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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF
DANGEROUS GOODS AND ON THE GLOBALLY
HARMONIZED SYSTEM OF CLASSIFICATION
AND LABELLING OF CHEMICALS**

**Sub-Committee of Experts on the
Transport of Dangerous Goods**
(Nineteenth session, 2-6 July 2001,
agenda item 7(b))

LISTING AND CLASSIFICATION

**Assignment of substances and solutions to the correct UN number
in relation to the physical state (liquid/solid)**

Transmitted by the experts from the Netherlands and Germany

In its twenty-first session of the Committee of December 2000, the Netherlands submitted a paper (ST/SG/AC.10/2000/29) concerning the correct assignment of UN Numbers to substances, mixtures and solutions especially related to the physical state.

During the reformatting/restructuring process several discrepancies within the UN Recommendations were identified and the proposal by the Netherlands to discuss these problems in the coming biennium and give guiding principles in the UN Recommendations was adopted.

Intersessionally, the matter has been discussed between several experts and the result is presented in this paper.

The principle of the lay-out of the Dangerous Goods List, is to indicate unambiguously transport requirements related to the substance listed. The cases discussed in this paper, concern substances which may appear in liquid or solid form. Since for liquids and solids different transport requirements apply, separate lines are needed.

It is proposed to have a discussion on the general principle whether separate UN numbers are needed or whether different lines under the same UN number should be used.

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To facilitate the discussion, different situations are identified:

- A *Solid substances and their solutions*
- B *Substances, having a melting point around the borderline of the definition solid/liquid including isomers and mixtures thereof*
- C *Molten substances*
- D *Discrepancies in the dangerous goods list.*

A. *Solid substances and their solutions*

The first situation deals with the classification of the solution of a solid substance. Should such a solution be assigned to the same UN number as the solid substance or should the solution have a separate UN number whereby the most specific collective liquid entry is assigned? These two options are discussed below together with the consequences.

Option A1. Separate UN numbers in the DGL for solids and solutions thereof.

A basic point in the discussion is the principle as laid down in 2.0.2.5 and 2.0.2.6 to have separate UN numbers to differentiate in physical state liquid/solid. In other words: if the physical state changes, the UN number should change as well. This means that a solution of a solid substance should not be classified under the UN number for the solid substance but under the most appropriate collective entry available.

As a consequence a solution of UN 1689 SODIUM CYANIDE should not be assigned to UN 1689, but to the most specific liquid entry, in this case UN 1935 CYANIDE SOLUTIONS N.O.S.

In most cases however the most specific entry is a general N.O.S entry with no direct relation to the substance, for example: UN 2810 TOXIC LIQUID, ORGANIC, N.O.S.

In these cases however the chemical or technical name should be added to the proper shipping name.

The general principle as laid down in 2.0.2.5 and 2.0.2.6 is followed, for example, in Class 5.1 where the solid substance has a different UN-number than its related solution:

UN 1485 POTASSIUM CHLORATE
UN 2427 POTASSIUM CHLORATE, AQUEOUS SOLUTION

Within the GHS discussion on labelling and hazard communication and especially from the point of view of emergency response, it has been argued that such a differentiation is relevant.

However in most emergency response systems there is no different indication for solids or liquids, although the action to be taken might be quite different.

In other cases however, this principle has not been followed in the UN model regulations, for example:

UN 1658 NICOTINE SULPHATE, SOLID
UN 1658 NICOTINE SULPHATE, SOLUTIONS

If the principle of 2.0.2.5 and 2.0.2.6 is followed, entries like UN 1658 should be divided as follows:

UN 1658 NICOTINE SULPHATE, SOLID
UN 9999 NICOTINE SULPHATE, SOLUTIONS

In the Dangerous Goods List there will be separate entries for solids and liquids, clearly indicating their applicable transport conditions.

However, only where there is a real need for transport, a new UN number should be assigned to the solutions. This should be considered on a case by case basis.

Consequently, it should be made very clear that in case of a solution, the most specific liquid entry should be used.

