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IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP
JOINT GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS
OF MARINE POLLUTION
- GESAMP -

REPORTS AND STUDIES

No. 35

The Evaluation of the Hazards of Harmful Substances Carried by Ships: Revision of GESAMP Reports and Studies No. 17

INTERNATIONAL MARITIME ORGANIZATION

J/3955

Reports and Studies No.35

IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts
on the Scientific Aspects of Marine Pollution (GESAMP):

THE EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS: REVISION OF GESAMP REPORTS AND STUDIES NO.17

IMO, 1989

This report is an updated and revised version of an earlier report on the evaluation of the hazards of harmful substances carried by ships (GESAMP Reports and Studies No.17) which was published by IMO in 1982.

9678V/jen

NOTES

1 GESAMP is an advisory body consisting of specialized experts nominated by the sponsoring agencies (IMO, FAO, Unesco, WMO, WHO, IAEA, UN, UNEP). Its principal task is to provide scientific advice on marine pollution problems to the sponsoring agencies and to the Intergovernmental Oceanographic Commission (IOC).

2 This report is available in English from any of the sponsoring agencies.

3 The report contains views expressed by members of GESAMP who act in their individual capacities; their views may not necessarily correspond with those of the sponsoring agencies.

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* * *

Definition of marine pollution by GESAMP:

"POLLUTION MEANS THE INTRODUCTION BY MAN, DIRECTLY OR INDIRECTLY, OF SUBSTANCES OR ENERGY INTO THE MARINE ENVIRONMENT (INCLUDING ESTUARIES) RESULTING IN SUCH DELETERIOUS EFFECTS AS HARM TO LIVING RESOURCES, HAZARDS TO HUMAN HEALTH, HINDRANCE TO MARINE ACTIVITIES INCLUDING FISHING, IMPAIRMENT OF QUALITY FOR USE OF SEAWATER AND REDUCTION OF AMENITIES."

* * *

For bibliographic purposes, this document may be cited as:

IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP).

The evaluation of the hazards of harmful substances carried by ships: Revision of GESAMP Reports and Studies No.17. Rep. Stud. GESAMP 35.

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NOTE

GESAMP wishes to draw attention to the fact that the hazard evaluation rationale was developed for the particular purpose of the development of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). As a consequence, the hazard profiles are intended to be used solely for that purpose. Information should not be extracted from the text or from the tables and used out of context unless the limitations and restrictions imposed upon it by the hazard assessment rationale are fully appreciated.

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THE EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS

(Composite report)

FOREWORD

The assessment of environmental hazards of substances carried by ships started in 1972, initially as preparatory work for the development of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73). This was in response to a request made by the Sub-Committee on Marine Pollution* of the International Maritime Organization (IMO) with regard to questions on hazards which might arise through the operational discharge at sea of tank washings by chemicals or through the accidental spillage of substances carried either in bulk or in packaged form. Originally, it was envisaged that this might include major inland waterways, e.g. St. Lawrence Seaway and Houston Ship Channel. The procedures were therefore initially developed to cover certain forms of fresh water pollution. Following signature of MARPOL 73** which deals only with marine pollution, this aspect has been given no further attention.

Work has continued throughout the intervening period and reports have been prepared of individual meetings of the GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships. These reports have been available to GESAMP members and to the relevant IMO committees and sub-committees. Bearing in mind that the original working procedures*** have been progressively clarified, GESAMP in 1981 considered it desirable that the entire package of separate reports be drawn together and

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* The Sub-Committee on Marine Pollution was the predecessor of the Marine Environment Protection Committee (MEPC), established by the IMO Assembly in 1973 (resolution A.297(VIII)).

** In 1978 MARPOL 73 was extended by parts of the Protocol on Tanker Safety and Pollution Prevention (TSPP 78). Since that time the official title of the Convention is "International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto" (MARPOL 73/78)

*** The very early work had been made available to particularly interested parties as copies of document GESAMP IV/19/Supp.1, but was not published.

published as a single entity, together with all the hazard profiles developed at that time. Accordingly, GESAMP adopted a composite report, Reports and Studies No.17, which was published by IMO in 1982. It should be emphasized that since that time the original working procedures have not been substantively altered; to do so would require changes to the MARPOL 73/78 Convention. However, taking into account the progress of work carried out since 1982 and the considerable number of clarifications and advisory components prepared by the GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships, GESAMP in 1987 agreed that an updated and revised version of GESAMP Reports and Studies No.17 be published by IMO. Since 1984 the United Nations Environment Programme (UNEP) has co-sponsored the work of the Working Group. IMO acts as lead agency. The updated and revised version of GESAMP Reports and Studies No.17 was approved for publication by GESAMP as Reports and Studies No.35 at its eighteenth session (Paris, 11-15 April 1988).

In making this report widely available, GESAMP wishes to draw attention to the fact that the hazard profile rationale was developed for the particular purpose of the development of MARPOL 73/78. As a consequence, the hazard profiles were intended to be used solely for that purpose. Accordingly, information should not be extracted from the text nor from the tables and used out of context unless the limitations and restrictions imposed upon it by the hazard assessment rationale are fully appreciated.

The lists of hazard profiles included in this composite report are accurate as of August 1988; however, they are continuously being reviewed as new data become available. In this connection it should be recognized that GESAMP has continually been faced with the problem of limited data availability. This has meant that in many cases extrapolations have had to be made. As more information becomes available, hazard profiles are reviewed and, if necessary, revised. It is recognized that the consequent change of hazard profiles may cause operational problems, but until Governments and the chemical industry supply the data necessary for GESAMP to carry out a complete hazard assessment this problem will remain. Being aware that in many cases such data have been prepared for restricted distribution only, GESAMP pointed out that such information might, if necessary, be provided to GESAMP on an "In Confidence" basis.

1 INTRODUCTION

1.1 Historical background

In 1969 the Assembly of the International Maritime Organization (IMO) decided to convene an International Conference for the purpose of preparing a suitable international agreement for placing restraints on the contamination of the sea, land and air by ships and other equipment operating in the marine environment.

Late in 1971, in the course of preparing for the International Conference on Marine Pollution, which was held in 1973, the Sub-Committee on Marine Pollution of IMO experienced considerable difficulty in categorizing pollution hazards of substances carried by ships in a way which could be utilized in the development of control measures. As a means of solving the problem the Sub-Committee on Marine Pollution prepared a detailed enquiry requesting GESAMP to examine a number of lists of chemicals and products and to consider the hazards which these substances might pose to the aquatic environment. A copy of the enquiry is attached to this report as Annex 1. At that time (late 1971) it was the intention that the International Convention, which was to be developed in 1973, should contain regulations for the prevention of pollution by oil, noxious liquid substances carried in bulk, dangerous goods carried in packages, portable tanks, freight containers or road or rail tank wagons, as well as sewage and garbage from ships. It was originally also planned to include in the Convention not only measures for the control and prevention of the marine environment, but also of inland waters used by seagoing vessels, as well as of air (e.g. emissions from vessels), hence the title "International Convention for Prevention of Pollution from Ships". The inclusion of provisions for the prevention of pollution that might be caused by emissions from ships into the air is currently (1988) being discussed by IMO.

Due to the urgency of the problems related to evaluating the hazards of all the substances carried by ships, the then Chairman of GESAMP, Dr. M. Waldichuk (Canada), agreed that an Ad Hoc Panel of IMO and GESAMP experts should be established. A list of members of the Ad Hoc Panel is given

in Annex 2. The panel met on three occasions prior to the International Conference on Marine Pollution and, following the second meeting of the Ad Hoc Panel, the proposed methods for assessing the hazards likely to be posed were approved by GESAMP at its fourth session (18-23 September 1972). The outcome of the Ad Hoc Panel was set out in document GESAMP IV/19/Supp.1 which was not published, although it has been made available to interested parties on request and has, as a consequence, been widely distributed. In 1982 GESAMP Reports and Studies No.17 was published, which updated and replaced both the Rationale and Hazard Profile List included in the original report, GESAMP IV/19/Supp.1. The present document, Reports and Studies No.35, is a further update and supersedes all the earlier documents.

The International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL)* was adopted in 1973 by the International Conference on Marine Pollution. Annex II of the Convention contains detailed requirements for the discharge criteria and measures for control of pollution by noxious liquid substances carried in bulk. It also refers to the need to develop specific requirements for the prevention of accidental spillages from chemical tankers. For the purpose of developing discharge requirements, noxious liquid substances were divided into four pollution categories depending upon their

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* MARPOL covers all the technical aspects of pollution that might be caused by discharges into the sea of substances from ships, except for the disposal of land-generated waste by dumping from ships and the discharge of substances directly arising from of the exploration and exploitation of sea-bed mineral resources. It consists of articles, two protocols dealing respectively with reports on incidents involving harmful substances and arbitration, and five Annexes which contain regulations for the prevention and control of marine pollution by:

(1) oil;

(2) noxious liquid substances carried in bulk;

(3) harmful substances carried in packages, portable tanks, freight containers, or road or rail tank wagons, etc.;

(4) sewage from ships; and

(5) garbage from ships.

The International Conference on Tanker Safety and Pollution Prevention, 1978, by adopting the "1978 MARPOL Protocol" modified the provisions of the Convention, referred to thereafter as MARPOL 73/78.

hazards to marine resources, human health, amenities and other legitimate uses of the sea as evaluated by the Ad Hoc Panel. Guidelines for the categorization of noxious liquid substances were set out in Appendix I to Annex II to MARPOL 73/78 together with some 250 substances that had then been categorized at that time.

Following the conclusion of the Convention, GESAMP agreed to undertake the ongoing task of evaluating the environmental hazards of additional substances proposed for carriage by ships, and a Working Group was established. This met for the first time in 1974 and has since met on 22 further occasions. Both the terms of reference and the membership of the Working Group have changed over the years, although an effort has always been made to maintain reasonable continuity in membership. A list of those experts who have been members of the Working Group is given in Annex 3. The two sets of terms of reference are shown in Annex 4. Under the earlier and wider terms of reference the Working Group was asked by GESAMP to not only deal with questions which were directly related to the main task of assessing the environmental hazards of substances carried by ships (through the development of hazard profiles), but also to consider such questions as quantities of dangerous goods which might be carried in packaged form without the need to consider pollution prevention measures. The Working Group was also asked to advise on questions related to the interpretation of the expression "rapidly rendered harmless at sea" as used in various international legal agreements on the prevention of marine pollution by dumping of wastes at sea. The results of the considerations of the Working Group were used by IMO and non-IMO bodies in subsequent deliberations. After the establishment of specific scientific advisory bodies under a number of international conventions (e.g. the Scientific Group on Dumping under the London Dumping Convention), the Working Group now solely evaluates hazards of harmful substances transported by ships and does not evaluate wastes carried by dumping vessels for the purpose of disposal at sea. In this context it should be noted that the Marine Environment Protection Committee (MEPC) of IMO had agreed that liquid chemical wastes transported for dumping at sea should be classified as pollution category A substances, i.e. tank washings would have to be discharged at the dumping site designated by the responsible national authority, together with the cargo of wastes, or to a shore reception facility.

1.2 Factors taken into account by the Ad Hoc IMO/GESAMP Panel in 1972 when developing the hazard evaluation rationale

As mentioned above, an Ad Hoc Panel of IMO and GESAMP Experts had been requested to develop a means by which substances carried by ships could be classified according to the hazards they might pose if released to the environment. In order to assist the Panel concerning the scale and nature of the problems, a report had been made available by the Government of Norway regarding the pollution that might be caused by the normal operational procedures of ships engaged in chemical bulk transport. Further information was made available by representatives of the International Chamber of Shipping (ICS). A list of substances reported to be carried in bulk was also provided, as was a list of dangerous goods carried in packages.

In the light of this information, the Ad Hoc Panel in 1972 agreed to consider all shipborne substances with the exception of:

.1 oil, as then defined by the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 (OILPOL 1954); and

.2 radioactive substances (transported as packaged goods).

With regard to the prevention of marine pollution by oil, it was recognized that the definition of oil as laid down in OILPOL 1954 might well be extended to include some of the chemicals listed as being carried in bulk. Later on, for the purposes of MARPOL 73/78, Annex I, which "superseded" OILPOL 1954, a definition of "oil" was developed as follows:

> "Oil means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals which are subject to the provisions of Annex II of the present Convention) and, without limiting the generality of the foregoing, includes the substances listed in Appendix I to this Annex".

The list of oils in Appendix I to Annex I in fact includes "Naphtha Solvent" which under various different names is also contained in the list of noxious liquid substances contained in Annex II to the Convention.

Radioactive substances were excluded on the grounds that the requirements laid down by the International Maritime Dangerous Goods Code (class 7) involve a high degree of containment to avoid exposure to individuals; this should be sufficient to minimize accidental spillage and should therefore be adequate to take account of environmental hazards. It was also recognized that the safety aspects related to the loading and handling of radioactive substances is continuously being reviewed by the IMO Sub-Committee on the Carriage of Dangerous Goods (CDG) in co-operation with the International Atomic Energy Agency (IAEA)*. The hazard assessment of radioactive materials would also need very specific expertise and could only properly be assessed by a group of experts specially selected with that expertise.

The Ad Hoc Panel considered that there were a number of circumstances in which substances carried by ships might escape to the environment. For example, packaged goods could be swept overboard as a result of bad weather or be released as a direct result of a collision. As a result the contents of these packages may be released either where they are lost (for example, on the high seas or in the coastal zone) or during or subsequent to being swept onto a beach. Substances carried in bulk might escape to the environment as a result of collisions or of ships sinking and grounding. Such releases would occur in the vicinity of the accident.

Shipping experts advised the Ad Hoc Panel that it was rarely possible to unload the entire contents of a chemical tanker in a port, and that in most cases the vessel involved would be expected to carry different substances in its tanks on its next voyage. As a result the tanks had to be washed out and the normal practice at that time (1971/1972) was to discharge the wash and rinse waters overboard, either in or close to the port of unloading or loading, or en route between ports. The amount of tank washings discharged would be dependent on the product involved and on the design of the tank.

The Ad Hoc Panel agreed it should not consider questions relating to the effects of substances on either the vessel or its crew. Such matters were

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* IAEA Regulations for the Safe Transport of Radioactive Materials, 1973, Revised Edition - IAEA Safety Series No.6

considered to involve aspects of occupational safety which were covered by other Conventions* and were therefore outside the scope of the Panel. However, since people might come into contact with the substance, its solution or its reaction products after its release into the environment, the Panel believed it necessary to consider these wider aspects of hazards to human health, in particular with regard to the possible reduction of public amenities.

At that time it was noted that the scope of the proposed Marine Pollution Convention was not clear and that ships involved in sea passages might also travel considerable distances via inland waterways, and almost invariably enter river estuaries. Accordingly, it was concluded that any of the substances could enter waters that might be abstracted and used as a source of potable water supplies. However, the Convention did not include inland waterways in its provisions and the consideration of fresh-water problems has subsequently been discontinued.

Using the definition of pollution adopted by GESAMP**, the Ad Hoc Panel was asked to evaluate substances according to the hazards they might pose when released into the sea for the following four considerations:

.1 short-term and long-term hazards to living resources;

.2 short-term and long-term hazards to human health;

.3 reduction of amenities; and

.4 interference with other uses of the sea.

Recognizing that the evaluation of hazards would eventually be required for all substances carried by ships, the Ad Hoc Panel made no attempt to select particularly hazardous substances; rather, a conscious attempt was

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* e.g. the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74).

** The definition of marine pollution adopted by GESAMP is "Introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities including fishing, impairing of quality for use of seawater and reduction of amenities".

made to cover examples from the full range of substances which might be carried in the form of bulk liquid or dry cargoes or as packaged goods.

Note: In 1987 Parties to MARPOL 73/78 agreed that specific requirements for the prevention and control of marine pollution by bulk solid cargoes be developed and eventually added to the Convention.

The Ad Hoc Panel noted that guidance was required on the potential scales of problems which might be involved in terms of the bodies of waters which might be affected, e.g. a river, an estuary, coastal waters or deep sea.

Following a thorough analysis of the range of problems which could be encountered in a broadly defined hazard assessment, the Ad Hoc Panel adopted a procedure consisting of a seven-step process which became known as the hazard evaluation procedure. By this procedure hazard profiles were established and were used in 1973 by the International Conference on Marine Pollution in the preparation of the Convention. The hazard rating system developed by GESAMP was included in the MARPOL 73/78 Convention (MARPOL 73/78, Annex II, Appendix I: Guidelines for the Categorization of Noxious Liquid Substances) and it was therefore essential that the procedures used for hazard profiling remain in basically the same structure as conceived, as the incorporation of any changes would require that the Convention be amended. However, since the 1973 Conference adopted the evaluation procedure, certain definitions have been modified in the light of difficulties encountered. Such modifications have been introduced by way of clarification and have not in any way changed the substance of the procedure except that in 1978 the question of carcinogenesis was introduced and subsequently other specific adverse health effects were considered.

2 THE HAZARD EVALUATION PROCEDURE

2.1 Outline

Figure 1 on page 12 illustrates the originally developed procedure and its subsequent modifications. All the hazard profiles set out in Annex 6 to this document have been assessed according to the procedure as it now stands.

It is important to recognize that in assigning a hazard profile to any particular substance it is essential that these steps are followed as summarized below.

The first step in the process of hazard evaluation is designed to ensure that the substance involved is carried by ships and that hazard profiles are not produced unnecessarily.

The second step is designed to eliminate oils from further consideration. Oils were already covered by the 1954 Oil Pollution Convention. A somewhat extended range of oils is listed in Annex I to MARPOL 73/78. Consequently, conditions for the carriage of noxious liquid substances other than oil, plus the procedures and arrangements for the discharge of their residues and tank washings, are covered by a different Annex of the Convention and differ in several respects from those laid down for oil (e.g. rates of discharge and position of the outlet for the discharge). However, since the development of MARPOL 73/78 there have been a number of cases where different views were expressed as to whether a certain substance from the regulatory viewpoint should be covered by Annex I or by Annex II (Liquid Noxious Substances). In this respect it has been agreed by the relevant IMO bodies to assign to a number of substances "dual status".

The third step was introduced because it is very difficult to establish a safe limit of discharge for substances which are liable to bioaccumulate. Even small discharges may be hazardous since very low concentrations of such substances in the water may be concentrated by marine life and as a result, pose a hazard, either to the organisms themselves or to their predators, including man. In the special context where the marine organism is commercially exploited, its flesh may also be rendered unpalatable. For these reasons it was felt that special measures are called for in order to restrict the input of such substances.

The fourth step is followed in order to give a ranking of the potential danger of marine organisms being killed in the short term, either as a result of operational discharges or as a result of spillages. These dangers are

assessed by use of acute toxicity information. It was also noted that certain substances may exert a very high oxygen demand as they degrade in the water and it was initially felt desirable to identify substances particularly likely to pose such problems. Similarly, certain substances, especially bulk solids, if spilled in large quantities, may blanket the sea-bed and seriously affect the marine benthos. An indication was given where such dangers were felt likely.

The fifth step provides for ranking on the basis of acute toxicity, primary irritancy and longer term specific adverse health hazards to humans, other than ship, salvage, or dock-side personnel, who might accidentally or unwittingly come into contact with the substance once released into marine waters. The dangers are assessed by review of published information on all relevant toxicology by oral, inhalation, cutaneous and ocular exposure.

The sixth step is a somewhat subjective one. It was introduced in the light of several actual incidents and is designed to make provision for the protection of amenity incidents such as beach uses and water sports, e.g. sailing. Aesthetic considerations such as discolouration of the water, objectionable smells and creation of scums or floating material are also taken into account.

The seventh step was useful, prior to the conference leading to the 1973 Convention, to provide some measure of the potential of a substance to create a hazard in particular water bodies. In order to illustrate this, hypothetical bodies of water were postulated in which the quantity of substance being carried could be shown to be potentially hazardous. The assessment proved useful in combining the previous hazard evaluations and in drawing attention to the protective measures needed. This step has not been used by GESAMP since 1973.

Figure 1. RATIONALE FOR THE EVALUATION OF HARMFUL SUBSTANCES

		Action taken	Details of consideration	Rating assigned in	Remarks
STEP 1					
Is the substance carried by ship or proposed for carriage by ship?	NO	No action			
	YES				
STEP 2					
Is the substance an oil? (as defined in MARPOL 73/78, Annex I)	YES	No action			Mixtures containing oil are rated on basis of laboratory test results. Evaluation may also be carried out if composition of oil is known
	NO				
STEP 3					
Is the substance, or its reaction/degradation product(s) liable to be bioaccumulated?	YES	Assess duration and potential effect on:	1) Aquatic organisms directly 2) Predators, including man	Column A	
Is the substance liable to taint fish?	YES	Assess threshold concentration and potential effect concerning:	Tainting of seafood		Guidelines for Evaluating Threshold Values for Tainting of Seafood by Chemical Substances developed in 1988
STEP 4					
How great is the risk posed to living aquatic organisms by discharges from ships or spillages at sea?		Assess on basis of acute toxicity as:	1) Highly toxic 2) Moderately toxic 3) Slightly toxic 4) Practically non-toxic 5) Non-hazardous	Column B	Conditions of laboratory tests and information sources evaluated/scrutinized
STEP 5					
How great a hazard is posed to human health?	1)	Assess on basis of acute toxicity (oral intake) as:	1) Highly hazardous 2) Moderately hazardous 3) Slightly hazardous 4) Practically non-hazardous 5) Non-hazardous	Column C	
	2)	Assess on basis of acute percutaneous and inhalation toxicity, skin and eye irritancy and specific long-term health effects as:	1) Hazardous 2) Slightly hazardous 3) Non-hazardous	Column D	
	3)	Assess potential for specific long-term adverse health effects	Possible risk from carcinogenicity, teratogenicity, reproductive toxicity, sensitization, neurotoxicity and other specific serious adverse health effects.	Columns D and E; Remarks column	
STEP 6					
What impact would a spill have on recreational use of a beach, amenity interests and aesthetics?		Assess as:	1) Highly objectionable 2) Moderately objectionable 3) Slightly objectionable 4) No problem	Column E	
STEP 7 (only used in preparatory work)					
What hazard potential does the substance pose to different bodies of water?		Assess in relation to:	1) River 2) Estuary 3) Coastal waters 4) Deep sea	---	Dropped at one of the earlier meetings because the state of the art in the early seventies did not permit the preparation of meaningful models concerning exposure assessments relating to the various water bodies

2.2 Detailed explanation of the hazard evaluation steps

Prior to the 1973 Conference, no records of the basis of decisions were kept by the Ad Hoc Panel. Subsequently it was recognized that from time to time questions would be raised as to the information used in the derivation of the hazard profiles. It was therefore agreed, at the first meeting of the GESAMP Working Group (1974), that a data sheet should be completed for each substance for which a hazard profile was assigned. These sheets are stored at IMO for future reference and updated as necessary. A copy of a blank data sheet as currently used is included in this report as Annex 7. Most of the substances originally assessed by the Ad Hoc Panel have subsequently been re-examined by the GESAMP Working Group. Where this is the case, data sheets have been prepared. The data sheets are the property of GESAMP and as such are intended as working records only. They are not made available to outside persons, although certain details can be made available on request through the IMO Technical Secretary of GESAMP in consultation with the Chairman of the Working Group, taking into account the confidential character of some of the data.

Each substance is listed under a commonly accepted chemical name. Where substances are commonly known by several such names, those names are listed but the hazard profile is given under one name and the reader is referred to that name and entry at each of the additional entries. It is recognized that various formal nomenclature systems exist but, as these are not universally adopted, the Working Group has basically used those names of substances listed in the Bulk Chemicals* and Dangerous Goods Codes** developed by IMO. In some instances these names have not given sufficient definition for the purpose of describing the hazard to the marine environment and additional information concerning the material has been required. Examples include limits on impurities, or on materials added as stabilizers, degree of chlorination of the material, extent of polymerization, etc. Trade names are listed in the hazard profiles only in exceptional circumstances (see section 5).

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* International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code);

** International Maritime Dangerous Goods Code (IMDG Code).

Based on the procedure shown in figure 1 each substance is given a hazard profile, an example of which is shown below:

	Bioaccumulation	Damage to living resources	Hazard to human health		Reduction of amenities	
			Oral intake	Skin contact and inhalation		
Substances	A	B	C	D	E	Remarks
Mercuric arsenate	+	4	(2)	II	XX	Carcinogen

2.2.1 Column A - Bioaccumulation and tainting

Bioaccumulation occurs if an aquatic organism takes up a chemical to which it is exposed so that it contains a higher concentration of that substance than is present in the ambient water or its food. The process is usually reversible through metabolism and depuration, although the rates of loss may be substantially slower than the rate of uptake. Where the rate of metabolism or elimination of the substance is high and the degree or period of exposure is small, bioaccumulation may be short-lived. Where the rates of metabolism or elimination are low or the degree or period of exposure great, bioaccumulation may be of long duration.

The hazard posed by a substance, e.g. certain metals and organic compounds, is increased if the substance is accumulated in aquatic organisms, since poisoning of the organisms may eventually ensue. Although the effect on the target organism in terms of the end result is the same whether the accumulation takes place directly from the water or via the consumption of food, the relative contributions of these two pathways may differ greatly depending on the organisms, the substance and its chemical forms in both water

and food. Once accumulated in an aquatic organism, predators including man may be adversely affected. In certain situations there may be no adverse health effect but the palatability of fish or shellfish may be adversely affected through tainting of their flesh.

Accumulation is not necessarily harmful and in some cases with naturally occurring substances may even be beneficial; the hazard evaluation procedure recognizes such harmless accumulations. Occasionally a substance may be altered in the environment and as a consequence become more readily bioaccumulated and harmful, e.g. mercury may be changed to methyl mercury. Similarly some compounds are degraded or metabolised fairly readily but yield products which are either equally or more harmful, e.g. aldrin is metabolised to dieldrin. Substances such as these are considered also in terms of their reaction products.

It was felt that the hazard evaluation procedure should distinguish between those substances which have a long residence time in the animal and are harmful and those which are harmful but have a shorter residence time in the animal (e.g. some short-chain chlorinated hydrocarbons). Furthermore, in view of the importance of commercial fishing it was felt important to identify substances which might affect the acceptability of the appearance or taste of fisheries products. This is important even if the effect is short-lived; consumer confidence is only slowly restored once affected by an off-flavoured meal.

Four symbols have been adopted. Brief definitions of these symbols are given in the summary legend to the hazard profiles in Annex 5 but the detailed definitions adopted, i.e. the ones to which the Working Group operate, are as follows:

"+" Refers to a substance which is known to be accumulated to a significant extent by certain marine organisms, which is not readily excreted or degraded into a less harmful metabolite by the organism and which as a consequence is known, or strongly suspected to be harmful to the animal, or to man if he eats the organism. Examples are mercury compounds and DDT.

Note 1: No precise definition of the words "significant extent" has been adopted but it is generally agreed that a material which is bioaccumulated to the extent of one hundredfold would be a candidate for this rating. Similarly where the log of the octanol: water partition coefficient (log P_{OW}) exceeds three the substance would be a candidate for inclusion. Final inclusion is dependent on the assessment of likely harm.

Note 2: Substances which are known to be converted to other substances which by themselves will fall within this definition are included in this group.

"T" Refers to a substance which is known to be taken up by marine organisms with the result that it is tainted and rendered unpalatable as seafood. Examples are chlorophenols. A taint is defined as:

"A FOREIGN FLAVOUR OR ODOUR IN THE ORGANISMS INDUCED BY CONDITIONS IN THE WATER TO WHICH THE ORGANISMS ARE EXPOSED".

Note 1: Where a substance causes taint but also merits a "+" rating, a "+" rating only is allocated.

Note 2: Where a substance causes taint it would be given a "T" rating even though it is known to have a relatively short half-life in the animal.

"Z" Refers to a substance which is known or strongly suspected to be accumulated by marine organisms but which is rapidly lost (biological half-life of about 1 week or less) by that organism when it moves or is moved from the zone of exposure. Substances are only given this rating when they are also known or strongly suspected to be harmful to the organisms or man.

Note: Where a substance causes taint but also merits a "Z" rating, a "T" rating only is allocated.

"0" Indicates a substance for which there is no evidence to support one of the above ratings (+, T or Z).

Note: The symbol "0" is used in cases where the available evidence or scientific assessment indicates that a substance will not accumulate or that there is little possibility of the compound being harmful to the animal or man, even though the bioconcentration factor or partition octanol: water coefficient (P_{OW}) indicates that bioaccumulation does or may occur. Examples of such compounds are the higher alcohols and phthalates.

"-" Indicates a substance for which information is not available to the Working Group to enable them to make an assessment.

In cases where no information is available for firm evaluation the Working Group, wherever possible, will make a tentative assessment based either on comparison with other structurally similar substances or some such extrapolation. Where this is done the rating is shown in parenthesis, e.g. (+), indicating inadequate evidence to give a firm evaluation but enough to indicate this is the most likely correct assessment. The ( ) symbol has a similar meaning in columns B and C. Because the assessment of potential impact on amenities (column E) is necessarily a subjective one and in view of the multiplicity of toxicological effects which are taken into account in assigning a rating to column D, the ( ) symbol is not used for columns D or E. The "-" symbol may be used in any of the columns and always indicates a consensus opinion that there are insufficient data to make an assessment.

It was recognized that a number of compounds which are usually regarded as contaminants also occur naturally, examples being benzo-a-pyrene and the halomethanes, e.g. methyl iodide and chloromethane. It may therefore be wrong to regard small-scale inputs, e.g. from tank washings, as being detrimental to the environment. However, information on the naturally occurring concentrations of such substances is sparse and its accuracy is uncertain.

The Working Group will keep this topic under review but until reliable information becomes available on the relative inputs (man-made and natural) of such substances it was considered prudent to rate them according to the standard hazard procedure.

2.2.1.1 Guidelines and recommendations for testing "taint"

"T" ratings were assigned by the Working Group on the basis of literature referring to test results and actual spill incidents. However, it became evident, after a survey carried out by the Working Group, that no internationally agreed method for the evaluation of tainting properties of substances was available which would serve the particular needs of the Group.

In 1983 the Working Group recognized that there was a need for the development of procedures by which the potential of taint could be determined. Although the Working Group recognized that it was not within its purview to establish detailed testing procedures, it nevertheless felt that broad guidelines should be developed based upon scientific principles by which such testing might be done. Such guidelines developed by the Working Group are given in Annex 8.

In 1987, a Task Force established by the European Chemical Industry Ecology and Toxicology Centre (ECETOC) completed a protocol on procedures for determining the ability of a chemical to taint fish (ECETOC Technical Report No.25). It was noted that the experimental procedures for determining such tainting ability, recommended by the ECETOC Task Force, are very similar to those included in the Working Group guidelines, Annex 8. The exposure conditions recommended by ECETOC and by the Working Group are virtually the same: fish or other seafood is exposed for 24 hours in continuous flow seawater systems containing the test compound over a suitable range of concentrations. The flesh of the exposed fish, after cooking, is compared with that from control fish (unexposed) to determine if exposure has resulted in any change in flavour or odour. The exposed fish is then assessed for taint by using a "triangular test" procedure described in an international standard (ISO 4120-1983). The difference between the ECETOC protocol and the guidelines established by the Working Group shown in Annex 8, resides in the evaluation and presentation of the results of tests. The GESAMP guidelines recommend that the compound be tested at five or more concentrations and that the data be processed to present a tainting threshold concentration of the substance concerned, whereas the ECETOC protocol recommends that a compound be

tested at fixed concentrations of 10.0, 1.0 and 0.1 mg/l with the overriding restriction that maximum concentrations should be no more than one tenth of the LC50 values obtained. The data from these sensory evaluations will be expressed as "tainting" or "not tainting" at the various concentrations tested.

2.2.1.2 Thresholds and allocation of "T" ratings

The Working Group recognized that the great majority of chemicals have a flavour, but for most of them the potential to taint fish cannot be realized because the detection threshold in fish flesh will not be reached. After a review of the reported concentrations of compounds at which tainting had occurred, the Working Group selected 1 mg/l in the ambient water as the tainting threshold (see Annex 8, section 1.3) and chemicals causing a taint at or below this value would be assigned a "T" rating. In this regard it should be noted that MARPOL 73/78 refers to tainting substances as being those "that are liable to taint seafood". The threshold of 1 mg/l selected by the Working Group has also been adopted by GESAMP at its eighteenth session in 1988. However, it has not yet been approved from the regulatory viewpoint (carriage and discharge requirements) by the relevant IMO bodies.

2.2.1.3 Depuration time

The ECETOC guidelines provide for a depuration test if the compound taints at the highest concentration tested. Fish should be exposed at 10.0 mg/l (or one tenth of the LC50 value) for 24 hours (ideally related back to a percentage of aqueous solubility values) and then be transferred to clean water for another 24 hours. The fish would then be assessed for taint.

With regard to the introduction of "depuration time" in tainting test protocols, the Working Group, however, decided to allocate all substances causing taint with a "T" rating even in cases where they are known to have a relatively short half-life in the animal. This decision was based on the assumption that, in the case of accidental spillages of tainting substances from chemical tankers, fishing areas that were affected would have to be closed for a certain period of time even in those cases where the effect was

short-lived and the living resources would have lost the taint after a short time.

2.2.2 Column B - Damage to living resources

2.2.2.1 Direct toxic effects

In order to rank the hazard posed to living resources the most practical solution available was considered to be the use of acute toxicity test data. Wherever possible 96 hr LC50* data relating to marine species are used and wherever possible the Working Group use data relating to adult or juvenile stages of organisms representing the middle to upper levels of an aquatic food chain, e.g. crustacea or fish. Where data are not available for marine species but are available for freshwater species these may be used after due consideration of the possible effect on toxicity of the different water medium. Where data are available for several species, it is generally the figure which indicates the greater degree of toxicity that is used. Data are checked as to the reliability of the test procedures used and if such checks indicate the data are unreliable they will be discarded (i.e. inappropriate test conditions are assumed).

As mentioned above, in most cases data relating to crustacea and/or fish are used wherever possible. A few substances have been considered which were known to have particularly serious effects on algae, including phytoplankton; in such instances these effects were taken into account in assessing the rating given.

Where it is known that a chemical is likely to be rapidly altered once it has entered the aquatic environment, the substance is rated taking into account the changes that occur.

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* LC50 = the median lethal concentration, which is an estimate of the concentration of a substance which will, within the specified time (generally 96 hrs) kill 50% of the exposed group of test organisms. It may be specified in ug/l (ppb), mg/l (ppm), etc.

The Working Group is fully aware that other stages in the life cycle of aquatic organisms are more sensitive than those which are usually the subject of toxicity testing. It is also well aware that sub-lethal effects may manifest themselves after prolonged or chronic exposure to much lower concentrations than those which are acutely toxic and that these may ultimately be more important in their effect on the marine ecosystem. Similarly, it is recognized that behavioural and chemoreceptive capabilities may be affected at concentrations considerably lower than at the 96 hr LC50. These factors were recognized when the use of acute toxicity test data was adopted as the means of hazard ranking, however, the hazard profile system required by IMO simply calls for a means of ranking hazard, and the only type of data sufficiently widely available to permit this to be done with reasonable accuracy is that from acute toxicity tests.

It must be emphasized that the concentration bands selected do not mean that under other circumstances a substance with a 96 hr LC50 above 1000 mg/l would not be harmful nor does it mean that in other situations subdivisions below 1 mg/l would not be appropriate. However, it was considered that if the 96 hr LC50 exceeded 1000 mg/l then it was unlikely, in the context under consideration, to pose a significant hazard to marine organisms. Similarly any substance with a 96 hr LC50 less than 1 mg/l was considered to be sufficiently toxic to merit the strictest precautions to prevent it entering the sea. Five subdivisions (less than 1 mg/l; 1-10 mg/l; 10-100 mg/l; 100-1000 mg/l; greater than 1000 mg/l) of the category were considered appropriate.

The Working Group very carefully evaluates the data and notes the test conditions under which these have been obtained, and there have been a number of cases where data have been rejected due to unreliable test procedures. This has led to comments from those who submitted the data to GESAMP. In each case, advice on how tests should be carried out has been provided by the Working Group.

In particular, problems have been encountered when substances of low density, high volatility and low solubility had been tested. Results of tests

with such substances carried out by members of the Working Group were sometimes different from those which had been obtained by the chemical industry. In light of problems encountered when testing these substances, the Working Group presents guidelines for the testing of such substances. These are set out in Annex 9.

The chemical industry argued that for substances with certain physical properties the test procedures acknowledged by the Working Group would result in data which would not be representative of what would occur in an actual spill at sea or when tank residues from ships would be discharged into the sea.

In response, the Working Group made a general statement, emphasizing that in its evaluation of harm to living marine resources it has used the LC50 values obtained by recognized procedures such as those described in the OECD Guidelines for Testing of Chemicals. This requires the exposure of the test organism to known and constant concentrations of the substance for the required periods of time. The results obtained should be regarded as an intrinsic property of the substance concerned. In other words, where the method of testing permits the loss of the substance from the test, as for example by volatilization, then it cannot be said that the test organism has been exposed to the specific known concentration of the substance (unless chemical analyses have been carried out), and the results obained cannot be regarded as an intrinsic property of the substance.

The Working Group recognized the validity of the argument that the tests carried out under internationally recognized procedures do not represent what will necessarily happen when substances of low solubility, low density and high volatility are spilled at or discharged into the sea. However it maintained the view that it was important for all substances to be considered on the same basis, namely that of their marine toxicity as expressed by LC50 values obtained by exposure to measured and constant concentrations of the substances for the whole of the test period. It also noted that these test conditions do mimic what would happen at sea under the severe weather conditions under which many accidents occur. As such, they do reflect the inherent toxicological impact of substances of low solubility, low density or

high volatility likely to be exerted under such conditions. The Working Group could not accept a less stringent test procedure. The Working Group recognized the right of IMO expert groups to take certain physical properties of substances into account when allocating specific requirements for the carriage of these substances and for their discharge into the sea. In this context the Working Group emphasized the rationale for its decision, as recorded above, and drew attention to the fact that allowance for physical properties may lead to an underestimation of the actual risk to the marine environment in any but good sea conditions.

2.2.2.2 Indirect toxic effects

It was originally considered that in certain areas (enclosed bays, lagoons and inland waterways), especially under tropical or sub-tropical conditions, certain substances would be so rapidly degraded biochemically that the biochemical oxygen demand (BOD) exerted on the water column might lead to severe oxygen depletion which in turn might cause fish mortalities. For this reason it was felt desirable to indicate substances where this risk was considered most severe. The BOD rating, in combination with effects related to blanketing of the sea floor, was taken into account at the 1973 Conference and does feature in the Guidelines for the Categorization of Noxious Liquid Substances in appendix I to Annex II to MARPOL 73/78 by which substances were divided into different pollution categories.

However, when attempts were made by GESAMP to quantify the assignment of a BOD rating, difficulties were encountered. It was then noted that of the 54 substances originally allocated a BOD rating, 14 had not been considered by IMO to be worthy of any measure of control. The BOD ratings were accordingly removed from these 14 substances. Moreover, it was noted that no liquid substance could be identified which had a high BOD and caused blanketing of the sea-bed. Subsequent consideration of this problem led to the conclusion that under most circumstances it was unlikely that the discharge of chemicals at sea from ships would lead to serious deoxygenation of the water. It was therefore decided that notification of BOD hazards is no longer necessary unless it is associated with blanketing effects.

A number of substances have been assessed which it was considered were liable, if spilt in substantial quantities, to blanket the sea-bed rendering it unsuitable for bottom living animals and plants. To date, the only such substances have all been solids; no liquid has been considered sufficiently dense and insoluble that it was likely to blanket the sea-bed and cause a significant problem.

2.2.3 Columns C and D - Hazards to human health

It was considered that as a consequence of pollution of the sea or waterways a substance might pose a hazard to humans by one or more of three possible ways, namely:

.1 through ingestion of fish or shellfish which have accumulated toxic substances;

.2 from ingestion of water containing the substances;

.3 from the adverse action of the substance or its vapour or the substance in solution, on the skin, eyes, or respiratory tract, or through absorption via the skin to affect internal organs.

The first of these routes was considered amply covered by the bioaccumulation assessment under column A but the other two routes were considered worthy of separate assessment; the latter being particularly relevant in the context of consideration of the potential impact on amenity interests.

2.2.3.1 Column C - Ingestion of water containing the chemical

It was recognized that ingestion of water contaminated by the substance being assessed may pose both an acute and long-term problem. However, it was considered that consumption of contaminated water was likely to be rare and to extend over a short time period, and it was therefore considered that the acute toxicity situation was that which needed to be guarded against. As with

the assessment of the hazards to living resources, a factor which had to be taken into account was the availability of suitable data on which to base an assessment. These considerations led to the conclusion that the most appropriate data to use would be oral LD50 data*.

It is recognized that the degree of hazard posed to human life might be modified by factors such as dilution, degradation of the substances in water or by aquatic life and the extent, if any, of their removal by water treatment processes or evaporation. However, the main requirement in the context under consideration is a simple comparative ranking system. The hazard is therefore assessed in terms of oral LD50 values, as determined in suitable mammalian species, on the assumption that the hazard increases with toxicity. It was considered that if the LD50 exceeded 5,000 mg/kg then the substance could, in the context under consideration, be regarded as non-hazardous. Similarly, it was decided that substances with an LD50 less than 5 mg/kg merited the strictest measures of control to prevent them entering the aquatic environment by discharges from ships or contaminating recreational areas as a result of accidental spillages or loss of packages.

The five ratings as adopted are shown in Annex 5. It must be emphasized that these descriptions of non-hazardous, slightly hazardous, hazardous, etc. do not indicate that water contaminated by the concentrations of the substance indicated would be safe for drinking. A completely different set of toxicological criteria is needed to define standards for drinking water. The ratings and the descriptive terms used are intended purely to reflect the degree of concern which should be shown if the chemicals were released from a ship into seawater.

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* LD50 = The dose of a substance which it is calculated will, within the specified conditions of the test, kill 50% of a group of test animals to which it has been administered. The dose is usually expressed in terms of mg of the substance administered for each kg of the animals body weight. Oral LD50 usually refers to a single dose with observations over the subsequent 14 days period.

As stated above, in making the assessment of acute hazard to human health, oral LD50 data are normally used. However, in certain cases the toxic action of a substance (and hence its LD50) might be highly dependent on concentration. In such cases the use of the LD50 figure for a pure or concentrated substance might give a misleading impression of the degree of hazard involved in ingesting a dilute solution (e.g. acids or alkalies). Accordingly, for such substances the hazard rating also takes into account the properties of dilute solutions.

Data relating to human exposures are comparatively uncommon and usually the assessment is made on the basis of LD50 data for laboratory mammals. Where date are available for several species or test conditions, those indicating the greatest toxicity are usually used unless they are radically different and there is reason to believe that they are of doubtful relevance to human health hazard assessment. When human data are available they relate to accidental or suicidal exposure situations, where dosages may be difficult to estimate. Thus, although such human data are taken into account, they may only in part be the basis for human hazard evaluation.

2.2.3.2 Column D - Risk to human health by skin and eye contact or inhalation

It was recognized that some substances, their vapours or aqueous solutions, may cause irritation or injury to the skin, mucous membranes, or eyes.

Certain substances may cause allergic reactions in a proportion of an exposed population. This will result in allergic contact dermatitis if sensitization is by skin contact, or asthma if respiratory sensitization occurs. Some chemicals are readily absorbed through the skin and may cause toxic injury to internal organs and tissues. Because of their physical properties, certain substances carried by ships are liable, in the event of a spillage, to contaminate beaches. These may pose a particular hazard to human health from direct contact or from inhalation of their vapours. It is considered that the narcotic or irritant action of vapours from volatile substances is unlikely, in other than the most confined conditions, to present

a significant health risk. With rare exceptions, this risk is not considered in the context under consideration. Materials which are highly irritant, have surfactant properties, or are of a water-insoluble nature, may cause lung injury if aspirated. This represents a significant practical consideration in relation to near beach spills of such materials. The Working Group took into consideration the fact that certain delayed and/or persistent toxic effects can develop subsequent to exposures to high single dose or a few moderate doses of certain substances, and that some materials are carcinogenic. Column D has also been used to call attention to these special cases; for example see sections 2.4 and 2.5. Three categories are considered appropriate to classify the hazards posed by aqueous solutions or water-borne films or scums of the substances being considered:

Hazardous	Contact leads to severe irritation (pain and burns) of the skin and mucous membranes and injury to the eyes on short contact. The vapour or solution may cause similar injuries and damage to the lungs even at low concentrations. Substances may be strongly allergenic. Absorption of substance through the skin may lead to damage to internal organs. There is potential for delayed or persistent toxicity. The material has been demonstrated to be carcinogenic.
Slightly hazardous	Contact likely to lead to mild skin irritation (reddening with or without slight pain) of a temporary nature. Vapour likely to cause temporary mild irritation to eyes or mucous membranes to a degree that subjects find unpleasant. Maybe slightly allergenic. Injury to internal organs is unlikely.
Not hazardous	Substances which on short exposure are unlikely to lead to irritation, allergy, or local injury. Substances which are not absorbed to any

significant extent through the skin. Substances which evaporate rapidly, the substance and the vapour do not cause irritation to the skin, eyes or mucous membranes or lungs.

