# REGULATIONS FOR HAZARDOUS CHEMICAL AGENTS, 2021

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## SCHEDULE

### Arrangement of regulations

**Definitions**

1. In these regulations any word or expression to which a meaning has been assigned in the Act shall have the meaning so assigned and, unless the context otherwise indicates—

**"air monitoring"** means the monitoring of the concentrations of airborne hazardous chemical agents;

**"Asbestos Abatement Regulations"** means the Asbestos Abatement Regulations, 2020, published as Government Notice No. R.11196 of 10 November 2020 under section 43(1) of the Act;

**"assessment"** means a programme to determine any risk from exposure to an HCA associated with the workplace in order to identify the steps needed to be taken to remove, reduce or control such HCA;

**"BEI"** or **"biological exposure index"** is a value for assessing biological monitoring results, intended as a reference guideline for the likelihood of adverse health effects, and generally represents the level of determinants that are most likely to be observed in specimens collected from healthy employees who have been exposed to HCAs with inhalation exposure at the occupational exposure limit, as listed in Table 4 of Annexure 2 hereby, as revised from time to time and published in the *Gazette*;

**"carcinogen"** or **"CARC"** means any chemical agent or mixture which induces cancer or increases its incidence, classified by the GHS as—

(a) Category 1: known or presumed human carcinogens; or

(b) Category 2: suspected human carcinogens;

**"CAS number"** or **"chemical identity"** means the number or name, respectively, that uniquely identifies a chemical, given in accordance with the nomenclature systems of the International Union of Pure and Applied Chemistry or the Chemical Abstracts Service, or a technical name;

**"chemical agent"** means a GHS-aligned chemical agent or mixture;

**"chief director: provincial operations"** means the provincial director as defined in regulation 1 of the General Administrative Regulations;

**"consumer product"** means a product containing an HCA, which—

(a) is packed or repacked primarily for use by a household consumer or for use in an office;

(b) if the product is packed or repacked primarily for use by a household consumer, is packed in the way and quantity in which it is intended to be used by a household consumer; and

(c) if the product is packed or repacked primarily for use in an office, is packed in the way and quantity in which it is intended to be used for office work;

**"container"**, in relation to an HCA, means anything in or by which an HCA is, or has been, wholly or partly covered, enclosed or packed, including anything necessary for the container to perform its function as a container;

**"cut-off value"** or **"GHS cut-off value"** or "**GHS concentration limit"** means the minimum concentration of an HCA, expressed as a percentage, to trigger the classification of a mixture containing the HCA;

**"exposed"** means exposed to an HCA whilst at the workplace and **"exposure"** has a corresponding meaning;

**"Facilities Regulations"** means the Facilities Regulations, 2004, published as Government Notice No. R. 924 of 3 August 2004;

**"General Administrative Regulations"** means the General Administrative Regulations, 2003, published as Government Notice No. R. 929 of 25 June 2003;

**"GHS hazard classification"** means the GHS hazard classes and hazard categories assigned to HCAs;

**"hazard category"** means a division of criteria within a hazard class in the GHS, where these hazard categories compare hazard severity within a hazard class and should not be taken as a comparison of hazard categories more generally;

**"hazard class"** means the nature of a physical, health or environmental hazard under the GHS;

**"hazard pictogram"** means a graphical composition, including a symbol plus other graphical elements such as a border, background pattern or colour that is intended to convey specific information, that is assigned in the GHS to a hazard class or hazard category;

**"hazard statement"** means a statement assigned in the GHS to a hazard class or hazard category describing the nature of the hazards of an HCA including, if appropriate, the degree of hazard;

**"hazardous chemical agent"** or **"HCA"** means a GHS-aligned chemical agent as provided for in Annexure 1;

**"HSG 173"** means the Guidance Note HSG 173 of the Health and Safety Executive (HSE) of the United Kingdom: Monitoring Strategies for Toxic Substances, 2006, ISBN 978 0 7176 6188 6, as revised from time to time and published in the *Gazette*;

**"importer"** means an employer or self-employed person who, by any means, imports an HCA into the Republic that is to be used, or could reasonably be expected to be used, at a workplace;

**"Lead Regulations"** means the Lead Regulations, 2001, published as Government Notice No. R. 236 of 28 February 2002;

**"manufacturer"** means an employer or self-employed person who manufactures an HCA that is to be used, or could reasonably be expected to be used, at a workplace;

**"measurement programme"** means a programme according to the monitoring strategy as contemplated in HSG 173;

**"Minister"** means the Minister of Employment and Labour;

**"monitoring"** means the planning, carrying out, and recording of the results of a measurement programme;

**"OEL"** or **"occupational exposure limit"** means a limit value set by the Minister, which represents the airborne concentration of an HCA, where the exposure standard may be—

(a) an eight-hour time-weighted average;

(b) a ceiling limit; or

(c) a short-term exposure limit;

**"OEL ceiling limit"** or **"ceiling limit"** or **"C"** means a maximum or peak airborne concentration of an HCA determined over the shortest analytically practicable period of time, which does not exceed 15 minutes;

**"OEL eight-hour time-weighted average"** or **"TWA"** means the maximum average airborne concentration of an HCA when calculated over an eight-hour working day, for a five-day working week;

**"OEL-ML"** or **"occupational exposure limit - maximum limit"** means an HCA as listed in Table 2 of Annexure 2;

**"OEL-RL"** or **"occupational exposure limit - restricted limit"** means an HCA as listed in Table 3 of Annexure 2;

**"OEL-short-term exposure limit"** or **"STEL"** means the time-weighted average maximum airborne concentration of an HCA calculated over a 15-minute period;

**"OESSM"** means the Occupational Exposure Sampling Strategy Manual, published by the National Institute for Occupational Safety and Health (NIOSH), Publication No. 77-173 of 1977, United States of America: Department of Health, Education and Welfare;

**"permanent respirator zone"** means an area where the concentration of an airborne HCA during normal operations exceeds the OEL-RL for that HCA;

**"precautionary statement"** means a phrase prescribed by the GHS that describes recommended measures that should be taken to minimise or prevent—

(a) the adverse effects resulting from exposure to an HCA; or

(b) the improper storage or handling of an HCA;

**"prohibited agent"** means an HCA prohibited by the Minister and listed in Table 1 of Annexure 2, where the agents prohibited may be revised from time to time by notice in the *Gazette*;

**"respiratory protective equipment"** means a device that is worn over at least the mouth and nose to prevent the inhalation of an airborne HCA and that is of a type, or conforms to a standard, approved by the Minister;

**"respirator zone"** means an area where the concentration of an airborne HCA exceeds the recommended limit for that agent;

**"retailer"** means an employer or self-employed person who supplies consumer products containing an HCA to members of the public who are not primarily engaged in the further supply of those products;

**"safety data sheet"** or **"SDS"** means a document that is aligned to the GHS, providing information on hazard classification, properties of hazardous chemicals, procedures for handling or working with hazardous chemicals in a safe manner, and the effects of hazardous chemicals on health and safety at the workplace, and that is prepared in accordance with regulation 14A;

**"sensitiser"** means an HCA that causes a substantial proportion of exposed people to develop an allergic reaction in normal tissue after repeated exposure, and includes dermal sensitisers and respiratory sensitisers;

**"signal word"** means the word "danger" or "warning" used on a GHS-aligned label to indicate to the reader a potential hazard, as well as the relative severity level of such hazard;

**"skin"**, the notation, means that the HCA might be absorbed in toxicologically significant amounts through direct contact with skin or mucous membranes and eyes from airborne exposure to gases, vapours or liquids, so that conclusions about exposure and health effects based solely on airborne concentration limits may be incomplete;

**"supplier"** means an employer or self-employed person who conducts a business or undertaking of supplying an HCA, also to a retailer;

**"the Act"** means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993);

**"UN Globally Harmonized System"** or **"GHS"** means the Globally Harmonized System of classification and labelling of chemicals, a guidance document developed by the United Nations for standardising and harmonising the classification and labelling of chemicals globally, as may be updated from time to time, commonly known as the UN Purple Book;

**"UN IMO International Maritime Dangerous Goods Code"** means the International Maritime Organization's (IMO's) International Maritime Dangerous Goods (IMDG) Code, which was developed as an international code by the IMO, an agency of the United Nations, for the maritime transport of dangerous goods in packaged and bulk form, with particular reference to the segregation of incompatible substances, as may be updated from time to time;

**"UN number"** means the four-digit identification number assigned to an HCA in the UN Transport of Dangerous Goods: Model Regulations, as may be updated from time to time;

**"UN proper shipping name"** means the proper shipping name of an HCA as specified in the UN Transport of Dangerous Goods: Model Regulations, most accurately describing the goods, as may be updated from time to time;

**"UN Transport of Dangerous Goods**" means the UN Recommendations on the Transport of Dangerous Goods: Model Regulations, Volumes 1 and 2, which are guidance documents developed by the United Nations to harmonise dangerous goods transport regulations, as may be updated from time to time, commonly known as the UN Orange Book.

**Scope of application**

2. (1) Subject to the provisions of subregulation (2), these regulations apply to—

(a) an employer or a self-employed person who carries out work at a workplace which may expose any person to an HCA at the workplace; and

(b) a manufacturer, importer, supplier or retailer of an HCA that is intended for use at a workplace.

(2) The provisions of regulations 3(1), 6 and 7 do not apply to—

(a) a self-employed person; or

(b) a person who visits a workplace referred to in subregulation (1).

(3) The provisions of these regulations do not apply in the case where the Lead Regulations or Asbestos Abatement Regulations apply.

**Information, instruction and training**

3. (1) An employer who undertakes work which is liable to expose an employee to an HCA must, before any employee is exposed or may be exposed, after consultation with the health and safety committee established for that section of the workplace, provide that employee with suitable and sufficient information, instruction and training, as well as thereafter inform, instruct and train that employee at intervals as may be recommended by that health and safety committee.

(2) The information, instruction and training contemplated in subregulation (1) must include—

(a) in regard to these regulations for HCAs—

(i) the chemical substance regulations that are in place that govern all aspects of HCA use at the workplace;

(ii) the legislated OELs that are in place; and

(iii) the duties of persons who are likely to be exposed to an HCA, as contemplated in regulation 4;

(b) details of the HCAs to which the employee is likely to be exposed at the workplace, including—

(i) the names of the HCAs and where they may be found in the workplace;

(ii) information on the potential harmfulness of the HCAs at the workplace; and

(iii) significant findings of the HCA exposure assessment, as required by regulation 5(2);

(c) information on how to access the relevant SDSs;

(d) the information that each part of an SDS provides;

(e) the information that each part of the label on containers provides and why the information is being provided;

(f) the work practices and procedures that must be followed for the use, handling, storage, transportation, spillage and disposal of an HCA, in emergency situations, as well as for good housekeeping and personal hygiene;

(g) the necessity of personal air sampling, biological monitoring and medical surveillance;

(h) the need for engineering controls and how to use and maintain them;

(i) the need for personal protective equipment, including respiratory protective equipment, and its use and maintenance;

(j) the precautions that must be taken by an employee to protect themselves against health risks associated with exposure, including wearing and using protective clothing and respiratory protective equipment; and

(k) the necessity, correct use, maintenance and potential of safety equipment, facilities and engineering control measures provided.

(3) An employer must give written instructions of the procedures to be followed in the event of spillages, leakages or any similar emergency situations to the drivers of vehicles transporting an HCA.

(4) As contemplated in section 37(2) of the Act, the employer and mandatary must agree in writing to the arrangements and procedures between them to ensure compliance by the mandatary with information, instruction and training requirements specified in subregulation 1,2 and 3.

**Duties of persons who may be exposed to hazardous chemical agents**

4. Every person who is or may be exposed to an HCA must obey a lawful instruction given by or on behalf of the employer or self-employed person regarding—

(a) HCA release prevention;

(b) the wearing of personal protective equipment;

(c) the wearing of monitoring equipment to measure personal exposure;

(d) reporting for health evaluations and biological tests as required by these regulations;

(e) the cleaning up and disposal of materials containing an HCA;

(f) housekeeping at the workplace, personal hygiene and environmental and health practices; and

(g) information, instruction and training as contemplated in regulation 3.

**Assessment of exposure**

5. (1) An employer or self-employed person must, after consultation with the relevant health and safety representative or relevant health and safety committee, cause an assessment to be made immediately, and thereafter at intervals not exceeding two years, to determine if any employee may be exposed by any route of intake.

(2) The employer must inform the relevant health and safety representative or relevant health and safety committee in writing of arrangements made for the assessment contemplated in subregulation (1), give them reasonable time to comment thereon, and ensure that the results of the assessment are made available to the relevant representative or committee who may comment thereon.

(3) When making the assessment, the employer or self-employed person must keep a record of the assessment and take into account such matters as—

(a) the HCA to which an employee may be exposed;

(b) the effects the HCA may have on an employee;

(c) where the HCA may be present, and the physical form in which it is likely to exist;

(d) the route of intake by which, and the extent to which, an employee may be exposed; and

(e) the nature of the work process, and any reasonable deterioration in, or failure of, control measures.

(4) If the assessment made in accordance with subregulation (3) indicates that any employee may be exposed, the employer must ensure that monitoring is carried out in accordance with the provisions of regulations 6 and 7, and that the exposure is controlled as contemplated in regulation 10.

(5) An employer or self-employed person must immediately review the assessment required by subregulation (1) if—

(a) there is reason to suspect that the previous assessment is no longer valid; or

(b) there has been a change in a process involving an HCA or in the methods, equipment or procedures for the use, handling, control or processing of the HCA,

and the provisions of subregulations (2) and (3) will apply.

**Air monitoring**

6. (1) Where the inhalation of an HCA is concerned, an employer contemplated in regulation 5(4) must ensure that the measurement programme of the airborne concentrations of the HCA to which an employee is exposed, is—

(a) carried out in accordance with the provisions of these regulations;

(b) carried out only after the relevant health and safety representative or relevant health and safety committee has been informed thereof and given a reasonable opportunity to comment thereon;

(c) carried out by an approved inspection authority; and

(d) representative of the exposure of an employee to the airborne HCA in accordance with the provisions of subregulation (2).

(2) In order to comply with the provisions of subregulation (1)(d), an employer must—

(a) ensure that the measurement programme, in the case of a group measurement, makes provision for the selection of the number of persons for a sample to be done as contemplated in Chapter 3 and 4 and Technical Appendix A of the OESSM: Provided that such sample size must be chosen for the top 10% of the group at the 95% confidence level for

an HCA with a control limit, and for the top 10% of the group at the 90% confidence level for an HCA with a recommended limit; and

(b) subject to the criteria contained in regulation 6(1), carry out representative measurements at least every 24 months for an HCA with an OEL-ML or an OEL-RL as listed in Table 2 or 3 of Annexure 2.

**Medical surveillance**

7. (1) An employer must ensure that an employee is under medical surveillance if—

(a) the employee may be exposed to an HCA listed in Table 4 of Annexure 2;

(b) the exposure of the employee to any chemical agent hazardous to his or her health is such that an identifiable disease or adverse effect to his or her health may be related to the exposure, there is a reasonable likelihood that the disease or effect may occur under the particular conditions of his or her work, and there are techniques to diagnose indications of the disease or the effect as far as is reasonably practicable; or

(c) the occupational health practitioner recommends that the relevant employee should be under medical surveillance, in which case the employer may call on an occupational medicine practitioner to ratify the appropriateness of such recommendation.

(2) In order to comply with the provisions of subregulation (1), the employer must, as far as is reasonably practicable, ensure—

(a) that an initial health evaluation is carried out by an occupational health practitioner immediately before or within 14 days after a person commences employment, where any exposure exists or may exist, which comprises—

(i) an evaluation of the employee's medical and occupational history;

(ii) a physical examination; and

(iii) any other essential examination which, in the opinion of the occupational health practitioner, is desirable in order to enable the practitioner to do a proper evaluation;

(b) that, subsequent to the initial health evaluation contemplated in paragraph (a), the relevant employee undergoes examinations as contemplated in paragraph (a)(ii) and (iii), at intervals not exceeding two years or at intervals specified by an occupational medicine practitioner.

(3) An employer may not permit an employee, who has been certified unfit for work by an occupational medicine practitioner, to work in a workplace or part of a workplace in which he or she would be exposed: Provided that the relevant employee may be permitted to return to work which will expose him or her, if he or she is certified fit for that work beforehand by an occupational medicine practitioner.

(4) The employer must record and investigate the incident contemplated in subregulation (3) in compliance with regulation 8 of the General Administrative Regulations.

**Respirator zone**

8. An employer must ensure—

(a) that any workplace or part thereof under his or her control, where the concentration of an HCA in the air is or may be such that the exposure of an employee working in that workplace exceeds the restricted limit without the wearing of respiratory protective equipment, is zoned as a respirator zone;

(b) that a respirator zone is clearly demarcated and identified by a notice indicating that the relevant area is a respirator zone and that personal protective equipment as contemplated in regulation 11 must be worn there; and

(c) that no person enters or remains in a permanent respirator zone unless he or she is wearing the required personal protective equipment.

**Records**

9. An employer must—

(a) keep records of the results of all assessments, air monitoring, and medical surveillance reports required by regulations 5, 6 and 7, respectively: Provided that personal medical records may be made available to only an occupational health practitioner;

(b) subject to the provisions of paragraph (c), make the records contemplated in paragraph (a), excluding personal medical records, available for inspection by an inspector;

(c) allow any person, subject to the personal written consent of an employee, to peruse the records with respect to that particular employee;

(d) make the records of all assessments and air monitoring available for perusal by the relevant health and safety representative or relevant health and safety committee;

(e) keep all records of assessments and air monitoring for a minimum period of 30 years;

(f) if the employer ceases activities, hand over or forward all records by registered post to the relevant regional director; and

(g) keep, for at least three years, a record of the investigations and tests carried out in terms of regulation 12(b) and of any repairs resulting from these investigations and tests.

**Control of exposure to hazardous chemical agents**

10. (1) An employer must ensure that the exposure of an employee is either prevented or, where this is not reasonably practicable, adequately controlled: Provided that—

(a) where there is exposure for which there is a restricted limit, the control of the exposure must be regarded as adequate if the level of exposure is below that limit or if the relevant area is zoned and the level of exposure is reduced to below that restricted limit by means of adequate personal protective equipment only after the level has been reduced to as low as is reasonably practicable by any other means than personal protective equipment; or

(b) where there is exposure for which there is a maximum limit, the control of the exposure must be regarded as adequate if the exposure is at a level as low as is reasonably practicable below that maximum limit: Provided that in the case of temporary excursions above the control limit, the employer must ensure—

a) that the excursion is without a significant risk from exposure;

b) that the excursion is not indicative of a failure to maintain adequate control;

c) that during the excursion, the area is temporarily demarcated and prescribed and identified as contemplated in regulation 8(b); and

d) that the provisions of regulation 11 are complied with.

(2) Where reasonably practicable, the employer must control the exposure of an employee by—

(a) limiting the amount of an HCA used, which may contaminate the working environment;

(b) limiting the number of employees who will be exposed or may be exposed;

(c) limiting the period during which an employee will be exposed or may be exposed;

(d) using a substitute for an HCA;

(e) introducing engineering control measures for the control of exposure, which may include—

(i) process separation, automation or enclosure;

(ii) the installation of local extraction ventilation systems to processes, equipment and tools for the control of emissions of an airborne HCA;

(iii) use of wet methods; and

(iv) separate workplaces for different processes; and

(f) introducing appropriate work procedures which an employee must follow where materials are used or processes are carried out which could give rise to exposure of an employee, and which procedures must include written instructions to ensure—

(i) that an HCA is safely handled, used and disposed of;

(ii) that process machinery, installations, equipment, tools and local extraction and general ventilation systems are safely used and maintained;

(iii) that machinery and work areas are kept clean; and

(iv) that early corrective action may be readily identified.

(3) An employer must ensure that the emission of an HCA into the atmosphere comply with the provisions of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004).

**Personal protective equipment and facilities**

11. (1) If it is not reasonably practicable to ensure that the exposure of an employee is adequately controlled as contemplated in regulation 10, the employer must—

(a) in the case of an airborne HCA, provide the employee with suitable respiratory protective equipment and protective clothing; and

(b) in the case of an HCA which can be absorbed through the skin, provide the employee with suitable non-HCA impermeable protective equipment.

(2) Where respiratory protective equipment is provided, the employer must ensure—

(a) that the relevant equipment is capable of controlling the exposure to below the OEL for the relevant HCA;

(b) that the relevant equipment is correctly selected and properly used;

(c) that information, instructions, training and supervision, which is necessary with regard to the use of the equipment, is known to the employee; and

(d) that the equipment is kept in good condition and efficient working order.

(3) An employer must, as far as is reasonably practicable—

(a) not issue any used personal protective equipment to an employee, unless the relevant protection equipment is decontaminated and sterilised;

(b) provide separate containers or storage facilities for personal protective equipment when not in use; and

(c) ensure that all personal protective equipment not in use is stored in only the place provided therefor.

(4) An employer must, as far as is reasonably practicable, ensure that all contaminated personal protective equipment is cleaned and handled in accordance with the following procedures:

(a) Where personal protective equipment is cleaned on the premises of an employer, care must be taken to prevent contamination during handling, transport and cleaning;

(b) where personal protective equipment is sent off the premises to a contractor for cleaning purposes, the equipment must be packed in impermeable containers;

(c) the impermeable containers must be tightly sealed and must have a clear indication thereon that the contents thereof are contaminated; and

(d) the relevant contractor must be fully informed of the requirements of these regulations and of the precautions that must be taken for handling contaminated personal protective equipment.

(5) Subject to the provisions of subregulation (4)(b), an employer must ensure that no person removes dirty or contaminated personal protective equipment from the premises: Provided that where contaminated personal protective equipment has to be disposed of, it is treated as HCA waste as contemplated in regulation 15.

