: This instruction applies to solids and liquids (provided the design type is tested and marked appropriately).

NOTE 2: For Class 3, packing group II, these packagings may be used only for substances with no subsidiary risk and a vapour pressure of not more than 110 kPa at 50 °C and for slightly toxic pesticides.

10.2.4 ADR Column 9b - Mixed packing instructions

The ADR mixed packaging instructions are summarised in Table 20.

Table 20. ADR Mixed packing instructions

ADR Reference	Description
MP 7	May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of the same class covered by other classification codes when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of ADR, provided they do not react dangerously with one another.
MP 17	May - in quantities not exceeding 0.5 litre per inner packaging and 1 litre per package - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of other classes, except Class 7, when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of ADR, provided they do not react dangerously with one another.
MP 19	May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of the same class covered by other classification codes or with

	goods of other classes, when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of ADR, provided they do not react dangerously with one another.
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10.2.5 ADR Column 10 - Portable Tanks and Bulk Containers: Instructions

Portable tank instructions specify the requirements applicable to a portable tank when used for the carriage of specific substances. Portable tank instructions T1 to T22 specify the applicable minimum test pressure, the minimum shell thickness (in mm reference steel), and the pressure-relief and bottom-opening requirements.

PORTABLE TANK INSTRUCTIONS				
<i>These portable tank instructions apply to liquid and solid substances of Classes 3 to 9. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met.</i>				
Portable tank instruction	Minimum test pressure (bar)	Minimum shell thickness (in mm reference steel) (see 6.7.2.4)	Pressure-relief requirements^a (see 6.7.2.8)	Bottom opening requirements (see 6.7.2.6)
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T14	6	6mm	See 6.7.2.8.3	Not allowed

The details for the sections referred to in Table 18 are given in Table 21.

Table 21. ADR vessel requirements

ADR reference	Description
6.7.2.4.2	The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.
6.7.2.6.3	Every bottom discharge outlet, except as provided in 6.7.2.6.2, shall be equipped with three serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and include: (a) A self-closing internal stop-valve, that is a stop-valve within the shell or within a welded flange or its companion flange, such that: (i) The control devices for the operation of the valve are designed so as to prevent any unintended opening through impact or other inadvertent act; (ii) The valve may be operable from above or below; (iii) If possible, the setting of the valve (open or closed) shall be capable of being verified from the ground; (iv) Except for portable tanks having a capacity of not more than 1 000 litres, it shall be possible to close the valve from an

	accessible position of the portable tank that is remote from the valve itself; and (v) The valve shall continue to be effective in the event of damage to the external device for controlling the operation of the valve; (b) An external stop-valve fitted as close to the shell as reasonably practicable; and (c) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.
6.7.2.8.3	When required for certain substances by the applicable portable tank instruction indicated in Column (10) of Table 14 of Chapter 3.2 and described in 4.2.5.2.6, portable tanks shall have a pressure-relief device approved by the competent authority. Unless a portable tank in dedicated service is fitted with an approved relief device constructed of materials compatible with the substance carried, the relief device shall comprise a frangible disc preceding a spring-loaded pressure-relief device. When a frangible disc is inserted in series with the required pressure-relief device, the space between the frangible disc and the pressure-relief device shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure-relief system. The frangible disc shall rupture at a nominal pressure 10% above the start to discharge pressure of the relief device.

The full details of tank specifications are beyond the scope of this work and the reader is referred to the ADR Regulations for further detailed information on tank and vessel specifications and testing procedures (3).

10.2.6 ADR Column 11 - Portable Tanks and Bulk Container: Provisions

ADR portable tank provisions are given in Table 22.

Table 22. ADR Portable tank provisions

ADR Code	Description
TP1	The degree of filling prescribed in 4.2.1.9.2 shall not be exceeded $\text{Degree of filling} = \frac{97}{1 + \alpha(t_r - t_f)}$
TP2	The degree of filling prescribed in 4.2.1.9.3 shall not be exceeded $\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$
	In these formulae, α is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transport (t_r) (both in °C). For liquids transported under ambient conditions α could be calculated by the formula: $\alpha = \frac{d_{15} - d_{50}}{35d_{50}}$ in which d_{15} and d_{50} are the densities of the liquid at 15°C and 50°C, respectively.
TP8	The test pressure for the portable tank may be reduced to 1.5 bar when the flash point of the substances transported is greater than 0°C.
TP9	A substance under this description shall only be transported in a portable tank under an approval granted by the competent authority.

TP27	A portable tank having a minimum test pressure of 4 bar may be used if it is shown that a test pressure of 4 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP28	A portable tank having a minimum test pressure of 2.65 bar may be used if it is shown that a test pressure of 2.65 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP29	A portable tank having a minimum test pressure of 1.5 bar may be used if it is shown that a test pressure of 1.5 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

10.2.7 ADR Column 12 – Tank Codes

The four parts of the codes (tank codes) given in Column (12) of Table 15 have the following meanings as given in Table 23.

Table 23. ADR Tank Codes description

Part	Description	Tank Code
1	Types of tank	L = tank for substances in the liquid state (liquids or solids handed over for carriage in the molten state);
2	Calculation pressure	G = minimum calculation pressure in bar general requirements of 6.8.2.1.14; or 1.5; 2.65; 4; 10; 15 or 21= minimum calculation pressure in bar (see 6.8.2.1.14).
3	Openings (see 6.8.2.2.2)	A = tank with bottom-filling and discharge openings with 2 closures; B = tank with bottom-filling and discharge openings with 3 closures; C = tank with top-filling and discharge openings with only cleaning openings below the surface of the liquid; D = tank with top-filling and discharge openings with no openings below the surface of the liquid.
4	Safety valves/devices	V = tank with a venting system, according to 6.8.2.2.6, but no flame trap; or non-explosion-pressure proof tank; F = tank with a venting system, according to 6.8.2.2.6, fitted with a flame trap; or explosion-pressure proof tank; N = tank without a venting system according to 6.8.2.2.6 and not hermetically closed; H = hermetically closed tank (see 1.2.1).

Tanks with tank codes different from those indicated in this table or in Table A of Chapter 3.2 may also be used provided that:

- the first part of the code (L or S) remains unchanged and
- any other element (number or letter) of parts 2 to 4 of these tank codes correspond to a level of safety at least equivalent to the corresponding element of the tank code indicated in Table A of Chapter 3.2, according to the following increasing order:

Part 2: Calculation pressure

G → 1.5 → 2.65 → 4 → 10 → 15 → 21 bar
 Part 3: Openings
 A → B → C → D →
 Part 4: Safety valves/devices
 V → F → N → H.

For example, a tank with the tank code L10CN is authorized for the carriage of a substance to which the tank code L4BN has been assigned.

10.2.8 ADR Column 13 – ADR Tank Special provisions

ADR Tank Special provisions are detailed in Table 24.

Table 24. ADR Tank Special provisions

ADR Code	Description
TU14	The protective caps of closures shall be locked during carriage.
TU15	Tanks shall not be used for the carriage of foodstuffs, articles of consumption or animal feeds.
TU21	The substance shall, if water is used as a protective agent, be covered with a depth of not less than 12 cm of water at the time of filling; the degree of filling at a temperature of 60 °C shall not exceed 98%. If nitrogen is used as a protective agent, the degree of filling at a temperature of 60 °C shall not exceed 96%. The remaining space shall be filled with nitrogen in such a way that, even after cooling, the pressure at no time falls below atmospheric pressure. The tank shall be closed in such a way that no leakage of gas occurs.
TE15	Tanks fitted with vacuum valves which open at a negative pressure of not less than 21 kPa (0.21 bar) shall be considered as being hermetically closed. For tanks intended for the carriage of solid substances (powdery or granular) of packing groups II or III only, which do not liquefy during transport, the negative pressure may be reduced to not less than 5 kPa (0.05 bar).

10.2.9 ADR Column 14 – Vehicle for tank carriage

For the purposes of ADR, "FL vehicle" means:

- (a) a vehicle intended for the carriage of liquids having a flash-point of not more than 61°C (with the exception of diesel fuel complying with standard EN 590:1993, gas oil, and heating oil (light) - UN No. 1202 - with a flash-point as specified in standard EN 590:1993) in fixed tanks or demountable tanks with a capacity exceeding 1 m³ or in tank-containers or portable tanks with an individual capacity exceeding 3 m³; or
- (b) a vehicle intended for the carriage of flammable gases in fixed tanks or demountable tanks with a capacity exceeding 1 m³ or in tank-containers, portable tanks or MEGCs with an individual capacity exceeding 3 m³; or,
- (c) a battery-vehicle with a total capacity exceeding 1 m³ intended for the carriage of flammable gases;

10.2.10 ADR Column 18 – Special Provision for Carriage: Loading, unloading

and handling

The ADR special provisions are detailed in Table 25.

Table 25. ADR Special Provision for Carriage: Loading, unloading and handling

ADR Code	Description
CV13	If any substances have leaked and been spilled in a vehicle or container, it may not be re-used until after it has been thoroughly cleaned and, if necessary, disinfected or decontaminated. Any other goods and articles carried in the same vehicle or container shall be examined for possible contamination.
CV28	If special provision CV28 is indicated for a substance or article in Column (18) of Table 15, precautions with respect to foodstuffs, other articles of consumption and animal feeds shall be taken as follows. Packages as well as uncleaned empty packagings, including large packagings and intermediate bulk containers (IBCs), bearing labels conforming to models Nos. 6.1 or 6.2 and those bearing labels conforming to model No.9 containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, shall not be stacked on or loaded in immediate proximity to packages known to contain foodstuffs, other articles of consumption or animal feeds in vehicles, in containers and at places of loading, unloading or transshipment. When these packages, bearing the said labels, are loaded in immediate proximity of packages known to contain foodstuffs, other articles of consumption or animal feeds, they shall be kept apart from the latter: (a) by complete partitions which should be as high as the packages bearing the said labels; (b) by packages not bearing labels conforming to models Nos. 6.1, 6.2 or 9 or packages bearing labels conforming to model No.9 but not containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245; or (c) by a space of at least 0.8 m; unless the packages bearing the said labels are provided with an additional packaging or are completely covered (e.g. by a sheeting, a fibreboard cover or other measures).

10.2.11 ADR Column 19 – Special Provision for Carriage: Operation

Special provisions are detailed in Table 26.

Table 26. ADR Special Provision for Carriage: Operation

ADR Code	Description
S2	Additional requirements concerning the carriage of flammable liquids or gases 1) <i>Portable lamps</i> Closed vehicles carrying liquids having a flash-point of not more than 61 °C or flammable substances or article of Class 2, shall not be entered by persons carrying lighting apparatus other than portable lamps so designed and constructed that they cannot ignite any flammable vapours or gases which may have penetrated into the interior of the vehicle. (2) <i>Operation of combustion heaters during loading or unloading</i> The operation of combustion heaters of vehicles of type FL (see Part 9) is forbidden during loading and unloading and at loading sites. (3) <i>Precautions against electrostatic charges</i> In the case of vehicles of type FL (see Part 9), a good electrical connection from the vehicle

	chassis to earth shall be established
S19	The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of such substances in the vehicle exceeds 5 000 kg.
S20	The provisions of Chapter 8.4 concerning the supervision of vehicles shall apply when the total mass of these substances in the vehicle exceeds 10 000 kg.

10.2.12 ADR Column 20 – Hazard identification No.

Special provisions are detailed in Table 27.

Table 27. ADR Hazard identification No.

ADR Code	Description
30	flammable liquid (flash-point between 23°C and 61°C, inclusive) or flammable liquid or solid in the molten state with a flash-point above 61°C, heated to a temperature equal to or above its flash-point, or self-heating liquid
33	highly flammable liquid (flash-point below 23°C)
336	highly flammable liquid, toxic

The applicability of the hazard codes to pyrolysis liquids are a bit problematical, as code 33 assigns a flash point lower than that typically measured for pyrolysis liquids, code 336 applies only if the liquids are toxic and to date the fact that they are potentially mutagenic is evident, but the oral toxicity of the liquids has not been determined. Code 30 is the most applicable, but it is only applicable with one UN N.O.S. - UN 1993 N.O.S. packing Group 3.

11. ANNEX II: Rail [RID]

The provisions for transport by road are covered by RID (4). The classifications for pyrolysis liquid are basically the same as UN Model Regulations, however there are minor differences in coding of the liquids depending on vapour pressure of the liquids. Class 3 liquids are defined as:

- Liquids according to subparagraph (a) of the definition for "liquid" in 1.2.1;
- Have at 50°C a vapour pressure of not more than 300 kPa [3 bar] and are not completely gaseous at 20°C and at standard pressure of 101.3 kPa; and
- have a flash-point of not more than 61 °C [see 2.3.3.1 of (4) for the relevant test].

The heading of Class 3 also covers liquid substances and molten solid substances with a flash-point of more than 61°C and which are carried or handed over for carriage whilst heated at temperatures equal to or higher than their flash-point. These substances are assigned to UN No. 3256. Other constraints include:

- Substances having a flash-point above 35°C, non-toxic and non-corrosive, which do not sustain combustion according to the criteria of sub-section 32.2.5 of Part III of the Manual of Tests and Criteria, are not substances of Class 3; if, however, these substances are handed over for carriage and carried whilst heated at temperatures equal to or higher than their flashpoint, they are substances of Class 3.
- By derogation from paragraph 2.2.3.1.1 above, diesel fuel, gasoil, heating oil (light) having a flash-point above 61°C and not more than 100 °C shall be deemed substances of Class 3, UN No. 1202.
- Liquids which are highly toxic on inhalation, having a flash-point below 23 °C and toxic substances, having a flash-point of 23 °C or above are substances of Class 6.1 (see 2.2.61.1).

The substances and articles of Class 3 are subdivided as follows:

- F Flammable liquids, without subsidiary risk:
 - F1 Flammable liquids having a flash point of or below 61°C;
 - F2 Flammable liquids having a flash point above 61°C, which are carried or handed over for carriage at, or above their flash point (elevated temperature substance)
- FT Flammable liquids, toxic:
 - FT1 Flammable liquids, toxic;
- FC Flammable liquids, corrosive:
- FTC Flammable liquids, toxic, corrosive:

Substances and articles classified in Class 3 are listed in Table A of Chapter 3.2. Substances not mentioned by name in Table A of Chapter 3.2 shall be assigned to the relevant entry of 2.2.3.3 and the relevant packing group in accordance with the provisions of this section. Flammable liquids shall be assigned to one of the following packing groups according to the degree of danger they present for carriage as shown in Table 28.

