

Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)



International
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Office
Geneva

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First published 2001

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Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool).

ILO code of practice

Geneva, International Labour Office, 2001

Code of practice, occupational safety, occupational health, synthetic organic fibres.

13.04.2

ISBN 92-2-111629-8

Also published in French: *Sécurité dans l'utilisation des laines isolantes en fibres vitreuses synthétiques (laine de verre, laine de roche et laine de laitier)*. Recueil de directives pratiques du BIT (ISBN 92-2-211629-1, Geneva, 2001); and in Spanish: *Seguridad en la utilización de las lanas aislantes de fibra vítrea sintética (lana de vidrio, lana mineral de roca y lana mineral de escorias)*. Repertorio de recomendaciones prácticas (ISBN 92-2-311629-5, Geneva, 2001).

ILO Cataloguing in Publication Data

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Preface

This ILO code of practice defines major principles and approaches concerning safety requirements and precautions in the use of insulation wools (glass wool, rock wool and slag wool). It provides practical control measures to minimize occupational exposure to fibres and dusts from insulation wools, prevent irritation and discomfort, and avert any long-term health risks involved in working with such products. The code promotes an integrated approach, taking account of the fact that synthetic vitreous fibre insulation wools do not appear in the workplace in their pure forms but rather as a product with mixed components. Emphasis is placed on addressing all the hazards arising from the product (insulation fibres, binders and other materials), taking account of real work situations.

This code was adopted unanimously by a Meeting of Experts on Safety in the Use of Insulation Wools, held in Geneva from 17 to 26 January 2000.¹ The good spirit of

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Experts nominated by the employers:

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- Dr. Anthony R. Wells, Owens-Corning Canada, Toronto (Canada).

Experts nominated by the workers:

- Mr. Dave Bennett, National Director, Health, Safety and Environment, Canadian Labour Congress, Ottawa (Canada).
- Mr. Justin Daerden, Centrale chrétienne des travailleurs du bois et du bâtiment, Brussels (Belgium).
- Mr. Bernd Eisenbach, Trade Union for Building, Forestry, Agriculture and the Environment (IG-BAU), Frankfurt am Main (Germany).

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cooperation among all participants paved the way for moving from the divergent initial positions towards the consensus necessary for the code to be useful for all and effectively applied. The Governing Body of the ILO approved the publication of the code at its 277th Session (March 2000).

The Meeting recommended that the present code be widely distributed. Follow-up procedures, including regional meetings and conferences, should be held to assess its effectiveness and to review it in the light of future developments in science and technology. The experts also suggested that the ILO should produce new codes of practice to address other synthetic and organic fibres not covered by existing ILO instruments, such as refractory ceramic fibres, cellulose and silicon carbide.

The code specifies general duties for manufacturers, suppliers, specifiers, employers, workers and the competent authorities, all of whom have an important role to play in maintaining safety in the entire process, from manufacture to waste disposal. The perspective has thus been enlarged in order to establish a proper chain of responsibility so that the diversified situations prevailing in various countries will be covered.

The general measures of prevention and protection specified by the code, and the relevant information included in the appendices (systems of classification, exposure data and risk assessment), are of particular use to developing countries and countries in transition. The code emphasizes that such measures should be consistent with the classification and potential health effects of the insulation wools, and the competent

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International governmental and non-governmental organizations represented:

World Health Organization (WHO).

International Organisation of Employers (IOE).

European Insulation Manufacturers Association (EURIMA).

North American Insulation Manufacturers Association (NAIMA).

International Confederation of Free Trade Unions (ICFTU).

International Federation of Building and Wood Workers (IFBWW).

World Confederation of Labour (WCL).

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authority should ascertain which measures are to be applied. This guidance will benefit especially small-scale enterprises in establishing an appropriate level of protection for workers.

The code is published as a part of the ILO's efforts to improve working conditions and environment. It is intended to be applied worldwide, and particularly in countries which do not have, or are in the process of developing, safe work practices in the use of insulation wools. It was prepared through extensive research work and technical consultations with the ILO constituents. Good work practices for dealing with insulation wools, already developed in some member States, provided a solid basis for the preparatory work.

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Introduction

In accordance with a decision of the Governing Body of the ILO at its 270th Session (November 1997), a Meeting of Experts on Safety in the Use of Insulation Wools was convened in Geneva from 17 to 26 January 2000 to draw up and adopt a code of practice on safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool). The Meeting was composed of 22 experts, seven appointed following consultations with governments, seven following consultations with the Employers' group and eight following consultations with the Workers' group of the Governing Body (since one of them had to be replaced during the Meeting).

This code of practice is based on principles established in international instruments relevant to the prevention and protection of workers' safety and health, as well as on the findings of the Meeting of Experts on Safety in the Use of Mineral and Synthetic Fibres, Geneva, 17-25 April 1989. The development of an ILO code of practice on synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool) was a specific recommendation of the 1989 Meeting of Experts, which stated in its report:

It was noted that the industry producing such fibres had been aware of the health aspects of its products and had worked closely with scientists for developing guide-lines for safety in their use. The experts felt that it was precisely because a large amount of work on safety had been done by the industry that a code of practice, specifically on insulation wools, was suggested. The experts unanimously agreed to recommend the preparation of a code of practice on safety in the use of insulation wools. It was suggested that a code of practice could benefit both the industry and workers and would be particularly useful for developing countries.¹

This code focuses on synthetic vitreous fibre insulation wools (glass wool, rock wool and slag wool), but it is recognized that other synthetic vitreous fibre materials, such as refractory ceramic fibres (RCF), refractory fibres other than RCF, and special-purpose glass fibres, are potentially more hazardous. Although the code was written for insulation wools, many of its provisions represent good practice for the prevention of occupational health hazards generally, and this could be applied to RCF, refractory fibres other than RCF, and special-purpose glass fibres. Guidance in this respect can also be found in other codes of practice.² Furthermore, the International Programme on Chemical Safety (IPCS), a joint programme of the United Nations Environment Programme (UNEP), the International Labour Organization (ILO) and the World Health Organization (WHO), has provided practical information in the form of an International

¹ "Annex 2: Report of the Meeting of Experts on Safety in the Use of Mineral and Synthetic Fibres" (Geneva, 17-25 April 1989), in ILO: *Safely in the use of mineral and synthetic fibres*, Occupational Safety and Health Series No. 64 (Geneva, 1990), p. 79.