2.2.4 Column E - Reduction of amenities

It was agreed at the outset that amenities should be understood to embrace all aspects of recreational use of the aquatic environment including its appearance. Thus reduction of amenities may be a consequence of the presence of poisonous, irritant or foul-smelling substances that may be released by ships. Objectionable slicks, floating scums or other floating or suspended materials on the sea surface or on the beach may also result from such releases. Impairment of scenic values may also be brought about by discolouration of the water, or by conversion of some of the liquid substances into solids, by polymerization on exposure to air and sunlight.

Where substances are both persistent and either poisonous, irritant, foul-smelling or otherwise obnoxious, the seriousness of the effect on amenities will be greatly increased. While transient interference with recreational use of coastal areas lasting perhaps up to 48 hours may be regarded merely as a nuisance, longer-term persistence of effects, particularly the presence of poisonous or irritant substances, may create serious problems in areas of importance to the holiday and tourist industries. For this reason, substances which are highly persistent and which are carcinogenic or capable of producing other serious specific adverse health effects (see sections 2.4 and 2.5) are given high-hazard ratings. In many cases they will also have been taken into account by rating under column D.

A hazard to human health may occur if noxious liquid or solid substances, contained in drums or packages, are lost from a ship and are washed up on the shore. The Working Group was aware of many such incidents, some involving highly hazardous chemicals and others quite harmless ones. Particular note

is taken if substances have the potential for long-term adverse health effects (see e.g. section 2.4).

The local hazard arising from such packages or containers, if opened or damaged, will be similar to that considered and evaluated in the handling and carriage of dangerous goods. If the substances cannot be identified by suitable markings, then the containers and packages have to be regarded as hazardous to human health and/or to the environment until proven otherwise; in such circumstances local closure of beaches may be desirable. The Working Group at its earlier sessions recognized that the development and use on all packages, drums, containers, etc., of a marking system which would be capable of withstanding immersion in the sea for a period of months would involve additional expense. Nevertheless, it was felt by the Working Group that the advantages of some simple identification system (not necessarily the full label) make its introduction desirable as a requirement of the International Maritime Dangerous Goods Code. In the light of these considerations labels have been introduced which would survive an immersion in the sea of three months.

The risk to amenities and human health due to flammable materials carried ashore or from toxic gases which are carried in bulk is not considered by the Working Group in relation to amenities. It is understood that measures are taken within IMO to minimize these risks in the context of other Conventions.

2.3 Other considerations and remarks

Consideration was given at the outset to the need to assign hazard ratings to the possible interference, by substances released from ships, with other uses of the sea, such as:

.1 with fishing or navigation through the presence of containers or bulky objects on the sea floor;

.2 with ship operations from persistent floating or suspended materials such as plastic, netting, bags and sheets;

.3 underwater corrosion of structures in docks or harbours; and

.4 impairment of water quality for industrial use.

However, this was felt to be inappropriate, mainly due to the wide variety of possible effects, some of which are not attributable to polluting effects as such. Nevertheless, the remarks column is used to include additional comments about the substance, e.g. an unusual hazard which has been taken into account in the assessment or drawing attention to some particular property which has been assumed.

2.4 Carcinogenicity

A particular aspect which was introduced at the eighth session of the GESAMP Working Group was the consideration of carcinogenic potential of substances. This was discussed with regard to the possibilities of there being a carcinogenic risk as a result of marine pollution, as defined by GESAMP, arising from shipping operations. The Working Group also discussed how this hazard could be indicated in a way that IMO could note but which would not automatically, by virtue of the hazard profile assigned, force the adoption of unduly stringent pollution prevention measures.

It was realized that the UN Group of Rapporteurs does take carcinogenicity into account when considering the measures required to protect personnel involved in transport and associated activities. However, it was apparent that such measures are not designed to take account of marine pollution aspects on which matters IMO looks to the GESAMP Working Group for advice.

After due consideration of the potential pollution situations the GESAMP Working Group is required to assess, it was concluded that a carcinogenic hazard to the health of bathers or members of the public enjoying marine amenities was unlikely to arise as a result of tank washing operations. However, it was considered that such a hazard might arise in the event of a large spill or through broken or leaking containers which might contaminate

commercial fish catches or be deposited on beaches. Accordingly, the Working Group concluded that such risks should be noted in the hazard profile. It should be noted that consideration is given only to human health risks, the possibility of carcinogenic effects on marine biota was not considered to have sufficiently serious implications to the well-being of the resource as a whole.

Recognizing that a substantial body of evidence is available demonstrating that a large number of chemicals have (under particular circumstances) been observed to be carcinogenic, it was agreed that a very selective process of identification should be used. It was also recognized that all the previously rated substances would also have to be evaluated in respect of carcinogenicity.

At the time this task was undertaken, the number of substances which had already been assigned hazard profiles was about 1,000. A comparison of these substances with those listed by the US National Institute of Occupational Safety and Hygiene (NIOSH) as suspect carcinogens produced 114 candidate substances. Further examination of the lists indicated that many of these 114 substances were named in the NIOSH list for reasons other than established carcinogenic activity in mammals. This left a total of only 49 compounds. These were compared with the information contained in the reviews of the cumulative work of expert committees of the International Agency for Research on Cancer (IARC). As a separate approach, the cumulative IARC list of carcinogens was compared with the list of 1,000 or so substances assigned hazard profiles to ensure the NIOSH listing of suspects had not omitted any possible candidates.

The individual IARC monographs for each of the 49 candidate substances were then reviewed and a judgement was made as to whether carcinogenicity either in man or laboratory mammals, had been reasonably established. The Working Group agreed that compounds which had only been demonstrated to cause tumours at the site of subcutaneous injections in laboratory mammals should not be considered to pose a demonstrable hazard with respect to possible pollution incidents as a result of marine transport. In addition several

compounds which had been demonstrated to be carcinogenic at high doses* in laboratory mammals were considered unlikely to persist on beaches for repeated exposure, even in the event of a large spill; these were therefore only identified as "carcinogens" in the remarks column - no other notation or change to the hazard profile was introduced for these substances. The same process of assessment is now followed for all substances considered by the Working Group. On completion of the original assessment of the original 1,000 compounds it was concluded that only 27 substances should be identified as posing a carcinogenic risk in the type of environment envisaged by the Working Group. In the course of the subsequent evaluation of additional substances the number of substances which have been identified as posing a carcinogenic risk has been increased to 70 of a total of approximately 2,500 compounds.

Consideration was given to how the attention of IMO could be drawn to the potential carcinogenic hazard. It was concluded that the introduction of a new symbol would be confusing and could as a result be counter-productive. Enhanced ratings in any of columns, A, B or C would have caused substantial alterations to pollution categorization requirements and was therefore rejected. However, the regulatory impact of enhanced ratings in columns D or E would in itself be minimal, as columns D and E have little automatic effect on the pollution category assigned by IMO, unless moderately high hazard assessments are also assigned in columns A, B or C.

Compounds which have clearly been established as causing cancer in man, or which have produced malignant tumours in animals through systemic action and which are of a chemical nature to suggest potential reactivity with cellular genetic material, are considered to have a serious potential for

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* It is recognized that the term "high doses" is somewhat subjective and as such is dependent on expert judgement. Generally, however, the term is used in relation to tests in which an increased incidence of tumours was produced only after repeated, prolonged doses at or near the maximum dose tolerated by the test organism with respect to other non-carcinogenic toxic actions of the substance.

carcinogenic hazard to man. Such chemicals are rated II in column D, and XXX in column E for human carcinogens or XX for animal carcinogens. Notation is given in the remarks column as to whether the material is a "human carcinogen", or a "carcinogen" where the evidence is credible for animal carcinogenicity but for which there is no evidence for humans. The hazard symbols used are felt to be consistent with the hazard posed (column D) and the impact that would be felt by amenity interests and the response which would be taken by the authorities concerned (column E) - i.e. closure of beaches.

Recognizing that the introduction of the carcinogenicity hazard was a development which had taken place after the conclusion of the 1973 MARPOL Conference, the Working Group gave some consideration as to what steps IMO might take to incorporate the assessment in its categorization schemes. It was considered that, provided tank washings are not discharged close to land, the risk to human health would be small and the Group noted that through the notation of XX or XXX in column E the lowest assignment possible would be pollution category D of Annex II of MARPOL 73/78 which means that tank washings are not allowed within 12 miles of land. However, the Working Group considered it was reasonable to expect that precautions should be taken to prevent accidental spillage of large volumes of such substances or the possibility of packages containing such substances being washed up on beaches. To this end the Working Group at a very early stage suggested that consideration should be given by the appropriate IMO bodies to the transport of such bulk liquids in middle tanks or, if in packages, stowage under deck or in some other position where the possibility of accidental loss overboard is reduced. These matters have been addressed by IMO as outlined in the appendix to this report.

2.5 Other specific adverse health effects

The Working Group at its 14th session reviewed the current situation regarding the human health element of hazard profiles and, in particular, considered whether greater emphasis should be given to potential specific hazards to human health, in addition to carcinogenicity, posed by the release

of noxious liquid substances. It agreed that acute toxic and primary irritant effects are adequately covered by the ratings given in columns C and D (hazard to human health) and by their corresponding definitions. A satisfactory scheme has also been devised for drawing attention to carcinogenic properties of substances, which involves a statement being inserted in the "remarks" column of the hazard profiles announcing that there is firm evidence that the material concerned is an animal or human carcinogen. A carcinogenicity assignment accordingly modifies the rating in columns D and E. The Working Group also noted that the remarks column has been used to draw attention to materials which could produce neurotoxic effects and immune-mediated hypersensitivity reactions. These were taken into account in assigning ratings for columns D and E. The Working Group agreed that in cases where there could be a potentially serious health hazard resulting from a particular type of toxic injury or a specific adverse health effect, whether produced by acute or repeated exposure, it would be appropriate that this be recorded in the "remarks" column. In this way the contributions of a particular type of adverse health effect to the hazard profile would be more readily appreciated. For specific adverse health effects other than carcinogenicity, neurotoxicity, and sensitization, the decision to introduce a statement and to modify the columns D and E rating should be made on a case-by-case basis. However, the Working Group agreed that consideration should be given particularly to the following: teratogenicity, adverse reproductive effects, lachrymation, skin vesication, haemotoxicity, high percutaneous toxicity, phototoxicity and anticholinesterase activity. Four categories are considered appropriate to classify the hazards which could result in a reduction of amenities, and are as follows:

XXX - Highly objectionable because of persistency, smell or poisonous or irritant characteristics; as a result beaches liable to be closed; also used when there is clear evidence that the substance is a human carcinogen or that the substance has the potential to produce other serious specific long-term adverse health effects in humans.

XX - Moderately objectionable because of the above characteristics, but short-term effects leading only to temporary interference with use of beaches; also used when there is credible scientific evidence that the substance is an animal carcinogen, but where there is no clear evidence to indicate that the material has caused cancer is humans, or when there is evidence from laboratory studies that the substance could have the potential to produce other serious specific long-term adverse health effects.

X - Slightly objectionable, non-interference with use of beaches.

0 - No problem.

2.6 Amendment procedures

It has always been recognized that for many substances only tentative hazard assessments will initially be possible. Subsequently it is hoped that additional information will become available which confirms the tentative rating, or at least allows a firm rating to be assigned. It is also recognized that test procedures are improving and that new data may become available which may necessitate a review of earlier assessments. Furthermore, from time to time hazard assessments are challenged either by individual manufacturers, trade associations, or by Government Administrations or sub-committees of IMO. The proper procedure by which new information should be brought to the attention of the Working Group is that it should be provided in full to the IMO Technical Secretary of GESAMP (IMO Headquarters in London) who will bring it to the attention of the Working Group at the next possible opportunity.

Any individual member of the Working Group may draw attention to the need for amendment of an existing hazard rating based on new information. To allow for such eventualities and in recognition that the hazard profiles are used by IMO bodies as a basis for decision on ship-type, tank washing arrangements, labelling, stowage, etc., a protocol has been devised to ensure that

amendments to hazard profiles are only made with adequate reason and after serious consideration.

The Working Group prepared guidelines on amendment procedures which stipulate that:

.1 no change should be considered to an existing rating unless a clear proposal is made for such a change;

.2 no change should be made unless there is positive scientific evidence that the change is justified;

.3 in the event of a proposal to change an existing rating, the members of the Working Group are then required to decide between the following alternatives:

.3.1 advocate no change;
.3.2 agree to the proposed change; or
.3.3 propose another change, which must be other than a "-" (dash) rating;

.4 there should be no change of any rating without unanimous agreement in the Working Group.

3 SOURCES OF AND REQUIREMENTS FOR DATA

The information used by the Working Group in assigning hazard profiles to substances comes from a wide variety of sources. In recent years a number of Governments have provided information on lists of substances. This has saved considerable time and effort on the part of the Working Group, although it has not, of course, eliminated the need for careful cross-checking of available information or comparison with other data. IMO has developed a questionnaire which Governments are expected to complete when submitting new substances or proposals for shipping regulations. A copy of the questionnaire is set out in Annex 10.

For the most part, however, individual members of the Working Group have had to obtain relevant data from various literature sources in order to make an assessment of hazard. The source of data used is recorded on the data sheets for individual substances which are filed at IMO Headquarters. As the data are taken from individual scientific papers as well as from major compilations of data, it is not practicable or even appropriate in a report of this nature to give all the references used. However, as a general guide to the most commonly used reference sources such as handbooks and manuals, a list is given in Annex 11.

As the work has progressed, the Working Group encountered increasing problems of deficiency of data, particularly in relation to the effect on living resources. Unless data are available for a similar substance a rating is not possible for such substances until data are provided; this may require the commissioning of toxicity tests by the interested party. Concern has been expressed that the resultant data might not meet the standards of current laboratory techniques. Accordingly the advice of the Working Group has, on occasions, been sought with respect to the type of aquatic toxicity test which should be conducted. After due consideration it has been concluded that it is not the task of the Working Group to establish standard test procedures. Such matters are under discussion in such fora as the International Organization for Standardization (ISO) and the Organisation for Economic Co-operation and Development (OECD) and some national organizations have made their own recommendations based on internationally adopted guidelines.

Nevertheless, by way of general guidance, the Working Group has offered the following advice in relation to its requirements for aquatic toxicity testing:

> Tests should be conducted using a marine crustacean and a marine fish in seawater and should produce 96 hr LC50 values.* If continuous flow

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* If only one test, (i.e. one test species used) is performed, the Working Group recommends the use of a small crustacean, e.g. Mysidopsis bahia

conditions are not utilized the exposure medium should be changed at least every 24 hours. Full details of the test procedure used should be provided with the results.

For compounds of substances of low solubility, guidelines prepared by the Working Group are shown in Annex 9.

4 CONSIDERATION OF CLASSES OF CHEMICALS

During recent years, as the number of representatives of particular classes of compounds has increased considerably, it has been found useful to review the hazard profiles for entire classes of compounds. In this way the consistency of use of the various hazard ratings is ensured and, where necessary, data for individual substances can be reviewed and, where appropriate, amendments can be made.

The classes of substances which have been established by the Working Group and which are periodically reviewed are as follows:

ALCOHOLS
ALKANES AND CYCLOALKANES
ALKENES AND CYCLOALKENES
BENZENE AND ALKYL BENZENES
CHLOROSILANES
CARBOXYLIC ACIDS
GLYCOLS AND THEIR DERIVATIVES
HALOGENATED COMPOUNDS (excluding Fluorocompounds)
ALIPHATIC COMPOUNDS
AROMATIC COMPOUNDS
ORGANOPHOSPHORUS COMPOUNDS (EXCLUDING PESTICIDES)
FORMATES
ACETATES AND ACETOACETATES
PROPIONATES, BUTYRATES, ETC.
ACRYLATES AND MATHACRYLATES
ESTERS OF HYDROXY CARBOXYLIC ACIDS AND OF ALIPHATIC DIBASIC ACIDS

ESTERS OF AROMATIC DIBASIC ACIDS (including Phthalates)

ESTERS:

KETONES

SUBSTITUTED PHENOLS

AMINES

PESTICIDES

ALDEHYDES

In the course of establishing the above classes a number of generalizations have been made, as described in the following paragraphs.

4.1 Alcohols

It was considered that BOD problems severe enough to be worthy of preventative measures are unlikely to occur with compounds above C_4 or with a tertiary carbon atom - e.g. tertiary butyl alcohol. Alcohols above C_7 are mobile waxy solids at most ambient temperatures and would, if released into the marine environment, cause some interference with the amenity use of beaches. As such they merit a single X in column E. Alcohols above C_{18} would not be mobile and an X rating would not be justified. Primary saturated alcohols show an increase in toxicity to marine organisms with increase in carbon number, but in practice the extent of this increase is limited by their water solubility. Above C_{12} it was considered unlikely that toxic concentrations could be attained in the natural environment and such alcohols are rated "0" in column C.

4.2 Halogenated compounds

In the course of reviewing the profiles of aliphatic halogenated substances it was noted that there was no direct evidence of short-term bioaccumulation for many of these compounds. However, it was noted that in connection with work on EDC tars (residues from vinyl chloride production which contain a large proportion of ethylene dichloride (1,2 Dichloroethane)) a number of specific chlorinated compounds had been specifically identified as giving rise to short-term bioaccumulation. These studies followed reports in

the early 1970s of deaths of marine organisms in the wake of vessels dumping EDC tars. In addition, the halocarbon profile obtained from marine organisms after exposure to EDC tars, indicated that most, if not all, of the 200 or so observed but not separately identified halocarbons (C_2-C_8) in EDC tar were accumulated. On the basis of this evidence, it was agreed that a "Z" rating would be appropriate for many of the halocarbons containing 2 - 8 carbon atoms. Further consideration of the technical information available on this type of compound, in particular the partition octanol:water (P_{OW}) coefficients, the lack of reported presence of any of the C_1 compounds in marine organisms and the information on half-lives in biota of some of the lower aliphatic compounds, led the Working Group at its twelfth session to conclude that a "Z" rating for every halogenated aliphatic compound would be ill-advised.

The group of compounds was then examined as a complete series and such information was considered for each compound. It was concluded that for practical purposes a value of about 1.5 or greater for the log P_{OW} could be used as an indication of a candidate for a "Z" rating. Final assignment of this symbol being dependent on the evidence for harm and persistence in the animal. The Working Group in 1988 agreed to review within the near future the column A ratings (bioaccumulation and tainting) of halogenated compounds (as well as column A ratings of all other substances contained in the composite list).

4.3 Phthalates

The phthalates have been reviewed as a group of compounds on a number of occasions. In the course of review it was noted that there has been a substantial number of reports on the presence of these compounds in marine organisms. The Working Group recognized that the accurate chemical analysis of these commonly used products is very difficult and that there must be some reservations over the compound identification and the actual quantities present. Nevertheless, the fact that they are detected indicates that bioaccumulation occurs in the marine environment. The consensus was that the lower phthalates, up to dipropyl, were unlikely to be significantly

bioaccumulated (based on octanol:water partition coefficients). Above this there is sufficient evidence to indicate that most phthalates may be bioaccumulated by marine organisms. However, the evidence for and against this bioaccumulation proving harmful is conflicting.

At the twelfth session of the Working Group consideration was given to the most recent information from uptake and loss experiments and tests on reproduction with the most widely used phthalates. It was concluded that excretion of phthalates by most marine organisms is probably rapid. Therefore, at concentrations likely to be encountered as a consequence of discharges or spillages from ships, harm as a result of the short-term bioaccumulation is unlikely to arise. It was noted that tests are being undertaken in a number of countries to further clarify the effects, both long-term and short-term, of phthalates on man and other animals and that there are suggestions that certain phthalates may be carcinogenic. Accordingly, it was agreed that the entire set of hazard profiles for phthalates should be reviewed by the Working Group at a later stage.

The Working Group at its seventeenth meeting, reviewed in detail the toxicology of the phthalates. Based on this review they concluded that phthalic acid esters are of low to moderate acute toxicity perorally and low toxicity by percutaneous absorption. They are of mild to moderate primary skin and eye irritation, and do not produce immune-mediated hypersensitivity reactions. Phthalic acid esters are readily absorbed from the alimentary tract and probably also from the lung, but poorly absorbed across skin. A threshold for alimentary absorption may exist, and lipase activity in the gut results in diesters being absorbed mainly as the monoester hydrolysis product. However, if high doses are given perorally then the diester may be absorbed in significant amounts. Genotoxicity studies generally indicate that phthalic acid esters are not mutagenic, but there is limited evidence that some may be clastogenic. Carcinogenic studies for the phthalic acid esters are mostly unsuitable to assess the oncogenic potential of these materials. One study conducted by the NTP indicates that at very high chronic peroral doses, di(2-ethylhexyl)phthalate is hepatocarcinogenic. Considerations on the conditions of the study suggest that di(2-ethylhexyl)phthalate is probably of

low potency in this respect. The available evidence suggests that the di(2-ethylhexyl)phthalate is not a genotoxic carcinogen, but may act through a peroxisome proliferation mechanism. Phthalic acid esters may be teratogenic and embryofetotoxic, but only at high dose levels. Testicular injury can be produced by phthalic acid esters, possibly by a primary effect on sertoli cells with an early disruption of relationships between sertoli cells and germ cells.

In addition to the scientific review by the Working Group, aquatic toxicity information was supplied by the US Chemical Manufacturers' Association. On the basis of both these sources of information, the hazard profiles were revised.

This extensive review led to the current ratings for the phthalic acid esters.

4.4 Chlorinated Paraffins

The Working Group reviewed the material on the hazards of chlorinated paraffins taking into account all available material on the hazards of these substances to marine life, including the conclusions on the hazardous effects of these substances by the Swedish National Chemicals Inspectorate, and concluded:

.1 chlorinated paraffins are produced in large quantities and have a wide use;

.2 chlorinated paraffins are accumulated in mammals, both in fat tissues and in the nervous system. The carbon chain length is important for the bioaccumulation potential. Short chain and high level of chlorination give the slowest excretion rate, and retention could last for more than ten months. Low-chlorinated paraffins with short carbon chain length are the most toxic, in particular to marine organisms;

.3 there is clear evidence for carcinogenic effects in rats and mice, probably by epigenetic mechanisms;

.4 chlorinated paraffins are embryotoxic, but not teratogenic;

.5 the chemical analytical methods are very unsatisfactory for chlorinated paraffins. The present methods give only a very limited possibility of performing analyses on tissue samples. The difficulties in undertaking analysis for chlorinated paraffins could result in problems in metabolic studies except where radio-labelled chlorinated paraffins have been used;

.6 the lack of alarming reports on chlorinated paraffins in the environment (such as exist for PCBs, DDT, etc.) is probably due to the lack of analytical methods;

.7 there are very good reasons to continue the study of environmental effects of chlorinated paraffins. In particular, analytical techniques should be developed aiming at discriminating chlorinated paraffins from other chlorinated persistent and bioaccumulating substances;

.8 exposure panoramas, referring both to human and animal exposure, are lacking for chlorinated paraffins;

.9 the accumulation of chlorinated paraffins in brain tissue in combination with reduced motoric activity in higher animals should be investigated;

.10 the high affinity of chlorinated paraffins for liver tissue, together with observations of specific cases of liver cancer, deserves attention; and

.11 a survey of the industrial use of chlorinated paraffins is lacking.

Stabilizers used with chlorinated paraffins include organotin compounds. This would warrant a note in the "remarks" column of the hazard profiles. It was also noted, with regret, that aquatic toxicity data for chlorinated paraffins (C_{14}-C_{17}) with less than 50% chlorine are not yet available.

4.5 Pesticides

The majority of pesticides fall into the following chemical classes: urea-based herbicides, triazines, organophosphates, organothiophosphonates, carbamates, organochlorines, and pyrethroid compounds.

Pesticides cover a wide range of chemical structures and exhibit a great variety of physico-chemical properties, which govern their fate in marine organisms. The majority of them are highly toxic for marine species as well as for man; some pesticides containing chlorine are known to be highly persistent in the marine environment. The Group rated the pesticides listed in the International Maritime Dangerous Goods Code (IMDG Code) and a substantial number of these pesticides were assigned a "+" rating in column A on account of their high toxicity to aquatic organisms. For those compounds which had not been tested for bioaccumulation, the bioconcentration factors (BCF) were calculated by using relationships between BCF and physico-chemical data of the compounds, such as water solubilities and n-octanol-water partition coefficients. The Working Group recognized that crustacea were more sensitive than fish to the action of insecticides and in cases where only toxicity data on vertebrate fish were available a higher rating on column B was given than the fish data alone would warrant.

By the nature of their chemistry and intended use, pesticides are biologically active materials, in many cases having the central and peripheral nervous systems as target tissues. As a consequence of the moderately high toxicity of pesticides, perorally and percutaneously, and the potential for neuropharmacological and/or neurotoxic effects, many pesticides have a high hazard rating in order to ensure adequate protection against their potential adverse biological activity. Also, because of the mechanistic and monitoring relevance, those pesticides with anticholinesterase activity are specifically

identified in the Remarks column. In view of their common use pattern, and their biological activities, pesticides were re-evaluated in detail by the Working Group at its twenty-first session, and identified as a Class of materials for hazard profiles.

5 CONSIDERATION OF MIXTURES UNDER TRADE OR GENERIC NAMES

Many of the substances carried by ships are identified only by their trade names. Some of these are pure substances, but a substantial number may contain toxic impurities or additives, and others are mixtures which are used as chemical raw materials. With mixtures, the same products are likely to be referred to by several different trade names, depending on which company produces them. It is also likely that the precise composition of trade-named substances will vary, depending on the customer's requirements and on the feed stocks available to the producer at the time of manufacture. In spite of these problems many trade-name substances are carried under MARPOL 73/78 requirements and as such require a hazard profile before they can be assigned a pollution category. The Working Group is strongly of the opinion that substances should not be carried only under trade names and feels that shipments should be made with clearly stated chemical descriptions.

The Working Group at its seventeenth session confirmed that it is prepared and will attempt, in exceptional cases and on a case-by-case basis, to assign a hazard profile to substances with only trade names, provided that adequate relevant physiochemical and biological information on the substances concerned is provided to allow a hazard evaluation to be undertaken. At the same time, an assurance is required of the manufacturer that the composition of the substance will be within stated limits. A description of the composition of the product is also required. If details are provided in confidence the content of the data sheet will not be made available to other parties without prior approval by the notifier. Also, confidential technical material supplied by the notifier will be retained by the IMO Technical Secretary of GESAMP for any future reference by the Working Group; requests for details of such submissions will be referred to the notifier. However, the hazard profile will be included under a separate title in the composite list or subsequent updatings thereof.

A number of substances are offered for shipment which are known simply by generic titles, e.g. acrylic ester, which may mean one of a number of acrylic esters of which there may be many compounds or isomers. The Working Group is in principle opposed to such practices and will require details of which compounds may be carried under the generic name. If the necessary information is provided the Working Group will assign hazard profiles to the compounds concerned, provided adequate data are available for it to do so. Hazard profiles allocated to generic groups of substances reflect the assessment of that compound which is the most hazardous member of the generic group.

6 CONSIDERATION OF SUBSTANCES CONTAINING MINERAL OIL

On a number of occasions the Working Group has been asked to assign a hazard profile for substances containing mineral oils. Full details of their composition have usually been provided, although in some cases the precise nature of the mineral oil was not known. Although the hazard assessment procedures require the exclusion of all substances which are classified as "oil" under the terms of MARPOL 73/78, Annex I does not give a comprehensive list of mineral oils, but only a list of examples.

Under these circumstances and fully recognizing that the requirements for carriage, tank washings, etc., differ between Annex I and Annex II of MARPOL 73/78, the Working Group has experienced difficulties in resolving this problem. As an interim measure, it has been agreed that hazard profiles will continue to be assigned to substances containing oil. This decision is, of course, subject to the provision of full information on the composition and properties of the substances.

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ANNEX 1

ENQUIRY TO GESAMP

The International Maritime Organization (IMO) has scheduled an International Conference on Marine Pollution for the fall of 1973. Presently under consideration is a draft convention which will address pollution of the marine environment by the marine transportation of bulk and packaged "noxious substances"; a "noxious substance" being a product or concentration of a product, other than oil, sewage or garbage or refuse, yet to be defined*.

The following decisions are examples of those that have to be made by the Conference concerning the marine transportation of "noxious substances" to minimize any damage to the marine environment.

1 What degree of containment is required, that is, the structure of vessels carrying the products in bulk or the containers for packaged shipments?

2 What degree of sophistication is required for cargo (product) handling and control?

3 What limit, if any, should be placed upon cargo (product) shipment size?

4 What limit, if any, needs to be placed upon the intentional discharge of substances in the process of tank washing?

5 What degree of operational control must be placed upon vessels carrying "potential noxious substances"?

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* MARPOL 73/78, Annex II, in Regulation 1(6) defines a "noxious liquid substance" as "any substance designated in Appendix II to this Annex or provisionally assessed under the provisions of Regulation 3(4) as falling into Category A, B, C or D" (established on the basis of the GESAMP hazard evaluation procedure).

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The decisions to be made concerning the carriage of "noxious substances" will directly affect mankind in general by not only protecting the environment but changing the cost or even the availability of certain products basic to his society. IMO must make these decisions and solicits the assistance of GESAMP in reaching these decisions.

Therefore, IMO requests GESAMP to review the attached list of products and consider their hazard to the environment if released accidentally or deliberately into the water.

Specifically GESAMP is requested:

(1) to evaluate substances under at least four degrees of hazard, according to each of the following effects when released into the sea:

(a) damage to living resources;

(b) hazards to human health;

(c) reduction of amenities;

(d) interference with other uses of the sea;

in doing so, take into account the release in the following four forms:

(i) through normal operation of ships other than the disposal of shore-generated waste;

(ii) through marine casualties to ships carrying cargoes in bulk;

(iii) through marine casualties to ships carrying cargoes in packages;

(iv) through accidental spillage (e.g. overflow);

(2) to indicate how their hazard ratings apply to areas such as rivers, estuaries, inshore waters, enclosed seas, and deep ocean, under the different climatic conditions;

(3) to specify as far as possible criteria and critical parameters used in determining hazard ratings of the substances.

IMO is prepared to provide such information as it has and to assist GESAMP as much as possible in this extremely necessary and important task. The time constraints dictate an urgent response from GESAMP. It would therefore be desirable to receive their reply if possible by 31 May 1972.

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ANNEX 2

LIST OF MEMBERS OF THE ORIGINAL IMO/GESAMP AD HOC PANEL
ON ENVIRONMENTAL HAZARDS OF NOXIOUS SUBSTANCES
OTHER THAN OIL TRANSPORTED BY SHIPS

(21-25 February 1972)
(26-28 June 1972)
(22-26 January 1973)

Dr. H.A. Cole (Chairman)
United Kingdom

Dr. G.J. Van Esch
Netherlands

Dr. Roy W. Hann, Jr.
United States

Dr. P.G. Jeffery
United Kingdom

Mr. R.J. Lakey
United States

Dr. K.H. Palmork
Norway

Dr. J.E. Portmann
United Kingdom

Dr. M. Sharratt
United Kingdom

Dr. C. Hugh Thompson
United States

Dr. M. Waldichuk
Canada

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ANNEX 3

LIST OF SESSIONS AND EXPERTS PARTICIPATING IN SESSIONS OF THE WORKING GROUP ON THE EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS

(Originally referred to substances in the marine environment)

Session

1 London 14-15 October 1974
2 London 4-6 June 1975
3 London 15-17 October 1975
4 London 12-14 July 1976
5 London 22-24 October 1976
6 Delft 9-13 May 1977
7 London 4-6 July 1977
8 Bergen 22-26 May 1978
9 Burnham 5-9 November 1979
10 London 2-6 June 1980
11 Houston 15-19 December 1980
12 London 21-25 September 1981
13 Delft 25-29 October 1982
14 London 6-10 June 1983
15 Aberdeen 9-13 January 1984
16 London 21-25 May 1984
17 Plymouth 11-15 February 1985
18 London 7-11 October 1985
19 Delft 26-30 May 1986
20 London 3-7 November 1986
21 Trondheim 18-22 May 1987
22 London 18-22 January 1988
23 London 29 August - 2 September 1988

Experts	Session numbers																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Dr. P.G. Jeffery United Kingdom (Chairman 1974-78 and 1983-86)	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X		X	X
Dr. J.E. Portmann United Kingdom (Chairman 1978-1982)	X	X	X	X	X	X	X	X	X	X	X	X	X										
Dr. C.H. Thompson United States	X				X	X		X															
Dr. B-E. Bengtsson Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X	X		
Mr. L. Føyn Norway	X	X	X	X	X	X	X	X	X	X	X		X	X	X								
Prof. E. Vigliani Italy	X		X	X																			
Ms. D.M. Adema Netherlands			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Dr. V. Zitko Canada			X																				
Prof. B. Ballantyne United States							X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mr. T.A. Wastler United States							X																
Dr. K.W. Wilson United Kingdom							X																
Prof. S.D. Murphy United States								X	X	X	X	X					X	X					
Dr. P. Lefcourt United States								X															
Mr. D. Enreth United States											X	X											
Prof. T. Yoshida Japan													X	X	X	X	X	X	X	X	X	X	X
Prof. W. Ernst Federal Republic of Germany (Chairman since 1987)																X	X	X		X	X	X	X
Mr. P. Howgate United Kingdom																X	X	X	X	X	X	X	X
Prof. T. Syversen Norway																	X	X	X	X	X		X
Mr. M. Morrissette United States																		X	X	X		X	X
Dr. P. Wells Canada																							X
Secretaries																							
Mr. S.L.D. Young (IMO)	X	X	X	X	X																		
Mr. S. Okamura (IMO)						X	X																
Dr. M. Nauke (IMO)								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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ANNEX 4

TERMS OF REFERENCE

1 Terms of reference given by GESAMP at its sixth session (Geneva, 22-28 March 1974) to the Working Group on the Evaluation of the Hazards of Harmful Substances in the Marine Environment:

(1) to examine and evaluate available data and to provide such other advice as may be requested, particularly by IMO, for evaluating the environmental hazards of harmful substances carried by ships, in accordance with the rationale approved by GESAMP for this purpose (GESAMP IV/19/Supp.1); and

(2) to examine annually the Review of Harmful Substances (GESAMP Reports and Studies No. 2, New York 1976) in accordance with Recommendation 88 of the United Nations Conference on the Human Environment (Stockholm, 5-16 June 1972) in order to amend the Review, if and when appropriate.

2 Terms of reference amended by GESAMP at its eighth session (Rome, 21-27 April 1976):

The second part of the terms of reference concerning the updating of the Review of Harmful Substances was deleted and consequently the title of the Working Group was changed to "Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships".

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ANNEX 5

ABBREVIATED LEGEND TO THE HAZARD PROFILES

Column A - Bioaccumulation and Tainting

+	Bioaccumulated to significant extent and known to produce a hazard to aquatic life or human health
Z	Bioaccumlated with attendant risk to aquatic organisms or human health, however with short retention of the order of one week or less
T	Liable to produce tainting of seafood
0	No evidence to support one of the above ratings (+, Z, T)

Column B - Damage to living resources

Ratings		96 hr LC50
4	Highly toxic	less than 1 mg/l
3	Moderately toxic	1-10 mg/l
2	Slightly toxic	10-100 mg/l
1	Practically non-toxic	100-1000 mg/l
0	Non-hazardous	greater than 1000 mg/l
D	Substance likely to blanket the sea-bed	
BOD	Substance with oxygen demand	

Column C - Hazard to human health by oral intake

Ratings		LD50 (laboratory mammal)
4	Highly hazardous	less than 5 mg/kg
3	Moderately hazardous	5-50 mg/kg
2	Slightly hazardous	50-500 mg/kg
1	Practically non-hazardous	500-5000 mg/kg
0	Non-hazardous	greater than 5000 mg/kg

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Column D - Hazard to human health by skin and eye contact or inhalation

II - Hazardous (severe irritation, strong sensitizer, lung injury, percutaneous toxicity, carcinogenic, or other specific long-term adverse health effect)

I - Slightly hazardous (mild irritation, weak sensitizer)

0 - Non-hazardous (non-irritant, not a sensitizer)

Column E - Reduction of amenities

XXX - Highly objectionable because of persistency, smell or poisonous or irritant characteristics; as a result contaminated beaches liable to be closed; also used when there is clear evidence that the substance is a human carcinogen or that the substance has the potential to produce other serious specific long-term adverse health effects in humans.

XX - Moderately objectionable because of the above characteristics, but short-term effects leading only to temporary interference with use of beaches; also used when there is credible scientific evidence that the substance is an animal carcinogen but where there is no clear evidence to indicate that the material has caused cancer in humans, or when there is evidence from laboratory studies that the substance could have the potential to produce other serious specific long-term adverse health effects.

X - Slightly objectionable, non-interference with use of beaches

0 - No problem

Ratings in brackets, ( ), indicate insufficient data available to the GESAMP experts on specific substances, hence extrapolation was required.

N Not applicable (e.g. if gases)

\- Indicates data were not available to the GESAMP Working Group

Note: The descriptive terms such as highly toxic, non-hazardous, etc., were used by the original panel for the purposes of the 1973 International Conference on Marine Pollution. They have no particular significance in terms of hazard posed outside the particular circumstances addressed by that Conference and IMO Sub-Committees, i.e. marine pollution as a consequence of discharges or spillages from ships.

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ANNEX 6

COMPOSITE LIST OF HAZARD PROFILES 1988

Substances	A	B	C	D	E	Remarks	Considered/ Revised
	Bioaccumulation and tainting	Damage to living resources	Hazard to human health: Oral intake	Hazard to human health: Skin contact and inhalation	Reduction of amenities		
Acetaldehyde	0	2	1	II	XX	Carcinogen	3/73 6/75 8/88
Acetic acid	0	1	1	II	X		3/73 5/77 11/86 1/88
Acetic anhydride	0	1	1	II	XXX	Lachrymator	3/73 6/75 1/88
Acetone	0	0	1	I	X	Tested for tainting	7/76 9/81 1/88
Acetone cyanohydrin	0	4	3	II	XX		3/73 6/75
Acetonitrile	0	0	2	I	X	Tested for tainting	3/73 6/75 1/88 8/88
Acetophenone	0	1	1	II	XX		10/75 6/83 1/88
Acetyl bromide	0	(2)	(2)	II	XXX	Lachrymator	11/76 1/88
Acetyl chloride	0	1	1	II	XX		6/75 11/76 6/80 12/80 8/88
Acetylene tetrabromide	See 1,1,2,2-Tetrabromoethane						
Acetylene tetrachloride	See 1,1,2,2-Tetrachloroethane						
Acetyl iodide	0	(2)	(2)	II	XX		11/76 8/88
Acetyl tributyl citrate	-	-	0	0	0		11/86
Acid butyl phosphate	0	-	-	II	XX		11/76 6/80
Acid mixtures (Hydrofluoric and Sulphuric)	0	2	3	II	X		11/76 8/88
Acid mixtures (nitrating acid)	0	2	2	II	X		11/76 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Acrolein	T	4	3	II	XXX	Lachrymator; Tested for tainting; High acute lethal vapour toxicity	3/73 6/75 1/88 8/88
Acrylamide	0	1	2	II	XX	Delayed neurotoxicity	7/76 6/80 10/82
Acrylate ester	0	3	2	II	XX		11/79 2/85
Acrylic acid	0	1	2	II	XX		3/73 11/74 10/75 6/80
Acrylic latex	0	(0)	0	0	XX		3/73 11/74 10/75 6/80
Acrylonitrile	0	3	3	II	XXX	Human carcinogen; Teratogen; Reproductive toxicity; Tested for tainting	3/73 6/80 1/84 10/85 8/88
Acrylonitrile-Styrene copolymer dispersion in polyether polyol	0	1	0	0	X		8/88
Adiponitrile	0	1	3	I	XX		11/74 1/88
Alcoholic beverages	0	0	0	0	0		10/75
Alcohols C_1, C_2, C_3 (as individual alcohols)	0	0	1	0	0		5/84
Alcohols C_1, C_2, C_3 mixtures	0	0	1	0	0		5/84
Alcohol, C_4	0	0	1	0	0		5/84
Alcohols, C_5	0	1	2	II	X		5/84
Alcohols, C_6	0	1	1	II	XX		5/84
Alcohols, C_4, C_5, C_6 mixtures	0	1	2	II	XX		5/84
Alcohols, C_7, C_8, C_9 as individuals and mixtures	0	2	1	0	X		5/84
Alcohols, C_{10}, C_{11}, C_{12} as individuals and mixtures	0	3	1	0	X		5/84
Alcohols, C_{13} and above as individuals and mixtures	0	0	0	0	X		5/84
Alcohol C_6-C_{17} (secondary)poly(7-12) ethoxylate	0	3	1	0	0		11/86 1/88
Alcohol C_6-C_{17} (secondary)poly(3-6) ethoxylate	0	4	1	0	0		11/86 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Alcohol C_{13}-C_{15} poly (3) ethoxylate	0	4	1	I	X		8/88
Alcohol C_{13}-C_{15} poly (7) ethoxylate	0	3	1	I	X		8/88
Alcohol C_{13}-C_{15} poly (11) ethoxylate	0	3	1	I	X		8/88
Alcohol C_{13}-C_{15} poly (20) ethoxylate	0	2	1	I	X		8/88
Alcohol C_{12}-C_{15} poly (1-3)ethoxylate	0	4	1	I	X		5/86 11/86 5/87 1/88
Alcohol C_{13}-C_{15} poly (1-6)ethoxylates	0	4	1	I	X		8/88
Alcohol C_{13}-C_{15} poly (7-19)ethoxylates	0	3	1	I	X		8/88
Alcohol C_{13}-C_{15} poly (20 and above) ethoxylates	0	2	1	I	X		8/88
Aldicarb	0	4	4	II	XXX	High dermal toxicity; ChE inhibitor*	5/87
Aldrin	+	4	3	II	XXX	Carcinogen; High dermal toxicity; Convulsant	3/73 11/79 10/82 5/87
n-Alkanes (C_{10}-C_{20})	0	0	(1)	0	0		6/83 11/86
Alkane C_1-C_3 sulphonic acids	0	-	2	I	X		11/76
Alkenyl succinic anhydride	-	-	-	-	-		5/86 11/86
Alkyl acrylate/Vinyl pyridine copolymer in toluene	0	2	1	II	XX	Neurotoxic	5/86 5/87
Alkyl amine, alkenyl acid ester	1	1	1	I	XX		8/88
Alkylate gasoline for aviation	See Aviation alkylates						
Alkyl benzenes, C_9-C_{17} (straight or branched)	-	-	-	-	-		11/79 10/85 5/86 11/86
Alkyl benzene sulphonate (straight chain)	0	2	1	0	0		3/73
Alkyl benzene sulphonate (branched chain)	0	2	1	I	0		3/73 6/80
Alkylene amine mixtures	0	2	1	II	XX	Potent sensitizer	10/85
Allidochlor	0	3	1	I	X		5/87