Table 28. RID Packing groups for Class 3 related to flash point

Packing Group	Flash point [closed cup]	Initial Boiling Point
I	--	< 35°C
II ^(a)	< 23°C	> 35°C
III ^(a)	>23°C and ≤61°C	> 35°C

Note: ^(a) For a liquid with (a) subsidiary risk(s), the packing group determined in accordance with the table above and the packing group based on the severity of the subsidiary risk(s) shall be considered; the classification and packing group shall then be determined in accordance with the table of precedence of hazards in 2.1.3.10.

11.1 RID Dangerous Goods List

As a rule, each row of Table 30 deals with the substance(s) or article(s) covered by a specific UN number. However, when substances or articles belonging to the same UN number have different chemical properties, physical properties and/or carriage conditions, several consecutive rows may be used for that UN number.

Each column of Table 30 is dedicated to a specific subject as indicated in the explanatory notes below. The intersection of columns and rows (cell) contains information concerning the subject treated in that column, for the substance(s) or article(s) of that row:

- The first four cells identify the substance(s) or article(s) belonging to that row (additional information in that respect may be given by the special provisions referred to in Column (6));
- The following cells give the applicable special provisions, either in the form of complete information or in coded form. The codes cross-refer to detailed information that is to be found in the Part, Chapter, Section and/or Sub-section indicated in the explanatory notes below. An empty cell means either that there is no special provision and that only the general requirements apply, or that the carriage restriction indicated in the explanatory notes is in force. The applicable general requirements are not referred to in the corresponding cells. The explanatory notes below indicate for every column the Part(s), Chapter(s), Section(s) and/or Sub-section(s) where these are to be found.

The explanatory notes for Table 30 are given in Table 29.

Table 29. Explanatory notes for each column in RID

RID Code	Description
Column (1) "UN No."	Contains the UN number: – of the dangerous substance or article if the substance or article has been assigned its own specific UN number, or – of the generic or n.o.s. entry to which the dangerous substances or articles not mentioned by name shall be assigned in accordance with the criteria ("decision trees") of Part 2.

Column (2) "Name and description"	Contains, in upper case characters, the name of the substance or article, if the substance or article has been assigned its own specific UN number, or of the generic or n.o.s. entry to which it has been assigned in accordance with the criteria ("decision trees") of Part 2. This name shall be used as the proper shipping name or, when applicable, as part of the proper shipping name (see 3.1.2 for further details on the proper shipping name). A descriptive text in lower case characters is added after the proper shipping name to clarify the scope of the entry if the classification and/or carriage conditions of the substance or article may be different under certain conditions.
Column (3a) "Class"	Contains the number of the Class, whose heading covers the dangerous substance or article. This Class number is assigned in accordance with the procedures and criteria of Part 2.
Column (3b) "Classification code"	Contains the classification code of the dangerous substance or article. – For dangerous substances or articles of Class 1, the code consists of a division number and compatibility group letter, which are assigned in accordance with the procedures and criteria of 2.2.1.1.4. – For dangerous substances or articles of Class 2, the code consists of a number and hazardous property group, which are explained in 2.2.2.1.2 and 2.2.2.1.3. – For dangerous substances or articles of Classes 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 6.2, 8 and 9, the codes are explained in 2.2.x.1.2 ¹ . [1 x = the Class number of the dangerous substance or article, without dividing point if applicable]
Column (4) "Packing group"	Contains the packing group number(s) (I, II or III) assigned to the dangerous substance. These packing group numbers are assigned on the basis of the procedures and criteria of Part 2. Certain articles and substances are not assigned to packing groups.
Column (5) "Labels"	Contains the model number of the labels/placards (see 5.2.2.2 and 5.3.1.7) that have to be affixed to packages, containers, tank-containers, portable tanks, MEGCs, tank-wagons, wagons with demountable tanks, battery-wagons and wagons. The shunting labels in accordance with models Nos. 13 and 15 (see 5.3.4) indicated in brackets for some substances shall only be affixed in the following cases: – Class 1: on both sides of wagons which comprise a wagon load – Class 2: on both sides of tank-wagons, battery-wagons, wagons with demountable tanks and wagons carrying tank-containers, MEGCs and portable tanks. The general provisions on labelling/placarding (e.g. number of labels, their location) are to be found in 5.2.2.1 for packages and small containers, and in 5.3.1, for large containers, tank-containers, MEGCs, portable tanks, tank-wagons, wagons with demountable tanks, battery-wagons and wagons. NOTE: Special provisions, indicated in Column (6), may change the above labelling provisions.
Column (6) "Special provisions"	Contains the numeric codes of special provisions that have to be met. These provisions concern a wide array of subjects, mainly connected with the contents of Columns (1) to (5) (e.g. carriage prohibitions, exemptions from requirements, explanations concerning the classification of certain forms of the dangerous goods concerned and additional labeling or marking provisions), and are listed in Chapter 3.3 in numerical order. If Column (6) is empty, no special provisions apply to the contents of Columns (1) to (5) for the dangerous goods concerned.
Column (7) "Limited quantities"	Contains an alphanumeric code with the following meaning: – "LQ0" signifies that no exemption from the provisions of RID exists for the dangerous goods packed in limited quantities; – All the other alphanumeric codes starting with the letters "LQ" signify that the provisions of RID are not applicable if the conditions indicated in

	Chapter 3.4 are fulfilled (general conditions of 3.4.1 and conditions of 3.4.3, 3.4.4, 3.4.5 and 3.4.6, as appropriate, for the relevant code).
Column (8) "Packing instructions "	Contains the alphanumeric codes of the applicable packing instructions: – Alphanumeric codes starting with the letter "P", which refers to packing instructions for packagings and receptacles (except IBCs and large packagings), or "R", which refers to packing instructions for light gauge metal packagings. These are listed in 4.1.4.1 in numerical order, and specify the packagings and receptacles that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "P" or "R", the dangerous goods concerned may not be carried in packagings; – Alphanumeric codes starting with the letters "IBC" refer to packing instructions for IBCs. These are listed in 4.1.4.2 in numerical order, and specify the IBCs that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "IBC", the dangerous goods concerned may not be carried in IBCs; – Alphanumeric codes starting with the letters "LP" refer to packing instructions for large packagings. These are listed in 4.1.4.3 in numerical order, and specify the large packagings that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. If Column (8) does not contain a code starting with the letters "LP", the dangerous goods concerned cannot be carried in large packagings; – Alphanumeric codes starting with letters "PR" refer to packing instructions for particular pressure receptacles. These are listed in 4.1.4.4 in numerical order, and specify the pressure receptacles that are authorized. They also indicate which of the general packing provisions of 4.1.1, 4.1.2 and 4.1.3, and which of the special packing provisions of 4.1.5, 4.1.6, 4.1.7, 4.1.8 and 4.1.9 have to be met. NOTE: Special packing provisions, indicated in Column (9a), may change the above packing instructions.
Column (9a) "Special packing provisions"	Contains the alphanumeric codes of the applicable special packing provisions: – Alphanumeric codes starting with the letters "PP" or "RR" refer to special packing provisions for packagings and receptacles (except IBCs and large packagings) that have additionally to be met. These are to be found in 4.1.4.1, at the end of the relevant packing instruction (with the letter "P" or "R") referred to in Column (8). If Column (9a) does not contain a code starting with the letters "PP" or "RR", none of the special packing provisions listed at the end of the relevant packing instruction apply; – Alphanumeric codes starting with the letter "B" or the letters "BB" refer to special packing provisions for IBCs that have additionally to be met. These are to be found in 4.1.4.2, at the end of the relevant packing instruction (with the letters "IBC") referred to in Column (8). If Column (9a) does not contain a code starting with the letter "B" or the letters "BB", none of the special packing provisions listed at the end of the relevant packing instruction apply; – Alphanumeric codes starting with the letter "L" refer to special packing provisions for large packagings that have additionally to be met. These are to be found in 4.1.4.3, at the end of the relevant packing instruction (with the letters "LP") referred to in Column (8). If Column (9a) does not contain a code starting with the letter "L", none of the special packing provisions listed at the end of the relevant packing instruction apply.
Column (9b) "Mixed"	Contains the alphanumeric codes starting with the letters "MP" of the

packing provisions"	applicable mixed packing provisions. These are listed in 4.1.10 in numerical order. If Column (9b) does not contain a code starting with the letters "MP", only the general requirements apply (see 4.1.1.5 and 4.1.1.6).
Column (10) "Portable tank and bulk container instructions"	Contains an alphanumeric code assigned to a portable tank instruction, in accordance with 4.2.5.2.1 to 4.2.5.2.4 and 4.2.5.2.6. This portable tank instruction corresponds to the least stringent provisions that are acceptable for the carriage of the substance in portable tanks. The codes identifying the other portable tank instructions that are also permitted for the carriage of the substance are to be found in 4.2.5.2.5. If no code is given, carriage in portable tanks is not permitted unless a competent authority approval is granted as detailed in 6.7.1.3. The general requirements for the design, construction, equipment, type approval, testing and marking of portable tanks are to be found in Chapter 6.7. The general requirements for the use (e.g. filling) are to be found in 4.2.1 to 4.2.4. The indication of an "(M)" means that the substance may be carried in UN MEGCs. NOTE: Special provisions, indicated in Column (11), may change the above requirements. May also contain alphanumeric codes starting with the letters "BK" referring to types of bulk containers described in Chapter 6.11 which may be used for the carriage of bulk goods in accordance with 7.3.1.1 (a) and 7.3.2.
Column (11) "Portable tank and bulk container special provisions"	Contains the alphanumeric codes of the portable tank special provisions that have additionally to be met. These codes, starting with the letters "TP" refer to special provisions for the construction or use of these portable tanks. They are to be found in 4.2.5.3.
Column (12) "Tank codes for RID tanks"	Contains an alphanumeric code describing a tank type, in accordance with 4.3.3.1.1 (for gases of Class 2) or 4.3.4.1.1 (for substances of Classes 3 to 9). This tank type corresponds to the least stringent tank provisions that are acceptable for the carriage of the relevant substance in RID tanks. The codes describing the other permitted tank types are to be found in 4.3.3.1.2 (for gases of Class 2) or 4.3.4.1.2 (for substances of Classes 3 to 9). If no code is given, carriage in RID tanks is not permitted. If in this column a tank code for solids (S) and for liquids (L) is indicated, this means that this substance may be offered for carriage in tanks in the solid or the liquid (molten) state. In general this provision is applicable to substances having melting points from 20°C to 180°C. If for a solid, only a tank code for liquids (L) is indicated in this column, this means that this substance is only offered for carriage in tanks in the liquid (molten) state. The general requirements for the construction, equipment, type approval, testing and marking that are not indicated in the tank code are to be found in 6.8.1, 6.8.2, 6.8.3 and 6.8.5. The general requirements for the use (e.g. maximum degree of filling, minimum test pressure) are to be found in 4.3.1 to 4.3.4. The indication of a "(M)" after the tank code means that the substance can also be carried in battery-wagons or MEGCs. The indication of a "(+)" after the tank code means that the alternative use of the tanks is permitted only where this is specified in the certificate of type approval. For fibre-reinforced plastic tank-containers, see 4.4.1 and Chapter 6.9; for vacuum operated waste tanks, see 4.5.1 and Chapter 6.10. NOTE: Special provisions, indicated in Column (13), may change the above requirements.
Column (13) "Special provisions for RID tanks"	Contains the alphanumeric codes of the special provisions for RID tanks that have additionally to be met: – Alphanumeric codes starting with the letters "TU" refer to special provisions for the use of these tanks. These are to be found in 4.3.5;

	NOTE: The symbol "***" in relation to special provision TU38 means that this provision will not enter into force until 1 January 2007. – Alphanumeric codes starting with the letters "TC" refer to special provisions for the construction of these tanks. These are to be found in 6.8.4 (a); – Alphanumeric codes starting with the letters "TE" refer to special provisions concerning the items of equipment of these tanks. These are to be found in 6.8.4 (b); NOTE: The symbol "***" in relation to special provision TE22 means that this provision will not enter into force until 1 January 2007. – Alphanumeric codes starting with the letters "TA" refer to special provisions for the type approval of these tanks. These are to be found in 6.8.4 (c); – Alphanumeric codes starting with the letters "TT" refer to special provisions for the testing of these tanks. These are to be found in 6.8.4 (d); – Alphanumeric codes starting with the letters "TM" refer to special provisions for the marking of these tanks. These are to be found in 6.8.4 (e).
Column (14)	(Reserved)
Column (15) "Transport category"	Contains a figure indicating the transport category to which the substance or article is assigned for the purposes of exemption from transport operations performed by undertakings in connection with their main business (see 1.1.3.1 (c)).
Column (16) "Special provisions for carriage – Packages"	Contains the alphanumeric code(s), starting with letter "W", of the applicable special provisions (if any) for carriage in packages. These are listed in 7.2.4. General provisions concerning the carriage in packages are to be found in Chapters 7.1 and 7.2. NOTE: In addition, special provisions indicated in Column (18), concerning loading, unloading and handling, shall be observed.
Column (17) "Special provisions for carriage – Bulk"	Contains the alphanumeric code(s), starting with letters "VW", of the applicable special provisions for carriage in bulk. These are listed in 7.3.3. If no code is given, carriage in bulk is not permitted. General Provisions concerning the carriage in bulk are to be found in Chapters 7.1 and 7.3. NOTE: In addition, special provisions indicated in Column (18), concerning loading, unloading and handling, shall be observed.
Column (18) "Special provisions for carriage – Loading and unloading"	Contains the alphanumeric code(s), starting with letters "CW", of the applicable special provisions for loading, unloading and handling. These are listed in 7.5.11. If no code is given, only the general provisions apply (see 7.5.1 to 7.5.4 and 7.5.8).
Column (19) "Colis Express (express goods)"	Contains alphanumeric codes beginning with the letters "CE" for the requirements applicable to forwarding as Colis Express (express goods). These requirements are given in Chapter 7.6. When column 19 does not contain a code, forwarding as Colis Express (express goods) is not permitted.
Column (20) "Hazard identification number"	Contains a two or three figure number (preceded in certain cases by the letter "x") for substances and articles of classes 2 to 9, and for substances and articles of Class 1, the classification code (see column (3b)). In the cases described in 5.3.2.1, this number shall appear in the upper half of the orange-coloured marking. The meaning of the hazard identification numbers is explained in 5.3.2.3.