Other entries which might be effected by following this option, are listed in Annex 1 of this proposal. These entries are taken from the present UN Recommendation and from the proposal by IMO (ST/SG/AC.10/C.3/2000/5).

Annex 1 also includes specific N.O.S. entries, for which it appeared necessary to assign new UN numbers for the entries for solutions.

Option A2. The solution of a solid is assigned to the same UN number as the solid itself.

In this option the general rule is that the UN number for the solid substance should also be used for its solution. In this case the word SOLUTION should be added as part of the proper shipping name as has been done for molten substances.

Consequences for this option are:

- The principle to have separate UN numbers to differentiate in physical state liquid/solid, as laid down in 2.0.2.5 and 2.0.2.6 should be amended.
- The information solid/liquid is no longer linked to the UN number.
- For each solid, which can be carried as a solution, the UN entry in the dangerous goods list should be associated with two lines: one for the solid (existing line) and another one for its solution together with the corresponding conditions of transport.

Within this option the following question should be answered. Should the word *solution* or *liquid* be in upper case, becoming a part of the Proper Shipping Name (PSN), or should it be in lower case.

UN 1658 NICOTINE SULPHATE, SOLID*
UN 1658 NICOTINE SULPHATE, SOLUTIONS

or

UN 1658 NICOTINE SULPHATE, solid
UN 1658 NICOTINE SULPHATE, solution

* The word SOLID, could be in lower case if this is regarded as the default possibility.

When using the words *solid* or *solution* in lower case, the combination UN number/proper shipping name is associated with different conditions of transport.

In this case it is not clear from the proper shipping name on the transport document which situation applies during transport. From an enforcement point of view this is a difficult situation

B. Substances, having a melting point around the borderline of the definition solid/liquid including isomers and mixtures thereof

It is always difficult to deal with borderline cases. In this discussion these are the substances, isomers, mixtures and mixtures of isomers having a melting point of appr. 20 °C.

Depending on amongst others, the temperature, degree of purity or the composition of the mixture of isomers, these substances are solids or liquids.

Therefore, it is felt necessary to have two lines in the Dangerous Goods List, showing the applicable transport provisions

The present UN Recommendations cover this in 3.1.2.4:

“Unless it is already included in capital letters in the name indicated in the Dangerous Goods List, the qualifying words LIQUID or SOLID, as appropriate, shall be added as part of the proper shipping name, when a substance specifically listed by name may, due to the differing physical states of the various isomers of the substance, be either liquid or solid (e.g. DINITROTOLUENES, LIQUID; DINITROTOLUENES, SOLID). ”

It is the responsibility of the shipper to apply the transport condition depending on the properties of the substance or mixture of substances and the temperature which might be encountered in the particular transport involved. See also 4.1.3.4 which indicates the types of packagings allowed for substances which are liable to become liquid during transport.

Substances involved are contained in Annex 2.

In principle there are three options:

Option B1

follow the principles as set out in 2.0.2.5 and 2.0.2.6 in full, that is to say two different UN numbers, different proper shipping names and separate entries associated with the liquid and the solid entry in the Dangerous Goods List.

e.g. UN 2038 DINITROTOLUENES, LIQUID
UN 9999 DINITROTOLUENES, SOLID

It should be noted that depending on the circumstances, inherent to borderline cases, the substance might be a liquid or a solid.

Option B2

follow the general principle as set out in 3.1.2.4 of the UN Recommendations, as is done for the IMDG Code, which results in the use of one UN number, associated with two different descriptions, one for the liquid and one for the solid and two lines in the Dangerous Goods List.

e.g. UN 2038 DINITROTOLUENES, LIQUID
UN 2038 DINITROTOLUENES, SOLID

In options B1 and B2 it is clear which decision the consignor has taken in order to fulfil the conditions of transport. In case of a liquid, a special provision might be appropriate to indicate that the substance might be liquid or solid depending on the circumstances. If shipped as a solid, this indicates that the consignor declares implicitly that the substance does not become liquid during transport.

Option B3

one UN number associated with one PSN and two lines in the DGL. This situation can be found in some cases in the existing UN Recommendations,

e.g. UN 2038 DINITROTOLUENES, liquid
UN 2038 DINITROTOLUENES, solid

In this case it is not clear from the proper shipping name on the transport document which situation applies during transport. From an enforcement point of view this is a difficult situation.