(6) Subject to the provisions of the Facilities Regulations, an employer must, where reasonably practicable, provide an employee who is using personal protective equipment, as contemplated in subregulation (1), with—

(a) adequate washing facilities, which are readily accessible and located in an area where the facilities will not become contaminated, in order to enable an employee to meet a standard of personal hygiene consistent with the adequate control of exposure, and to avoid the spread of an HCA;

(b) two separate lockers, separately labelled "protective clothing" and "personal clothing", and ensure that the clothing is kept separately in the locker concerned; and

(c) separate "clean" and "dirty" change rooms if the employer uses or processes an HCA to the extent that the HCA could endanger the health of persons outside of the workplace.

**Maintenance of control measures**

12. An employer must ensure—

(a) that all control equipment and facilities provided in terms of regulations 10 and 11 are maintained in good working order; and

(b) that thorough examinations and tests of engineering control measures are carried out at intervals not exceeding 24 months by an approved inspection authority.

**Prohibitions**

13. No person may, as far as is reasonably practicable—

(a) use compressed air or permit the use of compressed air to remove particles of an HCA from any surface or person;

(b) smoke, eat, drink or keep food or beverages in a respirator zone or permit any other person to smoke, eat, drink or keep food or beverages in that zone;

(c) use statements such as "non-toxic", "non-harmful", "non-polluting" or "non-hazardous" or similar statements indicating the HCA as not hazardous, or any other statements that are inconsistent with the HCA's GHS classification on the label or packaging of any HCA; and

(d) manufacture, procure, use, handle or store within the workplace—

(i) a prohibited HCA as listed in Table 1 of Annexure 2;

(ii) ozone-depleting substances provided for in the Regulations regarding the Phasing-Out and Management of Ozone-Depleting Substances, published as Government Notice No. R. 351 of 8 May 2014; and

(iii) persistent organic pollutants prohibited by the Prohibition on the Import, Export, Possession, Acquisition, Sale, Use and Disposal of Agricultural Remedies, under section 7 of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947), published as Government Notice No. R. 862 of 29 July 2016.

**Classification of hazardous chemical agents**

14. The manufacturer or importer of a chemical agent must, before it is supplied to a workplace—

(a) determine whether the chemical agent is an HCA by carrying out a hazard assessment referencing the cut-off values provided in Tables 4 and 5 of Annexure 1;

(b) if the substance, mixture or article is an HCA, ensure that a GHS classification is carried out for the HCA; and

(c) review the GHS classification should a change in the composition of the HCA be made.

**14A. Safety data sheet**

(1) Subject to section 10(3)*(b)* of the Act and regulation 14, a safety data sheet for an HCA must be—

(a) prepared by an importer or manufacturer before manufacture and, if this is not reasonably practicable, immediately after manufacture but before import: Provided that the safety data sheet is—

(i) GHS compliant;

(ii) classified for the HCA, in accordance with regulation 14;

(iii) reviewed at least once every five years;

(iv) amended whenever necessary to ensure that it contains correct and current information, aligned to its GHS classification required by regulation 14(c), which includes new data regarding the hazard presented by an HCA that changes its classification in a category or subcategory of a hazard class or results in its classification to another hazard class; and

(v) given the most recent applicable date, which may be the date of first issue, review or amendment;

(b) provided by a manufacturer or importer to—

(i) a supplier of the HCA to a workplace; and

(ii) any person who is likely to be affected by the HCA;

(c) provided by a supplier of the HCA—

(i) when the HCA is first supplied to the workplace;

(ii) if the SDS for the HCA is amended; and

(iii) to any person at the workplace if they request the SDS; and

(d) obtained by the employer from the manufacturer, importer or supplier of the HCA and provided to—

(i) any person who is involved in using, handling, or likely to be exposed to, the HCA at the workplace;

(ii) any person at the workplace who needs the information to assess risk related to health and safety;

(iii) any health practitioner who needs the information to treat a person who has been exposed to the HCA; or

(iv) an emergency service professional who requires the information to fulfil his duties as an emergency respondent.

(2) Paragraphs (a) and (b) of subregulation (1) do not apply to a manufacturer or importer of an HCA who has not manufactured or imported that HCA in the past five years.

(3) The information in the GHS compliant safety data sheet must be presented using the following 16 headings in the order given below, as may be updated from time to time:

(a) Section 1: identification of the substance/mixture and of the company/undertaking;

(b) Section 2: hazards identification;

(c) Section 3: composition/information on ingredients;

(d) Section 4: first-aid measures;

(e) Section 5: firefighting measures;

(f) Section 6: accidental release measure;

(g) Section 7: handling and storage;

(h) Section 8: exposure controls/personal protection;

(i) Section 9: physical and chemical properties;

(j) Section 10: stability and reactivity;

(k) Section 11: toxicological information;

(l) Section 12: ecological information;

(m) Section 13: disposal considerations;

(n) Section 14: transport information;

(o) Section 15: regulatory information; and

(p) Section 16: other information.

**14B. Labelling of hazardous chemical agents**

(1) With regard to the labelling of an HCA—

(a) a manufacturer or importer of an HCA must ensure that the HCA is correctly labelled as soon as practicable after the HCA is manufactured or imported;

(b) a supplier of an HCA may not supply an HCA if it is not correctly labelled;

(c) a retailer of an HCA may not supply any consumer product containing an HCA to be used in a workplace if it is not correctly labelled; and

(d) an employer must—

(i) ensure that an HCA that is used, handled or stored at the workplace is correctly labelled;

(ii) ensure that a container labelled for an HCA is used for only the use, handling or storage of that HCA;

(iii) as far as is reasonably practicable, ensure that when an HCA is transferred or decanted at the workplace, from its original container into a destination container, the destination container is correctly labelled for that HCA; and

(iv) ensure that an HCA within pipework is identified by a label or sign or in any other suitable manner, on or near the pipework, subject to the following:

*(aa)* Where the product is a mixture of two or more HCAs, the intermediate or finished product name may be used for identification;

*(bb)* sampling, loading points or any other termination point of a pipe, where during normal operations an employee may be exposed to an HCA, must be identified; and

*(cc)* pipework, including the splitting of flanges, where an employee may be exposed during routine maintenance activities, should be identified as far as is reasonably practicable.

(2) Subject to the provisions of subregulation (1), an HCA is correctly labelled if the selection and use of label elements are in accordance with the GHS and if the HCA is packed in a container that has a label—

(a) that includes—

(i) the product identifier and, where applicable, the United Nations proper shipping name;

(ii) the chemical identity of all the ingredients contributing to the final GHS classification of the HCA;

(iii) the name, address, and business telephone number of the manufacturer or importer;

(iv) an emergency telephone number where support is available; and

(v) a signal word, hazard statement, precautionary statement and hazard pictogram consistent with the HCA's GHS classification, made in accordance with regulation 14; and

(b) that may include—

(i) the quantity of the HCA in the package, unless this quantity is specified elsewhere on the package;

(ii) the quantity of each HCA ingredient;

(iii) any information about the hazards, and first-aid and emergency procedures relevant to the HCA, not otherwise included in the hazard statement or precautionary statement;

(iv) first-aid measures; and

(v) an expiry date, where applicable.

**14C. Packaging of hazardous chemical agents**

a) Packaging for an HCA must satisfy the relevant requirements of the UN Transport of Dangerous Goods, with respect to packaging and fastenings, or, where applicable, the UN IMO International Maritime Dangerous Goods Code, including the following requirements:

(a) The manufacturer or importer of an HCA must ensure that the HCA is correctly packed, as soon as reasonably practicable after manufacturing or importing.

(b) For the purposes of paragraph (a), the expression "correctly packed" means—

(i) that the packaging is in sound condition;

(ii) that the packaging is durably and legibly marked;

(iii) that the packaging will safely contain the chemical for the time the chemical is likely to be packed;

(iv) that the packaging is made of a material that is compatible with the HCA and will not be adversely affected by the HCA;

(v) that the packaging and fastenings are strong and solid throughout to ensure that they will not loosen and will meet the normal stresses and strains of handling; and

(vi) that the packaging does not usually contain food or beverages and cannot mistakenly be identified as containing food or beverages.

b) Where a retailer supplies an HCA in a container that is supplied by the person purchasing the chemical, the retailer must ensure that the HCA is correctly packed or repacked as contemplated in subregulation (1).

c) Where a retailer supplies the person purchasing the chemical with a container, the retailer must ensure that the HCA is correctly packed or repacked as contemplated in subregulation (1).

d) The employer or self-employed person must receive, use, handle or store an HCA only if it is correctly packed as contemplated in subregulation (1).

e) An employer must—

(a) as far as reasonably practicable, ensure that a container or a vehicle in which an HCA is transported is clearly identified as transporting an HCA; and

(b) ensure that such transportation complies with the National Road Traffic Act, 1996 (Act No. 93 of 1996).

**14D. Disclosure of ingredient identity**

(1) Where an ingredient in an HCA causes the correct classification of the chemical, in terms of regulation 14(b) to include a hazard class and hazard category—

(a) referred to in Table 4 of Annexure 1, the chemical identity of the ingredient detailed must be disclosed; or

(b) referred to in Table 5 of Annexure 1, the chemical identity of the ingredient may be disclosed by its generic name if—

(i) the identity of the ingredient is commercially confidential;

(ii) the ingredient does not cause the correct classification of the hazardous chemical to include any other hazard class and hazard category in Table 4 of Annexure 1; and

(iii) an OEL for the ingredient has not been established; and

(c) in all other cases not included in subregulation (1)(b), the ingredient must be disclosed by its chemical identity.

(2) The identity of the ingredient of an HCA in terms of subregulation (1)(a), or the generic name of the ingredient of the hazardous chemical in terms of subregulation (1)(b), must be on the label and SDS.

(3) Where an ingredient of an HCA must be disclosed in terms of subregulation (1)(a), the proportion of the ingredient to the hazardous chemical must be disclosed as follows:

(a) Where the exact proportion of the ingredient is not commercially confidential, the exact proportion is expressed as a percentage of the chemical by mass or volume; or

(b) where the exact proportion of the ingredient is commercially confidential, the exact proportion is expressed as a percentage of the chemical by mass or volume in terms of the following ranges within which the exact proportion fits:

(i) < 10%;

(ii) 10 to 30%;

(iii) 30 to 60%;

(iv) > 60%;

(v) a range that is narrower than the ranges provided for in subparagraph (i), (ii), (iii) or (iv).

**Disposal of hazardous chemical agents**

15. An employer must, as far as is reasonably practicable—

(a) recycle all HCA waste;

(b) ensure that all HCA waste is classified and disposed of as waste in terms of the following legislation:

(i) The Waste Classification and Management Regulations, 2013, published as Government Notice No. R. 634 of 23 August 2013; and

(ii) the National Norms and Standards for the Assessment of Waste for Landfill Disposal, published as Government Notice No. R. 635 of 23 August 2013; and

(c) ensure that all collectable HCA waste is placed in containers that prevent the likelihood of exposure during handling;

(d) ensure that all vehicles, reusable containers and covers, which have been in contact with HCA waste, are cleaned and decontaminated after use in such a way that the vehicles, containers or covers do not cause a hazard inside or outside the premises concerned;

(e) ensure that all employees occupied in the collection, transport and disposal of HCA waste, who may be exposed to that waste, are provided with suitable personal protective equipment; and

(f) ensure that if the services of a waste disposal contractor are used, a provision is incorporated into the contract stating that the contractor must also comply with the provisions of these regulations.

**Offences and penalties**

16. Any person who contravenes or fails to comply with any provision of regulation 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,14, 14A, 14B, 14C or 14D shall be guilty of an offence and liable on conviction to a fine or to imprisonment for a period not exceeding six months and, in the case of a continuous offence, to an additional fine of R500 for each day on which the offence continues or additional imprisonment of one day for each day on which the offence continues: Provided that the period of such additional imprisonment shall in no case exceed 90 days.

**Repeal of regulations**

17. (1) The Regulations for Hazardous Chemical Substances, 1995, published as Government Notice No. R. 1179 of 25 August 1995, are hereby repealed.

**Short title and commencement**

18. (1) These regulations shall be called the Regulations for Hazardous Chemical Agents, 2021.

(2) Regulations 13(d), 14, 14A, 14B, 14C, 14D; Annexure 1, Tables 1, 2, 3, 4 and 5; and Annexure 2, Tables 1, 2, 3 and 4 shall come into effect 18 months after the promulgation of these regulations.

**ANNEXURE 1**

**Table 1: GHS HAZARD CLASSES – PHYSICAL HAZARDS**

| HAZARD CLASSES | CATEGORIES/DIVISIONS/TYPES | | | | | |
|---|---|---|---|---|---|---|
| Flammable gases | Cat 1A & B | Cat 2 | | | | |
| Aerosols, flammable and non-flammable | Cat 1 | Cat 2 | | | | |
| Oxidising gases | Cat 1 | | | | | |
| Gases under pressure<br>Compressed gas<br>Liquefied gas<br>Refrigerated liquefied gas<br>Dissolved gas | <br>Cat 1<br>Cat 1<br>Cat 1<br>Cat 1 | | | | | |
| Flammable liquids | Cat 1 | Cat 2 | Cat 3 | | | |
| Flammable solids | Cat 1 | Cat 2 | | | | |
| Self-reactive substances and mixtures | Type A | Type B | Type C | Type D | Type E | Type F |
| Pyrophoric liquids | Cat 1 | | | | | |
| Pyrophoric solids | Cat 1 | | | | | |
| Self-heating substances and mixtures, | Cat 1 | Cat 2 | | | | |
| Substance and mixtures which, in contact with water, emit flammable gases | Cat 1 | Cat 2 | Cat 3 | | | |
| Oxidising liquids | Cat 1 | Cat 2 | Cat 3 | | | |
| Oxidising solids | Cat 1 | Cat 2 | Cat 3 | | | |
| Organic peroxides | Type A | Type B | Type C | Type D | Type E | Type F |
| Corrosive to metals | Cat 1 | | | | | |

**Table 2: GHS HAZARD CLASSES – HEALTH HAZARDS**

| HAZARD CLASSES | CATEGORIES | | | |
|---|---|---|---|---|
| Acute toxicity | | | | |
| Oral | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Dermal | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Inhalation | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Skin corrosion/irritation | Cat 1, 1A, B & C[a] | Cat 2 | | |
| Serious eye damage/eye irritation | Cat 1 | Cat 2/ 2A | | |
| Respiratory sensitizer | Cat 1 | Cat 1A[a] | Cat 1B[a] | |
| Skin sensitizer | Cat 1 | Cat 1A[a] | Cat 1B[a] | |
| Germ cell mutagenicity | Cat 1, 1A & B | Cat 2 | | |
| Carcinogenicity | Cat 1, 1A & B | Cat 2 | | |
| Reproductive toxicity | Cat 1A & B | Cat 2 | Lactation | |
| Specific target organ toxicity - single exposure | Cat 1 | Cat 2 | Cat 3 | |
| Specific target organ toxicity - repeated exposure | Cat 1 | Cat 2 | | |
| Aspiration hazard | Cat 1 | Cat2 | | |

[a] sub-categories may be applied where data are sufficient and where required by a competent authority.

**Table 3: GHS HAZARD CLASSES – ENVIRONMENTAL HAZARDS***

| HAZARD CLASSES | CATEGORIES | |
|---|---|---|
| Hazardous to the aquatic environment short-term (Acute) | Acute 1 | |
| Hazardous to the aquatic environment long-term (Chronic) | Chronic 1 | Chronic 2 |
| Hazard to the ozone layer | Cat 1 | |

***** the hazard classes and categories provided in Table 3 for environmental hazards are intended as references and a guideline for the classification of chemicals.

For Annexure 1, Table 1 and 2, the classes and categories provided are based on GHS, Rev. 8, 2019, they will be adjusted with changes to the GHS, as may be updated from time to time.

**Table 4: IDENTITY OF INGREDIENTS TO BE DISCLOSED**

| HAZARD CLASSES | CATEGORIES | | | |
|---|---|---|---|---|
| Acute toxicity | | | | |
| Oral | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Dermal | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Inhalation | Cat 1 | Cat 2 | Cat 3 | Cat 4 |
| Respiratory or skin sensitisation | Cat 1 | | | |
| Germ cell mutagenicity | Cat 1A & B | Cat 2 | | |
| Carcinogenicity | Cat 1A & B | Cat 2 | | |
| Reproductive toxicity | Cat 1A & B | Cat 2 | Lactation | |
| Specific target organ toxicity - single exposure | Cat 1 | Cat 2 | Cat 3 | |
| Specific target organ toxicity - repeated exposure | Cat 1 | Cat 2 | | |
| Aspiration hazard | Cat 1 | | | |
| Skin corrosion or irritation | Cat 1A, B & C | Cat 2 | | |
| Serious eye damage or eye irritation | Cat 1 | Cat 2A | | |

**Table 5: GENERIC NAMES USED TO DISCLOSE IDENTITY OF INGREDIENTS**

| HAZARD CLASSES | CATEGORIES | | | |
|---|---|---|---|---|
| Acute toxicity | | | | |
| Oral | | | | Cat 4 |
| Dermal | | | | Cat 4 |
| Inhalation | | | | Cat 4 |
| Aspiration hazard | Cat 1 | | | |
| Serious eye damage or eye irritation | | Cat 2A | | |
| Skin corrosion or irritation | | Cat 2 | | |
| Specific target organ toxicity - single exposure | | | Cat 3 | |

**ANNEXURE 2**

**Table 1: PROHIBITED HAZARDOUS CHEMICAL AGENTS**

| HAZARDOUS CHEMICAL AGENT | CAS NUMBER |
|---|---|
| 4-AMINOPHENYL and its salts | 92-67-1 |
| BENZIDINE and its salts | 92-87-5 |
| 2-NAPHTYLAMINE and its salts | 91-59-8 |
| 4-NITROPHENYL | 92-93-3 |
| POLYCHLORINATED BIPHENYLS (PCB), except MONO- and DICHLORINATED BIPHENYLS | 1336-36-3 |
| POLYCHLORINATED TERPHENYLS (PCT) | 61788-33-8 |
| PREPARATIONS with a PCB or PCT content higher than 0,01% by weight | |

**Table 2: OCCUPATIONAL EXPOSURE LIMITS – MAXIMUM LIMITS FOR HAZARDOUS CHEMICAL AGENTS**

| AGENT | CAS NUMBER | FORMULA | RHCA – OEL ppm | RHCA – OEL mg/m³ | RHCA – STEL/C ppm | RHCA – STEL/C mg/m³ | NOTATIONS |
|---|---|---|---|---|---|---|---|
| **A** | | | | | | | |
| Acrylamide | 79-06-1 | $CH_2$=CHCONH$_2$ | - | 0,06[IFV] | - | - | CARC, SKIN |
| Acrylonitrile | 107-13-1 | $CH_2$=CHCN | 4 | - | - | - | SKIN |
| Arsenic and compounds, except arsine [as As] | 7440-38-2 | As | - | 0,02 | - | - | CARC |
| Asbestos, all forms (see Asbestos Regulations) | 1332-21-4 | - | - | - | - | - | CARC |
| **B** | | | | | | | |
| Benzene | 71-43-2 | $C_6H_6$ | 1 | - | 5 | - | CARC, SKIN |
| Bis(chloromethyl) ether [BCME] | 542-88-1 | $(CH_2Cl)_2O$ | 0,002 | - | - | - | CARC |
| 1,3-Butadiene [buta-1,3-diene] | 106-99-0 | $CH_2=(CH)_2=CH_2$ | 4 | - | - | - | CARC |
| 2-Butoxyethanol [EGBE] | 111-76-2 | - | 40 | - | - | - | |
| **C** | | | | | | | |
| Cadmium and compounds [as Cd] | 7440-43-9 (metal) | Cd (metal) | | | | | CARC (cadmium metal, cadmium chloride, fluoride and sulphate) |
| | | | - | 0,004[R] | - | - | |
| Total particulate | | | - | 0,02 | - | - | |
| Carbon disulphide | 75-15-0 | $CS_2$ | 2 | - | - | - | SKIN |
| Chromium, and inorganic compounds | 7440-47-3 | | | | | | |
| Metallic chromium | | Cr(0) | - | 1[I] | - | - | - |

| AGENT | CAS NUMBER | FORMULA | RHCA – OEL ppm | RHCA – OEL mg/m³ | RHCA – STEL/C ppm | RHCA – STEL/C mg/m³ | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Trivalent chromium compounds: water-soluble compounds | | Cr(III) | - | 0,006(I) | - | - | CARC, RSEN |
| Hexavalent chromium compounds: water-soluble compounds | | Cr(VI) | - | 0,0004(I) | - | 0.001(I) | CARC, RSEN, SKIN |
| Chromyl chloride | 14977-61-8 | Cr(VI) | 0,0002(IFV) | - | 0,0005(IFV) | - | CARC, RSEN, SKIN |
| Chromite ore processing | | See hexavalent and trivalent chromium compounds | | | | | |
| **D** | | | | | | | |
| 1,2-Dibromoethane | 106-93-4 | $BrCH_2CH_2Br$ | 0,5 | - | - | - | CARC, SKIN |
| Dichloromethane | 75-09-2 | CH2Cl2 | 100 | - | - | - | SKIN, CARC |
| 2,2'-Dichloro-4,4'-methylene dianiline [MbOCA] | 101-14-4 | $CH_2(C_6H_3ClNH_2)_2$ | 0,02 | - | - | - | CARC, SKIN |
| **E** | | | | | | | |
| 2-Ethoxyethanol [EGEE], [ethylene glycol monoethyl ether] | 110-80-5 | $CH_3CH_2OCH_2CH_2OH$ | 10 | - | - | - | SKIN |
| 2-Ethoxyethyl acetate [EGEEA], [ethylene glycol monoethyl ether acetate] | 111-15-9 | $C_2H_5OCH_2CH_2OOCCH_3$ | 10 | - | - | - | SKIN |
| Ethylene oxide | 75-21-8 | $CH_2CH_2O$ | 2 | - | - | - | CARC |
| **F** | | | | | | | |
| Formaldehyde | 50-00-0 | HCHO | 0,2 | - | 0,6 | - | CARC, DSEN, RSEN |
| **G** | | | | | | | |

| AGENT | CAS NUMBER | FORMULA | RHCA – OEL ppm | RHCA – OEL mg/m³ | RHCA – STEL/C ppm | RHCA – STEL/C mg/m³ | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Grain dust (oat, wheat, barley, maize, rye) | - | - | - | 8 | - | - | RSEN |
| **H** | | | | | | | |
| Hydrogen cyanide [as CN] | 74-90-8 | HCN | - | - | 9,4 | - | SKIN |
| **L** | | | | | | | |
| Lead and compounds (see Lead Regulations) | | Pb | See Lead Regulations | | | | CARC (lead compounds, inorganic) |
| Tetraethyl lead [as Pb] | 78-00-2 | | See Lead Regulations | | | | SKIN |
| Tetramethyl lead [as Pb] | 75-74-1 | | See Lead Regulations | | | | SKIN |
| **N** | | | | | | | |
| Nickel and its inorganic compounds [as Ni] | 7440-02-0 | | | | | | |
| Soluble inorganic compounds (NOS) | | | | 0,1(I) | | | CARC |
| | | | | 0,02(R) | | | CARC |
| Insoluble inorganic compounds (NOS) | | | | 0,1(I) | | | CARC |
| | | | | 0,02(R) | | | CARC |
| **R** | | | | | | | |
| Rubber fume | - | - | - | 0,4 | - | - | CARC |
| **S** | | | | | | | |
| *Silica, crystalline | | | | | | | |

| AGENT | CAS NUMBER | FORMULA | RHCA – OEL ppm | RHCA – OEL mg/m³ | RHCA – STEL/C ppm | RHCA – STEL/C mg/m³ | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Cristobalite | 14464-46-1 | SiO | - | 0,1(R) | - | - | CARC |
| Quartz | 14808-60-7 | $SiO_2$ | - | 0,1(R) | - | - | CARC |
| Tridymite | 15468-32-3 | $SiO_2$ | - | 0,1(R) | - | - | |
| Tripoli | 1317-95-9 | $SiO_2$ | - | 0,1(R) | - | - | |
| Styrene, monomer | 100-42-5 | $C_6H_5CH=CH_2$ | 40 | - | 80 | - | CARC |
| **T** | | | | | | | |
| Talc (containing asbestos fibres) | 14807-96-6 | $Mg_3Si_4O_{10}(OH)_2$ | See Asbestos Regulations | | | | CARC |
| 1,1,1-Trichloroethane | 71-55-6 | $CH_3CCl_3$ | 700 | - | 900 | - | |
| Trichloroethylene | 79-01-6 | $CCl_2=CHCl$ | 20 | - | 50 | - | CARC, SKIN |
| **V** | | | | | | | |
| Vinyl chloride | 75-01-4 | $H_2C=CHCl$ | 2 | - | - | - | CARC |
| **W** | | | | | | | |
| Wood dust species: oak, beech, birch, mahogany, teak and walnut | - | - | - | 2(I) | - | - | CARC, RSEN |