* Cholinesterase inhibitor

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Allyl alcohol	0	3	2	II	XXX	Potent lachrymator; latent skin vesication	2/73 11/76 1/88
Allyl bromide	See 3-Bromopropylene						
Allyl chloride	See 3-Chloropropylene						
Allyl chloroformate	0	-	2	II	XXX		11/76 1/88 8/88
Allyl iodide	See 3-Iodopropylene						
Allyl isothiocyanate	0	(2)	2	II	XX		11/74 1/84 2/85
Allyl trichlorosilane (stabilised)	0	(1)	(1)	II	XX		11/76 6/80
Alum (solid or in solution up to 80%) (aluminium sulphate)	0	1	0	I	0		3/73 10/82 6/83 11/86 5/87 1/88
Alumina	0	D	0	0	0		3/73
Aluminium bromide	0	(1)	(2)	II	XXX		11/76 1/88
Aluminium chloride, solution	0	1	1	I	X		10/75 1/88
Aluminium chloride, anhydrous	0	1	1	II	XXX		1/88
Aluminium chloride/ Hydrogen chloride, aqueous solution	See Hydrochloric acid						
Aluminium phosphide	0	3	3	II	XX		11/79
Aluminium sulphate solution	See Alum						
1-Amino-3-aminomethyl-3, 3,5-trimethylcyclohexane	See Isophoronediamine						
Aminobenzene	See Aniline						
1-Aminobutane	See n-Butylamine						
Aminocarb	0	4	3	II	XX		5/87
Aminocyclohexane	See Cyclohexylamine						
Amino-3,4-dimethylbenzene	See Xylidenes						
2-Aminoethanol	See Ethanolamine						
2-(2-Aminoethoxy)ethanol	0	1	0	II	X		10/82 1/84 5/84 2/85 10/85
Aminoethyldiethanolamine/ Aminoethylethanolamine, water solution	0	0	1	I	0		10/85
Aminoethylethanolamine	0	(1)	1	I	0		7/76 12/80 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
1-Amino-2-ethylhexane	See Mono-2-ethylhexylamine						
N-Aminoethylpiperazine	0	0	1	II	XX		1/84 5/84 2/85 10/85
6-Aminohexanoic acid, lactam	See Caprolactam						
2-Amino-2-hydroxymethyl-1,3-propanediol solution (40% or less)	0	0	0	0	0		5/86 11/86
Aminomethane	See Monomethylamine						
Aminomethylbenzene	See Toluidenes						
2-Amino-2-methyl-1-propanol (90% or less)	0	1	1	II	X		5/86
2-Aminopropane	See iso-Propylamine						
Aminotoluene	See Toluidenes						
Aminotrimethylcyclohexane	See Trimethylcyclohexylamine						
Ammonia (anhydrous and aqueous, 28% or less)	0	2	1	I	X		3/73 10/75 7/76 7/77 11/79 10/82
Ammonium arsenate	+	3	-	-	0		3/73 10/82 6/83
Ammonium bisulphite solution, greater than 15%	0	1	1	0	0		11/86
Ammonium dichromate	See Potassium dichromate						
Ammonium dinitro ortho cresolate	See 4,6-Dinitro ortho cresol						
Ammonium fluoride	0	1	2	I	X		11/79
Ammonium hydrogen fluoride	0	2	(2)	II	XXX		11/76 1/88
Ammonium metavanadate	0	(2)	(2)	0	0		11/79
Ammonium nitrate	0	1/BOD	1	0	0		3/73
Ammonium phosphate	0	1/BOD	0	0	0		3/73
Ammonium polyvanadate	0	(2)	(3)	I	X		11/79
Ammonium silicofluoride	See Silicofluoride						
Ammonium sulphate	0	1	1	0	0		5/78 11/79
Ammonium sulphide soln. (45% or less)	0	3	2	II	XX		2/85
Ammonium sulphite	0	1	1	0	0		11/86
Ammonium thiocyanate/ Ammonium thiosulphate solution	0	(2)	1	0	0		5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Ammonium thiosulphate solution (60% or less)	0	(2)	1	0	0		5/86
iso-Amyl acetate	0	2	0	I	X		3/73 10/82 6/83 8/88
n-Amyl acetate	0	2	0	0	X	Tested for tainting	3/73 10/82 6/83 8/88
sec-Amyl acetate	0	2	1	I	X		1/84 8/88
iso-Amyl alcohol	See 3-Methyl-2-butanol and 3-Methyl-1-butanol						10/75 10/82
n-Amyl alcohol	See 1-Pentanol						
sec-Amyl alcohol	See 2-Pentanol and 3-Pentanol						
tert-Amyl alcohol	See 2-Methyl-2-butanol						
Amyl chloride	See 1-Chloropentane						
tert-Amylenes	See Pentene (all isomers)						
Amyl mercaptan	T	2	2	0	XXX		3/73 10/82 6/83
Amyl trichlorosilane	0	1	1	II	XX		11/76 6/80 8/88
Aniline	0	2	2	II	XX	Tested for tainting	3/73 10/82 1/84 2/85 8/88
Aniline hydrochloride	0	2	2	II	0		3/73 10/82
Animal oil	0	0	0	I	XX	Skin sensitizer	10/85 5/86
ortho-Anisidine	0	4	1	II	XX		11/79 6/80 12/80 5/87
Anisoyl chloride	0	(1)	(1)	0	XX		11/76 9/81
Anthracite	0	D	0	0	0		3/73
Antimony compounds	0	2	3	II	XXX		3/73 5/78 1/88
Antimony lactate	0	2	2	0	0		3/73 10/82 6/83 1/88
Antimony pentachloride (liquid)	0	(2)	1	II	XX		11/79 1/88
Antimony pentachloride (solutions)	0	(2)	1	0	0		11/79 1/88
Antimony pentafluoride	0	(2)	(2)	II	XXX		5/78 1/88
Antimony potassium tartrate	0	2	2	I	0		3/73 10/82 6/83 1/88
Antimony trichloride (solid)	0	2	1	II	XX		11/79 1/88
Antimony trichloride (solutions)	0	2	1	I	0		11/79 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
ANTU	See alpha-Naphthylthiourea						
Apatite	0	D	0	0	0		3/73
Apple juice	0	0	0	0	0		5/86
meta-Arsenic acid	+	3	3	0	0		3/73 10/82 6/83
ortho-Arsenic acid	+	3	3	0	0		3/73 10/82 6/83
Arsenical flue dust	See Arsenic compounds (solid, N.O.S.)						
Arsenic compounds (liquid, N.O.S.)	+	3	4	II	XXX	Human carcinogen	7/76 11/79 6/83
Arsenic compounds (solid, N.O.S.)	+	3	4	II	XXX	Human carcinogen	7/76 11/79 6/83 1/84 2/85
Arsenic (metallic)	(+)	(3)	2	II	XXX	Human carcinogen	11/79
Arsenic pentoxide	+	3	3	II	XXX	Human carcinogen	3/73 10/82 1/84 2/85 11/86
Arsenic tribromide	+	3	4	I	0		3/73 10/82 6/83
Arsenic trichloride	+	3	4	I	0		3/73 10/82
Arsenic trioxide	+	3	4	II	XXX	Human carcinogen	3/73 11/79 10/82 6/83
Atrazine	0	2	1	I	XXX		3/73 10/82 6/83 1/84 2/85
1-Azacycloheptane	See Hexamethyleneimine						
Aviation alkylates (C_8 paraffins and iso-paraffins BPt 95-120°C)	0	(3)	(1)	0	0		6/83 11/86
Azinphos-ethyl	-	4	3	I	XX	ChE inhibitor	5/87
Azinphos-methyl	0	4	3	II	XXX	ChE inhibitor	6/80 10/82 6/83 5/87
Aziridine	See Ethyleneimine						
Babassu oil	See Coconut oil						
Ball clay	0	D	0	0	0		3/73
Barium azide	0	3	3	0	XX		3/73 11/76 10/82 6/83 1/88 8/88
Barium bromate	0	(1)	-	-	-		8/88
Barium chlorate	0	(1)	-	-	-		8/88
Barium chloride	-	-	2	I	XX		8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Barium compounds (N.O.S.)	0	4	3	II	XX	Teratogen	11/76 10/82 6/83 1/84 8/88
Barium cyanide	0	4	3	II	XX		3/73 11/76 10/82 6/83 8/88
Barium hypochlorite	0	(3)	-	-	-		8/88
Barium metal	0	0	3	II	XX	Teratogen	11/76 10/82 6/83 1/84 11/86 8/88
Barium nitrate	0	-	2	I	XX		8/88
Barium oxide	0	0	3	II	XX		3/73 11/79 8/88
Barium perchlorate	0	-	-	-	-		8/88
Barium permanganate	0	3	-	-	-		8/88
Barium peroxide	0	2	-	-	-		8/88
Barium sulphate	0	0	-	-	-		8/88
Barley	0	0/BOD	0	0	X		3/73
Battery fluid (acid)	See Sulphuric acid						
Battery fluid (alkaline, corrosive)	See Potassium hydroxide						
Bauxite	0	D	0	0	0		3/73
Behenyl alcohol	0	0	0	0	X		5/86
Bendiocarb	0	4	3	I	XX	ChE inhibitor	5/87
Benfuracarb	0	-	2	O	O		1/88
Benquinox	-	4	2	I	X		5/87
Benzaldehyde	0	3	3	I	X		2/85 10/85 8/88
Benzene	0	2	1	II	XXX	Human carcinogen; Haemotoxic; Tested for tainting	10/75 11/76 11/79 5/87 1/88 8/88
1,2-Benzene dicarboxylic acid, butyl benzyl ester	See Butyl benzyl phthalate						
1,2-Benzene dicarboxylic acid, butyl ester	See Dibutyl phthalate						
1,2-Benzene dicarboxylic acid, decyl octyl ester	See Octyl decyl phthalate						
1,2-Benzene dicarboxylic acid, diethyl ester	See Diethyl phthalate						
1,2-Benzene dicarboxylic acid, di-2-ethyl hexyl ester	See Di-2-ethyl hexyl phthalate						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
1,2-Benzene dicarboxylic acid, diheptyl ester	See Diheptyl phthalate						
1,2-Benzene dicarboxylic acid, diisobutyl ester	See Diisobutyl phthalate						
1,2-Benzene dicarboxylic acid, dimethyl ester	See Dimethyl phthalate						
1,2-Benzene dicarboxylic acid, dinonyl ester	See Dinonyl phthalate						
1,2-Benzene dicarboxylic acid, dioctyl ester	See di-n-octyl phthalate						
1,2-Benzene dicarboxylic acid, dipropyl ester	See Dipropyl phthalate						
1,2-Benzene dicarboxylic acid, ditridecyl ester	See Ditridecyl phthalate						
1,2-Benzene dicarboxylic acid, diundecyl ester	See Diundecyl phthalate						
Benzene sulphonyl chloride	0	1	1	II	XX		11/79 6/83
1,2,4-Benzene tricarboxylic acid, trioctyl ester	0	0	1	I	X		5/87
Benzidine	0	3	2	II	XXX	Human carcinogen	3/73 11/79 10/82 1/84
2,3-Benzofuran	-	-	(2)	-	-		5/86 11/86
Benzoic acid	0	1	1	I	X		11/76 9/81 1/88
Benzoic acid, 4 methoxy chloride	See Anisoyl chloride						
Benzonitrile	0	2	1	I	X		11/79
Benzotrichloride	0	-	1	II	XX	Carcinogen	11/79 1/88
Benzoyl chloride	0	1	1	0	XX		11/76 9/81
Benzyl acetate	0	2	1	I	0		12/75 12/80 5/84 2/85
Benzyl alcohol	0	2/BOD	1	I	XX		3/73 5/77 1/88
Benzyl bromide	0	-	1	I	X		11/76
Benzyl chloride	0	3	1	II	XXX	Lachrymator	11/76 12/80 1/88
Benzyl chloroformate	0	4	-	I	XXX		11/76 6/83
Benzyl cyanide (liquid)	0	(2)	2	I	X		11/79
Benzyl ether	See Dibenzyl ether						
Benzylidene chloride	0	(3)	1	II	XX		7/76
Beryllium chloride	0	2	2	II	XXX	Carcinogen; Teratogen	3/73 11/74 7/76 11/79 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Beryllium compounds (N.O.S.)	-	2	2	II	XXX	Carcinogen; Teratogen	3/73 7/76 11/79 1/84
Beryllium powder	0	2	2	II	XXX	Carcinogen; Teratogen	3/73 11/74 11/79 1/84
Binapacryl	+	4	2	I	XX		5/87
Blue gas	See Water gas						
Blasticidin-S	0	-	3	II	X		5/87
Blasticidin-S-3	-	-	3	-	-		5/87
Boracic acid	See Boric acid						
Borax	0	1	2	I	XX	Testicular toxicity	3/73 5/78 5/86
Bordeaux arsenites	See Copper arsenite						
Boric acid	0	1	2	I	XX	Testicular toxicity	5/78 5/86
Boron trifluoride, acetic acid complex	0	-	-	-	XX		11/76
Boron trifluoride, propionic acid complex	0	-	-	-	XX		11/76
Bran pellets	0	0/BOD	0	0	0		3/73
Brazil nuts	0	0	0	0	0		3/73
Bricks	0	0	0	0	0		3/73
Brodifacoum	+	4	4	II	XXX		5/87
Bromine	0	3	2	II	XX		3/73
Bromine pentafluoride	0	(3)	(2)	II	XXX		11/76
Bromine trifluoride	0	(3)	(2)	II	XXX		11/76
Bromoacetic acid (solid and solution)	0	(2)	2	0	X		11/76
Bromoacetone	0	2	(3)	II	XXX	Potent lachrymator	3/73 9/81 10/82 1/84 1/88
Bromoacetyl bromide	0	(2)	(2)	II	XX		11/79
1-Bromobenzyl cyanide	Z	2	3	II	XX		3/73 9/81 10/82 6/83
1-Bromo-2,3-epoxy propane	-	-	-	-	-		11/79
Bromoethane	0	-	1	I	X		5/78 9/81 1/84
Bromoethene	See Bromoethylene						
Bromoethylene	0	-	2	II	X		5/78 9/81
Bromoform	Z	2	1	II	XX		11/79 10/82 1/84 2/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Bromomethane	0	3	-	II	X	Gas; Neurotoxic	5/78 9/81 1/84
Bromophos-ethyl	+	4	3	I	XX	ChE inhibitor	5/87
1-Bromo-2-propanone	See Bromoacetone						
3-Bromopropene	See 3-Bromopropylene						
3-Bromopropylene	Z	4	3	II	XX		5/78 1/88
Bromoxynil	0	4	2	I	XX		5/87
Brucine	0	2	3	I	0		7/76 5/78
1,3-Butadiene (inhibited)	---------gas---------						3/73 10/82
Butanal	See n-Butyraldehyde						
Butane	---------gas---------						3/73
Butanedioic acid	See Succinic acid						
trans-Butanedioyl chloride	See Fumaryl chloride						
Butanoic acid	See n-Butyric acid						
Butanoic acid, butyl ester	See n-Butyl butyrate						
1-Butanol	See n-Butanol						
2-Butanol	See sec-Butanol						
iso-Butanol	0	0	1	I	X		11/76 9/81 5/84 1/88
n-Butanol	0	0	1	I	X	Tested for tainting	11/76 9/81 5/84 1/88 8/88
sec-Butanol	0	0	0	0	X		11/76 5/77 8/84 2/85 1/88
tert-Butanol	0	0	1	0	0		7/76 11/76 5/84
2-Butanone	0	0	1	I	X		3/73 10/85 11/86 1/88
Butene	---------gas---------						6/80
Butene oligomer	0	(3)	0	0	0		6/83 1/88
cis-Butenedioic acid	See Maleic acid						
Butocarboxim	0	2	2	I	X		5/87
2-Butoxyethanol	See Ethyleneglycol, monobutyl ether						
iso-Butyl acetate	0	2	1	I	X		6/80 8/88
n-Butyl acetate	0	2	0	I	X		6/80 10/82 6/83 1/84 8/88
sec-Butyl acetate	0	1	0	I	X		3/73 10/82 6/83 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
iso-Butyl acrylate	0	3	0	0	X		6/80 1/88 8/88
n-Butyl acrylate	0	3	1	I	X		6/80 1/88 8/88
n-Butylamine	0	2	2	II	XXX	Lachrymator	7/76 6/80 10/82 1/84 5/84 2/85 1/88
sec-Butylamine	0	2	2	II	XXX	Lachrymator	6/80 10/82 1/84 5/84 1/88
tert-Butylamine	0	2	2	II	XXX	Lachrymator	6/80 10/82 1/84 5/84 1/88
iso-Butylamine	0	2	2	II	XXX	Lachrymator	5/84 2/85 1/88
Butyl benzenes, all isomers	(T)	(4)	1	I	X		2/85 10/85 11/86 1/88
Butyl benzyl phthalate	Z	4	1	0	X		11/79 12/80 10/82 2/85 10/85
n-Butyl butyrate	0	(2)	0	0	X		3/73 12/80 11/86
iso-Butyl isobutyrate	0	-	0	0	0		11/86
Butyl carbitol	See Diethylene glycol, monobutyl ether						
n-Butyl chloride	Z	-	1	I	X		5/78 2/89
Butyl/Decyl/Cetyl/Eicosyl methacrylate mixture	See n-Butylmethacrylate						
Butylene	---------gas---------						10/75
Butylene glycol(s)	0	1/BOD	0	0	0		3/73 10/82 6/83
Butylene glycol monomethyl ether	0	0	1	I	X		6/80 5/84 10/85
Butylene glycol monomethyl ether acetate	0	1	1	I	0		6/80 6/83
1,2-Butylene oxide	0	2	1	I	X		7/76 10/85 5/86
Butyl ether	See Dibutyl ether						
n-Butyl formate	0	(1)	1	II	XX		1/84 5/84 8/88
iso-Butyl formate	0	1	1	I	X		9/81 10/82 1/84 5/84 8/88
iso-Butyl formate and iso-butanol (mixture)	0	1	1	I	X		6/80 9/81
Butyl glycol acetate	See Ethylene glycol, mono butyl ether acetate						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
n-Butyl lactate	0	1	2	II	X		10/75 12/80 5/84
iso-Butyl methacrylate	0	1	0	I	XX	Skin sensitizer	3/73 6/80 5/86 1/88
n-Butyl methacrylate	0	1	0	I	XX	Skin sensitizer	3/73 6/80 9/81 5/86 1/88
1-tert-Butyl-4-methyl benzene	See para-tert-Butyl toluene						
Butyl methyl ketone	See Methyl iso-butyl ketone or Methyl n-butyl ketone as appropriate						
Butyl octyl phthalate	0	-	-	-	X		2/85 10/85
Butyl phenols (liquid or solid)	T	3	1	II	XX		11/79 8/88
Butyl phosphoric acid	See Acid butyl phosphate						
n-Butyl stearate	0	0	1	0	0		10/75 6/80 9/81 5/84 10/85
para-tert-Butyl toluene	T	3	1	I	X		10/75 11/76 1/88
n-Butyl trichlorosilane	0	1	(1)	II	XX		11/76 6/80
iso-Butyraldehyde	0	2	1	II	XX		3/73 8/88
n-Butyraldehyde	0	2	1	I	XX		3/73 8/88
iso-Butyric acid	0	1	2	II	XX	Tested for tainting	5/77 6/80 11/86
n-Butyric acid	0	1	1	II	XX	Tested for tainting	5/77 6/80 11/86
Butyrolactone	0	0	1	II	XXX	Carcinogen	3/73 11/79
Cacodylic acid	+	2	2	0	XX		3/73 10/82 1/84
Cadmium chloride	+	3	2	II	XXX	Carcinogen; Teratogen; Reproductive toxicity	11/79 10/82 6/83 1/84 10/85
Cadmium compounds (N.O.S.)	+	4	2	II	XXX	Carcinogen; Teratogen; Reproductive toxicity	11/79 10/82 1/84 8/88
Cadmium cyanide	+	(4)	-	-	-		8/88
Cadmium selenide	-	-	-	-	-		8/88
Cadmium sulphide	+	0	0	II	XX	Carcinogen	8/88
Calcium alkyl salicylate	0	2	0	0	0		6/80 10/82 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Calcium alkyl salicylate overbased, in mineral oil	0	2	0	I	XX		6/80 10/82 11/86 5/87 1/88
Calcium arsenate	+	3	3	I	XX		3/73 10/82 6/83
Calcium arsenate and arsenite (solid mixtures)	+	3	3	I	XX		3/73 10/82 6/83
Calcium bromide/Zinc bromide solutions	+	3	1	II	XX		11/86
Calcium bromide (solutions)	0	0	1	I	0		10/82 1/84
Calcium carbonate slurry	0	D	0	0	0		5/87
Calcium chloride (solutions)	0	0	1	0	0		3/73 10/82 6/83 11/86
Calcium cyanide	See Potassium cyanide						
Calcium hydrogen sulphite (solution)	0	(1)	1	0	X		11/76
Calcium hydroxide	0	1	0	I	0		3/73 10/82 1/84 10/85
Calcium hypochlorite solutions containing 15% $Ca(OCl)_2$ and more	0	3	1	II	XX		3/73 10/82 6/83 10/85 5/86 5/87
Calcium hypochlorite solutions containing less than 15% but more than 1.5% $Ca(OCl)_2$	0	2	1	II	XX		3/73 10/82 6/83 10/85 5/86 5/87
Calcium hypochlorite solutions containing 1.5% and less $Ca(OCl)_2$	0	1	1	I	X		3/73 10/82 6/83 10/85 5/86 5/87
Calcium naphthenate	T	3	3	0	X		5/78 12/80 9/81 10/82
Calcium naphthenate (overbased) in 65% mineral oil	See Calcium naphthenate						
Calcium nitrate/Magnesium nitrate/Potassium chloride solution	0	0	0	0	0		11/86
Calcium phosphate	See Apatite						
Calcium spent sulphite liquor	See Lignin sulphonic acid, salt, solutions						
Camphechlor	+	4	3	II	XXX	Carcinogen; Convulsant	6/83 1/84 2/85 5/87
Camphor oil	T	0	2	0	XX		3/73 5/77
Candelilla wax	-	-	-	-	X		5/86
Capric acid	See Decanoic acid						
Caprolactam	0	1	1	0	0		10/75 5/78 9/81

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Caproic acid	See Hexanoic acid						
Caprylic acid	See Octanoic acid						
Carbaryl (Sevin)	0	4	2	II	XXX	Teratogen; ChE inhibitor	3/73 10/82 6/83 10/85 5/87
Carbofuran	0	4	4	II	XXX	ChE inhibitor	5/87
Carbolic oil	T	3	2	II	XX	rated as cresols	7/76 10/82
Carbon anode pellets	0	D	0	0	0		3/73
Carbon disulphide	(T)	2	3	II	XXX	Teratogen	3/73 11/74 10/75 6/80 12/80 10/85 11/86
Carbonic acid, diethyl ester	See Diethyl carbonate						
Carbon monoxide	---------gas---------						5/78
Carbon tetrabromide	Z	(2)	1	I	0		10/75 5/78 9/81
Carbon tetrachloride	See Tetrachloromethane						
Carbophenothion	+	4	3	II	XXX	ChE inhibitor	6/80 5/87
Carnauba wax	-	-	-	-	X		5/86
Cartap hydrochloride	0	4	2	0	X		5/87
Cashew nut shell oil	0	0	0	I	XX		6/80
Castor oil	0	0	0	0	XX		3/73 5/77 9/81 1/84
Caustic alkali liquids (N.O.S.)	See Sodium hydroxide						
Caustic potash	See Potassium hydroxide						
Caustic soda	See Sodium hydroxide						
Cement	0	D	0	0	0		3/73
Cetyl/Eicosyl methacrylate (mixture)	0	0	0	I	X		6/83 1/84 5/84 2/85
Cetyl stearyl alcohol	See Alcohols C_{13} and above						
China clay	0	D	0	0	X		3/73
Chinomethionat	-	-	1	I	XX		5/87
Chloral	See Trichloroacetaldehyde						
Chloral hydrate	See Trichloroacetaldehyde						
Chlordane	+	4	3	II	XXX	Carcinogen; Convulsant	5/87
Chlordimeform	0	3	2	I	XX		

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Chlorfenvinphos	0	4	3	II	XXX	ChE inhibitor	5/87
Chlorinated paraffins (C_{10}-C_{13}) with less than 60% chlorine	+	4	0	0	0	Additional hazards if organotin compounds used as stabilizer	5/86
Chlorinated paraffins (C_{10}-C_{13}) with 60% chlorine or more	+	4	0	II	XX	Epigenetic carcinogen; additional hazards if organotin compounds used as stabilizer	5/86 1/88
Chlorinated paraffins (C_{14}-C_{17}) with less than 50% chlorine	-	-	0	0	0	Additional hazards if organotin compounds used as stabilizer	5/86
Chlorinated paraffins (C_{14}-C_{17}) with 50% chlorine or more	0	0	0	0	0	Additional hazards if organotin compounds used as stabilizer	5/86
Chlorinated paraffins (C_{18} and above) with any level of chlorine	0	0	0	II	XX	Epigenetic carcinogen; additional hazards if organotin compounds used as stabilizer	5/86 1/88
Chlorine	0	4	N/A	II	XX	Gas	3/73 10/82 6/83
Chlorine trifluoride	0	2	(2)	II	XX		5/78
Chlormephos	0	4	3	II	XXX	ChE inhibitor	5/87
Chloroacetaldehyde	0	3	3	II	XXX	Lachrymator	11/79 6/80 8/88
Chloroacetic acid	0	2	2	0	0		3/73
Chloroacetone	0	2	3	II	XXX	Potent lachrymator	3/73 9/81 1/88
Chloroacetyl chloride	0	2	2	0	X		11/76
4-Chloro-2-aminotoluene hydrochloride	0	-	2	I	XX	Carcinogen	7/76 11/79
2-Chloroaniline	See ortho-Chloroaniline						
3-Chloroaniline	See meta-Chloroaniline						
4-Chloroaniline	See para-Chloroaniline						
meta-Chloroaniline	0	3	2	I	XX		7/76 9/81 8/88
ortho-Chloroaniline	0	3	2	I	XX		7/76 9/81 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
para-Chloroaniline	0	3	2	I	XX		7/76 9/81 8/88
Chlorobenzene	0	3	1	0	X		3/73 10/82 6/83 8/88
para-Chlorobenzyl chloride	Z	(3)	(1)	I	XX		11/79
2-Chloro-1,3-butadiene	Z	(2)	2	II	XX	Carcinogen	3/73 11/74 10/75 6/80 12/80 9/81 1/84 5/86 11/86
1-Chlorobutane	Z	-	1	-	-		5/78
alpha-Chloro-4 chlorotoluene	See para-Chlorobenzyl chloride						
Chlorodifluoromethane	---------gas---------						10/75 10/82
Chlorodinitrobenzenes	Z	3	1	II	XXX		5/78 9/81
2-Chloro-1-ethanal	See Chloroacetaldehyde						
1-Chloroethane	0	0	N/A	0	0		3/73 5/78 9/81
2-Chloroethanol	See Ethylene chlorohydrin						
Chloroethene	See Vinyl chloride						
Chloroethylene	See Vinyl chloride						
Chlorofenvinphos	-	-	3	II	XXX		6/80
Chloroform	See Trichloromethane						
1-Chloroheptane	-	4	-	-	-		5/78 5/84
1-Chlorohexane	Z	4	-	-	-		5/78 5/84
Chlorohydrins	0	(1)	2	I	XX		3/73 11/74 12/80
Chloromethane	0	1	(1)	II	X	gas	3/73 1/84
4-Chloro-2-methyl phenoxy-acetic acid diethylamine salt, solution	See 2-Methyl-4-chlorophenoxy-acetic acid, diethylamine salt, solution						
3-Chloro-4-methyl phenyl isocyanate	-	-	-	II	XX		11/79
Chloronitroanilines	0	4	2	I	XX		11/79 9/81 6/83 8/88
ortho-Chloronitrobenzene	See Chloronitrobenzenes						
2-Chloronitrobenzene	See Chloronitrobenzenes						
Chloronitrobenzenes	0	3	2	II	XX		5/77 10/82 8/88
Chloro-ortho-nitrotoluene	See 4-Chloro-2-nitrotoluene						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
4-Chloro-2-nitrotoluene	Z	2	1	I	XX		11/79 6/80 12/80 9/81 10/82
1-Chlorooctane	-	(4)	-	-	-		2/85 11/86
Chloro-ortho-toluene	See ortho-Chlorotoluene						9/81 10/82
1-Chloropentane	-	-	-	-	-		5/78
Chlorophacinone	0	-	4	II	XXX		5/87
Chlorophenates	See Sodium pentachlorophenate						
Chlorophenyl trichloro-silane	(+)	-	(1)	II	XX		11/76 6/80
Chloropicrin	0	(3)	2	II	XXX		3/73 10/82 1/84
Chloroprene	See 2-Chloro-1,3-butadiene						
1-Chloropropane	See n-Propyl chloride						
2-Chloropropane	Z	-	-	-	-		5/78
1-Chloro-2-propanol	See Propylene chlorohydrin						
1-Chloro-2-propanone	See Chloroacetone						
1-Chloropropene	See 1-Chloropropylene						
2-Chloropropene	See 2-Chloropropylene						
3-Chloropropene	See 3-Chloropropylene						
2-Chloropropionic acid	0	2	1	II	XX		6/80
1-Chloropropylene	Z	-	1	-	-		5/78 6/83
2-Chloropropylene	Z	-	-	-	-		5/78
3-Chloropropylene	Z	3	2	II	XX		5/78 10/82 6/83
Chlorosulphonic acid	0	2	3	II	X		3/73 10/82 6/83
2-Chlorotoluene	See ortho-Chlorotoluene						
3-Chlorotoluene	See meta-Chlorotoluene						
4-Chlorotoluene	See para-Chlorotoluene						
ortho-Chlorotoluene	T	3	1	I	X		12/80 10/82
para-Chlorotoluene	Z	3	1	I	X		3/73 11/74 12/80 10/82
meta-Chlorotoluene	Z	2	(1)	I	X		10/82
Chlorotoluidines	0	-	2	I	XX	Carcinogen	11/79
Chlorpyriphos	+	4	2	II	XX	ChE inhibitor	5/87
Chlorthiophos	+	4	3	II	XXX	ChE inhibitor	5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Choline chloride, solutions	0	1	1	0	0		1/84 5/84 10/85
Chrome concentrates	See Chrome ore						
Chrome ore	0	D	0	0	0		3/73 1/88 8/88
Chromic acid	See Chromium trioxide						
Chromic fluoride	-	-	2	II	XXX		11/76 1/88
Chromium nitrate	-	-	1	0	0		1/88 8/88
Chromium oxychloride	0	4	(2)	II	XXX	Hydrolized in seawater to substances known to be carcinogenic & teratogenic	5/77 10/82 1/88
Chromium trioxide (anhydrous)	0	2	2	II	XXX	Carcinogen; Teratogen	5/78 1/88
Chromosulphuric acid	0	2	3	II	XXX	Carcinogen; Teratogen	11/79 10/82 1/88
Citric acid	0	1/BOD	0	0	0		3/73 5/77 11/86
Citric juices	0	0	0	0	0		6/80 9/81
Clay	0	D	0	0	0		3/73
Coal (dust)	0	D	0	0	X		3/73
Coal gas	---------gas---------						5/78
Coal (large)	0	0	0	0	0		3/73
Coal slurry	0	0	0	0	0		11/86
Coal tar	T	3	-	II	XXX	Human carcinogen; Dermal phototoxicity	2/85 5/86
Coal tar creosote	See Creosote, coal tar						
Coal-tar naphtha	T	2	1	II	XXX	Human carcinogen	1/84 2/85
Coal-tar pitch (molten)	0	1	-	II	XXX	Human carcinogen; Dermal phototoxicity	2/85 5/86 11/86
Cobalt naphthenate in solvent naphtha	T	3	1	II	XXX	Human carcinogen	2/85
Cocculus (solid)	0	4	4	I	XX		3/73 10/82 6/83
Coconuts	0	0	0	0	0		3/73
Coconut oil fatty acid	0	2	-	-	-		11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Coconut oil	0	0	0	0	XX		3/73 9/81 10/82 1/84
Coconut oil fatty acid methyl ester	0	0	-	-	-		8/88
Coconut stearin fatty acid	0	0	-	-	-		11/86 8/88
Codfish (fresh, salted)	0	0	0	0	X		3/73
Cod liver oil	0	0	0	0	XX		3/73 9/81
Coke	0	0	0	0	0		3/73
Coke breeze	0	D	0	0	X		3/73
Colemanite	0	1	2	0	0		3/73
Copper acetoarsenite	+	3	3	0	XX		3/73 10/82
Copper arsenate	-	-	(3)	0	XX		6/83
Copper arsenite	+	3	3	0	XX		3/73 10/82 6/83
Copper chloride (soln.)	+	3	3	0	0		6/83
Copper concentrates (sulphides)	0	2	1	0	0		3/73 9/81
Copper cyanides	+	4	3	I	XX		3/73 10/82 6/83
Copper ore	See Copper concentrates						
Copra	0	0/BOD	0	0	X		3/73
Corn oil	0	0	0	0	XX		6/83 1/84
Cotton seed cake	0	0/BOD	0	0	X		3/73
Cotton seed oil	0	0	(1)	I	XX		6/80 6/83 1/84
Coumachlor	+	-	1	I	XX		5/87
Coumafuryl	-	-	3	-	XX		5/87
Coumaphos	+	4	3	I	XXX	ChE inhibitor	5/87
Coumarone	See 2,3 Benzofuran						
Coumatetralyl	0	1	0	-	XX		5/87
Creosote (coal tar)	T	3	1	II	XXX	Human carcinogen; Dermal phototoxicity	3/73 6/80 10/82 1/84 2/85 10/85 5/86
Creosote (wood tar)	T	3	2	II	XXX	Human Carcinogen	7/76 10/82 5/84 2/85
Cresols (mixed isomers)	T	3	2	II	XX	Tested for tainting	3/73 6/80 10/82 1/88
Cresyl diphenyl phosphate	+	4	0	0	0		2/85
Cresylic acid	See Cresols						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Cresylic acid, sodium salt solution	T	3	2	II	XXX		1/88
Crimidine	0	1	4	-	XXX	Convulsant	5/87
Crotonaldehyde	0	4	2	II	XX		3/73 10/82 6/83 8/88
Croton oil	-	-	(3)	II	XXX	Skin sensitizer	5/86 11/86
Crotoxyphos	0	4	2	II	XX	ChE inhibitor	5/87
Crufomate	-	3	2	I	XX	ChE inhibitor	5/87
Cumene	See iso-Propylbenzene						
Cupriethylene diamine, solution	+	(3)	(2)	I	X		3/73 10/82
Cyanazine	0	3	2	I	XX		5/87
Cyanides (including solutions)	See Potassium cyanide						
2-Cyanoethanol	See Ethylene cyanohydrin						
Cyanogen bromide	0	4	3	II	XX		3/73 10/82 6/83
Cyanomethane	See Acetonitrile						
Cyanogen chloride	0	4	3	II	XX		3/73 10/82 6/83
Cyanophos (Cyanox)	0	4	3	I	XX	ChE inhibitor	5/87
2-Cyanopropan-2-ol	See Acetone cyanohydrin						
Cyanuric chloride	0	3	2	II	XX		11/79
1,5,9-Cyclododecatriene	0	3	1	II	XX	Skin sensitizer	11/79 8/88
Cycloheptane	0	(3)	(1)	II	X		10/75 12/80 11/86
Cyclohexanal	0	3	-	-	-		8/88
Cyclohexane	0	3	1	II	X		3/73 6/80 6/83 11/86
Cyclohexane/Cyclohexanol (mixture)	0	3	1	II	X		3/73 6/80
Cyclohexanol	0	2	1	II	X		3/73 6/80
Cyclohexanone	0	1	1	I	X		3/73 10/82 1/88
Cyclohexenal	0	3	-	-	-		8/88
Cyclohexenyl trichlorosilane	0	1	1	II	XX		5/77 6/80
Cycloheximide	0	3	4	I	XX		5/87
Cyclohexyl acetate	0	(3)	0	II	XX		11/86 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Cyclohexylamine	0	2	2	II	XXX	Lachrymator	3/73 11/79 12/80 1/88
Cyclohexyl isocyanate	0	-	-	II	XXX		11/79 8/88
Cyclohexyl trichlorosilane	0	1	(1)	II	XX		5/77 6/80
1,3-Cyclopentadiene dimer, (molten)	0	3	2	II	XXX	Lachrymator	2/85 10/85 5/86 11/86 8/88
Cyclopentane	0	3	(1)	I	X		11/86
Cyclopentene	0	(3)	1	0	0		11/86
Cyclotrimethylene trinitramine	0	-	2	0	XX		5/78
Cyhexatin	+	4	2	I	XX		5/87
para-Cymene	0	2	1	I	X		3/73 12/80
Cypermethrin	+	4	2	I	XX		1/88
2,4-D	See 2,4-Dichlorophenoxyacetic acid						
Dazomet	0	-	2	II	X		5/87
2,4-DB	0	3	1	I	X		5/87
DDT	+	4	2	II	XXX	Reproductive toxicity; Carcinogen; Convulsant	3/73 10/82 6/83 10/85 5/87
Decaborane	0	-	3	II	XX		5/78
Decahydronaphthalene	0	(1)	1	0	X		3/73 12/80
iso-Decaldehyde	0	2	1	I	X		10/75 12/80 10/82 8/88
n-Decaldehyde	0	3	1	I	X		10/75 12/80 10/82 8/88
Decanal	See n-Decaldehyde						
n-Decane	0	0	(1)	0	0		12/80 11/86
Decanedioic acid, dibutyl ester	See Dibutyl sebacate						
Decanedioic acid, dimethyl ester	See Dimethyl sebacate						
Decanoic acid (Capric acid)	0	2	0	II	XX		5/77 11/86 1/88
1-Decanol	0	3	1	0	X		3/73 11/76 11/79 8/88
iso-Decanol, mixed isomers	0	3	0	0	X		3/73 11/76 11/79 12/80
1-Decene	0	3	(1)	0	0		3/73 10/75 12/80 10/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Decyl acrylate	0	4	1	I	X		6/80 1/84 5/84 1/88
iso-Decyl acrylate	0	4	0	0	X		6/80 5/84 1/88 8/88
iso-Decyl diphenyl phosphate	+	3	0	I	X		2/85 11/86 1/88 8/88
Decyl octyl alcohol	See 1-Octadecanol						
DEF	-	4	2	II	XX	ChE inhibitor	5/87
Demephion	0	-	2	II	XX	ChE inhibitor	5/87
Demeton-O-methyl	-	-	2	II	XX	ChE inhibitor	5/87
Demeton-S-methyl	0	-	2	II	XX	ChE inhibitor	6/80
Demeton-S-methylsulphoxide	-	-	3	II	XXX	ChE inhibitor	5/87
Dextrose solution	0	0	0	0	0		10/75 9/81 10/82 6/83
Diacetin	See Glyceryl-1,3-diacetate						
Diacetone alcohol	0	1	1	0	0		3/73 5/77
Dialifos	+	4	3	II	XXX	ChE inhibitor	5/87
Dialkyl phthalates C_7-C_9	0	(1)	(0)	I	X		10/85
Dialkyl phthalates C_9-C_{11}	0	0	(1)	0	XX		10/85
Dialkyl phthalates C_9-C_{13}	0	0	(1)	0	XX		10/85
Di-allate	+	3	2	II	XXX	Carcinogen; ChE inhibitor	5/87
Diaminobenzenes	See Phenylenediamines						
4,4'-Diaminobiphenyl	See Benzidine						
1,6-Diaminohexane	See Hexamethylene diamine						
Diamino methyl benzene	See 2,4-Tolylenediamine						
1,3-Diaminopropane	0	-	2	II	XX		1/84
3,3-Diamino propylamine	See Dipropylene triamine						
Diamino (3,3,5) trimethylhexane	See 2,4,4-Trimethylhexamethylenediamine						
Diammonium phosphate	See Ammonium phosphate						
Diazinon	+	4	2	II	XXX	ChE inhibitor	6/80 1/84 5/87
Dibenzyl dichlorosilane	-	(1)	(1)	II	XX		6/80
Dibenzyl ether	0	(2)	1	I	X		3/73 11/74 12/80
Diborane	0	1	2	II	XX		5/78

Substances	A	B	C	D	E	Remarks	Considered/ Revised
1,2-Dibromo-3-chloro-propane	0	2	2	II	XXX	Carcinogen; Testicular toxicity	5/87
1,1-Dibromoethane	Z	(2)	(2)	I	X		5/78
1,2-Dibromoethane	See Ethylene dibromide						
1,2-Dibromoethylene	Z	(2)	2	II	XXX	Carcinogen	5/78 11/79
Dibromomethane	(Z)	(2)	(1)	I	X		5/78
Di-iso-butene	See Octene (all isomers)						
Di-iso-butylamine	0	(2)	2	II	XX		6/80 1/88
Di-n-butylamine	0	2	1	II	XX		10/75 7/76 1/84 1/88
n-Dibutylamine	See Di-n-butylamine						
Di-n-butyl ether	0	2	0	0	0		3/73 10/75 12/80
Di-iso-butyl carbinol	See 2,6-Dimethyl-4-heptanol						
Di-iso-butyl ketone	0	1	1	I	X		3/73 10/82 6/83 1/84 1/88
Di-n-butyl ketone	-	-	-	-	-		1/88
Di-n-butyl maleate	0	3	1	I	X		11/86 1/88
Di-n-butyl phthalate	0	4	1	II	XX	Testicular toxicity; Teratogen	10/75 7/76 11/79 12/80 9/81 2/85 10/85 11/86
Di-iso-butyl phthalate	0	3	0	0	X		10/75 11/79 9/81 10/85
Dibutyl sebacate	0	0	0	0	0		10/75 6/80 5/84 8/88
Di-n-butyl tin oxide	+	4	2	II	XXX		1/88
Di-iso-butyl tin oxide	+	4	2	II	XXX		1/88
Dichlofenthion	+	4	2	I	XX	ChE inhibitor	5/87
Dichloroacetic acid	0	2	1	I	X		5/77 6/83
Dichloroacetyl chloride	0	(2)	1	I	XX		5/77
Dichloroanilines	See 3,4-Dichloroaniline						
3,4-Dichloroaniline	Z	4	2	I	XX		3/73 9/81
1,2-Dichlorobenzene	See ortho-Dichlorobenzene						
1,3-Dichlorobenzene	See meta-Dichlorobenzene						
1,4-Dichlorobenzene (molten)	See para-Dichlorobenzene (molten)						
ortho-Dichlorobenzene	T	3	1	I	X	Tested for tainting	3/73 6/80 2/85 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
meta-Dichlorobenzene	Z	3	1	I	X		2/85
para-Dichlorobenzene (molten)	Z	3	1	I	X		5/86 11/86
Dichlorodiethyl ether	T	2	2	I	X		3/73 9/81 10/82
Dichlorodifluoromethane	---------gas---------						3/73 5/78
sym-Dichlorodimethyl ether	0	(3)	2	II	XXX	Human carcinogen	11/79
1,1-Dichloroethane	Z	(1)	1	0	0		5/78
1,2-Dichloroethane	Z	1	2	II	XX	Carcinogen	10/75 5/78 6/80 1/84 2/85
Dichloroethanoic acid	See Dichloroacetic acid						
Dichloroethanoic acid, chloride	See Dichloroacetyl chloride						
1,1-Dichloroethene	See Vinylidine chloride						
1,2-Dichloroethene	See 1,2-Dichloroethylene						
1,1-Dichloroethylene	See Vinylidene chloride						
1,2-Dichloroethylene	0	(1)	1	I	X		10/75 12/80 9/81
Dichloroethyl ether	See Dichlorodiethylether						
1,6-Dichlorohexane	Z	3	1	0	0		10/75 7/76 12/80 9/81 10/82
Dichloromethane	0	1	1	I	XX	Carcinogen	10/75 7/76 5/78 9/81 10/85
2,4-Dichlorophenol	T	3	1	II	XX	Tested for tainting	9/81 10/82 5/86 8/88
2,6-Dichlorophenol	T	3	1	II	XX	Tested for tainting	10/82 5/86 8/88
Dichlorophenols (mixed)	T	3	1	II	XX	Tested for tainting	10/82 5/86 8/88
2,4-Dichlorophenoxyacetic acid	T	3	2	I	XX		3/73 10/82 6/83 10/85 11/86 5/87
2,4-Dichlorophenoxyacetic acid, diethanolamine salt, solution	T	3	1	II	XX		10/85 5/86 11/86 5/87
2,4-Dichlorophenoxyacetic acid, dimethylamine salt, 70% or less solution	T	3	1	II	XX	Sensitizer Tested for tainting	10/85 5/86 11/86 5/87 8/88
2,4-Dichlorophenoxyacetic acid, triisopropanolamine salt, soln.	T	3	2	II	XX		2/85 10/85 5/86 11/86 5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Dichlorophenyl isocyanates	-	-	-	II	XXX		11/79 8/88
Dichlorophenyl trichlorosilane	(+)	-	(1)	II	XX		5/77 6/80
1,1-Dichloropropane	Z	2	0	I	X		10/75 5/78 12/80 6/83
1,2-Dichloropropane	Z	2	1	II	XX		10/82 6/83 1/84 2/85
1,3-Dichloropropane	Z	1	(1)	I	X		10/75 5/78 12/80 6/83
Dichloropropane and dichloropropene (mixtures)	Z	3	2	I	XX		3/73 6/80 10/82 6/83 1/84
1,1-Dichloropropene	See 1,1-Dichloropropylene						
1,2-Dichloropropene	See 1,2-Dichloropropylene						
1,3-Dichloropropene	See 1,3-Dichloropropylene						
2,3-Dichloropropene	See 2,3-Dichloropropylene						
3,3-Dichloropropene	See 3,3-Dichloropropylene						
2,2-Dichloropropionic acid	0	1	1	II	X		10/82 1/84
1,1-Dichloropropylene	Z	-	-	-	-		5/78
1,2-Dichloropropylene	Z	-	1	-	-		5/78 10/85
1,3-Dichloropropylene	Z	3	2	I	X		5/78 6/83 1/84 2/85 10/85
2,3-Dichloropropylene	Z	(3)	2	I	X		5/78
3,3-Dichloropropylene	Z	-	-	-	-		5/78
Di-(2-chloro-iso-propyl) ether	0	2	2	I	XX		11/79 10/82 10/85
Dichlorvos	0	4	3	II	XXX	ChE inhibitor; Carcinogen if containing epichlorohydrin as stabilizer	6/80 5/87
Dicoumarol	-	-	2	I	XX		5/87
Dicrotophos	0	4	3	II	XXX	ChE inhibitor	5/87
Dicyclohexylamine	0	-	2	II	XXX	Lachrymator	11/79 1/88
Dicyclopentadiene	See 1,3-Cyclopentadiene dimer						
Didecyl adipate	-	-	0	0	0		7/76 8/88
Di-decyl-dimethyl ammonium chloride in ethanol and water	-	-	2	II	XX		11/86
Di-iso-decyl phthalate	0	0	0	0	XX		11/79 12/80 9/81 10/82

