TECHNICAL REPORT

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Rubber materials — Chemical resistance

Matériaux en caoutchouc — Résistance chimique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 7620 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

This second edition cancels and replaces the first edition (ISO/TR 7620:1986), which has been technically revised.

Introduction

A wide range of rubber products are used in contact with liquids and other chemicals, in some cases throughout their service life, and thus require suitably resistant rubber formulations. Rubber hoses are used to convey a range of fluids from hot water to fuels, conveyor belting may have to carry aggressive slurries, seals and gaskets are installed to prevent leakage of gases and liquids, rubber-covered rollers manipulate webs as diverse as printing inks, paper pulp and textiles, and rubber-lined tanks are used to store industrial chemicals, including corrosive alkalis and acids, for prolonged periods without risk of contamination. Other products, ranging from tyres to flexible roofing membranes, are exposed to rainfall and atmospheric pollutants.

It is essential a suitably resistant rubber be used because contact with a chemical, whether in the form of a liquid or gas, can lead to deterioration of properties through swelling, extraction of additives and polymer degradation. The rate and extent of such attack depends not only on the chemical composition of the rubber polymer and other compounding ingredients but also on the nature of the liquid or gas, its concentration, temperature, pressure and the duration of contact. The thickness of the rubber must be taken into account since the time of penetration of the swelling fluid is dependent on product dimensions, and the bulk of a very thick rubber product may remain unaffected for the whole of the projected service life.

This document has been prepared to assist the selection or evaluation of rubber for chemical resistance. It includes an extensive classification of resistance based on information in over 20 sources and involving about 400 chemicals and up to 25 types of rubber.

Rubber materials — Chemical resistance

1 Scope

This Technical Report describes a classification system for the reporting and tabulation of the chemical resistance of rubber materials. It also provide guidance on the testing and evaluation of rubber with particular reference to test chemicals described in a number of ISO standards.

This document gives guidance on the behaviour of rubber in contact with chemicals such as aggressive gases and fluids, e.g. acids, alkalis, aqueous solutions, oil and solvents.

The information given in this document is based on the practical experience of manufacturers and users of rubber materials.

Unless there is prior knowledge or experience of the application, a selection based on the tables should always be confirmed by tests on the proposed rubber compounds using the actual product under the appropriate service conditions. In such tests, attention should also be given to the possibility of the rubber material contaminating the liquid or gas.

2 Types of chemical and physical change

2.1 Physical penetration

Physical penetration and absorption of an agent into a rubber material, for instance of isooctane into SBR, may occur. These phenomena cause swelling of the rubber, sometimes combined with extraction of soluble material from the rubber. If the absorbed fluid is removed, for instance by drying, most of the physical properties return to their original level. If the antidegradants in the rubber are extracted, a loss in ageing resistance may result. If extender oil or plasticizer is extracted in quantity, the rubber will harden and shrink.

Gases may penetrate throughout the thickness of thin-walled products without any swelling or damage to the rubber. Gas permeability falls outside the scope of this document but may need to be considered when selecting a rubber material.

2.2 Chemical attack

The effect of reactive chemicals on rubber can in most cases be referred to one or more of the following categories:

a) **Hydrolysis**. This is a chemical reaction between water and the rubber polymer, especially under acid and alkaline conditions, which results in degradation of physical properties. At the same time, swelling could take place but this is not always the case. A typical example is the attack of hot water on polyester urethanes.

b) **Oxidation**. All organic materials are more or less sensitive to oxidation. The oxidation is often associated with chemical and thermal processes. This attack will result in degradation of physical properties. Usually, the tensile strength will decrease, but hardness and elongation at break can either increase or decrease depending on the rubber type and the environment. If liquid oxidizing media are used, oxidation may be combined with swelling. A typical example of the latter is the effect of nitric acid on SBR and NBR. As with most other forms of chemical attack, the rate of oxidation increases with temperature.

NOTE Thermal or thermal-oxidative ageing may be the main consequence of exposure to some chemically inert fluids at high temperatures.

c) **Specific effects**. Examples are those due to reaction with chlorine, bromine, ozone, etc. Attack by these chemicals is usually confined to the surface of the rubber, but can become progressively deeper with time. Hardened surfaces can crack due to thermal or physical movement.

3 Rubber polymers

The rubber materials considered in this document are based on the following rubber polymers:

Rubber polymer	Symbol
Natural rubber	NR
Butadiene rubber	BR
Isoprene rubber	IR
Styrene-butadiene rubber	SBR
Isobutene-isoprene rubber (butyl rubber)	IIR
Bromo- or chloro-isobutene-isoprene (halobutyl) rubber	BIIR/CIIR
Ethylene-propylene-diene rubber (terpolymer)	EPDM
Ethylene-propylene rubber (copolymer)	EPM
Acrylonitrile-butadiene rubber	NBR
Hydrogenated acrylonitrile-butadiene rubber	HNBR
Chloroprene rubber	CR
Chloropolyethylene rubber	CM
Chlorosulfonyl-polyethylene rubber	CSM
Acrylate rubber (copolymer)	ACM
Ethylene-acrylate rubber (ethylene acrylic rubber)	AEM
Ethylene-vinylacetate rubber	EVM
Epichlorohydrin rubber (homopolymer)	CO
Epichlorohydrin rubber (copolymer)	ECO
Polyester urethane rubber	AU
Polyether urethane rubber	EU
Polysulfide rubber	T
Silicone rubber	MQ
Fluorinated silicone rubber	FMQ
Fluorinated rubber	FKM

About half of the rubbers in the list are marketed as “oil-resistant”. Care should be exercised when using this term for chemical resistance because “oil-resistant” is usually defined in terms of resistance to swelling by mineral oils (or, in test terms, to swelling in one of the ISO 1817 reference oils). It should be appreciated that a rubber resistant to such oils is not necessarily resistant to oils of other types.

It must also be observed that the classification of chemical resistance is also directly dependent on the compounding variations (see Annex A).

Thermoplastic rubbers have not been included because of insufficient experience and test data. Consult suppliers for information on chemical resistance.

4 Chemicals

The chemicals listed in this document are thought to be representative of those coming into contact with rubber, and as far as possible at least one member or each class of commonly used organic chemical has been included. Proprietary materials have not been included except those representative of a particular class of service or industrial fluids.

The classification is for normal technically pure chemicals. The same performance may not necessarily apply to commercial chemicals even of broadly similar composition because of any effect contaminants or minor active constituents may have. Several commercial chemicals for example may contain trace quantities of oxidizing agents or pro-oxidants. Detergents provide another example: these contain chemically active materials and the type and level will vary from supplier to supplier. It should also be noted that mineral oils and fuels vary appreciably in composition even when supplied to a recognized specification. The chemical composition governs the extent to which a rubber can swell, whereas the oil viscosity governs the rate of penetration into the rubber. A viscous oil diffuses more slowly than a less viscous one.

Common chemical names are used in this document.

5 Effect of service conditions

The amount of change which may be tolerated in a rubber material depends to some extent on the application and whether it is static or dynamic. If, for instance, an O-ring is used in a dynamic application, the permissible volume change or shrinkage has to be much lower than in a static application. Several chemicals will only attack the rubber at its surface and, in the case of ozone, a tensile strain must be present for cracking (the main form of degradation with ozone) to occur. The service temperature is also important because an increase will normally raise the rate of penetration of a fluid and raise the level of swelling.

6 Criteria applied for the ranking of chemical resistance

As criteria for the chemical resistance in this document the degradation of the physical properties and the change in volume are taken, and it is presumed that standard 2 mm thick test pieces are completely submerged in the medium. The data referred to for gases and organic solvents are, as far as possible, based on 4 weeks at 23 °C, for oils 14 days at 100 °C and for aqueous solutions 4 weeks at 70 °C if no other conditions are stated. If no temperature is reported, this is unknown and therefore caution must be exercised when assessing the level of resistance. In many cases, no time is reported in the references. When a concentration is listed, it is in aqueous solution.

Resistance is divided into four classes as defined in Table 1. For chemicals absorbed by the rubber material, resistance is classified primarily according to the extent of volume swell (column B of Table 1) and this criterion applies as long as the hardness change accompanying the swelling is lower than the change given in column C for the same class. If the hardness decrease is higher than that indicated for a given volume swel, the material is classified by hardness change.

For chemicals which do not cause swelling, shrinkage or a significant hardness change, the material is classified in terms of the effect on other properties using the descriptions in column D of Table 1. These properties will include tensile stress/strain characteristics, especially in the case of chemicals able to penetrate into the bulk of the rubber, and surface changes such as crack appearance, crazing, erosion and discoloration in the case of chemicals attacking at the rubber surface.

The descriptions used in column D should not be regarded as being equivalent to the changes given in columns B andC. For most applications, a change in hardness as large as 20 IRHD will be considered much more than a “minor effect”, regardless of its importance to product service.

Table 1 — Classification of chemical resistance

A	B	C	D
Grade	**Change in volume** [a] **(if applicable)**, %	**Change in hardness (if applicable)**, IRHD	**Effect on physical properties**
1	Less than 10	Max. 10	No significant effect
2	10 to 30	Max. 20	Minor effect
3	30 to 60	Max. 30	Moderate effect
4	More than 60	Above 30	Severe effect

[a] Contact with some chemicals may cause some rubber vulcanizates to shrink. For some applications, this is unacceptable and it may be necessary to include specific requirements in product specifications to cover this point.

In the classification, the rate of diffusion of gases or liquids into the rubber material has not been taken into consideration. Sufficient time should be allowed for diffusion before effects on swelling and property deterioration are examined.

7 Chemical resistance of rubber materials

The classification of the rubber materials in accordance with Clause 6 is shown in Table 3 and is made on the basis of the references listed in Annex C. The appropriate references for each chemical are listed in the right-hand column in the table. It is presumed that a suitable compound of the polymer is used.

The assignment of class 1 rating will not necessarily mean that a rubber is suitable for a given application. The exposure conditions may be more severe than those referred to in Table 3. Other considerations affecting the choice of rubber will include the following:

— processing and manufacturing;

— the specified levels of physical properties;

— the size of the product;

— regulatory requirements, e.g. for foodstuff or water contact.

Where a class does not appear in Table 3, it is because no reliable information exists. An omission does not infer that a rubber material has poor resistance to a given chemical.

Care should be taken when selecting rubber coming into contact with more than one chemical. The classifications given in Table 3 may not be comparable because of differences in exposure conditions (e.g. temperature) and in the formulations used. Note that mixtures of some chemicals can be more aggressive than the individual components.

The classes of chemical resistance have been distilled from a large number of reputable sources in order to obtain a representative result. Nonetheless, it will be appreciated that discrepancies among similar rubber types and related chemicals can still arise because of differences in exposure conditions and the rubber formulation.

8 Methods for the evaluation of chemical resistance

8.1 General

This clause gives guidance on the evaluation of chemical resistance, with particular reference to the standard ISO test methods available for contact with chemicals, fluids and gases.

This guidance is intended for organizations and laboratories wishing to

a) evaluate the resistance of a specific rubber formulation to one of the chemicals listed in Table 3;

b) evaluate the resistance of a rubber to a chemical under particular exposure conditions (e.g. temperature or concentration);

c) use a suitable test rubber for the evaluation of the behaviour of a chemical not listed in Table 3.