² For example, the ILO codes of practice, *Occupational exposure to airborne substances harmful to health* (Geneva, 1980) and *Safely in the use of asbestos* (Geneva, 1984), contain many relevant provisions, establish the principles of the prevention of contamination of the working environment and specify general preventive methods. These principles include the elimination of hazards or risks and substitution by harmless or less harmful agents (which may in turn be associated with a prohibition of certain work practices). After efforts to apply these two principles, the emphasis is on engineering controls and on the implementation of an effective control programme.

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Chemical Safety Card on Ceramic Fibres (ICSC:0123), and has prepared an analytical criteria document on man-made mineral fibres.¹

Important research has been conducted since the 1989 Meeting of Experts and efforts have been made by the industry to improve its products. There have been important technological developments as regards the chemical composition and physico-chemical properties of insulation wool fibres, in particular biosolubility. An extensive programme was carried out to evaluate current scientific knowledge concerning the biopersistence and pathogenicity of various types of fibres. On this basis, the European Union (EU) considered that it seemed justified to exclude, under certain circumstances, some man-made vitreous (silicate) fibres from classification as carcinogens. The criteria embodied in European Commission Directive 97/69/EC are provided in Appendix A, section 3. There are other potential health effects and discomfort connected with the use of synthetic vitreous fibre insulation wools which may not have been changed by the introduction of less biopersistent fibres. The products have mechanical irritant properties, which may result in eye, upper respiratory tract and skin irritation.

The practical recommendations of ILO codes of practice are intended for the use of all those, in both the public and the private sectors, who have responsibility for safety and health management in relation to specific occupational hazards (e.g. noise and vibration, radiation), sectors of activity (e.g. construction, mining) or equipment (e.g. tractors, chainsaws). Codes of practice are not intended to replace national laws or regulations, or accepted standards. They are drawn up with the object of providing guidance to those who may be engaged in framing provisions of this kind or developing programmes of prevention and protection at the national or enterprise levels. They are addressed in particular to governmental and public authorities, and employers, workers and their organizations, as well as management and safety and health committees in related enterprises.

Codes of practice are designed primarily as a basis for preventive and protective measures and are considered as ILO technical standards in occupational safety and health. They contain general principles and specific guidance which concern, in particular: the surveillance of the working environment and of workers' health; education and training; consultation and cooperation; record-keeping; and the role and duties of the competent authority, employers, workers, manufacturers and suppliers. The provisions of the codes should be read in the context of conditions in the country proposing to use this information, the scale of operation involved and technical possibilities. In this regard, the needs of developing countries are also taken into consideration.

¹ WHO: *Man-made mineral fibres*, Environmental Health Criteria No. 77 (Geneva, 1988).

1. Scope and purpose

1.1. Scope

1.1.1. This code applies to all exposures of workers to fibres and dust from synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)¹ during manufacture, transport and storage, use, maintenance, removal, recycling and disposal of insulation wools.

1.1.2. This code is a reference document for the development of workplace strategies, policies and mechanisms for dealing with safety in the use of insulation wools.

1.1.3. This code is not intended to replace international or national laws or regulations, or accepted standards.

1.2. Purpose

1.2.1. This code addresses occupational hazards due to insulation wools. Its purpose is to protect workers' health by ensuring safety in the use of insulation wools taking into account the preventive and protective measures listed in paragraphs 2.1.3 and 2.2.1.

1.2.2. The provisions of this code are aimed at:

- (i) minimizing exposure to fibres and dust from insulation wools at work;
- (ii) preventing the mechanical irritation and discomfort known to be associated with these materials, and averting the potential for long-term health effects; and
- (iii) providing practical control measures for minimizing occupational exposure to fibres and dust from insulation wools during manufacture, transport and storage, use, maintenance, removal, recycling and disposal of insulation wools.

1.2.3. The provisions of this code should be considered as the basic requirements for protecting workers health.²

¹ In the following sections of this code, the expression "insulation wools" means synthetic vitreous fibre insulation wools (glass wool, rock wool and slag wool) and products or materials containing such fibres. Definitions are given in Chapter 9 (Glossary).

² The evaluation of intrinsic properties of substances, products and materials (hazard assessment) and risk assessment of potential adverse effects on health may show that these are so low that they are of no regulatory concern. This may result from technological development and product improvement (section 3.4). In such cases, the competent authority often considers the possibility of adopting exemption criteria. Such criteria usually apply to the protection of both workers and the public. The exemption resulting from these criteria may be from the regulatory framework as a whole or from specific provisions such as classification of hazards and labelling (section 2.3). An example of criteria used for exemption from classification is given in Appendix A, section 3.10.

2. Principles and approaches

2.1. Organizational measures

2.1.1. The prevention or reduction of occupational risks due to insulation wools should be:

- i) based on the general principles of occupational safety and health, taking due account of the relevant provisions of the Occupational Safety and Health Convention (No. 155) and Recommendation (No. 164), 1981, and of the Working Environment (Air Pollution, Noise and Vibration) Convention (No. 148) and Recommendation (No. 156), 1977; and
- ii) conducted within the general framework of the organization of occupational safety and health at the enterprise level, taking due account of the relevant provisions of the Occupational Health Services Convention (No. 161) and Recommendation (No. 171), 1985.