C. Molten substances

As a general rule molten substances may be carried under the same UN number as the solid substance with the addition to the proper shipping name: MOLTEN, unless there is a specific entry for the molten substance (see 3.1.2.5).

As indicated under A and B the same can be discussed for molten substances

e.g. 2448 SULPHUR, MOLTEN and 1350 SULPHER or
2215 MALEIC ANHYDRIDE, MOLTEN and 2215 MALEIC ANHYDRIDE.

A problem concerns the question whether or not the substance is allowed to be transported in the molten state and which transport conditions should apply. This is not specifically indicated in the Dangerous Goods List.

In RID/ADR many more solid substances in the molten state are allowed in tanks as compared with the UN Recommendations. In order to cope with the problem of molten substances it was argued that the problems arise primarily in tank transport. For molten substances a tank for liquids is required, contrary to the associated solid (powder, granules). In the cases where a substance may be transported in the molten state this should be clear from the dangerous goods list. After consultation of the industry it was decided to foresee in RID/ADR the possibility of transport in the molten state for substances with a melting point of not more than 180 °C.

In those cases two tank codes are indicated in the column for the RID/ADR tanks, one for the solid and one for the molten substance.

In order to tackle this problem it is necessary to have a discussion on the questions in which case the transport in the molten form is allowed and under which conditions of transport. However this is beyond the scope of this proposal.

D. Discrepancies in the dangerous goods list

Some discrepancies have been discovered in comparing the dangerous goods lists for the different modes of transport. It appears that in some cases the UN Recommendations indicate a packing instruction for liquid where the IMDG Code states in the column “ properties and observations” that the substance involved is a solid. Or the other way around, a P002 for solids is indicated and the column “ properties and observations” indicates that the substance involved is a liquid.

It concerns the substances in Annex (in preparation).

Experts are asked to consider these entries on a case by case basis and to remove the discrepancies which are identified.

Annex 1

All entries which appear in one of the regulations mentioned as a solid and as a liquid or solution, under the same UN number

X means entry is listed in the regulation.

N means entry not listed in the regulation.

Class/UN No.	PSN	UN (12ed)	RID/ADR	IMDG Amdt. 30-00	CFR 49
1.1C/0497	PROPELLANT, LIQUID	X	X	X	X
1.1C/0497	PROPELLANT, SOLID	N	N	X	N
4.3/1389	ALKALI METAL AMALGAM, LIQUID	X, P402/403	X, P402	X	X
4.3/1389	ALKALI METAL AMALGAM, SOLID	N	N	X	X
4.3/1392	ALKALINE EARTH METAL AMALGAM, LIQUID	X, P402/403	X, P402	X	N
4.3/1392	ALKALINE EARTH METAL AMALGAM, SOLID	N	N	X	X
5.1/1445	BARIUM CHLORATE, SOLUTION	N	N	X	N
5.1/1445	BARIUM CHLORATE, SOLID	X	X	X	X
5.1/1447	BARIUM PERCHLORATE, SOLUTION	N	N	X	N
5.1/1447	BARIUM PERCHLORATE, SOLID	X	X	X	X
5.1/1459	CHLORATE AND MAGNESIUM CHLORIDE MIXTURE, SOLUTION	N	N	X	N
5.1/1459	CHLORATE AND MAGNESIUM CHLORIDE MIXTURE, SOLID	X	X	X	X
5.1/1470	LEAD PERCHLORATE, SOLUTION	N	N	X	X
5.1/1470	LEAD PERCHLORATE, SOLID	X	X	X	X
6.1/1579	4-CHLORO-ortho-TOLUIDINE HYDROCHLORIDE, SOLUTION	N	N	X	?
6.1/1579	4-CHLORO-ortho-TOLUIDINE HYDROCHLORIDE, SOLUTION	X	X	X	?