Use of appropriate standard test procedures, reference materials and test chemicals will enable comparisons of resistance to be made and reduce differences caused by variations in rubber compound, test conditions and the composition of a chemical.

8.2 Test methods

Essentially, four types of standard test are available:

1) *Standard methods for resistance to liquids*.

The most appropriate for rubber is ISO 1817. The equivalent for plastics is ISO 175.

2) *Standard methods for resistance to gases*.

These include the following:

— ISO 188 for resistance to air oxygen under conditions that cause oxidative ageing;

— ISO 1431 for resistance to ozone attack, under static or dynamic test strain and under accelerated test conditions;

— ISO 4665 for resistance to weathering involving oxidative ageing, ozone attack and exposure to light with or without water spray.

3) *Standard methods for permeation of fluids*.

These include the following:

— ISO 2782 for gas permeability;

— ISO 6179 for the rate of transmission of volatile liquids.

NOTE These last two standards are not intended to determine chemical resistance but are relevant when determining the suitability of a rubber type or rubber formulation for applications such as thin membranes. A chemically resistant rubber may not necessarily be the best choice for resistance to permeation and thus additional measurements are needed to ascertain suitability.

4) *Standard methods for product testing*.

Specific tests for determining chemical resistance are described in some methods for finished products, including rubber hoses, footwear, coated fabrics, rubber thread and rubber gloves. For the evaluation of a rubber or rubber formulation, these methods may specify test conditions that are directly relevant to the service environment of the intended product.

8.3 Test chemicals

The test chemical for the evaluation of a rubber is selected in one of two ways:

1) *Use of the chemical used in service*.

   By definition, adopting the service chemical will ensure the closest match with behaviour in service as long as the test conditions that could influence chemical resistance are comparable. The shortcomings of this approach are that the composition and purity of the service chemical may vary from source to source and from site to site, resulting in a range of test results. Some service fluids may also be unsuitable for laboratory testing.

2) *Use of a reference chemical*.

   The advantage of using a reference chemical is that composition is constant and so test results can be compared from one laboratory to another. Thus this approach is suitable for material specifications, the assembly of information for a chemical-resistance database, and determining the effect of variations in rubber compounding. The obvious shortcoming is that a reference chemical many not reflect variations in service chemicals that could change the order of chemical resistance.

   The best-known reference chemicals in the rubber industry are the test fluids given in ISO 1817. However, many other internationally accepted test liquids and gases are available to the rubber compounder and user as shown in Table 2. Some of the standards listed in the table specify appropriate test procedures for evaluation.

8.4 Rubber formulation

The rubber formulation for evaluating chemical resistance is also selected in one of two ways:

1) *Use of the rubber intended for the application*.

   This will ensure the closest match with service performance as long as factors such as product thickness and temperature are taken into account. Once again the main shortcoming is that the data may be so specific to the formulation that it cannot be applied to another one.

2) *Use of a standard or reference formulation*.

   The advantages of using a “standard” rubber formulation are that comparisons can be made between test data from different laboratories, the behaviour of one chemical can be compared with that of another, and comparative information can be added to a chemical-resistance database. An agreed reference formulation can also be designed to ensure reproducible properties, not least those that might influence chemical resistance, e.g. swelling, and to avoid additives that might cause anomalous results or mask the effect the chemical has on the rubber.

   The reference formulation may be one developed in-house by the rubber supplier or manufacturer or one taken from an appropriate national or ISO standard.

   NOTE The formulations for standard reference elastomers given in ISO 13226 may be suitable for some evaluation work as they have been designed to characterize the effects of liquids on vulcanized rubbers.

   The information given in Annex A should assist the development of suitable formulations for reference use. Thus attention is drawn to the effects of plasticizers and oils, crosslinking and antidegradants. Test formulations should be representative but should be as simple as possible to ensure consistency and freedom from unexpected changes such as leaching of oils.

8.5 Test conditions

There are again two approaches:

1) The first is to adopt as far as practicable the anticipated conditions, say of temperature, encountered in service. On the other hand, it needs to be appreciated that more severe conditions, say also of temperature, are required to accelerate the process to a relatively short test period. Attention is drawn to the guidance given in ISO 188, ISO 1431 and ISO 1817.

2) The second approach is to standardize conditions, such as time and temperature, to avoid unnecessary variations in tests, especially in those used for evaluation or data collection purposes. The test conditions given in Clause 6 of this document may be found suitable because test information for comparison already exists.

8.6 Measurement of chemical resistance

Guidance on selection of properties and other criteria for measurement of chemical resistance is given in Clause 6 of this document and in the test methods listed in 8.2.

Table 2 — Reference chemicals

Media	Relevant standard for reference test liquid and gases (see Annex B)
Acids (dilute)	ISO 175
Alkalis (dilute)	ISO 175
Bleaches [a]	ISO 105, Parts N01 to N04
Brake fluid	ISO 4926
Detergent and soap solutions [b]	ISO 105, Parts C01 to C09
Disinfectants for water: — chlorination (swimming pools) — chloramines	 ISO 105-E03 ASTM D 6284
Dry cleaning solvent [c]	ISO 105-D01
Fuels [d]	ISO 1817
Hydraulic oils	ISO 1817
Insulating oil	IEC 60296
Lubricating oils	ISO 1817
Nitrogen oxides [e]	ISO 105, Parts G01 and G02
Petroleum oils	ISO 1817
Perspiration [f]	ISO 105-E04
Salts (dilute)	ISO 175
Salt spray	ISO 4611, ISO 7253
Seawater [g]	ISO 105-E02
Sterilization media	[h]

[a] Including sodium chlorite and hydrogen peroxide.

[b] References include AATCC and ECE detergents and other standardized test detergent formulations. Standard soap compositions are also available. The reference and test solutions are designed to simulate the behaviour of detergents for the washing and cleaning of textiles and so will be relevant to elasticated fabrics, garments, etc.

[c] Perchloroethylene is a recognized test solvent.

[d] In ISO 1817, standard simulated fuels are available for conventional gasoline fuels, diesel fuel and alcohol-containing fuels.

[e] Use to simulate atmospheric fume fading and discoloration from nitrogen oxides in the combustion fumes of gases, coal, etc.

[f] A simulated perspiration is used for the assessment of elastomeric thread used in garments. For further information, see CAIN, M.E., Effect of perspiration simulants on the degradation of uncovered natural rubber threads, *Textile Institute and Industry*, 1977, 15, pp. 28-31.

[g] Should actual seawater be required instead of a prepared saline solution, attention is drawn to ISO 5667-9, which gives guidance on the sampling of seawater.

[h] Methods of sterilizing surgical and medical products include steam autoclaving and treatment with ethylene oxide. Attention is drawn to the standards prepared by ISO/TC 198, *Sterilization of health care products*.

9 Chemical resistance

See Table 3.

Table 3 — Classification of rubber for different chemical media

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																						References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Acetaldehyde		23	3	4	4	1	-	1	1	4	-	4	3	4	4	4	1	4	4	-	4	-	-	-	-	CEGKLNOU
Acetamide		100	4	3	3	1	-	1	1	2	1	2	2	4	4	4	2	2	4	-	1	-	-	-	-	CDEGLOYZ
Acetic acid	10	50	4	4	4	2	2	3	4	4	-	4	2	4	2	3	2	4	4	-	-	2	-	-	-	BEGHLNRSU
	50	50	4	4	4	3	3	4	4	3	-	4	3	4	3	2	1	4	3	-	-	4	-	3	4	BEGHLNRSU
	25	100	4	4	4	4	4	4	3	4	-	4	4	4	4	4	2	4	-	-	-	-	-	-	-	BEGHLNRS
Acetic anhydride		23	1	2	2	2	-	2	2	4	4	1	1	-	-	1	3	4	4	-	4	3	4	1	-	DEGLNOUYZ
Acetone		23	1	1	1	1	2	1	1	4	4	2	3	3	4	2	2	4	4	4	4	4	4	1	4	ABDGKLORSUVYZ
Acetophenone		23	3	4	4	1	-	1	1	4	4	4	4	4	4	4	-	4	4	-	4	4	4	-	-	CGKLNOY
Acetyl chloride			-	-	-	-	-	-	-	-	4	4	4	-	-	-	-	1	-	-	1	-	-	-	-	OZ
Acetylene			1	1	1	1	-	-	-	1	-	2	2	-	-	3	3	1	1	-	-	-	-	-	-	CKLO
Acrylonitrile		50	4	4	4	4	-	3	3	4	4	3	3	-	-	-	-	4	-	-	-	-	-	1	-	CDEHKLNOUYZ
Adhesives (see solvents)																										
Adipic acid		23	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	OUYZ
Air [a]		70	1	-	1	1	-	1	-	1	1	1	1	1	1	-	1	1	1	1	1	1	-	-	-	DEHKLNVZ
		100	2	2	2	1	-	1	1	-	-	-	-	1	1	3	1	1	1	1	1	1	-	-	-	DEHKLNV
		150	4	-	3	1	-	2	-	3	-	3	3	2	4	-	1	1	1	1	1	3	-	-	-	DEHKLNV
		200	4	4	4	4	-	3	3	4	-	4	4	4	4	4	1	1	3	2	1	3	-	-	-	DEHKLNV
Allyl alcohol		23	-	-	-	2	-	-	3	1	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	U
Ammonia, anhydrous		23	1	-	-	1	-	1	1	1		1	3	-	-	1	3	4	-	-	4	-	-	-	-	CDGLNCO