2.1.2. The basic approach of the assessment of occupational hazards, and the evaluation and control of risks, should be followed as regards occupational hazards due to insulation wools, with a view to continuing improvement, as it should be for the other occupational hazards present at the workplace (such as chemicals, other dust, noise and vibration). This approach should include surveillance of the working environment and of the workers' health.

2.1.3. The application of the provisions of this code should take into account the following recognized hierarchy of preventive and protective measures:

- (i) eliminate the risks by using products or technologies which permit risks to be eliminated or reduced to a minimum;
- (ii) control the risks at source, for example by isolating the process and engineering control measures;
- (iii) minimize the risks, for example, by technical measures such as local and general ventilation, safe work practices, and administrative measures such as job rotation;
- (iv) use appropriate personal protective equipment.

2.2. Procedures

2.2.1. Procedures should be developed for the specific needs of each operation,¹ and should include provisions on:

¹ Technical information and guidance documents can be found in the CISDOC database produced by the ILO's International Occupational Safety and Health Information Centre.

- (i) hazard assessment and risk assessment;¹
- (ii) engineering control and technical measures,² as for local and general ventilation;
- (iii) protective clothing and equipment;
- (iv) adequate information, such as material safety data sheets;
- (v) education and training, such as developing manuals on work procedures, operational ventilation equipment and cleaning the work environment;
- (vi) allocation of responsibilities to supervisors and workers, including arrangements for consultation; and
- (vii) a review process and improvement plans.

2.2.2. Procedures, such as safe work practices, should be developed for all insulation wools manufacturing and user operations. Their development and implementation should be monitored in consultation with workers or their representatives so as to benefit from knowledge gained from experience.

2.3. Classification of hazards

2.3.1. The competent authority should:

- (i) identify any intrinsic properties of insulation wool fibres and dust which require a hazard classification;
- (ii) establish or select the criteria³ for determining the hazards arising from exposure to insulation wool fibres and dust; and
- (iii) ensure that insulation wools are classified appropriately, taking into account the above-mentioned properties and criteria.

2.3.2. Classification should be considered as a tool to guide preventive action (e.g. the labelling of chemicals, materials and equipment). The competent authority should establish criteria to determine whether specific chemicals, materials or equipment

¹ An example of a format for risk assessments and action plans is given in Appendix D.

² Additional information can be found in ILO: *Occupational lung diseases: Prevention and control*, Occupational Safety and Health Series No. 67 (Geneva, 1991); and in WHO: *Prevention and Control Exchange (PACE). Hazard prevention and control in the work environment: Airborne dust*, Occupational and Environmental Health Series (Geneva, 1999), doc. WHO/SDE/OEH/99.14 (http://whqlibdoc.who.int/hq/1999/WHO_SDE_OEH_99.14.pdf).

³ The monographs published in the Environmental Health Criteria (EHC) series are intended to assist national and international authorities in making risk assessments and subsequent risk management decisions. They provide critical reviews of the effects of chemicals, and of combinations of chemicals and physical and biological agents, on human health and the environment. The EHC monographs represent one of the major areas of activity of the joint UNEP/ILO/WHO International Programme on Chemical Safety (IPCS), and are the basis for developing health and safety guides and International Chemical Safety Cards (ICSC).

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should be classified, on the basis of which property and at what level, considering the guidance available at the international level.¹

2.3.3. In developing the above-mentioned criteria and determining the need to classify insulation wools by category and quantitative level, the competent authority should take into account the opinion of technically qualified persons nominated by the most representative organizations of the employers and workers concerned.

2.4. Exposure limits

2.4.1. Exposure limits should be based on sound scientific and technical knowledge, as well as on an evaluation of occupational health hazards and risks due to insulation wools, based on the criteria mentioned in paragraph 2.3.1 (ii).

2.4.2. In accordance with national legislation and practice or guidance, and taking due account of the consultations provided for in paragraph 2.3.3, the exposure limits should be established by:

- (i) statutory provisions; or
- (ii) an agreement between employers and workers at the national level which is approved by the competent authority; or
- (iii) other means approved by the competent authority, after consultation with competent scientific bodies and with the most representative organizations of the employers and workers concerned.²

2.4.3. Concentrations of airborne insulation wool fibres and dust in the working environment should not exceed the exposure limits set or approved by the competent authority.

2.4.4. Where it is reasonably practicable, or required by the competent authority, to achieve exposures below the exposure limits, then these lower levels should be maintained. Exposure limits should be regarded as values above which remedial action should necessarily be taken, and as a tool to guide preventive and protective action with a view to continuing improvement.

2.4.5. The exposure limits should be reviewed in the light of technological progress and advances in scientific knowledge, as well as the results of workplace monitoring and experience.

¹ Appendix A provides information on international classification systems.

² Examples of exposure limits are given in Appendix B.

3. General duties

3.1. Manufacturers

3.1.1. Manufacturers should promote an ongoing process of product improvement, and the establishment of databases containing validated measurements of exposure levels in different working situations where the materials that they manufacture are used.

3.1.2. Manufacturers should support product development which addresses issues of potential health concern, such as the risk of a release of respirable fibres and dust particles, the biopersistence properties, and the chemical additives.

3.1.3. Manufacturers should ensure that the products can be transported, stored, used and disposed of with the minimal release of fibres and dust. Where practicable, manufacturers should supply pre-cut, ready-to-install products.

3.1.4. Material safety data sheets and labels, as well as other product information on health and safety in the use of insulation wools, conforming to the requirements of the competent authority, should be prepared by manufacturers and made available to suppliers and users. The production of material safety data sheets in electronic format should be encouraged.