The RID regulations are in a format which is very similar to that of ADR and ADN.

Table 30. RID Packaging and Transportation Requirements

UN No.	Name and description 3.1.2	Class 2.2	Classification code 2.2	Packing group 2.1.1.3	Labels 5.2.2	Special provisions 3.3	Limited quantities 3.4.6	Packaging			Portable tanks and bulk containers		RID tanks		Transport category 1.1.3.1 (c)	Special provisions for carriage			Coles express 7.6	Hazard identification No. 5.3.2.3
								Packing instructions 4.1.4	Special packing provisions 4.1.4	Mixed packing provisions 4.1.10	Instruc- tions 4.2.5.2 7.3.2	Special provi- sions 4.2.5.3	Tank code 4.3	Special provision s 4.3.5 + 6.8.4		Packages 7.2.4	Bulk 7.3.3	Loading, unloading and handling 7.5.11		
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(11)	(12)	(13)	(15)	(16)	(17)	(18)	(19)	(20)
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	I	3+6.1	274	LQ0	P001		MP7 MP17	T14	TP2 TP9 TP27	L10CH	TU14 TU15 TU38* TE21 TE22*	1			CW13 CW28		336
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	II	3+6.1	274	LQ0	P001 IBC02		MP19	T7	TP2	L4BH	TU15 TE15	2			CW13 CW28	CE7	336
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	III	3+6.1	274	LQ7	P001 IBC03 R001		MP19	T7	TP1 TP28	L4BH	TU15 TE15	3			CW13 CW28	CE4	36
1993	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 175 kPa)	3	F1	I	3	274 640A	LQ3	P001		MP7 MP17	T11	TP1 TP9 TP27	L4BN		1					33
1993	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 110 kPa but not more than 175 kPa)	3	F1	I	3	274 640B	LQ3	P001		MP7 MP17	T11	TP1 TP9 TP27	L1.5BN		1					33
1993	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 110 kPa but not more than 175 kPa)	3	F1	II	3	274 640C	LQ4	P001		MP19	T7	TP1 TP8 TP28	L1.5BN		2				CE7	33
1993	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C not more than 110 kPa)	3	F1	II	3	274 640D	LQ4	P001 IBC02 R001		MP19	T7	TP1 TP8 TP28	LGBF		2				CE7	33
1993	FLAMMABLE LIQUID, N.O.S.	3	F1	III	3	274 640E	LQ7	P001 IBC03 LP01 R001		MP19	T4	TP1 TP29	LGBF		3				CE4	30
1993	FLAMMABLE LIQUID, N.O.S. (having a flash-point below 23 °C and viscous according to 2.2.3.1.4) (vapour pressure at 50 °C more than 175 kPa)	3	F1	III	3	274 640F	LQ7	P001 LP01 R001		MP19	T4	TP1 TP29	L4BN		3				CE4	33
1993	FLAMMABLE LIQUID, N.O.S. (having a flash-point below 23 °C and viscous according to 2.2.3.1.4) (vapour pressure at 50 °C more than 110 kPa but not more than 175 kPa)	3	F1	III	3	274 640G	LQ7	P001 LP01 R001		MP19	T4	TP1 TP29	L1.5BN		3				CE4	33

Transport, Storage and Handling of Fast Pyrolysis Liquids

UN No.	Name and description 3.1.2	Class 2.2	Classification code 2.2	Packing group 2.1.1.3	Labels 5.2.2	Special provisions 3.3	Limited quantities 3.4.6	Packaging			Portable tanks and bulk containers		RID tanks		Transport category 1.1.3.1 (c)	Special provisions for carriage			Colis express 7.6	Hazard identification No. 5.3.2.3
								Packing instructions 4.1.4	Special packing provisions 4.1.4	Mixed packing provisions 4.1.10	Instruc- tions 4.2.5.2 7.3.2	Special provi- sions 4.2.5.3	Tank code 4.3	Special provision s 4.3.5 + 6.8.4		Packages 7.2.4	Bulk 7.3.3	Loading, unloading and handling 7.5.11		
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)	(9a)	(9b)	(10)	(11)	(12)	(13)	(15)	(16)	(17)	(18)	(19)	(20)
1993	FLAMMABLE LIQUID, N.O.S. (having a flash-point below 23 °C and viscous according to 2.2.3.1.4) (vapour pressure at 50 °C not more than 110 kPa)	3	F1	III	3	274 640H	LQ7	P001 IBC02 LP01 R001		MP19	T4	TP1 TP29	LGBF		3				CE4	33
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	I	3+8	274	LQ3	P001		MP7 MP17	T14	TP2 TP9	L10CH	TU14 TU38* TE21 TE22*	1					338
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	II	3+8	274	LQ4	P001 IBC02		MP19	T11	TP2 TP27	L4BH	TE15	2				CE7	338
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	FC	III	3+8	274	LQ7	P001 IBC03 R001		MP19	T7	TP1 TP28	L4BN		3				CE4	38
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	3	FTC	I	3+6.1+8	274	LQ0	P001		MP7 MP17	T14	TP2 TP9 TP27	L10CH	TU14 TU15 TU38* TE21 TE22*	1			CW13 CW28		368
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	3	FTC	II	3+6.1+8	274	LQ0	P001 IBC02		MP19	T11	TP2 TP27	L4BH	TU15 TE15	2			CW13 CW28	CE7	368

11.2.1 RID Column 3b – Classification Code

The heading of Class 3 covers substances and articles containing substances of this Class which:

The substances and articles of Class 3, which may be applicable to fast pyrolysis liquids, are sub-divided as follows:

- F Flammable liquids, without subsidiary risk:
 - F1 Flammable liquids having a flash point of or below 61°C;
 - F2 Flammable liquids having a flash point above 61°C, which are carried or handed over for carriage at, or above their flash point (elevated temperature substance)
- FT Flammable liquids, toxic:
 - FT1 Flammable liquids, toxic;
- FC Flammable liquids, corrosive:
- FTC Flammable liquids, toxic, corrosive:

11.2.2 RID Column 6 - Special Provisions

The specification of the ADR special provisions are given in Table 31.

Table 31. RID Special Provisions on naming

RID reference	Description
274	The provisions of 3.1.2.8 apply. 3.1.2.8 Generic or "not otherwise specified" (N.O.S.) names 3.1.2.8.1 Generic and "not otherwise specified" proper shipping names that are assigned to special provision 274 in Column (6) of Table A in Chapter 3.2 shall be supplemented with the technical name of the goods unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of Class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical names shall be entered in brackets immediately following the proper shipping name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc. and the percentage of the technical constituent may also be used. For example: "UN 1993 FLAMMABLE LIQUID, N.O.S. (CONTAINS XYLENE AND BENZENE), 3, II". 3.1.2.8.1.1 The technical name shall be a recognized chemical name, if relevant a biological name, or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used.
640	The physical and technical characteristics mentioned in column (2) of Table A of Chapter 3.2 determine different tank codes for the carriage of substances of the same packing

	group in RID tanks. In order to identify these physical and technical characteristics of the product carried in the tank, the following shall be added, to the particulars required in the consignment note, only in case of carriage in RID tanks: "Special provision 640X" where "X" is the applicable capital letter appearing after the reference to special provision 640 in column (6) of Table A of Chapter 3.2. These particulars may, however, be dispensed with in the case of carriage in the type of tank which, for substances of a specific packing group of a specific UN number, meets at least the most stringent requirements.
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11.2.3 RID Column 7 - Limited Quantities

RID guidance and general requirements are given in Table 32 with the relevant RID reference and code details in Table 33.

Table 32 RID limited quantities guidance

RID reference	Description
3.4-1	The maximum gross mass of a combination packaging shall not exceed 30 kg and for shrink and stretched wrapped trays shall not exceed 20 kg. NOTE: The limit for combination packagings does not apply when LQ5 is used.
3.4.2	When the code "LQ0" is shown in Column (7) of Table 30 for a given substance or article, that substance or article is not exempted from any of the applicable provisions of Annexes A and B when it is packed in limited quantities, unless otherwise specified in these Annexes.
3.4.3	Unless otherwise provided, when one of the codes "LQ1" or "LQ2" is shown in Column (7) of Table 30 for a given substance or article, the provisions of other Chapters of RID do not apply to the carriage of that substance or article, provided: (c) The provisions of 3.4.5 (a) to (c) are observed; with respect to these provisions, articles are considered to be inner packagings; (d) Inner packagings meet the conditions of 6.2.1.2 and 6.2.4.1 to 6.2.4.3.
3.4.4	Unless otherwise provided in this Chapter, when the code "LQ3" is shown in Column (7) of Table A in Chapter 3.2 for a given substance, the provisions of other Chapters of RID do not apply to the carriage of that substance, provided: (d) The substance is carried in combination packagings, the following outer packagings being allowed: - steel or aluminium drums with removable head; - steel or aluminium jerricans with removable head; - plywood or fibre drums; - plastics drums or jerricans with removable head; - boxes of natural wood, plywood, reconstituted wood, fibreboard, plastics, steel or aluminium; and be so designed that they meet the relevant construction requirements of 6.1.4; (e) The maximum net quantities per inner packaging shown in columns (2) or (4) and per package in columns (3) or (5), where indicated, of table 3.4.6 are not exceeded; (f) Each package is clearly and durably marked with: (i) the UN number of the goods contained therein, as given in Column (1) of Table A in Chapter 3.2, preceded by the letters "UN"; (ii) in the case of different goods with different UN numbers within a single package: - the UN numbers of the goods contained therein,

	preceded by the letters "UN", or - the letters "LQ"². These markings shall be displayed within a diamond-shaped area surrounded by a line that measures at least 100 mm × 100 mm. The width of line forming the diamond shall be at least 2 mm; the number shall be at least 6 mm high. Where more than one substance assigned to different UN numbers are included in the package, the diamond shall be large enough to include each relevant UN number. If the size of the package so requires, the dimension may be reduced, provided the markings remain clearly visible.
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The packaging limits for limited quantities are given in Table 33.

Table 33. RID limits on combination and inner packaging

RID code	Combination packagings ^a Maximum net quantity		Inner packagings placed in shrink-wrapped or stretch-wrapped trays ^a Maximum net quantity	
	Per inner packaging	Per package ^b	Per inner packaging	Per package ^b
LQ0	No exemption under the conditions of 3.4.2.			
LQ3 ^c	500 ml	1 l	Not allowed	Not allowed
LQ4	3 l		1 l	
LQ7 ^c	5 l		5 l	

Notes:

^a The maximum gross mass of a combination packaging shall not exceed 30 kg and for shrink and stretched wrapped trays shall not exceed 20 kg.

NOTE: The limit for combination packagings does not apply when LQ5 is used.

^b Subject to the maximum limits in 3.4.1.2 and individual limits in table 3.4.6, dangerous goods may be packed together with other articles or substances, provided they will not react dangerously in the event of leakage.

^c In the case of homogenous mixtures of Class 3 containing water, the quantities specified relate only to the substance of Class 3 contained in those mixtures.

11.2.4 RID Column 8 - Packing Instructions

Packing instructions are given in Table 34 below.

Table 34. RID Packing instructions

IBC01 PACKING INSTRUCTION	
The following IBCs are authorized, provided the general provisions of 4.1.1 , 4.1.2 and 4.1.3 are met: Metal (31A, 31B and 31N).	
Additional requirement: Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.	
Special packing provision specific to RID and ADR: BB1 For UN No. 3130, the openings of receptacles for this substance shall be tightly closed by means of two devices in series, one of which shall be screwed or secured in an equivalent manner.	

2. The letters "LQ" are an abbreviation of the English words "Limited Quantities". The letters "LQ" are not permitted by the IMDG Code or the ICAO Technical Instructions.

IBC 02	PACKING INSTRUCTION	IBC 02
The following IBCs are authorized, provided the general provisions of 4.1.1, 4.1.2 and 4.1.3 are met:		
(1) Metal (31A, 31B and 31N);		
(2) Rigid plastics (31H1 and 31H2);		
(3) Composite (31HZ1).		
Additional requirement		
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.		
Special packing provisions		
B 5	For UN Nos. 1791, 2014, 2984 and 3149, IBCs shall be provided with a device to allow venting during carriage. The inlet to the venting device shall be sited in the vapour space of the IBC under maximum filling conditions during carriage.	
B 7	For UN Nos. 1222 and 1865, IBCs with a capacity greater than 450 litres are not permitted due to the substance's potential for explosion when carried in large volumes.	
B 8	The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.	

IBC 03	PACKING INSTRUCTION	IBC 03
The following IBCs are authorized, provided the general provisions of 4.1.1, 4.1.2 and 4.1.3 are met:		
(1) Metal (31A, 31B and 31N);		
(2) Rigid plastics (31H1 and 31H2);		
(3) Composite (31HZ1, 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2).		
Additional requirement		
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.		
Special packing provision		
B 8	The pure form of this substance shall not be carried in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.	

P 001		PACKING INSTRUCTION (LIQUIDS)			P 001
The following packagings are authorized provided the general provisions of 4.1.1 and 4.1.3 are met:					
Combination packagings		Maximum capacity/Net mass (see 4.1.3.3.)			
Inner packagings	Outer packagings	Packing group I	Packing group II	Packing group III	
Glass 10 l Plastics 30 l Metal 40 l	Drums steel (1A2) aluminium (1B2) metal other than steel or aluminium (1N2) plastics (1H2) plywood (1D) fibre (1G)	250 kg 250 kg 250 kg 250 kg 150 kg 75 kg	400 kg 400 kg 400 kg 400 kg 400 kg 400 kg	400 kg 400 kg 400 kg 400 kg 400 kg 400 kg	
	Boxes steel (4A) aluminium (4B) natural wood (4C1, 4C2) plywood (4D) reconstituted wood (4F) fibreboard (4G) expanded plastics (4H1) solid plastics (4H2)	250 kg 250 kg 150 kg 150 kg 75 kg 75 kg 60 kg 150 kg	400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 60 kg 400 kg	400 kg 400 kg 400 kg 400 kg 400 kg 400 kg 60 kg 400 kg	
	Jerricans steel (3A2) aluminium (3B2) plastics (3H2)	120 kg 120 kg 120 kg	120 kg 120 kg 120 kg	120 kg 120 kg 120 kg	
Single packagings					
Drums steel, non-removable head (1A1) steel, removable head (1A2) aluminium, non-removable head (1B1) aluminium, removable head (1B2) metal other than steel or aluminium, non-removable head (1N1) metal other than steel or aluminium, removable head (1N2) plastics, non-removable head (1H1) plastics, removable head (1H2)		250 l 250 l ^(a) 250 l 250 l ^(a) 250 l 250 l ^(a) 250 l 250 l ^(a)	450 l 450 l 450 l 450 l 450 l 450 l 450 l 450 l	450 l 450 l 450 l 450 l 450 l 450 l 450 l 450 l	
Jerricans steel, non-removable head (3A1) steel, removable head (3A2) aluminium, non-removable head (3B1) aluminium, removable head (3B2) plastics, non-removable head (3H1) plastics, removable head (3H2)		60 l 60 l ^(a) 60 l 60 l ^(a) 60 l 60 l ^(a)	60 l 60 l 60 l 60 l 60 l 60 l	60 l 60 l 60 l 60 l 60 l 60 l	
Single packagings (cont'd)					
Composite packagings plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1) plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1) plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2) glass receptacle with outer steel, aluminium, fibreboard, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)		250 l 120 l 60 l 60 l	250 l 250 l 60 l 60 l	250 l 250 l 60 l 60 l	
Additional requirement					
For substances of Class 3, packing group III, which give off small quantities of carbon dioxide or nitrogen, the packagings shall be vented.					