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Dieldrin	+	4	3	II	XXX	Carcinogen; Convulsant	5/87
Diethanolamine	0	0	1	I	0		3/73 10/82 6/83
Diethylamine	0	2	2	II	XXX	Lachrymator	3/73 10/82 6/83 1/88
2,6-Diethylaniline	0	2	1	II	X		8/88
Diethyl ethanolamine	0	2	1	II	XX		10/75 11/79 10/82 6/83
N,N-Diethyl aniline	-	3	1	I	X		11/79 12/80
Diethyl benzene (mixed isomers)	0	2	1	I	X		3/73 11/76 1/88
Di-(2-ethylbutyl)phthalate	0	0	0	0	X		10/75 11/79 12/80 9/81 2/85 11/86
Diethyl carbonate	0	(1)	1	I	XX		6/75 7/76 8/88
Diethyl dichlorosilane	0	1	1	II	XX		5/77 6/80
Diethylene glycol	0	0	1	0	0		3/73 9/81 10/82 6/83
Diethylene glycol dibutyl ether	0	1	1	I	0		2/85 10/85
Diethylene glycol diethyl ether	0	0	1	I	0		3/73 10/75 7/76
Diethylene glycol monobutyl ether	0	0	1	I	0		10/75 7/76 5/77
Diethylene glycol monobutyl ether acetate	0	(1)	1	I	X		10/75 7/76 12/80 8/88
Diethylene glycol monoethyl ether	0	0	1	I	0		6/75 7/76 5/77
Diethylene glycol monoethyl ether acetate	0	1	1	I	X		6/75 10/75 7/76 12/80 8/88
Diethylene glycol mono-n-hexyl ether	0	1	1	II	XX		8/88
Diethylene glycol monomethyl ether	0	2	1	I	0		10/75 7/76
Diethylene glycol monomethyl ether acetate	0	(1)	1	I	X		10/75 7/76 8/88
Diethylene glycol phenyl ether	-	-	1	II	X		5/86 1/88
Diethylene glycol phthalate	0	1	0	0	0		8/88
Diethylene triamine	0	1	1	I	XX	Skin sensitizer	3/73 10/75 7/76 5/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Diethylene triamine pentaacetic acid	0	-	1	-	-		1/84
Diethylene triamine pentaacetic acid, (sodium salt, tetra sodium salt, penta)	See Diethylene triamine pentaacetic acid						
Diethylene triamine pentaacetic acid, (sodium salt, tetra sodium salt, penta) (40% sol. in water)	0	0	1	0	0		10/82 1/84 5/84
Diethyl ether	0	0	1	0	0		3/73 5/77 6/83 11/86
Di-(2-ethylhexyl) adipate	0	0	0	0	XX		6/75 5/84 2/85 10/85
Di-(2-ethylhexyl) phosphoric acid	0	2	1	I	X		1/84 5/84 2/85 10/85
Di-(2-ethylhexyl) phthalate	0	0	0	II	XX	Testicular toxicity; Carcinogen	11/79 9/81 2/85 10/85 5/86 11/86
Diethyl ketone	0	0	1	I	X		3/73 5/77 6/83 1/88
Diethyl maleate	0	-	1	I	-		2/85
Diethyl malonate	0	2	0	I	X		10/75 12/80 6/83
Diethyl oxalate	0	(1)	2	I	X		6/75 7/76 11/79 8/88
Diethyl phthalate	0	2	1	I	X		6/75 11/79 9/81 10/82 2/85
Diethyl sulphate	0	(2)	1	II	XXX	Carcinogen	6/75 7/76 11/79 6/80 10/82
Diethyl sulphide	0	-	-	-	X		6/75
Diethyl tartrate	0	(1)	-	-	0		6/75
Difenacoum	-	-	4	-	XXX		5/87
Difenzoquat	0	2	2	I	X		5/87
Difluorophosphoric acid (anhydrous)	0	(1)	-	I	0		5/77
Diglycidyl ether of Bisphenol A	0	3	0	II	XX	Testicular toxicity	5/84 10/85
Diglycidyl ether of Bisphenol F	0	3	0	II	XX	Testicular toxicity	5/87
Diglycol chlorohydrin	0	(1)	(2)	II	XX		6/75 11/79
Diheptyl phthalate	0	0	(0)	0	X		11/79 9/81 2/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Di-n-hexyl adipate	0	3	0	0	0		5/86 11/86
Dihexyl phthalate	See Di-(2-ethylbutyl)phthalate						
1,4-Dihydro-9,10-dihydroxy anthracene, disodium salt (soln.)	0	1	0	0	0		1/84
2,3-Dihydroxybutanedioic acid	See Tartaric acid						
2,3-Dihydroxybutanedioic acid, diethyl ester	See Diethyl tartrate						
2,3-Dihydroxypropane, methyl ether	See Tripropylene glycol, monomethyl ether						
Dimefox	0	-	4	II	XXX	ChE inhibitor; High dermal toxicity	5/87
Dimetan	0	-	2	I	XX	ChE inhibitor	5/87
Dimethoate	0	4	3	I	XXX	ChE inhibitor	3/73 6/80 10/82 5/87
Dimethyl acetamide	0	0	1	II	XX		6/75 5/86 11/86
Dimethyl adipate	0	3	0	I	0		2/85 10/85 11/86
Dimethylamine (anhydrous or 40-50% solution)	0	2	2	II	XXX	Potent skin sensitizer; Lachrymator Tested for tainting	3/73 10/82 6/83 1/84 5/86 1/88 8/88
Dimethylaminoethyl methacrylate	-	-	2	II	XXX	Lachrymator	11/79 8/88
Dimethyl carbonate	0	1	0	0	0		11/86 1/88
N,N-Dimethyl aniline	0	2	2	I	X		11/79 5/86
2,6-Dimethyl aniline	See Xylidines						
3,4-Dimethyl aniline	See Xylidines						
Dimethyl benzene	See Xylenes						
Dimethyl benzene bromide	See Xylyl bromide						
N,N-Dimethyl cyclohexyl-amine	0	2	2	II	XX		6/83 1/84 5/84 2/85
Dimethyl dichlorosilane	0	1	1	II	XX		5/78 6/80 9/81
Dimethyl ethanolamine	0	(0)	1	II	XX		3/73 6/80
Dimethyl ether	0	(0)	(1)	0	0		6/75
Dimethyl formal	-	-	0	I	X		11/86
Dimethyl formamide	0	0	0	II	XX	Teratogen	3/73 5/78 1/84 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Dimethyl glutarate	0	2	0	I	0		2/85 10/85 11/86
2,6-Dimethyl-2,5-heptadiene-4-one	0	3	-	-	0		6/75 5/84
2,6-Dimethyl-4-heptanol	0	(2)	1	0	0		5/86
Dimethylhydrogen phosphite	0	-	1	I	X		5/84 10/85 11/86
Dimethyl ketone	See Acetone						
Dimethyl naphthalene sulphonates, sodium salt solution	0	-	0	I	X		5/86 11/86
2,2-Dimethyl octanoic acid	0	(2)	1	II	XX		11/86
Dimethyl phenols	See Xylenols						
3,5-Dimethyl phenol	T	2	1	I	XX		9/81
Dimethyl phthalate	0	2	1	0	X		6/75 10/75 7/76 11/79 2/85
2,2-Dimethylpropane-1,3-diol	0	(1)	0	0	0		5/86
Dimethyl sebacate	-	3	-	-	-		10/75 5/84
Dimethyl succinate	0	2	0	I	0		2/85 10/85 11/86
Dimethyl sulphate	0	2	2	I	XX	Carcinogen	11/74 7/76 11/79
Dimethyl thiophosphoryl chloride	0	-	1	I	XX		11/79
Dimetilan	0	3	3	I	XX	ChE inhibitor	5/87 8/88
Dimexano	-	-	2	-	XX		5/87
Dinitroanilines	0	2	2	I	XX		3/73 5/78
Dinitrobenzenes	0	3	3	II	XXX		7/76 5/78
4,6-Dinitro-ortho-cresol	T	4	3	II	XXX	Neurotoxic	3/73 5/78 5/87 1/88 8/88
Dinitrophenates	See Dinitrophenols						
Dinitrophenols	T	3	3	II	XXX	Tested for tainting	3/73 5/78 6/83 1/88
Dinitrotoluene	0	2	2	II	XXX	Carcinogen	3/73 5/78 6/80
Dinobuton	-	4	2	I	XX		5/87
Dinonyl phthalate	0	0	1	0	XX		12/80 9/81
Di-iso-nonyl adipate	0	0	0	0	XX		2/85 10/85 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Di-iso-nonyl phthalate	0	0	0	0	XX		11/79 6/80 12/80 9/81
Dinoseb	0	4	3	II	XXX		5/87
Dinoseb-acetate	0	-	2	II	XXX		5/87 8/88
Dinoterb	-	-	3	II	XX		5/87
Dinoterb-acetate	-	-	2	II	XX		5/87
Di-iso-octyl acid phosphate	See Di-(2-ethyl hexyl) phosphoric acid						
Di-octyl adipate	See Di(2-ethyl hexyl) adipate						
Di-n-octyl phthalate	0	0	0	I	X		10/75 11/79 12/80 9/81
Di-iso-octyl phthalate	0	0	0	I	X		10/75 11/79 12/80 9/81 2/85
Dioxacarb	0	4	2	I	XX		5/87
1,4-Dioxane	0	0	0	II	XXX	Carcinogen	3/73 5/77 11/79
Dioxanedimethanol/Glycerine mixture	See Glycerine/Dioxanedimethanol mixture						
Dioxathion	-	4	3	II	XXX	ChE inhibitor	5/87
Dipentene	0	2	1	I	X		6/80 12/80
Diphacinone	+	3	4	0	XXX		5/87
Diphenyl	+	3	1	II	XXX		5/86
Diphenylamine chloroarsine	+	(4)	4	II	XXX		3/73 10/82
Diphenyl bromomethane	See Diphenyl methyl bromide						
Diphenyl chloroarsine	+	(4)	4	II	XXX		3/73 10/82 6/83
Diphenyl dichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
Diphenyl/Diphenyl oxide (mixtures)	+	3	1	II	XXX		3/73 12/80 9/81 10/82 5/86
Diphenyl ether (= Diphenyl oxide)	T	3	1	I	X	Tested for tainting	10/75 10/85 8/88
Diphenyl methane-4,4'-diisocyanate	0	(2)	1	II	XXX	Skin sensitizer	6/75 8/88
Diphenyl methyl bromide	-	-	-	-	-		5/77
Diphenylol propane-epichlorohydrin resins	See Diglycidyl ether of Bisphenol A						
Diphenyl oxide/Biphenyl phenyl ether mixtures	T	3	1	I	XX		10/85
Di-iso-propanolamine	0	2	1	0	X		3/73 10/82 6/83

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Di-n-propylamine	0	2	1	II	XXX	Lachrymator	9/81 10/82 6/83 1/88
Di-iso-propylamine	0	2	3	II	XXX	Lachrymator	3/73 10/82 6/83 1/88
Di-iso-propylbenzenes	(T)	4	0	0	0		6/83 2/85 10/85 1/88
Dipropylene glycol	0	0	0	0	0		3/73 9/81 10/82
Dipropylene glycol dibenzoate	0	-	0	0	0		5/86 11/86
Dipropylene glycol mono-butyl ether	0	1	1	II	XX		8/88
Dipropylene glycol monomethyl ether	0	(1)	1	I	0		10/75 7/76 12/80
Dipropylene triamine	0	(1)	1	I	XX		11/79
Di-iso-propyl ether	0	1	0	0	0		3/73 10/75 7/76 10/82 6/83
Di-n-propyl ketone	0	-	1	I	X		1/88
Di-iso-propyl naphthalene	0	1	1	0	0		6/83 2/85
Di-n-propyl phthalate	0	(3)	(1)	I	X		11/79 9/81 10/82
Diquat	0	2	2	I	XX		5/87
Disodium salt of 1,4-dihydro 9,10-dihydroxy anthracene (soln.)	See 1,4-Dihydro-9,10-dihydroxy anthracene, disodium salt (soln.)						
Disulfoton	0	4	4	II	XXX	ChE inhibitor	6/80 5/87
Ditridecyl phthalate	0	0	0	0	XX		10/75 11/79 12/80 9/81 2/85
Diundecyl phthalate	0	0	(1)	0	XX		6/80 9/81 2/85
Diuron	0	3	1	0	XX		3/73 10/82 6/83
Divinyl acetylene	0	(2)	(0)	0	0		10/75 7/76 12/80
DNOC	See 4,6-Dinitro-ortho-cresol						
n-Dodecane	0	0	(1)	0	0		10/75 12/80 1/84 11/86
Dodecanol	0	3	0	0	X		10/75 11/76 11/79 12/80 5/86
Dodecanoic acid	See Lauric acid						
Dodecene (all isomers)	0	(3)	(1)	I	0		2/85 10/85 5/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
1-Dodecene	See Dodecene (all isomers)						
2-Dodecenyl succinic acid, dipotassium salt, solution	0	(1)	1	O	O		5/87
Dodecylamine/Tetradecylamine mixture	-	-	2	II	XX		5/86 1/88
Dodecyl benzene	0	0	-	-	-		3/73 5/76 11/86 1/88
Dodecyl benzene sulphonic acid (contains 1.5% Sulphuric acid)	0	3	1	I	X		5/86
Dodecyl diphenyl oxide disulphonate (solns.)	0	3	1	II	X		6/80 9/81 5/84 2/85
Dodecyl mercaptan	See Lauryl mercaptan						
Dodecyl methacrylate	See Lauryl methacrylate						
Dodecyl/pentadecyl methacrylate (mixture)	0	0	0	0	X		6/83 2/85
Dodecyl phenol	+	4	1	II	XX		6/75 12/80 10/82 1/84 8/88
Dodecyl trichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
Drazoxolan	-	4	2	I	XX	Skin sensitizer	5/87
Dytol R-52	See 1-Tetradecanol						
Edifenphos	-	4	2	-	XX	ChE inhibitor	5/87
Eicosanic acid	See Eicosanoic acid						
Eicosanoic acid (Arachidic acid)	0	0	(0)	0	0		5/77 11/86
Emery stone	0	D	0	0	0		3/73
Endosulphan	+	4	4	II	XXX		3/73 5/87
Endothal - sodium	0	3	2	II	XX		5/87
Endothion	0	-	3	II	XXX	ChE inhibitor	5/87
Endrin	+	4	4	II	XXX	Convulsant	3/73 10/82 6/83
Epibromohydrin	See 1-Bromo-2,3-epoxypropane						
Epichlorohydrin	0	2	2	II	XXX	Carcinogen	3/73 5/77 11/79 6/80
EPN	+	4	3	II	XXX	ChE inhibitor	5/87
1,2-Epoxybutane	See 1,2-Butylene oxide						
Ethanal	See Acetaldehyde						
Ethane	---------gas---------						7/76

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Ethanedial	See Glyoxal solution 40% or less						
Ethanedioic acid	See Oxalic acid						
Ethanedioic acid, diethyl ester	See Di-ethyl oxalate						
1,2-Ethanediol	See Ethylene glycol						
Ethanoic acid	See Acetic acid						
Ethanoic acid, anhydride	See Acetic anhydride						
Ethanoic acid, bromide	See Acetyl bromide						
Ethanoic acid, 2-butoxy ethyl ester	See Ethylene glycol monobutyl ether acetate						
Ethanoic acid, butyl ester	See n-Butyl acetate						
Ethanoic acid, chloride	See Acetyl chloride						
Ethanoic acid, 2-ethyl butyl ester	See 2-Ethyl butyl acetate						
Ethanoic acid, hexyl ester	See Hexyl acetate						
Ethanoic acid, 2-hydroxy-3-methoxy propyl ester	See Tripropylene glycol, monomethyl ether acetate						
Ethanoic acid, iodide	See Acetyl iodide						
Ethanoic acid, 3-methoxy butyl ester	See 3-Methoxy butyl acetate						
Ethanoic acid, 2-methoxy ethyl ester	See Ethylene glycol, monomethyl ether acetate						
Ethanoic acid, 2-methyl propyl ester	See iso-Butyl acetate						
Ethanoic acid, octyl ester	See n-Octyl acetate						
Ethanoic acid, 2-phenyl ethyl ester	See 2-Phenyl ethyl acetate						
Ethanoic acid, propyl ester	See n-Propyl acetate						
Ethanoic acid, 2-propyl ester	See iso-Propyl acetate						
Ethanol	0	0	0	0	0		11/76 9/81
Ethanolamine	0	1	1	0	0		3/73
Ethene	---------gas---------						6/80
Ethenyl trichloride	See 1,1,2-Trichloroethylene						
Ethion	+	4	3	II	XXX	ChE inhibitor	5/87
Ethoate-methyl	-	-	3	I	XX	ChE inhibitor	5/87
Ethoprophos	0	4	3	II	XXX	ChE inhibitor	5/87
4-Ethoxy aniline	See Para-Phenetidine						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
2-Ethoxy ethanol	See Ethylene glycol, monoethyl ether						
2-Ethoxy ethyl acetate	See Ethylene glycol, monoethyl ether acetate						
beta-Ethoxy ethyl methacrylate	See Ethylene glycol, monoethylether methacrylate						
Ethoxy triglycol (crude)	See Triethylene glycol monoethyl ether						
Ethyl acetate	0	1	0	0	0		3/73 11/79 10/82
Ethyl acetoacetate	0	(1)	1	I	X		6/75 8/88
Ethyl acrylate	T	3	2	I	X	Tested for tainting	3/73 11/79 6/80 5/84 1/88
Ethylamine	0	2	2	II	XXX	Potent skin sensitizer; Lachrymator	9/81 10/82 5/86 1/88
Ethyl iso-amyl ketone	0	-	1	I	X		1/88
Ethyl n-amyl ketone	0	2	1	I	X		3/73 12/80
N-Ethylaniline	-	2	2	I	X		11/79 6/83
2-Ethylaniline	-	2	1	I	XX		11/79 12/80
Ethyl benzene	0	2	1	I	X		3/73 11/76 1/88
N-Ethyl-N-benzylaniline	-	-	-	I	X		11/79
Ethyl bromide	See Bromoethane						
Ethyl bromoacetate	0	1	3	I	XXX		3/73 6/83
2-Ethyl butanal	0	3	1	I	XX		8/88
2-Ethyl-1-butanol	0	1	1	I	X		6/75 7/76 11/76 6/80
2-Ethyl butyl acetate	0	(1)	-	-	0		6/75
2-Ethyl butyl alcohol	See 2-Ethyl-1-butanol						
N-Ethyl butylamine	0	(2)	(3)	II	XX		6/80 1/88
Ethyl butyl carbonate	0	-	-	-	0		6/75
Ethyl n-butyl ketone	0	(0)	1	I	X		6/75 1/88
Ethyl iso-butyl ketone	-	-	-	-	-		1/88
Ethyl butyrate	0	2	0	I	X		5/86
Ethyl chloroformate	0	3	2	II	XXX		5/78 6/83 8/88
Ethyl chlorothioformate	T	(4)	-	-	-		11/86
Ethyl cyanide	See Propionitrile						
Ethyl cyclohexane	0	(3)	1	0	0		3/73 6/83 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
N-Ethyl cyclohexylamine	0	1	1	II	XX		6/80 10/82 2/85 1/88
Ethyl dichloroarsine	+	4	(4)	I	XXX		3/73 6/83
Ethyl dichlorosilane	0	1	(1)	II	XX		6/80
Ethylene carbonate	0	0	0	I	X		9/81 6/83
Ethylene chloride	See Vinyl chloride						
Ethylene chlorohydrin	0	2	2	II	XX		3/73 11/74 12/80 6/83
Ethylene cyanohydrin	0	(1)	1	I	X		3/73 10/75 12/80 9/81
Ethylene diamine	0	2	2	II	XX	Potent skin sensitizer	3/73 6/83 2/85
Ethylene diamine, tetra acetic acid, di- and tetra-sodium salt	0	1	1	II	0		5/84 2/85
Ethylene diamine tetra acetic acid, tetrasodium salt (soln. 39%)	See Ethylene diamine, tetra acetic acid, di- and tetra-sodium salt						
Ethylene dibromide	Z	2	2	II	XXX	Carcinogen; Reproductive toxicity	11/79 6/80 10/85
Ethylene dichloride	See 1,2-Dichloroethane						
Ethylene glycol	0	0	1	II	XX	Teratogen	3/73 10/75 9/81 10/85 5/86 11/86
Ethylene glycol diacetate	0	2	1	0	0		2/85 5/86
Ethylene glycol mono-acetate	0	(1)	1	I	X		5/78 8/88
Ethylene glycol mono-acrylate	0	3	1	II	XX		7/76 6/80 6/83 1/88 8/88
Ethylene glycol dibutyl ether	0	-	1	I	X		2/85 11/86
Ethylene glycol methyl butyl ether	0	1	-	-	0		9/81 10/82 5/84 2/85 10/85 11/86
Ethylene glycol monobutyl ether	0	0	2	I	0		10/75 7/76 10/85
Ethylene glycol monobutyl ether acetate	0	(2)	1	I	X		7/76 10/85 8/88
Ethylene glycol monoethyl ether	0	0	1	II	XX	Teratogen	7/76 5/77 1/84
Ethylene glycol mono-ethyl ether acetate	0	2	1	II	XX	Teratogen	3/73 12/80 10/82 6/83 1/84 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Ethylene glycol mono-ethyl ether methacrylate	-	-	-	-	-		10/75
Ethylene glycol monomethyl ether	0	0	1	II	XX	Teratogen	10/75 7/76 5/77 1/84 11/86
Ethylene glycol mono-methyl ether acetate	0	1	1	II	XX	Teratogen	10/75 7/76 11/79 1/84 11/86
Ethylene glycol monophenyl ether	0	1	1	I	X		9/81
Ethylene glycol mono-iso-propyl ether	0	1	1	I	0		6/80
Ethylene glycol mono-tertiary butylether	0	0	1	I	0		10/85
Ethylene glycol phenyl ether	0	1	1	II	X		10/85 1/88
Ethylene glycol phenyl ether/Diethylene glycol phenyl ether, mixture	0	1	1	II	X		10/85 1/88
Ethyleneimine	0	(2)	3	II	XXX	Carcinogen	5/78 6/80
Ethylene oxide	0	2	2	II	XXX	Carcinogen; Neurotoxic; Reproductive toxicity	10/85 11/86
Ethylene oxide/Propylene oxide mixtures with an ethylene oxide content of not more that 30% by weight	See Propylene oxide/Ethylene oxide mixture						
Ethylene vinyl acetate copolymer (emulsion)	0	0	0	0	0		6/83
Ethyl-3-ethoxypropionate	0	2	1	I	X		8/88
2-Ethyl hexaldehyde	0	3	1	I	X		5/86 8/88
2-Ethyl hexanoic acid	0	1	1	I	0		6/80 11/86
2-Ethylhexan-1-ol	0	2	1	0	X	Tested for tainting	11/76 6/83 8/88
2-Ethyl-2-hexenal	See 2-Ethyl-3-propyl acrolein						
2-Ethyl hexyl acrylate	0	(3)	0	I	X		11/79 12/80 1/88
2-Ethyl hexyl alcohol	See 2-Ethylhexan-1-ol						
2-Ethyl hexylamine	See iso-Octylamine						
Ethyl hexyl phthalate	See Di-(2-ethylhexyl)phthalate						
2-Ethyl-2-(hydroxy methyl)-1,3-propanediol	See Trimethylol propane						
5-Ethylidene-2-norbornene	0	3	1	I	X		10/82 1/84 5/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Ethyl lactate	0	(1)/ BOD	1	0	0		3/73 12/80 1/88
Ethyl mercuric chloride	-	-	3	II	XX		5/84
Ethyl methacrylate	0	(1)	1	I	XX	Skin sensitizer	6/75 6/80 5/86 1/88
2-Ethyl-6-methyl-N-(1'methyl-2-methoxy-ethyl)aniline	-	-	1	I	0		11/86
Ethyl oxalate	See Di-ethyl oxalate						
ortho-Ethyl phenol	(T)	(3)	2	II	XX		10/85 8/88
Ethyl phenyl dichlorosilane	-	(1)	(1)	II	XX		6/80
Ethyl parathion	See Parathion						
Ethyl propionate	0	1	1	I	X		5/86
2-Ethyl-3-propyl acrolein	(T)	(1)	1	II	XX		3/73 12/80 8/88
Ethyl n-propyl ketone	0	-	1	I	X		1/88
Ethyl iso-propyl ketone	-	-	-	-	-		1/88
Ethyl sulphide	See Diethylsulphide						
para-Ethyl toluene	See 1,4-Methyl ethyl benzene						
Ethyl trichlorosilane	0	1	1	II	XX		5/78 6/80
Eucalyptus oil	-	-	1	I	X		11/86
Fatty alcohols C_{12-20}	0	3	1	0	X		11/76 12/80
Fenaminosulf	0	3	3	-	XX		5/87
Fenaminphos	0	4	3	II	XXX	ChE inhibitor	5/87
Fenitrothion	+	4	3	II	XXX	ChE inhibitor	6/80 5/87
Fenpropathrin	+	4	3	I	XX		5/87
Fensulfothion	0	4	4	II	XXX	ChE inhibitor; High dermal toxicity	5/87
Fenthion	+	4	2	II	XXX	ChE inhibitor	5/87
Fentin acetate	+	4	3	II	XXX		3/73 6/83 5/87
Fentin hydroxide	+	4	3	II	XXX		5/87
Ferric arsenate	+	2	3	0	XX		3/73
Ferric arsenite	+	3	4	0	XX		3/73
Ferric chloride	0	2	2	0	X		3/73 6/83
Ferric chloride solution	See Ferric chloride						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Ferric chloride waste solution	0	2	(2)	O	X		1/88
Ferric hydroxyethyl ethylene diamine triacetic acid, tri-sodium salt, solution	0	1	1	II	0		10/85
Ferric nitrate and Nitric acid solution	See Nitric acid						
Ferrosilicon (30%-90% silicon)	-	-	*	-	-	* Hazard from immediate release of highly toxic arsine and phosphine	5/78
Ferrous arsenate	+	2	3	0	XX		3/73
Fertilizer NPK	0	0	1	0	0		3/73 6/83
Fishmeal	0	0/BOD	0	0	XX		3/73 6/83
Fishoil	0	0	0	I	XX	Skin sensitizer	6/83 1/84 2/85
Fluoboric acid	0	-	-	-	-		5/77
Fluoracetamide	0	2	3	II	XXX	Convulsant	5/87
Fluorophosphoric acid, anhydrous	0	(1)	-	I	0		5/77
Fluorosulphonic acids	0	2	3	II	XX		5/77 11/79
Fluorspar	0	D	0	0	0		3/73
Fluosilicic acid	0	2	2	II	0		3/73 11/74 7/76
Fonofos	+	4	4	II	XXX	ChE inhibitor	5/87
Formaldehyde (37%-50% solution)	0	2	2	II	XX	Skin sensitizer; Carcinogen; Tested for tainting	3/73 6/83 2/85 8/88
Formamide	0	0	1	I	XX	Teratogen	10/75 12/80 9/81 1/84
Formetanate	0	4	3	II	XXX		5/87
Formic acid	0	1	1	I	X		3/73 5/77 11/86
Formic acid, methyl ether	See Methyl formate						
Formothion	0	-	2	II	XXX		5/87
Fumaric adduct of rosin (water dispersion)	0	3	1	0	X		10/85
Fumaryl chloride	0	2	-	II	XX		5/77 6/80 12/80
Furfural	0	2	2	II	XX		3/73 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Furfuryl alcohol	0	2	2	0	0		3/73 6/83
Gallotanic acid	See Tannic acid						
Glucose (solution)	See Dextrose solution						
Glutaraldehyde solutions	See 1,5-Pentanedial solutions						
Glycerine	0	0	0	0	0		3/73 9/81 6/83 1/84
Glycerine (83%)/Dioxane-dimethanol (17%) mixture	0	1	1	I	X		8/88
Glycerol polyalkoxylate	0	0	0	0	0		10/85 5/86
Glyceryl diacetate	-	-	-	-	-		1/88
Glyceryl 1,3-diacetate	See Glyceryl diacetate						
Glyceryl triacetate	0	(0)	1	0	0		10/75 12/80
Glycidyl ester of C_{10} trialkyl acetic acid ("Cardura E10")	0	3	1	II	XX		6/80 10/82
Glycine, Sodium salt, sol.	0	0	0	0	0		6/83
Glycol diacetate	See Ethylene glycol diacetate						
Glycol monoacetate	See Ethylene glycol monoacetate						
Glyoxal solutions (40% or less)	0	1	1	I	X		5/86 11/86 1/88 8/88
Ground nuts (shelled)	0	0	0	0	0		3/73
Ground nut oil	0	0	0	0	XX		10/85
Guano	0	O/BOD	1	0	X		3/73
Guthion	See Azinphos methyl						
Gypsum	0	0	0	0	0		3/73
Haematite	0	0	0	0	X		3/73
alpha-HCH	See Lindane						
Hemimellitene	See 1,2,3-Trimethylbenzene						
Heptachlor	+	4	3	II	XXX	Carcinogen	3/73 6/83 5/87
n-Heptadecane	0	0	(0)	0	0		10/75 12/80 11/86
n-Heptadecanoic acid	0	0	(0)	0	0		10/75 5/77 11/86
1-Heptadecene	0	0	0	0	0		5/84
n-Heptanal	0	3	0	I	XX		8/88
n-Heptane	0	3	0	0	0		3/73 6/83 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
n-Heptanoic acid	0	1	0	I	X		3/73 5/77 12/80 11/86
1-Heptanol	0	2	1	I	0		7/76 11/76 11/79
2-Heptanol	0	(2)	1	I	0		10/75 7/76 12/80
3-Heptanol	0	(2)	1	I	0		10/75 7/76 12/80
2-Heptanone	See Methyl n-amyl ketone						
3-Heptanone	See Ethyl n-butyl ketone						
1-Heptene	0	2	(1)	0	0		3/73 10/75
Heptene, mixed isomers	See 1-Heptene						6/80 12/80
Heptenophos	0	4	2	I	XX		5/87
Heptyl acetate	0	(3)	0	I	X		10/85
Hexachlorobutadiene	+	4	2	I	X		11/79 6/80
alpha-Hexachlorocyclohexane	See Lindane						
n-Hexadecanoic acid (Palmitic acid)	0	0	0	0	0		5/77 11/86 1/88
Hexadecanoic acid, propyl ester	See Propyl palmitate						
Hexadecene	0	0	0	0	0		5/84
Hexadecyl trichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
2,4-Hexadiene aldehyde	0	-	1	II	XX		10/82 8/88
2,4-Hexadienoic acid	0	1	0	I	X		10/82 1/84 11/86
Hexaethylene glycol	0	0	0	0	0		5/86
Hexaethyl tetraphosphate	0	4	3	II	XXX		3/73 6/83
Hexafluoroacetone hydrate	0	-	2	II	XX		11/79
Hexafluorophosphoric acid	0	-	-	II	XX		5/77
Hexaglycerol	See Trimethylolpropane						
Hexahydrocymol	0	(3)	(1)	II	X		10/75 12/80
Hexamethylene diamine	0	2	1	II	XX	Potent skin sensitizer	3/73 12/80 10/82 5/86
Hexamethylene diamine adipate, 50% in water	0	1	1	II	X		10/85
Hexamethylene glycol	0	0	1	0	0		5/86
Hexamethyleneimine	0	2	3	II	X		5/78 12/80 10/82

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Hexamethylene tetramine	0	0	1	II	XX	Skin sensitizer	10/75 7/76 5/86 5/87
n-Hexane	0	3	0	II	X	Neurotoxic	3/73 6/80 6/83 11/86
Hexanedioic acid, didecyl ester	See Di-decyl adipate						
Hexanedioic acid, di-(2-ethyl hexyl) ester	See Di-(2-ethyl hexyl) adipate						
Hexanedioic acid, dinitrile	See Adiponitrile						
1,2,6-Hexanetriol	0	0	0	0	0		10/75 7/76 12/80
Hexanitrodiphenylamine	0	-	2	-	XX		5/78
Hexanoic acid (Caproic acid)	0	1	1	I	X		5/77 11/86
Hexanoic acid, 6-amino, lactam	See Caprolactam						
1-Hexanol	0	1	1	II	XX		10/75 7/76 11/76 12/80
2-Hexanone	See Methyl n-butyl ketone						
3-Hexanone	See Ethyl n-propyl ketone						
1-Hexene	0	2	(1)	0	0		10/75 6/80 12/80 10/85
2-Hexene	0	(2)	-	0	0		5/86
n-Hexyl acetate	0	3	0	0	0		10/75 12/80 6/83
sec-Hexyl acetate	0	(2)	0	0	0		3/73 1/84
n-Hexyl aldehyde	0	3	1	I	XX		8/88
Hexylene glycol	0	0	1	0	0		10/75 7/76
Hexyl trichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
Hydrazine	0	3	2	II	XXX	Carcinogen; Teratogen	3/73 11/79 9/81 6/83 1/84
Hydriodic acid (solution)	-	-	-	II	XX		5/77 11/79
Hydrobromic acid	0	-	-	II	X		5/77
Hydrochloric acid	0	1	1	II	XX		3/73 6/83 1/88
Hydrocyanic acid	0	4	3	II	X		3/73 6/83
Hydrofluoric acid (solution)	0	2	(2)	II	X		3/73 6/80
Hydrogen bromide (anhydrous)	See Hydrobromic acid						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Hydrogen chloride (anhydrous)	See Hydrochloric acid						
Hydrogen cyanide	See Hydrocyanic acid						
Hydrogen fluoride (anhydrous)	See Hydrofluoric acid						
Hydrogen peroxide	0	2	0	I	0		3/73 6/83
Hydrogen sulphide	0	3	2	II	XX		5/78
2-Hydroxybenzoic acid, methyl ester	See Methyl salicylate						
2-Hydroxybutanedioic acid	See Malic acid						
2-Hydroxyethyl acrylate	See Ethylene glycol (mono)acrylate						
N-(2-Hydroxyethyl)ethylene diamine triacetic acid, trisodium salt (solution)	0	1	1	II	0		1/84 5/84 2/85
2-Hydroxy-4-(methylthio) butanoic acid	0	2	1	II	XX		11/86 8/88
Hydroxyl 42	See Propoxylated polyglycol						
4-Hydroxy-4-methyl-2-pentanone	See Diacetone alcohol						
2-Hydroxy-2-methyl propionitrile	See Acetone cyanohydrin						
2-Hydroxy-1,2,3-propanetricarboxylic acid	See Citric acid						
2-Hydroxypropanoic acid	See Lactic acid						
2-Hydroxypropanoic acid, butyl ester	See Butyl lactate						
2-Hydroxypropanoic acid ethyl ester	See Ethyl lactate						
3-Hydroxypropanoic acid, beta-lactone	See beta-Propiolactone						
2-Hydroxypropyl acrylate	See Propylene glycol (mono)acrylate						
Hydroxy terminated polybutadiene	0	0	0	I	X		5/87
Hypochlorite solutions,	See Sodium hypochlorite solutions						
Ilmenite	0	0	0	0	0		3/73
Imazalil	-	3	2	I	XX		5/87
Iodine monochloride	-	-	2	II	XX		5/77 11/79
3-Iodopropylene	0	(3)	(3)	II	XX		11/76 5/78
Ioxynil	0	4	2	I	XX		5/87
Iprobenfos	0	(3)	1	0	X	ChE inhibitor	1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Iron chloride/Copper chloride (solutions)	See Copper chloride (solution)						
Iron concentrates	See Haematite						
Iron ore	See Haematite						
Iron pentacarbonyl	0	-	3	II	XX		5/78
Iron pyrites	0	0	0	0	0		3/73
Isobenzan	-	-	4	II	XXX	High dermal toxicity	5/87
Isocyanic acid, methyl ester	See Methyl isocyanate						
Isododecane	See Dodecane						
Isodrin	-	-	3	II	XXX	High dermal toxicity	5/87
Isodurene	See 1,2,3,5-Tetramethyl benzene						
Isofenphos	0	4	3	II	XXX		5/87
Isolan	-	-	3	II	XXX	High dermal toxicity	5/87
Isophorone	0	1	1	II	XX		3/73 1/84
Isophoronediamine	0	1	1	II	XXX	Potent skin sensitizer	11/79 12/80 10/82 5/86
Isophorone diisocyanate	-	3	1	II	XXX	Potent skin sensitizer	6/80 10/82 5/86
Isoprene	0	2	0	I	0		3/73 6/80 12/80
Isoprocarb	-	4	2	0	XX		5/87
Isothioate	0	3	2	II	XXX		5/87
Isothiocyanic acid, allyl ester	See Allyl isothiocyanate						
Isoxathion	+	4	2	II	XXX		5/87
Kaolin slurry	0	D	0	0	0		5/87
Karmex	See Diuron						
Kelevan	-	-	2	II	XXX		5/87
Kieserite	See Magnesium sulphate						
Kyanite	0	0	0	0	0		3/73
Lactic acid	0	1/BOD	1	0	0		3/73 5/77 11/86
Lactonitrile solution (80% or less)	0	3	2	II	XX		10/85
Lanette wax KS	See 1-Tetradecanol						
Lard	0	0	0	0	X		6/83

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Latex (ammonia inhibited)	0	1	0	0	XX		3/73 11/74 7/76
Latex (mercury salts inhibited)	-	-	0	0	XX		7/76
Latex (carboxylated styrene/butadiene copolymer)	See Styrene butadiene rubber latex						
Lauric acid	0	3	0	I	X		10/75 12/80 11/86 5/87 1/88
Lauryl mercaptan	0	-	-	I	XX		2/85
Lauryl methacrylate	0	0	0	I	X		10/75 6/80 12/80 2/85 1/88
L.A.W.S.	See White spirit, low aromatic						
Lead acetate	+	(2)	0	0	XX	Carcinogen	11/79
Lead arsenates	+	3	2	II	XX	Carcinogen	3/73 1/84
Lead arsenites	+	3	(2)	II	XX		3/73 1/84
Lead chromate	0	0	0	II	XX	Carcinogen	1/88 8/88
Lead compounds (soluble, N.O.S.)	+	(3)	(3)	I	XX	Carcinogen	11/79
Lead concentrates (sulphides)	0	0	0	0	0		3/73
Lead cyanide	+	3	(3)	II	XX		3/73 1/84
Lead nitrate	+	1	1	0	0		5/78
Lead ore	See Lead concentrates						
Lead perchlorate	+	1	(1)	I	0		5/78
Lead sulphate, (more than 3% free sulphuric acid)	See Sulphuric acid						
Lead tetraethyl	See Tetraethyl lead						
Lead tetramethyl	See Tetramethyl lead						
Lignin sulphonic acid, salt, solution	0	0	0	0	0		5/84 2/85 10/85 11/86
Ligroin	0	(3)	0	II	XX		5/86
Limestone	0	D	0	0	0		3/73 5/87
Lindane	+	4	3	II	XXX	Carcinogen; Convulsant	3/73 1/84 5/87 8/88
Linoleic acid	0	0	0	0	XX		5/77 11/86
Linolenic acid	0	(0)	0	0	XX		5/77 11/86
Linseed oil	0	0	0	I	XX		6/80 1/84
Liquid sulphur	See Sulphur, molten						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
London purple	See Arsenic compounds, N.O.S.						
Loxanol W	See 1-Tetradecanol						
Magnesia	0	0	0	0	0		3/73
Magnesite	0	0	0	0	0		3/73
Magnesium alkyl salicylate	0	2	0	0	0		1/88
Magnesium alkyl salicylate, overbased, in mineral oil	0	2	0	I	XX		11/86 5/87 1/88
Magnesium arsenate	+	2	2	II	XX	Carcinogen	3/73 1/84
Magnesium chloride	0	0	1	0	0		6/80
Magnesium hydroxide (slurry)	0	0	0	0	0		6/83
Magnesium phosphide	0	3	*	II	XXX	*Hazard from immediate release of highly toxic phosphine	5/77
Magnesium silicofluoride	See Silicofluorides						
Magnesium sulphate	0	0	0	0	0		10/75
Maize (not seed grain)	0	0/BOD	0	0	X		3/73
Malathion	0	4	2	I	XX	ChE inhibitor	3/73 6/80 1/88
Maleic acid	0	1	1	0	0		7/76 5/77 11/86
Maleic anhydride	0	1	2	II	XX		11/79
Malic acid	0	-	(1)	0	0		5/77 11/86
Malonic acid	0	-	1	0	0		5/77 11/86
Margaric acid	See Heptadecanoic acid						
Maneb	0	4	2	II	XX	Teratogen; ChE inhibitor	3/73 6/83 1/84 10/85 11/86 1/88
Manganese concentrates	See Manganese ore						
Manganese ore	0	D	0	0	0		3/73
MCPA	See 2-Methyl-4-chlorophenoxyacetic acid						
Mecarbam	-	4	3	II	XXX		5/87
Medinoterb	-	-	3	I	XXX		5/87
Menazon	-	-	2	I	XX	ChE inhibitor	6/80 1/88
Mephosfolan	0	4	3	II	XXX	High dermal toxicity	5/87
Mercaptoacetic acid	See Thioglycolic acid						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
2-Mercaptobenzothiazol	0	3	2	II	XX	Potent skin sensitizer	10/82 1/84
2-Mercaptobenzothiazol, sodium salt, solution	See 2-Mercaptobenzothiazol						
Mercaptodimethur	See Methiocarb						
Mercuric acetate	+	4	2	II	XXX	Human teratogen	3/73 1/84 10/85
Mercuric ammonium chloride	+	4	4	II	XXX		3/73 1/84
Mercuric arsenate	+	4	(3)	II	XX	Carcinogen	3/73 1/84
Mercuric benzoate	+	4	(2)	II	XX		3/73 1/84
Mercuric chloride	+	4	4	II	XXX		3/73 1/84
Mercuric cyanide	+	4	3	II	XXX		3/73 1/84
Mercuric iodide	+	3	3	II	XX		3/73 1/84
Mercuric nitrate	+	4	(3)	II	XX		3/73 1/84
Mercuric oleate	+	4	(3)	II	XX		11/79 1/84
Mercuric oxide	+	4	3	II	XXX	Neurotoxic; Skin sensitizer	11/79 1/84 8/88
Mercuric oxycyanide	+	4	(3)	II	XXX		3/73 1/84
Mercuric potassium cyanide	+	4	(3)	II	XX		3/73 1/84
Mercuric potassium iodide	+	4	(3)	II	XX		3/73 1/84
Mercuric salicylate	+	4	(3)	II	XX		11/79 1/84 8/88
Mercuric sulphate	+	4	3	II	XX		3/73 1/84
Mercuric sulphide	+	0	(3)	II	XXX	Neurotoxic; Skin sensitizer	8/88
Mercuric thiocyanate	+	4	(3)	II	XX		11/79 1/84
Mercurous gluconate	+	4	(3)	II	XX		3/73 1/84
Mercurous nitrate	+	4	2	II	XX		3/73 1/84
Mercurous sulphate	+	4	(3)	II	XX		3/73 1/84
Mercury, alkyls	See Methyl mercuric chloride						
Mercury bisulphate	See Mercuric sulphate						
Mercury bromides	+	4	(3)	II	XXX		3/73 1/84
Mercury compounds (organic)	See Methyl mercuric chloride						
Mercury nucleate	See Methyl mercuric chloride						
Mesitylene	See 1,3,5-Trimethylbenzene						
Mesityl oxide	0	1	1	I	0		3/73 12/80