3.1.5. Manufacturers should initiate and maintain a process for regular consultations with the affected parties concerning health, safety and working environment issues relating to product development, and as regards the extent and effectiveness of the application of the guidance and instructions given for the use of their products.

3.2. Suppliers and importers

3.2.1. As the link between manufacturers and users, suppliers and importers should ensure that the information and instructions of the manufacturers are transmitted to their customers. Any repackaging by the supplier should meet the requirements set out for manufacturers on packaging, storage, transport, labelling, material safety data sheets and product information.

3.3. Building clients, designers and specifiers

3.3.1. Building clients, designers and specifiers should consider the potential for fibre and dust generation during installation, use, maintenance and removal whenever designing, selecting or specifying the use of insulation materials.

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3.3.2. Designers and specifiers should keep themselves informed regarding the development of appropriate products in respect of health and safety, as materials technology improves. Building clients undertaking insulation work should seek information about the development of insulation technology and materials.

3.3.3. Specifiers should choose insulation wools which: (a) meet the necessary insulation requirements; and (b) are least likely to result in the generation of fibres and dust because of their intrinsic properties, method of use, and pre-supply preparation. Specifiers should aim to use construction techniques that minimize cutting and handling of insulation wool products on site.

3.3.4. Building clients, designers and specifiers should ensure that all requirements of the competent authority are included in specification and tender documents. They should maintain records of the location and type of insulation used so as to provide the necessary information to those who may have potential for exposure in the future.

3.3.5. Building clients and main contractors should always give preference to contracting insulation firms which conform to the requirements of the competent authority.

3.4. Employers

3.4.1. Employers in the user and removal industries, as well as manufacturers, should develop and implement safe work practices which, as a minimum, conform to the requirements laid down by the competent authority, taking into account the recognized hierarchy of preventive and protective measures set out in paragraph 2.1.3. Employers should be provided with assistance by the competent authority whenever practicable.

3.4.2. Manufacturing employers should ensure that the design, installation, operation and maintenance of manufacturing processes, and the management of wastes within the manufacturing facility, result in the lowest practicable release of fibres and dust into the working environment.

3.4.3. Employers using insulation wools should, as far as practicable, select appropriate products or handling methods so as to minimize the generation of fibres and dust, and should keep themselves informed regarding the development of changing insulation technology.

3.4.4. Employers should assess the hazards and risks, inform the workers about them, and provide appropriate supervision. They should ensure that all workers involved in the production and handling of insulation wools, including supervisors, receive adequate instructions and training in safe work practices and, where necessary, in the selection, wearing and maintenance of personal protective equipment.

3.4.5. Employers should provide the equipment, including personal protective equipment, necessary for the production and handling of insulation wools, and offer appropriate washing and changing facilities for workers exposed to insulation wools.

3.4.6. Employers should ensure that exposures to fibres and dust are kept as low as reasonably achievable, and at least below the exposure limits set by the competent authority. Unnecessary exposures should be avoided.

3.4.7. Employers should ensure appropriate site maintenance, removal and disposal procedures which minimize the generation of fibres and dust. Disposal should be carried out in accordance with the requirements laid down by the competent authority.

3.4.8 Whenever two or more employers undertake activities simultaneously at one workplace, they should cooperate in applying the provisions of this code, without prejudice to the responsibility of each employer for the health and safety of workers in his or her employment. Insulation contractors should inform other workers on the job site, including supervisors, regarding the presence of insulation wools brought on to the site by the insulation contractor.

3.4.9. Employers should initiate and maintain a process of consultation and cooperation with workers and their representatives concerning all aspects of safety in the use of insulation wools specified in this code, and in particular as regards the preventive and protective measures listed in paragraphs 3.4.1 to 3.4.8. This process should be carried out within the framework of safety and health committees, where they exist, or through another mechanism determined by the competent authority or by voluntary agreements.

3.5. Workers

3.5.1. Workers should contribute to preventing, controlling and minimizing the generation of fibres and dust, within the limitations of their responsibilities, taking into account the information, instructions and training they have received.

3.5.2. Workers should carry out the work with insulation wools in accordance with the instructions and training they have received in safe work practices. They should report to their supervisor, and to the employer when necessary, any observed shortcomings in the safe work practices and their implementation.

3.5.3. Workers should report to their supervisor unusual conditions at the workplace or affecting installations and equipment. When preventive measures, as specified, are not taken or the appropriate personal protective equipment is not available, workers should have the right to withdraw, until remedial action has been taken, from such working conditions if they have reasonable justification to believe that they endanger their health or safety.

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3.5.4. Workers should participate in instruction and training programmes provided by the employer or required by the competent authority.

3.5.5. When required, and in the manner instructed, workers should use control measures and properly wear the personal protective equipment provided by the employer.

3.5.6. Workers should participate in exposure monitoring and health surveillance programmes required by the competent authority or provided by the employer for the protection of their health.

3.5.7. Workers and their representatives should participate in the process of consultation and cooperate with employers concerning all aspects of safety in the use of insulation wools specified in this code, and in particular as regards the protective and preventive measures listed in paragraphs 3.4.1 to 3.4.8.

3.6. Competent authority

3.6.1. The competent authority, in consultation with the most representative organizations of employers and workers, should consider making new, or updating existing, statutory provisions for the protection of workers against exposure to fibres and dust from insulation wools, taking into account national conditions and practice, and the provisions of this code.

3.6.2. The competent authority, in consultation with the most representative organizations of employers and workers, should determine which statutory provisions should apply to classified and non-classified insulation wools according to the criteria mentioned in paragraph 2.3.2.

3.6.3. Statutory provisions should include regulations, approved codes of practice, exposure limits, as required, and procedures for consultation and dissemination of information, as appropriate.

4. General measures of prevention and protection

4.1. Introduction

4.1.1. The application of the preventive and protective measures described in this chapter should be consistent with the classification and potential health effects of the insulation wool, as determined by the competent authority.

