INTERNATIONAL LABOUR OFFICE GENEVA

ENCYCLOPAEDIA OF OCCUPATIONAL HEALTH AND SAFETY

THIRD (REVISED) EDITION

VOLUME 2 L-Z

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Technical editor:
Dr. Luigi Parmeggiani

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HOW TO USE THE ENCYCLOPAEDIA

Articles are classified in strict alphabetical order. When a title consists of several words, the most significant of these is used as a heading. Because of their complexity the different aspects of some subjects, such as "Accidents", are dealt with in several articles, which are, as far as possible, usually grouped together.

Wherever necessary for the understanding of the subject, the articles themselves contain cross references to other articles, in particular to those whose direct relation to the entry might escape the reader.

However, the analytical index remains the main tool for guiding the reader to a given item. It lists, again in strict alphabetical order, the subjects dealt with in the articles, including those which, though treated more briefly or sometimes even only mentioned in the bibliography attached to an article, are nevertheless of some importance for occupational health and safety. The page indicated against each entry in the index is the first page of the article concerned.

Chemical and physical data

Normally, the nomenclature of chemical substances follows that of the International Union of Pure and Applied Chemistry, with the exception of a few products for which the old terminology is still very widely used in occupational safety and health practice. For organic compounds the main synonyms have also been provided.

Certain physical and chemical data of interest from the standpoint of occupational safety and health are given at the beginning of articles dealing with dangerous substances. For the sake of uniformity the main sources of these data have been the following publications: *CRC handbook of chemistry and physics*. Weast, R. C., and Astle, M. J. (eds.) (West Palm Beach, CRC Press Inc., 59th ed., 1978-79); *Dangerous properties of industrial materials*. Sax, I. N. (New York, London, Toronto, Melbourne, Van Nostrand Reinhold Company, 5th ed., 1979); *Handling chemicals safely* (Amsterdam, Het Veiligheids-instituut, 2nd ed., 1980).

The information given is usually as follows:

m.w. molecular weight
or alternatively
a.w. atomic weight
sp.gr. specific gravity (water = 1) or density (kg/m³)
m.p. melting point
b.p. boiling point
fr.p. freezing point
v.d. vapour density (air = 1)
v.p. vapour pressure
f.p. flash point (closed cup, unless indicated oc = open cup)
e.l. explosive limits in % by volume, lower and upper
i.t. auto-ignition temperature
Solubility: slightly soluble = less than 10 g/100 cm³;
soluble = 10-100 g/100 cm³;
very soluble = more than 100 g/100 cm³
Description
Exposure limits for concentrations of toxic substances in the air (see below).

Exposure limits

These include the United States Occupational Safety and Health Administration (OSHA) values and when they differ or are the only ones in existence, those of the National Institute of Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH), as well as the MAC values (maximum allowable concentrations) fixed by the Ministry of Public Health in the USSR. The values quoted are those valid in 1980. They are subject to periodical adjustment and should not be taken over-rigidly.

The following further details may be given:

TWA	time-weighted average for a normal 8-h work-day and 40-h work-week, unless otherwise indicated;
TLV	time-weighted average adopted by the ACGIH for a normal 8-h work-day and 40-h work-week;
ceil	ceiling, i.e. the concentration that should not be exceeded even instantaneously;
skin	possibility of absorption in significant amounts through the skin, mucous membranes and eye;
STEL	short-term exposure limit of the ACGIH, i.e. the maximum concentration to which workers can be exposed for a period of up to 15 min continuously, provided that no more than four excursions per day are permitted, with at least 60 min between exposure periods and provided that the daily TLV/TWA is not exceeded;
IDLH	concentration immediately dangerous to life or health from which a worker could escape without any escape-impairing symptoms or any irreversible health effects (NIOSH/OSHA Standards Completion Programme);
MAC USSR	maximum allowable concentration not to be exceeded;
TSRAL USSR	temporary safe reference action level.

In view of their general usefulness for preventive purposes, the above-mentioned exposure limits have been added by the editor; their inclusion in an article does not imply that the author of the article accepts their accuracy.