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Metam - sodium	0	4	2	II	XX		5/87
Methacrylate mixtures (butyl/decyl/cetyl/ eicosyl)	0	1	0	I	X		9/81 1/84 2/85
Methacrylic acid (inhibited)	0	(1)	(2)	II	XX		11/79 6/80 12/80
Methacrylic resin in 1,2 Dichloroethane soln.	Rated as 1,2 Dichloroethane						
Methacrylonitrile	(T)	1	2	I	X		6/83
Methamidophos	0	(4)	3	II	XXX		5/87
Methanethiol	(T)	4	(2)	II	XXX		6/83 1/84 5/84
Methanal	See Formaldehyde						
Methanoic acid	See Formic acid						
Methanoic acid, amide	See Formamide						
Methanoic acid, propyl ester	See n-Propyl formate						
Methanol	0	0	1	0	0		3/73 11/76 5/77 10/82
Methasulfocarb	-	-	-	-	-		1/88
Methidathion	0	4	3	II	XXX	High dermal toxicity	5/87
Methiocarb	0	4	3	II	XXX		5/87
Methomyl	0	4	3	II	XXX		5/87
2-Methoxy aniline	See ortho-Anisidine						
3-Methoxy-1-butanol	See Butylene glycol monomethyl ether						
3-Methoxy butyl acetate	See Butylene glycol monomethyl ether acetate						
1-Methoxy-2,3-dihydroxy-propane	See Tripropylene glycol, monomethyl ether						
2-Methoxy ethanol	See Ethylene glycol, monomethyl ether						
Methoxy ethylene	See Vinyl methyl ether						
Methoxytriglycol	See Triethylene glycol (mono)methyl ether						
Methyl acetate	0	0	1	0	0		3/73 11/79 1/84
Methyl acetoacetate	0	1	1	I	X		5/86 11/86 1/88
Methyl acetylene propadiene	---------gas---------						7/76
Methyl acrylate	0	3	2	II	XX		3/73 11/79 6/80 1/88
Methyl alcohol	See Methanol						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Methyl allyl alcohol	0	2	(2)	I	X		2/85 5/86 11/86
Methylamine solution (42% or less)	0	2	2	II	XXX	Potent skin sensitizer; Lachrymator; Tested for tainting	6/80 6/83 5/84 5/86 1/88 8/88
Methyl amyl acetate	See sec-Hexyl acetate						
Methyl amyl alcohol	0	(2)	1	I	X		3/73 1/84 1/88
Methyl n-amyl ketone	0	(2)	1	I	X		10/75 12/80 1/88
Methyl iso-amyl ketone	0	(2)	1	I	X		10/75 12/80 1/88
N-Methylaniline	-	-	2	I	X		11/79
Methyl benzene	See Toluene						
Methyl benzoate	0	3	1	I	0		2/85
Methyl bromide	See Bromomethane						
Methyl bromide and ethylene dibromide (liquid mix)	See Ethylene dibromide						
2-Methyl-1,3-butadiene	See Isoprene						
2-Methyl butanal	See 2-Methyl butyraldehyde						
2-Methyl-1-butanol	0	(1)	1	0	0		11/76
2-Methyl-2-butanol	0	0	1	0	0		11/76 10/82
3-Methyl-1-butanol	0	1	1	0	0		10/75 11/76 10/82
3-Methyl-2-butanol	0	(1)	(1)	0	0		11/76 10/82
3-Methyl-2-butanone	See Methyl isopropyl ketone						
2-Methyl butene	See Pentene (all isomers)						
Methyl butenol	0	(1)	1	I	X		2/85 5/86 11/86
Methyl iso-butyl carbinol	See Methyl amyl alcohol						
Methyl butynol	0	1	1	-	-		2/85 5/86 11/86
Methyl tert-butyl ether	0	1	1	0	0		9/81
Methyl n-butyl ketone	0	(1)	1	II	XXX	Neurotoxic; Testicular toxicity	5/86 1/88
Methyl iso-butyl ketone	0	1	1	I	X		3/73 1/84 5/86 11/86 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
2-Methyl butyraldehyde	0	2	1	I	X		10/75 12/80 8/88
3-Methyl butyraldehyde	See iso-Valeraldehyde						
Methyl butyrate	0	(2)	1	I	X		5/86
Methyl chloride	See Chloromethane						
Methyl chloroform	See 1,1,1-Trichloroethane						
Methyl chloroformate	0	3	2	II	XXX		5/78 6/83 8/88
2-Methyl-4-chlorophenoxy-acetic acid	0	2	1	0	0		3/73 1/84 1/88
2-Methyl-4-chlorophenoxy-acetic acid, diethylamine salt, solution	0	2	2	I	X		5/86 11/86
Methyl cyanide	See Acetonitrile						
Methyl cyclohexane	0	3	-	-	-		11/86
Methyl cyclopentadiene dimer	0	(3)	1	I	X		10/75 12/80 10/85 5/86 11/86
Methyl cyclopentadienyl manganese tricarbonyl	-	-	2	I	-		7/76
Methyl cyclopentane	-	3	-	-	-		11/86
4,4-Methylene-dianiline and higher molecular wt. polymers and ortho-Dichlorobenzene	Z	3	2	II	XX		2/85 10/85
Methyl dichloroacetate	0	(2)	(1)	I	X		11/79
Methyl dichlorosilane	0	1	(1)	II	XX		5/78 6/80
N-Methyl dithiocarbamate sodium salt, solution (33% or less)	see Metam-sodium						
Methylene chloride	See Dichloromethane						
Methylene dichloride	See Dichloromethane						
Methyl-1,2-ethanediol	See Ethylene glycol, monomethyl ether						
N-Methyl ethanolamine	0	2	1	I	X		3/73 1/84
2-Methyl-6-ethylaniline	0	2	1	II	XX		10/82 5/84 2/85
1,4-Methyl ethyl benzene	(T)	(2)	0	0	0		5/84 1/88
Methyl ethyl ketone	See 2-Butanone						
2-Methyl-5-ethyl pyridine	(T)	(1)	1	II	XX		3/73 12/80
Methyl formal	See Dimethyl formal						
Methyl formate	0	1	1	I	X		1/84 5/84 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Methyl glycol acetate	See Ethylene glycol, monomethyl ether acetate						
6-Methyl-1-heptanal	See iso-Octaldehyde						
4-Methyl-3-heptanone	See Ethyl iso-amyl ketone						
Methyl heptyl ketone	0	3	1	-	-		5/86 11/86 1/88
2-Methyl-3-hexanone	See Ethyl iso-butyl ketone						
5-Methyl-2-hexanone	See Methyl iso-amyl ketone						
Methyl n-hexyl ketone	0	-	1	I	X		1/88
Methyl hydrazine	0	-	3	II	X		5/78
2-Methyl-2 hydroxy-3-butyne	0	0	1	I	0		1/84 5/84 2/85 10/85
Methyl isocyanate	0	-	2	II	XXX		5/78 2/85 10/85
Methyl mercaptan	See Methanethiol						
Methyl-mercapto-propionaldehyde	-	-	-	-	-		2/85
Methyl mercuric chloride	+	4	4	II	XXX	Human teratogen	1/84
Methyl methacrylate	0	1	1	I	XX	Skin sensitizer	3/73 6/80 1/88
3-Methyl-3-methoxy butanol	0	0	0	I	X		2/85 10/85
3-Methyl-3-methoxy butyl acetate	0	0	0	I	X		2/85 10/85
7-Methyl-3-methylene-1, 6-octadiene	See Myrcene						
1-Methyl naphthalene	T	3	1	0	X		10/75 12/80 11/86 1/88
2-Methyl naphthalene	T	(3)	1	0	X		2/85 11/86 1/88
Methyl naphthalenes	T	(3)	1	0	X		2/85 11/86
1-Methyl-2-nitrobenzene	See ortho-Nitrotoluene						
1-Methyl-3-nitrobenzene	See meta-Nitrotoluene						
1-Methyl-4-nitrobenzene	See para-Nitrotoluene						
2-Methyl pentane	0	3	(0)	0	0		12/80 11/86
2-Methyl-1-pentanol	0	1	1	0	0		11/76
4-Methyl-2-pentanol	See Methyl amyl alcohol						
2-Methyl-3-pentanone	See Ethyl iso-propyl ketone						
4-Methyl-2-pentanone	See Methyl iso-butyl ketone						
2-Methyl pentene	0	2	(1)	0	0		3/73 6/80 5/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
4-Methyl-3-penten-2-one	See Mesityl oxide						
Methyl phenyl dichlorosilane	-	1	(2)	II	XX		6/80 9/81
Methyl phenyl ketone	See Acetophenone						
2-Methyl propanoic acid	See iso-Butyric acid						
2-Methyl-1-propanol	See iso-Butanol						
2-Methyl-2-propanol	See tert-Butanol						
2-Methyl propenoic acid	See Methacrylic acid						
2-Methyl propenoic acid, butyl ester	See n-Butyl methacrylate						
2-Methyl propenoic acid, iso-butyl ester	See iso-Butyl methacrylate						
2-Methyl propenoic acid, dodecyl ester	See Lauryl methacrylate						
2-Methyl propenoic acid, ethyl ester	See Ethyl methacrylate						
2-Methyl propenoic acid, methyl ester	See Methyl methacrylate						
2-Methyl propenoic acid, nonyl ester	See Nonyl methacrylate						
Methyl propionate	0	(1)	1	0	0		6/75 8/88
1-Methyl-4-(2-propyl) benzene	See iso-Propyl toluene						
Methyl n-propyl ether	0	(0)	-	0	0		6/75
Methyl n-propyl ketone	0	0	1	I	X		6/75 2/85 1/88 8/88
Methyl iso-propyl ketone	0	1	1	I	X		6/75 2/85 1/88
Methyl propyl ketone, unspecified	0	1	1	I	X		2/85 1/88
2-Methyl pyridine	T	1	1	II	XX		9/81 10/82 6/83 11/86
3-Methyl pyridine	-	-	-	-	-		11/86
4-Methyl pyridine	T	1	1	II	XX		6/83
N-Methyl pyrrolidone	0	1	0	0	0		5/78 11/79 8/88
Methyl salicylate	(T)	2	2	II	XX	Teratogen	6/75 6/83 10/85 11/86 1/88
Methyl styrene	See Vinyl toluene						
alpha-Methyl styrene	T	3	1	0	X		3/73 11/76 6/80 12/80 5/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Methyl trichlorosilane	0	1	1	II	XX		5/78 6/80
Methyl trinitrobenzene	See Trinitrotoluene						
Methyl trithion	-	4	3	II	XXX		5/87
Metolachlor	0	3	1	I	X		6/83 5/86 11/86 1/88
Mevinphos	0	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor	6/80 5/87
Mexacarbate	-	4	3	I	XX		5/87
Milk	0	0	0	0	0		3/73 9/81
Mirex	+	-	2	I	XX		5/87
Mobam	-	-	2	-	-		5/87
Molasses	0	0	0	0	X		3/73 9/81
Molybdenum pentachloride	0	(2)	(2)	II	XX		11/79
Monoacetin	See Glycol monoacetate						
Monobromoethane	See Bromoethane						
Monobromoethylene	See Bromoethylene						
Monobromomethane	See Bromomethane						
Monochlorodifluoro-methane	---------gas---------						
Monochloroethene	See Vinyl chloride						
Monochloroethylene	See Vinyl chloride						
Monocrotophos	0	4	3	II	XXX	ChE inhibitor	5/87
Monoethanolamine	See Ethanolamine						
Monoethylamine	See Ethylamine						
Monoethylene glycol	See Ethylene glycol						
Mono-2-ethyl hexylamine	See iso-Octylamine						
Monomethylamine	See Methylamine						
Mononitrobenzene	0	2	2	I	XXX		5/78 6/80
Motor fuel anti-knock compounds	See Tetraethyl lead and Tetramethyl lead						10/82
Morpholine	0	1	1	I	0		3/73 7/76
Myrcene	0	1	0	0	0		6/85 8/88
Myristic acid	See Tetradecanoic acid						
Myristyl alcohol	See 1-Tetradecanol						
Nabam	0	4	2	-	-		5/87
Naled	-	4	2	II	XXX		5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Naphthalene	T	3	2	I	X		3/73 6/75 11/79 6/80 11/86
Naphthalene sulphonic acid condensed with formaldehyde, sodium salt, solution	0	1	1	0	0		5/87
Naphtha solvent	See Coal tar naphtha						
Naphthenic acids	(T)	3	1	0	X		3/73 6/80 12/80
alpha-Naphthyl amine	0	3	1	0	XX		3/73 1/84
beta-Naphthyl amine	0	3	1	II	XXX	Human carcinogen	3/73 11/79 1/84
alpha-Naphthylthiourea	0	3	3	II	XXX		3/73 5/87
Naphthyl urea	-	-	-	-	-		7/76
Neodecanoic acid	0	2	1	II	XX		10/85 5/86 11/86 8/88
Neopentanoic acid	See Trimethyl acetic acid						
Nickel concentrates (sulphides)	0	0	0	II	XXX	Human carcinogen	3/73 11/79
Nickel cyanide	+	4	3	II	XX		7/76
Nickel ore	See Nickel concentrates						
Nickel tetracarbonyl	+	4	(3)	II	XXX	Human carcinogen; Teratogen	5/78 6/80 10/85
Nicotine	0	3	3	II	XXX	Carcinogen	7/76 5/87
Nicotine, compounds and preparations N.O.S.	See Nicotine						
Nitric acid (90% or less)	0	2	2	II	X		3/73 1/84
Nitrilotriacetic acid, trisodium salt	0	0	1	1	XX	Carcinogen	2/85 10/85
Nitroanilines	0	2	2	I	XX		7/76 5/78
Nitrobenzene	See Mononitrobenzene						
Nitrobenzene sulphonic acids	0	(2)	(1)	II	XX		11/79
Nitrobenzotrifluorides	Z	(3)	(3)	I	XX		11/79 9/81
Nitrobutanes	0	-	1	I	X		5/78
Nitrochlorobenzenes	See Chloronitrobenzenes						
3-Nitro-4-chlorobenzo trifluoride	Z	(3)	(3)	I	XX		11/79
Nitrocresols	T	(3)	1	I	XX		11/79 1/88 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Nitroethane	0	(1)	1	I	X		6/75 5/78
Nitroglycerine	0	-	2	0	XX		5/78
Nitrohydrochloric acid	0	2	2	II	X		11/76
Nitromethane	0	(1)	1	I	X		5/78
2-Nitrophenol	0	3	1	I	XX		1/84 1/88 8/88
3-Nitrophenol	0	3	2	I	XX		1/84 1/88 8/88
4-Nitrophenol	0	3	2	I	XX		1/84 1/88 8/88
ortho-Nitrophenol	See 2-Nitrophenol						
meta-Nitrophenol	See 3-Nitrophenol						
para-Nitrophenol	See 4-Nitrophenol						
Nitrophenols (mixed isomers)	0	3	2	I	XX		1/84 1/88 8/88
1-Nitropropane	0	(1)	2	II	XX		6/75 5/78 12/80 1/84
2-Nitropropane	0	1	2	II	XX	Carcinogen	3/73 5/78 6/80 1/84 10/85
Nitropropane (60%)/ Nitroethane (40%) (mixture)	0	1	2	II	XX	Carcinogen	5/84 8/88
Nitrosyl chloride	0	2	-	II	XX		5/78
Nitrosyl sulphuric acid	0	2	-	II	XX		11/79
2-Nitrotoluene	See ortho-Nitrotoluene						
3-Nitrotoluene	See meta-Nitrotoluene						
4-Nitrotoluene	See para-Nitrotoluene						
ortho-Nitrotoluene	0	2	1	I	X		3/73 5/78
meta-Nitrotoluene	0	2	1	I	X		5/78 5/84
para-Nitrotoluene	0	2	1	I	X		5/78 5/84
Nitroxylenes	0	4	-	II	XX		7/76 5/78
Nonadecanoic acid	0	0	(0)	0	0		5/77 11/86
n-Nonanal	0	3	-	I	XX		8/88
n-Nonane	0	3	(0)	0	0		12/80 11/86
Nonanoic acid	0	1	1	II	XX		7/76 5/77 5/86 11/86
iso-Nonanoic acid	0	(1)	(1)	II	XX		11/86
Nonanoic/Tridecanoic acid mixtures	0	1	1	II	XX		5/86 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
1-Nonanol	0	2	1	0	X		3/73 11/76 11/79
Nonanone	See Methyl heptyl ketone						
1-Nonene	0	3	(1)	0	0		6/75 6/80 5/84 10/85 11/86
Nonoic acid	See Nonanoic acid						
iso-Nonoic acid	See iso-Nonanoic acid						
iso-Nonyl alcohol	0	2	(1)	-	X		10/82 5/86 8/88
Nonyl methacrylate monomer	0	0	-	-	-		6/80 2/85 10/85 11/86 1/88
Nonyl phenol	Z	4	1	I	X		3/73 1/84
Nonyl phenol poly(4-12) ethoxylate	0	3	1	I	X		10/85
Nonyl phenyl sulphide	-	-	-	-	-		7/76
Nonyl trichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
Norbormide	0	0	2	-	X		5/87
9,12-Octadecadienoic acid	See Linoleic acid						
Octadecanoic acid (Stearic acid)	0	0	0	0	0		5/77 11/86 1/88
Octadecanoic acid, butyl ester	See Butyl stearate						
1-Octadecanol	0	0	0	0	X		3/73 10/75 11/76 12/80 10/82 1/84
Octadecene	0	0	0	0	0		5/84
cis-9-Octadecenoic acid	See Oleic acid						
9,12,15-Octadecatrienoic acid	See Linolenic acid						
Octadecyl trichlorosilane	0	(1)	(1)	II	XX		5/77 6/80
Octadiol	See Trimethyl pentanediol						
n-Octaldehyde	0	3	0	I	X		6/75 6/80 1/84 5/84 8/88
iso-Octaldehyde	0	3	1	I	X		6/80 9/81 6/83 1/84 8/88
Octanal	See n-Octaldehyde						
n-Octane	0	3	(1)	0	0		3/73 10/75 11/86
iso-Octane	0	3	(1)	0	0		3/73 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Octanoic acid (Caprylic acid)	0	1	0	I	X		5/77 11/86 1/88
Octanol	See 2-Ethyl hexan-1-ol						
1-Octanol	0	2	1	0	X		3/73 11/76 11/79
iso-Octanol	0	2	1	0	X		3/73 11/76
2-Octanone	See Methyl n-hexyl ketone						
3-Octanone	See Ethyl n-amyl ketone						
1-Octene	0	3	0	I	X		10/75 6/80 10/85
2-Octene	0	3	0	I	X		2/85 10/85
Octene (all isomers)	0	3	0	I	X		10/85
n-Octyl acetate	0	(1)	1	I	X		6/75 8/88
iso-Octyl alcohol	See iso-Octanol						
iso-Octyl aldehyde	See iso-Octaldehyde						
iso-Octylamine	0	3	2	II	XX		6/80 1/88
n-Octyl chloride	See 1-Chlorooctane						
Octyl decyl adipate	-	0	-	-	-		10/75 6/80 9/81 2/85 10/85
Octyl/Decyl alcohol (mixture)	0	3	1	0	X		6/80
Octyl decyl phthalate	0	0	0	0	XX		10/75 11/79 9/81 2/85
Octyl epoxytallate	-	-	0	-	X		5/86
iso-Octyl nitrate mixture	+	3	0	II	XX	Potent skin sensitizer	2/85 10/85 11/86
Octyl trichlorosilane	0	(1)	(1)	II	XX		5/77 5/80
Oil gas	--------gas---------						5/78
Oleamide	-	-	-	-	-		5/86
Olefins, straight chain, mixtures	0	3	0	0	0		10/85
Olefin mixture (C_6-C_8)	0	3	0	I	X		11/79 6/83 5/84 10/85
Olefins (C_{13}-C_{14})	see Tridecene, Tetradecene mixtures						
Olefins C_{13} and above, all isomers	0	0	0	0	0		10/85
alpha-Olefins (C_6-C_{18}), mixture	0	3	0	0	0		10/85
alpha-Olefins (C_{13}-C_{18})	0	0	0	0	0		6/83 5/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
alpha-Olefins (C_{16}-C_{18})	0	0	0	0	0		11/79 10/82 6/83 5/84 10/85
Oleic acid	0	0	0	0	XX		3/73 5/77 11/86 1/88
Olive oil	0	0	0	0	XX		3/73 5/77 5/78 1/84
Omethoate	0	-	2	I	XX		5/87
Organotin compounds (N.O.S.)	+	4	3	II	XXX	Neurotoxic; Immunotoxic	8/88
Organotin pesticides	+	4	3	II	XXX	Neurotoxic; Immunotoxic	8/88
Osmium tetroxide	0	4	3	II	XXX		11/79 6/80
Oxalates (water soluble)	0	1	1	0	0		11/79
Oxalic acid (10-25%)	0	1	1	0	0		5/77 11/86
Oxamyl	0	4	3	I	XX		5/87
3-Oxobutanoic acid, ethyl ester	See Ethyl acetoacetate						
Oxydemeton-methyl	0	3	3	II	XXX	ChE inhibitor	5/87
Oxydisulfoton	-	4	4	II	XXX		5/87
Palmitic acid	See Hexadecanoic acid						
Palm nut oil	0	0	0	0	XX		6/80 1/84
Palm nut oil fatty acid	0	2	-	-	-		11/86
Palm nut stearin fatty acid	0	0	-	-	-		11/86 8/88
Palm oil	see Palm nut oil						
Palm oil fatty acid methyl ester	0	0	0	0	XX		6/80 8/88
Palm stearin	See Palm oil						
Paraffins (C_{10}-C_{20})	See Alkanes						
Paraffin wax	0	0	0	0	0		1/84
Paraldehyde	0	2	1	I	X		10/75 9/81
Paraoxon	0	4	4	II	XXX	ChE inhibitor	5/87
Paraquat	0	3	3	II	XXX	Delayed lung injury	3/73 1/84 8/88
Parathion	0	4	4	II	XXX	ChE inhibitor	3/73 6/80 6/83
Parathion methyl	0	4	3	II	XXX	ChE inhibitor	5/87
Paroxon	-	-	-	-	-		5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Pentachloroethane	Z	3	2	0	X		3/73 11/74 7/76
Pentachlorophenol	+	4	3	II	XXX	High percutaneous toxicity	5/87 1/88 8/88
Pentadecanoic acid	0	0	(0)	0	0		5/77 6/80 6/83 11/86
Pentadecanol	See Alcohols C_{13} and above						
1-Pentadecene	0	0	0	0	0		5/84
1,3-Pentadiene	0	2	-	-	-		6/80 10/82 5/84 2/85
1,3-Pentadiene-1-carboxy acid	See 2,4-Hexadienoic acid						
1,3-Pentadiene-1-carboxaldehyde	See 2,4-Hexadiene aldehyde						
Pentaethyleneglycol	See Polyethyleneglycol						
Pentaethylenehexamine	0	(1)	1	II	XX		11/86
Pentaethylenehexamine/ Tetraethylenepentamine, mixtures	0	1	1	II	XX		10/85
1-Pentanal	See n-Valeraldehyde						
n-Pentane	0	3	0	0	0		3/73 1/84 11/86
iso-Pentane	0	3	0	0	0		3/73 1/84 11/86
1,5-Pentanedial solution (less than 50% but greater than 5%)	0	1	2	II	XX	Skin sensitizer	10/82 6/83 1/84 5/84
1,5-Pentanedial solution (less than 5%)	0	1	0	II	X	Skin sensitizer	10/82 6/83 1/84 5/84
1-Pentanethiol	See Amyl mercaptan						
Pentanoic acid	0	1	1	II	XX		3/73 6/80 12/80 11/86
Pentanoic acid chloride	See Valeroyl chloride						
1-Pentanol	0	1/BOD	2	II	X		11/76 9/81 10/82
2-Pentanol	0	(1)	1	0	0		11/76 10/82
3-Pentanol	0	(1)	1	I	0		11/76 6/83 1/84
2-Pentanone	See Methyl-n-propyl ketone						
3-Pentanone	See Diethyl ketone						
iso-Pentene	0	2	-	0	0		5/84 2/85 10/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
n-Pentene	See 1- or 2- Pentene						
1-Pentene	0	(2)	(1)	0	0		6/75 6/80 1/84
2-Pentene	0	2	(1)	0	0		6/75 6/80 1/84 5/84
Pentene (all isomers)	0	2	(1)	0	0		10/85
Peracetic acid	0	-	(3)	I	0		5/78
Perchlorethylene	See 1,1,2,2-Tetrachloroethylene						
Perchloric acid (not exceeding 50%)	0	-	-	II	0		5/77
Perchloromethylmercaptan	0	(4)	2	II	XX		7/76
Perlite	0	0	0	0	0		3/73
Petalite	0	0	0	0	0		3/73
Petrol, leaded	Z	3	2	II	XX		6/80 5/84
Petroleum coke	0	0	0	0	0		3/73
Petroleum wax	0	0	0	0	X		5/86
para-Phenetidine	0	(2)	(2)	II	XX		6/75
Phenkapton	-	-	2	I	XX		5/87
Phenol	0	2	2	II	XX	Tested for tainting	3/73 6/80 10/82 8/88
Phenol sulphonic acid	-	-	1	II	X		5/77 8/88
Phenthoate	+	4	2	I	XX		5/87
Phenylacetonitrile	See Benzylcyanide liquid						
Phenylamine	See Aniline						
Phenyl carbylamine chloride	0	-	-	II	XXX		7/76
Phenyl cyanide	See Benzonitrile						
1-Phenyl dodecane	See Dodecyl benzene						
Phenylene diamines	0	3	2	II	XX	Skin sensitizer	7/76 5/86
Phenyl ethane	See Ethyl benzene						
2-Phenyl ethanol	See Phenyl ethyl alcohol						
2-Phenyl ethyl acetate	0	2	1	I	X		6/75 6/83 8/88
Phenyl ethyl alcohol	0	(2)	1	0	0		6/75
Phenyl ethyl cumene	-	-	-	-	-		2/85 1/88
Phenyl ethylene	See Styrene monomer						
Phenyl hydrazine	0	-	2	II	XX		6/75

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Phenyl isocyanate	-	-	1	II	XXX	Lachrymator	11/79 8/88
Phenyl mercuric compounds (N.O.S.)	See Mercuric compounds, organic						
Phenyl mercuric hydroxide	+	(4)	3	II	XXX	Teratogen	5/77 10/85
Phenyl mercuric nitrate (basic)	see Phenyl mercuric hydroxide						
Phenyl methane	See Toluene						
Phenyl methyl ketone	See Acetophenone						
1-Phenyl propane	See n-Propyl benzene						
2-Phenyl propene	See alpha-Methyl styrene						
Phenyl trichlorosilane	0	1	1	II	XX		5/77 6/80 9/81
1-Phenyl tridecane	See Tridecyl benzene						
Phenylxylyl ethane	0	2	1	0	0		6/83 5/84 2/85 1/88
Phorate	0	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor	6/80 5/87
Phorone	See 2,6-Dimethyl-2,5-heptadiene-4-one						
Phorone diamine	see Isophorone diamine						
Phosalone	+	4	2	I	XX	ChE inhibitor	5/87
Phosfolan	0	-	3	II	XXX	ChE inhibitor	5/87
Phosgene	0	-	-	II	XX		5/78
Phosmet	0	4	3	II	XXX	ChE inhibitor; Reproductive toxicity	5/87
Phosphamidon	+	4	3	II	XXX		6/80 5/87
Phosphoric acid	0	1	1	I	0		3/73 5/77
Phosphorus (elemental yellow powder)	+	4	4	II	XXX		3/73 1/84 5/84
Phosphorus oxybromide	0	-	(2)	II	XX		5/77 11/79
Phosphorus oxychloride	0	(1)	2	II	XX		5/77 11/79 1/84
Phosphorus pentachloride	0	(1)	1	II	XX		5/77 11/79
Phosphorus pentoxide	0	1	1	II	XX		5/77 11/79
Phosphorus sulfochloride	See Thiophosphoryl chloride						
Phosphorus thiochloride	See Thiophosphoryl chloride						
Phosphorus tribromide	0	-	1	II	XX		5/77 11/79
Phosphorus trichloride	0	(1)	1	II	XX		6/75 5/77 11/79 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Phosphoryl chloride	See Phosphorus oxychloride						
Phthalic anhydride (molten)	0	2	1	II	XX		3/73 11/79
alpha Picolene	See 2-Methyl pyridine						
Picric acid	See Trinitrophenol						
Picrotoxin	See Cocculus						
Pig iron	0	0	0	0	0		3/73
Pilchard oil	See Fish oil						
Pindone (and salts of)	0	4	2	-	XX		5/87
alpha-Pinene	T	3	1	II	XX	Skin sensitizer Tested for tainting	6/75 12/80 9/81 6/83 11/86 8/88
beta-Pinene	0	3	1	II	XX	Skin sensitizer Tested for tainting	6/75 12/80 9/81 8/88
Pine oil	-	2	-	I	X	Skin sensitizer	2/85 11/86 11/86 8/88
Pirimicarb	0	4	2	0	XX		5/87
Pirimphos-ethyl	+	4	2	I	XX	ChE inhibitor	6/80 5/87
Pitch coke	0	0	0	0	0		3/73
Pivaloyl chloride	0	1	1	I	XX		11/79
Poly(C18-C22)alkyl acrylate in xylene	0	2	1	I	X		11/86
Polyalkylene glycol-monobutyl ether	0	(1)	(1)	I	0		2/85
Polyalkylene oxide polyol	0	2	0	0	0		8/88
Polyaluminium chloride (sol.)	0	0	(0)	0	0		1/84
Polybutene	0	0	0	0	0		6/83
Polychlorinated biphenyls (chlorinated dibenzo-furans less than 1 ppm)	+	4	1	II	XX	Carcinogen	3/73 11/79 11/86
Polyethylene amines	0	(2)	1	0	0		6/80 10/82
Polyethylene glycol	0	0	0	0	0		10/85
Polyethylene glycol dimethyl ether	0	0	0	0	0		10/85
Polyethylene imines (low molecular weight)	-	-	1	I	0		10/82 1/84 5/84
Polyethylene polyamines	See Polyethylene amines						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Polyferric sulphate solution	0	(2)	1	I	X		5/87 1/88
Polymethylene polyphenyl isocyanate	0	0	0	II	XX		7/76 6/83 1/84 5/84
Polyoxyethylene sorbitan mono-oleate	0	(1)	0	0	0		8/88
Polypropylene pentamer	See Olefins C_{13} and above						
Polypropylene glycol	0	1	0	0	0		3/73 5/77 9/81
Polypropylene glycol methyl ether	0	0	1	0	0		10/85
Polysiloxane	0	0	0	0	0		10/85
Polyvinyl benzyl trimethyl ammonium chloride (soln.)	-	-	1	I	0		6/80 10/82 5/84
Potash (potassium minerals)	0	0	0	0	0		3/73
Potassium arsenate	+	3	2	0	0		5/77
Potassium arsenite	+	3	3	0	0		5/77
Potassium bifluoride	0	(2)	2	II	0		5/77
Potassium chlorate	0	1	2	0	0		3/73 1/84
Potassium cuprocyanide	See Sodium cuprocyanide						
Potassium cyanide	0	4	3	II	XX		3/73 1/84
Potassium dichromate (solid and solution)	0	2	2	II	XX	Carcinogen; Teratogen	1/88
Potassium fluoride	0	1	2	0	0		5/77
Potassium hydroxide (sol.)	0	2	2	II	X		10/75 10/82 6/83
Potassium metavanadate	0	2	2	0	0		11/79
Potassium oxide	0	2	2	II	X		5/77
Potassium permanganate	0	3	1	0	X		3/73 1/84
Potassium phosphide	0	3	*	II	XXX	*Hazard from immediate release of highly toxic Phosphine	5/78
Potassium silicate (solution)	0	(1)	(0)	0	0		10/75
Potassium sulphate	0	0	1	0	0		10/75 7/76
Potassium sulphide	0	3	2	II	XX		11/79
Potatoes	0	0/BOD	0	0	X		3/73
Promecarb	0	4	3	II	XXX		5/87
Promurit	-	-	4	-	XXX		5/87

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Propanal	See Propionaldehyde						
Propane	--------gas---------						3/73 9/81 1/84
Propanedioic acid	See Malonic acid						
Propanedioic acid, diethyl ester	See Diethyl malonate						
Propanoic acid, methyl ester	See Methyl propionate						
1-Propanol	See n-Propanol						
2-Propanol	See iso-Propanol						
n-Propanol	0	0	1	0	0		3/73 11/76 5/77
iso-Propanol	0	0	1	0	0		11/76 9/81
iso-Propanolamine	0	2	1	I	X		3/73 10/82 6/83 1/84
n-Propanolamine	0	2	1	I	X		10/82 1/84 5/84
2-Propanone	See Acetone						
Propanoyl chloride	See Propionyl chloride						
Propaphos	0	4	2	II	XXX	ChE inhibitor	5/87
Propenal	See Acrolein						
Propene	---------gas---------						6/80
Propene oxide	See Propylene oxide						
Propenoic acid	See Acrylic acid						
Propenoic acid, amide	See Acrylamide						
Propenoic acid, butyl ester	See n-Butyl acrylate						
Propenoic acid, decyl ester	See Decyl acrylate						
Propenoic acid, ethyl ester	See Ethyl acrylate						
Propenoic acid, 2-ethyl hexyl ester	See 2-Ethyl hexyl acrylate						
Propenoic acid, 2-hydroxy ethyl ester	See 2-Hydroxy ethyl acrylate						
Propenoic acid, 2-hydroxy propyl ester	See 2-Hydroxy propyl acrylate						
Propenoic acid, methyl ester	See Methyl acrylate						
Propenoic acid, 2-methyl nonyl ester	See iso-Decyl acrylate						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Propenoic acid, 2-methyl propyl ester	See iso-Butyl acrylate						
Propenoic acid, nitrile	See Acrylonitrile						
2-Propen-1-ol	See Allyl alcohol						
beta-Propiolactone	0	1	2	II	XXX	Carcinogen	3/73 11/79 12/80
Propionaldehyde	0	2	1	I	X		3/73 1/84 8/88
Propionic acid	0	1	1	0	0		3/73 5/77 11/86
Propionic anhydride	0	2	1	I	X		3/73 1/84
Propionitrile	0	2	3	II	XX		1/84 5/84 2/85 10/85
Propionyl chloride	0	1	1	II	XX		11/79
Propoxur	0	4	3	II	XXX		5/87
Propoxylated polyglycol	0	1	0	0	XX		6/80 10/82
n-Propyl acetate	0	1	0	0	0		7/76 8/88
iso-Propyl acetate	0	(1)	1	I	X		3/73 10/75 7/76 8/88
iso-Propyl acetone	See Methyl isobutylketone						
iso-Propyl acid phosphate	0	-	-	I	-		5/77
n-Propyl amine	0	2	1	II	XXX	Skin sensitizer; Lachymator	3/73 1/84 1/88
iso-Propyl amine	0	2	1	II	XXX	Skin sensitizer; Lachrymator	3/73 1/84 1/88
n-Propyl benzene	0	(2)	(0)	0	0		6/75
iso-Propyl benzene	T	2	1	I	X		7/76 10/82 1/88
Propylene butylene polymer	See Olefins C_{13} and above						
n-Propyl chloride	Z	1	(1)	0	0		12/80 9/81 5/84
iso-Propyl cyclohexane	0	(3)	0	0	0		3/73 1/84 11/86
Propylene chlorohydrin	0	1	2	I	0		6/75 6/83
Propylene dichloride	See 1,2-Dichloropropene						
Propylene dimer	0	(2)	1	0	0		10/85
1,2-Propylene glycol	0	0	0	0	0		1/84 2/85 10/85
Propylene glycol (mono)acrylate	0	3	1	II	XX		6/80 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Propylene glycol monoalkyl ether	For mono ethyl and mono methyl ethers see individual profiles						
Propylene glycol mono ethyl ether	0	(1)	1	I	0		7/76 2/85
Propylene glycol mono methyl ether	0	(1)	0	0	0		9/81
Propylene oxide	0	1	1	II	XX	Carcinogen	3/73 10/75 11/79 12/80 1/84 2/85
Propylene oxide/Ethylene oxide mixture	0	2	2	II	XX	Carcinogen; Neurotoxic; Reproductive toxicity	10/85 8/88
Propylene tetramer	See Dodecene (all isomers)						
Propylene trimer	0	3	1	0	0		3/73 1/84 10/85
iso-Propyl ether	See Di-iso-propyl ether						
n-Propyl formate	0	(0)	1	I	X		6/75 8/88
1-iso-Propyl-4-methyl benzene	See para-Cymene						
iso-Propyl palmitate	0	(0)	(0)	0	X		10/75 12/80
iso-Propyl toluene	0	(2)	1	I	X		11/76 1/88
n-Propyl trichlorosilane	0	1	(1)	II	XX		5/77 6/80
Prothoate	0	4	3	II	XXX	ChE inhibitor	5/87
Pseudo cumene	See 1,2,4-Trimethyl benzene						
Pumice	0	0	0	0	0		3/73
Pyrazophos	+	4	2	0	XX	ChE inhibitor	5/87
Pyrazoxon	-	-	4	-	XXX	ChE inhibitor	5/87
Pyridine	0	1/BOD	1	I	XX	Tested for tainting	3/73 1/84 11/86 8/88
Pyrite residue	0	0	0	0	0		3/73 11/74 7/76
Pyrosulphuryl chloride	0	2	3	II	XX		5/77 11/79
Quicklime	0	1	0	0	0		3/73
Quinalfos	0	(4)	3	II	XXX	ChE inhibitor	1/88
Quinomethionate	See Chinomethionat						
Rape seed oil	0	0	0	0	XX		6/80 1/84
Rice bran oil	0	0	0	0	XX		6/83 1/84
Rosin	0	3	0	II	XX	Skin sensitizer	6/80 10/85 11/86

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Rosin soap (disproportionated solution)	0	3	1	0	X		6/83 11/86
Rotenone	Z	4	2	I	XX		5/87
Rutile	0	0	0	0	0		3/73
Safflower oil	0	0	0	0	XX		6/83 1/84
Salithion	-	4	2	0	XX	ChE inhibitor	5/87
Saltpetre	See Sodium nitrate						
Sand	0	0	0	0	0		3/73
Schradan	0	-	3	II	XXX	Very high dermal tocixity; ChE inhibitor	5/87
Selenic acid	+	3	4	II	XXX		5/77 8/88
Selenium	-	-	(3)	II	XX		8/88
Selenium chloride	-	-	(3)	II	XXX		8/88
Selenium dioxide	-	3	(3)	II	XXX		8/88
Selenium disulphide	-	-	3	II	XXX		8/88
Selenium oxychloride	-	-	3	II	XXX		8/88
Sesame oil	0	0	0	0	XX		6/83 1/84
Shell sand	0	0	0	0	0		3/73
Silicofluorides (solid, N.O.S.)	0	2	2	0	0		11/79
Silicon tetrachloride	0	1	1	II	XX		3/73 5/84
Silicon tetrafluoride	0	2	(2)	II	XX		5/78
Silver arsenite	+	(4)	(3)	0	0		5/77
Silver cyanide	0	4	2	I	X		5/77 6/83
Simazine	0	3	1	I	X		3/73 11/74 1/88
Soda lime	0	1	1	I	X		5/77
Sodium alkyl salicylate, overbased, in mineral oil	0	4	0	I	XX		11/86 5/87 1/88
Sodium aluminate (solution)	0	1	1	I	0		5/77
Sodium alumino silicate (slurry)	0	0	0	0	0		1/84
Sodium ammonium vanadate	0	2	3	0	0		11/79
Sodium arsanilate	+	(3)	(3)	I	X		11/79
Sodium arsenate	+	3	3	II	XX	Carcinogen; Teratogen	3/73 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Sodium arsenite	+	3	3	II	XXX	Human carcinogen; Teratogen	5/77 5/87
Sodium azide	0	3	3	0	XX		5/77
Sodium bisulphate	See Sodium hydrogen sulphate						
Sodium bisulphide	See Sodium hydrosulphide						
Sodium bisulphite	See Sodium hydrogen sulphite						
Sodium borate	See Borax						
Sodium borohydride/sodium hydroxide mixture (soln.)	0	1	2	II	X		10/82
Sodium bromate	0	1	2	I	X		5/86 11/86
Sodium bromide	0	0	1	I	0		10/82
Sodium cacodylate	+	-	1	0	0		5/77 8/88
Sodium carbonate	0	1	0	0	0		3/73
Sodium chlorate	0	0	2	0	0		10/82
Sodium chlorate (solution) (containing up to 50% sodium chlorate)	0	0	2	0	0		10/82
Sodium chloride	0	0	0	0	0		3/73
Sodium chlorite	See Sodium hypochlorite						
Sodium cuprocyanide (solid)	+	4	3	II	XX		11/79 1/88
Sodium cyanide	0	4	3	II	XX		5/77 11/79 5/84 2/85 1/88
Sodium cyanide solutions (30% or less)	See Sodium cyanide						
Sodium dichromate (solution)	See Potassium dichromate						
Sodium dinitro-ortho-cresolate	See 4,6-Dinitro-ortho-cresol						
Sodium fluoride	0	1	2	0	0		7/76
Sodium hydrogen sulphate	0	1	1	I	0		5/77
Sodium hydrogen sulphite (solutions)	0	(2)	1	0	0		5/77 10/85
Sodium hydrosulphide (solutions)	0	3	2	II	XX		7/76
Sodium hydrosulphide/ Ammonium sulphide (mixture)	0	3	2	II	XX		2/85
Sodium hydroxide	0	1	1	II	X		3/73 1/84 10/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Sodium hypochlorite solutions containing more than 20% NaOCl	0	3	2	II	XX	Skin sensitizer	10/75 7/76 10/85 5/87
Sodium hypochlorite solutions containing 20% and less but more than 2% NaOCl	0	2	2	II	XX	Skin sensitizer	10/85 5/87
Sodium hypochlorite solutions containing 2% or less NaOCl	0	1	2	I	X	Skin sensitizer	10/85 5/87
Sodium-2-mercaptobenzo-thiazol	See 2-Mercaptobenzothiazol, sodium salt						
Sodium monoxide	0	1	1	I	0		5/77
Sodium nitrate	0	0	0	0	0		3/73
Sodium nitrite	0	3	2	0	0		5/78 11/79 1/88
Sodium pentachloro-phenate	See pentachlorophenol						
Sodium phenate	0	2	2	II	XX	Tested for tainting	8/88
Sodium phenolate (solid)	See Phenol						
Sodium phosphide	0	3	*	II	XXX	*Hazard from immediate release of highly toxic Phosphine	5/78
Sodium salicylate	0	0	1	II	X	Animal teratogen	2/85 11/86
Sodium salt of glycine (solution)	See Glycine, sodium salt						
Sodium selenate	-	-	4	II	XXX		8/88
Sodium selenite	-	3	4	II	XXX		8/88
Sodium silicate (solution)	0	1	(0)	0	0		10/75
Sodium spent sulphite liquor	See Lignin sulphonic acid, salt, solutions						
Sodium sulphide (solution)	0	3	2	II	XX		5/78 11/79
Sodium sulphite (solution)	0	2	1	0	0		5/78 11/79 10/85 11/86
Sodium thiocyanate	0	(3)	1	0	0		5/86 11/86
Sorbic acid	See 2,4-Hexadienoic acid						
Sorbitol	0	0	0	0	0		3/73 9/81 1/84
Soya bean meal	0	0/BOD	0	0	X		3/73
Soya bean oil	0	0	0	0	XX		6/80 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Sperm oil	0	0	0	0	XX		1/84 2/85
Stannic chloride	0	(2)	(2)	II	XX		11/79
Stannic chloride penta-hydrate	See Stannic chloride						
Stearic acid	See Octadecanoic acid						
Stearyl alcohol	See 1-Octadecanol						
Stone	0	0	0	0	0		3/73
Strontium arsenite	+	3	3	0	0		5/77
Strontium phosphide	0	3	*	II	XXX	*Hazard from immediate release of highly toxic Phosphine	5/78
Strychnine (and salts)	0	4	4	II	XXX	Convulsant	5/77 5/87
Styrene (monomer)	T	2	2	II	XX	Carcinogen; Tested for tainting	10/75 7/76 6/80 10/82 1/84 2/85 1/88 10/85 11/86
Styrene butadiene rubber latex	0	0	0	I	X		6/83 2/85 10/85
Succinic acid	0	-	0	0	0		5/77 11/86
Sugar (brown, raw)	0	0/BOD	0	0	0		3/73
Sulfotep	See Tetraethyl dithiopyrophosphate						
Sulpholane	0	1	1	0	0		10/75 12/80 1/88
Sulphonyl chloride	See Sulphuryl chloride						
Sulphur	0	0	0	0	0		3/73 1/84
Sulphur, molten	See sulphur						
Sulphur chlorides	0	3	N/A	II	XXX		5/77 2/85 10/85 5/86
Sulphur dioxide (solution)	See Sulphurous acid						
Sulphuric acid	0	2	3	II	XX		3/73 1/84 1/88
Sulphurous acid	0	(2)	1	I	0	Column B calculated from COD	5/77 11/79 10/85
Sulphurous oxychloride	See Thionyl chloride						
Sulphur trioxide	See Sulphuric acid						
Sulphuryl chloride	0	(2)	(1)	II	XX		5/77 11/79
Sulprofos	+	4	2	I	XXX	ChE inhibitor	5/87
Sunflower oil	0	0	0	0	XX		6/80 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Superphosphates	0	0	0	0	0		3/73
2,4,5-T	See 2,4,5-Trichlorophenoxyethanoic acid						
Talc rock	0	0	0	0	0		3/73
Tall oil, crude and distilled	0	3	0	II	XX	Skin sensitizer	5/84 2/85 10/85 11/86
Tall oil fatty acid (resin acids less than 10%)	0	(2)	0	II	XX	Skin sensitizer	5/84 2/85 10/85 11/86
Tall oil soap (disproportionated solution)	0	3	1	0	X		6/83 2/85
Tallow	0	0/BOD	0	0	XX		3/73 1/84
Tallow fatty acid	0	(0)	0	0	XX		5/86
Tallow nitrile	-	-	(1)	0	0		5/86
Tannic acid	0	2	1	0	0		10/75 5/77 12/80 10/82 1/84 2/85
Tannin	See Tannic acid						
Tartaric acid	0	-	0	0	0		5/77 11/86
TBP	See Tributyl phosphate						
Temephos	-	4	2	II	XX	ChE inhibitor	5/87
TEPP	See Tetraethyl pyrophosphate						
Terbufos	+	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor	5/87
Terbumeton	0	3	2	I	XX		5/87
1,1,2,2-Tetrabromoethane	Z	2	2	II	XX		11/79 6/83
Tetrabromomethane	See Carbon tetrabromide						
Tetrachloroethane	See 1,1,2,2-Tetrachloroethane						
1,1,2,2-Tetrachloroethane	Z	2	2	II	X		5/77 10/82 6/83
1,1,2,2-Tetrachloro-ethylene	Z	2	0	0	X		5/78 10/82 6/83
Tetrachloromethane	Z	2	1	II	XX	Carcinogen; Teratogen	5/78 11/79 6/80 1/84 11/86
n-Tetradecane	-	0	-	-	-		11/86
Tetradecanoic acid (Myristic acid)	0	0	0	I	X		5/77 11/86 1/88 8/88
1-Tetradecanol	0	0	0	I	X		11/76 11/79 12/80 6/83 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Tetraethyl dichloro-pyrophosphate	-	-	-	-	-		6/80
Tetraethyl dithiopyro-phosphate	0	(4)	3	II	XXX	Very high dermal toxicity; ChE inhibitor	5/77 6/80 8/88
Tetraethylene glycol	0	(0)	0	0	0		10/75 12/80
Tetraethylene pentamine	0	1	1	I	X		7/76 6/80
Tetraethyl lead	Z	3	3	II	XXX		3/73 10/82
Tetraethyl pyrophosphate	0	4	4	II	XXX	Very high dermal toxicity; Neurotoxic	5/77 6/80 5/87
Tetrahydrofuran	0	1	1	0	0		3/73 1/84
Tetrahydronaphthalene	0	2	1	I	X		3/73 1/84
Tetrahydrothiophene-1,1-dioxide	See Sulpholane						
Tetramethyl ammonium hydroxide	0	2	-	II	XX		5/77 12/80 9/81
1,2,3,5-Tetramethyl benzene	0	(2)	0	0	0		11/76 12/80 1/88
Tetramethyl lead	Z	3	3	II	XXX		3/73 10/82
Thallium compounds	+	2	3	II	XXX	Neurotoxic	5/77 5/87 1/88
Thiocarbonyl chloride	See Thiophosgene						
Thioglycolic acid	0	-	2	II	XX		5/77
Thiometon	0	3	2	II	XXX	ChE inhibitor	5/87
Thionazin	0	-	4	II	XXX	Very high dermal toxicity; ChE inhibitor	5/87
Thionyl chloride	0	(2)	-	II	XX		5/77
Thiophosgene	-	-	1	II	XX		11/79
Thiophosphoryl chloride	0	-	-	II	XX		5/77 6/80
Titanium slag	0	0	0	0	0		3/73
Titanium tetrachloride	0	1	1	II	XX		3/73 5/84 2/85
TMA	See Trimethylamine						
TNT	See Trinitrotoluene						
Toluene	0	2	1	II	XX	Neurotoxic; Ototoxic; Tested for tainting	3/73 11/76 11/86 5/87 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Toluene-2,4-diamine	See 2,4-Tolylenediamine						
Toluene diisocyanate	0	2	0	II	XXX	Potent sensitizer	7/76 11/79 12/80 1/84
Toluidines	0	2	2	II	XX		5/77 10/82
ortho-Toluidine	See Toluidines						
2,4-Tolylenediamine	0	2	2	I	XX	Carcinogen	5/77 10/82 1/84 2/85
Toxaphene	See Camphechlor						
Triacetin	See Glyceryl triacetate						
1-Triacontanol	See Myristyl alcohol						
Triadimefon	0	3	2	I	XX		5/87
C_{10}-Trialkyl acetic acid	0	2	1	I	X		6/80
Triamiphos	-	-	3	II	XXX		5/87
Triaryl phosphate (unspecified)	+	4	1	II	XXX	Neurotoxic	10/82 5/87
Triaryl phosphates, isopropylated	+	3	0	II	XXX	Neurotoxic	8/88
Triazophos	0	4	2	I	XX	ChE inhibitor	5/87
Tribromomethane	See Bromoform						
Tributylamine	0	2	2	II	XX		11/79 1/88
Triisobutylene	See Dodecene (all isomers)						
Tributyl phosphate	0	3	1	II	XX		10/75 11/79 6/80
Tributyl tin acetate	+	4	2	II	XXX		1/88
Tributyl tin chloride	+	4	2	II	XXX		1/88
Tributyl tin compounds: (See also individual compounds)	+	4	3	II	XXX	Some compounds are neurotoxic others are immunotoxic	5/87 1/88
Tributyl tin oxide	+	4	2	II	XXX	Immunotoxic	1/88
Triethyl tin	+	4	3	II	XXX	Neurotoxic	1/88
Trimethyl tin	+	4	3	II	XXX	Neurotoxic	1/88
Tricamba	-	-	2	-	XX		5/87
Trichlorfon	0	4	2	I	XX		5/87
Trichloroacetaldehyde	0	1	2	0	0		3/73 7/76 8/88
Trichloroacetic acid	0	2	1	I	XX		11/79
Trichloroacetic acid, chloride	See Trichloroacetyl chloride						