4.1.2. Accordingly, the competent authority should decide which preventive and protective measures have to be applied.

4.2. Choice of insulation

4.2.1. The choice of insulation to be used in any application should be based on a thorough review of many factors, including:

- (i) the insulation properties required;
- (ii) the requirements of the competent authority;
- (iii) the ability to comply with safe working practices and exposure limits during installation, use, maintenance and removal;
- (iv) the adequacy of information on known and potential health effects; and
- (v) the potential for exposure to safety and health risks.

4.3. Product information

4.3.1. Information should be provided by manufacturers on the health, safety and working environment aspects of their insulation wool products, and all information should be in accordance with the requirements of the competent authority.

4.3.2. Information should be presented in formats, languages and styles which are understandable to employers, workers and other users, subject to the requirements of the competent authority.

4.3.3. Information should be revised as research results or product developments become known.

4.4. Material safety data sheets and labels

4.4.1. Material safety data sheets should, as a minimum, meet the requirements of the competent authority and are recommended to contain the following core information:

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- (i) identification of manufacturer, product and ingredients;
- (ii) physical and chemical properties, and information on health effects, physical hazards, environmental impact and exposure limits;
- (iii) recommendations concerning safe work practices; transport, storage and handling; waste disposal; protective clothing; personal protective equipment; and first aid and firefighting.

4.4.2. Labels should, as a minimum, meet the requirements of the competent authority, and are recommended to contain the following core information:

- (i) signal word or symbol; identification information, including the manufacturer, product and ingredients;
- (ii) risk and safety phrases; first-aid and disposal procedures; and
- (iii) reference to the material safety data sheets, and date of issue.

4.4.3. Labels should be on the outside of the product packaging, and in languages and formats which are understandable to those who need the information.

4.5. Packaging

4.5.1. Packaging should first meet the requirements of the competent authority, or be consistent with relevant international requirements.

4.5.2. Insulation wools should be packaged so that the appropriate labelling is clearly visible. Packaging materials should be sufficiently strong to ensure that the insulation wools are securely contained until used.

4.5.3. Packaging should take into consideration the needs and requirements for safe stacking, transport and storage.

4.5.4. Consideration should be given to packaging shapes and sizes which will facilitate handling, transport and use, as well as preventing manual handling injuries.

4.6. Transport and storage

4.6.1. Transport of insulation wools should be planned so as to avoid damage to the product and injury to people; and provisions should be made for recovery of material after spills or transport incidents.

4.6.2. Storage arrangements should allow for the movement of small quantities of insulation wools to the job site as required.

4.6.3. Storage arrangements should ensure security from damage, and make provision for recovery of material after spills or storage incidents.

4.7. Engineering and technical measures

4.7.1. The methods adopted to control exposure to insulation wools should follow the recognized hierarchy of preventive and protective measures listed in paragraph 2.1.3.

4.7.2. Stationary operations generating fibres and dust should be provided with local exhaust ventilation. The exhaust ventilation should be located as close as practicable to the emission source.

4.7.3. Movable local exhaust ventilation should be used wherever practicable if the source of potential dust generation is not stationary, and extracted dust and fibre captured in a sealed bag or the equivalent.

4.7.4. Local exhaust ventilation should provide for high-efficiency particulate air filtration or an equivalent, otherwise the air should not be recirculated to the working environment.

4.7.5. Local and general ventilation systems should be checked regularly and maintained so that they perform according to design specifications.

4.7.6. The design, installation, operation and maintenance of all ventilation equipment should be in accordance with the requirements of the competent authority.

4.7.7. Tools that generate the least possible amount of fibres and dust should be provided. Cutting insulation wools with a knife generates smaller amounts of fibres and dust than using a saw. If power tools are used to cut insulation wools, they should be equipped with appropriate dust-collection systems and, whenever practicable, with high-efficiency particulate air filters.

4.8. Sanitary facilities and other measures

4.8.1. Washing and changing facilities, including showers where appropriate, should be provided for workers dealing with insulation wools. Sufficient time should be given to the workers, during the working period, for using sanitary facilities for personal hygiene after their work with insulation wools.

4.8.2. Inhalation of airborne particles from other sources, including those from cigarette smoke, may increase the risk of respiratory diseases, so all work and storage areas should be smoke-free zones and other airborne contaminants should be kept to a minimum.

4.8.3. Appropriate first aid, including eyewash, should be provided and maintained in good operational order. Workers should be instructed in its use.

4.8.4. Meals should not be taken in areas contaminated with insulation wools.

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4.9. Protective clothing

4.9.1. Loose-fitting, comfortable, long-sleeved clothing, standard-duty gloves, and a cap should be worn during the use and removal of insulation wools.

4.9.2. Protective clothing contaminated with insulation wool material should be changed as necessary, and should not be worn outside the workplace in order to prevent skin irritation. Arrangements should be made by the employer for reusable items to be washed regularly, and separately from other clothing.

4.9.3. Wherever practicable, clothing which minimizes general heat stress and discomfort should be chosen, especially considering the weather conditions in tropical countries.

4.10. Personal protective equipment

4.10.1. Personal protective equipment cannot be regarded as a substitute for engineering and technical measures, but should be regarded as a last resort, as a temporary measure, or for use in an emergency.

4.10.2. Appropriate personal protective equipment, which has been approved by the competent authority, should be provided, maintained and replaced by the employer as needed.

4.10.3. Employers and manufacturers of insulation products and, if necessary, of personal protective equipment, in consultation with workers, should determine the need for specific personal protective equipment for specific work, and with guidance from the national occupational health services.

4.10.4. Appropriate eye protection, such as dust-resistant safety goggles or safety glasses with side shields, should be worn for overhead work, or in dusty environments.