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	References/comments (see Annex C)
Ammonia, gas		Cold	1	1	1	1	-	1	1	1	1	1	-	-	-	1	1	4	-	-	4	-	-	1	-	CDGKLNOUYZ
		Hot	3	3	3	3	-	2	2	3	4	1	-	-	-	4	1	4	-	-	4	-	-	-	-	CKLOU
Ammonia, liquid		23	2	-	1	2	-	1	-	1	2	1	4	4	2	2	4	4	-	-	-	-	-	-	-	EHLSYZ
Ammonium carbonate	Sat	70	1	1	1	1	-	1	1	4	4	2	2	-	-	-	2	-	-	-	-	2	2	-	-	EGLOYZ
Ammonium hydroxide	10	23	1	-	1	1	2	1	1	1	-	1	1	4	2	2	1	1	3	-	-	-	-	-	4	BDS
	Conc	23	1	1	1	1	1	1	1	2	-	1	1	4	3	4	1	1	4	-	-	-	2	-	-	BEGLNRSU
Amyl acetate		23	2	-	4	2	-	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	-	-	DEHIKLNOTUVYZ
Amyl alcohol (pentanol)		50	2	1	1	1	2	1	1	2	2	1	1	1	4	1	2	1	3	4	1	1	-	1	-	BDEKLMNOTUYZ
Amyl borate			4	4	4	4	-	4	-	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	ECLYZ
Amyl chloronaphthalene			4	4	4	4	-	4	4	4	4	3	4	4	4	3	4	1	4	-	2	-	-	-	-	CLOYZ
Amyl naphthalene			4	4	4	4	-	4	4	3	4	4	4	-	-	3	4	2	-	-	2	-	-	-	-	CELOY
Aniline		23	2	2	2	2	1	1	1	4	4	3	4	4	4	4	4	1	4	-	1	4	4	-	-	BDEGHILNPSUZ
		100	4	-	4	2	-	1	1	4	-	4	4	4	4	4	4	3	4	-	1	4	4	-	-	ABDEGHILNPS
Aniline hydrochloride			2	3	3	2	-	2	2	2	-	4	4	4	4	2	4	2	4	-	2	-	-	-	-	CELO
Animal oil (bone oil)		50	4	4	4	2	-	2	3	1	1	2	2	1	1	1	1	1	1	-	1	1	1	-	-	BELOYZ
Ansul ether			4	4	4	3	-	3	3	3	3	4	4	2	2	4	3	4	4	-	3	-	-	-	-	OYZ
Antifreeze (see ethylene glycol and methanol)																										
Anti-rust agents (see oxalic acid and phosphoric acid)																										
Aqua regia		23	4	4	4	3	-	-	-	4	4	3	3	-	-	-	-	2	-	-	-	-	-	3	-	LCBUYZ
Arsenic acid			1	-	-	1	-	1	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	LECYZ
Asphalt		100	4	4	4	4	-	4	4	2	-	3	3	2	2	-	4	1	2	-	2	1	1	-	-	ELO
Barium hydroxide	Conc	100	1	1	1	1	-	-	-	1	1	1	1	-	-	-	1	-	4	-	-	-	-	-	-	EILOYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Benzaldehyde		23	4	-	4	2	-	1	1	4	4	4	4	4	4	4	1	3	4	2	2	4	4	3	-	ABGLNSUYZ
		100	4	-	4	4	-	1	1	4	-	4	4	4	4	4	1	3	4	-	2	4	4	-	-	GLNS
Benzene		23	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	2	4	-	2	4	4	-	-	ABEGIKLORUYZ
Benzenesulfonic acid			-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	2	-	-	-	-	O
Benzoic acid		23	-	-	1	1	-	-	-	1	-	1	-	-	-	-	1	1	2	-	2	-	-	-	-	AOU
Benzyl alcohol		23	-	-	2	1	-	1	1	4	-	2	2	-	-	4	1	1	4	-	2	4	4	1	-	ADEGILMNORU
Benzyl benzoate			3	4	4	1	-	2	2	4	-	4	-	-	-	4	-	1	-	-	1	-	-	-	-	CELO
Benzyl chloride		23	3	3	3	2	-	4	4	4	-	4	4	-	-	4	-	1	-	-	1	-	-	-	-	CEGILNO
Bleach (see calcium hydrochlorite)																										
Body fluids (see oleic acid and palmitic acid, salt solution and urea solution)																										
Bone oil (see animal oil)																										
Boric acid	10	100	1	1	1	1	-	1	1	1	1	1	1	-	-	4	2	1	4	-	1	1	1	-	-	CEILMOUYZ
Boron fuel (type of rocket fuel)			-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	LZ
Brake fluid (vegetable oil type)		50	1	1	1	1	-	1	1	4	-	1	1	3	4	1	1	3	3	-	-	-	-	-	-	BP
Bromine		23	4	4	4	4	-	-	-	4	-	4	3	-	-	3	4	1	-	-	2	-	-	-	-	DKLOU
Bromine trifluoride			4	4	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	-	4	-	-	-	-	OYZ
Bromobenzene			4	4	4	4	-	4	4	4	4	4	4	4	4	3	4	1	4	-	1	4	4	-	-	OYZ
Bunker oil			4	4	4	4	-	4	4	1	1	4	4	-	-	1	3	1	1	-	1	-	-	-	-	CELOYZ
Butadiene		23	4	4	-	3	-	3	3	4	-	2	2	4	4	-	-	2	2	-	2	4	4	-	-	DOU
Butane liquid		23	4	4	4	4	4	4	4	1	1	2	2	1	1	1	4	1	1	-	1	1	1	2	3	KLNOUYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Butanediol		23	-	-	-	1	-	1	-	4	-	1	2	-	-	-	-	1	-	-	-	-	-	-	-	U
Butanol		50	1	1	1	1	1	1	1	1	1	1	1	2	4	2	2	1	3	4	1	-	-	1	4	BEGLOVZ
		100	4	4	4	1	1	-	-	1	-	3	2	2	4	4	4	3	2	4	-	-	-	-	-	BEGLUV
Butene			4	4	4	4	-	4	4	1	-	1	2	-	-	2	-	1	-	-	2	-	-	-	-	OU
Butter (water-free)		100	4	4	4	4	4	3	3	1	1	3	3	4	4	4	1	1	1	4	1	1	1	-	-	BEINSTYZ
Butyl acetate		23	4	4	4	3	-	2	-	4	-	4	4	2	3	2	4	4	4	4	4	4	4	-	-	ACDEHLNSTU
Butyl acetyl ricinolate			3	4	4	1	-	1	1	3	2	4	2	-	-	4	-	1	-	-	-	-	-	-	-	CLOYZ
Butyl acrylate		50	-	-	4	4	-	4	4	4	4	4	4	-	-	-	1	4	-	-	-	-	-	-	-	CDLOYZ
Butylamine		23	4	4	4	3	-	4	4	4	3	4	4	4	4	4	4	4	4	-	4	-	-	-	-	ACDELOYZ
Butyl benzoate			-	-	-	1	-	1	1	-	-	4	4	-	-	-	-	1	-	-	1	-	-	-	-	O
Butyl carbitol		23	2	-	2	1	-	1	1	3	4	3	2	-	-	1	4	4	4	-	-	-	-	-	-	ACDELO
Butyl glycol (see butyl cellosolve)																										
Butyl oleate			4	4	4	2	-	2	2	-	4	4	4	-	-	-	-	1	-	-	2	-	-	-	-	OYZ
Butyl phenol		23	-	-	-	4	-	4	-	4	-	4	4	-	-	-	-	-	2	-	-	-	-	-	-	U
Butyl stearate		70	4	4	4	2	-	3	3	1	2	4	4	-	-	1	-	1	-	-	2	-	-	-	-	CEGLOYZ
Butyl cellosolve			1	1	2	1	-	1	-	3	4	2	2	-	-	1	4	1	4	-	-	-	-	-	-	ACELZ
Butylene			4	4	4	4	-	4	4	2	-	3	3	-	-	2	-	1	-	-	2	-	-	-	-	O
Butyraldehyde			3	3	3	2	-	2	2	3	-	3	3	-	-	2	3	4	4	-	4	-	-	-	-	O
Butyric acid			-	-	-	2	-	2	-	4	-	2	2	-	-	-	-	2	-	-	-	-	-	-	-	U
Calcium hydroxide		100	1	1	1	1	-	-	-	2	1	1	1	-	-	2	3	1	4	-	-	-	-	1	-	BEILOYZ
Calcium hypochlorite	15		4	-	-	1	-	1	1	3	2	2	1	-	-	4	3	1	-	-	-	-	-	-	-	ELOYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																					References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Carbitol			2	2	2	1	-	2	2	3	-	3	2	4	4	3	-	2	4	-	2	-	-	-	-	CLO
Carbolic acid (see phenol)																										
Carbon dioxide			1	1	1	1	-	1	1	1	1	1	1	-	-	1	1	1	-	-	-	-	-	-	-	ELOYZ
Carbon disulfide		23	4	4	4	4	4	4	4	3	4	4	4	3	4	3	3	1	3	-	1	-	-	-	-	BDEGILNOAUYZ
Carbon monoxide		Hot	2	2	2	1	-	1	1	1	1	1	1	1	1	4	1	1	-	-	-	1	1	-	-	LOYZ
Carbon tetrachloride		23	4	4	4	4	4	4	4	3	2	4	4	2	3	3	4	1	4	-	2	4	3	3	4	ABFGHILRSUYZ
Castor oil		100	2	1	1	1	-	1	1	2	1	3	2	4	4	4	1	1	3	-	1	2	2	1	-	EGILOSYZ
Cellosolve		23	3	3	3	1	-	2	-	3	4	1	-	-	-	1	-	3	-	-	-	-	-	-	-	CDLZ
Cellosolve acetate		23	3	3	3	1	-	1	-	4	4	4	4	3	-	1	-	4	-	-	4	-	-	-	-	DELVYZ
Chloral hydrate	98	23	-	-	-	3	-	3	-	4	-	3	1	-	-	-	-	3	-	-	-	-	-	-	-	U
Chloric acid	20	23	-	-	-	1	-	1	-	4	-	4	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Chlorine, gas			3	3	3	3	-	3	3	-	3	3	2	-	-	4	4	2	-	-	2	2	2	-	-	CDHLOUYZ
Chlorine dioxide			-	-	-	4	-	3	3	4	4	4	2	-	-	-	3	1	-	-	2	-	-	-	-	CLOYZ
Chlorine trifluoride			4	4	-	3	-	4	4	4	4	4	4	4	4	4	3	4	-	-	2	4	4	-	-	CLOYZ
Chlorine water	Sat	23	4	-	4	4	-	4	-	4	3	4	3	4	3	-	3	1	-	-	-	4	-	-	-	NRSUYZ
Chlorodiphenyl		23	-	-	-	4	-	4	-	4	-	4	4	-	-	-	-	1	-	-	-	-	-	-	-	U
Chloroacetic acid		23	3	3	3	2	-	2	2	3	4	2	2	-	-	-	-	4	-	-	-	-	-	-	-	CELMOUYZ
Chloroacetone			2	-	-	3	-	1	1	4	4	3	3	-	-	-	3	4	-	-	4	-	-	-	-	CLOYZ
Chlorobenzene		23	4	4	4	4	-	4	4	4	4	4	4	3	4	4	4	1	4	-	2	4	4	-	-	DEHLOSYZ
		50	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	4	-	-	4	4	-	-	BCEOYZ
Chlorobromomethane		23	4	4	4	3	-	3	3	4	4	4	4	-	-	-	3	1	4	-	2	-	-	-	-	ACDEHLOYZ
Chlorododecane			4	4	4	4	-	4	4	4	4	4	-	-	-	-	-	1	-	-	1	-	-	-	-	OYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Chloroform		23	4	4	4	4	-	4	4	4	4	4	4	-	-	4	4	1	4	-	2	-	-	-	-	ADEFGILMNOUYZ
Chloronaphthalene		23	4	4	4	4	4	4	4	4	-	4	4	-	-	4	4	1	-	-	2	-	-	-	-	CEHLO
Chloronitroethane			4	4	4	4	-	-	-	4	-	4	4	-	-	4	-	3	4	-	-	-	-	-	-	CDLO
Chloroprene		23	4	4	4	4	4	4	4	4	4	4	4	4	4	2	4	1	4	-	2	-	-	2	-	BOZ
Chlorosulfonic acid	10	23	4	4	4	4	-	4	4	4	-	4	4	-	-	4	4	-	-	-	-	-	-	-	-	IKLMO
Chlorotoluene			4	4	4	4	-	4	4	4	4	4	4	-	-	4	4	1	-	-	2	-	-	-	-	CELOYZ
Chromic acid	40	50	4	4	4	3	-	3	4	4	4	4	1	4	4	4	4	1	-	-	3	-	-	1	-	BIKLOSUYZ
Citric acid	Sat	70	1	1	1	1	-	1	-	2	1	1	1	-	-	1	1	1	-	-	-	1	-	-	-	EGLMNUYZ
Cleaning agents (see ammonia, calcium hypochlorite, sodium hydroxide) (see also detergents and solvents)																										
Coconut oil			4	4	4	2	-	2	2	1	1	2	3	1	1	-	1	1	1	-	1	-	-	-	-	CHLNOUYZ
Cod liver oil		23	4	4	4	2	-	2	2	1	1	2	2	1	1	1	1	1	1	-	1	-	-	-	-	CDEHLNO
Coke oven gas			2	2	2	1	-	4	-	2	4	2	2	-	-	4	1	1	-	-	-	-	-	-	-	CELYZ
Corn oil			4	4	4	2	-	2	2	1	1	3	3	1	1	1	3	1	1	-	-	1	1	-	-	ELOYZ
Cottonseed oil		70	4	4	4	1	-	2	2	1	1	3	3	-	-	1	3	1	1	1	-	1	1	-	-	DEGHILVWOYZ
Cresylic acid		70	4	4	4	1	-	2	2	4	-	2	4	-	-	4	1	1	4	-	-	-	-	-	-	CDELMNOT
Creosote			4	4	4	4	-	4	4	2	1	3	3	2	2	3	4	1	1	-	1	3	3	-	-	ELOYZ
Crotonaldehyde		23	-	-	-	1	-	1	-	1	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Cumene			-	-	-	-	-	-	-	-	4	4	4	-	-	2	-	1	-	-	2	-	-	-	-	OYZ
Cyclohexane		23	4	4	4	4	4	4	4	1	1	4	3	1	2	1	4	1	2	3	2	1	1	1	1	ABDEHIKLMRSUVYZ
Cyclohexanol			2	4	4	3	-	4	4	3	1	1	1	-	-	2	-	1	-	-	1	-	-	1	-	ABOUYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Cyclohexanone		23	4	4	4	3	-	1	-	4	4	4	4	4	4	4	2	4	4	-	4	4	4	-	-	AEGHKLNSYZ
p-Cymene			4	4	4	4	-	4	4	4	-	4	4	-	-	2	4	1	-	-	-	-	-	-	-	CO
Decalin			4	4	4	-	-	-	-	-	-	4	4	-	-	-	-	1	-	-	1	-	-	-	-	O
Decane			4	4	4	4	-	-	-	2	1	4	4	2	2	-	2	1	1	-	1	-	-	-	-	OYZ
Detergents (see soap solution and water)																										
Diacetone (see diacetone alcohol)																										
Diacetone alcohol			4	4	2	1	-	1	1	4	4	2	1	2	2	-	4	4	4	-	4	4	4	-	-	OYZ
Dibenzyl sebacate		23	-	-	-	2	-	2	2	-	4	4	-	2	2	2	3	2	-	-	3	-	-	-	-	OYZ
Dibenzyl ether		23	4	4	4	1	-	2	2	4	4	4	4	2	2	4	-	4	-	-	-	-	-	-	-	CEILNOYZ
Dibutylamine			4	4	4	4	-	4	4	4	-	4	4	-	-	-	3	4	-	-	4	-	-	-	-	O
Dibutyl ether		23	4	4	4	4	-	4	3	3	4	4	3	2	2	1	4	1	3	-	3	-	-	-	-	OUYZ
Dibutyl phthalate		23	4	4	4	2	-	1	1	4	4	4	4	3	3	1	2	2	4	4	2	2	2	-	-	DEGILMNOUVYZ
Dibutyl sebacate			4	4	4	1	-	1	1	4	4	4	4	4	4	2	2	2	4	-	2	-	-	-	-	OUYZ
Dichlorobenzene		23	4	4	4	4	-	4	4	4	-	4	4	-	-	1	3	1	4	-	2	-	-	-	-	ACDEGHKLOU
Dichloroethylene		23	-	-	4	4	-	-	-	4	-	4	-	-	-	-	4	2	-	-	-	-	-	-	-	AU
Dichloroisopropyl ether			4	4	4	3	-	3	3	4	4	4	4	2	2	1	4	3	2	-	3	-	-	-	-	OY
Dicyclohexylamine			4	4	4	4	-	4	-	2	3	4	4	-	-	3	-	4	-	-	-	-	-	-	-	CLOY
Diester oil (liquid 101) [b]		100	4	4	4	4	4	4	4	1	1	4	4	3	4	4	2	1	3	4	1	2	3	-	-	BLSTY
Diethyl sebacate			4	-	-	2	-	2	2	4	3	4	4	-	-	1	1	2	-	-	2	-	-	-	-	CEHLOYZ
Diethylamine		23	4	4	4	4	4	4	4	2	-	3	3	3	4	1	4	4	4	-	-	-	-	-	-	BEL
Diethylbenzene			4	4	4	4	-	4	4	4	-	4	4	4	4	2	4	1	-	-	1	-	-	-	-	O