**Abbreviations**:
**mg/m³**: milligrams per cubic meter
**OEL-ML**: occupational exposure limit – maximum limit
**OEL-RL**: occupational exposure limit – restricted limit
**ppm**: parts per million
**RHCA**: Regulations for Hazardous Chemical Agents
**STEL/C**: short-term exposure limit, ceiling limit

**Notations**:
**CARC**: denotes carcinogenicity, which is based on GHS categorisation, including category 1A and 1B;
**DSEN**: dermal sensitisation, potential to produce dermal sensitisation;
**E**: the value is for particulate matter containing no asbestos and ≤ 1% crystalline silica;

**F**: respirable fibres: length > 5 µm; aspect ratio ≥ 3:1 as determined by the membrane filter method at 400-450X magnification (4 mm objective), using phase-contrast illumination;
**H**: aerosol only;
**I**: inhalable fraction;
**IFV**: inhalable fraction and vapour;
**Inhalable particulate matter (IPM)**: for those materials that are hazardous when deposited anywhere in the respiratory tract;
**R**: respirable fraction;
**RSEN**: respiratory sensitisation, potential to produce respiratory sensitisation;
**SKIN**: danger of cutaneous absorption – refers to the potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes, and the eyes by contact with vapours, liquids and solids; overexposure may also occur following dermal contact with liquids and aerosols, even when airborne exposures are at or below the OEL;
**T**: thoracic fraction; and
**V**: vapour fraction.

RSEN and DSEN do not imply that sensitisation is the critical effect on which the OEL is based, nor do they imply that this effect is the sole basis for the agent's OEL.

**Note**:

*All industries handling, manufacturing and producing silica dust are required to submit biannual reports that include the following:

- number of samples taken and analysed;
- composition of dust;
- concentration of the constituents; and
- whether the employer is complying with the OEL, and if not, what steps are implemented to comply with the exposure limit.