4.10.5. An appropriate particulate respirator, approved by the competent authority, should be worn when working in enclosed or poorly ventilated spaces, or in dusty environments.

4.10.6. Manufacturers and employers should ensure that workers required to wear personal protective equipment are fully informed of the requirements and the reasons for them, and are given adequate training in the selection, fit testing, wearing, maintenance and storage of this equipment.

4.10.7. Personal protective equipment, including eye protection and respirators, should be selected, used, maintained, stored and replaced, in accordance with standards or guidance set or recognized by the competent authority.

General measures of prevention and protection

4.10.8. The requirements for personal protection should be documented and reviewed as necessary or when conditions change. The documentation should include:

- (i) a summary of the personal protective equipment requirements and persons responsible;
- (ii) results of hazard and risk assessments, any monitoring results, and the nature of tasks, including changes to the tasks;
- (iii) types of personal protective equipment required for areas and tasks, selection procedure, and records of issue;
- (iv) training and fit testing;
- (v) methods and schedules for maintenance and cleaning procedures.

4.11. Housekeeping and cleaning

4.11.1. Insulation wool materials should be kept in their packaging until they are to be used.

4.11.2. An organized housekeeping programme should be followed at all times. Work areas should be kept clean, and scrap material and debris removed as the work progresses.

4.11.3. Water, sweeping compounds, or vacuum equipment with high-efficiency particulate air filters or the equivalent, should be used whenever practicable to clean work areas. Compressed air or dry sweeping should not be used for clean-up; these methods only blow the fibres back into the air and move them elsewhere. When the use of compressed air is inevitable, personal protective equipment should be worn.

4.11.4. Unnecessary handling of scrap material should be avoided by keeping waste-disposal containers and equipment as close to working areas as possible.

4.11.5. Where it is necessary to repair or maintain equipment that is either insulated with insulation wools or covered with settled insulation wool dust, the equipment should be cleaned by appropriate methods which do not, in themselves, generate fibres or dust.

4.12. Waste management and disposal

4.12.1. Manufacturers, suppliers and users of insulation wools should develop techniques which avoid or minimize the generation of waste material.

4.12.2. Where practicable, waste material and removed insulation wools should be recycled by inclusion in the manufacturing process or in other products. All material for recycling should be placed in clearly marked containers. Recycling practices should meet the requirements of the competent authority.

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4.12.3. All waste and removed insulation should be collected for disposal in accordance with the requirements of the competent authority. Waste insulation wools should be secured in containers for disposal as approved. A suitable container is one that prevents the release of fibres and dust. If not removed immediately, the containers should be protected from damage.

4.12.4. Collection of waste should occur as soon as practicable after its generation, in accordance with the methods outlined in paragraph 4.7.3; the other appropriate preventive and protective measures set out in Chapters 4 and 5 of this code should also be followed.

5. Specific measures of prevention and protection

5.1. General

5.1.1. In addition to the general preventive measures outlined in Chapter 4, specific measures should be taken concerning a number of applications of insulation wools.

5.1.2. The following sections list specific measures which should be taken with batt and blanket insulation, blown insulation in attics, spray-applied insulation, cavity fill insulation, boiler, oven and pipe insulation, muffler insulation, board insulation, uncured insulation, and insulation wool ceiling tiles, and cover the removal of insulation wools and maintenance work.

5.2. Batt and blanket insulation

5.2.1. Tearing the product to reduce its thickness should be avoided. Instead, the appropriate product for the intended application should be used.

5.2.2. Tearing the product by hand should be avoided. The materials should be cut with a sharp knife. The cutting should be done against a firm foundation.

5.2.3. Whenever possible, insulation work should not be performed above working height.

5.2.4. Workers installing batts overhead should wear appropriate eye protection such as dust-resistant safety goggles or safety glasses with side shields.

5.2.5. Whenever possible, insulation work should be performed before the construction and rooms are finished and closed.

5.2.6. Apart from power tools which do not generate fibres or dust, such as powered staple guns, power tools should not be used unless fitted with adequate exhaust extraction with high-efficiency particulate air filters, or an equivalent such as local exhaust ventilation.

5.3. Blown insulation in attics

5.3.1. The installer who is stationed in the attic should always wear an appropriate respirator and appropriate eye protection (see paragraphs 4.10.4 and 4.10.5).

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5.3.2. Unless they are wearing an appropriate respirator and appropriate eye protection, workers should not be permitted to enter the work area during or immediately after the insulation wool application.

5.3.3. The blower operator should not use a bare hand to direct the insulation stream as it emerges from the blowing hose. A gloved hand or a deflector should be used instead.

5.3.4. Information should be provided by the supplier on ways to minimize dust production and “hang-up” on the rafters and joists caused by static electricity.

5.3.5. The blowing systems in the work area should be inspected, and any cracks and openings sealed.

5.3.6. Care should be taken during a residential retrofit application to prevent fibres from entering the living space, by using a drop sheet under the access hatch.

5.3.7. Care should be taken to avoid blowing insulation wools out of open vents to the building exterior.

5.3.8. Any ceiling fixtures, including lights and registers, should be inspected to ensure that there are no openings that would allow the insulation being installed to fall through into the living space.

5.3.9. After the installation, hatch and window access locations should be cleaned.

5.4. Spray-applied insulation

5.4.1. All spray-applied insulation should be reduced to a minimum, and should be avoided if there are better technical alternatives.

5.4.2. Spraying machines should be set up to deliver the correct proportions of spray insulation materials and water or adhesives. They should be properly maintained.

5.4.3. The operator of the spraying machine should always wear an appropriate respirator and appropriate eye protection (see paragraphs 4.10.4 and 4.10.5).

5.4.4. Where the sprayed material includes binders such as cement or gypsum, these other dusts should be assessed and included in the determination of the appropriate personal protective equipment.