Note:^(a) Only substances with a viscosity of more than 2680 mm²/s are authorised.

11.2.5 RID Column 9b - Mixed packing instructions

When mixed packing is permitted in accordance with the RID provisions, different dangerous goods or dangerous goods and other goods may be packed together in combination packagings conforming to 6.1.4.21, provided that they do not react dangerously with one another and that all other relevant provisions are complied with.

When indicated for a given entry in Column (9b) of Table 30, the following special provisions as described in Table 35 shall apply to the mixed packing of the goods assigned to that entry with other goods in the same package.

Table 35. RID Special Provisions for Mixed Packaging

RID Reference	Description
MP 7	May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of the same class covered by other classification codes when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of RID, provided they do not react dangerously with one another.
MP 17	May - in quantities not exceeding 0.5 litre per inner packaging and 1 litre per package - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of other classes, except Class 7, when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of RID, provided they do not react dangerously with one another.
MP 19	May - in quantities not exceeding 5 litres per inner packaging - be packed together in a combination packaging conforming to 6.1.4.21: - with goods of the same class covered by other classification codes or with goods of other classes, when mixed packing is also permitted for these; or - with goods which are not subject to the requirements of RID, provided they do not react dangerously with one another.

11.2.6 RID Column 10 - Portable Tanks and Bulk Containers: Instructions

Portable tank instructions specify the requirements applicable to a portable tank when used for the carriage of specific substances. Portable tank instructions T1 to T22 specify the applicable minimum test pressure, the minimum shell thickness (in mm reference steel), and the pressure-relief and bottom-opening requirements. Those applicable to pyrolysis liquid are given in Table 36.

Table 36. RID portable tank instructions

PORTABLE TANK INSTRUCTIONS				
<i>These portable tank instructions apply to liquid and solid substances of Classes 3 to 9. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met.</i>				
Portable tank instruction	Minimum test pressure (bar)	Minimum shell thickness (in mm reference steel) (see 6.7.2.4)	Pressure-relief requirements^a (see 6.7.2.8)	Bottom opening requirements (see 6.7.2.6)
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T14	6	6mm	See 6.7.2.8.3	Not allowed

The details for the sections referred to in Table 34 are given in Table 37.

Table 37. RID vessel requirements

RID reference	Description
6.7.2.4.2	The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.
6.7.2.6.3	Every bottom discharge outlet, except as provided in 6.7.2.6.2, shall be equipped with three serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and include: (a) A self-closing internal stop-valve, that is a stop-valve within the shell or within a welded flange or its companion flange, such that: (i) The control devices for the operation of the valve are designed so as to prevent any unintended opening through impact or other inadvertent act; (ii) The valve may be operable from above or below; (iii) If possible, the setting of the valve (open or closed) shall be capable of being verified from the ground; (iv) Except for portable tanks having a capacity of not more than 1 000 litres, it shall be possible to close the valve from an accessible position of the portable tank that is remote from the valve itself; and (v) The valve shall continue to be effective in the event of damage to the external device for controlling the operation of the valve; (b) An external stop-valve fitted as close to the shell as reasonably practicable; and (c) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.
6.7.2.8.3	When required for certain substances by the applicable portable tank instruction indicated in Column (10) of Table 14 of Chapter 3.2 and described in 4.2.5.2.6, portable tanks shall have a pressure-relief device approved by the competent

	authority. Unless a portable tank in dedicated service is fitted with an approved relief device constructed of materials compatible with the substance carried, the relief device shall comprise a frangible disc preceding a spring-loaded pressure-relief device. When a frangible disc is inserted in series with the required pressure-relief device, the space between the frangible disc and the pressure-relief device shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure-relief system. The frangible disc shall rupture at a nominal pressure 10% above the start to discharge pressure of the relief device.
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The full details of tank specifications are beyond the scope of this work and the reader is referred to the RID Regulations for further detailed information on tank and vessel specifications and testing procedures (4).

11.2.7 RID Column 11 - Portable Tanks and Bulk Container: Provisions

RID portable tank provisions are given in Table 38.

Table 38. RID Portable tank provisions

RID Code	Description
TP1	The degree of filling prescribed in 4.2.1.9.2 shall not be exceeded $\text{Degree of filling} = \frac{97}{1 + \alpha(t_r - t_f)}$
TP2	The degree of filling prescribed in 4.2.1.9.3 shall not be exceeded $\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$
	In these formulae, α is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transport (t_r) (both in °C). For liquids transported under ambient conditions α could be calculated by the formula: $\alpha = \frac{d_{15} - d_{50}}{35d_{50}}$ in which d_{15} and d_{50} are the densities of the liquid at 15°C and 50°C, respectively.
TP8	The test pressure for the portable tank may be reduced to 1.5 bar when the flash point of the substances transported is greater than 0°C.
TP9	A substance under this description shall only be transported in a portable tank under an approval granted by the competent authority.
TP27	A portable tank having a minimum test pressure of 4 bar may be used if it is shown that a test pressure of 4 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP28	A portable tank having a minimum test pressure of 2.65 bar may be used if it is shown that a test pressure of 2.65 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP29	A portable tank having a minimum test pressure of 1.5 bar may be used if it is shown that a test pressure of 1.5 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

11.2.8 RID Column 12 – Tank Codes

The four parts of the codes (tank codes) given in Column (12) of RID Packaging and Transportation Requirements have the following meanings as given in RID Tank Codes description.

Table 39. RID Tank Codes description

Part	Description	Tank Code
1	Types of tank	L = tank for substances in the liquid state (liquids or solids handed over for carriage in the molten state);
2	Calculation pressure	G = minimum calculation pressure in bar general requirements of 6.8.2.1.14; or 1.5; 2.65; 4; 10; 15 or 21= minimum calculation pressure in bar (see 6.8.2.1.14).
3	Openings (see 6.8.2.2.2)	A = tank with bottom-filling and discharge openings with 2 closures; B = tank with bottom-filling and discharge openings with 3 closures; C = tank with top-filling and discharge openings with only cleaning openings below the surface of the liquid; D = tank with top-filling and discharge openings with no openings below the surface of the liquid.
4	Safety valves/devices	V = tank with a venting system, according to 6.8.2.2.6, but no flame trap; or non-explosion-pressure proof tank; F = tank with a venting system, according to 6.8.2.2.6, fitted with a flame trap; or explosion-pressure proof tank; N = tank without a venting system according to 6.8.2.2.6 and not hermetically closed; H = hermetically closed tank (see 1.2.1).

Tanks with tank codes different from those indicated in this table or in Table A of Chapter 3.2 may also be used provided that:

- the first part of the code (L or S) remains unchanged and
- any other element (number or letter) of parts 2 to 4 of these tank codes correspond to a level of safety at least equivalent to the corresponding element of the tank code indicated in Table A of Chapter 3.2, according to the following increasing order:

Part 2: Calculation pressure

G → 1.5 → 2.65 → 4 → 10 → 15 → 21 bar

Part 3: Openings

A → B → C → D →

Part 4: Safety valves/devices

V → F → N → H.

For example, a tank with the tank code L10CN is authorized for the carriage of a substance to which the tank code L4BN has been assigned.

11.2.9 RID Column 13 - Tanks: Special Provisions

The RID special provisions for tanks are detailed in Table 40.

Table 40. RID Tank Special provisions

RID Code	Description
TU14	The protective caps of closures shall be locked during carriage.
TU15	Tanks shall not be used for the carriage of foodstuffs, articles of consumption or animal feeds.
TU38*	See note
TU21	The substance shall, if water is used as a protective agent, be covered with a depth of not less than 12 cm of water at the time of filling; the degree of filling at a temperature of 60 °C shall not exceed 98%. If nitrogen is used as a protective agent, the degree of filling at a temperature of 60 °C shall not exceed 96%. The remaining space shall be filled with nitrogen in such a way that, even after cooling, the pressure at no time falls below atmospheric pressure. The tank shall be closed in such a way that no leakage of gas occurs.
TE15	Tanks fitted with vacuum valves which open at a negative pressure of not less than 21 kPa (0.21 bar) shall be considered as being hermetically closed. Shells shall also be considered as being hermetically closed if they are fitted with a controlled, spring-loaded ventilation (auto-vent) valve which opens at a negative pressure in excess of 0.21 bar.
TE21	The closures shall be protected with lockable caps.
TE22	In the event of a collision shock or accident, each end of tank-wagons for liquids and gases or battery- wagons shall be capable of absorbing at least 800 kJ of energy by means of elastic or plastic deformation of defined components of the subframe or by means of a similar procedure (e.g. crash elements). Energy absorption by means of plastic deformation shall only occur in conditions other than those encountered during normal conditions of rail transport.

NOTE: The symbol "*" in relation to the indication of special provision TU38 in column (13) of Table A of Chapter 3.2 means that this provision will not enter into force until 1 January 2007. (Reserved)

11.2.10 RID Column 15 - Transport category

Where, in accordance with 1.1.3.1 (c) of the RID regulations (4), dangerous goods of the same transport category are carried in the same wagon or large container, the maximum total quantity is indicated in column (3) of Table 41.

Table 41. RID Limits on comparable class 3 materials: maximum quantities per wagon

Transport category	Substances or articles packing group or classification code/group or UN No.	Maximum total quantity per wagon or large container
1	Substances and articles belonging to packing group I	20
2	Substances or articles belonging to packing group II and not classified in transport categories 0, 1 or 4 and substances of the following classes:	333

	Class 6.1: substances and articles belonging to packing group III	
3	Substances and articles belonging to packing group III and not classified in transport categories 0, 2 or 4.	1000

In the above table, "maximum total quantity per wagon or large container" means for liquids and compressed gases, nominal capacity of receptacles in litres.

11.2.11 RID Column 18 - Special Provisions for Carriage: Loading, unloading and handling

In addition to the provisions of 7.5.1 to 7.5.4 and 7.5.8, the following special provisions shall apply when an alphanumeric code beginning with "CW" is shown in column (18) of Table A of Chapter 3.2.

Table 42. RID special provisions for Carriage: Loading, unloading and handling

RID Code	Description
CW 13	If any substances have leaked and been spilled in a wagon or container, it may not be re-used until after it has been thoroughly cleaned and, if necessary, disinfected or decontaminated. Any other goods and articles carried in the same wagon or container shall be examined for possible contamination.
CW 28	Precautions with respect to foodstuffs, other articles of consumption and animal feeds If special provision CW28 is indicated for a substance or article in column (18) of Table 30, precautions with respect to foodstuffs, other articles of consumption and animal feeds shall be taken as follows: Packages as well as uncleaned empty packagings, including large packagings and intermediate bulk containers (IBCs), bearing labels conforming to models Nos. 6.1 or 6.2 and those bearing labels conforming to model No. 9 containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, shall not be stacked on or loaded in immediate proximity to packages known to contain foodstuffs, other articles of consumption or animal feeds in wagons, in containers and at places of loading, unloading or transshipment. When these packages, bearing the said labels, are loaded in immediate proximity of packages known to contain foodstuffs, other articles of consumption or animal feeds, they shall be kept apart from the latter: (a) by complete partitions which should be as high as the packages bearing the said labels; (b) by packages not bearing labels conforming to models Nos. 6.1, 6.2 or 9 or packages bearing labels conforming to model No.9 but not containing goods of UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245; or (c) by a space of at least 0.8 m; unless the packages bearing the said labels are provided with an additional packaging or are completely covered (e.g. by a sheeting, a fibreboard cover or other measures).

11.2.12 RID Column 19-Code Express

In accordance with RIEx § 2 (Annex IV of the CIM Uniform Rules), goods are only permitted for carriage as express goods when a special provision with an

alphanumeric code beginning with the letters "CE" is shown in column (19) of Table 30 specifically authorizing this form of transport, and the conditions of this special provision are complied with. The following special provisions apply when they are shown under an entry in column (19) of Table 30 as described in Table 43.

Table 43. RID Code Express limitations

RID Code	Description
CE4	An express parcels package shall not contain more than 45 litres of this substance and shall not weigh more than 50 kg.
CE7	An express parcels package shall not contain more than 6 litres of this substance.

11.2.13 RID Column 20 - Hazard Identification No.

The hazard identification numbers listed in Column (20) of Table 30 have the following meanings:

- 33 Highly flammable liquid (flash-point below 23 °C)
- 338 Highly flammable liquid, corrosive

As can be seen the, provisions for RID are very close to those of ADR and with the further harmonisation of the regulations for each transport mode, the minor distinctions will go.

12. ANNEX III: Air – IATA

The shipment of dangerous goods by air is covered by the IATA transportation regulations (7). The main difference between the UN specification package and the limited quantity specification is the testing. The limited quantity packaging, when packed for transport must be capable of withstanding a drop from four feet high in a position most likely to cause damage, without leaking, and be capable of withstanding — without breaking or leaking — a 24-hour stacking test. Although the packages must still be tested and constructed according to the UN specification standards, these packages do not need to bear the UN specification mark. The shipper will advise the supplier as appropriate.

It is unlikely that bulk samples of pyrolysis liquids will be sent by air, due to the costs involved, however, small samples for analysis may be sent as a matter of expediency. In this case, they will be treated as dangerous goods in excepted quantities. This section on air transport is therefore restricted to dangerous goods in excepted quantities.