Units of measurement and abbreviations

The units of measurement used in the encyclopaedia are those of the International System (SI), with the exception of a few that are recognised by the International Organisation for Standardisation and still widely used. A list of the symbols for units and of the their abbreviations, together with conversion tables, is to be found in appendices to the second volume.

Abbreviations other than those of units or measurement and the physical and chemical data mentioned above are given alongside the full expression the first time they are used in an article.

Some abbreviations commonly used in occupational health and safety are, however, employed without further amplification. These include:

mmHg	millimetres of mercury
ppm	parts per million
ppb	parts per billion
$ppcm^3$	particles per cubic centimetre
ppcf	particles per cubic foot
LC_{50}	lethal concentration 50
LD_{50}	lethal dose 50
%w/w	percentage, weight in weight, i.e. number of grammes of active substance in 100 g of product

Text of articles

Almost 70% of the entries consist of revised articles from the 1972 edition. Any significant addition to or alteration of the author's original text by the editor is included in square brackets. In several articles use has been made of the bibliography in order to enlarge the scope of the entry beyond the treatment given by the author; thus, on controversial matters that have not yet been settled, suggested readings may express views different from those of the author.

Throughout the encyclopaedia, whenever workers in general are referred to, for the sake of brevity only pronouns of the masculine gender have been used. Unless the context requires a restrictive interpretation any such reference should be read as applying equally to both women and men.

Transliteration

The recommendations of the ISO's International System for the Transliteration of Slavic Cyrillic Characters (2nd ed., R 9-1968) have been followed throughout the encyclopaedia.

Bibliographical references

Each article is usually accompanied by a short bibliography of suggested readings, the purpose of which is much more to supplement the information in the article and to develop individual points or different approaches than to support statements or figures quoted by the author.

Where possible and appropriate, care has been taken to include documents published in different countries so as to cater for as wide a circle of readers as possible. No mention is usually made of sources of general information, such as textbooks and standard works of reference; the information concerned is generally easily accessible. References preceded by a CIS number have been abstracted by the International Occupational Safety and Health Information Centre (CIS), and in those areas the CIS is available for further bibliographical research and services.

In addition to the language of publication, the choice of the reader may be further guided by the details given of the length of the suggested reading, the number of references it contains, and whether it is illustrated or not. Furthermore, in a number of cases the references have been grouped under subject headings according to their main content.

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Chloronaphthalenes
Chloropicrin
Chloroprene
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Chromosome aberrations
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Civil engineering
Clay
Climate and meteorology
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Coal and derivatives
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Coffee industry
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Conditioned reflexes
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Confined spaces
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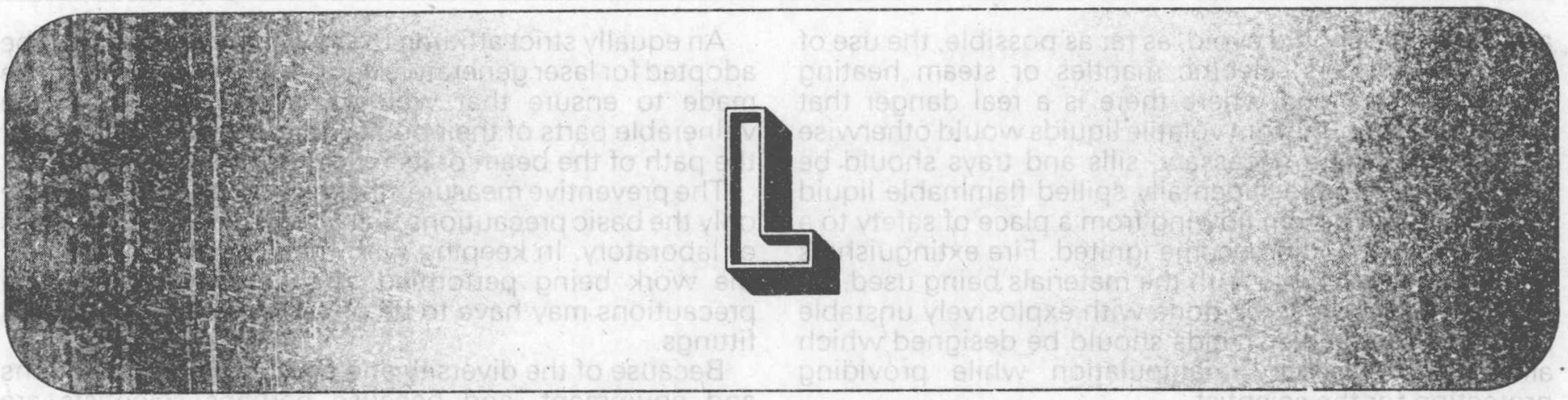
APPENDICES