5.4.5. Entrances to stairways and elevators to floors where spray application is in progress should be temporarily closed off to general construction traffic. “No entry” signs should be posted at entrances.

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5.4.6. Safety tape or other appropriate means should be used to mark the areas that are closed to construction traffic.

5.4.7. No workers, other than those performing the spray work, should be allowed in marked-off areas unless they are wearing the necessary personal protective equipment.

5.4.8. No spray work should commence until floor spaces within the marked-off area have been cleared of stored material and equipment, and floors have been cleaned.

5.4.9. All hangers, clips and miscellaneous fastening devices attached to the spray substrate should be completely installed before spray work commences.

5.4.10. Where practicable, no ducts, pipes, conduits or other installations that might impede clear access to the spray substrate should be installed before spray work commences.

5.4.11. Where cut-outs or attachments are to be made after completion of the spray work, the installed sprayed material should be wetted first.

5.4.12. After spray work is completed, all overspray should be removed from surrounding areas and the floor restored to a clean condition.

5.4.13. Where practicable, a temporary barrier, such as sheeting, should be erected to contain overspray.

5.4.14. Loose surface fibres should be fixed in place by surface tamping, water overspray or other suitable techniques, before the product has dried.

5.4.15. All waste insulation material should be cleaned up promptly and placed into suitable watertight containers for disposal.

5.5. Cavity fill insulation

5.5.1. Blowing machines should be set up to deliver the correct proportions of insulation wools and air, and should be properly maintained.

5.5.2. If required, water may be added to the insulation wool in the hopper to minimize dust production and hang-up.

5.5.3. Cavity filling should preferably be done from the outside.

5.5.4. When drilling through masonry materials, the operation should be assessed so as to determine the appropriate level of personal protective equipment.

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5.5.5. When cavity filling is done from inside a building, the installer in this operation should always wear an appropriate respirator and appropriate eye protection (see paragraphs 4.10.4 and 4.10.5).

5.5.6. No one should be permitted within 3 metres of the work area inside a building during or immediately after the insulation wool application without wearing an appropriate respirator and appropriate eye protection.

5.5.7. Care should be taken during a residential retrofit application to prevent fibres from entering the living space, by sealing electric and plumbing access in the wall.

5.5.8. After the installation, the window access location should be cleaned.

5.6. Boiler, oven and pipe insulation

5.6.1. In older buildings, a full assessment of potential asbestos contamination should be made, and any necessary remediation completed, prior to the installation of insulation wool boiler and pipe insulation. The building client and specifier should carry out this assessment in accordance with the rules set by the competent authority.

5.6.2. The pipe jacketing or finish should be applied as soon as practicable after the insulation in order to minimize the possibility of abrasion and unnecessary fibre release.

5.6.3. The vapour, smoke and gases given off as the binders decompose at start-up should be vented by actions such as: leaving some of the boiler panels uninstalled; or using temporary local exhaust ventilation.

5.6.4. Because organic binders decompose to some extent at operating temperatures above 175 °C, the binders may be burned off in the first 96 hours of operation, depending on the temperature of the boiler or oven. The presence of workers or other persons in the work area during this period should be avoided, or kept as short as possible. When people remain in the area, they should wear respirators appropriate for the decomposition products generated during this period at boiler or oven start-up. The likely decomposition products, including any toxic gases, should be listed in the material safety data sheet for the insulation wool.

5.6.5. Because flash fires have been reported at boiler start-up owing to excess oil in the insulation, fire-extinguishing equipment should be available.

5.7. Muffler insulation

5.7.1. Local exhaust ventilation should be used in workplaces where insulation wool parts are fabricated or installed into mufflers.

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5.7.2. A suitable pre-heating cycle, in conjunction with local exhaust ventilation, should be applied to the finished muffler to remove any vapour, smoke or gases.

5.8. Board insulation

5.8.1. Local exhaust ventilation should be used in workshops which fabricate thick boards of insulation wool into parts such as pipe insulation elbows, duct boards and tapered roof insulation.

5.8.2. Return air from local exhaust ventilation should be filtered using high-efficiency particulate air filters or their equivalent before it is recirculated into the working environment.

5.9. Uncured insulation

5.9.1. Local exhaust ventilation should be used in workshops that mould uncured insulation wools into parts of different shapes.

5.9.2. In the absence of adequate local exhaust ventilation, an appropriate approved organic vapour respirator and appropriate eye protection, or a full-face respirator, should be worn at all times.

5.9.3. If there is prolonged or repeated contact with the uncured wet product, chemical-resistant gloves should be worn.

5.10. Insulation wool ceiling tiles

5.10.1. Power tools without appropriate dust-extraction systems should not be used when installing insulation wool ceiling tiles. Otherwise, the tiles should be cut and trimmed with a sharp knife.

5.10.2. An organized housekeeping programme should be followed to avoid the accumulation of tile debris.

5.10.3. Appropriate eye protection, such as dust-resistant safety goggles or safety glasses with side shields, should be worn when fabricating or installing ceiling tiles.

5.11. Removal and maintenance work

5.11.1. The potential for generation of fibres and dust during maintenance work and removal of insulation wools should be identified by hazard and risk assessment.

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Care should be taken to prevent exposure to fibres and dust, and additional requirements for safe work practices should be determined as necessary.¹

5.11.2. Where practicable, the insulation should be thoroughly wetted before removal.

5.11.3. The work area should be designated by the use of ropes and signs. Workers not involved in the removal work should not be allowed within 3 metres of the designated area.

5.11.4. Where applicable, workers involved in maintenance work and the removal of insulation wools should wear appropriate protective clothing and protective equipment.

5.11.5. All waste material should be placed in suitable containers as it is removed. If the material is wet, it should be placed in waterproof containers.