12.1 IATA dangerous goods in excepted quantities

Very small quantities of dangerous goods may be transported, as described below, in such a manner that they may be excepted from the marking, labelling and documentation requirements of the IATA Regulations. When they are transported under these provisions, they are called dangerous goods in excepted quantities. Dangerous goods in excepted quantities are also subject to certain provisions relating to training, dangerous goods in airmail, classification and packing group, loading restrictions and reporting of dangerous goods accidents, incidents and other occurrences. For pyrolysis liquids, classed as Class 3, then the limits are shown in Table 44.

Table 44. Limitations on Packagings for dangerous goods in excepted quantities

Packing Group	I		II		III	
Class or Division or subsidiary risk	Packagings		Packagings		Packagings	
	Inner	Outer	Inner	Outer	Inner	Outer
Class3	30 ml	300 ml	30 ml	500 ml	30 ml	1 L

Note: there are airline variations on file and not all airlines will necessarily accept pyrolysis liquids as dangerous goods in excepted quantities. The shipping agent will know which airlines will not accept dangerous goods in excepted quantities.

Dangerous goods in excepted quantities are not permitted in or as checked or carry-on baggage nor in the mail. Shippers must ensure that packages comply with IATA standard conditions [Section 5.0.4 of the IATA Regulations].

12.2 Labelling of dangerous goods in excepted quantities

Each package containing dangerous goods in excepted quantities must be labelled with a label having a minimum dimension of 100 x 100 mm, which conforms in shape, colour and format to that shown in Figure 6. A label must be affixed or printed on the package on a contrasting background,. If the package is included in an overpack, this label must be clearly visible or appear on the overpack also. The border of the label must have a red diagonal hatching. The label may be printed in black and red on white paper o it may be printed in red only on white paper.

DANGEROUS GOODS IN EXCEPTED QUANTITIES

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.

Signature of Shipper

Title

Date

Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

Class: 2 3 4 5 6 8 9

☐ ☐ ☐ ☐ ☐ ☐ ☐

and the applicable UN Numbers are:

Figure 6. Dangerous Goods Label – Excepted Quantities Only

It should be noted that any pyrolysis liquids falling within Packing Group I are not permitted for transport by air. Limitations on the transport of packing groups II and III are summarised in Table 45. For such quantities, a separate Waybill and good declaration must be completed. These will be supplied by the transportation or airfreight company.

Table 45. IATA Identification for UN N.OS. specifications

UN No.	Proper Shipping Name and Description	Class or Division	Sub. Risk	Hazard Label(s)	Packin g Group	Passenger and Cargo Aircraft				Cargo Aircraft Only		S.P. see 4.4	ERG code
						Ltd Quantity		Pkg Inst	Max Net Qty/Pkg	Pkg Inst	Max Net Qty/Pkg		
						Pkg Inst	Max Net Qty/Pkg						
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)
199 2	FLAMMABLE LIQUID, TOXIC, N.O.S.*	3	6.1	Flammable Liquid & toxic	I	-	-	X	X	303	30 L	A3	3HP
		3	6.1		II	Y305	1 L	305	1 L	307	60 L		3HP
		3	6.1		III	Y309	2 L	309	60 L	310	220 L		3P
199 3	FLAMMABLE LIQUID, N.O.S.*	3		Flammable Liquid	I	-	-	302	1 L	303	30 L	A3	3H
					II	Y305	1 L	305	5 L	307	60 L		3H
					III	Y309	10 L	309	60 L	310	220 L		3L
292 4	FLAMMABLE LIQUID, CORROSIVE, N.O.S.*	3	8	Flammable Liquid & corrosive	I	-	-	302	0.5 L	303	2.5 L	A3	3CH
		3	8		II	Y305	0.5 L	305	1 L	307	5 L		3CH
		3	8		III	Y309	1 L	309	5 L	310	60 L		3C
328 6	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S. *	3	6.1 + 8	Flammable Liquid, Toxic & corrosive	I	-	-	X	X	303	2.5 L		3CP
		3	6.1 + 8		II	Y305	0.5 L	305	1 L	307	5 L		3CP

Notes:

* Generic and n.o.s. (not otherwise specified) indicated by the inclusion of * in Column B of the Dangerous Goods List must be supplemented with the technical or chemical group names in brackets immediately following the proper shipping name. The technical name shall be a recognized chemical or other name currently used in scientific and technical handbooks, journals and texts.

X Forbidden for transport by air

12.2.1 IATA Columns G, I and K -Passenger and Cargo traffic Ltq Quantity Packing Instructions

The packaging list is fairly straightforward for Class 3 liquids and these are found in Columns G, I and K, for which the restrictions are given below. Note that there are airlines which will not accept Class 3 liquids for shipment and they are noted in the tables.

Table 46. IATA Packing Instructions for Passenger and Cargo Aircraft

PACKING INSTRUCTION Y305															
STATE VARIATIONS: BEG-03, SAG-01, USG-04/08/13															
OPERATOR VARIATIONS AA-01, AF-02, AS-02, CI-01, FX-02, GF-04, IR-06, KJ-01, LH-01, LX-02, MH-14, MX-03, RG-01/04, SV-02, TN-04, TR-04, UA-01/02															
For Limited Quantities of flammable liquid in Packing Group II and UN3248.															
The General Packing Requirements of Subsection 5.0.2 (with the exception of 5.0.2.3, 5.0.2.5, 5.0.2.11(f), 5.0.2.11(g) and 5.0.2.14) must be met except that the packagings do not have to meet the marking and testing requirements of 6.0.4 and Subsection 6.3. Packagings must meet the construction criteria specified in Subsections 6.1 and 6.2 and the test criteria specified in Subsection 6.6. The requirements of Subsection 2.8 must be met. Single packagings are not permitted. Limited quantities of flammable liquids assigned to this packing instruction must be packed in one of the following inner packagings. The inner packagings must be packed in one of the following sturdy outer packagings with sufficient cushioning/absorbent material so as to prevent movement/leakage. The maximum quantity in each outer package must not exceed the quantity shown in Column H of the List of Dangerous Goods. The gross weight of the completed package must be 30kg (66 lb) or less.															
COMBINATION PACKAGINGS															
INNER PACKAGINGS															
Desc.		Glass, Earthenware (IP1)				Plastic (IP2)			Metal (not aluminium) (IP3)			Aluminium (IP3A)		Glass ampoule (IP8)	
Unit		L				L			L			L		L	
Max. Qty		0.5				0.5			0.5			0.5		0.5	
OUTER PACKAGINGS															
Type	Drums					Jerricans			Boxes						
Desc.	Steel	Aluminium	Plywood	Fibre	Plastic	Steel	Aluminium	Plastic	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic
PPR															83
Particular Packing Requirements (PPR)															
83	Solid plastic boxes must be used.														

PACKING INSTRUCTION Y309																
STATE VARIATIONS: BEG-02, USG-04/13																
OPERATOR VARIATIONS: AA-01, AF-02, AS-02, CI-01, CX-03, FX02, GF-04, KJ-01, LH-01, LX-02, MH-14, MX-03, SV-02, TN-04, UA-01																
For Limited Quantities of flammable liquids in Packing Group III.																
The General Packing Requirements of Subsection 5.0.2 (with the exception of 5.0.2.3, 5.0.2.5, 5.0.2.11(f), 5.0.2.11(g) and 5.0.2.14) must be met except that the packagings do not have to meet the marking and testing requirements of 6.0.4 and Subsection 6.3. Packagings must meet the construction criteria specified in Subsections 6.1 and 6.2 and the test criteria specified in Subsection 6.6.																
The requirements of Subsection 2.8 must be met. Single packagings are not permitted. Limited quantities of flammable liquids assigned to this packing instruction must be packed in one of the following inner packagings. The inner packagings must be packed in one of the following sturdy outer packagings with sufficient cushioning/absorbent material so as to prevent movement/leakage.																
The maximum quantity in each outer package must not exceed the quantity shown in Column H of the List of Dangerous Goods. The gross weight of the completed package must be 30kg (66lb) or less.																
COMBINATION PACKAGINGS																
INNER PACKAGINGS																
Desc.		Glass, Earthenware (IP1)			Plastic (IP2)			Metal (not aluminium) (IP3)			Aluminium (IP3A)			Glass ampoule (IP8)		
Unit		L			L			L			L			L		
Max. Qty		2.5			5			5			5			0.5		
OUTER PACKAGINGS																
Type	Drums					Jerricans			Boxes							
Desc.	Steel	Aluminium	Plywood	Fibre	Plastic	Steel	Aluminium	Plastic	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic	

PACKING INSTRUCTION 303

STATE VARIATIONS: BEG-03, USG-06/08/13

OPERATOR VARIATIONS: AA-01, AS-02, CI-01, CX-03, FX-02, IC-03, JL-09, KA-03, MX-03, RG-04, SK-04, SQ-03, TR-04, TU-05, UA-01

The General Packing Requirements of Subsection 5.0.2 must also be met.

Combination and single packagings are permitted.

COMBINATION PACKAGINGS

INNER PACKAGINGS

Desc.	Glass, Earthenware	Plastic	Metal (not aluminium)	Aluminium	Glass ampoule
Spec.	IP1	IP2	IP3	IP3A	IP8
Unit	L	L	L	L	L
Max. Qty	1.0	5.0	5.0	5.0	0.5
PPR		84			

Particular Packing Requirements (PPR)

84. Combination Packagings with inner plastic (IPP2) packagings are not permitted for liquids with a boiling point of 35°C (95°F) or less.

OUTER PACKAGINGS

Type	Drums				Jerricans		Boxes						
Desc.	Steel	Aluminium	Plywood	Fibre	Steel	Aluminium	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic
Spec	1A2	1B2	1D	1G	3A2	3B2	4A	4B	4C14C2	4D	4F	4G	4H2

SINGLE PACKAGING

Type	Drums		Jerricans		Composites	Cylinders
Desc.	Steel	Aluminium	Steel	Plastic		
Spec.	1A1		1B1	3A1	All	As permitted in PI 200

PACKING INSTRUCTION 305

STATE VARIATIONS: BEG-03, USG-04/08/13

OPERATOR VARIATIONS AA-01, AS-02, CI-01, FX-02, IC-03, IR-06, KJ-01, MX-03, RG-01/04, TR-04, TU-05, UA-01/02

This instruction applies to flammable liquids in Packing Group II and UN3248 on passenger and cargo aircraft.

The General Packing Requirements of 5.0.2 must be met.

Single packagings are not permitted.

COMBINATION PACKAGINGS

INNER PACKAGINGS

Desc.	Glass, Earthenware	Plastic	Metal (not aluminium)	Aluminium	Glass ampoule
Spec.	IP1	IP2	IP3	IP3A	IP8
Unit	L	L	L	L	L
Max. Qty	1.0	5.0	5.0	5.0	0.5

OUTER PACKAGINGS

Type	Drums					Jerricans			Boxes						
Desc.	Steel	Aluminium	Plywood	Fibre	Plastic	Steel	Aluminium	Plastic	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic
Spec.	1A2	1B2	1D	1G	1H2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H2

PACKING INSTRUCTION 307

STATE VARIATIONS: BEG-03, USG-04/08/13

OPERATOR VARIATIONS AA-01, AS-02, CI-01, CX-03, FX-02, IC-03, IR-06, JL-09, KA-05, KJ-01, MX-03, RG-01/04, SK-04, SQ-03, TG-02, TR-04, TU-05, UA-01/02

This instruction applies to flammable liquids in Packing Group II and UN3248 on CAO.

The General Packing Requirements of 5.0.2 must be met. Single packagings are not permitted.

COMBINATION PACKAGINGS

INNER PACKAGINGS

Desc.	Glass, Earthenware	Plastic	Metal (not aluminium)	Aluminium	Glass ampoule
Spec.	IP1	IP2	IP3	IP3A	IP8
Unit	L	L	L	L	L
Max. Qty	2.5	5.0	10.0	10.0	0.5

OUTER PACKAGING

Type	Drums					Jerricans			Boxes						
Desc.	Steel	Aluminium	Plywood	Fibre	Plastic	Steel	Aluminium	Plastic	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic
Spec.	1A2	1B2	1D	1G	1H2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H2

SINGLE PACKAGING

Type	Drums			Jerricans		Composites	Cylinders
Desc.	Steel	Aluminium	Plastic	Steel	Plastic	Plastic	
Spec.	1A1	1B1	1H1	3A1	3H1	All	As permitted in PI 200

PACKING INSTRUCTION 310

STATE VARIATIONS: BEG-03, USG-04/08/13

OPERATOR VARIATIONS AA-01, AS-02, CI-01, CX-03, FX-02, IC-03, JL-09, KA-05, KJ-01, MX-03, SK-04, SQ-03, TG-02, TR-04, TU-05, UA-01

This instruction applies to flammable liquids in Packing Group III on CAO.

The General Packing Requirements of 5.0.2 must be met. If the substance has a subsidiary corrosive risk, all of these packagings must meet Packing Group II performance standards. Combination and single packagings are not permitted.

COMBINATION PACKAGINGS

INNER PACKAGINGS

Desc.	Glass, Earthenware	Plastic	Metal (not aluminium)	Aluminium	Glass ampoule
Spec.	IP1	IP2	IP3	IP3A	IP8
Unit	L	L	L	L	L
Max. Qty	2.5	5.0	10.0	10.0	0.5

OUTER PACKAGING

Type	Drums					Jerricans			Boxes						
Desc.	Steel	Aluminium	Plywood	Fibre	Plastic	Steel	Aluminium	Plastic	Steel	Aluminium	Wood	Plywood	Reconstituted wood	Fibre-board	Plastic
Spec.	1A2	1B2	1D	1G	1H2	3A2	3B2	3H2	4A	4B	4C1 4C2	4D	4F	4G	4H2

SINGLE PACKAGING

Type	Drums			Jerricans		Composites	Cylinders
Desc.	Steel	Aluminium	Plastic	Steel	Plastic	Plastic	
Spec.	1A1	1B1	1H1	3A1	3H1	All	As permitted in PI 200

12.2.2 IATA Column M – Special Provisions

A3 code is for shipping agents and is not covered here, but full details are in the regulations for appropriately trained transporters.

12.2.3 IATA Column N – ERG Code

The ERG code – Emergency Response Guide code is for shipping agents and is not covered here, but full details are in the regulations for appropriately trained transporters.