Laboratory work

The variety, size, type and complexity of scientific laboratories preclude simple generalisations on the health and safety of laboratory work. It must be recognised that laboratory workers are selected and employed primarily because of their specialised education, knowledge and skills, and not because of any qualifications related to health or safety interest. Unless the laboratory is intimately integrated with a manufacturing facility, the degree of regulation and control actually enforced is usually lower than that for production operations. In addition, there is a feeling which has been fostered by the academic community itself that little should be done to interfere with "academic freedom", no matter how serious the consequence of that freedom. This is true of freedom to formulate and express scientific ideas, but control must be exercised over the laboratory handling of materials that may be toxic, corrosive, flammable or explosive, and scientific laboratory workers should be prepared to accept this control in return for the advantages that derive from a well organised scientific establishment.

Problems of safety and health associated with laboratory work have been reviewed by many organisations; summaries of the facilities which promote safer operation have been published; and the need for wider application and appreciation of industrial hygiene in the laboratory has been advocated. In spite of this, however, the basic problem remains that the laboratory worker has relatively limited appreciation of safety and health. Few academic institutions have made a serious attempt to integrate practical knowledge concerning hazardous materials and processes into their formal training, to ensure that the trained personnel will be able to recognise and to prevent excessive exposures. In addition, research laboratories in academic institutions and in government and industrial establishments are frequently at the frontiers of knowledge both of science and of hazards. For this reason, laboratory workers are often the first persons to be exposed to new chemical and physical dangers, and they may suffer unexpected injury unless effective control, monitoring and medical supervision are integrated into the planning of the laboratory operations.

Laboratory operations. No full detailed account could be given of the numerous and varied functions that are performed by laboratory workers in the great variety of laboratories in which research, analysis testing and process control are carried on. For the purpose of this article it may be sufficient to say that toxic, corrosive, flammable and explosive substances are handled often in fragile glass apparatus, ionising and other radiations are studied and used, electrical apparatus at lethal voltages may be assembled, tested and operated, and disease-infested tissue and animals may have to be examined, tested and assessed.

The hazards are not always obvious to the laboratory worker. Neglect of safety and health measures can have serious consequences.

SAFETY AND HEALTH MEASURES

A safety policy will be successful only if the arrangements are inaugurated and supported and enforced by the responsible director vested with adequate authority. His responsibilities will begin with the design of the laboratory and its fittings.

Laboratory facilities. If the laboratory is for chemical, biological or pathological work, certain basic safety provisions will almost certainly be necessary. One basic necessity is a properly designed and maintained ventilation system including chemical fume cupboards or hoods with sash windows and adequate air velocity at the openings. The provision of fume cupboards or hoods should be generous and they should be conveniently situated in relation to the benches to ensure that dangerous operations will not be performed on open benches because of the inconvenience of transferring the apparatus to a remote situation where it cannot be kept under continuous observation. They should be provided with the usual services—gas, electricity, water and, in certain circumstances, compressed air.

The laboratory design should include appropriate fire protection for dangerous chemicals. If flammable liquids are extensively used in considerable quantity, provision should be made to reduce the fire hazard. Heating

Figure 1. A laboratory worker using tongs and wearing goggles and asbestos gloves whilst handling material in a laboratory furnace.