Class/UN No.	PSN	UN (12ed)	RID/ADR	IMDG Amdt. 30-00	CFR 49
6.1/1656	NICOTINE HYDROCHLORIDE, SOLUTION	X	X	X	X
6.1/1656	NICOTINE HYDROCHLORIDE, SOLID	X	X	X	N
6.1/1658	NICOTINE SULPHATE, SOLUTION	X	X	X	X
6.1/1658	NICOTINE SULPHATE, SOLID	X	X	X	X
6.1/1680	POTASSIUM CYANIDE, SOLUTION	N	N	X	N
6.1/1680	POTASSIUM CYANIDE, SOLID	X	X	X	X
6.1/1689	SODIUM CYANIDE, SOLUTION	N	N	X	N
6.1/1689	SODIUM CYANIDE, SOLID	X	X	X	X
6.1/1690	SODIUM FLUORIDE, SOLUTION	N	N	X	N
6.1/1690	SODIUM FLUORIDE, SOLID	X	X	X	X
6.1/1693	TEAR GAS SUBSTANCE, LIQUID, N.O.S.	X	X	X	X
6.1/1693	TEAR GAS SUBSTANCE, SOLID, N.O.S.	X	X	X	X
6.1/1697	CHLOROACETOPHENONE, LIQUID	N	N	X	X
6.1/1697	CHLOROACETOPHENONE, SOLID	X	X	X	X
6.1/1699	DIPHENYLCHLOROARSINE, LIQUID	X	X	X	X
6.1/1699	DIPHENYLCHLOROARSINE, SOLID	X	X	X	X
6.1/1709	2,4-TOLUYLENEDIAMINE, LIQUID	N	N	X	N
6.1/1709	2,4-TOLUYLENEDIAMINE, SOLID	X	X	X	X
8/1729	ANISOYL CHLORIDE, LIQUID	X	X	X	X
8/1729	ANISOYL CHLORIDE, SOLID	N	N	X	N
8/1742	BORON TRIFLUORIDE ACETIC ACID COMPLEX, LIQUID	X	X	X	X

Class/UN No.	PSN	UN (12ed)	RID/ADR	IMDG Amdt. 30-00	CFR 49
8/1742	BORON TRIFLUORIDE ACETIC ACID COMPLEX, SOLID	N	N	X	N
8/1743	BORON TRIFLUORIDE PROPIONIC ACID COMPLEX, LIQUID	X	X	X	X
8/1743	BORON TRIFLUORIDE PROPIONIC ACID COMPLEX, SOLID	N	N	X	N
8/1811	POTASSIUM HYDROGENDIFLUORIDE, LIQUID	N	N	X	X (solution)
8/1811	POTASSIUM HYDROGENDIFLUORIDE, SOLID	X	X	X	X
8/1812	POTASSIUM FLUORIDE, LIQUID	N	N	X	N
8/1812	POTASSIUM FLUORIDE, SOLID	X	X	X	X
8/1938	BROMOACETIC ACID, SOLUTION	X	X	X	X
8/1938	BROMOACETIC ACID, SOLID	N	N	X	X
6.1/2074	ACRYLAMIDE, SOLUTION	N	N	X	N
6.1/2074	ACRYLAMIDE, SOLID	X	X	X	X
6.1/2236	3-CHLORO-4-METHYLPHENYL ISOCYANATE, LIQUID	X	X	X	X
6.1/2236	3-CHLORO-4-METHYLPHENYL ISOCYANATE, SOLID	N	N	X	N
8/2511	2-CHLOROPROPIONIC ACID, SOLUTION	X	X	X	X
8/2511	2-CHLOROPROPIONIC ACID, SOLID	X	X	X	N
6.1/2662	HYDROQUINONE, SOLUTION	N	N	X	N
6.1/2662	HYDROQUINONE, SOLID	X	X	X	X
4.2/3052	ALUMINIUM ALKYL HALIDES, LIQUID	X	X	X	X
4.2/3052	ALUMINIUM ALKYL HALIDES, SOLID	X	X	X	N