12.3 Shippers Paperwork for Shipment of Dangerous Goods

12.3.1 Shippers Declaration (IATA Section 8.02)

The supplier is responsible for the completion of a "Shippers Declaration for Dangerous Goods" for each and every shipment containing dangerous goods, unless exempted by other parts of this regulation. For each shipment containing "dangerous goods", the shipper must use the appropriate form, as shown in Figure 7. MSDSs shall be placed into the package for shipment, which is to be received by the destination, and a copy shall be provided to the transporter with the Shippers

Declaration. At this time, there are no internationally recognised MSDS for pyrolysis liquids and each manufacturer of liquids is using their own derived MSDS relevant to the liquids which they are producing.

12.3.2 Air Waybill

Air waybill(s) that are to be completed for the shipment of "Dangerous Goods" must include the following statements, as applicable in the "Handling Information Box"

Example:

"Dangerous Goods as per attached Shippers Declaration or Dangerous Goods as per attached Dangerous Goods Declaration, or "Cargo Aircraft Only" or "CAO"

Exception:

If the articles or substances are exempted because of quantity limitations or country or state variations (IATA Section 2.9 - Appendix A) a "Shippers Declaration" may not be required for the "Dangerous Goods." However, "The Nature and Quantity of Goods" box on the Air Way Bill must indicate in proper sequence:

- Proper Shipping Name
- Class or Division Number
- UN or ID Number (ex: UN 1993)
- Packing Group (I, II or III)
- Subsidiary Risk
- Number of Packages
- Net Quantity per package, and
- Packing Instruction Number

If a "Shippers Declaration" is not required for exempted articles or substances in limited quantities, then the "Nature and Quantity of Goods" box must have the following typed in "Dangerous Goods in Exempted Quantities". An example form is given in Figure 7.

12.3.3 Training Requirements for IATA shipments

Shipment by air is the only mode of transportation requiring those who deal with the liquids to have undergone specific training to IATA requirements. This is another factor which may deter shippers from sending any liquids by air transport. The IATA requirements are:

- Training must be provided to any person(s) who will have the responsibility of packaging and shipping "Dangerous Goods" by air.
- Training recertification for IATA Requirements must take place within 24 months of previous training.
- Training for Ground Transport of "Dangerous Goods" shall be provided by the transporter/common carrier.

Applicable IATA Training must be provided to:

- Transporters/Operators
- Agencies that accept, handle, load, unload or transfer "Dangerous Goods"
- Airport "Dangerous Goods" handlers, loaders, unloaders
- Agencies that process "Dangerous Goods"
- Shippers of Dangerous Goods
- Agencies engaged in security screening of passengers and their baggage

Training must include:

- General Familiarisation Training on the rules and regulations of IATA, ICAO, FAA, DOT and applicable shipper Standard Operating Guidelines.
- Function Specific Training - detailed training for the specific articles and substances being shipped.
- Environmental Health & Safety Training which must cover the hazards associated with the handling, packaging, processing, loading, unloading and emergency response procedures.

Training Records must include:

- Name of Individual
- Date of Initial Training or Recertification
- Training Content
- Name and address of company supplying the training
- A copy of certification for the individual who successfully completed the training.

It is recommended that if a producer of liquids needs to send sample by air that a trained person from a transportation company is used to ensure compliance with the IATA requirements.

Figure 7. IATA Shippers Declaration form

Shipper's Declaration Specimen Designed for Manual Completion

SHIPPER'S DECLARATION FOR DANGEROUS GOODS

Shipper

Air Waybill No.

Page of Pages

Shipper's Reference Number
(optional)

Consignee

*For optional use
for
Company logo
name and address*

*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.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for:
(delete non-applicable)

PASSENGER AND CARGO AIRCRAFT	CARGO AIRCRAFT ONLY
------------------------------	---------------------

Airport of Departure:

Airport of Destination:

Shipment type: (delete non-applicable)

NON-RADIOACTIVE	RADIOACTIVE
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NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification

UN or ID No.	Proper Shipping Name	Class or Division (Subsidiary Risk)	Packing Group	Quantity and type of packing	Packing Inst.	Authorization
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Additional Handling Information

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. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory

Place and Date

Signature
(see warning above)

13. ANNEX IV: Sea - IMO

The shipment of dangerous substances by sea is covered by the IMO Transportation Regulations (6). Class 3 liquids have the same definition in the IMO IMDG Regulations (6) as the UN regulations defined in Section 2. Note that IBCs are not permitted to be used for Packing Group I substances.

13.1 IMO Dangerous Goods List

The IMO dangerous list from the regulations for the UN N.O.S entries applicable to pyrolysis liquids are given in Table 48. Code description are given in Table 47.

Table 47. IMO Dangerous Goods List Structure and Description

Column No.	Title	Description	For fast pyrolysis liquids
1	UN No.	This column contains the United Nations Number assigned to the Dangerous Good by the UN Committee of Experts on the Transport of Dangerous Goods	1992, 1993, 2924, 3286
2	Proper Shipping Name [PSN]	This column contains the Proper Shipping Name in upper case characters; which may have to be followed by additional descriptive text in lower-case characters (see 3.1.2). Proper Shipping Names may be shown in plural where isomers of similar classification exist.	FLAMMABLE LIQUIDS N.O.S.
3	Class or Division	This column contains the class	3
4	Subsidiary Risk(s)	This column contains the class number(s) of any subsidiary risk(s) which have been identified by applying the classification system described in part 2. This column also identifies a dangerous good as a marine pollutant or a severe marine pollutant. P – marine pollutant PP – severe marine pollutant • - marine pollutant when containing 10wt% or more substances identified with ^P or 1% or more substances identified with ^{PP} in this column of Index	6.1 or 8 and • Can be a marine pollutant or a severe marine pollutant
5	Packing Group	This column contains the packing group number I, II or III	I, II, or III
6	Special Provisions	This column contains a number referring to any special provision(s) indicated in Chapter 3.3 that is relevant to the substance or article	See Notes
7	Limited quantities	This column provides the maximum quantity per inner packaging authorised for transport of the substance or article concerned according to the provisions for limited quantities in Chapter 3.4 (for marine pollutants see also 3.4.8). The word "NONE" means that the substance or article is not permitted to be transported under provisions of Chapter 3.4	Total gross mass of package shall not exceed 30 kg
8	Packing Instructions	This column contains alphanumeric codes, which refer to relevant packing instruction(s) in 4.1.4. The packing instructions indicate the packagings, which may be used for the transport of substances and articles. A code including the letter "P" refers to packing instructions for the use of packagings described in	

		Chapter 6.1, 6.2, 6.3 A code including the letters "LP" refers to packing instructions for the use of packagings described in Chapter 6.6 When a code including the letter(s) "P" or "LP" is not provided, it means the substance is not allowed in that type of packaging.	
9	Special packing provisions	This column contains alphanumeric codes which refer to relevant special packing provision(s) specified in 4.1.4.	None are applicable to pyrolysis liquids.
10	IBC packing instructions	This column contains alphanumeric codes that refer to the relevant IBC instruction, which indicates the type of IBC that shall be used for the transport of the substance under reference. A code including the letters "IBC" refers to packing instructions for the use of IBCs described in Chapter 6.5. When a code is not provided, the substance is not authorised in IBC.	Packing Groups II and III are permitted in IBC02 and IBC03.
11	IBC special provisions	This column contains an alphanumeric code which refers to special packing instructions applicable to IBC.	None are required for pyrolysis liquids
12	IMO Tank Instructions	This column only applies to IMO portable tanks and road tanks constructed in accordance with the requirements of Amendment 29 of the Code consistent with the transitional provision in 4.2.0. The provisions of this column may be used instead of the provisions of column 13 until 2010. This column contains T codes (see 4.2.5.2.6) and in some instances TP notes (see 4.2.5.3). When no T code is provided in this column, the T code provided in column 13 shall apply.	See Section 13.2.5
13	UN Tank and bulk container instructions	This column contains T codes (see 4.2.5.2.6) applicable to the transport of dangerous goods in portable tanks and road tank vehicles. When a T code is not provided in this column, it means that the dangerous goods are not authorised for transport in tanks unless specifically approved by the competent authority. Bulk container code – the code "BK" refers to closed bulk containers used of the transport of bulk goods described in chapter 6.8. When a bulk container code is not provided in this column, it means that the substance is not permitted in a bulk container.	See Section 13.2.6
14	Tank special provisions	This column contains TP notes (see 4.2.5.3) applicable to the transport of dangerous goods in portable and road tank vehicles. The TP notes specified in this column apply to the portable tanks specified in both columns 12 and 13	See applicable notes
15	EmS No.	This column refers to the relevant emergency schedules for FIRE and SPILLAGE in "The EmS Guide – Emergency Response Procedures for Ships Carrying Dangerous Goods". The first EmS code refers to the relevant Fire Schedule and the second EmS code refers to the relevant Spillage Schedule. Underlined EmS codes (special cases) indicate a substance, material or article for which additional advice is given in emergency response procedures. For dangerous goods offered for transport under N.O.S. entries or generic entries, the most relevant emergency response procedures may vary with the properties of the	

		hazardous constituents. As a consequence, shippers may have to declare different EmS codes from those indicated, if, to their knowledge, such codes are more appropriate. The provisions in this column are not mandatory.	
16	Stowage and segregation	This column contains the stowage and segregation provisions as prescribed in part 7.	
17	Properties and Observations	This column contains properties of and observations on the dangerous goods listed	Not miscible with water- forms two phases

Table 48. IMO Identification for UN N.OS. specifications – limited exceptions, quantities and packaging

UN No.	Proper Shipping Name [PSN]	Class or Division	Sub. Risk	Pack. Group	Special Provisions	Limited quantities	Packing		IBC		Portable Tanks and Bulk Containers			EmS	Stowage and segregation	Properties and observations
							Inst	Provisions	Inst	Provisions	IMO tank inst	UN Tank inst	Provisions			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1992	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	6.1 ●	I	274	NONE	P001	-	-	-		T14	TP2 TP9 TP13 TP27	F-E S-D	Category E Clear of living quarters	See Note 1
		3	6.1 ●	II	274 944	1 L	P001	-	IBC02	-		T7	TP2 TP13	F-E S-D	Category B Clear of living quarters	See Note 1
		3	6.1 ●	III	223 274 944	5 L	P001	-	IBC03	-		T7	TP1 TP28	F-E S-D	Category A.	See Note 1
1993	FLAMMABLE LIQUID, N.O.S.	3	●	I	274	NONE	P001	-	-	-	T4	T11	TP1 TP9 TP27	F-E S-E	Category E	-
		3	●	II	274 944	1 L	P001	-	IBC02	-	T4	T11	TP1 TP8 TP28	F-E S-E	Category B	-
		3	●	III	223 274 944 955	5 L	P001 LP01	-	IBC03	-	T1	T4	TP1 TP29	F-E S-E	Category A.	-
2924	FLAMMABLE LIQUID, CORROSIVE, N.O.S.	3	8 ●	I	274	NONE	P001	-	-	-	T13	T14	TP2 TP9	F-E S-C	Category E Clear of living quarters	See Note 2
		3	8 ●	II	274 944	1 L	P001	--	IBC02	-	-	T11	TP2 TP27	F-E S-C	Category B Clear of living quarters	See Note 2
		3	8 ●	III	223 274 944	5 L	P001 LP01	--	IBC03	-	-	T7	TP1 TP28	F-E S-C	Category A.	See Note 2
3286	FLAMMABLE LIQUID, TOXIC, CORROSIVE, N.O.S.	3	6.1/8 ●	I	274	None	P001	-	-	-	-	T14	TP2 TP9 TP13 TP27	F-E S-C	Category E See Note 3	See note 4

		3	6.1/8 ●	II	274 944	1 L	P001		IBC99	-		T11	TP2 TP13 TP27	F-E S-C	Category b Clear of living quarters	See Note 4
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Notes:

1. Flammable toxic liquid, which is not specified by name in this class, or, on account of its characteristics, in some other class. Toxic if swallowed, by skin contact or inhalation
2. Causes burns to eyes, skin and mucous membranes
3. Clear of living quarters. Segregation as for Class 3 but "Away from" Class 4.1
4. Flammable, toxic, corrosive, liquid. Toxic if swallowed, by skin contact or by inhalation. Causes burns to skin, eyes and mucous membranes.

13.2 IMO Dangerous Goods List Explanation

The description and applicable codes to be assigned to pyrolysis liquids are discussed below.

13.2.1 IMO Column 6 – Special provisions

The IMO special provisions codes are described in Table 49.

Table 49. IMO Column 7 - Special Provisions

IMO Code	Description
223	If the chemical or physical properties of a substance covered by this description are such that when tested it does not meet the established defining criteria for the class or division listed in column (3), or any other class or division, it is not subject to these Regulations.
274	For the purposes of documentation and package marking, the proper shipping name shall be supplemented with the technical name (see 3.1.2.8.1). 3.1.2.8.1 Generic and "not otherwise specified" proper shipping names that are assigned to special provision 274 in Column (6) of Table A in Chapter 3.2 shall be supplemented with the technical name of the goods unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of Class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical names shall be entered in brackets immediately following the proper shipping name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc. and the percentage of the technical constituent may also be used. For example: "UN 1993 FLAMMABLE LIQUID, N.O.S. (CONTAINS XYLENE AND BENZENE), 3, II". 3.1.2.8.1.1 The technical name shall be a recognized chemical name, if relevant a biological name, or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used.
944	If the material, substance or article transported under this entry is a severe marine pollutant, the figure in column 7, Limited quantities shall be changed to 0.5L for liquids.
955	

13.2.2 IMO Column 8 – Packing instructions

Packing instructions for IMO shipment of pyrolysis liquids are given in Table 50.