**Table 3: OCCUPATIONAL EXPOSURE LIMITS - RESTRICTED LIMITS FOR HAZARDOUS CHEMICAL AGENTS**

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| | | | ppm | mg/m$^3$ | ppm | mg/m$^3$ | |
| **A** | | | | | | | |
| Acetaldehyde | 75-07-0 | $CH_3CHO$ | - | - | 50 | - | CARC |
| Acetic acid | 64-19-7 | $CH_3COOH$ | 20 | - | 30 | - | |
| Acetic anhydride | 108-24-7 | $(CH_3CO)_2O$ | 2 | - | 6 | - | |
| Acetone | 67-64-1 | $(CH_3)_2CO$ | 500 | - | 1000 | - | |
| Acetonitrile | 75-05-8 | $CH_3CN$ | 40 | - | - | - | SKIN |
| Acetylsalicylic acid [aspirin] | 50-78-2 | $CH_3COOC_6H_4COOH$ | - | 10 | - | - | |
| Acrolein [Acrylaldehyde] | 107-02-8 | $CH_2=CHCHO$ | - | - | 0,2 | - | SKIN |
| Acrylic acid | 79-10-7 | $CH_2=CHCOOH$ | 4 | - | - | - | SKIN |
| Aldrin | 309-00-2 | $C_{12}H_8Cl_6$ | - | 0,1$^{(IFV)}$ | - | - | SKIN |
| Allyl alcohol | 107-18-6 | $CH_2=CHCH_2OH$ | - | 1 | - | - | SKIN |
| Allyl chloride | 107-05-1 | $CH_2=CHCH_2Cl$ | 2 | - | 4 | - | SKIN |
| Allyl glycidyl ether [AGE] | 106-92-3 | $C_6H_{10}O_2$ | 2 | - | - | - | |
| Aluminium metal and insoluble compounds [as Al] | 7429-90-5 (metal) | Al (metal) | - | 2$^{(R)}$ | - | - | |
| Aminodimethylbenzene | 95-64-7 | | | | See xylidine | | |
| 2-Aminoethanol | 141-43-5 | $NH_2CH_2CH_2OH$ | | | See ethanolamine | | |
| Ammonia, anhydrous | 7664-41-7 | $NH_3$ | 50 | - | 70 | - | |
| Ammonium chloride, fume | 12125-02-9 | $NH_4Cl$ | - | 10 | - | 20 | |
| Ammonium sulphamate | 7773-06-0 | $NH_2SO_3NH_4$ | - | 10 | - | - | |
| Aniline | 62-53-3 | $C_6H_5NH_2$ | 4 | - | - | - | SKIN |
| Anisidines, o- and p-isomers | 90-04-0, 104-94-9 | $NH_2C_6H_4OCH_3$ | - | 1 | - | - | CARC, SKIN |
| Antimony and compounds [as Sb], except antimony trisulphide, antimony trioxide and antimony | 7440-36-0 | Sb | - | 1 | - | - | CARC |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| hydride | | | | | | | |
| Antimony hydride | 7803-52-3 | | | | See stibine | | |
| Arsine | 7784-42-1 | $AsH_3$ | 0,01 | - | - | - | |
| Asphalt, petroleum fumes | 8052-42-4 | - | - | 1[(I)] | - | - | CARC |
| Atrazine | 1912-24-9 | $C_8H_{14}ClN_5$ | - | 4 | - | - | |
| Azinphos-methyl | 86-50-0 | $C_{10}H_{12}O_3PS_2N_3$ | - | 0,4[(IFV)] | - | - | DSEN, SKIN |
| **B** | | | | | | | |
| Barium and soluble compounds [as Ba] | 7440-39-3 | - | - | 1 | - | - | |
| Barium sulphate | 7727-43-7 | $BaSO_4$ | - | 10[(I, E)] | - | - | |
| Benomyl | 17804-35-2 | $C_{14}H_{18}N_4O_3$ | - | 2[(I)] | - | - | DSEN |
| Benzene-1,2,4,-tricarboxylic acid 1,2-anhydride | 552-30-7 | $C_9H_4O_5$ | - | 0,001[(IFV)] | - | 0,004[(IFV)] | DSEN, RSEN, SKIN |
| p-Benzoquinone | 106-51-4 | $C_6H_4O_2$ | 0,2 | - | - | - | |
| Benzoyl peroxide | 94-36-0 | $(C_6H_5CO)_2O_2$ | - | 10 | - | - | |
| Benzyl chloride | 100-44-7 | $C_6H_5CH_2Cl$ | 2 | - | - | - | CARC |
| Beryllium and compounds [as Be] | 7440-41-7 | Be | - | 0,0001[(I)] | - | - | DSEN, RSEN, SKIN |
| Biphenyl | 92-52-4 | $C_6H_5C_6H_5$ | 0,4 | - | - | - | |
| Bismuth telluride [as $Bi_2Te_3$] | | | | | | | |
| Undoped | 1304-82-1 | $Bi_2Te_3$ | - | 10 | - | - | |
| Selenium-doped | - | | - | 10 | - | - | |
| Borates, tetra, sodium salts | | | | | | | |
| Anhydrous | 1330-43-4 | $Na_2B_4O_7$ | - | 4 | - | 12 | |
| Decahydrate | 1303-96-4 | $Na_2B_4O_7.10H_2O$ | - | 4 | - | 12 | |
| Pentahydrate | 12179-04-3 | $Na_2B_4O_7.5H_2O$ | - | 4 | - | 12 | |
| Boron oxide | 1303-86-2 | $B_2O_3$ | - | 10 | - | - | |
| Boron tribromide | 10294-33-4 | $BBr_3$ | - | - | 1,4 | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Boron trifluoride | 7637-07-2 | $BF_3$ | - | - | 1,4 | - | |
| Bromacil | 314-40-9 | $C_9H_{13}BrN_2O_2$ | - | 10 | - | - | |
| Bromine | 7726-95-6 | $Br_2$ | 0,2 | - | 0,4 | - | |
| Bromine pentafluoride | 7789-30-2 | $BrF_5$ | 0,2 | - | - | - | |
| Bromoethane | 74-96-4 | $CH_3CH_2Br$ | 10 | - | - | - | SKIN |
| Bromoethylene | 593-60-2 | $CH_2$=CHBr | | | See vinyl bromide | | |
| Bromoform | 75-25-2 | $CHBr_3$ | 1 | - | - | - | |
| Bromomethane | 74-83-9 | $CH_3Br$ | | | See methyl bromide | | |
| n-Butane | 106-97-8 | $CH_3CH_2CH_2CH_3$ | - | - | 2000 | - | |
| 2-Butanol [sec-butyl alcohol] | 78-92-2 | $CH_3CH(OH)CH_2CH_3$ | 200 | - | - | - | |
| tert-Butanol [tert-butyl alcohol] | 75-65-0 | $(CH_3)_3COH$ | 200 | - | - | - | |
| trans-But-2-enal | | | | | See crotonaldehyde | | SKIN |
| n-Butyl acetate | 123-86-4 | $CH_3COO(CH_2)_3CH_3$ | 100 | - | 300 | - | |
| sec-Butyl acetate | 105-46-4 | $C_6H_{12}O_2$ | 100 | - | 300 | - | |
| tert-Butyl acetate | 540-88-5 | $CH_3COOC(CH_3)_3$ | 100 | - | 300 | - | |
| Butyl acrylate | 141-32-2 | $CH_2$=$CHCOOC_4H_9$ | 4 | - | - | - | DSEN |
| n-Butylamine | 109-73-9 | $CH_3(CH_2)_3NH_2$ | - | - | 10 | - | SKIN |
| n-Butyl glycidyl ether [BGE] | 2426-08-6 | $C_4H_9OCH_2CHCH_2O$ | 6 | - | - | - | DSEN, SKIN |
| n-Butyl lactate | 138-22-7 | $CH_3CH(OH)COOC_4H_9$ | 10 | - | - | - | |
| o-sec-Butylphenol | 89-72-5 | $C_2H_5(CH_3)CHC_6H_4OH$ | 10 | - | - | - | SKIN |
| **C** | | | | | | | |
| Calcium cyanamide | 156-62-7 | CaNC≡N | - | 1 | - | - | |
| Calcium hydroxide | 1305-62-0 | $Ca(OH)_2$ | - | 10 | - | - | |
| Calcium oxide | 1305-78-8 | CaO | - | 4 | - | - | |
| Calcium silicate, [naturally occurring as wollastonite] | 1344-95-2 | $CaSiO_3$ | - | $2^{(I, E)}$ | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Calcium sulphate [including plaster of Paris and gypsum] | 7778-18-9, 10034-76-1, 10101-41-4, 13397-24-5 | $CaSO_4$ | - | $10^{(I)}$ | - | - | |
| Camphor, synthetic | 76-22-2 | $C_{10}H_{16}O$ | 4 | - | 6 | - | |
| Caprolactam | 105-60-2 | $NH(CH_2)_5CO$ | | $10^{(IFV)}$ | | | |
| Captafol | 2425-06-1 | $C_{10}H_9Cl_4NO_2S$ | - | $0,2^{(IFV)}$ | - | - | CARC, SKIN |
| Captan | 133-06-2 | $C_9H_8Cl_3NO_2S$ | - | $10^{(I)}$ | - | - | DSEN, SKIN |
| Carbaryl | 63-25-2 | $CH_3NHCOOC_{10}H_7$ | - | $1^{(IFV)}$ | - | - | SKIN |
| Carbofuran | 1563-66-2 | $C_{12}H_{15}NO_3$ | - | $0,2^{(IFV)}$ | - | - | |
| Carbon black | 1333-86-4 | C | - | $6^{(I)}$ | - | - | CARC |
| Carbon dioxide | 124-38-9 | $CO_2$ | 10000 | - | 60000 | - | |
| Carbon monoxide | 630-08-0 | CO | 50 | - | - | - | |
| Carbon tetrabromide | 558-13-4 | $CBr_4$ | 0,2 | - | 0,6 | - | |
| Carbon tetrachloride | 56-23-5 | $CCl_4$ | 10 | - | 20 | - | CARC, SKIN |
| Catechol | 120-80-9 | $C_6H_4(OH)_2$ | 10 | - | - | - | CARC, SKIN |
| Cellulose | 9004-34-6 | $(C_6H_{10}O_5)_n$ | - | 10 | - | - | |
| Cement [Portland cement] | - | - | - | $2^{(E, R)}$ | - | - | |
| Chlordane | 57-74-9 | $C_{10}H_6Cl_8$ | - | $1^{(IFV)}$ | - | - | CARC, SKIN |
| Chlorine | 7782-50-5 | $Cl_2$ | 0,2 | - | 0,8 | - | |
| Chlorine dioxide | 10049-04-4 | $ClO_2$ | | - | 0,2 | - | |
| Chlorine trifluoride | 7790-91-2 | $ClF_3$ | - | - | 0,2 | - | |
| 2-Chloroacetophenone | 532-27-4 | $C_6H_5COCH_2Cl$ | 0,1 | - | - | - | |
| Chloroacetyl chloride | 79-04-9 | $ClCH_2COCl$ | 0,1 | - | 0,3 | - | SKIN |
| Chlorobenzene | 108-90-7 | $C_6H_5Cl$ | 20 | - | - | - | SKIN |
| Chlorobromomethane | 74-97-5 | $CH_2BrCl$ | 400 | - | - | - | |
| Chlorodifluoromethane | 75-45-6 | $CHClF_2$ | 2000 | - | - | - | |
| Chlorodiphenyl [PCBs] | | | - | - | - | - | CARC, SKIN |
| Chlorodiphenyl (42% chlorine) | 53469-21-9 | $C_6H_4ClC_6H_3Cl_2$ (approx.) | - | 2 | - | - | CARC, SKIN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Chlorodiphenyl (54% chlorine) | 11097-69-1 | $C_6H_3Cl_2C_6H_2Cl_3$ (approx.) | - | 1 | - | - | CARC, SKIN |
| 1-Chloro-2,3-epoxy-propane | 106-89-8 | $C_3H_5OCl$ | | | See epichlorohydrin | | |
| Chloroethane | 75-00-3 | $CH_3CH_2Cl$ | | | See ethyl chloride | | |
| 2-Chloroethanol | 107-07-3 | $CH_2ClCH_2OH$ | | | See ethylene chlorohydrin | | |
| Chloroethylene | 75-01-4 | $H_2C=CHCl$ | | | See vinyl chloride | | |
| Chloroform | 67-66-3 | $CHCl_3$ | 20 | - | - | - | CARC, SKIN |
| Chloropentafluoroethane | 76-15-3 | $CClF_2CF_3$ | 2000 | - | - | - | |
| Chloropicrin | 76-06-2 | $CCl_3NO_2$ | 0,2 | - | - | - | |
| beta-Chloroprene | 126-99-8 | $CH_2=CClCH=CH_2$ | 2 | - | - | - | CARC, SKIN |
| alpha-Chlorotoluene | 100-44-7 | $C_6H_5CH_2Cl$ | | | See benzyl chloride | | |
| 2-Chlorotoluene [o-Chlorotoluene] | 95-49-8 | $ClC_6H_4CH_3$ | 100 | - | - | - | |
| 2-Chloro-6-(trichloromethyl)pyridine | 1929-82-4 | ClC5H3NCCl3 | | | See nitrapyrin | | |
| Chlorpyrifos | 2921-88-2 | $C_9H_{11}Cl_3NO_3PS$ | | $0,2^{(IFV)}$ | | | SKIN |
| Chromium, metal | | | | | | | |
| Metallic chromium as Cr [0] | 7440-47-3 (metal) | Cr (metal) | - | $1^{(I)}$ | - | - | |
| Coal dust: | - | - | | | | | |
| Anthracite | | | - | $0,8^{(R)}$ | - | - | |
| Bituminous or lignite | | | - | $1,8^{(R)}$ | - | - | |
| Coal tar pitch volatiles [as cyclohexane soluble fraction] | 65996-93-2 | - | - | 0,4 | - | - | CARC |
| Cobalt and cobalt inorganic compounds [as Co] | 7440-48-4 (metal) | Co (metal) | - | $0,04^{(I)}$ | - | - | CARC, RSEN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Copper: | | | | | | | |
| Fume (copper oxide) [as Cu] | 1317-38-0 | CuO | - | 0,4 | - | - | |
| Dusts and mists [as Cu] | 7440-50-8 (metal) | Cu (metal) | - | 2 | - | - | |
| Cotton dust, raw, untreated | - | | | | | | |
| Cotton dust (less fly) | | | - | $0,2^{(T)}$ | - | - | |
| Cotton dust | | - | - | 2,5 | - | - | |
| Cresols, all isomers | 95-48-7, 106-44-5, 108-39-4, 1319-77-3 | $CH_3C_6H_4OH$ | - | $40^{(IFV)}$ | - | - | SKIN |
| Crotonaldehyde | 4170-30-3 | $CH_3CH=CHCHO$ | - | - | 0,6 | - | SKIN |
| Cumene | 98-82-8 | $C_6H_5CH(CH_3)_2$ | 100 | - | - | - | CARC, SKIN |
| Cyanamide | 420-04-2 | $NH_2CN$ | - | 4 | - | - | SKIN |
| Cyanide salts [as CN] | | | | | | | |
| Calcium cyanide | 592-01-8 | $Ca(CN)_2$ | - | - | - | 10 | SKIN |
| Potassium cyanide | 151-50-8 | KCN | - | - | - | 10 | SKIN |
| Sodium cyanide | 143-33-9 | NaCN | - | - | - | 10 | SKIN |
| Cyanogen | 460-19-5 | $(CN)_2$ | - | - | 10 | - | |
| Cyanogen chloride | 506-77-4 | ClCN | - | - | 0,6 | - | |
| Cyclohexane | 110-82-7 | $C_6H_{12}$ | 200 | - | - | - | |
| Cyclohexanol | 108-93-0 | $C_6H_{11}OH$ | 100 | - | - | - | SKIN |
| Cyclohexanone | 108-94-1 | $C_6H_{10}O$ | 40 | - | 100 | - | SKIN |
| Cyclohexene | 110-83-8 | $C_6H_{10}$ | 600 | - | - | - | |
| Cyclohexylamine | 108-91-8 | $C_6H_{11}NH_2$ | 20 | - | - | - | |
| Cyclonite [RDX] | 121-82-4 | $C_3H_6N_6O_6$ | - | 1 | - | - | SKIN |
| Cyhexatin | 13121-70-5 | $(C_6H_{11})_3SnOH$ | - | 10 | - | - | SKIN |
| **D** | | | | | | | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| DMDT [p,p'-dimethoxydiphenyltrichloroethane] | - | - | | See methoxychlor | | | |
| Diacetone alcohol | 123-42-2 | $CH_3COCH_2C(CH_3)_2OH$ | 100 | - | - | - | |
| Diazinon | 333-41-5 | $C_{12}H_{21}N_2O_3PS$ | - | $0,02^{(IFV)}$ | - | - | CARC, SKIN |
| Diazomethane | 334-88-3 | $CH_2N_2$ | 0,4 | - | - | - | |
| Dibenzoyl peroxide | 94-36-0 | $(C_6H_5CO)_2O_2$ | | | See benzoyl peroxide | | |
| Diborane | 19287-45-7 | $B_2H_6$ | 0,2 | - | - | - | |
| Diboron trioxide | 1303-86-2 | $B_2O_3$ | | | See boron oxide | | |
| Dibromodifluoromethane [difluorodibromomethane] | 75-61-6 | $CBr_2F_2$ | 200 | - | - | - | |
| Dibutyl phenyl phosphate | 2528-36-1 | $C_{14}H_{23}O_4P$ | 0,6 | - | - | - | SKIN |
| Dibutyl phosphate | 107-66-4 | $(C_4H_9O)_2(OH)PO$ | - | $10^{(IFV)}$ | - | - | SKIN |
| Dibutyl phthalate | 84-74-2 | $C_6H_4(CO_2C_4H_9)_2$ | - | 10 | - | - | |
| Dichloroacetylene | 7572-29-4 | ClC=CCl | - | - | 0,2 | - | |
| Diesel particulate matter (DPM) | | | 0,16 | | | | |
| 1,2-Dichlorobenzene [o-Dichlorobenzene] | 95-50-1 | $C_6H_4Cl_2$ | 50 | - | 100 | - | SKIN |
| 1,4-Dichlorobenzene [p-Dichlorobenzene] | 106-46-7 | $C_6H_4Cl_2$ | 20 | - | - | - | CARC |
| Dichlorodifluoromethane [difluorodichloromethane] | 75-71-8 | $CCl_2F_2$ | 2000 | - | - | - | |
| 1,3-Dichloro-5,5-dimethyl hydantoin | 118-52-5 | $C_5H_6Cl_2N_2O_2$ | - | 0,4 | - | 0,8 | |
| 1,1-Dichloroethane | 75-34-3 | $CH_3CHCl_2$ | 200 | - | - | - | SKIN |
| 1,2-Dichloroethane | 107-06-2 | $ClCH_2CH_2Cl$ | 20 | - | - | - | CARC, SKIN |
| 1,1-Dichloroethylene | 75-35-4 | $CH_2=CCl_2$ | - | 10 | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| 1,2 Dichloroethylene, cis and trans isomers | 540-59-0 | ClCH=CHCl | 400 | - | - | - | |
| Dichlorofluoromethane | 75-43-4 | $CHCl_2F$ | 20 | - | - | - | |
| 1,3-Dichloropropene (cis and trans isomers) | 542-74-6 | | 2 | - | - | - | CARC, SKIN |
| 1,3-Dichloropropene, cis and trans isomers | 542-75-6 | $ClHC=CHCH_2Cl$ | 2 | - | - | - | CARC, SKIN |
| 1,2-Dichlorotetrafluoroethane | 76-14-2 | $CClF_2CClF_2$ | 2000 | - | - | - | |
| Dichlorvos [DDVP] | 62-73-7 | $(CH_3O)_2POOCH=CCl_2$ | - | $0,2^{(IFV)}$ | - | - | CARC, DSEN, SKIN |
| Dicyclopentadiene | 77-73-6 | $C_{10}H_{12}$ | 1 | - | 2 | - | |
| Dicyclopentadienyl iron (as Fe) | 102-54-5 | $(C_5H_5)_2Fe$ | - | 10 | - | - | |
| Dieldrin | 60-57-1 | $C_{12}H_8Cl_6O$ | - | $0,2^{(IFV)}$ | - | - | SKIN |
| Diethanolamine | 111-42-2 | $(CH_2CH_2OH)_2NH$ | - | $2^{(IFV)}$ | - | - | CARC, SKIN |
| Diethylamine | 109-89-7 | $(C_2H_5)_2NH$ | 10 | - | 30 | - | SKIN |
| 2-Diethylaminoethanol | 100-37-8 | $(C_2H_5)_2NCH_2CH_2OH$ | 4 | - | - | - | SKIN |
| 1,4-Diethylenediamine | 110-85-0 | $C_4H_{10}N_2$ | | | See piperazine | | |
| Diethylenetriamine [DETA] | 111-40-0 | $(NH_2CH_2CH_2)_2NH$ | 2 | - | - | - | SKIN |
| Di-(2-ethylhexyl) phthalate [DEHP] | 117-81-7 | $C_6H_4(COOC_8H_{17})_2$ | - | 10 | - | - | CARC |
| Diethyl ketone | 96-22-0 | $CH_3CH_2COCH_2CH_3$ | 400 | - | 600 | - | |
| Diethyl phthalate | 84-66-2 | $C_6H_4(COOC_2H_5)_2$ | - | 10 | - | - | |
| Diglycidyl ether [DGE] | 2238-07-5 | $(OCH_2CHCH_2)_2O$ | 0,02 | - | - | - | |
| o-Dihydroxybenzene | | $C_6H_4(OH)_2$ | | | See catechol | | |
| m-Dihydroxybenzene | 108-46-3 | $C_6H_4(OH)_2$ | | | See resorcinol | | |
| p-Dihydroxybenzene | | $C_6H_4(OH)_2$ | | | See hydroquinone | | |
| Diisobutyl ketone | 108-83-8 | $[(CH_3)_2CHCH_2]_2CO$ | 50 | - | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Diisopropylamine | 108-18-9 | $(CH_3)_2CHNHCH(CH_3)_2$ | 10 | - | - | - | SKIN |
| N,N-Dimethylacetamide | 127-19-5 | $CH_3CON(CH_3)_2$ | 20 | - | - | - | SKIN |
| Dimethylamine | 124-40-3 | $(CH_3)_2NH$ | 10 | - | 30 | - | DSEN |
| N,N-Dimethylaniline | 121-69-7 | $C_6H_5N(CH_3)_2$ | 10 | - | 20 | - | SKIN |
| 1,3-Dimethylbutyl acetate | 108-84-9 | $C_8H_{16}O_2$ | 100 | - | - | - | |
| N,N-Dimethylformamide | 68-12-2 | $HCON(CH_3)_2$ | 20 | - | - | - | CARC, SKIN |
| Dimethyl phthalate | 131-11-3 | $C_6H_4(COOCH_3)_2$ | - | 10 | - | - | |
| Dimethyl sulphate | 77-78-1 | $(CH_3)_2SO_4$ | 0,2 | - | - | - | CARC, SKIN |
| Dinitolmide | 148-01-6 | $C_8H_7N_3O_5$ | - | 2 | - | - | |
| Dinitrobenzene, all isomers | 25154-54-5 | $C_6H_4(NO_2)_2$ | 0,3 | - | - | - | SKIN |
| Dinitro-o-cresol | 534-52-1 | $CH_3C_6H_2(OH)(NO_2)_2$ | - | 0,4 | - | - | SKIN |
| Dinitrotoluene | 25321-14-6 | $CH_3C_6H_3(NO_2)_2$ | - | 0,4 | - | - | CARC, SKIN |
| 1,4-Dioxane | 123-91-1 | $OCH_2CH_2OCH_2CH_2$ | 40 | - | - | - | CARC, SKIN |
| Dioxathion | 78-34-2 | $C_{12}H_{26}O_6P_2S_2$ | - | $0,2^{(IFV)}$ | - | - | SKIN |
| Diphenylamine | 122-39-4 | $(C_6H_5)_2NH$ | - | 10 | - | - | |
| Diquat [diquat] | 85-00-7 | $C_{12}H_{12}Br_2N_2$ | | | | | SKIN |
| | 2764-72-9 | - | - | $1^{(I)}$ | - | - | |
| | 6385-62-2 | - | - | $0,2^{(R)}$ | - | - | |
| Disulfoton | 298-04-4 | $C_8H_{19}O_2PS_3$ | - | $0,1^{(IFV)}$ | - | - | SKIN |
| 6,6-Di-tert-butyl-4,4'-thiodi-m-cresol | 96-69-5 | $C_{22}H_{30}O_2S$ | - | - | - | - | |
| Diuron | 330-54-1 | $C_9H_{10}Cl_2N_2O$ | - | 10 | - | - | |
| Divinyl benzene [DVB] | 1321-74-0 | $C_6H_4(HC=CH_2)_2$ | 20 | - | - | - | |
| **E** | | | | | | | |
| Endosulfan | 115-29-7 | $C_9H_6Cl_6O_3S$ | - | $0,2^{(IFV)}$ | - | - | SKIN |
| Endrin | 72-20-8 | $C_{12}H_8Cl_6O$ | - | 0,2 | - | - | SKIN |
| Enflurane | 13838-16-9 | $CHFClCF_2OCHF_2$ | 150 | - | - | - | |
| Epichlorohydrin | 106-89-8 | $C_3H_5OCl$ | - | 1 | - | - | CARC, SKIN |
| 1,2-Epoxy-4-epoxyethyl-cyclo-hexane | 106-87-6 | $C_8H_{12}O_2$ | | | See 4-vinyl cyclohexene | | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| | | | | | dioxide | | |
| 2,3-Epoxypropyl isopropyl ether | 4016-14-2 | $C_6H_{12}O_2$ | | | See isopropyl glycidyl ether [IGE] | | |
| Ethanethiol | 75-08-1 | $CH_3CH_2SH$ | | | See ethyl mercaptan | | |
| Ethanol [ethyl alcohol] | 64-17-5 | $CH_3CH_2OH$ | - | - | 2000 | - | |
| Ethanolamine | 141-43-5 | $NH_2CH_2CH_2OH$ | 6 | - | 12 | - | |
| Ethyl acetate | 141-78-6 | $CH_3COOC_2H_5$ | 800 | - | - | - | |
| Ethyl acrylate | 140-88-5 | $CH_2=CHCOOC_2H_5$ | 10 | - | 30 | - | CARC |
| Ethylamine | 75-04-7 | $CH_3CH_2NH_2$ | 10 | - | 30 | - | SKIN |
| Ethyl amyl ketone | 541-85-5 | $C_8H_{16}O$ | 20 | - | - | - | |
| Ethyl benzene | 100-41-4 | $CH_3CH_2C_6H_5$ | 40 | - | - | - | CARC, SKIN |
| Ethyl bromide | 74-96-4 | $CH_3CH_2Br$ | | | See bromoethane | | |
| Ethyl butyl ketone | 106-35-4 | $CH_3CH_2CO(CH_2)_3CH_3$ | 100 | - | 150 | - | SKIN |
| Ethyl chloride | 75-00-3 | $CH_3CH_2Cl$ | 200 | - | - | - | SKIN |
| Ethylene chlorohydrin | 107-07-3 | $CH_2ClCH_2OH$ | - | - | 2 | - | SKIN |
| Ethylenediamine | 107-15-3 | $NH_2CH_2CH_2NH_2$ | 20 | - | - | - | |
| Ethylene dibromide | 106-93-4 | $BrCH_2CH_2Br$ | | | See 1,2-dibromoethane | | |
| Ethylene dichloride | 107-06-2 | $ClCH_2CH_2Cl$ | | | See 1,2-dichloroethane | | |
| Ethylene glycol | 107-21-1 | | $50^{(V)}$ | - | $100^{(V)}$ | $20^{(H)}$ | SKIN |
| Ethylene glycol dinitrate [EGDN] | 628-96-6 | $O_2NOCH_2CH_2ONO_2$ | 0,1 | - | - | - | SKIN |
| Ethylene glycol methyl ether | 109-86-4 | $CH_3OCH_2CH_2OH$ | 0,2 | - | - | - | |
| Ethylene glycol monomethyl ether acetate [EGMEA] | 110-49-6 | $CH_3COOCH_2CH_2OCH_3$ | 0,2 | - | - | - | SKIN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Ethyleneimine | 151-56-4 | $CH_2NHCH_2$ | 0,1 | - | 0,2 | - | CARC, SKIN |
| Ethyl ether [diethyl ether] | 60-29-7 | $C_2H_5OC_2H_5$ | 800 | - | 1000 | - | |
| Ethyl formate | 109-94-4 | $CH_3CH_2OCHO$ | - | - | 200 | - | |
| Ethylidene dichloride | 75-34-3 | $CH_3CHCl_2$ | - | - | - | - | |
| Ethyl mercaptan | 75-08-1 | $CH_3CH_2SH$ | 1 | - | - | - | |
| 4-Ethylmorpholine [N-ethylmorpholine] | 100-74-3 | $C_4H_8ONCH_2CH_3$ | 10 | - | - | - | SKIN |
| Ethyl silicate | 78-10-4 | $Si(OC_2H_5)_4$ | 20 | - | - | - | |
| **F** | | | | | | | |
| Fenchlorphos | 299-84-3 | $(CH_3O)_2PSOC_6H_2Cl_3$ | - | 10 | - | - | |
| Ferbam | 14484-64-1 | $[(CH_3)_2NCSS]_3Fe$ | - | $10^{(I)}$ | - | - | |
| Ferrocene | 102-54-5 | $(C_5H_5)_2Fe$ | | | See dicyclopentadienyl iron | | |
| Fluorides [inorganic as F] | 16984-48-8 | F | - | 5 | - | - | |
| Fluorine | 7782-41-4 | $F_2$ | 0,2 | - | 1 | - | |
| Formamide | 75-12-7 | $HCONH^2$ | 20 | - | - | - | SKIN |
| Formic acid | 64-18-6 | HCOOH | 10 | - | 20 | - | |
| Furfural [2-furaldehyde] | 98-0101 | $C_5H_4O_2$ | 0,4 | - | - | - | SKIN |
| Furfuryl alcohol | 98-00-0 | $OCH=CHCH=CCH_2OH$ | 0,4 | - | 30 | - | SKIN |
| **G** | | | | | | | |
| Germanium tetrahydride [germane] | 7782-65-2 | $GeH_4$ | 0,4 | - | - | - | |
| Glutaraldehyde | 111-30-8 | $OCH(CH_2)_3CHO$ | - | - | 0,1 | - | DSEN, RSEN |
| Graphite, natural and synthetic | 7782-42-5 | C | - | $4^{(R)}$ | - | - | |
| Guthion | 86-50-0 | $C_{10}H_{12}O_3PS_2N_3$ | | 0,2 | 0,6 | - | SKIN |
| **H** | | | | | | | |
| Hafnium | 7440-58-6 | Hf | - | 1 | - | - | |
| Halothane | 151-67-7 | $CF_3CHClBr$ | 100 | - | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Heptachlor and heptachlor epoxide | 76-44-8, 1024-57-3 | $C_{10}H_5Cl_7$ | - | 0,1 | - | - | CARC, SKIN |
| Heptane, all isomers | 142-82-5, 590-35-2, 565-59-3, 108-08-7, 591-76-4, 589-34-4 | $CH_3(CH_2)_5CH_3$ (for n-heptane) | 800 | - | 1000 | - | |
| Heptan-3-one | 106-35-4 | $CH_3CH_2CO(CH_2)_3CH_3$ | | | See ethyl butyl ketone | | |
| Hexachloroethane vapour | 67-72-1 | | 2 | - | - | - | CARC, SKIN |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine | 121-82-4 | $C_3H_6N_6O_6$ | - | 1,5 | - | 3 | SKIN |
| Hexamethylene diisocyanate [HDI] | 822-06-0 | $OCN(CH_2)_6NCO$ | 0,01 | - | - | - | |
| Hexane, all isomers except n-hexane | 75-83-2, 79-29-8, 96-14-0, 107-83-5 | $C_6H_{14}$ | 1000 | - | 2000 | - | |
| n-Hexane | 110-54-3 | $CH_3(CH_2)_4CH_3$ | 100 | - | - | - | SKIN |
| 2-Hexanone [hexan-2-one] | 591-78-6 | $CH_3CO(CH_2)_3CH_3$ | | | See methyl-n-butyl ketone | | |
| Hexone | 108-10-1 | $CH_3COCH_2CH(CH_3)_2$ | | | See methyl isobutyl ketone [MIBK] | | |
| sec-Hexyl acetate | 108-84-9 | $C_8H_{16}O_2$ | | | See 1,3-dimethylbutyl acetate | | |
| Hexylene glycol | 107-41-5 | $C_6H_{14}O_2$ | $50^{(V)}$ | - | $100^{(V)}$ | $20^{(I, H)}$- | |
| Hydrazine [diamine] | 302-01-2 | $H_2NNH_2$ | 0,02 | - | - | - | CARC, SKIN |
| Hydrogen bromide | 10035-10-6 | HBr | - | - | 4 | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Hydrogen chloride (gas and aerosol mists) | 7647-01-0 | HCl | - | - | 4 | - | |
| Hydrogen fluoride [as F] | 7664-39-3 | HF | 1 | - | 4 | - | CARC, SKIN |
| Hydrogen peroxide | 7722-84-1 | $H_2O_2$ | 2 | - | - | - | |
| Hydrogen selenide [as Se] | 7783-07-5 | $H_2Se$ | 0,1 | - | - | - | |
| Hydrogen sulphide | 7783-06-4 | $H_2S$ | 2 | - | 10 | - | |
| Hydroquinone | 123-31-9 | $C_6H_4(OH)_2$ | - | 2 | - | - | DSEN |
| 2-Hydroxypropyl acrylate [Propylene glycol monoacrylate] | 999-61-1 | $C_6H_{10}O_3$ | 1 | - | - | - | DSEN, SKIN |
| **I** | | | | | | | |
| Indene [Indonaphthene] | 95-13-6 | $C_9H_8$ | 10 | - | - | - | |
| Indium and compounds [as In] | 7440-74-6 | In | - | 0.2 | - | - | CARC (indium phosphide) |
| Iodine | 7553-56-2 | $I_2$ | $0,02^{(IFV)}$ | - | $0,2^{(V)}$ | - | |
| Iodoform | 75-47-8 | $CHI_3$ | 1,2 | - | - | - | |
| Iodomethane | 74-88-4 | $CH_3I$ | 4 | - | - | - | SKIN |
| Iron oxide fume [as Fe] | 1309-37-1 | $Fe_2O_3$ | - | $10^{(R)}$ | - | - | |
| Iron pentacarbonyl [as Fe] | 13463-40-6 | $Fe(CO)_5$ | 0,2 | - | 0,4 | - | |
| Iron salts [as Fe] | - | - | - | 2 | - | - | |
| Isoamyl alcohol | 123-51-3 | $(CH_3)_2CHCH_2CH_2OH$ | 200 | - | 250 | - | |
| Isobutanol [isobutyl alcohol] | 78-83-1 | $(CH_3)_2CHCH_2OH$ | 100 | - | - | - | |
| Isooctyl alcohol | 26952-21-6 | $C_8H_{17}OH$ | 100 | - | - | - | SKIN |
| Isophorone | 78-59-1 | $C_9H_{14}O$ | - | - | 10 | - | |
| Isophorone diisocyanate [IPDI] | 4098-71-9 | $C_{12}H_{18}N_2O_2$ | 0,01 | - | - | - | |
| Isopropyl acetate | 108-21-4 | $CH_3COOCH(CH_3)_2$ | 200 | - | 400 | - | |
| Isopropyl benzene | 98-82-8 | $C_6H_5CH(CH_3)_2$ | | | See cumene | | |
| Isopropyl ether | 108-20-3 | $(CH_3)_2CHOCH(CH_3)_2$ | 500 | - | 620 | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Isopropyl glycidyl ether [IGE] | 4016-14-2 | $C_6H_{12}O_2$ | 100 | - | 150 | - | |
| **K** | | | | | | | |
| Ketene | 463-51-4 | $CH_2=CO$ | 1 | - | 3 | - | |
| **L** | | | | | | | |
| Liquefied petroleum gas [LPG] | 68476-85-7 | Mixture: $C_3H_6$; $C_3H_8$; $C_4H_{10}$; $C_4H_8$ | - | Asphyxiant | - | - | |
| Lithium hydride | 7580-67-8 | LiH | - | - | - | 0,1 | |
| **M** | | | | | | | |
| Magnesium oxide [as MgO] | 1309-48-4 | MgO | - | 10 | - | - | |
| Malathion | 121-75-5 | $C_{10}H_{19}O_6PS_2$ | - | $2^{(IFV)}$ | - | - | CARC, SKIN |
| Maleic anhydride | 108-31-6 | $C_4H_2O_3$ | - | $0,02^{(IFV)}$ | - | - | DSEN, RSEN |
| Manganese | 7439-96-5 | Mn | | | | | |
| inorganic compounds [as Mn] | - | - | - | 0,2 | - | - | |
| elemental | - | - | - | $0,04^{(R)}$ | - | - | |
| Manganese cyclopentadienyl tricarbonyl [as Mn] | 12079-65-1 | $C_5H_5Mn(CO)_3$ | - | 0,2 | - | - | SKIN |
| Mercaptoacetic acid | 68-11-1 | $HSCH_2COOH$ | 2 | - | - | - | SKIN |
| Mercury and divalent inorganic mercury compounds, including mercuric oxide and mercuric chloride [as Hg] | 7439-97-6 | Hg | | | | | |
| Alkyl compounds | | | - | 0,02 | - | 0,06 | CARC, SKIN |
| Aryl compounds | | | - | 0,2 | - | - | SKIN |
| Elemental and inorganic forms | | | - | 0,05 | - | - | SKIN |
| Mesityl oxide | 141-79-7 | $(CH_3)_2C=CHCOCH_3$ | 30 | - | 50 | - | |
| Methacrylic acid | 79-41-4 | $CH_2=C(CH_3)COOH$ | 40 | - | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Methanol [methyl alcohol] | 67-56-1 | $CH_3OH$ | 400 | - | 500 | - | SKIN |
| Methomyl | 16752-77-5 | $C_5H_{10}N_2O_2S$ | - | 0,4(IFV) | - | - | SKIN |
| Methoxychlor | 72-43-5 | $(C_6H_4OCH_3)_2CHCCl_3$ | - | 10 | - | - | |
| 1-Methoxypropan-2-ol | 107-98-2 | $CH_3CHOHCH_2OCH_3$ | | | See propylene glycol monomethyl ether | | |
| Methyl acetate | 79-20-9 | $CH_3COOCH_3$ | 400 | - | 500 | - | |
| Methyl acrylate | 96-33-3 | $CH_2=CHCOOCH_3$ | 4 | - | - | - | DSEN, SKIN |
| Methylacrylonitrile [methacrylonitrile] | 126-98-7 | $CH_2=C(CH_3)CN$ | 2 | - | - | - | SKIN |
| Methylal | 109-87-5 | $CH_2(OCH_3)_2$ | 2000 | - | - | - | |
| Methylamine | 74-89-5 | $CH_3NH_2$ | 10 | - | 30 | - | |
| Methyl n-amyl ketone | 110-43-0 | $CH_3CO(CH_2)_4CH_3$ | 100 | - | - | - | |
| N-Methylaniline | 100-61-8 | $C_6H_5NHCH_3$ | 1 | - | - | - | SKIN |
| Methyl bromide | 74-83-9 | $CH_3Br$ | 2 | - | - | - | SKIN |
| Methyl-n-butyl ketone | 591-78-6 | $CH_3CO(CH_2)_3CH_3$ | 10 | - | 20 | - | SKIN |
| Methyl chloride | 74-87-3 | $CH_3Cl$ | 100 | - | 200 | - | SKIN |
| Methyl chloroform | 71-55-6 | $CH_3CCl_3$ | | | See 1,1,1-trichloroethane | | |
| Methyl 2-cyanoacrylate | 137-05-3 | $CH_2=C(CN)COOCH_3$ | 0,4 | - | - | - | |
| Methyl ethyl ketone [MEK] | 78-93-3 | $CH_2COC_2H_5$ | 400 | - | 600 | - | SKIN |
| Methylcyclohexane | 108-87-2 | $CH_3C_6H_{11}$ | 800 | - | - | - | |
| Methylcyclohexanol | 25639-42-3 | $CH_3C_6H_{10}OH$ | 100 | - | - | - | |
| 2-Methylcyclohexanone | 583-60-8 | $CH_3CHCO(CH_2)_3CH_2$ | 100 | - | 150 | - | SKIN |
| Methylene bis(4-cyclohexylisocyanate) | 5124-30-1 | $CH_2[(C_6H_{10})NCO]_2$ | 0,01 | - | - | - | |
| Methylcyclopentadienyl manganese tricarbonyl [as Mn] | 12108-13-3 | $CH_3C_5H_4Mn(CO)_3$ | - | 0,4 | - | - | SKIN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| 4,4'-Methylenebis(2-chloroaniline) [MbOCA] | 101-14-4 | $CH_2(C_6H_4ClNH_2)_2$ | | | See 2,2'-dichloro-4,4'-methylene dianiline [MbOCA] | | |
| Methylene chloride | 75-09-2 | | | | See dichloromethane | | |
| 4,4'-Methylenedianiline [MDA] | 101-77-9 | $CH_2(C_6H_4NH_2)_2$ | 0,2 | - | - | - | |
| 4,4'-Methylene-diphenyl diisocyanate [MDI] | 101-68-8 | $CH_2(C_6H_4NCO)_2$ | 0,01 | - | - | - | |
| Methyl formate | 107-31-3 | $HCOOCH_3$ | 100 | - | 200 | - | SKIN |
| Methyl hydrazine | 60-34-4 | $CH_3NHNH_2$ | 0,02 | - | - | - | SKIN |
| Methyl iodide | 74-88-4 | $CH_3I$ | | | See iodomethane | | |
| Methyl isoamyl ketone | 110-12-3 | C7H14O | 40 | - | 100 | - | SKIN |
| Methyl isobutyl carbinol [4-Methylpentan-2-ol] | 108-11-2 | C6H14O | 50 | - | 80 | - | SKIN |
| Methyl isobutyl ketone [MIBK] | 108-10-1 | $CH_3COCH_2CH(CH_3)_2$ | 40 | - | 150 | - | CARC, SKIN |
| Methyl isocyanate [MIC] | 624-83-9 | $CH_3NCO$ | 0,04 | - | 0,12 | - | DSEN, RSEN, SKIN |
| Methyl mercaptan | 74-93-1 | $CH_3SH$ | 1 | - | - | - | |
| Methyl methacrylate | 80-62-6 | $CH_2=C(CH_3)COOCH_3$ | 100 | - | 200 | - | DSEN |
| Methyl parathion | 298-00-0 | $C_8H_{10}NO_5PS$ | - | $0,04^{(IFV)}$ | - | - | SKIN |
| Methyl propyl ketone | 107-87-9 | $CH_3(CH_2)_2COCH_3$ | - | - | 300 | - | |
| Methyl silicate | 681-84-5 | $(CH_3O)_4Si$ | 2 | - | - | - | |
| alpha-Methyl styrene | 98-83-9 | $C_6H_5C(CH_3)=CH_2$ | 20 | - | - | - | CARC |
| Mevinphos | 7786-34-7 | $C_7H_{13}PO_6$ | | | See phosdrin | | |
| Mica | 12001-26-2 | | - | $6^{(R)}$ | - | - | |
| Molybdenum compounds [as Mo]' | 7439-98-7 | Mo | | | | | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Soluble compounds | - | - | - | 1(R) | - | - | |
| Metal and insoluble compounds, total particulate | - | - | - | 10 | - | - | |
| Metal and insoluble compounds | - | - | - | 5(R) | - | - | |
| Monochloroacetic acid | 79-11-8 | $ClCH_2CO_2H$ | 1(IFV) | - | - | - | SKIN |
| Morpholine | 110-91-8 | $C_4H_9NO$ | 40 | - | - | - | SKIN |
| **N** | | | | | | | |
| Naled | 300-76-5 | $C_4H_7Br_2Cl_2O_4P$ | - | 0,2(IFV) | - | - | DSEN, SKIN |
| Naphthalene | 91-20-3 | $C_{10}H_8$ | 20 | - | - | - | CARC, SKIN |
| Nickel and its inorganic compounds [as Ni] | 7440-02-0 | | | | | | |
| Elemental | | | - | 3 | - | - | CARC, SKIN |
| Nickel carbonyl [as Ni] | 13463-39-3 | $Ni(CO)_4$ | - | - | 0,1 | - | CARC |
| Nickel, subsulphide [as Ni] | 12035-72-2 | $Ni_3S_2$ | - | 0,2 | - | - | CARC |
| Nicotine | 54-11-5 | $C_{10}H_{14}N_2$ | - | 1 | - | - | SKIN |
| Nitrapyrin | 1929-82-4 | $ClC_5H_3NCCl_3$ | - | 10(IFV) | - | 20 | |
| Nitric acid | 7697-37-2 | $HNO_3$ | 4 | - | 8 | - | CARC |
| Nitric oxide | 10102-43-9 | NO | | | See nitrogen monoxide | | |
| 4-Nitroaniline [p-nitroaniline] | 100-01-6 | $NO_2C_6H_4NH_2$ | - | 6 | - | - | SKIN |
| Nitrobenzene | 98-95-3 | $C_6H_5NO_2$ | 2 | - | - | - | CARC, SKIN |
| p-Nitrochlorobenzene | 100-00-5 | $ClC_6H_4NO_2$ | 0,2 | - | - | - | |
| Nitroethane | 79-24-3 | $C_2H_5NO_2$ | 200 | - | - | - | |
| Nitrogen monoxide | 10102-43-9 | NO | 50 | - | - | - | |
| Nitrogen dioxide | 10102-44-0 | $NO_2$ | 0,4 | - | - | - | |
| Nitrogen trifluoride | 7783-54-2 | $NF_3$ | 20 | - | - | - | |
| Nitroglycerine [NG] | 55-63-0 | $CH_2NO_3CHNO_3CH_2NO_3$ | 0,1 | - | - | - | SKIN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Nitromethane | 75-52-5 | $CH_3NO_2$ | 40 | - | - | - | CARC |
| 1-Nitropropane | 108-03-2 | $C_3H_7NO_2$ | 50 | - | - | - | |
| 2-Nitropropane | 79-46-9 | $(CH_3)_2CH(NO_2)$ | 20 | - | - | - | CARC |
| Nitrotoluene, all isomers | 88-72-2; 99-08-1; 99-99-0 | $CH_3C_6H_4NO_2$ | 4 | - | - | - | SKIN |
| Nitrous oxide | 10024-97-2 | $N_2O$ | 100 | - | - | - | |
| **O** | | | | | | | |
| Octachloronaphthalene | 2234-13-1 | $C_{10}Cl_8$ | - | 0,2 | - | 0,6 | SKIN |
| Osmium tetroxide [as Os] | 20816-12-0 | $OsO_4$ | 0,0004 | - | 0,0012 | - | |
| Oxalic acid | 144-62-7 | $COOHCOOH.2H_2O$ | - | 2 | - | 4 | |
| Ozone | 10028-15-6 | $O_3$ | | | | | |
| Heavy work | | | 0,1 | - | - | - | |
| Moderate work | | | 0,16 | - | - | - | |
| Light work | | | 0,2 | - | - | - | |
| Heavy, moderate or light workloads (< 2hrs) | | | 0,4 | - | - | - | |
| **P** | | | | | | | |
| Paraffin wax fume | 8002-74-2 | - | - | 4 | - | - | |
| Parathion | 56-38-2 | $(C_2H_5O)_2PSOC_6H_4NO_2$ | - | $0,1^{(IFV)}$ | - | - | CARC, SKIN |
| Particles not otherwise specified [PNOS] | - | - | | | | | |
| Total particulate | - | - | - | 10 | - | - | |
| | - | - | - | $5^{(R)}$ | - | - | |
| Pentachlorophenol | 87-86-5 | $C_6Cl_5OH$ | - | $1^{(IFV)}$ | - | 2 | CARC, SKIN |
| Pentaerythritol | 115-77-5 | | - | 10 | - | - | |
| Pentane, all isomers | 78-78-4; 109-66-0; 463-82-1 | $C_5H_{12}$ | 2000 | - | - | - | |
| Pentyl acetate, all isomers | 628-63-7; 626-38-0; | $CH_3COO(CH_2)_4CH_3$ | 100 | - | 200 | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| | 123-92-2; 625-16-1; 624-41-9; 620-11-1 | | | | | | |
| Perchloryl fluoride | 7616-94-6 | $ClFO_3$ | 6 | - | 12 | - | |
| Persulphates, as persulfate | | $SO_5/S_2O_8$ | - | 0,2 | - | - | |
| Phenol | 108-95-2 | $C_6H_5OH$ | 10 | - | - | - | SKIN |
| p-Phenylenediamine | 106-50-3 | $C_6H_4(NH_2)_2$ | - | 0,2 | - | - | SKIN |
| Phenyl ether | 101-84-8 | $C_6H_5OC_6H_5$ | $2^{(V)}$ | - | 4 | - | |
| Phenyl glycidyl ether [PGE] | 122-60-1 | $C_6H_5OCH_2CHOCH_2$ | 0,2 | - | - | - | CARC, DSEN, SKIN |
| Phenylhydrazine | 100-63-0 | $C_6H_5NHNH_2$ | 0,2 | - | - | - | SKIN |
| Phenyl mercaptan | 108-98-5 | $C_6H_5SH$ | 0,2 | - | - | - | SKIN |
| 2-Phenylpropene | 98-83-9 | $C_6H_5C(CH_3)=CH_2$ | | | See alpha-methyl styrene | | |
| Phorate | 298-02-2 | $C_7H_{17}O_2PS_3$ | - | $0,1^{(IFV)}$ | - | - | SKIN |
| Phosdrin | 7786-34-7 | $C_7H_{13}PO_6$ | - | $0,02^{(IFV)}$ | - | - | SKIN |
| Phosgene | 75-44-5 | $COCl_2$ | 0,2 | - | - | - | |
| Phosphine | 7803-51-2 | $PH_3$ | 0,1 | - | 0,3 | - | |
| Phosphoric acid | 7664-38-2 | $H_3PO_4$ | - | 2 | - | 6 | |
| Phosphorus oxychloride | 10025-87-3 | $POCl_3$ | 0,2 | - | - | - | |
| Phosphorus pentachloride | 10026-13-8 | $PCl_5$ | 0,2 | - | - | - | |
| Phosphorus pentasulphide | 1314-80-3 | $P_2S_5/P_4S_{10}$ | - | 2 | - | 6 | |
| Phosphorus trichloride | 7719-12-2 | $PCl_3$ | 0,4 | - | 1 | - | |
| Phthalic anhydride | 85-44-9 | $C_6H_4(CO)_2O$ | $0,004^{(IFV)}$ | - | 0,01 | - | DSEN, RSEN |
| Picloram | 1918-02-1 | $C_6H_3Cl_3N_2O_2$ | - | 10 | - | - | |
| Picric acid | 88-89-1 | $(NO_2)_3C_6H_2OH$ | - | 0,2 | - | - | |
| Piperazine and salts [as Piperazine] | 110-85-0 | $C_4H_{10}N_2$ | $0,06^{(IFV)}$ | - | - | - | DSEN, RSEN |
| Platinum | | | | | | | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Metal | 7440-06-4 | Pt | - | 1 | - | - | |
| Soluble salts [as Pt] | - | - | - | 0,002 | - | - | DSEN, RSEN |
| Polyvinyl chloride [PVC] | - | - | - | 2(R) | - | - | |
| Potassium hydroxide | 1310-58-3 | KOH | - | - | - | 4 | |
| n-Propanol [n-propyl alcohol] | 71-23-8 | $CH_3CH_2CH_2OH$ | 200 | - | - | - | SKIN |
| 2-Propanol [propan-2-ol] | 67-63-0 | $(CH_3)_2CHOH$ | 400 | - | 800 | - | |
| Propargyl alcohol [2-propyn-1-ol] | 107-19-7 | $HC{\equiv}CCH_2OH$ | 2 | - | - | - | SKIN |
| Propionic acid | 79-09-4 | $CH_3CH_2COOH$ | 20 | - | - | - | |
| Propoxur | 114-26-1 | $C_{11}H_{15}NO_3$ | - | 1(IFV) | - | - | |
| n-Propyl acetate | 109-60-4 | $CH_3COOC_3H_7$ | 200 | - | 300 | - | |
| Propylene glycol dinitrate [PGDN] | 6423-43-4 | $CH_3CHONO_2CH_2ONO_2$ | 0,1 | - | - | - | SKIN |
| Propylene glycol monomethyl ether | 107-98-2 | $CH_3CHOHCH_2OCH_3$ | 100 | - | 200 | - | SKIN |
| Pyrethrum | 8003-34-7 | - | - | 10 | - | - | |
| Pyridine | 110-86-1 | $C_5H_5N$ | 2 | - | - | - | |
| Pyrocatechol | 120-80-9 | $C_6H_4(OH)_2$ | 5 | 20 | - | - | |
| **Q** | | | | | | | |
| Quinone | 106-51-4 | C6H4O2 | | | See p-benzoquinone | | |
| Quintozene | 82-68-8 | $C_6Cl_5NO_2$ | | | See pentachloronitro benzene | | |
| **R** | | | | | | | |
| Resorcinol | 108-46-3 | $C_6H_4(OH)_2$ | 20 | - | 40 | - | SKIN |
| Rhodium | | | | | | | |
| Metal and insoluble compounds [as Rh] | 7440-16-6 | Rh | - | 2 | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Soluble compounds [as Rh] | | | - | 0,02 | - | - | DSEN |
| Rosin core solder thermal decomposition products [colophony] | 8050-09-07 | - | Exposure by all routes should be carefully controlled to ALARP | | | | |
| **S** | | | | | | | |
| Selenium and compounds, except hydrogen selenide [as Se] | 7782-49-2 | Se | - | 0,4 | - | - | |
| Silicon carbide | 409-21-2 | SiC | | | | | |
| Total particulate (nonfibrous) | - | - | - | 10 (I, E) | - | - | CARC |
| Respirable particulate (nonfibrous) | - | - | - | 5 (R) | - | - | CARC |
| Fibrous (including whiskers) | | | - | 0,1 f/ml (F) | - | - | CARC |
| Silicon tetrahydride [silane] | 7803-62-5 | $SiH_4$ | 10 | - | - | - | |
| Silver | | | | | | | |
| Metal | 7440-22-4 | Ag | - | 0,2 | - | - | |
| Soluble compounds [as Ag] | - | - | - | 0,02 | - | - | |
| Sodium azide | 26628-22-8 | $NaN_3$ | - | - | - | 0,6 | SKIN |
| Sodium 2,4-dichlorophenoxy ethyl sulphate [2,4-DES], [sesone] | 136-78-7 | $C_8H_7Cl_2NaO_5S$ | - | 10 | - | - | CARC |
| Sodium fluoroacetate | 62-74-8 | $CH_2FCOONa$ | - | 0,1 | - | - | SKIN |
| Sodium hydrogen sulphite [sodium bisulphite] | 7631-90-5 | $NaHSO_3$ | - | 10 | - | - | |
| Sodium hydroxide | 1310-73-2 | NaOH | - | - | - | 4 | |
| Sodium metabisulphate | 7681-57-4 | $Na_2S_2O_5$ | - | 10 | - | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Starch | 9005-25-8 | - | - | 10 | - | - | |
| Stibine [antimony hydride] | 7803-52-3 | $SbH_3$ | 0,2 | - | - | - | |
| Strychnine | 57-24-9 | $C_{21}H_{22}N_2O_2$ | - | 0,3 | - | - | |
| Subtilisins (proteolytic enzymes as 100% pure crystalline enzyme) | 1395-21-7, 9014-01-1 | - | - | - | - | 0,00012 | RSEN |
| Sucrose | 57-50-1 | $C_{12}H_{22}O_{11}$ | - | 10 | - | - | |
| Sulfotep | 3689-24-5 | $[(CH_3CH_2O)_2PS]_2O$ | - | $0,2^{(IFV)}$ | - | - | SKIN |
| Sulphur dioxide | 7446-09-5 | $SO_2$ | - | - | 0,5 | - | |
| Sulphur hexafluoride | 2551-62-4 | $SF_6$ | 2000 | - | - | - | |
| Sulphuric acid (mist) | 7664-93-9 | $H_2SO_4$ | - | $0,4^{(T)}$ | - | - | CARC |
| Sulphur monochloride | 10025-67-9 | $S_2Cl_2$ | - | - | 2 | - | |
| Sulphur pentafluoride | 5714-22-7 | $S_2F_{10}$ | - | - | 0,02 | - | |
| Sulphur tetrafluoride | 7783-60-0 | $SF_4$ | - | - | 0,2 | - | |
| Sulphuryl fluoride [sulphuryl difluoride] | 2699-79-8 | $SO_2F_2$ | 10 | - | 20 | - | |
| Synthetic vitreous fibres [SVF]: | - | - | | | | | |
| Continuous filament glass fibres | - | - | - | $2\ f/ml^{(F)}$ | - | - | |
| Continuous filament glass fibres | | | - | 10 | - | - | |
| Glass wool fibres | - | - | - | $2\ f/ml^{(F)}$ | - | - | |
| Rock wool fibres | - | - | - | $2\ f/ml^{(F)}$ | - | - | |
| Slag wool fibres | - | - | - | $2\ f/ml^{(F)}$ | - | - | |
| Special purpose glass fibres | | | - | $2\ f/ml^{(F)}$ | - | - | |
| Refractory ceramic fibres | - | - | - | $0,4\ f/ml^{(F)}$ | - | - | CARC |
| **T** | | | | | | | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Talc (containing no asbestos fibres) | 14807-96-6 | $Mg_3Si_4O_{10}(OH)_1$ | - | $4^{(E, R)}$ | - | - | |
| Tellurium and compounds, except hydrogen telluride [as Te] | 13494-80-9 | Te | - | 0,2 | - | - | |
| Terphenyls, all isomers | 26140-60-3 | $C_{18}H_{14}$ | - | - | - | 10 | |
| 1,1,2,2-Tetrabromoethane | 79-27-6 | $CHBr_2CHBr_2$ | 0,2 | - | - | - | SKIN |
| Tetracarbonyl nickel [as Ni] | 13463-39-3 | $Ni(CO)_4$ | | | See nickel carbonyl | | |
| 1,1,2,2-Tetrachloro-1,2-difluoroethane | 76-12-0 | $CCl_2FCCl_2F$ | 100 | - | - | - | |
| 1,1,1,2-Tetrachloro-2,2-difluoroethane | 76-11-9 | $CCl_3CClF_2$ | 200 | - | - | - | |
| Tetrachloroethylene | 127-18-4 | $Cl_2C=CCl_2$ | 50 | - | 200 | - | |
| Tetrachloronaphthalene | 1335-88-2 | $C_{10}H_4Cl_4$ | - | 4 | - | - | |
| Tetraethyl orthosilicate | 78-10-4 | Si(OC2H5)4 | | | See ethyl silicate | | |
| Tetraethyl pyrophosphate [TEPP] | 107-49-3 | $[(CH_3CH_2O)_2PO]_2O$ | - | $0,02^{(IFV)}$ | - | - | SKIN |
| Tetrahydrofuran | 109-99-9 | $C_4H_8O$ | 100 | - | 200 | - | SKIN |
| Tetramethyl succinonitrile | 3333-52-6 | $C_8H_{12}N_2$ | $1^{(IFV)}$ | - | - | - | SKIN |
| Tetryl | 479-45-8 | $(NO^2)^3C^6H^2N(NO^2)CH^3$ | - | 3 | - | - | |
| Thallium, soluble compounds [as Tl] | - | Tl | - | 0,04 | - | - | SKIN |
| 4,4'-Thiobis(6-tert-butyl-m-cresol) | 96-69-5 | $C_{22}H_{30}O_2S$ | - | 2 | - | - | |
| Thioglycolic acid | 68-11-1 | $HSCH_2COOH$ | | | See mercaptoacetic acid | | |
| Thionyl chloride | 7719-09-7 | $SOCl_2$ | - | - | 0,4 | - | |
| Thiram | 137-26-8 | $(CH_3)_2NCS_2CS_2N(CH_3)_2$ | - | $0,1^{(IFV)}$ | - | - | DSEN |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Tin compounds: | | - | | | | | |
| Tin metal | 7440-31-5 | - | - | 4 | - | - | |
| Tin oxide and inorganic, except $SnH_4$ [as Sn] | | - | - | 4 | - | - | SKIN |
| Organic except cyhexatin [as Sn] | - | - | - | 0,2 | - | - | SKIN |
| Titanium dioxide | 13463-67-7 | - | - | 10 | | - | CARC |
| Toluene | 108-88-3 | $C_6H_5CH_3$ | 40 | - | - | - | SKIN |
| 2,4-Toluene diisocyanate [TDI] | 584-84-9 | $CH_3C_6H_3(NCO)_2$ | 0,002(IFV) | - | 0,01(IFV) | - | |
| o-Toluidine | 95-53-4 | $CH_3C_6H_4NH_2$ | 4 | - | - | - | CARC, SKIN |
| m-Toluidine | 108-44-1 | $CH_3C_6H_4NH_2$ | 4 | - | - | - | SKIN |
| p-Toluidine | 106-49-0 | $CH_3C_6H_4NH_2$ | 4 | - | - | - | SKIN |
| Tribromomethane | 75-25-2 | $CHBr_3$ | | | See bromoform | | |
| Tributyl phosphate, all isomers | 126-73-8 | $(C_4H_9)_3PO_4$ | - | 10(IFV) | - | - | |
| Trichloroacetic acid | 76-03-9 | $CCl_3COOH$ | 1 | - | - | - | CARC |
| 1,2,4-Trichlorobenzene | 120-82-1 | $C_6H_3Cl_3$ | - | - | 10 | - | SKIN |
| 1,1,2-Trichloroethane | 79-00-5 | $CHCl_2CH_2Cl$ | 20 | - | - | - | SKIN |
| Trichlorofluoromethane | 75-69-4 | $CCl_3F$ | - | - | 2000 | - | |
| Trichloronitromethane | 76-06-2 | $CCl_3NO_2$ | | | See chloropicrin | | |
| 2,4,5-Trichlorophenoxyacetic acid [2,4,5-T] | 93-76-5 | $Cl_3C_6H_2OCH_2COOH$ | - | 10 | - | - | CARC |
| 1,2,3-Trichloropropane | 96-18-4 | $CH_2ClCHClCH_2Cl$ | 0,01 | - | - | - | CARC |
| 1,1,2-Trichlorotrifluoroethane [1,1,2-trichloro-1,2,2-trifluoroethane] | 76-13-1 | $CCl_2FCClF_2$ | 2000 | - | 2500 | - | |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| Tri-o-cresyl phosphate [Tri-o-tolyl phosphate] | 78-30-8 | $(CH_3C_6H_4O)_3P=O$ | - | 0,04 (IFV) | - | - | |
| Tricyclohexyltin hydroxide | 13121-70-5 | $(C_6H_{11})_3SnOH$ | | | See cyhexatin | | |
| Triethanolamine | 102-71-6 | $(CH_2OHCH_2)_3N$ | - | 10 | - | - | |
| Triethylamine | 121-44-8 | $(C_2H_5)_3N$ | 1 | - | 2 | - | SKIN |
| Trifluorobromomethane | 75-63-8 | $CF_3Br$ | 2000 | - | - | - | |
| Trimellitic anhydride | 552-30-7 | $C_9H_4O_5$ | | | See benzene-1,2,4,-tricarboxylic acid 1,2-anhydride | | |
| Trimethylamine | 75-50-3 | $(CH_3)_3N$ | 10 | - | 30 | - | |
| Trimethylbenzene, all isomers or mixtures | 25551-13-7 | $C_6H_3(CH_3)_3$ | 50 | - | - | - | |
| Trimethyl phosphite | 121-45-9 | $(CH_3O)_3P$ | 4 | - | - | - | |
| 2,4,6-Trinitrotoluene [TNT] | 118-96-7 | $CH_3C_6H_2(NO_2)_3$ | - | 0,2 | - | - | SKIN |
| Triphenyl phosphate | 115-86-6 | $(C_6H_5O)_3PO_4$ | - | 6 | - | - | SKIN |
| Tungsten and compounds, in the absence of cobalt, as W | 7440-33-7 | | | 5 (R) | | | |
| Turpentine | 8006-64-2 | $C_{10}H_{16}$ (approx.) | 40 | - | - | - | |
| **U** | | | | | | | |
| Uranium (natural), soluble and insoluble compounds [as U] | 7440-61-1 | - | - | 0,4 | - | 1,2 | |
| **V** | | | | | | | |
| Vanadium pentoxide | 1314-62-1 | $V_2O_5$ | 0,1 (I) | - | - | - | CARC |
| Vinyl acetate | 108-05-4 | $CH_2=CHOOCCH_3$ | 20 | - | 30 | - | CARC |
| Vinyl benzene | 100-42-5 | $C_6H_5CH=CH_2$ | | | See styrene, monomer | | |
| Vinyl bromide | 593-60-2 | $CH_2=CHBr$ | 1 | - | - | - | CARC |
| 4-Vinyl cyclohexene | 100-40-3 | $C_8H_{12}$ | 0,2 | - | - | - | CARC |