Class/UN No.	PSN	UN (12ed)	RID/ADR	IMDG Amdt. 30-00	CFR 49
6.1/3172	TOXINS, EXTRACTED FROM LIVING SOURCES, LIQUID, N.O.S.	X	X	X	?
6.1/3172	TOXINS, EXTRACTED FROM LIVING SOURCES, LIQUID, N.O.S.	X	X	X	?
4.2/3203	PYROPHORIC ORGANOMETALLIC COMPOUND, LIQUID, WATER-REACTIVE, N.O.S.	X	X	X	N
4.2/3203	PYROPHORIC ORGANOMETALLIC COMPOUND, SOLID, WATER-REACTIVE, N.O.S.	X	X	X	X
6.1/3278	ORGANOPHOSPHOROUS COMPOUND, TOXIC, N.O.S., LIQUID	X	X	X	X
6.1/3278	ORGANOPHOSPHOROUS COMPOUND, TOXIC, N.O.S., SOLID	X	X	X	N
6.1/3280	ORGANOARSENIC COMPOUND, N.O.S., LIQUID	X	X	X	N
6.1/3280	ORGANOARSENIC COMPOUND, N.O.S., SOLID	X	X	X	X
6.1/3281	METAL CARBONYLS, N.O.S., LIQUID	X	X	X	X
6.1/3281	METAL CARBONYLS, N.O.S., SOLID	X	X	X	N
6.1/3282	ORGANOMETALLIC COMPOUND, TOXIC, N.O.S., LIQUID	X	X	X	N
6.1/3282	ORGANOMETALLIC COMPOUND, TOXIC, N.O.S., LIQUID	X	X	X	X
6.1/3315	CHEMICAL SAMPLE, TOXIC, LIQUID	X	X	X	?
6.1/3315	CHEMICAL SAMPLE, TOXIC, SOLID	X	X	X	?

Annex 2

List of UN entries having a melting point around the borderline of the definition solid/liquid, including isomers and mixtures thereof

X means entry is listed in the regulation

N means entry not listed in the regulation.

Class/UN No.	PSN	UN 12 (12 ed)	RID/ADR	IMDG (30-00)	CFR 49
6.1/1577	CHLORODINITROBENZENES, LIQUID	X	X	X	N
6.1/1577	CHLORODINITROBENZENES, SOLID	X	X	X	X
6.1/1578	CHLORONITROBENZENES, LIQUID	N	N	X	X
6.1/1578	CHLORONITROBENZENES, SOLID	X	X	X	X
6.1/1590	DICHLOROANILINES, LIQUID	X	X	X	X
6.1/1590	DICHLOROANILINES, SOLID	X	X	X	X
6.1/1597	DINITROBENZENES, LIQUID	X	X	X	X
6.1/1597	DINITROBENZENES, SOLID	X	X	X	X
6.1/1664	NITROTOLUENES, LIQUID	X	X	X	X
6.1/1664	NITROTOLUENES, SOLID	X	X	X	X
6.1/1665	NITROXYLENES, LIQUID	X	X	X	X
6.1/1665	NITROXYLENES, SOLID	X	X	X	N
6.1/1694	BROMOBENZYL CYANIDES, LIQUID	X	X	X	X
6.1/1694	BROMOBENZYL CYANIDES, SOLID	X	X	X	X
6.1/1708	TOLUIDINES, LIQUID	X	X	X	X
6.1/1708	TOLUIDINES, SOLID	X	X	X	X
6.1/1711	XYLIDINES, LIQUID	X	X	X	X
6.1/1711	XYLIDINES, SOLID	X	X	X	X
8/1805	PHOSPHORIC ACID, LIQUID	X	X	X	X
8/1805	PHOSPHORIC ACID, SOLID	X	X	X	N
6.1/1843	AMMONIUM DINITRO-ortho-CRESOLATE, LIQUID	N	N	X	N
6.1/1843	AMMONIUM DINITRO-ortho-CRESOLATE, SOLID	X	X	X	X
6.1/2038	DINITROTOLUENES, LIQUID	X	X	X	X
6.1/2038	DINITROTOLUENES, SOLID	X	X	X	X
6.1/2076	CRESOLS, LIQUID	X	X	X	X