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																					References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Diethylene glycol		100	1	1	1	1	1	1	1	1	-	1	1	4	3	4	1	1	4	1	-	-	-	-	1	ABELV
Diethyl ether (see ether)																										
Diisobutylene			-	-	-	-	-	-	-	2	1	3	3	-	-	1	4	1	-	-	3	-	-	2	-	OBYZ
Diisobutyl ketone		23	-	-	-	2	-	2	-	4	-	4	4	-	-	-	-	4	-	-	-	-	-	-	-	U
Diisopropyl benzene			4	4	4	4	-	4	4	4	-	4	4	-	-	2	2	1	-	-	-	-	-	-	-	O
Di-isopropylketone			4	-	4	2	-	2	2	4	-	4	4	3	4	4	4	4	4	-	4	4	4	-	-	CELNT
Dimethylamine		23	-	-	-	3	-	3	-	4	-	4	4	-	-	-	-	4	-	-	-	-	-	-	-	U
Dimethyl aniline		23	4	4	4	2	-	2	-	4	-	4	4	-	-	4	-	4	-	-	4	-	-	-	-	CELN
Dimethyl formamide		23	2	-	2	3	-	2	1	2	-	2	2	-	-	3	1	4	-	-	-	4	-	-	-	DELMRU
Dimethyl phthalate			4	4	4	2	-	2	2	4	4	4	4	-	-	2	-	2	-	-	2	-	-	-	-	OYZ
Dinitrotoluene			4	4	4	4	-	4	4	4	4	4	4	-	-	-	3	3	-	-	-	-	-	-	-	COYZ
Dioctyl phthalate		100	4	4	4	3	-	2	-	3	-	4	4	1	1	2	2	1	4	4	1	4	4	-	-	EGILSTU
Dioctyl sebacate		23	4	4	4	2	-	2	2	3	4	4	4	2	2	3	-	2	4	-	3	-	-	-	-	CEHLOYZ
Dioxane		23	4	4	4	2	2	-	2	4	2	4	4	4	4	4	2	4	4	-	-	-	-	-	-	ABDELRUZ
Dioxolane			3	4	4	3	-	2	2	4	4	4	4	-	-	4	-	4	-	-	-	-	-	-	-	CLOYZ
Dipentene			4	4	4	4	-	4	4	2	2	4	4	-	-	2	-	1	-	-	3	-	-	-	-	CELOYZ
Diphenyl		70	4	4	4	4	-	4	4	4	4	4	4	-	-	3	3	1	-	-	2	-	-	-	-	ACLOZ
Diphenyl ether			4	4	4	4	-	1	1	4	4	4	4	-	-	4	2	1	-	-	2	-	-	-	-	CLOYZ
Dry cleaning fluids (see relevant chlorinated solvents and notably perchloroethylene)																										
Epichlorohydrin		50	4	4	4	3	-	2	2	4	4	4	4	-	-	-	-	4	-	-	4	-	-	-	-	CDELOYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Essential oils (see pinene and vegetable oils)																										
Ethane			4	4	4	4	-	4	4	1	-	2	2	2	2	1	4	1	1	-	1	-	-	-	-	O
Ethanol		50	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1	1	4	3	1	2	1	-	3	ABDEGHLMNRSTUV
Ethanolamine (mono)		23	2	2	2	2	-	1	-	4	-	4	4	-	-	-	2	4	-	-	4	-	-	-	-	CELO
		70	2	1	1	1	-	1	1	1	3	2	3	4	3	2	2	4	4	-	-	2	2	1	-	CBELOTZ
Ether		23	4	4	4	3	3	3	4	2	4	4	3	2	3	1	4	4	4	4	4	2	3	-	-	ABCDEFGHILNRSVYZ
Ethyl acetate		23	3	3	3	2	2	1	1	4	4	3	3	3	4	2	4	4	4	-	-	4	4	3	4	BDEGHLHORUZ
Ethyl acetoacetate			3	3	3	2	-	2	2	4	4	3	4	-	-	2	2	4	-	-	-	4	-	-	-	CELOZ
Ethyl acrylate		23	4	-	-	2	-	2	2	4	4	4	4	-	-	2	2	-	-	-	4	4	4	-	-	CDELOZ
Ethyl benzoate			-	-	-	2	-	2	2	-	4	-	-	-	-	2	-	1	-	-	1	-	-	-	-	OZ
Ethyl benzene		23	4	4	4	4	-	4	4	4	4	4	4	-	-	3	4	1	-	-	1	4	4	-	-	CEGILOUZ
Ethyl cellulose			1	1	1	2	-	-	-	1	-	1	-	-	-	2	3	4	4	-	4	-	-	-	-	LO
Ethyl chloride			2	2	2	1	-	1	1	2	3	2	4	2	2	4	4	1	3	-	1	2	2	-	-	ELOUZ
Ethyl chloro carbonate (see ethyl chloroformate)																										
Ethyl chloroformate		23	4	4	4	2	-	-	-	4	4	3	3	-	-	-	4	1	-	-	2	-	-	-	-	OAZ
Ethyl ether (see ether)																										
Ethyl formate			4	4	4	2	-	2	2	4	4	2	2	-	-	-	-	1	-	-	1	-	-	-	-	OZ
Ethyl mercaptan			4	4	4	4	-	4	4	4	-	4	2	-	-	4	-	2	-	-	-	-	-	-	-	CELO
Ethyl oxalate			1	1	1	1	-	1	1	4	-	3	4	-	-	1	-	1	-	-	-	4	4	-	-	CELO
Ethyl pentachlorobenzene			4	4	4	4	-	4	4	3	-	4	4	4	4	1	2	1	-	-	2	3	3	-	-	ECLO
Ethyl silicate			2	2	2	1	-	1	1	1	-	1	2	-	-	2	1	1	-	-	-	1	1	-	-	CELO