| AGENT | CAS NUMBER | FORMULA | OEL eight-hour TWA | OEL eight-hour TWA | OEL-STEL/C | OEL-STEL/C | NOTATIONS |
|---|---|---|---|---|---|---|---|
| 4-Vinyl cyclohexene dioxide | 106-87-6 | $C_8H_{12}O_2$ | 0,2 | - | - | - | CARC, SKIN |
| Vinyl toluene | 25013-15-4 | $CH_2=CHC_6H_4CH_3$ | 100 | - | 200 | - | |
| **W** | | | | | | | |
| Warfarin | 81-81-2 | $C_{19}H_{16}O_4$ | - | 0,02(I) | - | - | SKIN |
| Wood dust, all species, excluding oak, beech, birch, mahogany, teak and walnut | - | | - | 5 | - | - | CARC, RSEN |
| **X** | | | | | | | |
| Xylene, o-, m-, p- or mixed isomers | 1330-20-7 | $C_6H_4(CH_3)_2$ | 200 | - | 300 | - | SKIN |
| Xylidine, all isomers | 1300-73-8 | $(CH_3)_2C_6H_3NH_2$ | 1(IFV) | - | - | - | CARC, SKIN |
| **Y** | | | | | | | |
| Yttrium and compounds [as Y] | 7440-65-5 | Y | - | 2 | - | - | |
| **Z** | | | | | | | |
| Zinc chloride, fume | 7646-85-7 | $ZnCl_2$ | - | 2 | - | 4 | |
| Zinc oxide, fume | 1314-13-2 | ZnO | - | 4(R) | - | 20(R) | |
| Zirconium compounds [as Zr] | 7440-67-7 | Zr | - | 10 | - | 20 | |