Table 50. IMO Packing instructions

P 001

PACKING INSTRUCTION (LIQUIDS)

P 001

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

Combination packagings		Maximum capacity/Net mass (see 4.1.3.3.)		
Inner packagings	Outer packagings	Packing group I	Packing group II	Packing group III
Glass 10 l Plastics 30 l Metal 40 l	Drums			
	steel (1A2)	250 kg	400 kg	400 kg
	aluminium (1B2)	250 kg	400 kg	400 kg
	metal other than steel or aluminium (1N2)	250 kg	400 kg	400 kg
	plastics (1H2)	250 kg	400 kg	400 kg
	plywood (1D)	150 kg	400 kg	400 kg
	fibre (1G)	75 kg	400 kg	400 kg
	Boxes			
	steel (4A)	250 kg	400 kg	400 kg
	aluminium (4B)	250 kg	400 kg	400 kg
	natural wood (4C1, 4C2)	150 kg	400 kg	400 kg
	plywood (4D)	150 kg	400 kg	400 kg
	reconstituted wood (4F)	75 kg	400 kg	400 kg
	fibreboard (4G)	75 kg	400 kg	400 kg
	expanded plastics (4H1)	60 kg	60 kg	60 kg
	solid plastics (4H2)	150 kg	400 kg	400 kg
	Jerricans			
	steel (3A2)	120 kg	120 kg	120 kg
	aluminium (3B2)	120 kg	120 kg	120 kg
	plastics (3H2)	120 kg	120 kg	120 kg

Single packagings

Drums			
steel, non-removable head (1A1)	250 l	450 l	450 l
steel, removable head (1A2)	250 l ^(a)	450 l	450 l
aluminium, non-removable head (1B1)	250 l	450 l	450 l
aluminium, removable head (1B2)	250 l ^(a)	450 l	450 l
metal other than steel or aluminium, non-removable head (1N1)	250 l	450 l	450 l
metal other than steel or aluminium, removable head (1N2)	250 l ^(a)	450 l	450 l
plastics, non-removable head (1H1)	250 l	450 l	450 l
plastics, removable head (1H2)	250 l ^(a)	450 l	450 l
Jerricans			
steel, non-removable head (3A1)	60 l	60 l	60 l
steel, removable head (3A2)	60 l ^(a)	60 l	60 l
aluminium, non-removable head (3B1)	60 l	60 l	60 l
aluminium, removable head (3B2)	60 l ^(a)	60 l	60 l
plastics, non-removable head (3H1)	60 l	60 l	60 l
plastics, removable head (3H2)	60 l ^(a)	60 l	60 l

Single packagings (cont'd)

Composite packagings			
plastics receptacle with outer steel or aluminium drum (6HA1, 6HB1)	250 l	250 l	250 l
plastics receptacle with outer fibre, plastics or plywood drum (6HG1, 6HH1, 6HD1)	120 l	250 l	250 l
plastics receptacle with outer steel or aluminium crate or box or plastics receptacle with outer wooden, plywood, fibreboard or solid plastics box (6HA2, 6HB2, 6HC, 6HD2, 6HG2 or 6HH2)	60 l	60 l	60 l
glass receptacle with outer steel, aluminium, fibreboard, plywood, solid plastics or expanded plastics drum (6PA1, 6PB1, 6PG1, 6PD1, 6PH1 or 6PH2) or with outer steel or aluminium crate or box or with outer wooden or fibreboard box or with outer wickerwork hamper (6PA2, 6PB2, 6PC, 6PG2 or 6PD2)	60 l	60 l	60 l

Additional requirement

For substances of Class 3, packing group III, which give off small quantities of carbon dioxide or nitrogen, the packagings shall be vented.

LP 01		PACKING INSTRUCTION (LIQUIDS)			LP 01
The following large packagings are authorized provided the general provision of 4.1.1 and 4.1.3 are met:					
Inner packagings		Large outer packagings	Packing group I	Packing group II	Packing group III
Glass	10 litre	Steel (50A)	Not allowed	Not allowed	Maximum capacity: 3 m ³
Plastics	30 litre	Aluminium (50B)			
Metal	40 litre	Metal other than steel or aluminium (50N)			
		Rigid plastics (50H)			
		Natural wood (50C)			
		Plywood (50D)			
		Reconstituted wood (50F)			
		Fibreboard (50G)			

13.2.3 IMO Column 10 - IBC Instructions

The IMO IBC instructions are given in Table 51.

Table 51. IMO IBC instructions

IBC02 PACKING INSTRUCTION	
The following IBCs are authorized, provided the general provisions of 4.1.1 , 4.1.2 and 4.1.3 are met:	
(1) Metal (31A, 31B and 31N);	
(2) Rigid plastics (31H1 and 31H2);	
(3) Composite (31HZ1).	
Additional requirement:	
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.	
Special packing provisions:	
B5	For UN Nos. 1791, 2014, 2984 and 3149, IBCs shall be provided with a device to allow venting during carriage. The inlet to the venting device shall be sited in the vapour space of the IBC under maximum filling conditions during carriage.
B7	For UN Nos. 1222 and 1865, IBCs with a capacity greater than 450 litres are not permitted due to the substance's potential for explosion when carried in large volumes.
B8	The pure form of this substance shall not be transported in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.
IBC03 PACKING INSTRUCTION	
The following IBCs are authorized, provided the general provisions of 4.1.1 , 4.1.2 and 4.1.3 are met:	
(1) Metal (31A, 31B and 31N);	
(2) Rigid plastics (31H1 and 31H2);	
(3) Composite (31HZ1, 31HA2, 31HB2, 31HN2, 31HD2 and 31HH2).	
Additional requirement:	
Only liquids with a vapour pressure less than or equal to 110 kPa at 50 °C, or 130 kPa at 55 °C, are authorized.	
Special packing provision:	
B8	The pure form of this substance shall not be carried in IBCs since it is known to have a vapour pressure of more than 110 kPa at 50 °C or 130 kPa at 55 °C.
IBC99 PACKING INSTRUCTION	
Only IBCs which are approved by the competent authority may be used.	

13.2.4 IMO Columns 12 and 13 – Portable Tanks and Bulk Containers: IMO and UN tank instructions

The relevant portable tanks and bulk containers IMO and UN tank instructions are given in Table 52.

Table 52. Portable tanks and bulk containers IMO and UN tank instructions

PORTABLE TANK INSTRUCTIONS				
<i>These portable tank instructions apply to liquid and solid substances of Classes 3 to 9. The general provisions of Section 4.2.1 and the requirements of Section 6.7.2 shall be met.</i>				
Portable tank instruction	Minimum test pressure (bar)	Minimum shell thickness (in mm reference steel) (see 6.7.2.4)	Pressure-relief requirements ^a (see 6.7.2.8)	Bottom opening requirements (see 6.7.2.6)
T1	1.5	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T4	2.65	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T7	4	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T11	6	See 6.7.2.4.2	Normal	See 6.7.2.6.3
T14	6	6mm	See 6.7.2.8.3	Not allowed

The details for the sections referred to in Table 52 are given in Table 53.

Table 53. IMO vessel requirements

IMO reference	Description
6.7.2.4.2	The cylindrical portions, ends (heads) and manhole covers of shells not more than 1.80 m in diameter shall be not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used. Shells more than 1.80 m in diameter shall be not less than 6 mm thick in the reference steel or of equivalent thickness in the metal to be used, except that for powdered or granular solid substances of packing group II or III the minimum thickness requirement may be reduced to not less than 5 mm thick in the reference steel or of equivalent thickness in the metal to be used.
6.7.2.6.3	Every bottom discharge outlet, except as provided in 6.7.2.6.2, shall be equipped with three serially fitted and mutually independent shut-off devices. The design of the equipment shall be to the satisfaction of the competent authority or its authorized body and include: (a) A self-closing internal stop-valve, that is a stop-valve within the shell or within a welded flange or its companion flange, such that: (i) The control devices for the operation of the valve are designed so as to prevent any unintended opening through impact or other inadvertent act; (ii) The valve may be operable from above or below; (iii) If possible, the setting of the valve (open or closed) shall be capable of being verified from the ground; (iv) Except for portable tanks having a capacity of not more than 1 000 litres, it shall be possible to close the valve from an accessible position of the portable tank that is remote from the valve itself; and (v) The valve shall continue to be effective in the event of damage to the external device for controlling the operation of the valve; (b) An external stop-valve fitted as close to the shell as reasonably

	practicable; and (c) A liquid tight closure at the end of the discharge pipe, which may be a bolted blank flange or a screw cap.
6.7.2.8.3	When required for certain substances by the applicable portable tank instruction indicated in Column (10) of Table 48 and described in 4.2.5.2.6, portable tanks shall have a pressure-relief device approved by the competent authority. Unless a portable tank in dedicated service is fitted with an approved relief device constructed of materials compatible with the substance carried, the relief device shall comprise a frangible disc preceding a spring-loaded pressure-relief device. When a frangible disc is inserted in series with the required pressure-relief device, the space between the frangible disc and the pressure-relief device shall be provided with a pressure gauge or suitable tell-tale indicator for the detection of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure-relief system. The frangible disc shall rupture at a nominal pressure 10% above the start to discharge pressure of the relief device.

The full details of tank specifications are beyond the scope of this work and the reader is referred to the IMO Regulations for further detailed information on tank and vessel specifications and testing procedures (6).

13.2.5 IMO Column 14 – Portable Tanks and Bulk Containers: IMO and UN tank provisions

Table 54. RID Portable tank provisions

RID Code	Description
TP1	The degree of filling prescribed in 4.2.1.9.2 shall not be exceeded $\text{Degree of filling} = \frac{97}{1 + \alpha(t_r - t_f)}$
TP2	The degree of filling prescribed in 4.2.1.9.3 shall not be exceeded $\text{Degree of filling} = \frac{95}{1 + \alpha(t_r - t_f)}$
	In these formulae, α is the mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (t_f) and the maximum mean bulk temperature during transport (t_r) (both in °C). For liquids transported under ambient conditions α could be calculated by the formula: $\alpha = \frac{d_{15} - d_{50}}{35d_{50}}$ in which d_{15} and d_{50} are the densities of the liquid at 15°C and 50°C, respectively.
TP8	The test pressure for the portable tank may be reduced to 1.5 bar when the flash point of the substances transported is greater than 0°C.
TP9	A substance under this description shall only be transported in a portable tank under an approval granted by the competent authority.
TP27	A portable tank having a minimum test pressure of 4 bar may be used if it is shown that a test pressure of 4 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
TP28	A portable tank having a minimum test pressure of 2.65 bar may be used if it is shown that a test pressure of 2.65 bar or less is acceptable according to the test pressure definition in 6.7.2.1.

TP29	A portable tank having a minimum test pressure of 1.5 bar may be used if it is shown that a test pressure of 1.5 bar or less is acceptable according to the test pressure definition in 6.7.2.1.
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13.2.6 IMO Column 15 EmS

This refers to the Emergency Spill procedures and is beyond the scope of this work.

14 ANNEX V: Inland Waterway – ADN

Shipment of liquids on water not on the ocean or sea is covered by ADN (5). Shipment of liquids on the Rhine is covered by ADNR, but is not reviewed in this report. The definition of Flammable liquids for ADN is almost identical to that for ADR. Class 3 covers substances and articles containing substances of this Class which:

- are liquids according to subparagraph (a) of the definition for "liquid";
- have at 50 °C a vapour pressure of not more than 300 kPa (3 bar) and are not completely gaseous at 20 °C and at standard pressure of 101.3 kPa; and
- have a flash-point of not more than 61 °C (see 2.3.3.1 for the relevant test).

Substances having a flash-point above 35 °C, non-toxic and non-corrosive, which do not sustain combustion according to the criteria of 32.2.5 of Part III of the Manual of Tests and Criteria are not substances of Class 3; if, however, these substances are handed over for carriage and carried whilst heated at temperatures equal to or higher than their flash-point, they are substances of Class 3. Liquids which are highly toxic on inhalation, having a flash-point below 23 °C and toxic substances, having a flash-point of 23 °C or above are substances of Class 6.1 (see 2.2.61.1).

For the purpose of carriage in tank vessels, substances having a flash-point above 61°C and not more than 100°C are substances of Class 9 (identification number 9003). Some fractions of pyrolysis liquids may occasionally meet this criteria, but the properties of the liquids need to be carefully assessed and most likely would fall into Class 6 or 8.

The substances and articles of Class 3 for ADN are subdivided as follows:

- F Flammable liquids, without subsidiary risk:
- F1 Flammable liquids having a flash-point of or below 61°C;
- F2 Flammable liquids having a flash-point above 61°C which are carried or handed over for carriage at or above their flash-point (elevated temperature substances);
- F3 Substances having a flash-point above 61°C which are carried or handed over for carriage at a temperature within a range of 15 K below the flash-point;
- F4 Substances having an auto-ignition temperature of 200° C or below and which are not mentioned elsewhere.
- FT Flammable liquids, toxic:
- FT1 Flammable liquids, toxic;
- FC Flammable liquids, corrosive;
- FTC Flammable liquids, toxic, corrosive;

Flammable liquids shall be assigned to one of the following packing groups according to the degree of danger they present for carriage as shown in Table 55.

Table 55. ADN Packing groups for Class 3 related to flash point

Packing Group	Flash point [closed cup]	Initial Boiling Point
I	--	< 35°C
II ^(a)	< 23°C	> 35°C
III ^(a)	>23°C and ≤61°C	> 35°C

Note: ^(a) For a liquid with (a) subsidiary risk(s), the packing group determined in accordance with the table above and the packing group based on the severity of the subsidiary risk(s) shall be considered; the classification and packing group shall then be determined in accordance with the table of precedence of hazards in 2.1.3.10.

14.1 ADN Dangerous goods list

The applicable UN N.O.S codes are given in Table 57. As a rule, each row of Table 57 deals with the substance(s) covered by a specific UN number or identification number. However, when substances belonging to the same UN number or identification number have different chemical properties, physical properties and/or carriage conditions, several consecutive rows may be used for that UN number or identification number.

Each column of Table 57 is dedicated to a specific subject as indicated in the explanatory notes below. The intersection of columns and rows (cell) contains information concerning the subject treated in that column, for the substance(s) of that row:

- The first four cells identify the substance(s) belonging to that row;
- The following cells give the applicable special provisions, either in the form of complete information or in coded form. The codes cross-refer to detailed information that is to be found in the numbers indicated in the explanatory notes below. An empty cell means either that there is no special provision and that only the general requirements apply, or that the carriage restriction indicated in the explanatory notes is in force.

The structure of the ADN dangerous goods list is different to that of the other transportation modes as the basic requirements are the same as ADR and therefore the dangerous goods list provides details for the shipper and not the producer of the liquids, therefore the same detailed explanation of each column in is not required.