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Ethylene			-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	O
Ethylene chlorohydrin			3	3	3	1	-	-	-	4	4	1	2	-	-	3	-	1	-	-	-	-	-	-	-	CLOZ
Ethylene diamine			1	2	2	1	-	1	1	2	1	1	2	-	-	4	2	3	-	-	-	1	1	-	-	CLOUYZ
Ethylene dichloride		23	4	4	4	3	3	2	2	4	-	4	4	4	4	4	3	2	4	-	3	4	4	-	-	ABDEILNRSTU
Ethylene glycol		100	2	1	1	1	1	1	1	1	1	2	1	4	4	4	1	1	4	1	1	1	1	1	1	ABDEOSTUYZ
Ethylene glycol dimethyl ether (see ansul ether)																										
Ethylene glycol formal (see dioxolane)																										
Ethylene oxide			-	-	-	3	-	3	3	4	-	4	4	-	-	-	3	4	-	-	4	-	-	-	-	OU
Fluorine, liquid			-	-	-	3	-	3	-	-	-	4	-	-	-	4	4	2	-	-	-	-	-	-	-	CLO
Fluorobenzene			4	4	4	4	-	4	-	4	-	4	-	-	-	4	4	1	-	-	2	-	-	-	-	CLO
Fluoroboric acid			1	1	1	1	-	1	1	1	-	1	1	-	-	-	-	3	-	-	-	-	-	-	-	CELO
Fluorochloroethylene			-	-	-	3	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L
Fluosilicic acid	50	23	1	-	-	3	-	2	2	3	1	2	1	-	-	-	-	3	-	-	-	-	-	-	-	CELOUYZ
Foodstuffs (see butter, milk, salt solution, coconut oil, cod liver oil, soybean oil, vegetable oils, lard, malic acid and citric acid, cottonseed oil, olive oil, rapeseed oil, glucose solution, sucrose solution and tartaric acid)																										
Formaldehyde	40	23	1	1	1	1	-	-	-	1	2	1	1	4	4	1	1	1	-	-	-	-	-	1	2	BCEGHLNORUY
	40	70	-	-	-	-	-	-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	CEGHLNR
Formamide		23	-	-	-	1	-	1	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-	-	-	U

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																					References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Formic acid	Sat	23	3	-	2	1	-	2	-	3	-	2	2	4	4	4	2	3	4	-	2	4	3	1	-	EGLMNSTU
	Sat	70	4	-	2	2	-	2	3	3	-	3	3	4	4	4	4	4	-	2	4	4	4	-	-	GMST
Freon 11		23	2	-	2	4	-	4	-	1	2	1	1	3	3	1	4	3	-	-	-	-	-	-	-	CDFLYZ
Freon 12		23	1	-	1	1	-	2	-	1	1	1	1	-	-	1	4	2	-	2	-	1	-	-	-	CDFHLVYZ
Freon 13 B1		23	1	1	1	1	-	1	1	1	-	1	1	1	1	1	4	2	-	-	-	-	-	-	-	OF
Freon 21		23	4	-	4	3	-	3	3	4	-	3	4	-	-	3	-	3	-	-	-	3	3	-	-	CFLO
Freon 22		23	1	-	1	1	-	1	-	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	CDFHL
Freon 31		23	2	2	2	1	-	1	1	4	-	1	2	-	-	2	-	4	-	-	-	-	-	-	-	OF
Freon 32		23	1	1	1	1	-	1	1	1	-	1	1	-	-	1	-	3	-	-	-	-	-	-	-	OF
Freon 112		23	4	-	4	4	-	4	4	2	2	3	2	-	-	1	-	1	-	-	-	-	-	-	-	OFYZ
Freon 113		23	3	2	2	3	-	3	3	1	1	1	1	2	2	1	4	2	-	4	4	1	1	-	-	CDFLOUVYZ
Freon 114		23	1	1	-	1	-	1	-	1	1	1	1	-	-	1	3	2	-	-	-	-	-	-	-	CFLYZ
Freon 114 B2		23	4	3	3	4	-	4	4	2	2	1	1	-	-	1	-	2	-	-	-	-	-	-	-	OFZ
Freon 115		23	1	1	1	1	-	1	1	1	-	1	1	-	-	1	-	2	-	-	-	-	-	-	-	OF
Freon 142b		23	2	1	1	1	-	1	1	1	2	1	1	-	-	1	-	4	-	-	-	-	-	-	-	OFZ
Freon 152a		23	1	1	1	1	-	1	1	1	2	1	3	-	-	1	-	4	-	-	-	-	-	-	-	OFZ
Freon 218		23	1	1	1	1	-	1	1	1	-	1	1	-	-	1	-	1	-	-	-	-	-	-	-	OF
Freon C 316		23	1	1	1	1	-	1	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	OF
Freon C 318		23	1	1	1	1	-	1	1	1	1	1	1	-	-	1	-	1	-	-	-	-	-	-	-	OFYZ
Freon 502			1	1	1	-	-	-	-	2	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	O
Freon BF			4	4	4	4	-	-	-	2	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	OYZ
Freon MF			4	2	2	4	-	-	-	1	2	3	4	3	3	1	-	-	-	-	-	-	-	-	-	OYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	References/comments (see Annex C)
Freon TA			1	1	1	1	-	1	1	1	-	1	1	1	1	1	1	3	-	-	-	-	-	-	-	O
Freon TC			4	2	2	1	-	2	2	1	-	1	1	1	1	1	1	1	-	-	-	-	-	-	-	O
Freon TF			3	2	2	4	-	4	4	4	1	4	4	4	4	4	4	4	-	-	-	1	1	-	-	OY
Freon TMC			2	3	3	2	-	2	2	2	-	2	2	2	2	1	3	1	-	-	-	-	-	-	-	O
Freon T-P 35			1	1	1	1	-	1	1	1	-	1	1	1	1	1	1	1	-	-	-	-	-	-	-	O
Freon T-WD 602			3	2	2	1	-	2	2	2	-	2	2	1	1	1	4	1	-	-	-	-	-	-	-	O
Fuel B in accordance with ISO 1817 (70 % isooctane, 30 % toluene)		23	4	4	4	4	4	4	4	2	1	3	3	1	2	1	4	1	3	4	2	2	2	-	-	BFISTVZ
Fuel C in accordance with ISO 1817 (50 % isooctane, 50 % toluene)		23	4	4	4	4	4	4	4	2	2	4	4	2	3	2	4	1	4	4	2	3	3	-	-	BEISTVZ
Fuel with methanol (see gasohol)																										
Fumaric acid			1	1	1	3	-	-	-	1	1	2	2	-	-	-	2	1	4	-	1	-	-	-	-	OYZ
Furan (furfuran)		23	4	4	4	3	-	3	3	4	4	4	4	-	-	2	-	-	-	-	-	-	-	-	-	CEHLYZ
Furfural		23	3	3	3	2	-	2	2	4	4	4	3	-	-	3	3	3	4	4	-	-	4	-	-	CDEGILMNOY
Furfural alcohol		23	-	-	-	3	-	3	-	4	4	3	-	-	-	-	-	4	-	-	-	-	-	-	-	UZ
Gallic acid			1	2	2	1	-	2	2	3	2	2	2	4	4	-	-	-	1	-	1	-	-	-	-	CELOYZ
Gasohol 50:30:20 (toluene-isooctane-methanol)		23	4	4	4	4	-	4	4	3	-	4	-	-	-	-	-	1	-	-	2	4	-	-	-	T
Gelatine		40	1	1	1	1	-	1	1	1	-	1	1	-	-	1	-	1	-	-	-	-	-	-	-	CLU
Glucose solution		80	1	1	1	1	-	1	-	1	1	1	1	-	-	1	1	1	-	-	-	1	-	-	-	CELUYZ
Glue, animal or bone (see gelatine)																										

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																						References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Glycine	10	23	-	-	-	1	-	1	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	U
Glycerol		100	1	1	1	1	1	1	1	1	-	1	1	1	1	1	1	1	2	-	1	1	1	-	-	ABDELMSU
Glycol (see ethylene glycol)																										
Glycolic acid	37	23	-	-	-	1	-	1	-	1	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	UZ
Glycol monoethyl ether (see cellosolve)																										
Hexachlorobutadiene		23	4	4	4	4	4	4	4	1	-	4	4	1	4	2	4	1	4	-	-	-	-	-	-	B
Hexaldehyde			4	4	4	1	-	1	2	4	-	1	3	2	2	1	1	4	-	-	-	-	-	-	-	CELO
Hexane		23	4	4	4	4	-	4	-	1	1	1	2	1	2	1	4	1	1	-	2	1	1	-	-	ADEGILNRSY
Hexanol		23	1	1	2	2	-	3	3	2	-	2	2	4	4	1	3	1	4	-	1	-	-	-	-	ACEILNO
1-Hexene			4	4	4	4	-	4	4	2	2	2	2	1	1	1	4	1	1	-	1	-	-	-	-	OYZ
Hydrazine solution		23	-	-	-	1	-	1	1	4	4	4	2	4	4	4	3	1	-	-	-	-	-	-	-	CLOUY
Hydrofluosilicic acid			1	-	3	1	-	2	3	3	1	2	1	4	4	3	4	2	-	-	4	-	-	-	-	CELOYZ
Hydrobromic acid	37	23	1	2	2	1	-	1	1	4	4	1	1	4	4	-	4	1	4	-	3	-	-	-	-	CELNOUYZ
Hydrochloric acid	10	100	4	-	3	2	-	4	-	3	-	1	1	4	4	4	4	1	-	-	-	1	-	-	-	ERS
	21	50	3	-	2	1	-	2	-	2	-	1	1	4	2	-	4	1	-	-	-	-	-	-	-	S
	37	23	2	2	2	1	-	1	1	3	-	2	1	4	4	-	4	1	-	-	-	-	-	-	-	EIMNDRU
Hydrocyanic acid	20		2	3	3	1	-	1	1	3	2	3	1	-	-	4	-	1	4	2	-	-	-	-	-	CELOYZ
Hydrofluoric acid	48	23	3	3	3	1	-	1	1	3	-	1	1	4	4	4	4	1	-	-	-	2	-	-	-	CDLNR
	75	23	3	3	3	1	-	-	-	4	-	3	1	4	4	4	4	2	-	-	-	-	-	-	-	DEL
Hydrofluoric acid, anhydrous			-	-	-	1	-	3	-	4	-	1	-	-	-	-	4	2	-	-	-	-	-	-	-	LC
Hydrogen			1	1	1	1	-	1	-	1	-	1	1	1	-	1	1	1	-	-	-	-	-	-	-	LU