**Abbreviations**:
**ALARP**: as low as reasonable practicable
**OEL eight-hour TWA**: occupational exposure limit – eight-hour time-weighted average
**OEL-ML**: occupational exposure limit – maximum limit
**OEL-RL**: occupational exposure limit – restricted limit
**OEL-STEL/C**: occupational exposure limit – short-term exposure limit, ceiling limit

**Notations**:

**CARC**: denotes carcinogenicity, which is based on GHS categorisation, including category 1A, 1B;
**DSEN**: dermal sensitisation, potential to produce dermal sensitisation;
**E**: the value is for particulate matter containing no asbestos and ≤ 1% crystalline silica;
**F**: respirable fibres: length> 5 µm; aspect ratio ≥ 3:1 as determined by the membrane filter method at 400-450X magnification (4mm objective), using phase-contrast illumination;
**H**: aerosol only;
**I**: inhalable fraction;
**IFV**: inhalable fraction and vapour;
**Inhalable particulate matter (IPM)**: for those materials that are hazardous when deposited anywhere in the respiratory tract;
**R**: respirable fraction;
**RSEN**: respiratory sensitisation, potential to produce respiratory sensitisation;
**SKIN**: danger of cutaneous absorption – refers to the potential significant contribution to the overall exposure by the cutaneous route, including mucous membranes and the eyes by contact with vapours, liquids and solids; overexposure may also occur following dermal contact with liquids and aerosols, even when airborne exposures at or below the OEL;
**T**: thoracic fraction; and
**V**: vapour fraction.

RSEN and DSEN do not imply that sensitisation is the critical effect on which the OEL is based, nor do they imply that this effect is the sole basis for the agent's OEL.

**Table 4: BIOLOGICAL EXPOSURE INDICES (BEIs) FOR HAZARDOUS CHEMICAL AGENTS**

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| **A** | | | | | | |
| **Acetone** | **67-64-1** | | | | | |
| Acetone | | urine | End of shift | 25 | mg/L | Ns |
| **Acetylcholinesterase inhibitors** | | | | | | |
| Cholinesterase activity in red cells | | blood | Discretionary | 70 | % of baseline | Ns |
| **Aniline** | **62-53-3** | | | | | |
| p-Aminophenol | | urine | End of shift | 50 | mg/L | B, Ns, Sq |
| **Arsenic, elemental and soluble inorganic compounds (excluding gallium arsenide and arsine)** | **7440-38-2** | | | | | |
| Inorganic arsenic plus methylated metabolites | | urine | End of workweek | 35 | µg/L | B |
| **B** | | | | | | |
| **Benzene** | **71-43-2** | | | | | |
| S-phenylmercapturic acid (SPMA) | | urine | End of shift | 25 | µg/g creatinine | B |
| t,t-Muconic acid (ttMA) | | urine | End of shift | 500 | µg/g creatinine | B |
| **1,3-Butadiene** | **106-99-0** | | | | | |
| 1,2-Dihydroxy-4-(N-acetylcysteinyl)-butane | | urine | End of shift | 2,5 | mg/L | B, Sq |
| Mixture of N-1-and N-2-(hydroxybutenyl)valine haemoglobin adducts | | blood | Not critical | 2,5 | pmol/g Hb | Sq |
| **2-Butoxyethanol** | **111-76-2** | | | | | |
| Butoxyacetic acid (BAA) | | urine | End of shift | 200 | mg/g creatinine | - |
| **C** | | | | | | |
| **Cadmium and inorganic compounds** | **7440-43-9** | | | | | |
| Cadmium | | urine | Not critical | 5 | µg/g creatinine | B |

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| Cadmium | | blood | Not critical | 5 | µg/L | B |
| **Carbon disulphide** | **75-15-0** | | | | | |
| 2-thiothiazolidine-4-carboxlyic acid (TTCA) | | urine | End of shift | 0,5 | mg/g creatinine | B, Ns |
| **Carbon monoxide** | **630-08-0** | | | | | |
| Carboxyhaemoglobin | | blood | End of shift | 3,5 | % haemoglobin | B, Ns |
| Carbon monoxide | | end exhaled | End of shift | 20 | ppm | B, Ns |
| **Chlorobenzene** | **108-90-7** | | | | | |
| 4-Chlorocatechol | | urine | End of shift at end of workweek | 100 | mg/g creatinine | Ns |
| p-Chlorophenol | | urine | End of shift at end of workweek | 20 | mg/g creatinine | Ns |
| **Chromium VI (water-soluble fume)** | **7440-47-3** | | | | | |
| Total chromium | | urine | End of shift at end of workweek | 25 | µg/L | - |
| Total chromium | | urine | Increase during shift | 10 | µg/L | - |
| **Cobalt and inorganic compounds, including cobalt oxides but not combined with tungsten carbide** | **7440-48-4** | | | | | |
| Cobalt | | urine | End of shift at end of workweek | 15 | µg/L | Ns |
| **Cyclohexanone** | **108-94-1** | | | | | |
| 1,2-Cyclohexanediol | | urine | End of shift at end of workweek | 80 | mg/L | Ns, Sq |
| Cyclohexanol | | urine | End of shift | 8 | mg/L | Ns, Sq |
| **D** | | | | | | |
| **Dichloromethane** | **75-09-2** | | | | | |
| Dichloromethane | | urine | End of shift | 0,3 | mg/L | Sq |
| **N,N-Dimethylacetamide** | **127-19-5** | | | | | |

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| N-Methylacetamide | | urine | End of shift at end of workweek | 30 | mg/g creatinine | - |
| **N,N-Dimethylformamide (DMF)** | **68-12-2** | | | | | |
| N-methylformamide | | urine | End of shift | 15 | mg/L | - |
| N-Acetyl-S-(N-methylcarbamoyl) cysteine | | urine | Prior to last shift of workweek | 40 | mg/L | Sq |
| **E** | | | | | | |
| **2-Ethoxyethanol (EGEE) and 2-Ethoxyethyl acetate (EGEEA)** | **110-80-5; 111-15-9** | | | | | |
| 2-Ethoxyacetic acid | | urine | End of shift at end of workweek | 100 | mg/g creatinine | - |
| **Ethyl benzene** | **100-41-4** | | | | | |
| Sum of mandelic acid and phenylglyoxylic acid | | urine | End of shift | 0,15 | g/g creatinine | Ns |
| **F** | | | | | | |
| **Fluorides** | **16984-48-8** | | | | | |
| Fluoride | | urine | Prior to shift | 2 | mg/L | B, Ns |
| Fluoride | | urine | End of shift | 3 | mg/L | B, Ns |
| **Furfural** | **98-01-1** | | | | | |
| Furoic acid | | urine | End of shift | 200 | mg/L | Ns |
| **G** | | | | | | |
| **H** | | | | | | |
| **1,6-Hexamethylene diisocyanate** | **822-06-0** | | | | | |
| 1,6-Hexamethylene diamine | | urine | End of shift | 15 | µg/g creatinine | Ns |
| **n-Hexane** | **110-54-3** | | | | | |
| 2,5-Hexanedione | | urine | End of shift at end of workweek | 0,4 | mg/L | - |
| **L** | | | | | | |
| **Lead** | **7439-92-1** | | | | | |

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| Lead | | blood | Not critical | See Lead Regulations | | |
| **M** | | | | | | |
| **Mercury (Elemental)** | **7439-97-6** | | | | | |
| Mercury | | urine | Prior to shift | 20 | µg/g creatinine | - |
| **Methanol** | **67-56-1** | | | | | |
| Methanol | | urine | End of shift | 15 | mg/L | B, Ns |
| **Methemoglobin inducers** | | | | | | |
| Methemoglobin | | blood | During or at end of shift | 1,5 | % haemoglobin | B, Ns, Sq |
| **2-Methoxyethanol and 2-Methoxyethylacetate** | **109-86-4; 110-49-6** | | | | | |
| 2-Methoxyacetic acid | | urine | End of shift at end of workweek | 1 | mg/g creatinine | - |
| **Methyl n-butyl ketone** | **591-78-6** | | | | | |
| 2,5-Hexanedione | | urine | End of shift at end of workweek | 0,4 | mg/L | - |
| **Methyl chloroform** | **71-55-6** | | | | | |
| Methyl chloroform | | end exhaled | Prior to last shift of workweek | 40 | ppm | |
| Trichloroacetic acid | | urine | End of workweek | 10 | mg/L | Ns, Sq |
| Total trichloroethanol | | urine | End of shift at end of workweek | 30 | mg/L | Ns, Sq |
| Total trichloroethanol | | blood | End of shift at end of workweek | 1 | mg/L | Ns |
| **Methyl Ethyl ketone (MEK)** | **78-93-3** | | | | | |
| Methyl ethyl ketone (MEK) | | urine | End of shift | 2 | mg/L | Ns |
| **Methyl isobutyl ketone (MIBK)** | **108-10-1** | | | | | |
| Methyl isobutyl ketone (MIBK) | | urine | End of shift | 1 | mg/L | - |
| **N** | | | | | | |

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| **Nitrobenzene** | **98-95-3** | | | | | |
| Methemoglobin | | blood | See methemoglobin inducers BEI | | | |
| **P** | | | | | | |
| **Parathion** | **56-38-2** | | | | | |
| Total p-nitrophenol | | urine | End of shift | 0,5 | mg/g creatinine | Ns |
| Cholinesterase activity in red blood cells | | blood | Discretionary | 70 | % of baseline | B, Ns, Sq |
| **Phenol** | **108-95-2** | | | | | |
| Phenol | | urine | End of shift | 250 | mg/g creatinine | B, Ns |
| **2-Propanol** | **67-63-0** | | | | | |
| Acetone | | urine | End of shift at end of workweek | 40 | mg/L | B, Ns |
| **S** | | | | | | |
| **Styrene** | **100-42-5** | | | | | |
| Mandelic acid and phenylglyoxylic acid | | urine | End of shift | 400 | mg/g creatinine | Ns |
| Styrene | | urine | End of shift | 40 | µg/L | - |
| **T** | | | | | | |
| **Tetrachloroethylene (Perchloroethylene)** | **127-18-4** | | | | | |
| Tetrachloroethylene | | end exhaled | Prior to shift | 3 | ppm | - |
| Tetrachloroethylene | | blood | Prior to shift | 0,5 | mg/L | - |
| **Tetrahydrofuran** | **109-99-9** | | | | | |
| Tetrahydrofuran | | urine | End of shift | 2 | mg/L | - |
| **Toluene** | **108-88-3** | | | | | |
| Toluene | | blood | Prior to last shift of workweek | 0,02 | mg/L | - |
| Toluene | | urine | End of shift | 0,03 | mg/L | - |

| AGENT/DETERMINANT | CAS NUMBER | SAMPLE MATRIX | SAMPLING TIME | VALUE | UNIT | NOTATION |
|---|---|---|---|---|---|---|
| o-Cresol | | urine | End of shift | 0,3 | mg/g creatinine | B |
| **Toluene diisocyanate-2,4, or as a mixture of isomers** | **584-84-9** | | | | | |
| Toluene diamine | | urine | End of shift | 5 | µg/g creatinine | Ns |
| **Trichloroethylene** | **79-01-6** | | | | | |
| Trichloroacetic acid | | urine | End of shift at end of workweek | 15 | mg/L | Ns |
| Trichloroethanol | | blood | End of shift at end of workweek | 0,5 | mg/L | Ns |
| **U** | | | | | | |
| **Uranium** | **7440-61-1** | | | | | |
| Uranium | | urine | End of shift | 200 | µg/L | - |
| **X** | | | | | | |
| **Xylenes** | **95-47-6; 106-42-3; 108-38-3; 1330-20-7** | | | | | |
| Methylhippuric acids | | urine | End of shift | 1,5 | g/g creatinine | - |

**Notations**:

**B**: background

The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the results. Such background concentrations are incorporated in the BEI value.

**Nq**: non-quantitative

Biological monitoring should be considered for this compound based on the review; however, a specific BEI could not be determined due to insufficient data.

**Ns**: non-specific

The determinant is non-specific, since it is also observed after exposure to other chemicals.

**Sq**: semi-quantitative

The biological determinant is an indicator of exposure to the chemical, but the quantitative interpretation of the measurement is ambiguous. These determinants should be used as a screening test if a quantitative test is not practical or as a confirmatory test if the quantitative test is not specific and the origin of the determinant is in question.

## ANNEXURE 3

## HAZARDOUS CHEMICAL AGENT GUIDELINES

### Prevention and control of exposure

1. Exposure of employees to agents hazardous to health should be prevented or, where this is not reasonably practicable, adequately controlled. This is a fundamental requirement of the Regulations for Hazardous Chemical Agents (HCA), 2020. Exposure can occur by inhalation, ingestion or absorption through the skin, but inhalation is usually the main route of entry into the body. Tables 2 and 3 of Annexure 2 list the OELs which should be used in determining the adequacy of control of exposure by inhalation, as required by the HCA Regulations.
2. The advice in this document should be taken in the context of the requirements of the HCA Regulations, especially regulation 5 (Assessment of exposure) regulation 10 (Control of exposure), regulation 12 (Maintenance of control measures) and regulation 6 (Air monitoring). Agents hazardous to health are defined in regulation 1. There is separate legislation for lead and asbestos and these agents are not covered in detail in this document. This document also does not apply to exposure below ground in mines or exposure to hazardous biological agents.
3. Adequate control of exposure (when prevention is not reasonably practicable) should be achieved by one or more of a range of control measures described in regulation 10 of the HCA Regulations. Control by personal protective equipment should be applied only when other means are not reasonably practicable.

### Medical surveillance

### Guidance on medical surveillance and biological monitoring

### Important concepts

4. Medical surveillance refers to the overall monitoring of employees to identify changes in their health status because of exposure to certain chemical agents. These monitoring activities are not limited to only medical testing. Monitoring activities also include the monitoring and analysis of the individual and group outcome data, including historical data, derived from the medical testing.
5. Medical testing, therefore, is that aspect of medical surveillance that involves the use of interviews, questionnaires and standard clinical assessments to detect the presence of adverse health effects. This can also include tests like spirometry (lung function), radiography (e.g. chest X-rays) and laboratory tests (e.g. full blood counts).

6. Medical surveillance ideally aims to detect symptoms or a disease at an early subclinical or pre-symptomatic stage to enable interventions that may reverse these effects or slow their progression. However, medical surveillance is also directed at established occupational disease when the adverse effects have progressed to clinical impairment.