Class/UN No.	PSN	UN 12 (12 ed)	RID/ADR	IMDG (30-00)	CFR 49
6.1/2076	CRESOLS, SOLID	X	X	X	N
6.1/2077	alpha-NAPHTHYLAMINE, LIQUID	N	N	X	N
6.1/2077	alpha-NAPHTHYLAMINE, SOLID	X	X	X	X
6.1/2235	para-CHLOROBENZYL CHLORIDES, LIQUID	X	X	X	X
6.1/2235	para-CHLOROBENZYL CHLORIDES, SOLID	N	N	X	N
6.1/2239	CHLOROTOLUIDINES, LIQUID	N	N	X	X
6.1/2239	CHLOROTOLUIDINES, SOLID	X	X	X	X
6.1/2261	XYLENOLS, LIQUID	N	N	X	N
6.1/2261	XYLENOLS, SOLID	X	X	X	X
6.1/2306	NITROBENZOTRIFLUORIDES, LIQUID	X	X	X	X
6.1/2306	NITROBENZOTRIFLUORIDES, SOLID	N	N	X	N
8/2308	NITROSYLSULPHURIC ACID, LIQUID	X	X	X	X
8/2308	NITROSYLSULPHURIC ACID, SOLID	X	X	X	N
9/2315	POLYCHLORINATED BIPHENYLS, LIQUID	P906	P906	X	X
9/2315	POLYCHLORINATED BIPHENYLS, SOLID	P906	P906	X	X
6.1/2433	CHLORONITROTOLUENES, LIQUID	X	X	X	X
6.1/2433	CHLORONITROTOLUENES, SOLID	X	X	X	X
6.1/2669	CHLOROCRESOLS, SOLUTION	X	X	X	X
6.1/2669	CHLOROCRESOLS, SOLID	N	N	X	X
6.1/2730	NITROANISOLES, LIQUID	X	X	X	N
6.1/2730	NITROANISOLES, SOLID	X	X	X	X
6.1/2732	NITROBROMOBENZENES, LIQUID	X	X	X	X
6.1/2732	NITROBROMOBENZENES, SOLID	X	X	X	X
6.1/2753	N-ETHYLBENZYL TOLUIDINES, LIQUID	X	X	X	X
6.1/2753	N-ETHYLBENZYL TOLUIDINES, SOLID	X	X	X	X
6.1/2937	alpha-METHYLBENZYL ALCOHOL, LIQUID	X	X	X	X
6.1/2937	alpha-METHYLBENZYL ALCOHOL, SOLID	N	N	X	N

Annex 3**Discrepancies in the Dangerous Goods List**

Note: amendments are for identification purpose, only given in respect to the packing instructions concerning the use of packagings (except IBCs and large packagings).

Experts are invited to consider this list of discrepancies.

UN Number	Amendment	Reasoning discrepancy
1611	P002 should read P001	According to the IMDG Amdt. 30-00 HEXAETHYL TETRAPHOSPHATE is a yellow liquid
1704	P002 should read P001	According to the IMDG Amdt. 30-00 TETRAETHYL DITHIOPYROPHOSPHATE is a colourless liquid
1792	P002 should read P001	According to the IMDG Amdt. 30-00 IODINE MONOCHLORIDE is a brown, heavy, oily liquid
1793	P002 should read P001	According to the IMDG Amdt. 30-00 ISOPROPYL ACID PHOSPHATE is an oily liquid
2305	P001 should read P002	According to the IMDG Amdt. 30-00 NITROBENZENESULPHONIC ACID are crystals
2729	P001 should read P002	According to the IMDG Amdt. 30-00 HEXACHLOROBENZENE are white needle-like crystals
2751	P002 should read P001	According to the IMDG Amdt. 30-00 DIETHYLTHIOPHOSPHORYL CHLORIDE is a colourless liquid with a perceptible odour
2851	P002 should read P001	According to the IMDG Amdt. 30-00 BORON TRIFLUORIDE DIHYDRATE is a colourless liquid with a perceptible odour
2936	P002 should read P001	According to the IMDG Amdt. 30-00 THIOLACTIC ACID is an oily liquid with a foul odour