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	References/comments (see Annex C)
Hydrogen peroxide	30	23	1	-	1	1	-	1	-	1	-	1	1	1	1	-	1	1	-	-	-	-	-	-	-	ELNRSU
	90		4	4	4	3	-	3	3	4	2	4	3	-	-	4	1	2	-	-	2	-	-	-	-	CLOUYZ
Hydrogen sulfide	Sat	23	4	4	1	1	-	1	1	4	-	2	2	-	-	1	3	1	4	-	3	-	-	-	-	LNOU
Hydroquinone			2	2	2	-	-	-	-	3	4	-	-	-	-	3	-	4	-	-	2	-	-	-	-	OYZ
Hypochlorous acid			2	2	2	2	-	3	3	4	4	3	2	-	-	-	-	2	2	-	-	-	-	-	-	CELOY
Inks (see water, solvents, tannic acid and relevant alcohols and glycol)																										
Iodine pentafluoride			4	4	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	-	4	4	4	-	-	OYZ
Iodoform			-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O
Isooctane (Fuel A, ISO 1817)		23	4	3	3	4	4	4	4	1	1	1	2	1	1	1	4	1	1	2	2	1	1	1	4	BEILNPSTVYZ
Isobutyl alcohol		23	1	1	1	1	-	1	1	2	2	1	1	4	4	2	1	1	4	-	2	-	-	1	4	CDEGLOYZ
Isophorone			-	-	-	1	-	1	1	4	4	-	-	2	2	-	-	4	-	-	-	-	-	-	-	OYZ
Isopropyl alcohol (2-propanol)		40	1	2	2	1	-	1	1	2	2	1	1	-	-	1	1	1	4	-	-	-	-	1	4	CEILOUYZ
Isopropyl acetate			3	4	4	2	-	2	2	4	4	4	4	1	1	1	-	4	4	-	-	-	-	-	-	CELOYZ
Isopropyl chloride			4	4	4	4	-	4	4	4	4	4	-	-	-	4	3	1	-	-	2	-	-	-	-	CLOYZ
Isopropyl ether		23	4	4	4	4	-	-	-	4	2	4	4	-	-	1	-	4	3	-	-	-	-	-	-	LOUYZ
Kerosene		70	4	4	4	4	-	-	-	1	1	3	3	2	2	1	4	1	2	3	1	1	1	-	-	DEHILNOPVYZ
Lactic acid solution	10	70	1	1	1	1	-	1	1	1	-	1	1	-	-	-	1	1	-	-	-	-	-	-	-	ELMNOU
Lard		70	4	4	4	2	3	3	3	1	1	2	3	-	-	4	3	1	1	-	1	1	1	-	-	BCEHILNOYZ
Lead sulfamate, aq			2	2	2	1	-	1	-	2	-	2	2	-	-	4	3	1	4	-	1	-	-	-	-	CELO
Linoleic acid		70	-	-	-	4	-	4	-	2	2	4	4	2	2	-	1	2	-	-	-	-	-	-	-	CELNYZ
Linseed oil		23	4	4	3	1	-	2	2	1	1	2	2	-	-	1	2	1	1	-	1	-	-	-	-	ELMNOUYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material: NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	References/comments (see Annex C)
Liquid 101, ISO 1817 (see diester oil)																										
Liquid 103, ISO 1817 (see tributyl phosphate)																										
Liquid oxygen			-	-	-	1	-	-	-	3	4	-	-	-	-	-	3	-	-	-	-	-	-	-	-	LZ
Liquified petroleum gas			4	4	4	4	-	4	4	1	1	2	2	1	1	1	3	1	3	-	-	1	1	-	-	CLO
Lubricating oil (see Oil IRM 902)																										
Magnesium hydroxide			1	1	1	1	-	-	-	1	2	1	1	-	-	3	-	-	-	-	-	-	-	-	-	ELYZ
Maleic acid	Sat	23	2	2	2	3	-	3	3	2	4	3	4	-	2	-	-	1	-	-	-	-	-	-	-	CELOUYZ
Maleic anhydride			2	2	2	3	-	3	3	-	4	3	4	-	-	-	-	1	-	-	-	-	-	-	-	CLOYZ
Malic acid			-	2	2	4	-	4	4	1	1	2	2	-	-	-	2	1	4	-	1	-	-	-	-	OYZ
		125	4	4	4	2	2	2	2	4	-	4	4	4	4	2	4	4	4	-	-	-	-	-	-	B
Mercury			1	1	1	1	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	ELYZ
Mesityl oxide			4	4	4	2	-	2	2	4	4	4	4	-	-	2	4	4	-	-	4	-	-	-	-	CELOYZ
Methane		23	4	4	4	4	-	4	4	1	1	3	3	2	2	1	4	1	1	-	2	1	1	-	-	OUYZ
Methanol		50	1	1	1	1	1	1	1	1	1	1	1	4	4	1	1	3	4	-	1	2	2	-	-	ABDEILMNRSUYZ
Methyl acetate		23	4	4	4	2	-	2	1	4	4	4	4	-	-	1	3	4	-	-	-	-	-	-	-	CELMOUYZ
Methyl acrylate		23	4	4	4	2	-	2	2	4	-	4	4	-	-	-	4	4	4	-	-	-	-	-	-	DELO
Methylacrylic acid			4	4	4	2	-	2	2	-	-	2	-	-	-	-	-	2	4	-	4	-	-	-	-	O
Methylamine	32	23	-	-	-	1	-	1	-	4	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Methyl bromide		23	-	-	-	4	-	4	-	4	2	4	2	-	-	-	-	2	-	-	1	-	-	-	-	OUYZ
Methyl butyl ketone			4	4	4	2	-	2	-	4		4	4	-	-	1	3	4	-	-	-	-	-	-	-	CEL

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Methyl chloride			4	4	4	3	-	3	4	4	4	4	4	-	-	-	3	2	4	-	-	-	-	-	-	CELOUYZ
Methylcyclopentane			4	4	4	4	-	4	4	-	4	3	-	-	-	2	-	1	-	-	2	-	-	-	-	OYZ
Methylene dichloride		23	4	4	4	3	4	3	4	4	-	4	4	4	4	4	4	2	4	-	3	4	4			BDEHNRST
Methyl ethyl ketone (MEK)		23	3	3	3	1	2	1	1	4	4	3	4	3	4	2	4	4	4	-	4	4	4	-	-	BDEHILMNRSUYZ
Methyl formate			3	3	3	2	-	2	2	4	4	2	2	-	-	2	2	3	-	-	-	4	4	-	-	CELNOYZ
Methyl glycol acetate		50	3	3	2	1	2	-	1	4	-	3	2	4	4	3	2	4	4	-	-	-	-	-	-	B
Methyl isobutyl ketone		23	4	4	4	2	-	2	2	4	4	4	4	-	-	1	3	4	-	4	4	-	-	-	-	CEHLOVY
Methyl methacrylate		23	4	4	4	3	-	3	2	4	4	3	4	-	-	2	3	4	4	-	-	-	-	-	-	CDELMYZ
Methyl oleate			4	4	4	2	-	2	2	4	4	4	-	-	-	-	-	1	-	-	2	-	-	-	-	OZ
Methyl salicylate			-	-	-	2	-	2	2	4	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	CELNO
Milk		23	1	1	1	1	-	1	1	1	1	1	1	4	4	-	1	1	4	-	1	-	-	-	-	LOUY
Mineral oil (see Oils 1, 2 and 3)																										
Monobromobenzene (see bromobenzene)																										
Monoethanolamine [see ethanolamine (mono)]																										
Monomethylaniline			4	4	4	-	-	-	1	4	4	4	4	-	-	-	2	-	-	-	-	-	-	-	-	O
Monovinylacetylene		-20	2	2	2	1	-	1	1	-	-	2	2	-	-	3	3	1	-	-	-	-	-	-	-	CDLO
Monochlorobenzene (see chlorobenzene)																										
Morpholine		23	-	-	-	2	-	2	-	4	-	2	2	-	-	-	-	1	-	-	-	-	-	-	-	U
Mustard gas			3	-	-	1	-	3	3	-	-	3	1	-	-	-	1	1	-	-	-	-	-	-	-	O
Naphtha		23	4	4	4	4	-	4	4	1	2	4	4	3	-	2	4	1	-	-	1	1	-	-	-	CDEHLOYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Naphthalene		80	4	4	4	4	-	4	4	4	4	4	4	2	2	3	-	1	-	-	1	-	-	-	-	EILOYZ
Naphthenic acid			4	4	4	4	-	4	4	2	-	-	-	-	-	2	-	1	-	-	1	-	-	-	-	CLO
Natural gas			3	3	3	4	-	4	4	1	1	1	1	2	2	2	3	1	-	-	3	1	1	-	-	LOYZ
Nitric acid (conc)	65	23	4	4	4	4	-	4	4	4	4	4	2	4	4	4	4	1	-	-	4	4	4	4	4	DELMNORSUZ
Nitric acid (diluted)	10	50	2	-	2	1	-	1	1	2	-	3	1	4	4	4	4	1	-	-	-	4	-	4	4	DELMNRSTU
Nitric acid (fuming)	100	20	4	4	4	4	-	4	4	4	4	4	4	4	-	4	4	3	-	-	4	-	-	-	-	CLOUYZ
Nitrobenzene		50	4	4	4	1	2	1	1	4	4	4	4	4	4	4	4	3	4	-	-	4	-	-	-	ABDEHILMNRUYZ
Nitroethane			2	2	2	2	-	2	2	4	-	3	2	-	-	1	4	4	4	-	4	-	-	-	-	CELO
Nitromethane			2	2	1	1	-	2	2	4	4	2	3	-	-	1	4	4	4	-	4	-	-	-	-	ACELOYZ
1-Nitropropane		23	3	3	3	1	-	1	-	4	-	-	-	-	-	1	3	4	-	-	-	-	-	-	-	DEL
Nitrogen			1	1	1	1	-	1	-	1	-	1	1	-	-	1	1	1	-	-	-	1	-	-	-	EL
Nitrogen tetroxide			4	4	4	3	-	3	3	4	4	4	4	-	-	-	3	4	-	-	4	-	-	-	-	OYZ
Octachlorotoluene			4	4	4	4	-	4	4	4	-	4	4	4	4	4	4	1	4	-	2	-	-	-	-	O
Octadecane			4	4	4	4	-	4	4	1	2	2	2	1	1	1	4	1	2	-	1	-	-	-	-	OZ
n-Octane			4	4	4	4	-	4	4	-	-	-	-	-	-	2	4	4	-	-	2	-	-	-	-	O
Octanol			2	2	2	1	-	1	1	2	2	1	1	4	4	2	2	1	4	-	2	-	-	-	-	CELNOY
Oil 1 (ASTM No. 1, ISO 1817)		100	4	4	3	4	4	4	4	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	3	ABDEHIRSVYZ
Oil 2 (IRM 902, ISO 1817)		100	4	4	4	4	4	4	4	1	1	2	3	1	1	2	1	1	1	2	1	1	1	1	4	BDESIVYZ
Oil 3 (IRM 903, ISO 1817)		100	4	4	4	4	4	4	4	1	1	4	4	1	2	2	2	1	1	3	1	1	1	2	4	ABHIRSVYZ
Oleic acid		23	4	-	4	4	-	3	3	1	1	4	3	1	2	2	1	1	1	-	1	1	1	-	-	EILNORSUYZ
Olive oil		50	4	4	3	2	2	3	3	1	1	2	2	1	1	1	1	1	1	-	-	2	2	1	4	BDEILOU
Oxalic acid	25	70	1	-	1	1	-	1	1	3	2	2	1	-	-	4	3	1	-	-	-	3	3	1	-	EILMOTYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Oxygen		23	1	1	1	1	-	1	1	1	-	1	1	-	-	1	1	1	-	1	-	-	-	-	-	CL
Ozone (concn. 50 pphm) [c]		40	4	4	4	2	2	1	1	4	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	ELT
Paints (see xylene and solvents)																										
Paint removers (see cellosolves, methanol, turpentine, xylene and relevant chloranited hydrocarbons)																										
Palmitic acid		70	3	3	3	2	-	2	2	2	1	2	3	1	1	3	3	1	-	-	1	2	2	-	-	CELNOUYZ
Pentanol (see amyl alcohol)																										
Perchloric acid	70	23	2	-	-	1	-	1	-	4	4	3	2	-	-	-	4	1	-	-	-	-	-	-	-	CELNUY
Perchloroethylene		23	4	4	4	4	4	4	4	3	2	4	4	2	4	2	4	1	4	-	-	4	4	-	-	BDEILORUY
Pharmaceuticals (see water, ethanol and sucrose solution)																										
Phenol		100	4	-	4	2	-	2	1	4	4	4	4	4	4	4	2	1	4	-	1	4	4	-	-	ACDEHLMNOSUZ
Phenyl benzene (see diphenyl)																										
Phenyl ethyl ether			4	4	4	4	-	4	4	4	4	4	4	-	-	2	3	4	-	-	-	-	-	-	-	CLOYZ
Phenyl hydrazine		23	1	3	3	2	-	2	-	4	-	4	4	-	-	4	-	1	-	-	-	-	-	-	-	CLU
Phorone			4	4	4	2	-	2	2	4	4	4	4	-	-	3	-	4	-	-	-	-	-	-	-	CELOYZ
Phosgene		23	-	-	-	1	-	1	-	2	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Phosphate ester (*Skydrol 500*)		70	4	4	4	2	-	1	1	4	4	4	4	-	-	3	2	4	4	4	2	4	4	2	-	BCDEILMOPVZ
Phosphate ester (*Skydrol 7000*)		70	4	4	4	2	-	1	1	4	4	4	4	-	-	3	1	4	4	-	2	4	4	-	-	CELMYZ
Phosphate ester (*Pydraul F-9*)		80	4	4	4	3	4	2	2	4	-	4	4	4	4	3	1	1	4	-	2	-	-	-	-	BDEILOP
Phosphoric acid	60	50	2	-	1	1	-	1	1	3	-	2	1	-	-	4	1	1	-	-	-	4	-	1	-	BDELMNRUYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																						References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Phosphorus trichloride			4	4	4	1	-	1	1	4	4	4	1	-	-	-	-	1	-	-	1	-	-	-	-	OUYZ
Phthalic acid	Sat	23	-	-	-	1	-	1	-	4	-	1	1	-	-	-	-	4	-	-	-	-	-	-	-	U
Pickling acid (see sulfuric acid, hydrochloric acid and nitric acid)																										
Picric acid	10	100	2	2	2	1	-	1	1	2	-	2	1	-	-	4	4	1	-	-	2	4	-	-	-	CEILMOU
Pine oil		70	4	4	4	4	-	4	4	2	-	4	4	-	-	-	-	1	-	-	1	-	-	-	-	CELNO
Pinene		70	4	4	4	4	-	4	4	2	2	4	3	-	-	3	4	1	-	-	2	-	-	-	-	CELNOTY
Piperidine			4	4	4	4	-	4	4	4	-	4	4	-	-	-	-	4	-	-	4	-	-	-	-	CLO
Potassium permanganate	25	70	4	-	-	-	-	4	-	3	-	2	3	-	-	-	1	4	-	-	-	-	-	-	-	ERTU
Propane liquid			4	4	4	4	-	4	4	1	1	2	3	2	2	1	3	1	1	-	2	1	1	-	-	LOUYZ
Propanol		50	1	1	1	1	1	1	1	2	1	1	1	2	4	1	2	1	4	-	-	-	-	-	-	BELMOUYZ
Propene (propylene)			4	4	4	4	-	4	4	3	4	4	4	-	-	2	-	1	-	-	2	-	-	-	-	CLOYZ
Propene oxide			-	-	4	2	-	2	2	4	4	4	4	-	-	3	4	4	-	-	-	4	-	-	-	CORU
Propionic acid		23	-	-	-	1	-	1	-	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	U
Propyl acetate		23	4	4	4	2	-	2	2	4	4	4	4	-	-	2	3	4	4	-	4	-	-	-	-	CELNOY
Propylamine		23	4	4	4	3	3	3	3	4	-	4	4	4	4	4	4	4	4	-	-	-	-	-	-	B
Propyl nitrate		23	-	-	-	2	-	2	2	-	1	4	4	-	-	3	3	4	-	-	4	-	-	-	-	CDLMOTZ
Pyridine		23	4	4	4	2	-	2	2	4	4	4	4	-	-	4	2	4	4	-	-	4	4	-	-	ACDELMOUYZ
Pyrrole			3	3	3	4	-	3	3	4	-	4	4	-	-	4	2	4	4	-	2	-	-	-	-	CLO
Rape seed oil		100	4	4	4	3	-	2	2	1	2	2	3	1	1	4	4	1	1	-	1	1	1	-	-	ES
Refrigerants (see freons and ammonia)																										