**Medical surveillance and biological monitoring**

7. Biological monitoring is discussed in detail in paragraph 23. It is often incorrectly categorised as a type of medical surveillance. Biological monitoring provides an additional means to assess the exposure to an HCA by measuring metabolites of the HCA, or other similar markers of exposure. Therefore, it does not represent an adverse effect or an occupational disease – it only reflects exposure. A positive finding during biological monitoring does not necessarily mean that there has been a breach of the safety standard, but is a positive indication of employee exposure.
8. The distinction between early biological effects and established disease is not always clear, there tends to be a severity gradient in which one blends into the other. An occupational disease may be said to be present when the adverse biological effect progresses to clinically detectable organ damage requiring treatment or permanent impaired function. The categorisation of the condition is, therefore, sometimes at the discretion of the responsible medical practitioner. The distinction becomes important when considering a case for statutory reporting. As described in paragraphs 20, 21 and 22, where reporting of cases of established occupational disease is legally prescribed.
9. The presence of chemical agents in the workplace does not automatically infer the need for medical surveillance; certain criteria must be met for medical surveillance to be warranted. This principle is addressed in subregulation 7(1)(b) and is further elaborated in paragraphs 11, 12 and 13.
10. Work-related adverse health findings, identified by medical surveillance, not only affect the individual employee's management in the workplace but may also have important implications regarding the effectiveness of exposure control measures in the workplace and warrant further steps by the employer.
11. Medical surveillance must be provided if an employee is using, handling, generating or storing an HCA that is known to cause adverse health effects, and—
    (a) the level of exposure is such that an occupational disease or adverse effect may reasonably be expected to occur, and
    (b) valid medical testing techniques are available to detect the adverse effect on the employee's health.
12. This means the employer must ensure that a health risk assessment is conducted to determine the likelihood of exposure to an HCA, in conjunction with the known health effects of the HCA, which the occupational medicine practitioner can use to decide if a programme of medical surveillance is necessary. Test selection should consider relevant target organs and test performance as referred to in paragraph 14(b).
13. Additionally, medical surveillance should be provided if, in the opinion of an occupational medicine practitioner, it is necessary, notwithstanding the above criteria are not met.

**Designing and implementing a programme of medical surveillance**

14. The following steps should be included in any programme:

(a) Risk assessment: this will determine the potential exposure to and routes of absorption of an HCA, and identify potential target-organ toxicity to direct medical surveillance.

(b) Test selection: tests should have the desirable operating characteristics of appropriate sensitivity, specificity, reliability and predictive value.

(c) Test schedule: the frequency of testing is laid down in general terms by regulation 7(2), but should in any case be based on an understanding of the nature of the hazard and the natural history of any adverse effects that may develop in specific target organs.

(d) Development of action criteria: interpretative criteria for various types of medical tests have been published in the medical literature. However, the occupational medicine practitioner must develop pragmatic action criteria in the context of the specific workplace.

(e) Standardisation of test process: quality control needs to be exercised both at the testing site and in the laboratory contracted to carry out analyses. Consistency over time should be sought to make longitudinal measurements comparable.

(f) Ethical considerations:

i. Information and training of employees as required by regulation 3(1) should include the rationale for doing medical surveillance, and the consequence of abnormal findings.

ii. Written informed consent should be obtained for medical tests to be conducted, in accordance with requirements prescribed by the Health Professions' Council of South Africa. Should an employee refuse to give consent, it should be explained to the employee that this means he/she cannot be offered the work for which medical surveillance is required, which may affect his/her employment.

iii. An employee must be notified of the results and interpretation of his/her tests and any recommendations made, including, where appropriate, the need for medical referral for confirmation of diagnosis and related actions.

iv. The confidentiality of personal medical records is laid down by regulation 9.

(g) Determination of steps to be taken in the event of identifying a work-related health problem: this is detailed in paragraphs 20, 21 and 22. Cooperation of employees can be best secured by a policy of protection of conditions of service in case of medical removal from a particular job.

(h) Evaluation of controls: an abnormal finding in an employee, or a pattern of findings in a group of employees, may point to inadequate primary control of exposure(s). In such cases the employer needs to be notified of such details of the medical findings as

are necessary to evaluate the workplace problem and take remedial action to prevent the continued exposure of the worker and yet unexposed workers.

(i) Record keeping: this includes both medical records and exposure information for every employee. While the employer is responsible for record keeping in terms of regulation 9, access to the contents of personal medical records should be restricted to the occupational health practitioner, the employee, and any person nominated by the employee in writing.

15. The medical surveillance programme should be described in a written document in which the key issues listed in paragraph 14 are addressed. The document must be made available to the Health and Safety Committee.

16. The employer must provide the occupational health practitioner with the following information about the work to be performed, which has triggered the requirement for medical surveillance:

(a) the work the employee is, or will be, carrying out;

(b) if the employee has started that work, how long the employee has been carrying it out;

(c) a list of the HCAs to which the employee is, or will be, exposed, as detailed in the risk assessment and relevant SDSs;

(d) relevant risk assessment reports and results of air monitoring carried out at the workplace; and

(e) the type of personal protective equipment being used by the employee.

17. Non work-related findings include various health conditions that may be identified by the medical testing process, such as hypertension and diabetes. These findings should be shared with the employee (preferably in writing) by the occupational health practitioner to enable the employee to take appropriate action to improve his or her general health. In addition, the occupational health practitioner should refer the employee to his/her own healthcare provider for further treatment, if necessary.

18. The presence of non-occupational disease does not require notification to the employer.

**Work-related findings**

19. Work-related findings include two categories:

(a) Occupational disease: this relates to adverse health effects consequent on exposure to an HCA. It is a legal requirement that those which have progressed to occupational disease must be communicated to the employee, employer and the Department of Labour. This important process is further described below.

(b) Medical fitness to work: this relates to identified health conditions that are not caused by the workplace but which impact on the vulnerability of the employee who may be exposed to an HCA, and which may be aggravated by workplace exposures, for example, an employee who has had asthma since childhood and is performing work that may result in exposure to a respiratory irritant or allergen. In these circumstances, the occupational nurse practitioner, in consultation with an occupational medicine practitioner, must carefully consider the risks and convey the appropriate task or workplace restrictions to the employer in the form of a written

certificate of fitness. The employer may not allow the employee to return to normal duties until cleared by an occupational medicine practitioner (see regulation 7(3))

**Important notes**:

(a) Neither of the above work-related findings are reason to automatically declare that the employee is medically unfit to perform his or her job. It is an incapacity that should be handled with careful thought, and all options for accommodation should be considered, as prescribed by the Labour Relations Act, 1995 (Act No. 66 of 1995) and the Employment Equity Act, 1998 (Act No. 55 of 1998).

(b) Informing the employer of a health-related restriction does not mean that disclosure of the specific medical diagnosis is required. Disclosure of the diagnosis may occasionally be warranted, but then should be done with the consent of the employee, and where such disclosure is in the best interests of the employee. Should the employee refuse consent despite a necessity to inform the employer, the employee should be told that the employer will be informed and the details of the information to be provided, as allowed for in the Health Professions Act, 1974 (Act No. 56 of 1974).

**Actions by the employer if an occupational disease is identified**

20. The employer must initiate an incident investigation to identify the failures of controls that led to the disease and put into place appropriate corrective actions (subregulation 7(4); and also regulation 8 of the General Administrative Regulations).

(a) The employer must provide training to the employee on ways to mitigate further exposure.

(b) The employer has a statutory duty to report the incident.

(c) The employer must report the case as prescribed by regulation 8 of the General Administrative Regulations.

(d) If the prescribed criteria are met, the employer must notify the chief inspector as prescribed in section 24(1)(a) of the Act.

(e) The employer has a statutory duty to submit a claim for compensation as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1993 (Act No. 130 of 1993), by completing the necessary forms and following the procedure prescribed by the Compensation Commissioner.

**Legal duties prescribed for a medical practitioner* if an occupational disease is identified**

21. The medical practitioner must notify the chief inspector as prescribed in section 25 of the Act. The prescribed format is the use of the WCL forms used for the submission of claims for an occupational disease under the Compensation for Occupational Injuries and Diseases Act, 1993.

22. The occupational medical practitioner must facilitate the submission of a claim for compensation under the Compensation for Occupational Injuries and Diseases Act, 1993, by completing the necessary medical reports and following the procedure prescribed by the Compensation Commissioner. These are described in the "Internal Instruction" documents published by the Compensation Commissioner.

* Note that this legal duty is placed on any medical practitioner, not just an occupational medicine practitioner.

**Biological monitoring**

**Distinction between biological monitoring, biological exposure monitoring and biological effect monitoring**

23. In these regulations, biological exposure monitoring and biological effect monitoring are subsets of the overarching term, biological monitoring.
24. Biological exposure monitoring is the measurement and assessment of chemicals or their metabolites (substances the body converts the chemical into, for purposes of elimination) in exposed workers. These measurements are made on samples of exhaled air, urine, blood or other biological materials, or any combination of these. Biological monitoring measurements reflect the total uptake of a chemical by an individual by all routes (inhalation, ingestion, through the skin or by a combination of these routes). Biological exposure monitoring, therefore, does not represent an adverse effect or an occupational disease – it only reflects exposure, but it is often incorrectly listed as a type of medical surveillance.
25. Biological effect monitoring is the measurement and assessment of early non-adverse reversible subclinical physiological effects caused by absorption of chemicals (i.e. prior to established clinical disease). It typically involves measuring biochemical responses. For example, measuring plasma and erythrocyte cholinesterase activity in workers exposed to organophosphate pesticides; or measuring increases in urinary protein following exposure to cadmium; or changes in functioning of enzymes.
26. Biological effect monitoring should be distinguished from medical testing for established clinical disease, which is also known as effect monitoring. For example, changes in blood cell counts following exposure to bone marrow toxins do not constitute biological effect monitoring.
27. Biological effect monitoring responses may have potential health implications for the individual, and may also arise from causes other than occupational exposure. Consequently, biological effect monitoring should always be carried out with the close involvement of an occupational medicine practitioner.

**Objectives and uses of biological exposure monitoring**

28. The main objective of biological monitoring is to provide a complementary technique to air monitoring when air sampling techniques alone may not give a reliable indication of exposure. Hence, it may be particularly useful in the following ways:
    (a) to detect and determine absorption via the skin or gastrointestinal system, in addition to that by inhalation;
    (b) to test the efficacy of personal protective equipment and monitor work practices;
    (c) to compliment air monitoring in circumstances when work practices are not normal, such as abnormally long or variable working hours or very strenuous work (high breathing rates = increased chemical intake);
    (d) to detect non-occupational exposures;
    (e) to assess total body burden;

(f) to reconstruct past exposure in the absence of other exposure measurements for chemicals with long half-lives; and

(g) to assess the effectiveness of medical removal procedures when indicated for certain chemicals (e.g. arsenic).

**Important considerations in biological exposure monitoring**

29. In choosing a test to meet the above objectives, it is important to understand the relationship between environmental exposure and the concentration of an HCA in biological samples. This includes an understanding of the principles of absorption, biotransformation, distribution and excretion of the HCA or its metabolites.

30. In addition, there should be analytical methods available of sufficient sensitivity and specificity to detect concentrations of the agent in biological media in the range likely to be encountered in industry. The HCAs listed in Table 4 of Annexure 1 are those for which the above criteria have a reasonable chance of being met.

**Biological exposure indices**

31. Biological exposure indices (BEIs) are reference values intended as guidelines for the evaluation of potential health hazards in the practice of industrial hygiene. BEIs must not be used as statutory reference values.

32. A BEI represents in theory the level of an HCA or metabolite most likely to be observed in a specimen collected from a healthy worker who has been exposed to an HCA to the same extent as a worker with inhalation exposure to an OEL-TWA. BEIs do not represent a sharp distinction between hazardous and non-hazardous exposures. For example, owing to biological variability, it is possible that an individual's measurements can exceed the BEI without incurring an increased health risk. Conversely, there may be some susceptible individuals who may be harmed at levels below the BEI.

33. If measurements in specimens obtained from a worker on different occasions persistently exceed the BEI, or if the majority of measurements in specimens obtained from a group of workers at the same workplace exceed the BEI, the cause of the excessive values must be investigated and proper action be taken to reduce the exposure.

34. BEIs apply to eight-hour exposures, five days a week. However, BEIs for differing work schedules may be extrapolated on toxicokinetic grounds. BEIs should not be applied, either directly or through a conversion factor, in the determination of safe levels for non-occupational exposure to air and water pollutants, or food contaminants. The BEIs are not intended for use as a measure of adverse effects or for diagnosis of occupational disease.

35. Actual exposures can be determined using some of the above methods, but it is important to understand the limitations of results. The level of a hazardous chemical or its metabolites in the body does not necessarily correlate with exposure to the hazardous chemicals, symptoms or damage to health.

**Background to exposure limits**

36. Two types of OELs are defined in regulation 1 of the HCA Regulations. The two types are OEL - maximum limit (OEL-ML) and OEL - restricted limit (OEL-RL), as listed in Tables 2 and 3 of Annexure 2.
37. Regulation 10 of the HCA Regulations lays down the requirements for the use of an OEL-ML and an OEL-RL for an HCA for the purpose of achieving adequate control. Regulation 10(1) requires that, where there is exposure to an agent for which an OEL-ML is specified in Table 2 of Annexure 2, the control of exposure must, so far as inhalation of that agent is concerned, be treated as adequate only if the level of exposure is reduced as far as is reasonably practicable and, in any case, below the OEL-ML.
38. There is no fixed timeframe for the publication of new or revised OELs or BEIs.
39. Regulation 10(1) of the HCA Regulations requires that, where there is exposure to an agent for which an OEL-RL has been assigned, the control of exposure must, so far as inhalation of that agent is concerned, be treated as adequate if—
    (a) that OEL-RL is not exceeded; or
    (b) where that OEL-RL is exceeded, the employer identifies the reasons for the exceeding of the standard and takes appropriate action to remedy the situation as soon as is reasonably practicable.

**Setting occupational exposure limits**

40. OEL-RLs and OEL-MLs are proposed by the Standing Technical Committee No. 7, (TC7), reviewed by the chief inspector, approved by the Advisory Council for Occupational Health and Safety and promulgated by the Minister.
41. For both OEL-MLs and OEL-RLs, as listed in Tables 2 and 3 of Annexure 2, the intent is to provide a level of minimum protection for all workers in the Republic.
42. An OEL-ML is typically assigned to an agent with serious adverse implications for the health of workers exposed to the agent. Such effects are related to an agent being a carcinogen, sensitiser, teratogen or mutagen. However, those with lower orders of potency may not be assigned an OEL-ML.
43. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs) and biological exposure limits (BEIs) represent a scientific opinion, which are health-based values where exposure at these limits does not create an unreasonable risk of disease or injury. The TLVs and BEIs are established by committees that review existing published and peer reviewed literature in various scientific disciplines. These disciplines include occupational hygiene, toxicology, occupational medicine and epidemiology.
44. The primary method for setting an OEL is to double the ACGIH TLV. This provides a uniform and systematic method that considers the principle of reasonably practicable, including both health risk and socio-economic impacts. Guideline values such as the ACGIH TLVs and NIOSH RELs consider only health risk and not socio-economic impacts, so it follows that these are not comparable to the OEL-RL and OEL-ML.
45. For exposure to agents that are predominantly associated with mining operations, consideration will be given to align OEL-RLs and OEL-MLs with the Department of Mineral Resources. An example is setting of the OEL for silica.

46. With the extensive number of OELs and industry processes, it is beyond the resources of TC7 to consider all socio-economic impacts on industry as well as the range of use of the OEL within industry. To mitigate this risk, TC7 may request interested or affected parties to submit substantive evidence to TC7 for consideration of a change to the OEL.
47. The final OEL-RLs and OEL-MLs will form a combination of the outcomes of paragraphs 42, 43 and 44.

**Applying occupational exposure limits**

**General**

48. The lists of OELs given in Table 2 and Table 3 of Annexure 2, unless otherwise stated, relate to personal exposure to agents hazardous to health in the air of the workplace.

**Units of measurement**

49. For OELs, concentrations of gases and vapours in air are usually expressed in parts per million (ppm), a measure of concentration by volume, but, may also be expressed in milligrams per cubic metre of air ($mg/m^3$), a measure of concentration by mass. Concentrations of airborne particles (fume, dust, etc.) are usually expressed in $mg/m^3$. In the case of airborne particulates, the limits, where applicable, in Table 2 and Table 3 refer to the inhalable particulate matter, unless specifically indicated as referring to the respirable particulate matter. In the case of man-made mineral fibres, the limit is expressed as fibres per millilitre of air (f/ml).
50. OELs for prohibited agents are not provided in Table 2 of Annexure 2. The reason for this exclusion is that, as prohibited agents, the agents may not be used within the workplace and so it is appropriate that these HCAs are not provided with OELs.

**Occupational exposure limit - control limit: OEL-ML (Table 2 of Annexure 2)**

51. An OEL-ML is the maximum concentration of an airborne agent, averaged over a reference period, to which employees may be exposed by inhalation under any circumstances, and is specified together with the appropriate reference period in Table 2 of Annexure 2.
52. Regulation 10(1) of the HCA Regulations, when read in conjunction with the Act, imposes a duty on the employer to take all reasonable precautions and to ensure that exposure is kept as far below an OEL-ML as is reasonably practicable.
53. To comply with this duty, in the case of agents with an eight-hour reference period, employers should undertake a programme of monitoring, in accordance with regulation 6, so that they can show (if it is the case) that an OEL-ML is not exceeded. Such a monitoring programme needs not be undertaken if the assessment carried out in accordance with regulation 5 shows that the level of exposure is most unlikely ever to exceed an OEL-ML. For agents assigned a ceiling limit, such value should never be exceeded.

54. The assessment should also be used to determine the extent to which it is reasonably practicable to reduce exposure further below an OEL-ML, as required by regulation 10(1). In assessing reasonable practicability, the nature of the risk presented by the agent in question should be weighed against the cost and the effort involved in taking measures to reduce the risk. (See reasonably practicable as defined in the Act.)

**Occupational exposure limit - restricted limit: OEL-RL (Table 3)**

55. An OEL-RL is the concentration of an airborne agent, averaged over a reference period, at which, according to current knowledge, there is no evidence that it is likely to be injurious to employees if they are exposed by inhalation, day after day, to that concentration.

56. For an agent which has been assigned an OEL-RL, exposure by inhalation should be reduced to that standard. However, if exposure by inhalation exceeds the OEL-RL, then control will still be deemed to be adequate, provided that the employer has identified why the OEL-RL has been exceeded and is taking appropriate steps to comply with the OEL-RL as soon as reasonably practicable. In such a case, the employer's objective must be to reduce exposure to the OEL-RL, but the final achievement of this objective may take some time. The assessment under regulation 5 will determine the urgency of the necessary action, taking into account the extent and cost of the required measures in relation to the nature and degree of exposure involved.

57. Control of an OEL-RL as prescribed in regulation 10(1)(a) can always be regarded as adequate control of that agent for the purpose of the HCA Regulations, so far as exposure from inhalation is concerned. However, due to the variations in process control and the fluctuations in agent concentrations in the workplace, it will be prudent for employers to reduce exposure below an OEL-RL to ensure that the exposure of all employees does not exceed that OEL-RL. Similarly, it is not intended that the statutory requirements under regulation 10(1) should discourage the further application of good occupational hygiene principles in order to reduce exposure below the OEL-RL.

**Long-term and short-term exposure limits**

58. Effects of exposure to agents hazardous to health vary considerably depending on the nature of the agent and the pattern of exposure. Some effects require prolonged or accumulated exposure. The long-term (eight-hour TWA) exposure limit is intended to control such effects by restricting the total intake by inhalation over one or more work shifts, depending on the length of the shift. Other effects may be seen after brief exposures. Short-term exposure limits (usually 15 minutes) may be applied to control these effects. For those HCAs for which no short-term limit is specified, it is recommended that a figure of three times the long-term limit be used as a guideline for controlling short-term peaks in exposure. Some workplace activities give rise to frequent short periods (less than 15 minutes) of high exposure which, if averaged over time, do not exceed either an eight-hour TWA or a 15-minute TWA. Such exposures have the potential to cause harm and should be subject to reasonably practicable measures to protect the worker.

59. Ceiling limits are set for HCAs that are predominantly fast acting and whose OELs are more appropriately based on this particular response. HCAs with this type of response are best controlled by an OEL-C that should not be exceeded. It is implicit that the manner of sampling to determine non-

compliance with the OEL-C for each similar exposure group must differ. Consequently, a single, brief sample that is applicable to an OEL-C is not appropriate to the OEL-TWA; here a sufficient number of samples are needed to permit determination of a TWA concentration throughout a complete cycle of operation or throughout the work shift. Whereas the OEL-C places a definite boundary that exposure concentrations should not be permitted to exceed, the OEL-TWA requires an explicit limit to the excursions which are acceptable to the promulgated TLV-TWAs. HCAs with ceiling limits are identified in Table 2 and 3 in Annexure 2, in the column "STEL/C", by means of a "C" notation.

60. Both the long-term and short-term exposure limits are expressed as airborne concentrations averaged over a specified period of time. The period for the long-term limit is normally eight hours, when a different period is used this is stated. The averaging period for the short-term exposure limit is normally 15 minutes, such a limit applying to any 15-minute period throughout the working shift. Exposure to agents hazardous to health should be calculated according to the approved method, which is reproduced in Annexure 3.

**Limitations to the application of exposure limits**

61. The list of OELs, unless otherwise stated, relates to personal exposure to agents hazardous to health in the air of the workplace. The limits cannot be adapted readily to evaluate or control non-occupational exposure, e.g. levels of contamination in the neighbourhood close to an industrial plant. OELs are approved only for application to people at work. Although OELs are developed for atmospheric pressures between 85 kPa and 101,325 kPa, there are areas in South Africa where the atmospheric pressures are below 85 kPa. For practical purposes, uncorrected OELs may be used at atmospheric pressures as low as 80 kPa. Where higher atmospheric pressures may be encountered, for example, in tunnelling or underwater hyperbaric chambers, such situations will require special assessments. Guidance may be sought in the HSE guidance document "Occupational exposure limits for hyperbaric conditions", which is a hazard assessment document.

62. The OELs, as set out in Tables 2 and 3 of Annexure 2, are intended to be used for normal working conditions in workplaces. Employers should also take into account their duties and the provisions of the National Environmental Management Act, 1998 (Act No. 107 of 1998). OELs are not, however, designed to deal with serious accidents or emergencies, particularly where employees may be exposed to rapidly rising concentrations of gas, as may arise from a major escape due to plant failure. Over and above their responsibilities to ensure that the requirements of the HCA Regulations are met, employers also have a clear responsibility to ensure that the plant is designed, operated and maintained in a way that avoids accidents and emergencies. Where appropriate, detection, alarm and response measures should be used in order to minimise the effect of any such unplanned events. To help maintain adequate operational control, employers may find it helpful to select their own indicators of control when undertaking investigations or corrective action.