Table 56. ADN Explanatory notes for each column in Table 57

Column (1) "UN number/identification number"	Contains the UN number or identification number: – of the dangerous substance if the substance has been assigned its own specific UN number or identification number, or – of the generic or n.o.s. entry to which the dangerous substances not mentioned by name shall be assigned in accordance with the criteria ("decision trees") of Part 2.
Column (2) "Name and description"	Contains, in upper case characters, the name of the substance, if the substance has been assigned its own specific UN number or identification number or of the generic or n.o.s. entry to which the

	dangerous substances have been assigned in accordance with the criteria ("decision trees") of Part 2. This name shall be used as the proper shipping name or, when applicable, as part of the proper shipping name (see 3.1.2 for further details on the proper shipping name). A descriptive text in lower case characters is added after the proper shipping name to clarify the scope of the entry if the classification or carriage conditions of the substance may be different under certain conditions.
Column (3a) "Class"	Contains the number of the Class, whose heading covers the dangerous substance. This Class number is assigned in accordance with the procedures and criteria of Part 2.
Column (3b) "Classification code"	Contains the classification code of the dangerous substance. – For dangerous substances of Class 2, the code consists of a number and one or more letters representing the hazardous property group, which are explained in 2.2.2.1.2 and 2.2.2.1.3. – For dangerous substances or articles of Classes 3, 4.1, 4.2, 4.3, 5.1, 5.2, 6.1, 6.2, 8 and 9, the codes are explained in 2.2.x.1.2 1/ x = the Class number of the dangerous substance or article, without dividing point if applicable.
Column (4) "Packing group"	Contains the packing group number(s) (I, II or III) assigned to the dangerous substance. These packing group numbers are assigned on the basis of the procedures and criteria of Part 2. Certain substances are not assigned to packing groups.
Column (5) "Labels"	This column contains information concerning the hazards inherent in the dangerous substance. They are included on the basis of the danger labels of Table A, column (5). In the case of a chemically unstable substance the code "unst." is added to the information.
Column (6) "Type of tank vessel"	Contains the type of tank vessel: G, C or N.
Column (7) "Cargo tank design"	Contains information concerning the design of the cargo tank: 1 Pressure cargo tank 2 Closed cargo tank 3 Open cargo tank with flame arrester 4 Open cargo tank
Column (8) "Cargo tank type"	Contains information concerning the cargo tank type. 1 Independent cargo tank 2 Integral cargo tank 3 Cargo tank with walls distinct from the outer hull
Column (9) "Cargo tank equipment"	Contains information concerning the cargo tank equipment. 1 Refrigeration system 2 Heating system 3 Water-spray system
Column (10) "Opening pressure of high-velocity vent valve in kPa"	Contains information concerning the opening pressure of the high velocity vent valve in kPa.
Column (11) "Maximum degree of filling (%)"	Contains information concerning the maximum degree of filling of cargo tanks as a percentage.
Column (12) "Relative density"	Contains information concerning the relative density of the substance at 20° C. Data concerning the density are for information only.
Column (13) "Type of sampling device"	Contains information concerning the prescribed type of sampling device. 1 Closed sampling device 2 Partly closed sampling device 3 Open sampling device
Column (14) "Pump-room below deck permitted"	Contains an indication of whether a pump-room is permitted below deck. Yes pump-room below deck permitted

	No pump-room below deck not permitted
Column (15) "Temperature class"	Contains the temperature class of the substance.
Column (16) "Explosion group"	Contains the explosion group of the substance.
Column (17) "Anti-explosion protection required"	Contains a code referring to protection against explosions. Yes anti-explosion protection required No anti-explosion protection not required
Column (18) "Equipment required"	This column contains the alphanumeric codes for the equipment required for the carriage of the dangerous substance (see 8.1.5).
Column (19) "Number of cones/blue lights"	This column contains the number of cones/lights which should constitute the marking of the vessel during the carriage of this dangerous substance or article.
Column (20) "Additional requirements/Remarks"	This column contains the additional requirements or remarks applicable to the vessel.

Table 57. ADN Transportation guidance

UN No. or ID No.	Name and description 3.1.2	Class 2.2	Classification Code 2.2	Packing group 2.1.1.3	Labels 5.2.2	Special provisions 3.3	Limited quantities 3.4.6	Carriage permitted 3.2.1	Equipment required 8.1.5	Ventilation 7.1.6	Provisions concerning loading, unloading and carriage 7.1.6	Number of cones, blue lights 7.1.5
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
199 2	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	I	3+6.1	274 802	LQ0	T	PP, EP, EX, TOX, A	VE01, VE02		
199 2	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	II	3+6.1	274 802	LQ0	T	PP, EP, EX, TOX, A	VE01, VE02		
199 2	FLAMMABLE LIQUID, TOXIC, N.O.S.	3	FT1	III	3+6.1	274 802	LQ7	T	PP, EP, EX, TOX, A	VE01, VE02		
199 3	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 175 kPa)	3	FI	I	3	274 640A	LQ3	T	PP, EX, A	VE01		
199 3	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more	3	FI	I	3	274 640B	LQ3	T	PP, EX, A	VE01		

	than 110 kPa but not more than 175 kPa)											
199 3	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 110 kPa but not more than 175 kPa)	3	FI	II	3	274 640C	LQ4	T	PP, EX, A	VE01		
199 3	FLAMMABLE LIQUID, N.O.S. (vapour pressure at 50 °C more than 110 kPa but not more than 175 kPa)	3	FI	II	3	274 640D	LQ4	T	PP, EX, A	VE01		
199 3	FLAMMABLE LIQUID, N.O.S	3	FI	III	3	274 640E	LQ7	T	PP, EX, A	VE01		
199 3	FLAMMABLE LIQUID, N.O.S. (having a flash-point below 23°C and viscous according to 2.2.3.1.4) (vapour pressure at 50°C more than 175 kPa)	3	FI	III	3	274 640F	LQ7	T	PP, EX, A	VE01		
199	FLAMMABLE	3	FI	III	3	274	LQ7	T	PP, EX, A	VE01		

3	LIQUID, N.O.S. (having a flash-point below 23°C and viscous according to 2.2.3.1.4) (vapour pressure at 50°C more than 110 kPa but not more than 175 kPa)					640G						
199 3	FLAMMABLE LIQUID, N.O.S. (having a flash-point below 23°C and viscous according to 2.2.3.1.4) (vapour pressure at 50 °C not more than 110 kPa)	3	FI	III	3	274 640H	LQ7	T	PP, EX, A	VE01		
292 4	FLAMMABLE LIQUID CORROSIVE , N.O.S.	3	FC	I	3+8	274	LQ3	T	PP, EP, EX, A	VE01		1
292 4	FLAMMABLE LIQUID CORROSIVE , N.O.S.	3	FC	II	3+8	274	LQ4	T	PP, EP, EX, A	VE01		1
292 4	FLAMMABLE LIQUID	3	FC	III	3+8	274	LQ7	T	PP, EP, EX, A	VE01		0

	CORROSIVE , N.O.S.											
328 6	FLAMMABLE LIQUID, TOXIC, CORROSIVE , N.O.S.	3	FTC	I	3+6.1+ 8	274 802	LQ0	T	PP, EP, EX, TOX, A	VE01, VE02		2
328 6	FLAMMABLE LIQUID, TOXIC, CORROSIVE , N.O.S.	3	FTC	II	3+6.1+ 8	274 802	LQ0	T	PP, EP, EX, TOX, A	VE01, VE02		2

14.2 ADN Code Descriptions

14.2.1 ADN Column 6- Special Provisions

The specification of the ADN special provisions are given in Table 58.

Table 58. ADN Special Provisions on naming

ADN reference	Description
274	The provisions of 3.1.2.8 apply. 3.1.2.8 Generic or "not otherwise specified" (N.O.S.) names 3.1.2.8.1 Generic and "not otherwise specified" proper shipping names that are assigned to special provision 274 in Column (6) of Table A in Chapter 3.2 shall be supplemented with the technical name of the goods unless a national law or international convention prohibits its disclosure if it is a controlled substance. For explosives of Class 1, the dangerous goods description may be supplemented by additional descriptive text to indicate commercial or military names. Technical names shall be entered in brackets immediately following the proper shipping name. An appropriate modifier, such as "contains" or "containing" or other qualifying words such as "mixture", "solution", etc. and the percentage of the technical constituent may also be used. For example: "UN 1993 FLAMMABLE LIQUID, N.O.S. (CONTAINS XYLENE AND BENZENE), 3, II". 3.1.2.8.1.1 The technical name shall be a recognized chemical name, if relevant a biological name, or other name currently used in scientific and technical handbooks, journals and texts. Trade names shall not be used for this purpose. In the case of pesticides, only ISO common name(s), other name(s) in the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification, or the name(s) of the active substance(s) may be used.
640	The physical and technical characteristics mentioned in column (2) of Table 57 determine different tank codes for the carriage of substances of the same packing group in tanks conforming to Chapter 6.8 of RID or ADR. In order to identify these physical and technical characteristics of the product carried in the tank, the following shall be added, to the particulars required in the transport document/consignment note, only in case of carriage in tanks conforming to Chapter 6.8 of ADR or RID: "Special provision 640X" where "X" is the applicable capital letter appearing after the reference to special provision 640 in column (6) of Table 57. These particulars may, however, be dispensed with in the case of carriage in the type of tank which, for substances of a specific packing group of a specific UN number, meets at least the most stringent requirements.
802	When special provision 802 is indicated for a dangerous good in column (6) of Table 57, precautions shall be taken as follows with respect to foodstuffs, other articles of consumption and animal feeds: Packages, including intermediate bulk containers (IBCs), and uncleaned empty packagings, including uncleaned empty intermediate bulk containers (IBCs), bearing labels conforming to models Nos. 6.1 or 6.2, and those bearing labels of Class 9, containing substances of Class 9, UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, shall not be stacked on or loaded in immediate proximity to packages known to contain foodstuffs, other articles of consumption or animal feeds in the same hold and at places

	of loading and unloading or trans-shipment. When these packages, bearing the said labels, are loaded in immediate proximity of packages known to contain foodstuffs, other articles of consumption or animal feeds, they shall be kept apart from the latter: (a) by complete partitions which should be as high as the packages bearing the said labels, or (b) by packages not bearing labels conforming to models Nos. 6.1, 6.2 or 9 or packages bearing labels of Class 9 but not containing substances of that class, UN Nos. 2212, 2315, 2590, 3151, 3152 or 3245, or (c) by a space of at least 0.8 m, unless the packages bearing said labels are provided with an additional packaging or are completely covered (e.g. by a sheeting, a fibreboard cover or other measures).
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14.2.2 ADN Column 7 - Exemptions related to dangerous goods packed in limited quantities

Explanation for the exemptions related to dangerous goods in limited quantities are given in Table 59.

Table 59. ADN limited quantities guidance

ADN reference	Description
3.4.1.1	Packagings used in accordance with 3.4.3 to 3.4.6 below, need only to conform to the general provisions of 4.1.1.1, 4.1.1.2 and 4.1.1.4 to 4.1.1.8.
3.4.1.2	The maximum gross mass of a combination packaging shall not exceed 30 kg and for shrink and stretched wrapped trays shall not exceed 20 kg. NOTE: <i>The limit for combination packagings does not apply when LQ5 is issued.</i>
3.4.1.3	Subject to the maximum limits in 3.4.1.2 and individual limits in table 3.4.6, dangerous goods may be packed together with other articles or substances, provided they will not react dangerously in the event of leakage.
3.4.2	When the code "LQ0" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, that substance or article is not exempted from any of the applicable provisions of Annexes A and B when it is packed in limited quantities, unless otherwise specified in these Annexes.
3.4.3	Unless otherwise provided in this Chapter, when one of the codes "LQ1" or "LQ2" is shown in Column (7) of Table A in Chapter 3.2 for a given substance or article, the provisions of other Chapters of ADR do not apply to the carriage of that substance or article, provided: (e) The provisions of 3.4.5 (a) to (c) are observed; with respect to these provisions, articles are considered to be inner packagings; (f) Inner packagings meet the conditions of 6.2.1.2 and 6.2.4.1 to 6.2.4.3.
3.4.4	Unless otherwise provided in this Chapter, when the code "LQ3" is shown in Column (7) of Table 57 for a given substance, the provisions of other Chapters of ADR do not apply to the carriage of that substance, provided: (g) The substance is carried in combination packagings, the following outer packagings being allowed: - steel or aluminium drums with removable head; - steel or aluminium jerricans with removable head; - plywood or fibre drums; - plastics drums or jerricans with removable head; - boxes of natural wood, plywood, reconstituted wood, fibreboard, plastics, steel or aluminium; and be so designed that they meet the relevant construction requirements of 6.1.4; (h) The maximum net quantities per inner packaging shown in columns (2) or (4) and per package in columns (3) or (5), where indicated, of table 3.4.6 are not exceeded; (i) Each package is clearly and durably marked with:

	(i) the UN number of the goods contained therein, as given in Column (1) of Table A in Chapter 3.2, preceded by the letters "UN"; (ii) in the case of different goods with different UN numbers within a single package: - the UN numbers of the goods contained therein, preceded by the letters "UN", or - the letters "LQ"³. These markings shall be displayed within a diamond-shaped area surrounded by a line that measures at least 100 mm × 100 mm. The width of line forming the diamond shall be at least 2 mm; the number shall be at least 6 mm high. Where more than one substance assigned to different UN numbers are included in the package, the diamond shall be large enough to include each relevant UN number. If the size of the package so requires, the dimension may be reduced, provided the markings remain clearly visible.
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14.2.3 ADN Column 8 - Carriage permitted

The T code means that transport is permitted under ADN.

14.2.4 ADN Column 9 - Equipment required

Insofar as the provisions of Table 57 require, the following equipment shall be available on board:

- PP: for each member of the crew, a pair of protective goggles, a pair of protective gloves, a protective suit and a suitable pair of protective shoes (or protective boots, if necessary). On board tank vessels, protective boots are required in all cases;
- EP: a suitable escape device for each person on board;
- EX: a flammable gas detector with the instructions for its use;
- TOX: a toximeter with the instructions for its use;
- A: a breathing apparatus ambient air-dependent;

14.2.5 ADN Column 10 -Ventilation

The following additional requirements shall be met when they are indicated in column (10) of Table 57:

VE01: Holds containing these substances shall be ventilated with the ventilators operating at full power, where after measurement it has been established that the concentration of gases given off by the cargo exceeds 10% of the lower explosive limit. The measurement shall be carried out immediately after loading. The measurement shall be repeated after one hour for monitoring purposes. The results of the measurement shall be recorded in writing.

VE02: Holds containing these substances shall be ventilated with the ventilators operating at full power, where after measurement it has been established that the holds are not free from gases given off by the cargo. The measurement shall be carried out immediately after loading. The measurement shall be

³. The letters "LQ" are an abbreviation of the English words "Limited Quantities". The letters "LQ" are not permitted by the IMDG Code or the ICAO Technical Instructions.

repeated after one hour for monitoring purposes. The results of the measurement shall be recorded in writing.

Other requirements under ADN are the responsibility of the transportation company and are not covered here.

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