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																						References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Salicylic acid			1	-	-	1	-	1	1	1	2	1	-	-	-	-	-	1	-	-	1	-	-	-	-	CELOYZ
Salt and salt solution (non-oxidizing) [d]	Sat	70	1	1	1	1	-	1	1	1	1	1	1	4	4	1	1	1	4	1	1	1	1	-	-	ERSYZ
Silicate esters			4	4	4	4	-	4	4	2	2	1	1	1	1	-	4	1	-	-	1	-	-	-	-	CLOYZ
Silicone greases			-	-	-	1	-	1	-	1	1	2	2	-	-	-	3	1	1	1	1	-	-	-	-	CELVYZ
Silicone oils		60	-	-	-	1	-	1	-	1	1	1	1	-	-	-	3	1	1	-	1	1	1	-	4	BCELUYZ
Soap solution			1	1	1	1	-	1	1	1	1	1	1	-	-	-	1	1	4	-	1	1	1	-	-	ELOZ
Sodium bicarbonate (see sodium hydrogen carbonate)																										
Sodium carbonate	20	100	1	1	1	1	-	1	1	1	1	1	1	4	1	-	1	1	-	-	-	1	1	-	-	ELOSY
Sodium hydrogen carbonate			1	1	1	1	-	1	-	1	-	1	1	-	-	1	1	1	-	-	-	1	-	-	-	ELC
Sodium hydroxide	10	100	1	1	1	1	1	1	1	1	2	1	1	4	4	4	4	4	4	-	-	-	-	1	1	BEISZ
	25	100	1	1	1	1	1	1	1	4	-	1	1	4	4	4	4	4	4	-	-	-	-	-	-	BIMS
Sodium hypochlorite	10	50	2	-	2	1	-	1	1	3	2	3	1	4	4	4	2	1	-	-	-	2	-	-	-	DELMRSUYZ
Sodium peroxide			2	2	2	1	-	1	1	-	2	2	2	4	4	-	4	1	4	-	1	-	-	-	-	OYZ
Solvents (see relevant hydrocarbons, chlorinated hydrocarbons, ketones and alcohols, carbon disulfide and cellosolve)																										
Soybean oil		23	4	4	3	3	-	3	3	1	1	2	2	2	2	1	1	1	1	-	1	1	1	-	-	CELNO
Steam			3	3	3	1	-	1	1	1	-	2	2	4	4	4	4	2	4	-	2	-	-	-	-	DL
Stearic acid		70	3	3	3	4	-	2	2	2	2	2	2	1	1	-	1	-	-	-	-	-	-	-	4	CEILNOUYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Sterilization media (see steam, formaldehyde and ethylene oxide)																										
Styrene		23	4	4	4	4	-	4	-	4	4	4	4	-	-	3	3	1	4	-	-	-	-	-	-	ACDELYZ
Sucrose solution		80	1	1	1	1	-	1	-	1	2	1	1	-	-	1	-	-	-	-	-	-	-	-	-	CELYZ
Sulfur			4	4	4	1	-	1	1	4	4	1	1	-	-	4	1	1	4	-	1	3	3	-	-	CLOZ
Sulfur dichloride			4	4	4	4	-	-	-	3	-	3	2	-	-	4	-	1	-	-	1	-	-	-	-	CLO
Sulfur dioxide		23	3	3	3	1	-	1	1	3	4	3	3	-	-	4	3	1	4	-	2	-	-	1	-	CEHLNOUYZ
Sulfur hexafluoride			-	1	1	1	-	1	1	1	2	1	2	-	-	-	1	1	-	-	1	-	-	-	-	CLO
Sulfuric acid	10	100	1	1	1	1	1	1	1	3	-	1	1	4	4	4	4	1	4	-	-	-	-	-	-	BEIS
	20	23	1	1	1	1	-	-	1	1	-	1	1	4	4	4	4	1	4	-	-	-	-	1	4	BEIS
	25	100	1	1	1	1	1	-	1	4	-	1	1	4	4	4	4	1	4	-	-	-	-	-	-	BN
	50	100	1	1	1	1	1	-	1	4	-	1	1	4	4	4	4	1	4	-	-	-	-	-	-	B
	60	100	3	-	3	1	-	-	4	4	-	4	4	4	4	4	4	1	-	-	-	-	-	-	-	SU
	75	100	4	4	4	4	4	3	3	4	-	4	4	4	4	4	4	1	-	-	-	-	-	-	-	BU
	96	23	4	4	4	4	-	4	-	4	2	4	4	4	4	4	4	1	4	4	-	-	-	-	-	BILMRSUVZ
Sulfurous acid	Sat	23	1	2	2	1	-	2	-	2	2	2	1	4	4	4	3	1	4	-	3	-	-			CELNOYZ
Sulfuryl chloride		23	-	-	-	2	-	2	-	4	-	2	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Tannic acid			1	2	2	1	-	1	1	1	1	1	1	-	-	-	1	1	4	-	-	-	-	-	-	EILMNOUYZ
Tar, bituminous			4	4	4	4	-	4	4	2	2	3	3	-	-	-	3	1	4	-	1	2	2	-	-	CELOYZ
Tartaric acid	10	100	1	1	1	1	-	2	-	1	1	1	1	-	-	-	1	1	-	-	-	1	-	-	-	CEIL
Terpineol		23	4	4	4	3	-	3	-	1	2	4	4	-	-	1	-	1	-	-	-	1	-	-	-	CELN
Tetraethyl lead		23	-	-	-	4	-	4	4	-	2	2	4	-	-	-	-	1	-	-	-	2	-	-	-	CHLOYZ