**Exposure in mines**

63. The HCA Regulations and the OELs in this publication do not apply to exposure to agents hazardous to health in mines.

**Lead and asbestos**

64. Work with asbestos or lead is not subject to the HCA Regulations. The exposure limits for various types of asbestos and lead are specified in the Asbestos Regulations and the Lead Regulations.

**Pesticides**

65. Agents used as active ingredients in pesticides are listed under their chemical names and/or their common names. These names may sometimes be used as parts of the names of proprietary pesticide formulations. In all cases, the exposure limit applies to the specific active ingredients and not to the formulation as a whole.

**Dusts**

66. The general approach necessary to control occupational exposure to dusts is as follows: not all dusts have been assigned OELs, but the lack of such limits should not imply an absence of hazard. In the absence of a specific exposure limit for a particular dust, exposure should be adequately controlled. Where there is no indication of the need for a lower value, personal exposure should be kept below both 10 mg/m$^3$, eight-hour time-weighted average, total airborne dust and 5 mg/m$^3$, eight-hour time-weighted, average respirable dust. Such, or greater, dust concentrations should be taken as excessive concentrations.
67. Where dusts contain components which have their own assigned OELs, all the relevant limits should be complied with.

**Particle size selective criteria for sampling of total airborne particulate and respirable particulate**

68. Unless specified otherwise, OELs for all airborne particulates (HCAs comprising of airborne particulates) refer to the inhalable particulate matter of that agent. Sampling of these airborne particulates must be carried out with a method specifically designed to collect the inhalable particulate matter of the HCA. Inhalable particulate matter approximates to the particle size fraction of particulates that can be suspended in air with an upper size limit of approximately 100 micrometres (µm) in aerodynamic diameter.
69. Respirable particulate matter refers to materials that are hazardous when deposited in the gas exchange region of the lung. Respirable particulates generally have an aerodynamic diameter of less than 10 µm and a median of 4 µm. These materials are sampled with a respirable particulate matter sampler with a median cut point of 4 µm.

**Inhalable fraction**: the mass fraction of total airborne particles which is inhaled through the nose and mouth, measured by a size-selective device conforming to a sampling efficiency curve which passes through the points in the table below.

| Aerodynamic diameter (µm) | Inhalable fraction (%) |
|---|---|
| 0 | 100 |
| 1 | 97 |
| 2 | 94 |
| 5 | 87 |
| 10 | 77 |
| 20 | 65 |
| 30 | 58 |
| 40 | 54,5 |
| 50 | 52,5 |
| 100 | 50 |

**Thoracic fraction**: the mass fraction of inhaled particles which penetrate beyond the larynx, measured by a size-selective device conforming to a sampling efficiency curve which passes through the points in the table below.

| Aerodynamic diameter (µm) | Thoracic fraction (%) |
|---|---|
| 0 | 100 |
| 2 | 94 |
| 4 | 89 |
| 6 | 80,5 |
| 8 | 67 |
| 10 | 50 |
| 12 | 35 |
| 14 | 23 |
| 16 | 15 |
| 18 | 9,5 |

**Respirable fraction:** the mass fraction of inhaled particles which penetrate to the unciliated airways, measured by a size-selective device conforming to a sampling efficiency curve which passes through the points in the table below.

| Aerodynamic diameter (µm) | Respirable fraction (%) |
|---|---|
| 0 | 100 |
| 1 | 97 |

| Aerodynamic diameter (µm) | Respirable fraction (%) |
|---|---|
| 2 | 91 |
| 3 | 74 |
| 4 | 50 |
| 5 | 30 |
| 6 | 17 |
| 7 | 9 |
| 8 | 5 |
| 10 | 1 |

**Wood dust**

70. Wood dust is a general term covering a wide variety of airborne wood dusts. The health effects of wood dust differ between the dust generated from the processing of different species of trees. Specific species of both hard and soft woods induce sensitisation and so the categorisation of woods into hard and soft woods to indicate relative toxicity is not useful. For this reason, OELs are indicated by species and not hard/soft wood categorisation. Oak and beech are listed with an A1 (confirmed human) carcinogenic potential and birch, mahogany, teak and walnut are listed with an A2 (suspected human) carcinogenic potential by the ACGIH. For further information on the health effects of woods refer to the HSE (UK) Woodworking Sheet No. 30 and the ACGIH TLVs and BEIs, Appendix D, which provides information on tree species suspected of inducing sensitisation. Dust is generated by the machining and working of wood and wood-containing materials such as chipboard and fibreboard. Operations such as sawing, turning and routing produce relatively coarse dust, while sanding and assembly operations generate fine dust.

71. Dust is generated by the machining and working of wood and wood-containing materials such as chipboard and fibreboard. Operations such as sawing, turning and routing produce relatively coarse dust, while sanding and assembly operations generate fine dust.

**Fume**

72. The word fume is often used to include gases and vapours. This is not the case for exposure limits where fume should normally be applied to solid particles generated by chemical reactions or condensed from the gaseous state, usually after volatilisation from melted substances. The generation of fume is often accompanied by a chemical reaction such as oxidation or thermal breakdown.

**Absorption through the skin**

73. In general, for most agents the main route of entry into the body is by inhalation. The OELs given in these regulations relate solely to exposure by this route. Certain agents such as phenol, aniline and certain pesticides (marked in the Tables with a SKIN notation) have the ability to penetrate

intact skin and thus become absorbed into the body. Absorption through the skin can result from localised contamination, for example, from a splash on the skin or clothing, or in certain cases from exposure to high atmospheric concentrations of vapour. Serious effects may result with little or no warning; therefore, it is necessary to take special precautions to prevent skin contact when handling these agents. Where the properties of the agents and the methods of use provide a potential exposure route via skin absorption, these factors should be taken into account in determining the adequacy of the control measures.

**Sensitisers**

74. Certain agents may cause sensitisation of the respiratory tract if inhaled or if skin contact occurs. Respiratory sensitisers can cause asthma, rhinitis or extrinsic allergic alveolitis. Skin sensitisers cause allergic contact dermatitis. Agents which cause skin sensitisations are not necessarily respiratory sensitisers or vice versa. Only a proportion of the exposed population will become sensitised, and those who do become sensitised will not have been identified in advance. Individuals who become sensitised may produce symptoms of ill health after exposure even to minute concentrations of the sensitiser.
75. In general, for most agents the main route of entry into the body is by inhalation. The OELs given in these regulations solely relate to exposure by this route.
76. Where it is reasonably practicable, exposure to sensitisers should be prevented. Where this cannot be achieved, exposure should be kept as low as is reasonably practicable and activities giving rise to short-term peak-concentrations should receive particular attention. As with other agents, the spread of contamination by sensitisers to other working areas should also be prevented, as far as is reasonably practicable.
77. RSEN and DSEN notations (marked in the Tables) have been assigned only to those sensitisers that may cause sensitisation by inhalation and skin respectively. Other agents not contained in these Tables may act as sensitisers.

**Other factors**

78. Working conditions which impose additional stress on the body, such as exposure to ultra-violet radiation and high temperatures, pressures and humidity, may increase the toxic response to an agent. In such cases, specialist advice may be necessary to evaluate the effect of these factors.

**Mixed exposures**

**General**

79. The majority of OELs listed in Tables 2 and 3 of Annexure 2 are for single compounds or for HCAs containing a common element or radical, e.g. tungsten and compounds, and isocyanates. A few of the limits relate to HCAs commonly encountered as complex mixtures or compounds, e.g. white

spirit, rubber fume and welding fume. However, workers are frequently subject to other mixed exposures involving solids, liquids, aerosols or gases. These exposures can arise as a result of work with materials containing a mixture of agents, or from work with several individual HCAs, simultaneously or successively, in a work shift. Mixed exposures require careful assessment of their health effects and the appropriateness of control standards. The following paragraphs provide a brief summary of the advice on the application of exposure limits in these circumstances. In all cases of doubt, specialist advice should be sought.

**Effects of mixed exposures**

80. The ways in which the constituent agents of a mixed exposure interact vary considerably. Some mixed exposures involve agents that act on different body tissues or organs, or by different toxicological mechanisms, these various effects being independent of each other. Other mixtures will include agents that act on the same organs, or by similar mechanisms, so that the effects reinforce each other and the agents are additive in their effect. In some cases the overall effect is considerably greater than the sum of the individual effects and the system is synergistic. This may arise from mutual enhancement of the effects of the constituents or because one agent potentiates another, causing it to act in a way which it would not do alone.

**Assessment and control**

81. With all types of mixed exposures it is essential that assessments be based on the concentrations of each of the constituents in air to which workers are exposed. Depending on the nature of the constituents and the circumstances of use, the relative concentrations of the constituents in air may differ considerably from those in the liquid or solid source material. The composition of the bulk material should not be relied on for assessment unless there is good evidence for doing so.

82. The ways in which the constituent agents of a mixed exposure interact vary considerably. Some mixed exposures involve agents that act on different body tissues or organs, or by different toxicological mechanisms, these various effects being independent of each other. Other mixtures will include agents that act on the same organs, or by similar mechanisms, so that the effects reinforce each other and the agents are additive in their effect.

(a) **Synergistic agents**: known cases of synergism and potentiation are considerably less common than the other types of behaviour in mixed exposures. However, they are the most serious in their effects and require the strictest control. They are also the most difficult to assess and wherever there is reason to suspect such interaction, specialist advice should be obtained;

(b) **Additive agents**: where there is reason to believe that the effects of the constituents are additive, and where the exposure limits are based on the same health effects, the mixed exposure should be assessed by means of the formula-

$$E_m = \frac{(C1)}{(OEL1)} + \frac{(C2)}{(OEL2)} + \frac{(Cn...)}{(OELn...}$$

Here $E_m$ is the exposure for the mixture, and C1, C2, etc. are the time-weighted average (TWA) concentrations of constituents in air. OEL1, OEL2, etc. are the corresponding exposure limits. The use of this formula is only applicable where the additive agents have been assigned OELs which relate to the same reference period in the list of promulgated OELs. If the equation generates a result that is > 1, then the exposure limit for the mixture ($E_m$) has been exceeded. If one of the constituents has been assigned an OEL-ML, then the additive effect should be taken into account in deciding the extent to which it is reasonably practicable to further reduce exposure; and

(c) **Independent agent**: where no synergistic or additive effects are known or considered likely, the constituents can be regarded as acting independently. It is then sufficient to ensure compliance with each of the OELs individually.

83. The above steps provide basic protocol for assessment of mixed exposures. It is open to persons responsible for control of exposure to treat all non-synergistic systems as though they were additive. This avoids the need to distinguish additive and independent systems and can be regarded as the most prudent course, particularly where the toxicity data are scarce or difficult to assess.

**Monitoring mixed exposure**

84. Further information on monitoring airborne contaminants is given in paragraphs 55 and 56. The number of components of a mixed exposure for which routine air monitoring is required can be reduced if their relative concentrations can be shown to be constant. This involves the selection of a key or marker, which may be one of the constituents, as a measure of the total contamination. Exposure to the marker is controlled at a level selected so that exposures to all components will be controlled in accordance with the criteria in paragraphs 82(a) and (b). However, if one of the components has been assigned an OEL-ML, the level of the exposure to that agent should always be reduced as far as is reasonably practicable. If this approach is to be used, it should take place under the guidance of suitable specialist advice.

**Complicating factors**

85. Several factors that complicate the assessment and control of exposure to individual agents will also affect cases of mixed exposures and will require similar special consideration. Such factors include:

(a) exposure to an agent for which there is no established limit or for which an OEL-ML has been set;

(b) the relevance of factors such as alcohol, medication, smoking and additional stresses;

(c) exposure of the skin to one or more agents that can be absorbed by this route, as well as by inhalation; and

(d) agents in mixture may mutually affect the extent of their absorption, as well as their health effects, at a given level of exposure.

**Monitoring exposure**

86. Regulation 5(4) of the HCA Regulations imposes a duty on the employer to monitor the exposure of employees to agents hazardous to health. Details of routine sampling strategies for individual agents are outside the scope of this document. However, advice is available in HSG 173, Monitoring strategies for toxic substances, produced by the HSE, which provides practical guidance on monitoring agents hazardous to health in air.

**Calculation of exposure with regard to the specified reference periods**

87. The following guidance is provided as an approved method for the calculation of exposure in relation to the eight-hour, short-term and one-year reference periods.

**The 8-hour reference period**

88. The term "8-hour reference period" relates to the procedure whereby the occupational exposures in any 24-hour period are treated as equivalent to a single uniform exposure for eight hours [the 8-hour time weighted average (TWA) exposure].

**The eight-hour TWA may be represented mathematically by:**

$$\frac{C_1T_1 + C_2T_2 + .. + C_nT_n}{8}$$

where $C_1$ is the occupational exposure value (concentration) and $T_1$ is the associated exposure time in hours in any 24-hour period.

**Examples**

89. The operator works for 7 hours 20 minutes on a process in which he is exposed to an agent hazardous to health. The average exposure during that period is measured as 0,12 mg/m³.

The 8 - hour TWA therefore is - 7h20min (7.33h) at 0.12mg/m³
40 min (0.67h) at 0mg/m³

That is -

$$\frac{(0.12 \times 7.33) + (0 \times 0.67)}{8}$$

$$= 0.11 \text{ mg/m}^3$$

90. The operator works for eight hours on a process in which he is exposed to an agent hazardous to health. The average exposure during that period is measured as 0,15mg/m³.

The eight-hour TWA therefore is:

$$\frac{0.15 \times 8}{8}$$

$$= 0.15 \text{ mg/m}^3$$

91. Working periods may be split into several sessions for the purpose of sampling to take account of rest and meal breaks, etc. This is illustrated by the following example:

Exposure is assumed to be zero during the period 10:30 to 10:45, 12:45 to 13:30 and 15:30 to 15:45.

| **Working period** | **Exposure {mg/m³)** | **Duration of sampling (h)** |
|---|---|---|
| 08:00-10:30 | 0,32 | 2,5 |
| 10:45-12:45 | 0,07 | 2 |
| 13:30-15:30 | 0,20 | 2 |
| 15:45-17:15 | 0,10 | 1,5 |

The 8-hour TWA therefore is:

$$\frac{(0.32 \times 2.5) + (0.07 \times 2) + (0.20 \times 2) + (0.10 \times 1.5) + (0 \times 1.25)}{8}$$

$$= 0.19 \text{ mg/m}^3$$

92. An operator works for eight hours during the night shift on a process in which he is intermittently exposed to an agent hazardous to health. The operator's work pattern during the working period should be known and the best available data relating to each period of exposure should be

applied in calculating the eight-hour TWA. This data should be based on direct measurement, estimates based on data already available or reasonable assumptions.

| **Working period** | **Task** | **Exposure (mg/m³)** |
|---|---|---|
| 22:00-24:00 | Helping in workshop | 0,1 (known to be the exposure of full-time group in the workshop) |
| 24:00-01:00 | Cleaning elsewhere in factory | 0 (assumed) |
| 1:00-04:00 | Working in canteen | 0 (assumed) |
| 04:00-06:00 | Cleaning up after breakdown in workshop | 0,21 (assumed) |

The eight-hour TWA therefore is:

$$\frac{(0.10\ x) + (0.21\ x\ 2) = (0\ x\ 4)}{8}$$

= 0.078Gmg/$m^2$

93. The operator works a 12-hour shift each day for five days, and then has seven days' rest. The exposure limits are based on an eight-hour reference period in each 24 hours in which an exposure occurs; the seven days' rest makes no difference. While at work, the operator is exposed to 4 $mg.m^{-3}$.

The eight-hour TWA =

$$\frac{(4\ x\ 12)}{8}$$

= 6 $mg.m^{-3}$.

**The short-term reference period**

94. Exposure should be recorded as the average over the specified short-term reference period, normally 15 minutes, and should be determined by sampling over that period. For short emissions of less than the reference period, which still may have the potential to cause harm, appropriate action should be taken to ensure that a suitable and sufficient risk assessment is carried out to ensure that there is no risk to health from such exposures.

**Example where the short-term reference period is 15 minutes**

**Exposure period is less than 15 minutes**

95. The sampling result should be averaged over 15 minutes. For example, if a 5-minute sample produces a level of 600 ppm and is immediately followed by a period of zero exposure, then the 15-minute average exposure will be 200 ppm.

**Exposure period is 15 minutes or longer**

96. Measurements should be taken over a 15-minute period and the result is the 15-minute average exposure. Measurements for periods greater than 15 minutes should not be used to calculate a 15-minute average exposure, but if the average exposure over the longer period exceeds the 15-minute exposure limit, then this limit must have been exceeded over some 15-minute period.

**Methods of measurement and calculation for determining fibre concentrations of man-made mineral fibre**

**Refractory ceramic fibre (RCF)**

97. RCFs are man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide ($Na_2O+K_2O+CaO+MgO+BaO$) content less or equal to 18% by weight. The term RCF also includes non-oxide ceramic fibre such as boron and silicon carbides and nitrides.

**Cotton dust**

98. Cotton is the cellulose fibre that grows inside the seed pods (or bolls) of the cotton plant. When mature, the boll breaks and the cotton appears as a soft wad of fine fibres. After picking, the cotton is separated from the seed etc., and is packed and compressed into bales.

99. The OELs, which are based on personal sampling, applies to exposure to dust during the handling of raw and waste cotton, including blends containing raw or waste cotton, with the following exceptions:

    (e) dust from weaving, knitting, braiding and subsequent processes;
    (f) dust from bleached or dyed cotton; and
    (g) dust from finished articles, for example, garments.

    (*Where the OEL does not apply, exposure should still be adequately controlled*.)

    Two OELs apply:

    f) Cotton dust less fly; and
    g) Cotton dust inhalable airborne particulate.

**Cotton dust less fly**

100. Area concentrations of cotton dust less fly must be measured using a vertical elutriator in accordance with OSHA Analytical Method, Appendix A 29 CFR 1910.1043, as updated from time to time.

**Cotton dust inhalable airborne particulate**

101. Personal exposure concentrations must be measured by means of an Institute of UK Occupational Medicine (IOM) inhalable dust sampler in accordance with MDHS14/3 or any other sampler giving equivalent results, as updated from time to time.

**Asphyxiants**

102. Some gases and vapours, when present at high concentration in air, act as simple asphyxiants by reducing the oxygen content by dilution to such an extent that life cannot be supported. Many asphyxiants are odourless, colourless and not readily detectable. Monitoring the oxygen content of the air is often the best means of ensuring safety. The oxygen content of air in the workplace should never be allowed to fall below a minimum of 19% by volume under normal atmospheric pressure. Particular care is necessary when dense asphyxiants, e.g. argon, are used since very high localised concentrations can arise due to their collecting in pits, confined spaces and other low-lying areas where ventilation is likely to be poor. Many asphyxiants present a fire or explosion risk. The concentrations at which these risks can arise are liable to be well below those levels at which asphyxiation is likely to occur and should be taken into account when assessing the hazards.

**Rubber fume and rubber process dust**

103. Rubber fume is fume evolved in the mixing, milling and blending of natural rubber or synthetic elastomers, or of natural rubber and synthetic polymers combined with chemicals, and in the processes which convert the resultant blends into finished products or parts thereof, and including any inspection procedures where fume continues to be evolved.
104. Rubber process dust is evolved during the manufacture of intermediates or articles from natural rubber and/or synthetic elastomers. This definition does not include dusts, which, for occupational purposes, can be dealt with individually. In each case the relevant OEL will apply.
105. Dust produced by the abrasion of cured rubber should be dealt with as particles (insoluble or poorly soluble) not otherwise specified [PNOS], i.e. dust of any kind when present at a substantial concentration in air.

**Flour dust**

106. Flour dust is taken to be finely ground particles of cereals or pulses (including contaminants) that result from any grinding process and from any subsequent handling and use of that flour. Any additives (e.g. flour improvers) are included in this definition only after they have been added to the final product mix.

**Grain dust**

107. Grain dust is taken to be dust arising from the harvesting, drying, handling, storage or processing of barley, wheat, oats, maize and rye, including contaminants.

**Halogeno-platinum compounds**

108. These are coordination compounds in which a platinum atom or ion is directly coordinated to one or more halide (i.e. fluoride, chloride, bromide or iodide) ions. These compounds are subject to an OEL and cause sensitisation.

109. For substances which, although they contain platinum and halide ions, the halogen is not directly co-coordinated by a chemical bond to the platinum, the OEL for soluble platinum compounds is applicable.

**Globally Harmonised System (GHS)**

110. As SANS 10234 is aligned with the UN Globally Harmonized System (GHS), SANS 10234 may be used as alternate guide to HCA classification, preparation of safety data sheets and labelling. However, it is noted that version differences may exist between SANS 10234 and the GHS, Purple Book, which is updated biennially. By implication, if SANS 10234 is used by the manufacturer or importer of chemical agents for the classification of an HCA, preparation of an SDS or labelling, the requirement for conformance to the latest version of the GHS remains. The GHS requirements for classification, labelling and SDS are not applicable to foodstuffs, cosmetics or pharmaceutical in their final form.

111. Hazard classes and categories provided in Annexure 1, Table 3 for Environmental Hazards are intended as a guideline only for the classification of chemicals.

112. On any label of an HCA the pictogram size must be at least 16 x 16 millimetres where possible, with a red boarder and minimum letter size of 1,2 mm. For further guidance on labelling refer to the European Chemicals Agency (ECHA), Guidance on labelling and packaging in accordance with Regulation (EC) No. 1272/2008, as may be updated from time to time.

**UN number and proper shipping name**

113. The UN proper shipping name is the standard technical name to describe the hazard properties and the composition of dangerous goods. Select the UN number (4 digits) and a proper shipping name from the UN Transport of Dangerous Goods, Dangerous Goods List that can most accurately describe the dangerous goods. The UN number and a proper shipping name should also be included in the Dangerous Goods Declaration and section 14 of safety data sheets.