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Trichloroacetyl chloride	0	2	1	II	XX		11/79
1,2,4-Trichlorobenzene	Z	3	1	I	X		10/75 10/82 6/83 1/84
Trichlorobutene	Z	(2)	(2)	0	0		11/79
Trichloroethanal	See Trichloroacetaldehyde						
1,1,1-Trichloroethane	Z	2	1	0	0		3/73 10/75 5/78
1,1,2-Trichloroethane	Z	2	1	0	0		3/73 10/75 5/78
1,1,2-Trichloroethene	See 1,1,2-Trichloroethylene						
1,1,2-Trichloroethylene	Z	2	1	II	XX	Carcinogen	11/79 6/80 1/84
Trichlorofluoromethane	---------gas---------						3/73 5/78
Trichloromethane	Z	2	2	I	XX	Carcinogen	3/73 5/78 6/80 12/80 9/81
Trichloronat	0	4	3	II	XXX	High dermal toxicity; ChE inhibitor	5/87
2,4,5-Trichlorophenoxy-ethanoic acid	0	3	2	0	XXX		3/73 1/84 5/86
1,2,3-Trichloropropane	Z	(2)	2	II	X		10/82 1/84
2,4,6-Trichloro-1,3,5-triazine	See Cyanuric chloride						
1,1,2-Trichloro-1,2,2-trifluoroethane	0	2	0	I	X		10/85
Tricresyl phosphate (less than 1% ortho-isomers)	+	3	1	II	XX	Delayed neurotoxicity	6/80 9/81 10/82
Tricresyl phosphate (more than 1% ortho-isomers)	+	4	1	II	XXX	Delayed neurotoxicity	9/81 10/82
n-Tridecane	0	0	-	-	-		11/86
Tridecanoic acid	0	3	(1)	0	X		5/77 11/86 8/88
1-Tridecanol	0	0	0	0	X		3/73 11/76 12/80 9/81
Tridecene, Tetradecene and mixtures	0	0	0	0	0		6/80 5/84 2/85
Tridecyl benzene	-	-	-	-	-		5/76 11/86 1/88
Triethanolamine	0	1	0	I	0		3/73 1/84
Triethylamine	0	2	3	II	XXX	Skin sensitizer; Lachrymator	3/73 1/84 1/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Triethyl benzene	0	4	0	0	0		10/75 11/76 12/80 5/84 1/88
Triethylene glycol	0	0	0	0	0		3/73 9/81 1/84
Triethylene glycol diethyl butyrate	-	-	1	I	X		5/86
Triethylene glycol monobutyl ether	0	0	0	I	0		6/83
Triethylene glycol monoethyl ether	0	(1)	0	0	0		5/86
Triethylene glycol monomethyl ether	0	(1)	0	0	0		11/75 12/80
Triethyleneimine phosphoric acid	See Tris(1-aziridinyl) phosphine oxide						
Triethylene tetramine	0	1	1	I	XX	Skin sensitizer	10/75 10/85 5/86
Triethyl pentanediol	0	-	(1)	0	0		10/75 6/80 1/84 5/84
Triethyl phosphate	0	1	1	II	XX		10/75 7/76 11/79 6/80
Triethyl tin	See Tributyl tin compounds						
Trimethyl acetic acid	0	1	1	I	X		9/81 10/82 11/86
Trimethylamine	0	2	2	II	XXX	Skin sensitizer; Lachrymator	5/78 1/88
1,2,3-Trimethyl benzene	0	(3)	0	I	X		7/76 12/80 9/81 1/88
1,2,4-Trimethyl benzene	0	3	0	I	X		7/76 6/80 9/81 1/88
1,3,5-Trimethyl benzene	0	(3)	0	I	X		7/76 9/81 1/88
Trimethyl chlorosilane	0	1	(1)	II	XX		5/78 6/80
Trimethyl cyclohexylamine	0	(2)	(2)	I	XX		11/79
2,2,4-Trimethylene diamine	See 1,3-Diaminopropane						
2,4,4-Trimethyl hexamethylene diamine	0	(1)	(1)	I	XX		11/79
Trimethyl hexamethylene diisocyanate	0	3	-	I	X		11/79 12/80 10/82
Trimethylol propane	0	0	0	0	0		7/76 12/80
Trimethylol propane polyethoxylate	0	1	0	0	0		10/85
Trimethyl pentanediol	0	-	(1)	0	0		10/75 12/80

Substances	A	B	C	D	E	Remarks	Considered/ Revised
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	0	2	1	0	0		5/78 11/79 10/82
Trimethyl phosphite	0	-	1	0	0		1/84 5/84 2/85 10/85
2,4,4-Trimethylpent-2-ene	See Diisobutene						
Trimethyl tin	See Tributyl tin compounds						
1,3,5-Trinitrobenzene	0	-	2	-	X		5/78
2,4,6-Trinitrophenol	0	3	(2)	II	XX		5/78 8/88
2,4,6-Trinitrotoluene	0	3	1	II	XX		5/78
Trioxane-2,4,6-trimethyl	See Paraldehyde						
Triisooctyl trimellitate	-	-	-	-	-		5/86
Triphenyl tin compounds (other than Fentin acetate and Fentin hydroxide)	+	4	-	-	-		5/87
Triisopropanolamine	0	0	1	II	X		7/76 6/80 10/82
Tripropylamine	0	(2)	2	II	XXX	Lachrymator	1/88
Tripropylene glycol	0	0	0	0	0		3/73 9/81 1/84
Tripropylene glycol monomethyl ether	0	(1)	1	I	0		10/75 7/76
Tripropylene glycol monomethyl ether acetate	0	(1)	1	I	0		7/76
Triisopropylated phenyl phosphates	-	-	0	0	0		5/87
Trisodium nitrilotriacetate solution	See Nitrilotriacetic acid, trisodium salt						
Trisodium salt of N-hydroxyethylethylene diamine triacetic acid	See N-Hydroxyethylethylene diamine triacetic acid, trisodium salt						
Tris(1-aziridinyl) phosphine oxide (solution)	0	-	3	II	XX	Carcinogen	11/79 11/86
Trisodium salt of N-hydroxy diamine triacetic acid	-	-	-	-	-		10/82
Tritolyl phosphate	See Tricresyl phosphate						
Trixylenyl phosphate	+	3	(1)	II	XXX		10/75 7/76 12/80 9/81 10/82
Tung oil	0	0	0	0	XX		6/83 1/84
Turpentine (wood)	T	2	1	II	XX		3/73 1/84

Substances	A	B	C	D	E	Remarks	Considered/ Revised
n-Undecane	0	0	(1)	0	0		10/75 1/84 11/86
n-Undecanoic acid	0	3	(1)	I	XX		5/77 11/86 8/88
1-Undecanol	0	3	1	I	X		11/79 2/85
1-Undecene	0	3	(1)	0	0		6/80 1/84 10/85
Urea	0	0/BOD	0	0	0		3/73 1/84 10/85
Urea solutions	See Urea						
Urea, solution containing aqueous ammonia	0	2	1	I	X		1/84
Urea/Ammonium mono and dihydrogen phosphate/ Potassium chloride solution	0	1	0	0	0		5/87
Urea, ammonium nitrate solutions	0	1	1	0	0		9/81 1/84
Urea, ammonium phosphate solutions	0	1	0	0	0		9/81
Urea-formaldehyde resin solution	0	0	1	0	0		10/85
Urea resin solutions	See Urea-formaldehyde resin solution						
USAF CB-35	See Thioglycolic acid						
n-Valeraldehyde	0	2	1	I	X		10/75 6/80 12/80 8/88
iso-Valeraldehyde	0	2	1	II	XX		9/81 10/82 1/84 8/88
Valeric acid	See Pentanoic acid						
Valeroyl chloride	0	1	(1)	II	XX		11/79 6/83
Valeryl chloride	See Valeroyl chloride						
Vamidothion	0	-	3	II	XXX	ChE inhibitor	5/87
Vanadic anhydride	See Vanadium pentoxide						
Vanadium oxytrichloride	0	(2)	2	II	XX		11/79
Vanadium pentoxide	0	2	4	II	XX		11/79
Vanadium tetrachloride	0	(2)	2	II	XX		11/79
Vanadium trichloride	0	(2)	2	II	XX		11/79
Vanadium trioxide	0	(2)	2	I	X		11/79
Vegetable oil N.O.S.	0	0	(1)	I	XX		1/84
Vegetable protein solution, hydrolyzed	0	0	0	0	0		10/85

Substances	A	B	C	D	E	Remarks	Considered/ Revised
VCM	See Vinyl chloride						
Vermiculite (natural)	0	0	0	0	0		6/80
Vinyl acetate	0	2	1	0	0		6/80 1/84
Vinyl acetate, fumarate copolymer	-	-	-	-	-		5/86
Vinyl benzene	See Styrene monomer						
Vinyl chloride (inhibited)	0	N/A	N/A	II	XXX	Gas; Human carcinogen; Teratogen	10/75 6/80 12/80 9/81 1/84
Vinyl cyclohexene	0	-	1	0	0		2/85
Vinyl ester of C_{10} trialkyl acetic acid	See Vinyl neodecanoate						
Vinyl ethyl ether	0	2	0	0	XX	Explosive	10/75 6/80
Vinylidene chloride	Z	1	2	II	XX	Carcinogen	11/74 10/75 6/80 9/81
Vinyl methyl ether	0	-	1	0	0		10/75 6/80 1/84 5/84
Vinyl neodecanoate	0	3	0	II	X		6/80 5/84 2/85 10/85 5/86
Vinyl toluenes	T	3	1	I	X		1/84 2/85 10/85 11/86 1/88
Vinyl trichloride	See 1,1,2-Trichloroethylene						
Vinyl trichlorosilane	0	(1)	1	II	XX		5/78 6/80
Warfarin	0	4	2	II	XXX	Teratogen	3/73 11/74 7/76 5/87
Water gas	----------gas----------						5/78
White spirit, low (15-20%) aromatic	Z	3	1	II	X		6/80 10/82 6/83 1/84 10/85
Wine	0	0	0	0	0		3/73 9/81 1/84
Woodbark	0	O/D/ BOD	0	0	0		3/73
Wood creosote	See Creosote (wood tar)						
Wood pulp	0	O/D/ BOD	0	0	X		3/73
Xylene (mixed isomers)	0	2	1	I	X	Tested for tainting	3/73 12/76 5/77 5/87 1/88
2,3-Xylenol	T	2	2	I	XX		10/82 8/88
2,4-Xylenol	T	2	1	I	XX		10/82 8/88

Substances	A	B	C	D	E	Remarks	Considered/ Revised
2,5-Xylenol	T	2	2	I	XX		10/82 8/88
2,6-Xylenol	T	2	2	I	XX		10/82 8/88
3,4-Xylenol	T	2	2	I	XX		10/82 8/88
3,5-Xylenol	T	2	2	II	XX		10/82 8/88
Xylenols (mixtures)	T	2	2	II	XX		10/75 12/80 10/82 8/88
Xylidines	0	2	1	II	XX		5/77
Xylyl bromide	0	-	-	-	-		5/77
Zinc arsenate and arsenite (solid mixtures)	+	3	3	-	-		5/77
Zinc bromide/calcium bromide solutions	See Calcium bromide/Zinc bromide solutions						
Zinc chloride	+	3	2	0	0		5/77
Zinc concentrates (sulphides)	0	0	0	0	0		3/73
Zinc cyanide	+	4	3	I	0		5/77
Zinc dialkyl dithio-phosphate	-	-	-	-	-		7/76 6/80
Zinc ore (sulphides)	See Zinc concentrates (sulphides)						
Zinc phosphide	+	3	3	II	XX		5/77 11/79
Zinc silicofluoride	See Silicofluorides						
Zircon	0	0	0	0	0		3/73
Zirconium tetrachloride	0	1	1	I	XX		11/79

LUBE OIL ADDITIVES

	A	B	C	D	E
Alkaryl polyether (C_9-C_{20})	0	3	1	II	XX
Alkyl amine, alkenyl acid ester mixture	0	1	1	I	XX
Alkyl dithio thiadiazole (C_6-C_{24})	0	1	0	0	X
Alkyl ester copolymer (C_6-C_{18})	0	0	-	-	-
Alkyl phenol sulphide (C_8-C_{40})	-	-	-	-	-
Aryl polyolefin (C_{11}-C_{50})	0	0	-	0	XX
Barium long chain alkaryl sulphonate (C_{11}-C_{50})	-	3	1	0	0
Barium long chain alkyl phenate sulphide	-	-	0	I	XXX
Calcium long chain alkaryl sulphonate (C_{11}-C_{50})	0	0	0	I	XX
Calcium long chain alkyl phenate (C_8-C_{40})	-	-	-	-	-
Calcium long chain alkyl phenate sulphide (C_8-C_{40})	0	1	0	I	XXX
Calcium alkyl phenol sulphide, polyolefin phosphorosulphide mixture	-	4	0	0	XX
Calcium long chain alkyl salicylate (C_{13+})	0	2	0	I	XX
Long chain alkaryl polyether (C_{11}-C_{20})	0	2	1	II	XX
Long chain alkaryl sulphonic acid (C_{16}-C_{60})	0	0	0	II	XX
Magnesium long chain alkaryl sulphonate (C_{11}-C_{50})	0	0	0	0	XX
Magnesium long chain alkyl phenate sulphide (C_8-C_{20})	-	-	-	-	-
Magnesium long chain alkyl salicylate (C_{11+})	0	2	0	I	XX
Olefin/Alkyl ester copolymer (molecular weight 2000+)	0	0	-	-	XXX
Polyolefin amide alkeneamine (C_{28+})	0	0	0	0	XXX
Polyolefin amide alkeneamine borate (C_{28}-C_{250})	0	0	0	I	XXX
Polyolefin amide alkylene amine polyol	0	0	0	I	XXX
Polyolefin phenolic amine (C_{28}-C_{250})	0	0	0	I	XX
Polyolefin phosphoro sulphide - barium derivative (C_{28}-C_{250})	0	2	1	0	0
Poly alkyl methacrylate (C_1-C_{20})	-	-	-	-	-
Polyether (molecular weight 2000+)	0	1	-	-	-
Polyolefin (molecular weight 300+)	0	0	0	0	0
Polyolefin ester (C_{28}-C_{250})	0	0	0	0	XXX
Sulpho hydrocarbon (C_3-C_{88})	0	1	0	0	XX

Sulpho hydrocarbon, long chain alkyl amine mixture	0	3	0	-	XX
Zinc alkaryl dithiophosphate (C_7-C_{16})	+	(2)	1	II	XX
Zinc alkyl dithiophosphate (C_3-C_{14})	+	3	1	II	XX

TRADE-NAMED SUBSTANCES

Substances	A	B	C	D	E	Remarks	Considered/ Revised
Alphanol 79	0	2	(1)	0	X		5/78 11/79
Cardura E10	0	3	1	II	XX		6/80 10/82
Brake fluid DOT 3/400) Brake fluid DOT 3/500)	See Poly(2-8)alkylene (C_2-C_3) glycols/Polyalkylene glycol (C_2-C_{10}) monoalkyl (C_1-C_4) ethers and their borate esters						
Dilinevol phthalate 79	See Dialkylphthalate (C_7-C_9)						
Dilinevol phthalate 911	See Dialkylphthalate (C_9-C_{11})						
Dobane JN	0	0	(1)	0	0		11/79
Dobanol 91	0	3	1	0	0		5/78 11/79
Dowanol 3H Glycol Ether	0	0	1	II	X		
EXXSOL D80 (dearomatized white spirit, aromatics (less than 1%)	0	4	1	II	X		11/86
Hitec 320	0	3	0	II	XX		8/88
Hitec 686	0	4	0	I	XX		8/88
Isopar B (isoparaffin solvent, C_6-C_7)	0	3	0	I	X		11/86
Isopar M (isoparaffin solvent, C_{13}-C_{14})	0	4	0	II	XX		11/86
Kronitex 50) Kronitex 100)- Kronitex 200)	+	3	0	II	XXX	Neurotoxic	8/88
Laktane (light naphtha solvent, aromatics less than 25%)	T	2	-	II	XX	Neurotoxic	11/86
Lubad 321	T	3	3	0	X		11/86
MCP 121 (polycarboxylic ester)	0	0	0	I	X		11/86 1/88
Mobilad G 201 (gear oil package)	T	3	0	I	XX		11/86 1/88
Mobilad G 210	(T)	(3)	-	-	-		1/88
Mobilad G 221 (lube oil additive)	(T)	3	0	I	XXX		1/88
Mobilad G 521	(T)	-	-	-	-		1/88
Nylon 6:6 Salt	See Hexamethylene diamine adipate						

Substances	A	B	C	D	E	Remarks	Revised
OGA 472, OGA 478, ORA 502, ORA 702, AO 5301 (Polyolefine amine)	0	(2)	0	I	X		1/88
OGA 480)- (Polyether OGA 492) amine)	0	2	1	II	XX		8/88
OLOA 857 E-1	+	(2)	-	I	X		1/88
OLOA 2939	0	0	0	0	0		11/86
OLOA 2564A) (Polyolefin OLOA 2564B)- anhydride) OLOA PIBSA)	0	1	0	I	XXX		8/88
OLOA 374A	0	0	0	I	XXX		8/88
Organic Amine 70	See Aminoethyldiethanolamine/ Aminoethanolamine, water solution						
Petrinex 4R	+	3	(2)	II	XX		11/79
Resin feed C_9	T	3	-	II	XXX		1/88
Shell Sols A	(T)	3	1	0	X		
Shell Sols K	0	0	0	I	X		
SHF 61 (Polyolefin)	0	0	0	0	0		11/86
Solvesso 100 (aromatic solvent, aromatics more than 80%	T	3	-	-	-		
Synperonic A_3	See Alcohol C_{13}-C_{15} poly(3) ethoxylates						
Synperonic A_{11}	See Alcohol C_{13}-C_{15} poly(11) ethoxylates						
Synperonic NP_4 to NP_{12}	See Nonylphenol (4-12)ethoxylates						
Tergitol 15 S9	0	-	1	I	XX		11/79 6/80
Trioxitol	0	0	0	0	0		5/78
Veova 10	See Vinyl ester of C_{10} trialkyl acetic acid						
Versatic 10	0	2	1	I	X		6/80

HAZARD PROFILES FOR CLASSES OF COMPOUNDS

NOTE: For the use of the following lists particular attention is drawn to the note set out at page 1 of this document.

The classes of compounds are presented in the following order:

1 ALCOHOLS

2 ALKANES AND CYCLOALKANES

3 ALKENES AND CYCLOALKENES

4 BENZENE AND ALKYL BENZENES

5 CHLOROSILANES

6 CARBOXYLIC ACIDS

7 GLYCOLS AND THEIR DERIVATIVES

8 HALOGENATED COMPOUNDS (EXCLUDING FLUOROCOMPOUNDS):

ALIPHATIC COMPOUNDS

AROMATIC COMPOUNDS

9 ORGANOPHOSPHORUS COMPOUNDS (EXCLUDING PESTICIDES)

10 ESTERS:

FORMATES

ACETATES AND ACETOACETATES

PROPIONATES, BUTYRATES, etc.

ACRYLATES AND METHACRYLATES

ESTERS OF HYDROXY CARBOXYLIC ACIDS AND OF ALIPHATIC DIBASIC ACIDS

ESTERS OF AROMATIC DIBASIC ACIDS (INCLUDING PHTHALATES)

11 KETONES

12 SUBSTITUTED PHENOLS

13 AMINES

14 PESTICIDES

15 ALDEHYDES

1 Alcohols

Substances	A	B	C	D	E	Remarks
Methanol	0	0	1	0	0	
Methyl alcohol	See Methanol					
Ethanol	0	0	0	0	0	
Ethyl alcohol	See Ethanol					
n-Propanol	0	0	1	0	0	
iso-Propanol	0	0	1	0	0	
Propyl alcohol	See n-Propanol					
Allyl alcohol	0	3	2	II	XXX	Potent lachrymator; Latent skin visicator
n-Butanol	0	0	1	I	X	Tested for tainting
iso-Butanol	0	0	1	I	X	
sec-Butanol	0	0	0	0	X	
tert-Butanol	0	0	1	0	0	
Methyl allyl alcohol	0	2	(2)	I	X	
Butyl alcohol	See n-Butanol					
1-Pentanol	0	1/BOD	2	II	X	
2-Pentanol	0	(1)	1	0	0	
3-Pentanol	0	(1)	1	I	0	
2-Methyl-1-butanol	0	(1)	1	0	0	
3-Methyl-1-butanol	0	1	1	0	0	
2-Methyl-2-butanol	0	0	1	0	0	
3-Methyl-2-butanol	0	(1)	(1)	0	0	
Methyl butenol	0	(1)	1	I	X	
Methyl butynol	0	1	1	-	-	
n-Amyl alcohol	See 1-Pentanol					
iso-Amyl alcohol	See 3-Methyl-2-butanol and 3-Methyl-1-butanol					
sec-Amyl alcohol	See 2-Pentanol and 3-Pentanol					
tert-Amyl alcohol	See 2-Methyl-2-butanol					
1-Hexanol	0	1	1	II	XX	
2-Methyl-1-pentanol	0	1	1	0	0	
2-Ethyl-1-butanol	0	1	1	I	X	
Methyl amyl alcohol	0	(2)	1	I	X	

Substances	A	B	C	D	E	Remarks
1-Heptanol	0	2	1	I	0	
2-Heptanol	0	(2)	1	I	0	
3-Heptanol	0	(2)	1	I	0	
1-Octanol	0	2	1	0	X	
2-Ethyl hexyl alcohol	0	2	1	0	X	
iso-Octanol	0	2	1	0	X	
1-Nonanol	0	2	1	0	X	
iso-Nonanol	0	2	(1)	-	X	
1-Decanol	0	3	1	0	X	
iso-Decanol, mixed isomers	0	3	0	0	X	
1-Undecanol	0	3	1	I	X	
1-Dodecanol	0	3	0	0	X	
1-Tridecanol	0	0	0	0	X	
1-Tetradecanol	0	0	0	I	X	
1-Octadecanol	0	0	0	0	X	
Trimethyl pentanediol	0	-	(1)	0	0	
Triethyl pentanediol	0	-	(1)	0	0	
1,2,6-Hexanetriol	0	0	0	0	0	
Benzyl alcohol	0	2/BOD	1	I	XX	
Phenyl ethyl alcohol	0	(1)	1	0	0	
Cyclohexanol	0	2	1	II	X	
Alcohol mixtures:						
Alcohols C_1-C_3	0	0	1	0	0	
Alcohols C_4-C_6	0	1	2	II	X	
Alcohols C_7-C_9	0	2	1	0	X	
Alcohols C_8-C_{10}	0	3	1	0	X	
Alcohols C_{10}-C_{12}	0	3	1	0	X	
Alcohols C_{12}-C_{15}	0	3	1	0	X	
Alcohols C_{13} and above	0	0	0	0	X	
Neodols	See Alcohols C_{12}-C_{15}					

2 Alkanes and Cycloalkanes

Substances	A	B	C	D	E	Remarks
Ethane			gas			
Propane			gas			
Butane			gas			
n-Pentane	0	3	0	0	0	
iso-Pentane	0	3	0	0	0	
n-Hexane	0	3	0	II	X	Delayed neurotoxicity
2-Methyl pentane	0	3	(0)	0	0	
n-Heptane	0	3	0	0	0	
n-Octane	0	3	(1)	0	0	
iso-Octane	0	3	(1)	0	0	
n-Nonane	0	3	(0)	0	0	
n-Decane	0	0	(1)	0	0	
n-Undecane	0	0	(1)	0	0	
n-Dodecane	0	0	(1)	0	0	
n-Tridecane	0	0	-	-	-	
n-Tetradecane	-	0	-	-	-	
n-Heptadecane	0	0	(0)	0	0	
Cyclopentane	0	3	(1)	I	X	
Cyclohexane	0	3	1	II	X	
Cycloheptane	0	(3)	(1)	II	X	
Methyl cyclohexane	0	3	-	-	-	
Ethyl cyclohexane	0	(3)	1	0	0	
iso-Propyl cyclohexane	0	(3)	0	0	0	
Decahydronaphthalene	0	(1)	1	0	X	

3 Alkenes and Cycloalkenes
(In this table the difunction compounds are not separately grouped)

Substances	A	B	C	D	E	Remarks
Ethene			gas			
Propene			gas			
Butene			gas			
1,3-Butadiene			gas			
1-Pentene	0	(2)	(1)	0	0	
2-Pentene	0	2	(1)	0	0	
iso-Pentene	0	(2)	-	0	0	
Pentene (all isomers)	0	2	(1)	0	0	
1,3-Pentadiene	0	2	-	-	-	
Isoprene	0	2	0	I	0	
1-Hexene	0	2	(1)	0	0	
2-Methyl pentene	0	2	(1)	0	0	
1-Heptene	0	2	(1)	0	0	
1-Octene	0	3	0	I	X	
2-Octene	0	3	0	I	X	
Octene (all isomers)	0	3	0	I	X	
Di-iso-butene	See Octene (all isomers)					
Di-iso-butylene	See Octene (all isomers)					
Nonene	0	3	(1)	0	0	
Propylene dimer	0	(2)	1	0	0	
Propylene tetramer	See Dodecene (all isomers)					
Propylene trimer	0	3	1	0	0	
1-Decene	0	3	(1)	0	0	
Dipentene	0	2	1	I	X	
1-Undecene	0	3	(1)	0	0	
Dodecene (all isomers)	0	(3)	(1)	I	0	
Tridecene, Tetradecene and mixtures	0	0	0	0	0	
1-Pentadecene	0	0	0	0	0	
Tri-iso-butene	See Dodecene (all isomers)					
Tri-iso-butylene	See Dodecene (all isomers)					

Substances	A	B	C	D	E	Remarks
Propylene tetramer	See Dodecene (all isomers)					
Hexadecene	0	0	0	0	0	
Heptadecene	0	0	0	0	0	
Octadecene	0	0	0	0	0	
Divinyl acetylene	0	(2)	0	0	0	
alpha-Pinene	T	3	1	II	XX	Skin sensitizer; Tested for tainting
beta-Pinene	0	3	1	II	XX	Skin sensitizer; Tested for tainting
Cycloalkenes						
Cyclopentene	0	(3)	1	0	0	
1,3-Cyclopentadiene, molten	0	3	2	II	XXX	
Methyl cyclopentadiene dimer	0	(3)	1	I	X	
Alkene mixtures:						
Olefins, straight chain mixtures	0	3	0	0	0	
Olefins (C_6-C_8)	0	3	0	0	0	
Olefins (C_{13}-C_{14})	0	0	0	0	0	
Olefins C_{13} and above (all isomers)	0	0	0	0	0	
Tridecene and Tetradecene (mixture)	See Olefins (C_{13}-C_{14})					
alpha-Olefins (C_{13}-C_{18})	0	0	0	0	0	
alpha-Olefins (C_{16}-C_{18})	0	0	0	0	0	

4 Benzene and Alkyl Benzenes

Substances	A	B	C	D	E	Remarks
Benzene	0	2	1	II	XXX	Human carcinogen; Haemotoxic
Toluene	0	2	1	II	XX	Neurotoxic; Ototoxic; Tested for tainting
Ethyl benzene	0	2	1	I	X	
Xylene (ortho-)	0	2	1	I	X	Tested for tainting
Xylene (meta-)	0	2	1	I	X	Tested for tainting
Xylene (para-)	0	2	1	I	X	Tested for tainting
Xylene, mixed isomers	0	2	1	I	X	Tested for tainting
Styrene (monomer)	T	2	2	II	XX	Carcinogen; Tested for tainting
Iso-propyl benzene	T	2	1	I	X	
1,4-Methyl ethyl benzene	(T)	(2)	0	0	0	
1,2,3-Trimethyl benzene (hemimellitene)	0	(3)	0	I	X	
1,2,4-Trimethyl benzene (pseudocumene)	0	3	0	I	X	
1,3,5-Trimethyl benzene (mesitylene)	0	(3)	0	I	X	
Vinyl toluenes	T	3	1	I	X	
Cumene	See Iso-propyl benzene					
Ethyl toluene	See 1,4-Methyl ethyl benzene					
alpha-Methyl styrene	See Vinyl toluenes					
Butyl benzene (all isomers)	(T)	(4)	1	I	X	
iso-Propyl toluene	0	(2)	1	I	X	
Diethyl benzene (mixed isomers)	0	2	1	I	X	
1,2,3,5-Tetramethyl benzene	0	(2)	0	0	0	
p-tert-Butyl toluene	T	3	1	I	X	
Di-iso-propylbenzene	(T)	4	0	0	0	
Triethyl benzene	0	4	0	0	0	
Dodecyl benzene	0	0	-	-	-	
Tridecyl benzene	-	-	-	-	-	

Substances	A	B	C	D	E	Remarks
Phenylxylyl ethane	0	2	1	0	0	
Phenyl ethyl cumene	-	-	-	-	-	
Alkyl (C_9-C_{17}, straight or branched) benzenes	To be revised					

5 Chlorosilanes

Substances	A	B	C	D	E	Remarks
Trimethyl chlorosilane	0	1	(1)	II	XX	
Methyl dichlorosilane	0	1	(1)	II	XX	
Ethyl dichlorosilane	0	1	(1)	II	XX	
Dimethyl dichlorosilane	0	1	1	II	XX	
Diethyl dichlorosilane	0	1	1	II	XX	
Methyl trichlorosilane	0	1	1	II	XX	
Ethyl trichlorosilane	0	1	1	II	XX	
Vinyl trichlorosilane	0	(1)	1	II	XX	
Propyl trichlorosilane	0	1	(1)	II	XX	
Allyl trichlorosilane (stabilized)	0	(1)	(1)	II	XX	
Butyl trichlorosilane	0	1	(1)	II	XX	
Amyl trichlorosilane	0	(1)	1	II	XX	
Hexyl trichlorosilane	0	(1)	1	II	XX	
Octyl trichlorosilane	0	(1)	(1)	II	XX	
Nonyl trichlorosilane	0	(1)	(1)	II	XX	
Dodecyl trichlorosilane	0	(1)	(1)	II	XX	
Hexadecyl trichlorosilane	0	(1)	(1)	II	XX	
Octadecyl trichlorosilane	0	(1)	(1)	II	XX	
Methyl phenyl dichlorosilane	-	1	(2)	II	XX	
Ethyl phenyl dichlorosilane	-	(1)	(1)	II	XX	
Diphenyl dichlorosilane	0	(1)	(1)	II	XX	
Dibenzyl dichlorosilane	-	(1)	(1)	II	XX	
Phenyl trichlorosilane	0	1	1	II	XX	
Chlorophenyl trichlorosilane	(+)	-	(1)	II	XX	
Dichlorophenyl trichlorosilane	(+)	-	(1)	II	XX	

Substances	A	B	C	D	E	Remarks
Cyclohexyl trichlorosilane	0	(1)	(1)	II	XX	
Cyclohexenyl trichlorosilane	0	(1)	1	II	XX	

6 Carboxylic Acids

Substances	A	B	C	D	E	Remarks
Formic acid	0	1	1	I	X	
Acetic acid	0	1	1	I	X	
Propionic acid	0	1	1	0	0	
Lactic acid	0	1/BOD	1	0	0	
n-Butyric acid	0	1	1	II	XX	
iso-Butyric acid	0	1	2	II	XX	
n-Pentanoic acid	0	1	1	II	XX	
Trimethyl acetic acid	0	1	1	I	X	
Neopentanoic acid	See Trimethylacetic acid					
n-Hexanoic acid (Caproic acid)	0	1	1	I	X	
2,4-Hexadienoic acid	0	1	0	I	X	
1,3-Pentadiene-1-carboxy acid	See 2,4-Hexadienoic acid					
Sorbic acid	See 2,4-Hexadienoic acid					
n-Heptanoic acid	0	1	0	I	X	
n-Octanoic acid (Caprylic acid)	0	1	0	I	X	
2-Ethyl hexanoic acid	0	1	1	I	0	
n-Nonanoic acid	0	1	1	II	XX	
iso-Nonoic acid	0	(1)	(1)	II	XX	
n-Decanoic acid (Capric acid)	0	2	0	II	XX	
2,2-Dimethyl octanoic acid	0	(2)	1	II	XX	
Neodecanoic acid	0	2	1	II	XX	
n-Undecanoic acid	0	3	(1)	I	XX	
n-Dodecanoic acid (Lauric acid)	0	3	0	I	X	
Tridecanoic acid	0	3	(1)	0	X	
Tetradecanoic acid (Myristic acid)	0	0	0	I	X	
Pentadecanoic acid	0	0	(0)	0	0	
Hexadecanoic acid (Palmitic acid)	0	0	0	0	0	

Substances	A	B	C	D	E	Remarks
Heptadecanoic acid	0	0	(0)	0	0	
Octadecanoic acid (Stearic acid)	0	0	0	0	0	
Oleic acid	0	0	0	0	XX	
Linoleic acid	0	0	0	0	XX	
Linolenic acid	0	(0)	0	0	XX	
Nonadecanoic acid	0	0	(0)	0	0	
Eicosanoic acid (Arachidic acid)	0	0	(0)	0	0	
Oxalic acid (10-25%)	0	1	1	0	0	
Malonic acid	0	-	1	0	0	
Succinic acid	0	-	0	0	0	
Maleic acid	0	1	1	0	0	
Malic acid	0	-	(1)	0	0	
Tartaric acid	0	-	0	0	0	
Citric acid	0	1/BOD	0	0	0	
Tannic acid	0	2	1	0	0	
Coconut oil fatty acid	0	2	-	-	--	
Coconut stearin fatty acid	0	0	-	-	-	
Palm nut oil fatty acid	0	2	-	-	-	
Palm nut stearin fatty acid	0	0	-	-	-	
Nonanoic/Tridecanoic acid mixtures	0	1	1	II	XX	

7 Glycols and their Derivatives

Substances	A	B	C	D	E	Remarks
Glycols:						
Ethylene glycol	0	0	1	II	XX	Teratogen
Propylene glycol	0	0	0	0	0	
Butylene glycol	0	1	0	0	0	
Diethylene glycol	0	0	0	0	0	
Hexaethylene glycol	0	0	0	0	0	
Dipropylene glycol	0	0	0	0	0	
Triethylene glycol	0	0	0	0	0	
Tripropylene glycol	0	0	0	0	0	
Polyethylene glycol	0	0	0	0	0	
Polypropylene glycol	0	1	0	0	0	
Glycol ethers:						
Ethylene glycol monomethyl ether	0	0	1	II	XX	Teratogen
Ethylene glycol monoethyl ether	0	0	1	I	0	
Ethylene glycol monoisopropyl ether	0	1	1	I	0	
Ethylene glycol monobutyl ether	0	0	2	I	0	
Ethylene glycol monotertiarybutyl ether	0	0	1	I	0	
Ethylene glycol dibutyl ether	0	-	1	I	X	
Ethylene glycol monophenyl ether	0	1	1	I	X	
Ethylene glycol methyl butyl ether	0	1	-	-	0	
Propyleneglycol monomethyl ether	0	(1)	0	0	0	
Propylene glycol monoethyl ether	0	(1)	1	I	0	
Butylene glycol monomethyl ether	0	0	1	I	0	
Diethylene glycol monomethyl ether	0	2	1	I	0	

Substances	A	B	C	D	E	Remarks
Diethylene glycol monoethyl ether	0	0	1	I	0	
Diethylene glycol monobutyl ether	0	0	1	I	0	
Diethylene glycol mono n-hexyl ether	0	1	1	II	XX	
Diethylene glycol diethyl ether	0	0	1	I	0	
Diethylene glycol dibutyl ether	0	1	1	I	0	
Dipropylene glycol monomethyl ether	0	(1)	1	I	0	
Dipropylene glycol monobutyl ether	0	1	1	II	XX	
Triethylene glycol monomethyl ether	0	(1)	0	0	0	
Triethylene glycol monoethyl ether	0	(1)	0	0	0	
Triethylene glycol monobutyl ether	0	0	0	I	0	
Tripropylene glycol monomethyl ether	0	(1)	1	I	0	
Polypropylene glycol monomethyl ether	0	0	1	0	0	
Polyethylene glycol dimethyl ether	0	0	0	0	0	
Ethylene glycol phenyl ether/Diethylene glycol phenyl ether mixtures	0	1	2	II	XX	Carcinogen
Glycol ether acetates:						
Ethylene glycol monomethyl ether acetate	0	1	1	II	XX	Teratogen
Ethylene glycol monoethyl ether acetate	0	2	1	II	XX	Teratogen
Ethylene glycol monobutyl ether acetate	0	(2)	1	I	X	
Butylene glycol mono-methyl ether acetate	0	1	1	I	X	
Diethylene glycol monomethyl ether acetate	0	1	1	I	X	

Substances	A	B	C	D	E	Remarks
Diethylene glycol monoethyl ether acetate	0	1	1	I	X	
Diethylene glycol monobutyl ether acetate	0	(1)	1	I	X	
Tripropylene glycol monomethyl ether acetate	0	(1)	1	I	0	
Glycol acetates and others:						
Ethylene glycol monoacetate	0	(1)	1	I	X	
Ethylene glycol diacetate	0	2	1	0	0	
Ethylene glycol mono-acrylate	0	3	1	II	XX	
Ethylene glycol mono-ethyl ether meth-acrylate (2-Hydroxyethyl methacrylate)	-	-	-	-	-	
Propylene glycol (mono) acrylate (2-Hydroxypropyl acrylate)	0	-	1	II	XX	
Diethylene glycol phthalate	0	1	0	0	0	

8 Halogenated Compounds (Excluding Fluorocompounds)

Substances	A	B	C	D	E	Remarks
Aliphatic compounds						
Chloromethane	0	1	-	II	X	Gas
Bromomethane	0	3	-	II	X	Gas; Neurotoxic
Chloroethane	0	0	N/A	0	0	
Bromoethane	0	-	1	I	X	
Vinyl chloride (inhibited)	0	N/A	N/A	II	XXX	Gas; Human carcinogen
Monobromoethylene	0	-	2	I	X	
n-Propyl chloride	Z	(1)	(1)	0	0	
2-Chloropropane	Z	-	-	-	-	
1-Chloropropylene	Z	-	1	-	-	
2-Chloropropylene	Z	-	-	-	-	
3-Chloropropylene	Z	3	2	II	XX	
3-Bromopropene	Z	(3)	3	II	XX	
Allyl chloride	See 3-Chloropropylene					
1-Chlorobutane	Z	-	1	-	-	
2-Chloro-1,3-butadiene	Z	(2)	2	II	XX	Human carcinogen
1-Chloropentane	-	-	-	-	-	
1-Chlorohexane	Z	4	-	-	-	
1-Chloroheptane	-	4	-	-	-	
1-Chlorooctane	-	(4)	-	-	-	
n-Octyl chloride	See 1-Chlorooctane					
Dichloromethane	0	1	1	I	XX	Carcinogen
Dibromomethane	Z	(2)	(1)	I	X	
1,1-Dichloroethane	Z	(1)	1	0	0	
1,2-Dichloroethane	Z	1	2	II	XX	Carcinogen
1,1-Dibromoethane	Z	(2)	(2)	I	X	
Ethylene dibromide	Z	2	2	II	XXX	Carcinogen
Vinylidene chloride	Z	1	2	II	XX	Carcinogen
1,2-Dichloroethylene	0	(1)	1	I	X	
1,2-Dibromoethylene	Z	2	2	II	XXX	Carcinogen

Substances	A	B	C	D	E	Remarks
1,1-Dichloropropane	Z	2	0	I	X	
1,2-Dichloropropane	Z	2	1	II	XX	
1,3-Dichloropropane	Z	2	(1)	I	X	
1,1-Dichloropropylene	Z	-	-	-	-	
1,2-Dichloropropylene	Z	-	1	-	-	
1,3-Dichloropropylene	Z	3	2	I	X	
2,3-Dichloropropylene	Z	(2)	2	I	X	
3,3-Dichloropropylene	Z	-	-	-	-	
Propylene dichloride	See 1,2-Dichloropropene					
1,6-Dichlorohexane	Z	3	1	0	0	
Trichloromethane	Z	2	2	I	XX	Carcinogen
Bromoform	Z	2	1	II	XX	
1,1,1-Trichloroethane	Z	2	1	0	0	
1,1,2-Trichloroethane	Z	2	1	0	0	
1,1,2-Trichloroethylene	Z	2	1	II	XX	Carcinogen
1,2,3-Trichloropropane	Z	(2)	2	II	X	
Trichlorobutene	Z	(2)	(2)	0	0	
Tetrachloromethane	Z	2	1	II	XX	Carcinogen; Teratogen
Carbon tetrabromide	Z	(3)	1	I	0	
1,1,2,2-Tetrachloro-ethane	Z	3	2	II	X	
Tetrachloroethane	See 1,1,2,2-Tetrachloroethane					
Acetylene tetrachloride	See 1,1,2,2-Tetrachloroethane					
1,1,2,2-Tetrabromoethane	Z	2	2	II	XX	
Tetrabromoethane	See 1,1,2,2-Tetrabromoethane					
Acetylene tetrabromide	See 1,1,2,2-Tetrabromoethane					
1,1,2,2-Tetrachloro-ethylene	Z	3	0	0	X	
Pentachloroethane	Z	3	2	0	X	
Dichloropropane and dichloropropene (mixture)	Z	3	2	I	XX	