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material																							References/comments (see Annex C)
			NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	
Tetrabromomethane			4	4	4	4	-	4	4	4	4	-	-	-	-	-	-	1	-	-	2	-	-	-	-	OY
Tetrabutyl titanate			2	2	2	2	-	1	1	1	2	1	-	-	-	-	-	1	-	-	1	-	-	-	-	OYZ
Tetrachlorethane		23	-	-	4	4	-	-	-	4	4	4	-	-	-	4	3	1	4	-	-	-	-	-	-	ADLUYZ
Tetrahydrofuran		23	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	-	-	4	-	-	-	BEORUYZ
Tetralin		23	4	4	4	4	-	4	4	4	4	4	4	2	3	4	3	1	4	-	1	4	4	-	-	LMNSYZ
Thionyl chloride		23	4	4	4	4	-	4	4	-	-	4	4	-	-	-	-	2	-	-	-	-	-	-	-	CDLNOU
Titanium tetrachloride			4	4	4	4	-	4	4	3	2	4	4	-	-	3	-	1	-	-	2	-	-	-	-	OYZ
Toluene (Liquid E, ISO 1817)		23	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	2	4	4	2	4	4	-	-	BDEHILMNRSTVYZ
Toluene diisocyanate		70	4	3	3	1	-	2	2	-	4	4	4	4	4	4	2	2	4	-	-	-	-	-	-	BEHRSOYZ
Transformer oil			4	4	4	4	-	4	4	1	1	2	3	1	-	-	2	1	1	-	1	-	-	1	-	CLOPYZ
Triacetin			2	3	3	1	-	1	1	2	2	2	2	4	4	2	-	4	4	-	4	-	-	-	-	CLOYZ
Triaryl phosphate			4	4	4	1	-	1	1	4	4	3	3	2	2	2	3	1	4	-	2	-	-	-	-	OYZ
Tributoxy ethyl phosphate			3	3	3	2	-	2	2	4	4	4	4	-	-	1	-	1	-	-	2	-	-	-	-	CELOYZ
Tributyl mercaptan			4	4	4	4	-	4	4	4	-	4	4	-	-	-	-	1	-	-	-	-	-	-	-	O
Tributyl phosphate		100	3	3	3	3	-	1	1	4	4	4	4	4	4	1	3	4	4	-	4	-	-	-	-	ADELMOTUYZ
Trichloroethane		23	4	4	4	3	-	4	4	4	4	4	4	4	4	4	3	1	4	-	2	-	-	-	-	ACDLOUYZ
Trichloroethylene		23	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	2	4	4	2	4	4	-	-	ABDEHLOSTUYZ
Trichloroacetic acid		23	3	2	-	2	-	2	-	4	2	4	4	-	-	-	-	3	4	-	-	-	-	-	-	CLUYZ
Tricresyl phosphate		70	3	3	3	1	-	1	1	4	4	4	4	2	3	2	1	1	4	4	1	4	4	-	-	DEHILNSUVYZ
Triethanolamine		23	2	2	2	2	-	2	2	3	3	1	1	4	4	4	1	2	4	1	4	-	-	1	-	CEILMOUVYZ
Triethylamine		23	4	4	4	4	4	4	4	1	-	3	3	1	3	1	4	2	2	-	-	-	-	-	4	BU
Triethyl borane		70	-	-	-	-	-	3	-	-	-	4	4	-	-	-	-	1	-	-	-	-	-	-	-	CDL

Table 3 — (*continued*)

Medium For classification, see Table 1 (1 is good and 4 is poor)	Concn., %	Temp., °C	Material: NR/IR	BR	SBR	IIR	BIIR/CIIR	EPDM	EPM	NBR	HNBR	CR	CSM	AU	EU	T	MQ	FKM	ACM	AEM	FMQ	ECO	CO	CM	EVM	References/comments (see Annex C)
Trinitrotoluene			4	4	4	4	-	4	4	4	4	2	2	-	-	2	-	2	-	-	2	-	-	-	-	OYZ
Trioctyl phosphate			4	4	4	1	-	1	1	4	-	4	4	4	-	2	3	2	4	-	2	-	-	-	-	O
Turpentine		23	4	4	4	4	-	4	4	1	1	4	4	3	-	1	3	1	2	-	2	1	1	-	-	CDEHLNOYZ
Urea solution	30	23	-	-	-	1	-	1	-	1	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	U
Vegetable oils			4	4	4	2	-	2	2	1	1	2	2	1	1	1	2	1	1	1	1	1	4	-	-	CELYZ
Vinyl chloride			-	-	-	2	-	2	2	4	-	4	4	-	-	-	-	1	-	-	-	-	-	-	-	OU
Water, deionized or distilled		23	1	1	1	1	2	1	1	2	1	2	2	4	4	4	2	1	4	-	-	2	2	2	2	CELSUZ
		100	1	1	1	1	2	1	1	2	1	2	2	4	4	4	2	1	4	-	-	2	2	2	2	CELSUZ
Xylene		23	4	4	4	-	-	4	4	4	4	4	4	3	-	2	4	2	4	-	2	4	-	-	-	DEHILNUYZ

[a] Test time 4 weeks.

[b] Test liquid comprising 99,5 % diethyl sebacate and 0,5 % phenothiazine (ISO 1817).

[c] pphm = parts per 100 million parts of air.

[d] For sodium chloride or common salt. The resistance levels will also apply to some other non-oxidizing inorganic salts. They do not necessarily apply to salts of metals (e.g. copper) capable of catalysing rubber oxidation.

Annex A
(informative)

Effect of compounding variations on chemical resistance

A.1 General

In this document, the classification of chemical resistance is directly related to the rubber types listed in Clause 3. However, the information used for the classification relates largely to vulcanized rubber compositions containing such compounding ingredients as fillers, extenders, plasticizers and protective agents. Whilst the type of rubber polymer has a dominant role in determining resistance to many of the chemicals listed in Table 3, vulcanization and compounding can have an important effect on behaviour. Within one polymer type, there can also be significant differences among grades.

The classes given in Table 3 are believed to be representative of each rubber type, but it should be stressed that these classes can be changed by a change in composition.

The classification given in Table 3 is based on the properties of a formulation suitable for the particular rubber. Usually a compromise between properties is required for an application and this may affect the level of chemical resistance. Under certain conditions, e.g. ozone attack, performance may be improved by special additives, the use of which may permit an upgrading in class for some polymers. This document is concerned with the behaviour of rubbers, not their selection. The choice of rubber type (and compound) will depend on many factors other than just chemical resistance.

A.2 Raw-rubber variations

There are normally many different grades of each rubber polymer and this can have some influence on the chemical resistance. Solution-polymerized rubbers are generally more water-resistant than their emulsion-polymerized equivalents, and rubber containing polar groups are generally more mineral-oil-resistant than non-polar-hydrocarbon rubbers. The following are examples of the effect of the particular grade of polymer on its chemical resistance.

NR: Resistance to water depends on the non-rubber content, especially the protein level. Thus deproteinized NR is more resistant than normal NR, whereas the fast-curing skim rubber is less resistant because of its high non-rubber content. A low dirt grade is recommended for thin-walled products to minimize the risk of imperfections.

IR: The chemical resistance is similar to that of NR. Solution-polymerized IR and low ash content grades are even more resistant to water absorption.

SBR: Glue-acid (GA) coagulated SBR has lower water swelling than most other grades. Solution-polymerized SBR and low ash content grades are even more resistant to water absorption.

NBR: The content of acrylonitrile (ACN), which can vary from about 12 % to about 50 %, has a great influence on the swelling of nitrile rubber materials in oil and solvents. With higher ACN contents, the rubber swells less in mineral oils and most non-polar solvents, but the opposite effect can be observed with polar solvents.

CSM: The content of chlorine has an influence on the swelling of CSM in oils and solvents. With higher chlorine contents, the rubber swells less in mineral oils and most non-polar solvents, but the opposite effect can be observed with polar solvents.

FKM: Some of the peroxide-curable types are more resistant to certain solvents and acids and to steam and water than fluorinated rubber with other types of curing system.

IIR, EPDM: The chemical resistance within each type is, in general, related to the degree of unsaturation. Brominated IIR has similar chemical resistance to chlorinated IIR but both may be less resistant to aqueous media when zinc-oxide-containing vulcanizing systems are used.

Urethane rubber: There are two main types of urethane rubber: ester urethane (AU) and ether urethane (EU). EU has a better resistance to hydrolysis in acids, alkalis and water. On the other hand, AU swells less in mineral oils and in many solvents.

A.3 Fillers, extenders and plasticizers

Carbon black is generally the preferred filler to obtain chemically resistant rubber, but mineral fillers can also be used in most rubbers if colours are required. The swelling of a rubber material in oils and solvents is reduced by increasing the filler content because it is the polymer that swells. Increased filler loading generally increases hardness, and too high a filler loading results in a weaker rubber. Urethane rubbers generally are not filled while silicone rubber is generally filled with silica. Fillers which are reactive for instance in acids should be avoided in all rubber materials when used in such agents. When the content of extender and plasticizer is high in a compound, which sometimes is the case in NBR and EPDM, but also in SBR and CR, most of the extender and the plasticizer can be extracted from the compound by oils and solvents. Thus the volume of the material can decrease, which can cause problems in the case of seals. Chemically resistant rubber materials consequently should have a low content of extractable plasticizers, but the latter are difficult to avoid completely.

A.4 Crosslinking

Vulcanization can influence chemical resistance in two ways. Firstly, crosslinking reduces swelling and therefore the crosslink density should be as high as other properties allow. Secondly, the crosslink type can influence resistance to oxidation and heat, both of which may contribute to chemical resistance at elevated temperatures. The crosslinking system can also influence the degradation of a rubber material. With suitable protective agents present, rubber vulcanized by low-sulfur systems (i.e. with monosulfidic crosslinks), peroxides (i.e. with carbon-carbon crosslinks) or other systems giving thermally stable crosslinks is more resistant to atmospheric oxidation than rubber crosslinked with conventionally higher levels of sulfur. An example is that butyl rubber cured with resins is much more oxidation-resistant at high temperatures than butyl rubber cured with sulfur. The number of crosslinks between the rubber molecules will also have an effect on the swelling in oils, solvents and water. Increasing the sulfur content in NR, SBR and NBR generally reduces the level of swelling, and if sufficient sulfur is present an ebonite is formed which has better all-round chemical resistant than soft vulcanized rubber.

A.5 Antidegredants

Antioxidants are added to such rubbers as NR, IR, SBR, BR, CR and NBR to improve resistance to oxidative ageing. Special types may be required where the rubber is to be exposed to chemicals containing trace quantities of certain metals, such as copper, which might otherwise assist oxidation. Antiozonants are added to the same group of rubbers to provide ozone resistance. The choice of the protective system will depend on the conditions of service. As far as possible, antidegradants resistant to extraction by solvents or to leaching by aqueous solutions should be used in rubber coming into repeated contact with liquids.

Annex B
(informative)

References in Table 2

ISO 105, *Textiles — Tests for colour fastness*

ISO 175, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing or heat resistance tests*

ISO 1431 (all parts), *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking*

ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 2782, *Rubber, vulcanized or thermoplastic — Determination of permeability to gases*

ISO 4611, *Plastics — Determination of the effects of exposure to damp heat, water spray and salt mist*

ISO 4665, *Rubber, vulcanized and thermoplastic — Resistance to weathering*

ISO 4926, *Road vehicles — Hydraulic brake systems — Non-petroleum base reference fluids*

ISO 5667-9, *Water quality — Sampling — Part 9: Guidance on sampling from marine waters*

ISO 6179, *Rubber, vulcanized or thermoplastic — Rubber sheets and rubber-coated fabrics — Determination of transmission rate of volatile liquids (gravimetric technique)*

ISO 7253, *Paints and varnishes — Determination of resistance to neutral salt spray (fog)*

ISO 13226, *Rubber — Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

IEC 60296, *Fluids for electrotechnical applications — Unused mineral insulating oils for transformers and switchgear*

ASTM D 6284, *Standard Test Method for Rubber Property — Effect of Aqueous Solutions with Available Chlorine and Chloramine*

Annex C
(informative)

References in Table 3

The following sources have been used in the construction of Table 3. It will be appreciated that many are no longer available and some contain the same information.

A Picking the right Elastomer to fit your fluids; Beerbower A, Kaye L A, Pattison DA: *Chemical Engineering*, Dec 18, 1967, pp. 118-128

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T Private information from Trelleborg AB, Sweden (1974)

U *Liste des chemishen Beständigkeit von Elastomeren*; G. Fischer; June 1981

V *Fluid Resistance of "Vamac"* (Du Pont EA-510)

Y *The General Chemical Resistance of Various Elastomers*. The Los Angeles Rubber Group Inc 2000

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