Substances	A	B	C	D	E	Remarks
Chlorinated paraffins (C_{10}-C_{13}) with less than 60% chlorine	+	4	0	0	0	Additional hazards if organotin compounds compounds used as stabilizer
Chlorinated paraffins (C_{10}-C_{13}) with 60% chlorine or more	+	4	0	II	XX	Epigenetic carcinogen; additional hazards if organotin compounds used as stabilizer
Chlorinated paraffins (C_{14}-C_{17}) with less than 50% chlorine)	-	-	0	0	0	Epigenetic carcinogen; additional hazards if organotin compounds used as stabilizer
Chlorinated paraffins (C_{14}-C_{17} with 50% chlorine or more)	0	0	0	0	0	Additional hazards if organotin compounds used as stabilizer
Chlorinated paraffins (C_{18} and above) with any level of chlorine	0	0	0	II	XX	Epigenetic carcinogen; additional hazards if organotin compounds used as stabilizer
Aromatic compounds						
Chlorobenzene	Z	3	1	0	X	
o-Dichlorobenzene	Z	3	1	I	X	
m-Dichlorobenzene	Z	3	1	I	X	
p-Dichlorobenzene	not listed					
1,2,4-Trichlorobenzene	Z	3	1	I	X	
o-Chlorotoluene	T	3	1	I	X	
m-Chlorotoluene	Z	2	(1)	I	X	
p-Chlorotoluene	Z	3	1	I	X	
Benzyl chloride	0	3	1	II	XX	
Benzylidene chloride	0	(3)	1	II	XX	
p-Chlorobenzyl chloride	Z	(3)	(1)	I	XX	
Benzyl bromide	0	-	1	I	X	
Xylyl bromide	0	-	-	-	-	
Diphenyl methyl bromide	-	-	-	-	-	

9 Organophosphorus Compounds (excluding pesticides)

Substances	A	B	C	D	E	Remarks
Dimethylhydrogen phosphite	0	-	1	I	X	
Trimethyl phosphite	0	-	1	0	0	
iso Propyl acid phosphate	0	-	-	I	-	
Acid butyl phosphate	0	-	-	II	XX	
Triethyl phosphate	0	1	1	II	XX	
Tetraethyl pyrophosphate	0	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor
Tributyl phosphate	0	3	1	II	XX	
Hexaethyl tetraphosphate	0	0	3	II	XXX	
Di-(2-ethyl hexyl) phosphoric acid	0	2	1	I	X	
Di-iso octyl acid phosphate	See Di-(2-ethylhexyl)phosphoric acid					
Cresyl diphenyl phosphate	+	4	0	0	0	
Tricresyl phosphate (less than 1% ortho-isomers)	+	3	1	II	XX	Delayed neurotoxicity
Tricresyl phosphate (more than 1% ortho-isomers)	0	4	1	II	XXX	Delayed neurotoxicity
iso-Decyldiphenyl phosphate	+	3	0	I	X	
Trixylenyl phosphate	+	3	(1)	II	XXX	
Triaryl phosphate (unspecified)	+	4	1	II	XXX	
Triaryl phosphate, isopropylated	+	3	0	II	XXX	Neurotoxic
Dimethyl thiophosphoryl chloride	0	-	1	I	XX	
Tris (1-aziridinyl) phosphine oxide (solution)	0	-	3	II	XX	Carcinogen

10 Esters

Substances	A	B	C	D	E	Remarks
Formates						
Methyl formate	0	1	1	I	X	
Ethyl formate	Not listed					
n-Propyl formate	0	(0)	1	I	X	
n-Butyl formate	0	(1)	1	II	XX	
iso-Butyl formate	0	1	1	I	X	
Acetates and Acetoacetates						
Methyl acetate	0	0	1	0	0	
Ethyl acetate	0	1	0	0	0	
n-Propyl acetate	0	1	0	0	0	
iso-Propyl acetate	0	0	1	I	X	
n-Butyl acetate	0	2	0	I	X	
iso-Butyl acetate	0	2	1	I	X	
sec-Butyl acetate	0	1	0	I	X	
n-Amyl acetate	0	2	0	0	X	Tested for tainting
iso-Amyl acetate	0	2	0	I	X	
sec-Amyl acetate	0	2	1	I	X	
n-Hexyl acetate	0	3	0	0	0	
iso-Hexyl acetate	0	(1)	-	-	0	
sec-Hexyl acetate	0	(2)	0	0	0	
Cyclohexyl acetate	0	(3)	0	II	XX	
Heptyl acetate	0	(3)	0	I	X	
n-Octyl acetate	0	(1)	1	I	X	
Vinyl acetate	0	2	1	0	0	
Benzyl acetate	0	2	1	I	0	
Methyl acetoacetate	0	1	1	I	X	
Ethyl acetoacetate	0	(1)	1	I	X	
Propionates, Butyrates, etc.						
Methyl propionate	0	(1)	1	0	0	
n-Butyl butyrate	(T)	2	0	0	X	

Substances	A	B	C	D	E	Remarks
iso-Butyl iso-butyrate	0	-	0	0	0	
Vinyl neodecanoate	0	2	0	I	X	
Propyl palmitate	0	(0)	(0)	0	X	
Butyl stearate	0	0	1	0	0	
Acrylates and Methacrylates						
Methyl acrylate	0	3	2	II	XX	
Ethyl acrylate	T	3	2	I	X	Tested for tainting
n-Butyl acrylate	0	3	1	I	X	
iso-Butyl acrylate	0	3	0	0	X	
iso-Octyl acrylate (2-Ethylhexyl acrylate)	0	(3)	0	I	X	
Decyl acrylate	0	4	1	I	X	
iso-Decyl acrylate	0	4	0	0	X	
2-Hydroxyethyl acrylate	0	3	1	II	X	
2-Hydroxypropyl acrylate	0	3	1	II	XX	
Methyl methacrylate	0	1	1	I	XX	Skin sensitizer
Ethyl methacrylate	0	2	1	I	XX	Skin sensitizer
n-Butyl methacrylate	0	1	0	I	XX	Skin sensitizer
iso-Butyl methacrylate	0	1	0	I	XX	Skin sensitizer
Nonyl methacrylate	0	0	-	-	-	
Lauryl methacrylate	0	0	0	I	X	
Esters of Hydroxy Carboxylic Acids and Aliphatic Dibasic Acids						
Methyl salicylate	(T)	2	2	II	XX	Teratogen
Ethyl lactate	0	(1)/BOD	1	0	0	
Butyl lactate	0	1	2	II	X	
Diethyl oxalate	0	(2)	2	I	X	
Diethyl malonate	0	2	0	I	X	
Dimethyl succinate	0	2	0	I	0	
Dimethyl glutarate	0	2	0	I	0	
Dimethyl sebacate	-	3	-	-	-	
Dibutyl sebacate	0	0	0	0	0	
Diethyl maleate	0	3	1	I	-	
Dibutyl maleate	0	-	1	I	X	

Substances	A	B	C	D	E	Remarks
Dimethyl adipate	0	3	0	I	0	
Di-n-hexyl adipate	0	3	0	0	0	
Di-(2-ethylhexyl)adipate	0	0	0	0	XX	
Dioctyl adipate	See Di-(2-ethylhexyl)adipate					
Octadecyl adipate	-	0	-	-	-	
Di-iso-nonyl adipate	0	0	0	0	XX	
Didecyl adipate	-	-	0	0	0	
Esters of Aromatic Dibasic Acids (including phthalates)						
Dimethyl phthalate	0	2	1	0	X	
Diethyl phthalate	0	2	1	I	X	
Di-n-propyl phthalate	0	(3)	(1)	I	X	
Dibutyl phthalate	0	4	1	II	XX	Testicular toxicity; Teratogen
Di-iso-butyl phthalate	0	3	0	0	X	
Di-n-hexyl phthalate	See Di-(2-ethylbutyl)phthalate					
Butyl octyl phthalate	0	-	-	-	X	
Di-(2-ethylbutyl) phthalate	0	0	0	0	X	
Diheptyl phthalate	0	0	(0)	0	X	
Di-n-octyl phthalate	0	0	0	I	X	
Di-2-ethyl hexyl phthalate	0	0	0	II	XX	Testicular toxicity; Carcinogen
Di-iso-octyl phthalate	0	0	0	I	X	
Dinonyl phthalate	0	0	1	0	XX	
Octyl decyl phthalate	0	0	0	0	XX	
Di-iso-nonyl phthalate	0	0	0	0	XX	
Di-iso-decyl phthalate	0	0	0	0	XX	
Diundecyl phthalate	0	0	(1)	0	XX	
Ditridecyl phthalate	0	0	0	0	XX	
Butyl benzyl phthalate	Z	4	1	0	X	
Dialkyl phthalates C_7-C_9	0	(1)	(0)	I	X	
Dialkyl phthalates C_9-C_{13}	0	0	(1)	0	XX	

11 Ketones

Substances	A	B	C	D	E	Remarks
Dimethylketone, acetone 2-Propanone	0	0	1	I	X	Tested for tainting
Methylethylketone 2-Butanone	0	0	1	I	X	
Methyl n-propylketone 2-Pentanone	0	0	1	I	X	Tested for tainting
Methyl iso-propylketone 3-Methyl-2-butanone	0	1	1	I	X	
Methyl propylketone (unspecified)	0	1	1	I	X	
Methyl n-butylketone 2-Hexanone	0	(1)	1	II	XXX	Neurotoxic; Testicular toxicity
Methyl iso-butylketone 4-Methyl-2-pentanone	0	1	1	I	X	
Methyl tert-butylketone 3,3-Dimethyl-2- butanone	-	-	-	-	-	
Methyl n-amyl ketone 2-Heptanone	0	(2)	1	I	X	
Methyl iso-amylketone 5-Methyl-2-hexanone	0	(2)	1	I	X	
Methyl-n-hexylketone 2-Octanone	0	-	1	I	X	
Methyl heptyl ketone 2-Nonanone	0	3	1	-	-	
Diethyl ketone 3-Pentanone	0	0	1	I	X	
Ethyl n-propylketone 3-Hexanone	0	-	1	I	X	
Ethyl iso-propylketone 2-Methyl-3-pentanone	-	-	-	-	-	
Ethyl n-butylketone 3-Heptanone	0	(0)	1	I	X	
Ethyl iso-butylketone 2-Methyl-3-hexanone	-	-	-	-	-	
Ethyl iso-amylketone	0	-	1	I	X	
Ethyl n-amyl ketone 4-Methyl-3-heptanone	0	2	1	I	X	
Di-n-propyl ketone	0	-	1	I	X	
Di-n-butyl ketone	-	-	-	-	-	

Substances	A	B	C	D	E	Remarks
Di-iso-butyl ketone	0	1	1	I	X	
Chloroacetone 1-Chloro-2-propanone	0	2	3	II	XXX	Potent lachrymator
Bromoacetone 1-Bromo-2-propanone	0	2	(3)	II	XXX	Potent lachrymator
Cyclohexanone	0	1	1	I	X	
Acetophenone Methyl phenyl ketone	0	1	1	II	XX	

12 Substituted Phenols

Substances	A	B	C	D	E	Remarks
2-Nitrophenol o-Nitrophenol	0	3	1	I	XX	
3-Nitrophenol m-Nitrophenol	0	3	2	I	XX	
4-Nitrophenol p-Nitrophenol	0	3	2	I	XX	
Nitrophenols (mixed isomers)	0	3	2	I	XX	
Nitrocresols	T	(3)	1	I	XX	
Di-nitrophenols	T	3	3	II	XXX	
4,6-Dinitro-ortho-cresol	T	4	3	II	XXX	Neurotoxic
2,4-Dichlorophenol	T	3	1	II	XX	Tested for tainting
2,6-Dichlorophenol	T	3	1	II	XX	Tested for tainting
Dichlorophenols (mixed isomers)	T	3	1	II	XX	Tested for tainting
Pentachlorophenol	+	4	3	II	XXX	High percutaneous toxicity

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13 Amines

Substances	A	B	C	D	E	Remarks
Methylamine (42% or less in solution)	0	2	2	II	XXX	Potent skin sensitizer; Lachrymator; Tested for tainting
Dimethylamine (40-50% in solution or anhydrous)	0	2	2	II	XXX	Potent skin sensitizer; Lachrymator; Tested for tainting
Trimethylamine	0	2	2	II	XXX	Lachrymator
Ethylamine	0	(2)	2	II	XXX	Lachrymator
Diethylamine	0	2	2	II	XXX	Lachrymator
Triethylamine	0	2	3	II	XXX	Skin sensitizer; Lachrymator
n-Propylamine	0	2	1	II	XXX	Skin sensitizer; Lachrymator
iso-Propylamine	0	2	1	II	XXX	Skin sensitizer; Lachrymator
Di-n-propylamine	0	2	1	II	XXX	Lachrymator
Di-iso-propylamine	0	2	3	II	XXX	Lachrymator
Tripropylamine	0	(2)	2	II	XXX	Lachrymator
n-Butylamine	0	2	2	II	XXX	Lachrymator
sec-Butylamine	0	2	2	II	XXX	Lachrymator
tert-Butylamine	0	2	2	II	XXX	Lachrymator
iso-Butylamine	0	2	2	II	XXX	Lachrymator
Di-n-butylamine	0	2	2	II	XX	
Di-iso-butylamine	0	(2)	2	II	XX	
Tri-butylamine	0	2	2	II	XX	
iso-Octylamine	0	3	2	II	XX	
N-Ethylbutylamine	0	(2)	2	II	XX	
Cyclohexylamine	0	2	2	II	XXX	Lachrymator
Dicyclohexylamine	0	-	2	II	XXX	Lachrymator
N-Ethylcyclohexylamine	0	1	1	II	XX	
Dodecylamine/Tetra-decylamine mixture	-	-	2	II	XX	

14 Pesticides

Substances	A	B	C	D	E	Remarks
Aldicarb	0	4	4	II	XXX	High dermal toxicity; ChE inhibitor
Aldrin	+	4	3	II	XXX	Carcinogen; High dermal toxicity; Convulsant
Allidochlor	0	3	1	I	X	
Aminocarb	0	4	3	II	XX	
ANTU	See alpha-Naphthylthio urea					
Azinphos-ethyl	-	4	3	I	XX	ChE inhibitor
Azinphos-methyl	0	4	3	II	XXX	ChE inhibitor
Bendiocarb	0	4	3	I	XX	ChE inhibitor
Benfuracarb	0	-	2	0	0	
Benquinox	-	4	2	I	X	
Binapacryl	+	4	2	I	XX	
Blasticidin-S	0	-	3	II	X	
Blasticidin-S-3	-	-	3	-	-	
Brodifacoum	+	4	4	II	XXX	
Bromophos-ethyl	+	4	3	I	XX	ChE inhibitor
Bromoxynil	0	4	2	I	XX	
Butocarboxim	0	2	2	I	X	
Camphechlor	+	4	3	II	XXX	Carcinogen; Convulsant
Carbaryl (Sevin)	0	4	2	II	XXX	Teratogen; ChE inhibitor
Carbofuran	0	4	4	II	XXX	ChE inhibitor
Carbophenothion	+	4	3	II	XXX	ChE inhibitor
Cartap hydrochloride	0	4	2	0	X	
Chinomethionat	-	-	1	I	XX	
Chlordane	+	4	3	II	XXX	Carcinogen; Convulsant
Chlordimeform	0	3	2	I	XX	
Chlorfenvinphos	0	4	3	II	XXX	ChE inhibitor
Chlormephos	0	4	3	II	XXX	ChE inhibitor
Chlorophacinone	0	-	4	II	XXX	
Chlorpyriphos	+	4	2	II	XX	ChE inhibitor

Substances	A	B	C	D	E	Remarks
Chlorthiophos	+	4	3	II	XXX	ChE inhibitor
Coumachlor	+	-	1	I	XX	
Coumafuryl	-	-	3	-	XX	
Coumaphos	+	4	3	I	XXX	ChE inhibitor
Coumatetralyl	0	1	0	-	XX	
Crimidine	0	1	4	-	XXX	Convulsant
Crotoxyphos	0	4	2	II	XX	ChE inhibitor
Crufomate	-	3	2	I	XX	ChE inhibitor
Cyanazine	0	3	2	I	XX	
Cyanophos (Cyanox)	0	4	3	I	XX	ChE inhibitor
Cycloheximide	0	3	4	I	XX	
Cyhexatin	+	4	2	I	XX	
Cypermethrin	+	4	2	I	XX	
2,4-D	See 2,4-Dichlorophenoxyacetic acid					
Dazomet	0	-	2	II	X	
2,4-DB	0	3	1	I	X	
DDT	+	4	2	II	XXX	Reproductive toxicity; Carcinogen; Convulsant
DEF	-	4	2	II	XX	ChE inhibitor
Demephion	0	-	2	II	XX	ChE inhibitor
Demeton-O-methyl	-	-	2	II	XX	ChE inhibitor
Demeton-S-methyl	0	-	2	II	XX	ChE inhibitor
Demeton-S-methylsulphoxide	-	-	3	II	XXX	ChE inhibitor
Dialifos	+	4	3	II	XXX	ChE inhibitor
Di-allate	+	3	2	II	XXX	Carcinogen; ChE inhibitor
Diazinon	+	4	2	II	XXX	ChE inhibitor
1,2-Dibromo-3-chloro-propane	0	2	2	II	XXX	Carcinogen; Testicular toxicity
Dichlofenthion	+	4	2	I	XX	ChE inhibitor
2,4-Dichlorophenoxyacetic acid	T	3	2	I	XX	
Dichlorvos	0	4	3	II	XXX	ChE inhibitor; Carcinogen if containing epichlorohydrin as stabilizer

Substances	A	B	C	D	E	Remarks
Dicoumarol	-	-	2	I	XX	
Dicrotophos	0	4	3	II	XXX	ChE inhibitor
Dieldrin	+	4	3	II	XXX	Carcinogen; Convulsant
Difenacoum	-	-	4	-	XXX	
Difenzoquat	0	2	2	I	X	
Dimefox	0	-	4	II	XXX	ChE inhibitor; High dermal toxicity
Dimetan	0	-	2	I	XX	ChE inhibitor
Dimethoate	0	4	3	I	XXX	ChE inhibitor
Dimetilan	0	3	3	I	XX	ChE inhibitor
Dimexano	-	-	2	-	XX	
4,6-Dinitro-ortho-cresol	T	4	3	II	XXX	
Dinobuton	-	4	2	I	XX	
Dinoseb	0	4	3	II	XXX	
Dinoseb-acetate	0	-	2	II	XXX	
Dinoterb	-	-	3	II	XX	
Dinoterb-acetate	-	-	2	II	XX	
Dioxacarb	0	4	2	I	XX	
Dioxathion	-	4	3	II	XXX	ChE inhibitor
Diphacinone	+	3	4	0	XXX	
Diquat	0	2	2	I	XX	
Disulfoton	0	4	4	II	XXX	ChE inhibitor
DNOC	See 4,6-Dinitro-ortho-cresol					
Drazoxolon	-	4	2	I	XX	Skin sensitizer
Edifenphos	-	4	2	-	XX	ChE inhibitor
Endosulphan	+	4	4	II	XXX	
Endothal-sodium	0	3	2	II	XX	
Endothion	0	-	3	II	XXX	ChE inhibitor
Endrin	+	4	4	II	XXX	Convulsant
EPN	+	4	3	II	XXX	ChE inhibitor
Ethion	+	4	3	II	XXX	ChE inhibitor
Ethoate-methyl	-	-	3	I	XX	ChE inhibitor

Substances	A	B	C	D	E	Remarks
Ethoprophos	0	4	3	II	XXX	ChE inhibitor
Fenaminosulf	0	3	3	-	XX	
Fenaminphos	0	4	3	II	XXX	ChE inhibitor
Fenitrothion	+	4	3	II	XXX	ChE inhibitor
Fenpropathrin	+	4	3	I	XX	
Fensulfothion	0	4	4	II	XXX	ChE inhibitor; High dermal toxicity
Fenthion	+	4	2	II	XXX	ChE inhibitor
Fentin acetate	+	4	3	II	XXX	
Fentin hydroxide	+	4	3	II	XXX	
Fluoracetamide	0	2	3	II	XXX	Convulsant
Fonofos	+	4	4	II	XXX	ChE inhibitor
Formetanate	0	4	3	II	XXX	
Formothion	0	-	2	II	XXX	
Heptachlor	+	4	3	II	XXX	Carcinogen
Heptenophos	0	4	2	I	XX	
Imazalil	-	3	2	I	XX	
Ioxynil	0	4	2	I	XX	
Iprobenfos	0	(3)	1	0	X	ChE inhibitor
Isobenzan	-	-	4	II	XXX	High dermal toxicity
Isodrin	-	-	3	II	XXX	High dermal toxicity
Isofenphos	0	4	3	II	XXX	
Isolan	-	-	3	II	XXX	High dermal toxicity
Isoprocarb	-	4	2	0	XX	
Isothioate	0	3	2	II	XXX	
Isoxathion	+	4	2	II	XXX	
Kelevan	-	-	2	II	XXX	
Lindane	+	4	3	II	XXX	Carcinogen, Convulsant
Malathion	0	4	2	I	XX	ChE inhibitor
Maneb	0	4	2	II	XX	Teratogen; ChE inhibitor
MCPA	0	2	1	0	0	
Mecarbam	-	4	3	II	XXX	

Substances	A	B	C	D	E	Remarks
Medinoterb	-	-	3	I	XXX	
Menazon	-	-	2	I	XX	ChE inhibitor
Mephosfolan	0	4	3	II	XX	High dermal toxicity
Mercaptodimethur	See Methiocarb					
Metam - sodium	0	4	2	II	XX	
Methamidophos	0	(4)	3	II	XXX	
Methasulfocarb	-	-	-	-	-	
Methidathion	0	4	3	II	XXX	High dermal toxicity
Methiocarb	0	4	3	II	XXX	
Methomyl	0	4	3	II	XXX	
Methyl trithion	-	4	3	II	XXX	
Metolachlor	0	3	1	II	X	
Mevinphos	0	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor
Mexacarbate	-	4	3	I	XX	
Mirex	+	-	2	I	XX	
Mobam	-	-	2	-	-	
Monocrotophos	0	4	3	II	XXX	ChE inhibitor
Nabam	0	4	2	-	-	
Naled	-	4	2	II	XXX	
Nicotine	0	3	3	II	XXX	Carcinogen
Norbormide	0	0	2	-	X	
Omethoate	0	-	2	I	XX	
Oxamyl	0	4	3	I	XX	
Oxydemeton-methyl	0	3	3	II	XXX	ChE inhibitor
Oxydisulfoton	-	4	4	II	XXX	
Paraoxon	0	4	4	II	XXX	ChE inhibitor
Paraquat	0	3	3	II	XXX	Delayed lung injury
Parathion	0	4	4	II	XX	ChE inhibitor
Parathion methyl	0	4	3	II	XXX	ChE inhibitor
Pentachlorophenol	+	4	3	II	XXX	High percutaneous toxicity
Phenkapton	-	-	2	I	XX	

Substances	A	B	C	D	E	Remarks
Phenthoate	+	4	2	I	XX	
Phorate	0	4	4	II	XXX	Very high dermal toxicity ChE inhibitor
Phosalone	+	4	2	I	XX	ChE inhibitor
Phosfolan	0	-	3	II	XXX	ChE inhibitor
Phosmet	0	4	3	II	XXX	ChE inhibitor; Reproductive toxicity
Phosphamidon	+	4	3	II	XXX	
Pindone (and salts of)	0	4	2	-	XX	
Pirimicarb	0	4	2	0	XX	
Pirimiphos-ethyl	+	4	2	I	XX	ChE inhibitor
Promecarb	0	4	3	II	XXX	
Promurit	-	-	4	-	XXX	
Propaphos	0	4	2	II	XXX	ChE inhibitor
Propoxur	0	4	3	II	XXX	
Prothoate	0	4	3	II	XXX	ChE inhibitor
Pyrazophos	+	4	2	0	XX	ChE inhibitor
Pyrazoxon	-	-	4	-	XXX	ChE inhibitor
Quinalfos	0	(4)	3	II	XXX	ChE inhibitor
Quinomethionate	See Chinomethionat					
Rotenone	Z	4	2	I	XX	
Salithion	-	4	2	0	XX	ChE inhibitor
Schradan	0	-	3	II	XXX	Very high dermal toxicity; ChE inhibitor
Simiazine	0	3	1	I	X	
Sodium arsenite	+	3	3	II	XXX	Human carcinogen; Teratogen
Strychnine (and salts)	0	4	4	II	XXX	Convulsant
Sulfotep	See Tetraethyl dithiopyrophosphate					
Sulprofos	+	4	2	I	XXX	ChE inhibitor
2,4,5-T	See 2,4,5-Trichlorophenoxyethanoic acid					
Temephos	-	4	2	II	XX	ChE inhibitor
TEPP	See Tetraethyl pyrophosphate					
Terbufos	+	4	4	II	XXX	Very high dermal toxicity; ChE inhibitor

Substances	A	B	C	D	E	Remarks
Terbumeton	0	3	2	I	XX	
Tetraethyl dithiopyro-phosphate	0	(4)	3	II	XXX	Very high dermal toxicity; ChE inhibitor
Tetraethyl pyrophosphate	0	4	4	II	XXX	Very high dermal toxicity; Neurotoxic
Thallium compounds	+	2	3	II	XXX	Neurotoxic
Thiometon	0	3	2	II	XXX	ChE inhibitor
Thionazin	0	-	4	II	XXX	Very high dermal toxicity; ChE inhibitor
Triadimefon	0	3	2	I	XX	
Triamiphos	-	-	3	II	XXX	
Triazophos	0	4	2	I	XX	ChE inhibitor
Tributyl tin compounds	+	4	3	II	XXX	Some compounds are neurotoxic, others are immunotoxic
Tricamba	-	-	2	-	XX	
Trichlorfon	0	4	2	I	XX	
Trichloronat	0	4	3	II	XXX	High dermal toxicity; ChE inhibitor
2,4,5-Trichlorophenoxy-ethanoic acid	0	3	2	0	XXX	
Triphenyl tin compounds (other than Fentin acetate and Fentin hydroxide)	+	4	-	-	-	
Vamidothion	0	-	3	II	XXX	ChE inhibitor
Warfarin	0	4	2	II	XXX	Teratogen

15 Aldehydes

Substances	A	B	C	D	E	Remarks
Methanal (Formaldehyde) (37-50% solution)	0	2	2	II	XX	Skin sensitizer; Carcinogen; Tested for tainting
Ethanal (Acetaldehyde)	0	2	1	II	XX	Carcinogen
Propanal (Propionaldehyde)	0	2	1	I	X	
n-Butanal (n-Butyraldehyde)	0	2	1	I	XX	
iso-Butanal (iso-Butyraldehyde)	0	2	1	II	XX	
n-Pentanal (n-Valeraldehyde)	0	2	1	I	X	
2-Methyl butanal (Methyl butyraldehyde)	0	2	1	I	X	
3-Methyl butanal (iso-Valeraldehyde; iso-Pentaldehyde)	0	2	1	II	XX	
n-Hexanal (n-Hexyl aldehyde)	0	3	1	I	XX	
2-Ethyl butanal	0	3	1	I	XX	
n-Heptanal	0	3	0	I	XX	
n-Octanal (n-Octaldehyde)	0	3	0	I	X	
iso-Octanal (iso-Octaldehyde)	0	3	1	I	X	
2-Ethyl hexanal (2-Ethylhexaldehyde)	0	3	1	I	X	
n-Nonanal	0	3	-	I	XX	
n-Decanal (n-Decaldehyde)	0	3	1	I	X	
iso-Decanal (iso-Decaldehyde)	0	2	1	I	X	
Furfural (2-Furfuraldehyde)	0	2	2	II	X	
Cyclohexanal (Cyclohexane carboxy-aldehyde)	0	3	-	-	-	
Benzaldehyde	0	3	3	I	X	
Acrolein (Allyl aldehyde)	T	4	3	II	XXX	Lachrymator; High acute lethal vapour toxicity

Substances	A	B	C	D	E	Remarks
Crotonaldehyde (2-Butenal)	0	4	2	II	XX	
2-Ethyl-2-hexenal (2-Ethyl-3-propyl acrolein)	(T)	(1)	1	II	XX	
2,4-Hexadienal (2,4-Hexadiene aldehyde)	-	-	1	II	XX	
3-Cyclohexenal (3-Cyclohexene-1-carboxyaldehyde)	0	3	-	-	-	
Chloroacetaldehyde (2-Chloro-1-ethanal)	0	3	3	II	XXX	Lachrymator
Trichloroacetaldehyde	0	1	2	0	0	
Glyoxal 40% or less solution (Ethanedial)	0	1	1	I	X	

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ANNEX 7

EHS

HAZARD EVALUATION OF HARMFUL SUBSTANCES
IN THE MARINE ENVIRONMENT

DATA SHEET
(for reference only)

1. Material:

2. Identification:

Alternative names:

Trade names:

Uses:

UN No.:
IMO DG:
Other UN Agency ID:
CAS:
RTECS:
US CHRIS:
Class:
Carbon number:

3. Characterisation:

Chemical formula:
Molecular weight:

4. Physical properties:

Description:
BPt ^{o}C:
MPt ^{o}C:
Flash Pt ^{o}C:
Relative density:
Vapour pressure:
Viscosity:
Solubility in water:

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EHS (Cont.)

5. Chemical and biological properties:

Chemical Stability:
Reactivity with water:
Biodegradability:
COD:
BOD:
Lipid solubility (POW):
Bioaccumulation:

Assigned A:

6. Damage to marine living resources:

Assigned B:

7. Hazard to human health:

Assigned C:

Assigned D:

8. Effect on amenities:

Assigned E:

9. Additional information:

Producer(s):
Proposal for bulk shipment:

Assigned hazard profile:

Date:

Profile checked: Date:

***

ANNEX 8

GUIDELINES FOR EVALUATING THRESHOLD VALUES FOR TAINTING OF SEAFOOD BY CHEMICAL SUBSTANCES

1 INTRODUCTION

1.1 Purpose of the guidelines

These guidelines propose a procedure for measuring the ability of a chemical substance to taint seafood when the substance is present in the water to which the seafood is exposed. Data on the tainting potential of chemicals are used when evaluating the hazards of harmful substances carried by ships. They relate specifically to the 'T' ratings in column A of hazard profiles as developed by the Working Group and approved by GESAMP (GESAMP Reports & Studies No. 17). Although these guidelines have been developed by GESAMP to facilitate its work, they can also be used as a basis for the chemical industry and national administrations in the screening of chemicals for assessing the impact of chemical substances on the marine environment with regard to the tainting of seafood.

1.2 Definition of tainting

GESAMP when developing the principles for constructing hazard profiles felt that it was important to identify substances which if injected into the marine environment might affect the acceptability of fisheries products to the consumer. A 'T' rating is allocated in column A if the substance can result in the seafood becoming tainted and taint is defined as "a foreign flavour or odour in the organisms induced by conditions in the water to which the organisms are exposed".

This definition includes any change in odour or flavour induced by the chemical whether or not the induced flavour is judged pleasant or unpleasant. Taints usually are unpleasant in character but in the context of evaluating the effects of pollution even a flavour which may be pleasant in character can be considered an undesirable effect.

1.3 Principles of a procedure for measuring ability to cause tainting

Measurement of the capacity of a chemical to taint seafood when present in the ambient water is conducted in 2 stages: exposure of the organism to the chemical, and evaluation of the exposed organism for taint.

Exposure of the organism to the chemical follows, in essentials, the procedures used for testing chemicals for toxic effects. Examples of the selected organism are exposed to known concentrations of the chemical under defined conditions for the required length of time and the exposed animals examined for an effect. However there are some important differences in the case of taint testing. The test organism must be suitable for evaluation by a sensory panel, that is, must be an edible species, and a much larger mass of fish must be exposed than in the case of toxicity testing.

At least 300 g of edible flesh is required for the sensory procedure described in these guidelines for each exposure concentration which means exposing at least 750 g of live fish. Facilities for testing chemicals for tainting will therefore usually have to have a greater capacity than those for testing chemicals for toxicity.

The effect being looked for is taint which is a sensory experience and can be directly evaluated only by a sensory procedure. There are few published reports on quantitative measurement of tainting of seafoods and the procedures that have been used fall into two broad groups: those in which the exposed fish is evaluated, sometimes in comparison with a reference, and the presence or absence of taint is recorded, and those in which any taint is recorded and its intensity expressed on an intensity scale. Where the former procedure is used the overall results of an experiment are usually expressed as "tainting" or "not tainting" at concentrations used in the trial. Where intensity of tainting is recorded the data can be processed to determine the concentration which results in a stated intensity, including zero intensity. (A zero intensity concentration is analogous to the 'no effect' level in toxicological studies.)

The Guidelines given here recommend a direct comparison approach using the triangular test procedure. This procedure is well known to sensory testing laboratories and an international standard for its conduct is available[1/]. When carried out in accordance with the prescribed procedure it is free from the systematic errors present in other comparison methods and it does not require that assessors be familiar with the character of the flavour or odour induced by the chemical. The data from the triangular test are binary in nature, the effect is detected or it is not detected by an assessor, and are analogous to the data resulting from toxicity testing. The proportion of detections, that is the proportion of assessors in a panel detecting the exposed samples, form a sigmoid curve when plotted against logarithm of concentration, similar in shape to dose/effect curves in general. The data can be processed by the same statistical procedures used in toxicity testing with the important restriction that in the triangular test there is a probability of 1/3 of selecting the exposed sample by chance even if it is not tainted. The data can be processed to give a median effect concentration - analogous to the LC_{50} used in the field of aquatic toxicity - that can be defined as the "tainting threshold".

2 EXPERIMENTAL PROCEDURES

2.1 General considerations and background information

The experimenter will need to have background information on the relevant chemical properties of the test substance in order to determine if it can be prepared and maintained at the required concentrations, and to have a method for analysis of the substance in water.

It will be necessary to have an approximate estimate of the likely tainting threshold concentration. It is not possible to predict this from chemical constitution or from analogy from similar compounds since there is no simple relationship between the molecular structure of a chemical and the intensity of its odour or flavour. An estimate of the threshold can be obtained by adding the substance to fish muscle until it can be detected by

odour or flavour and dividing this concentration by the expected bioconcentration during the exposure period.

The maximum exposure concentration should be no more than one tenth of the LC_{50} for the substance. If the anticipated tainting threshold is above this maximum it may be sufficient to test the compound only at the maximum as confirmation.

A few chemicals may be regarded as having specific toxicity that would make it highly undesirable to expose humans to them (e.g. very high acute toxicity, carcinogenicity, teratogenicity). The experimenter should arrange for independent evaluation of the short- and long-term hazards and if necessary modify the experimental conditions.

2.2 Exposure of test animals

2.2.1 Test organisms

It is recommended that fin fish with a moderate fat content (3-10%) which can be maintained in aquaria should be used as test animals. Salmo gairdneri (rainbow trout) is particularly suitable as it is available world wide from commercial sources and though usually reared in freshwater can be acclimatized to sea water. Other suitable species would be Mugil cephalus (mullet) and Pagrus maior (red sea bream) Sufficient fish should be exposed at each test concentration to give 300 g of edible flesh, about 750 g of live fish, preferably obtained from several individual specimens.

Invertebrate species can also be used as test animals but these Guidelines will refer only to vertebrate fish.

2.2.2 Exposure concentrations

Fish should be exposed to 5 or more concentrations of the test substance preferably spaced in a geometric series with a concentration increment of

around 3- to 4-fold. The highest concentration should be not more than one tenth of the 24 hour LC_{50} for the test substance. A preliminary screening test may be carried out at this maximum concentration only to determine if it is necessary to proceed to a full test for determination of tainting threshold. Fish should also be exposed under the same conditions to the same ambient water but without addition of test substance to provide reference material.

Chemicals should be made up to the required concentrations in the ambient water if possible without the use of adjuvants; where these must be used it must be established that they do not cause taint of themselves and should be added to the water to which the reference fish are exposed. The concentrations of the test substance should be confirmed by chemical analysis of the water to which the fish are exposed.

2.2.3 Test conditions

The test should be carried out preferably in sea water and the exposure period should be at least 24 hours.

Flow-through conditions are preferred with aeration of the make up water prior to injection into the test chamber. Static or semi-static conditions are acceptable provided that during the exposure period the concentration of test substance does not drop below 50% of the initial value. The dissolved oxygen should be at least 60% of the air saturation value.

In cases where substances of components of mixtures of low solubility have to be tested for tainting the procedures set out in annex 9 to this report should be taken into account for the preparation of test solutions. In such cases it might also be difficult to use flow-through systems, and static or semi-static conditions may have to be used.

The temperature should be suitable for the species chosen. The pH of the water should be between 6.0 and 8.5.

The fish loading under flow-through conditions should not exceed 20 g of fish for each one litre capacity of test chamber and the flow rate should be at least one litre per 2 g of fish per day. Under static or semi-static conditions the loading should not exceed 1 g of fish for each litre of capacity.

The fish should not be fed preceding the test for a time that ensures that the gut is empty, nor during the test period.

There should not be any mortalities following exposure and only fish behaving normally should be used for sensory evaluation.

2.3 Evaluation of taint

2.3.1 Harvesting of fish

At the end of the exposure period the fish should be harvested from the test chamber and allowed to die by suffocation or killed by a blow to the head. The fish should be gutted immediately and allowed to bleed. If the fish are not to be tasted within two hours they should be wrapped in foil or plastic and stowed in crushed ice prepared from potable water at a ratio of at least one part of ice to three parts of fish by weight. The fish should be assessed within 48 hours of harvesting.

2.3.2 Preparation of samples

All utensils and equipment used for preparing and holding samples should be free of taints. Where the same equipment is used in the preparation of all the samples, the lowest concentration should be processed first then the other concentrations successively to the highest, cleaning the equipment between each sample.

The fish may be washed briefly in potable water to remove blood, slime or ice. The flesh from all of the fish exposed at a particular concentration

must be thoroughly mixed before being dispensed to the members of the sensory panel. This mixing may be performed before or after cooking. If the former the flesh should be cut from the bone and freed from skin and membranes. The flesh should then be passed through a mincer with 6 mm diameter holes and mixed. If mixing is to be carried out after cooking the head should be removed and the fish may be cooked 'on the bone', or fillets may be cut off and cooked.

2.3.3 Cooking

One of the following procedures should be used. Fish flesh is judged cooked when its temperature reaches 65°C and the exact time required for cooking with the equipment and procedure being used should be determined by prior experimentation.

.1 Steaming method. 100-150 g of material is placed in a lidded casserole or wrapped tightly in aluminium foil. The casserole or wrapped material is suspended over or in boiling water or steam until cooked.

.2 Boil-in-the-bag method. 150 g of material is put into a plastic bag intended for cooking foods in boiling water. The bag is weighted by putting into it glass rods or weights and the bag is closed loosely. The bag should be suspended in boiling water or steam until the flesh is cooked.

.3 Microwave cooking. The fish is placed in a covered container and cooked according to the optimum conditions prescribed by the manufacturer of the equipment.

Care should be taken to prevent transfer of taint between samples during cooking.

After cooking, if the fish has been cooked without prior mincing, the flesh should be freed from bones and skin. The flesh from all the fish exposed to a particular concentration should be pooled and well mixed. The mixed flesh should be dispensed into the containers in which it will be evaluated by the panel members, the containers closed, and kept warm until evaluation.

2.3.4 Selection of assessors

Fifteen to twenty assessors should be used. They should have had some previous experience of the normal flavours of the species of fish used - but they need not be experts - and of the triangular test procedure. They should not be specially selected for acuity to the substance under test.

2.3.5 Conduct of test

The material from each test concentration is presented to the panel of assessors as a triangular test in comparison with the control (exposed at zero concentration). Detailed instructions for carrying out the triangular test are given in ISO 4120 (Sensory analysis - Methodology - Triangular test)[1/] or the equivalent national standard. The following is a summary of the procedure.

An assessor is presented with a set of 3 identical receptacles each containing at least 10 g of sample. The receptacles are coded with 3- or 4-digit random numbers. Two samples are identical and the third is different. The assessor is required to select the single sample. The assessor may assess the sample by odour or flavour or both. If the assessor can confidently make the selection on odour there is no need to proceed to tasting the samples.

The pair of identical samples can be from the test material or from the control, but across all the assessors there should be an equal (or near equal in the case of an odd number of assessors) presentation of the two

possibilities. Further, within each of these two possibilities there are three ways the receptacles can be ordered when presented to the assessors giving six combinations in all. If the test and control materials are denoted as A and B the six combinations are AAB, ABA, BAA, BBA, BAB and ABB. As far as possible, considering the number of assessors, the combinations should be presented an equal number of times and distributed randomly among the assessors.

The ISO standard[1/] permits a "forced choice" or "no difference" option. The "forced choice" option is however recommended, that is, the option where the assessor must make a selection even if that selection is made by hardly more than guessing.

The number of assessors who correctly identify the odd sample is recorded.

3 DATA RECORDING AND PROCESSING

3.1 Nature of the data

Data from triangular tests have the nature of binary data: the response is correct or is not correct. The data then is similar to data obtained from dose/effect trials and can be processed by procedures used in them.

There is an important difference between the responses from triangular tests and typical dose/effect trials in that in the former there is a probability of 1/3 that an effect, a correct selection of the odd sample, will be recorded even when the stimulus, the taint, is not detectable. This is equivalent in dose/effect trials to 1/3rd of the animals in the control group showing the effect.

A proportion of control animals showing the effect can occur in dose/effect trials and the results from the test exposures can be corrected for the proportion or is included in the statistical model as data point. However, in the triangular test this probability of 1/3 of making the correct

selection by chance is a fixed probability and derives from the statistical model of the triangular test. It should be incorporated in any procedure for processing the data.

There are a number of ways of processing the data but one of the following should be suitable depending on the nature of result required and the computing facilities available.

3.2 Data processing procedures

3.2.1 Significance of the effect at a known concentration

The exposure test may be carried out at one concentration to determine whether or not the test compound taints at that concentration, for example when screening chemicals as candidates for tainting below some limiting concentration.

The probability that a particular number of correct selections of the odd sample would be obtained by chance in a triangular test is binominally distributed and the probability of obtaining a given number of correct selections by chance can be calculated from the properties of this distribution. The minimum number of correct selections for selected significance levels for ranges of panel sizes are tabulated in most manuals of sensory analysis, including ISO 4120.

3.2.2 Calculation of threshold concentration by the method of limits

This procedure is based on the threshold model and assumes that above a limiting concentration in a series of increasing concentrations an assessor will always correctly select the odd samples while below it the assessor will make both correct and incorrect selections. It is a suitable procedure when the substance has been tested at five or more concentrations which should be in a geometric series with a fixed concentration ratio. The threshold concentration should be near the centre of the range of concentrations tested.

The procedure for determining the threshold is described in full in the American Society for Testing and Material's standard ANSI/ASTM E679-79, Standard Practice for Determination of Odour and Taste Thresholds by a Forced-choice Ascending Concentration Series Method of Limits[2/]. The following is a brief summary.

For each assessor the results of the triangular test, either correct or incorrect, are listed in ascending sequence of the concentrations. The point at which an incorrect selection is followed by a complete run of correct selections is noted. A single correct selection at the highest concentration tested following an incorrect selection is counted as a run. The threshold for the assessor is the geometric mean of the concentration of the incorrect selection and that of the following, correct selection. If there are sets of data in which all selections are correct or in which there is an incorrect selection at the highest concentration then it is conventional to assume in the former case that the next lowest test concentration if it had been present would have resulted in an incorrect selection and in the latter case the next higher concentration if it had been tested would have resulted in a correct selection. The calculation proceeds as described using these fictional extra concentrations.

The threshold for the panel is calculated as the geometric mean of all the individual thresholds.

3.2.3 Graphical procedure for determining the threshold

If proportions of assessors truly detecting the taint are plotted against the logarithms of concentrations of test substance in the ambient water the points form a sigmoid curve. The threshold is the concentration corresponding to the point of inflexion of this curve. The line can be linearised by adjusting the observed proportions for the proportion of correct responses obtained by guessing and assuming the resulting ogive is the cumulate of the normal distribution function.

At a concentration between the extremes, (when all assessors are guessing and when all can correctly distinguish the odd sample) the proportion of assessors correctly selecting the odd sample consists of those who truly distinguished the odd sample and those who could not distinguish it but were forced to choose and selected correctly by chance. If P = proportion of correct selections, P_d = proportion of assessors who can detect at that concentration, and P_n the proportion who cannot detect, then

$$P = P_d + \frac{P_n}{3}$$

Given that $P_d + P_n = 1$ this equation can be rearranged to

$$P_d = \frac{3P - 1}{2}$$

The proportion of detectors calculated in this way is plotted against the logarithm of exposure concentration on normal probability graph paper and a straight line drawn through the points. The concentration where $P_d = 0.5$ is the threshold, the concentration at which 50% of the population can detect the change in concentration. Alternatively the proportions can be converted to probits using tables in manuals of statistics and the probits plotted on linear graph paper against logarithm of concentration. Again, a straight line can be drawn through the points and the threshold is the concentration corresponding to a probit of 0.

3.2.4 Calculating the threshold using probits

This procedure is the analytical version of that described in the preceding section but has the advantage that fiducial limits can be calculated for the estimate of the threshold.

The probits obtained as described in 3.1.3 are fitted by an iterative procedure to a weighted linear model to calculate the threshold and its standard error. Programmes for performing the calculation on computers have been published and many computer statistical packages contain procedures for the calculation. Some programmes and packages enable the user to correct for the response at zero concentration; proportion of 1/3 in the case of the triangular test.

3.2.5 Calculating the threshold using the logistic model[3/]

The probit procedure assumes that the ogive formed by plotting proportion against logarithm of concentration is that of the cumulative probability distribution function of the normal distribution. This curve and that given by the cumulate of the logistic function are very similar and observations from exposure tests can be fitted equally well to either.

Both models have been used in computing median effects like the LC_{50} but the mathematical properties of the logistic model are simpler when it comes to curve fitting.

The form of the logistic model for the proportion, P, of correct selections in the triangular test for determining thresholds is:

$$P = \frac{1/3 + e^{k}}{1 + e^{k}}$$

k is the linear function $b(x - t)$ where b is a slope parameter, x is the logarithm of the concentration, and t is the location parameter, the threshold in log concentration units. It can be seen from this equation (and also from the equation in 3.2.1) that the proportion of correct responses at the threshold is 2/3.

The experimental data can be fitted to this model using an iterative procedure weighting the data at each concentration by the probability given by the logistic model. Computational procedures for this fitting are not usually explicitly included in statistical packages but those such as GLIM which include programmes for fitting generalised linear models by maximum likelihood methods can be adapted to fit data to this model.

REFERENCES

1 ISO (International Organization for Standardization) 4120-1983(E) Sensory Analysis-Methodology-Triangle Test.

2 ASTM (American Society for Testing Materials) E 679-79 Determination of Odour and Taste Thresholds by a Froced-Choice Ascending Concentration Series Method of Limits.

3 P. Howgate, Unpublished Report.

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ANNEX 9

ADVICE FOR AQUATIC TOXICITY TESTING OF SUBSTANCES OR OF MIXTURES CONTAINING COMPOUNDS OF LOW SOLUBILITY

1 Preparation of test solutions

1.1 In principle, five or more test solutions should be prepared in a geometric series of concentrations bracketing the expected LC50. Each test concentration should be prepared separately by measuring the required amount of substance and adding it to the suitable, measured, volume of water. The solutions should not be prepared by dilution of one stock solution only.

1.2 Thoroughly mix these amounts into the water phase by continuously and rigorously stirring, for periods long enough to reach equilibrium, guided either by chemical analyses or by choosing periods of 16-24 hr.

1.3 When, for non-toxic substances, only one high concentration is tested (e.g. 10 $g.l^{-1}$), this will only be acceptable if it is shown by chemical analysis that mixing of the substance with sea water resulted in equilibrium between these two phases.

1.4 Solvents may be used to add those amounts that cannot otherwise be adequately added; but it should still be shown that equilibrium is obtained (for type and concentration of solvents to be used, see other international guidelines, e.g. OECD).

1.4 Use these mixtures, or alternatively, the aqueous phases after some settling time, avoiding physical contact of small test animals with the undissolved material.

1.5 Avoid loss of the test compound by evaporation during the stirring and settling periods. It should be shown by chemical analysis that there was a negligible loss or that the procedure was carried out in such a way that the loss would be neglible. An appropriate procedure would be to make the extraction in closed containers (glass stoppered Erlenmayer flask) with very little air space (this is important only for volatile or codistilling products).

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2 Carrying out the biological test

2.1 Exposure time to be appropriate to test animals.

2.2 Daily renewal of test medium, prepared as described under 1 above.

2.3 Advised and preferred test species:

- a small marine crustacean, e.g. young mysid shrimp (Mysidopsis bahia) or young gammarids (Chaetogammarus marinus); and

- a small fish (so as to avoid the need to prepare large volumes of test solutions).

2.4 Preferably no aeration should be made, especially when volatile or codistilling products are present. For volatile compounds it will be necessary to test in closed containers.

2.5 Record oxygen concentration and pH of the test solutions.

2.6 The LC50 values (with 95% confidence limits), the "no observed effect level" (NOEL), etc. are to be expressed as mg of the substance added per litre of water used for extraction.

2.7 Supply complete test report, including details on sample characteristics, the method(s) and all raw data.

2.8 When large animals are used, e.g. adult Crangon crangon (brown shrimp) or fish of 3-6 cm, it is strongly advised not to test via an aqueous phase (WSF) prepared as described here because it would be very difficult to prepare in a proper way the large volumes needed. The test system with the "propellor mixing", in which test substance and water are in continuous contact, is under these circumstances a good alternative.

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CHARACTERISTICS OF LIQUID CHEMICALS PROPOSED FOR MARINE TRANSPORT IN BULK

Please supply all relevant information available. If necessary, use additional sheets. All information should relate to the product in the form carried.

When completed, this questionnaire should be returned to:

1 IDENTITY OF PRODUCT

1.1 Name of chemical:

1.2 Other chemical or trade names:

1.3 Chemical formula (If carried as a solution, indicate concentration and solvent; if as a mixture, specify composition):

1.4 United Nations classification (if any)	UN Number:	UN class:	Subsidiary risks:	Packaging group:

2 PHYSICAL PROPERTIES

Note: If the material is to be carried at other than ambient temperature, state the proposed carriage temperature: °C; and where possible supply physical data below at this temperature as well as at ambient.

2.1 Melting point or range: °C

2.2 Boiling point or range: °C

2.3 Relative density (specific gravity)
at 20°C:
at 37.8°C:
at carriage temperature
(if different):

2.4 Solubility in water:
mg/100 ml at 20°C

2.5 Vapour pressure, kPa at 20°C:
at 37.8°C:
at 45°C:
at carriage temperature
(if different):

2.6 Vapour density:

2.7 Dynamic viscosity at 20°C: Pa/s
at carriage temperature
(if different): Pa/s

2.8 Colour:

2.9 Odour and odour threshold (ppm):

2.10 Impurities likely to be present (with concentrations):

2.11 Coefficient of cubical expansion:

2.12 Electrical conductivity:

2.13 Other relevant physical data:

3 CHEMICAL PROPERTIES

3.1 If the product is corrosive to or reactive with normal ship construction materials (listed below), indicate the nature of the problem and supply corrosion rates, etc., if available.

Mild steel	Zinc
Stainless steel	Brass
Aluminium	Other (specify)
Copper	

3.2 Is inhibition or stabilization required to prevent hazardous reactivity?

YES NO

If so, state inhibitor or stabilizer used:

Concentration:

How long will the inhibitor or stabilizer remain active at the carriage temperature?

Conditions or materials likely to render the inhibitor or stabilizer ineffective:

3.3 Does the material require tank environmental control? YES NO

If so, give details below of the hazards to be overcome and the methods used.

1. Vapour space control, e.g. to prevent peroxide formation, dangerous reaction with moisture, flammability hazards, etc.:

2. Temperature control, e.g. to prevent dangerous self reaction:

3. Any other environmental control.

3.4 Will the material react with water or steam to produce gas, aerosols or significant quantities of heat? YES NO

If so, give details:

3.5 Give details of any other hazards or characteristics not mentioned above, such as possible hazardous reactions with other cargoes, temperature sensitivity, oxidizing properties, explosive properties, stability problems, etc.:

3.6 Are highly toxic vapours produced at high temperatures or in a fire?

YES NO

If so, supply details:

4 FLAMMABILITY

4.1 Flashpoint: °C open cup closed cup	4.4 Suitable extinguishing agents, in order of effectiveness:
4.2 Autoignition temperature: °C (ASTM D 2155-66; DIN 51794)	4.5 Temperature Class, as defined in IEC Publication 79 (T1 to T6):
4.3 Flammable limits (volume % in air at 20°C and 1 atmosphere): Upper limit per cent Lower limit per cent	4.6 Apparatus Group, as defined in IEC Publication 79 (IIA, IIB or IIC):

5 HARMFUL BIOLOGICAL EFFECTS

5.1 *TO HUMANS*

Acute Effects

Describe toxic effects from inhalation, ingestion and skin absorption. Include information on pathological findings if available. State approximate quantities or concentrations which will produce symptoms and serious effects.

Irritation and Sensitization

Describe any irritant or corrosive effects on the lungs. State whether sensitization by skin contact or inhalation can occur.

Repeated Exposure Effects

State whether repeated exposure can result in cumulative toxic effects or chronic effects, including carcinogenicity.

Past Experience

Describe past experience relating to hazards of handling and transporting this material.

5.2 *TO OTHER MAMMALS*

Supply all relevant information, including data sources or copies of laboratory reports.

5.2.1 INHALATION TOXICITY

.1 Acute LC_{50}: ppm
Time, specifiy: (1 hour or 4 hours are preferred):
Specify test animal (preferred species is rat):

.2 Does inhalation of vapours cause allergic sensitization? YES NO
If so, supply details:

.3 Are the vapours corrosive or strongly irritating? YES NO
If so, supply details:

.4 Will repeated exposure to vapours cause chronic or cumulative effects? YES NO
If so, supply details:

.5 Will exposure to the vapour cause a narcotic effect? YES NO
If so, at what concentration?

5.2.2 DERMAL TOXICITY

.1 Acute LD_{50}: mg per kg
Specify test animal (preferred species is rabbit):

.2 Is the material readily absorbed by the skin? YES NO

.3 Does the material cause skin sensitization? YES NO
If so, supply details:

.4 Will repeated exposure to the material cause chronic or cumulative effects? YES NO
If so, supply details:

5.2.3 ORAL TOXICITY

.1 Acute LD_{50} mg per kg
Specify test animal (preferred species is rat):

.2 Will repeated ingestion cause chronic or cumulative effects? YES NO
If so, supply details:

5.2.4 CORROSIVITY TO SKIN (state species used):
Does the material cause irritation or corrosion to the skin? YES NO
If so, does visible necrosis of the skin occur in: less than 3 minutes?
less than 1 hour? less than 4 hours? more than 4 hours?

5.2.5 SPECIFIC TOXIC EFFECTS
Has the material been tested for specific toxic effects such as neurotoxicity, mutagenicity, teratology or reproductive effects?

Give details of the results, indicating the species tested.

5.3 *TO FISH*

Supply all relevant information, including data sources or copies of laboratory reports.

5.3.1 ACUTE TOXICITY TO AQUATIC ORGANISMS

Preferably supply 96-hour TLm (the concentration of the substance which will within 96 hours kill 50% of the exposed group of test organisms) with confidence limits.

	(a) a marine fish	(b) a marine crustacean
.1 Subject of test		
.2 96 hours TLm		
.3 Confidence limits		
.4 Method of test (static, static replaced, intermittent flow, etc.)		
.5 Conditions of test		
Temperature	°C	°C
Salinity		
Number of animals		
Test volume (litre)		

If further information is available, please supply on a separate sheet.
If no information on marine species is available, please supply data on freshwater species.

5.3.2 BIOACCUMULATION IN MARINE ORGANISMS

.1 Rate of uptake: Accumulation factor for uptake: Retention time or half life:	.3 Tainting potential:
.2 Octanol/water partition coefficient (Log_{10}):	.4 Colouring potential:

5.4 *OTHER PROPERTIES OF INTEREST IN ENVIRONMENTAL ASSESSMENT CONTEXT*

5.4.1 Biodegradability:	5.4.5 Lipid solubility:
5.4.2 Chemical oxygen demand:	5.4.6 Biotransformation:
5.4.3 Biochemical oxygen demand:	5.4.7 Reactivity with air:
5.4.4 Reactivity with seawater:	5.4.8 Other (specify):

6 OTHER RELEVANT INFORMATION

6.1 Recommended personnel protection for handling and emergency use:

6.2 IMO Medical First Aid Guide table number:

6.3 Recommended antidotes and first aid treatment:

6.4 Methods of vapour detection (including sensitivity):

6.5 Recommended emergency procedures in cases of:

6.5.1 Spillages:

6.5.2 Fire:

6.6 Other:

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ANNEX 11

BIBLIOGRAPHY

For the very large number of substances which have been considered by the Working Group a large number of manuals and electronic data base sources are consulted. The individual data sheets for each substance include such references as part of the record of decisions taken.

The following list is intended only as a general guide to the most commonly used reference sources. In some cases these reference works are compilations of data rather than primary reference works. However, original references are consulted in many cases to ensure the adequacy and relevance of the information.

General Chemistry and Physical Properties:

The Condensed Chemical Dictionary - as revised by Hawley, G.G.: Van Nostrand Reinhold Co., New York.

The Merck Index - Stecher, P.G., et al. (eds.): Merck and Co. Inc., Rahway N.J., USA.

Handbook of Chemistry and Physics: CRC Press Inc. Boca Raton, Florida, USA.

Aquatic Toxicology:

The Toxicity of 140 Substances to Marine Organisms: Portmann, J.E. and Wilson, K.W., MAFF Fisheries Information Leaflet No. 22, 1971.

The Effects of Effluents from the Canadian Plastics Industry on Aquatic Organisms: Smith, A.L.; Fisheries and Marine Service Canada, Tech. Rep. 473 pp. 64.

Toxicity of 4,346 Chemicals of Larval Lampreys and Fish: United States Dept. of the Interior Fish and Wildlife Service, Special Sect. Rep. No. 207, 1957.

Wirkungskonzentration (gesundheits-) schädigender bzw. toxischer Stoffe in Wasser für niedere Wasserorganismen sowie kalt - und warmblütige Wirbeltiere einschliesslich des Menschen bei oraler Aufnahme des Wassers oder Kontakt mit dem Wasser. Hygiene - Institut des Ruhrgebiets, Gelsenkirchen, 1972 und Ergänzung 1976. (in German)

Effects of Chemicals on Aquatic Life. Water Quality Criteria Data Book Vol. 3: United States Environmental Protection Agency, 1971.

Water Quality Control Branch of California, 1963.

Water Quality Criteria Documents for a Variety of Compounds, e.g. Phthalates and PCBs, published by the United States Environmental Protection Agency.

Bioaccumulation and Elimination of Selected Water Pollutants by Bluegill Sunfish (Lepois macrochirus): Dynamics, Exposure and Hazard Assessment of Toxic Chemicals, Ed. R. Hague: Ann Arbor Science Pub. Inc. M.I. 1980.

Partition Coefficients and their Uses: Leo, A.H., Hansch, C., Hausich and Elkins, D; Chemical Reviews, 71 (6), 525-616, 1971.

Results of Studies on the Acute Toxicity of 200 Chemical Compounds Using the Golden Orfe. von Juhnke, I. and Ludemann, D.; Zeitschrift für Wasser und Abwasser-Forschung, 1978, 11 (5), 161-165 (in German).

The Acute Toxicity of 78 Chemicals and Pesticide Formulations Against Two Brackish Water Organisms, the Bleak (Alburnus alburnus) and the Harpaticoid Nitocra spinipes. Linden, E., Bengtsson, B-E., Svanberg, O. and Sundstrom, G.; Chemosphere, 11/12, 843-851, 1979.

Measuring and Estimating the Bioconcentration Factor of Chemicals in Fish. Veith, G.D., DeFoe, D. L. and Bergstadt, B.V. J.; Fish Res. Cd. Con., 36 (9), 1040-1048, 1979.

Handbook of Environmental Data on Organic Chemicals - Ed. K. Verschuren; Van Nostrand Reinhold Co., New York.

The Acute Toxicity of Some Petrochemicals to Goldfish: Bridie, A.L., Wolf, C.J.M. and Winter, M.; Water Res., 13, 623-626, 1979.

The Acute Toxicity of Some Substances Carried by Ships: Bengtsson, B-E., and Tarpea, M., Marine Pollut. Bull., 14 (6), 213-214, 1983.

Befunde der Schadwirkung wassergefährdender Stoffe gegen Daphnia magna: von Brinkman, B. und Kuhn, R.; Zeitschrift für Wasser und Abwasser-Forschung 10 (5) 161-166, 1977.

Partition Coefficients and Bioaccumulation of Selected Organic Chemicals: Chon, C.T., Freed, V.H.; Schmedding, D.W. and Kohnert, R. L.; Environ. Sci. and Tech., 11 (5), 475-478, 1977.

The Acute Toxicity of 47 Industrial Chemicals to Fresh and Salt Water Fishes: Dawson, C.W., Jennings, A.C., Drozdowski, D., and Rider, E.; J. of Hazardous Materials 1, 303-318 1975-1977.

Shell Industrie Chemicaliën Gids (1981) (in Dutch): Shell Nederland Chemie B.V., Afd. Industriechemicaliën, Floris Grijpstraat 2, 2596 XE 's-Gravenhage.

Acute toxicity of 54 Industrial Chemicals to Sheepshead Minnow Cypri nodon variegatus): Heitmuller, P.T., Mollister, T.A. and Parrish, P.R. Bull. Environm. Contam. Toxicol. 27, pp 596-604, 1981

Ergebnisse der Schadwirkung wassergefährdender Stoffe gegen Daphnia magna in einem weiterentwickelten standardisiertem Testverfahren: Bringmann, G. and Kühn, R. Z. Wasser Abwasser Forsch. 15 (1), pp 1-6, 1982.

Structure-Toxicity Relationships for the Fathead Minnow, Pimephales promelas; Veith, G.D., Call, D.J. and Brooks, L.T. Can. J. Fish. Aquat. Sci. 40, pp 743-748, 1983.

Acute Toxicities of Organic Chemicals to Fathead Minnows (Pimephales promelas): Brooke, L.T., Call, D.J., Geiger, D.L. and Northcott, C.E. (eds). Center for Lake Superior Environmental Studies, University of Wisconsin-Superior, Volume I, II and III.

Manual of Acute Toxicity: Mayer, F.L. Jr., and Ellersieck, M.R.: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. United States Department of the Interior, Fish and Wildlife Service, Resource Publication 160, 506 pp., 1986.

Tainting

Compilation of Odor and Taste Threshold Values Data: ASTM Data Series DS 48A. F.A. Fazzalari (ed). American Society for Testing and Materials, Philadelphia, USA, 1978.

Evaluation of Fish Tainting: European Chemical Industry Ecology and Toxicology Centre. Technical Report No. 25. ECETOC, Brussels, Belgium, 1987.

Impairment of the Flavor of Fish by Water Pollutants: Shumway, D.L. and Palensky, J.R.; EPA-R3-73-010. Office of Research and Monitoring, US Environmental Protection Agency, Washington, USA, 1973.

Uptake and Release of Environmentally Occurring Odorous Compounds by Fish - A review: Persson, P-E.; Water Research, 18, 1263-1271, 1984.

Mammalian and Human Toxicology

General Publications

Handbook of Toxic and Hazardous Chemicals; M. Sittig (ed.); Noyes Publications, New Jersey, 1985.

Clinical Toxicology of Commercial Products; edited by R.E. Gosselig, R.D. Smith, Hodge, H.C. and Braddock. J.E. Williams and Wilkins, Baltimore, 1984.

Registry of Toxic Effects of Chemical Substances: Publ. United States National Institute of Chemical Substances. United States National Institute of Occupational Safety and Hygiene.

Documentation of the Threshold Limit Values: American Conference of Governmental Industrial Hygienists.

Encyclopedia of Occupational Health and Safety; Vols. 1 and 2; International Labour Office, Geneva.

Poisoning; J.M. Arena and R.H. Drew (eds.); Charles C. Thomas, Springfield.

Chemical Hazards of the Work Place; Eds.: N. Proctor and J. Hughes; Publ. Lippincott, Philadelphia.

Dangerous Properties of Industrial Materials; Ed. I. Sunshine: The Chemical Rubber Co., Cleveland, Ohio, 1969.

Occupational Medicine, and Developments in Occupational Medicine; Zenz, C.; Year Book Medical Publishers, Chicago.

SPECIFIC TOPICS

The Pesticide Manual, A World Compendium; edited by C.R. Worthing and S. B. Walker. British Crop Protection Council, 1987.

Pesticide Index; edited by W.J. Wiswesser; Entomological Society of America.

Catalog of Teratogenic Agents; Shepart, T.H.; John Hopkins Press.

Reproductive Hazards of Industrial Chemicals; Barlow, S.M. and Sullivan, F.M., Academic Press, London.

Occupational Contact Dermatitis; Foussereau, J., Benezra, C. and Haibah, H.. Munksgaard.

Contact Dermatitis: E. Cronin. Churchill-Livingston, Edinburgh, 1980.

Ethel Browning's Toxicity and Metabolism of Industrial Solvents; Editor R. Snyder; Elsevier, Amsterdam.

Potential Industrial Carcinogens and Mutagens. Studies in Environmental Science, Vol. 4 - L. Fishbein (ed.) Elsevier, Amsterdam.

Toxicology of the Eye, W.M. Grant (ed).: Thomal, Springfield.

Information on specific compounds taken from the following:

Bioassays for Possible Carcinogens, National Cancer Institute, USA/

Current Intelligence Bulletin, National Institute of Occupational Safety and Hygiene, USA.

Criteria Documents for Recommended Standards, National Institute of Occupational Safety and Hygiene, USA.

IARC Monographs - International Agency for Research on Cancer, Lyon, France.

Environmental Health Criteria, Series World Health Organization, Geneva.

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APPENDIX */

THE ROLE OF GESAMP IN EVALUATING MARINE POLLUTION HAZARDS OF SUBSTANCES CARRIED BY SHIPS

*/ The text contained in this Appendix has been prepared by the IMO Technical Secretary of GESAMP in order to illustrate how the GESAMP hazard evaluations of substances carried by ships are being used by IMO for the implementation of its Conventions. It also demonstrates how the results of an independent scientific advisory body is being used in a rather direct way for establishing regulatory provisions.

1 Introduction

GESAMP is the recognized scientific advisory body for IMO in matters related to the evaluation of the hazards of substances carried by ships. It provides a scientific basis for the implementation of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 related thereto (MARPOL 73/78).

MARPOL 73/78 includes five Annexes as follows:

ANNEX I - Regulations for the Prevention of Pollution by Oil

ANNEX II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk

ANNEX III - Regulations for the Prevention of Pollution by Harmful Substances carried by Sea in Packaged Forms, or in Freight Containers, Portable Tanks or Road and Rail Tank Wagons.

ANNEX IV - Regulations for the Prevention of Pollution by Sewage from Ships.

ANNEX V - Regulations for the Prevention of Pollution by Garbage from Ships.

In addition, the International Conference on Marine Pollution, 1973, in context with the above regulations adopted resolution 17 on Recommendations Concerning the Prevention of Pollution by Noxious Solid Substances Carried in Bulk, refereing to a possible need to formulate appropriate provisions concerning pollution from bulk solids for inclusion in MARPOL 73/78 at a later stage.

In 1987 the Marine Environment Protection Committee of IMO agreed that work for the preparation of regulations for the prevention of pollution by noxious solid substances carried in bulk be started in the near future for possible inclusion in an Annex VI to MARPOL 73/78.

The hazard evaluation process and the hazard profiles developed by GESAMP as described in this report are currently used by the relevant IMO bodies for establishing criteria and requirements for.

.1 the discharge at sea of residues and tankwashings from chemical tankers (MARPOL 73/78, Annex II)

.2 the allocation of ship (chemical tanker) type requirements for the carriage of chemicals (MARPOL 73/78, Annex II and the IBC and BCH Codes (see section 3 below)); and.

.3 the identification of goods carried in packaged forms as "marine pollutants"; (MARPOL 73/78, Annex III and the IMDG Code (see section 4 below)).

IMO is developing a manual on chemical pollution and one of its sections deals with search and recovery of packaged goods accidentally lost at sea. Whether lost packaged goods should be searched and recovered depends on many factors but in assessing the environmental hazards such goods would present, it is recommended that the GESAMP hazards profiles of the substances involved be taken into account.

The consideration of preventive measures concerning marine pollution by noxious solid substances in bulk will also be based on the GESAMP hazard profiles.

2 Discharge requirements

Detailed requirements concerning the amounts, concentrations and circumstances under which residues might be discharged into the sea are prescribed in accordance with the severity of hazards of the substances concerned. In this respect all substances are assigned with pollution categories (A, B, C, or D) on the basis of Guidelines as follows:

2.1 Guidelines for the Categorization of Noxious Liquid Substances (MARPOL 73/78, Annex II, Appendix I).

Category A Substances which are bioaccumulated and liable to produce a hazard to aquatic life or human health; or which are highly toxic to aquatic life (as expressed by a Hazard Rating 4, defined by an LC50 less than 1 ppm); and additionally certain substances which are moderately toxic to aquatic life (as expressed by a Hazard Rating 3, defined by an LC50 of 1 or more, but less than 10 ppm) when particular weight is given to additional factors in the hazard profile or to special characteristics of the substance.

Category B Substances which are bioaccumulated with a short retention of the order of one week or less; or which are liable to produce tainting of the sea food; or which are moderately toxic to an LC50 of 1 ppm or more, but less than 10 ppm; and additionally certain substances which are slightly toxic to aquatic life (as expressed by a Hazard Rating 2, defined by an LC50 of 10 ppm or more, but less than 100 ppm) when particular weight is given to additional factors in the hazard profile or to special characteristics of the substance.

Category C Substances which are slightly toxic to aquatic life (as expressed by a Hazard Rating 2, defined by an LC50 of 10 or more, but less than 100 ppm); and additionally certain substances which are practically non-toxic to aquatic life (as expressed by a Hazard Rating 1, defined by an LC50 of 100 ppm or more, but less than 1,000 ppm) when particular weight is given to additional factors in the hazard profile or to special characteristics of the substance.

Category D Substances which are practically non-toxic to aquatic life, (as expressed by a Hazard Rating 1, defined by an LC50 of 100 ppm or more but less than 1,000 ppm); or causing deposits blanketing the sea floor with a high biochemical oxygen demand (BOD); or highly hazardous to human health, with an LD50 of less than 5 mg/kg; or

produce moderate reduction of amenities because of persistency, smell or poisonous or irritant characteristics, possibly interfering with use of beaches; or moderately hazardous to human health, with an LD50 of 5 mg/kg or more, but less than 50 mg/kg and produce slight reduction of amenities.

2.2 Categorization table

As part of an interpretation of the Guidelines set out above, the following table was adopted by IMO. It will be noted that no reference in that table is made to column D of the GESAMP hazard profiles. The column D rating by GESAMP has been dispensed with for this categorization as that rating relates to hazard to human health (skin contact and inhalation) which in the view of IMO has no direct bearing on aquatic pollution. GESAMP however continues evaluation under column D, due to its importance for assigning ratings under column E (reduction of amenities).

Hazard profile				Annex II pollution category
A	B	C	E	
+	-	-	-	category A
-	4	-	-	
T	3	-	-	
Z	3	-	XXX	
T	-	-	-	category B
Z	-	-	-	
-	3	-	-	
-	2	-	XXX*	
-	2	-	-	category C
-	1	4	XX	
-	1	3	XX	
-	1	-	-	category D
-	-	4	-	
-	-	3	X	
-	-	-	XXX	
-	-	-	XX	
-	D/BOD	-	-	

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* Subject to the proviso that the substance is non-volatile and insoluble (vapour pressure less than 1 mm HG at 20°C and solubility less than 2g/100 ml at 20°C); otherwise it may be rated as category C.

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3 Minimum requirements for the carriage of chemicals

In 1971 the International Maritime Organization adopted a Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk with a view to providing internationally agreed standards for the safe carriage by sea of chemicals in bulk. This described the constructional features of ships involved in such carriage and the equipment they should carry with regard to the hazards of the products involved. The basic philosophy was one of ship types (Ship types 1, 2 and 3) related to the hazards of the various chemicals covered by the so-called "Bulk Chemical Code" (BCH Code).

The Code became mandatory as "International Bulk Chemical Code" (IBC Code) for chemical tankers built after 1 July 1986 under the 1983 amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74). In 1985, the IBC and BCH Codes was extended to cover marine pollution aspects for the implementation of MARPOL 73/78, Annex II and thus became mandatory under MARPOL 73/78 from 6 April 1986.

The IBC and BCH Codes include guidelines for the assignment of ship types from the viewpoint of marine pollution prevention as set out in the following.

3.1 Text of Guidelines

3.1.1 Ship Type 1

.1 Substances which are bioaccumulated to a significant extent and are known to produce a hazard to aquatic life or human health ("+" in column A of the GESAMP hazard profile) and which are highly toxic to living resources ("4" in column B); or

.2 Substances which are bioaccumulated to a significant extent are known to produce a hazard to aquatic life or human health ("+" in column A) and which cause severe reduction of amenities ("XXX" in column E); or

.3 Substances which are liable to cause tainting of seafood ("T" in column A)* and which are highly toxic to living resources ("4" in column B).

3.1.2 Ship type 2

.1 Substances which are bioaccumulated to a significant extent and are known to produce a hazard to aquatic life or human health ("+" in column A) except those in type 1 above; or

.2 Substances which are bioaccumulated with attendant risk to aquatic organisms or human health, however with short retention of the order of one week or less ("Z" in column A) and which are highly or moderately toxic to living resources ("4" or "3" in column B); or

.3 Substances which are bioaccumulated with attendant risk to aquatic organisms or human health, but with short retention of the order of one week or less ("Z" in column A) and which cause severe reduction of amenities ("XXX" in column E).

.4 Substances which are liable to cause tainting of seafood ("T" in column A)* except those in type 1 above; or

.5 Substances which are highly toxic to living resources ("4" in column B); or

.6 Substances which are moderately toxic to living resources ("3" in column B) and which cause severe reduction of amenities (XXX in column E).

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* See the note to 3.2 Allocation table on page 10.

3.1.3 Ship type 3

All substances which do not fall under the criteria for ship types 1 and 2 above but which have been allocated with pollution categories A, B and C in accordance with Appendix I to Annex II of MARPOL 73/78 (see 2.1 above).

3.2 Allocation table

For ease of interpretation the criteria detailed in 3.1 above are shown in tabular form below. Those products whose hazard profiles exhibit the complete spectrum required by any one horizontal line in the table should be restricted to carriage in the ship type prescribed (or in ships offering even better protection).

Ship type	Bioaccumulation and tainting A	Damage to living resources B	Reduction of amenities E
1	+	4	
	+		XXX
	T*	4	
2	+		
	Z	4	
	Z	3	
	Z		XXX
	T*		
	O	4	
	O	3	XXX
3	All other substances falling under pollution categories A, B and C.		

T*: Substances with strong tainting properties as identified by the Sub-Committee on Bulk Chemicals at its thirteenth session. These are as follows:

Camphor oil	Dichlorophenols
Creosote (wood tar)	Ethyl acrylate
Cresols (mixed isomers)	Naphthalene
Carbolic oil	alpha-Methyl naphthalene
Dichloroethyl ether	Naphthenic acids

Note: The Sub-Committee selected the "tainters" listed above on the basis of experiences gained by actual spill situations. It agreed that substances which in accordance with internationally accepted testing procedures on tainting (e.g. the GESAMP Guidelines for Evaluation Threshold Values for Tainting Seafood) and show to taint fish would be included in the list.

4 Criteria for the selection of packaged goods as "marine pollutants"

SOLAS 74 prohibits carriage of dangerous goods in packaged form in ships engaged on international voyages except when carried in accordance with the requirements of part A of SOLAS Chapter VII, which are amplified in the International Maritime Dangerous Goods Code (IMDG Code). Depending on the nature and severity of the hazards of products, the IMDG Code lays down packing, identification, marking labelling, stowage, segregation and other requirements.

The Marine Environment Protection Committee (MEPC) considered how best to implement the requirements of MARPOL 73/78, Annex III, and agreed that they should be implemented through the IMDG Code. For this purpose, the IMDG Code is being extended and environmentally harmful substances are identified in the IMDG Code as "MARINE POLLUTANTS" and their carriage is governed by the Code. MEPC in 1987 agreed on the selection criteria for "marine pollutants" on the basis of the GESAMP hazard evaluation and decided to include them in the Appendix to Annex III of MARPOL 73/78, as follows:

4.1 Text of the Guidelines

For the purposes of this Annex, substances identified by any one of the following criteria are harmful substances:

- Bioaccumulated to a significant extent and known to produce a hazard to aquatic life or to human health (Hazard rating "+" in column A*); or

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* Reference is made to the Composite List of Hazard Profiles, prepared by the IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) which is circulated annually by the Organization by means of BCH circulars to all IMO Member States.

- Bioaccumulated with attendant risk to aquatic organisms or to human health with a short retention of the order of one week or less (Hazard rating "Z" in column A*); or

- Liable to produce tainting of seafood (Hazard rating "T" in column A*); or

- Highly toxic to aquatic life, defined by a LC_{50}/96** hour less than 1 ppm (Hazard rating "4" in column B*).

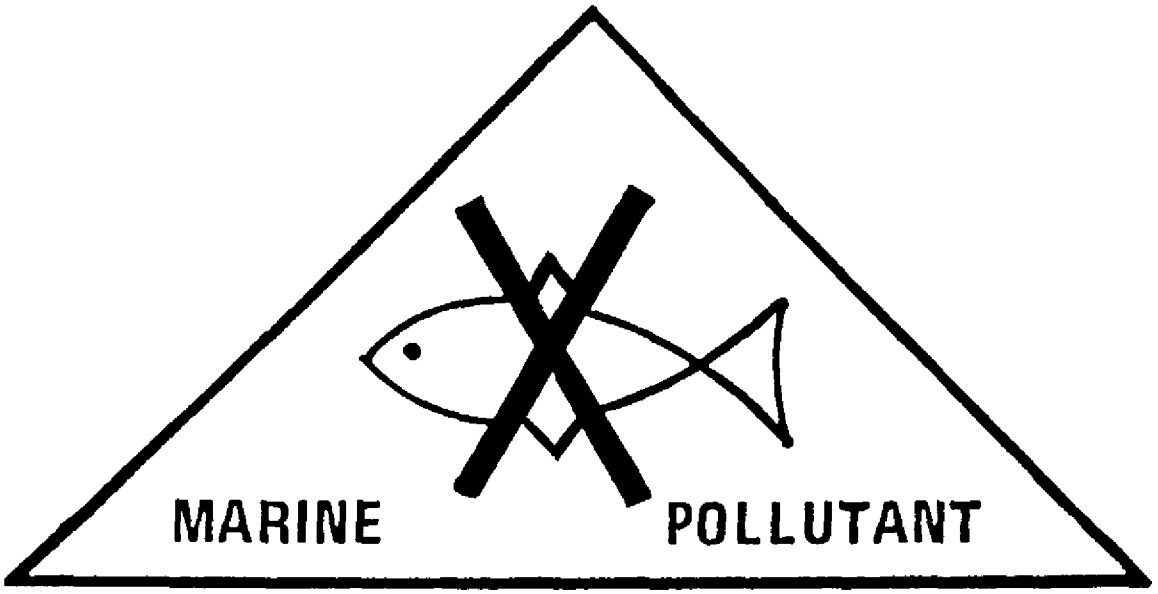
4.2 Allocation table

ANNEX III - MARPOL 73/78			
GESAMP Hazard Profiles			
A	B	C	E
+			
	4		
T			
Z			

** The concentration of a substance which will, within the specified time (generally 96 hours) kill 50% of the exposed group of test organisms. LC_{50} is often specified in mg/l (parts per million (ppm))

4.3 Marine pollution mark

A marine pollution mark for packaged goods which are marine pollutants has been adopted as given hereunder:



5 Substances which are proposed for carriage by ships but have not yet been evaluated by GESAMP

Regulation 3(4) of Annex II of MARPOL 73/78 foresees that liquid substances which are not included in Annex II may be offered for bulk carriage. In such cases, it requires the governments involved in the proposed operation (the governments of exporting and importing States and the flag State of the ship) to establish and agree on the provisional categorization of the substance. The safety hazards of the substance should also be considered and, if need be, minimum carriage requirements should be assigned.

5.2 In order to facilitate the "tripartite" agreement, MEPC agreed on the interpretation of regulation 3(4), establishing the procedures to be followed

in provisional categorization of liquid substances, which are summarized as follows:

1 When a substance which is not included in appendices II or III of MARPOL 73/78 is offered for bulk carriage, a provisional pollution category should be established by the Government of the Party shipping or producing the substance. The provisional assessment shall be carried out in accordance with the hazard evaluation procedures established by GESAMP, the Guidelines for the Categorization of Noxious Liquid Substances (MARPOL 73/78, Annex II, Appendix 1); and the criteria for Establishing Ship Type Requirements from the Marine Pollution Point of View adopted by IMO.

2 The Government of the Party which has carried out a provisional assessment should notify the Government of the State in whose port the cargo will be received and the Government of the flag State of the ship carrying the products of this assessment along with information providing the basis for their pollution and safety hazard assessments. Provisional assessments will be registered at IMO.

In the event of disagreement, the most severe conditions proposed should prevail.

3 The Organization maintains a register of all such substances provisionally assessed until such time as the substances are rated by GESAMP and formally included in the Annex II lists and the IBC and BCH Codes.

6 The pollution categorization of mixtures which have not been evaluated as such by GESAMP

MEPC in 1986 agreed on procedures for assigning pollution categories to mixtures comprised of substances that have individually been categorized.

For each component of a mixture, its percentage concentration is multiplied by a factor appropriate to the respective pollution properties (Table 1).

Table 1

Assigned pollution category	Factor
A	1000
B	100
C	10
D	1
Appendix III	0
Mineral oil used in lube oil additives	10

The multiples are added to obtain a sum (S) which in accordance to another table (Table 2) result in a pollution category of the mixture concerned.

Table 2

Sum of multiples (S)	Calculated pollution category of mixture
10000	A
1000 - 10000	B
100 - 1000	C
10 - 100	D
10	Substance of Appendix III to Annex II

It should also be noted that there is agreement that if a mixture contains 10% or more of a substance for which the highest pollution category in that mixture is assigned, the mixture should be assigned to that category. If less than 10% the next lower category may be assigned. However, this does not apply to a mixture containing 1% or more of a category A substance which is known to be bioaccumulated to a significant extent and to produce a hazard to aquatic life or human health as expressed by an entry of "+" in column A of the hazard profiles developed by GESAMP or substances highly toxic to aquatic life as designated by GESAMP (Rating "4" in column B of the hazard profiles).

In cases where there are mixtures listed in the IMO Bulk Chemical Codes as "solution" with NO reference to percentages, then for calculation purposes the concentration of the pure product should be used. For example, a mixture of calcium hyprochloride solution (category B) and hydrochloric acid (category D) where the calcium hypochloride solution is of 50%, the mixture should be regarded as containing 25% calcium hypochloride (pollution category B), 50% hydrochloric acid (pollution category D) and 25% water.

If a product is decribed in the Bulk Chemical Codes as "solution" qualified by a concentration (e.g. "45% or less") then the mixture should be adjusted to describe it in terms of that compound being at the maximum concentration described in the Code.

7 Calculation of ship types (carriage requirements) for MARPOL 73/78, Annex II Mixtures

Similar as in the cases of assigning pollution categories for mixtures shown in section 6 above the percentage concentration of a substance in a mixture is multiplied with factors according to its ship type assignment (Table 3)

Table 3

Component ship type	Factor
Type 1	100
Type 2	10
Type 3	1
Other	0

The multiples are added to obtain a sum (S) which in accordance with another table (Table 4) will regulate the carriage requirement.

Table 4

Sum of multiples (S)	Calculated ship type (pollution) for mixture
1000	1
100-1000	2
10-100	3
10	-

In cases where a mixture contains 10% or more of the substances for which the highest ship type is assigned, the ship type so assigned should prevail and if it is less than 10%, the next lower ship type may be assigned. If the pollution category derived by the calculation specified above is category C or higher, at least ship type 3 is assigned.

Note: In cases where the reader wishes to obtain more detailed information on the subject described in this appendix he/she should contact the IMO Technical Secretary of GESAMP, IMO Headquarters, (4 Albert Embankment, London SE1 7SR).

Reports and Studies GESAMP

The following reports and studies have been published so far. They are available from any of the organizations sponsoring GESAMP.

1. Report of the seventh session, London, 24-30 April 1975. (1975) Rep.Stud.GESAMP, (1):pag.var. Available also in French, Spanish and Russian

2. Review of harmful substances. (1976) Rep.Stud.GESAMP, (2):80p.

3. Scientific criteria for the selection of sites for dumping of wastes into the sea. (1975) Rep.Stud.GESAMP, (3):21p. Available also in French, Spanish and Russian

4. Report of the eighth session, Rome, 21-27 April 1976. (1976) Rep.Stud.GESAMP, (4):pag.var. Available also in French and Russian

5. Principles for developing coastal water quality criteria. (1976) Rep.Stud.GESAMP, (5):23p.

6. Impact of oil on the marine environment. (1977) Rep.Stud.GESAMP, (6):250p.

7. Scientific aspects of pollution arising from the exploration and exploitation of the sea-bed. (1977) Rep.Stud.GESAMP, (7):37p.

8. Report of the ninth session, New York, 7-11 March 1977. (1977) Rep.Stud.GESAMP, (8):33p. Available also in French, Spanish and Russian

9. Report of the tenth session, Paris, 29 May - 2 June 1978. (1978) Rep.Stud.GESAMP, (9):pag.var. Available also in French, Spanish and Russian

10. Report of the eleventh session, Dubrovnik, 25-29 February 1980. (1980) Rep.Stud.GESAMP, (10):pag.var. Available also in French and Spanisn

11. Marine pollution implications of coastal area development. (1980) Rep.Stud.GESAMP, (11):114p.

12. Monitoring biological variables related to marine pollution. (1980) Rep.Stud.GESAMP, (12):22p.

13. Interchange of pollutants between the atmosphere and the oceans. (1980) Rep.Stud.GESAMP, (13):55p.

14. Report of the twelfth session, Geneva, 22-29 October 1981. (1981) Rep.Stud.GESAMP, (14):pag.var. Available also in French and Russian

15. The review of the health of the oceans. (1982) Rep.Stud.GESAMP, (15):108p.

16. Scientific criteria for the selection of waste disposal sites at sea. (1982) Rep.Stud.GESAMP, (16):60p.

17. The evaluation of the hazards of harmful substances carried by ships. (1982) Rep.Stud.GESAMP, (17):pag.var.

18. Report of the thirteenth session, Geneva, 28 February - 4 March 1983. (1983) Rep.Stud.GESAMP, (18):50p. Available also in French and Spanish

19. An oceanographic model for the dispersion of wastes disposed of in the deep sea. (1983) Rep.Stud.GESAMP, (19):182p.

20. Marine pollution implications of ocean energy development. (1984) Rep.Stud.GESAMP, (20):44p.

21. Report of the fourteenth session, Vienna, 26-30 March 1984. (1984) Rep.Stud.GESAMP, (21):42p. Available also in French, Spanish and Russian

22. Review of potentially harmful substances. Cadmium, lead and tin. (1985) Rep.Stud.GESAMP, (22):114p.

23. Interchange of pollutants between the atmosphere and the oceans (part II). (1985) Rep.Stud.GESAMP, (23):55p.

24. Thermal discharges in the marine environment. (1984) Rep.Stud.GESAMP, (24):44p.

25. Report of the fifteenth session, New York, 25-29 March 1985. (1985) Rep.Stud.GESAMP, (25):49p. Available also in French, Spanish and Russian

26. Atmospheric transport of contaminants into the Mediterranean region. (1985) Rep.Stud.GESAMP, (26):53p.

27. Report of the sixteenth session, London, 17-21 March 1986. (1986) Rep.Stud.GESAMP, (27):72p. Available also in French, Spanish and Russian

28. Review of potentially harmful substances. Arsenic, mercury and selenium. (1986) Rep.Stud.GESAMP, (28)pag.var.

29. Review of potentially harmful substances. Organosilicon compounds (Silanes and Siloxanes). (1986) Printed in limited number only by IMO, but published also as UNEP Reg.Seas Rep.Stud., (78):24p.

30. Environmental capacity. An approach to marine pollution prevention. (1986) Rep.Stud.GESAMP, (30):49p.

31. Report of the seventeenth session, Rome, 30 March - 3 April 1987. (1987) Rep.Stud.GESAMP, (31):36p. Available also in French, Spanish and Russian.

32. Land-sea boundary flux of contaminants: contributions from rivers. (1987) Rep.Stud.GESAMP, (32):172p.

33. Report of the eighteenth session, Paris, 11-15 April 1988. (1988) Rep.Stud.GESAMP, (33):56p. Available also in French, Spanish and Russian

34. Review of potentially harmful substances. Nutrients. (in press). Rep.Stud.GESAMP, (34)

35. The evaluation of the hazards of harmful substances carried by ships: revision of GESAMP Reports and Studies No.17. (1989) Rep.Stud.GESAMP, (35):211p.

36. Pollutant modification of atmospheric and oceanic processes and climate: some aspects of the problem. (in press). Rep.Stud.GESAMP, (36)