¹ The two factors determining the need for additional safe work practices are the degree of binder burn-out in the insulation, and the potential airborne fibre and dust concentrations which may arise during removal.

6. Information, education, training and expertise

6.1. General

6.1.1. All those who work with insulation wool products should be provided with information suitable to their needs.

6.1.2. This information should, as a minimum, meet the requirements of the competent authority. It is recommended that the information contain the following:

- (i) applicable laws, regulations and codes of practice;
- (ii) labels and material safety data sheets;
- (iii) general and specific guidance on preventive measures, in particular on the procedures necessary to maintain exposures as low as practicable, safe work practices including cleaning and removal of waste material, ventilation, personal protective equipment, and protective clothing;
- (iv) representative fibre and dust exposure levels associated with the job, as well as data on the purpose and methods of workplace monitoring of airborne fibres and dust;
- (v) potential acute and chronic health effects which may result from exposure to insulation wools; and
- (vi) the responsibilities of manufacturers, suppliers, specifiers, installers, employers and workers, as well as the need for cooperation between them.

6.1.3. The extent of instructions and training should be appropriate to the duties, understanding and literacy of workers, and sufficiently detailed to ensure that they understand both the safety requirements and the reasons for these requirements.

6.1.4. Instruction, training and information should be provided by employers before commencing work with insulation wools and periodically thereafter. Wherever practicable, this should include practical on-the-job training.

6.1.5. Employers' training programmes should be developed in consultation with workers and their representatives.

6.2. Advisory services

6.2.1. Employers' and workers' organizations should, in cooperation with relevant health services and educational institutions, develop and maintain training courses for general and specific work with insulation wools.

6.2.2. Manufacturers and employers should ensure that persons responsible for the provision of information, education and training, and exposure monitoring and

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assessment, have received appropriate and, where required by the competent authority, approved training or qualifications.

6.2.3. When necessary, manufacturers and employers should request advice and obtain expertise as regards risk assessments where there are particular difficulties because of multiple or combined exposures in the working environment, where health surveillance reveals abnormal findings concerning workers' health, or where alternative technologies or solutions to a difficult technical problem have to be found.

7. Surveillance of the working environment

7.1. Monitoring of the workplace

7.1.1. Employers should ensure that there are representative data on airborne concentrations of respirable fibres, dust or both during manufacturing, installation, maintenance and removal applications. These data should be obtained by using databases of previous, scientifically valid, representative workplace monitoring,¹ or, if no representative data are available, by monitoring the working environment.

7.1.2. Periodic workplace monitoring should not be required when the general and specific preventive measures set out in Chapters 4 and 5 of this code are followed, and where there are representative data on comparable applications. However, some measurements should be made, as necessary, to verify the effectiveness of the control measures taken and their effective implementation.

7.1.3. Where monitoring is applicable, it should be carried out in accordance with the requirements of the competent authority. When required, workplace monitoring should include personal monitoring, static monitoring, or both, and should be carried out and assessed by trained and experienced persons in accordance with recognized and scientifically accepted methods.

7.1.4. The design and implementation of workplace monitoring programmes should be done in consultation with workers and their representatives.

7.1.5. Manufacturers and employers should make the results of workplace monitoring available to workers, their representatives and the competent authority.

7.1.6. Based on monitoring data, the competent authorities should decide on standardized working practices for frequently occurring work with insulation wools, and publish them as guidance documents. The standardized working practices² should ensure that exposures are kept below exposure limits. Employers who apply the standardized working practices should not be obliged to monitor exposure to fibres.

¹ Examples of airborne insulation wool fibre and dust concentrations monitored during typical manufacturing and user applications are given in Appendix C.

² In Germany, for example, standardized working practices for maintenance work with insulation wools are laid down in a code of practice: "Technische Regeln für Gefahrstoffe: TRGS 521 – Faserstäube", in *Bundesarbeitsblatt*, No. 10, Oct. 1996, pp. 96-105, as amended by a decision of the Federal Ministry of Labour dated 15 September 1998, which includes a new Annex 4 entitled "Umgang mit eingebauten Mineralwolle-Produkten im Hochbau und bei technischen Isolierungen", *ibid.*, No. 10., Oct. 1988, pp. 73-74.

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7.2. Personal and static monitoring guidelines

7.2.1. In order to evaluate the risk to the individual worker, air samples should be collected in the worker's breathing zone by means of personal samplers. Sampling should be carried out while the work process is under way. Special attention should be devoted to assessments during maintenance operations.

7.2.2. In order to obtain indications on the spatial and temporal distribution of airborne insulation wool fibres and dusts that will guide preventive action, air samples should be taken from static monitoring equipment which is placed: (i) at appropriate places in the working area to ascertain dissemination of fibres and dusts; and (ii) in working areas and at heights which represent typical worker exposures.

7.2.3. Where concentrations of fibres and dusts may vary from one work operation or phase to another, sampling should be carried out in such a manner that the average, and in any case the range of exposures for individual workers, can be determined.

7.2.4. Personal sampling should be carried out at various times throughout the work shift and, where necessary, supplemented by sampling during periods of peak activity.

7.2.5. Exposure profiles of particular jobs or occupational categories should be constructed from the air-sampling data of different operations and from the workers' exposure time in these jobs.

7.3. Measuring methods and strategy

7.3.1. Concentrations of airborne respirable fibres and of dust should be measured according to standardized procedures, and the results expressed as fibres per millilitre of air (f/ml) or as milligrams per cubic metre (mg/m³) respectively.^{1, 2} Laboratory modifications of the method should be validated by reference to quality control programmes, and approved by the competent authority.

¹ The relationship between fibre and mass concentrations has been summarized as follows: "Where fibre and mass concentrations were compared on a plant average basis a broad correlation was observed. In general, those plants which were dusty were also the ones with higher airborne fibre concentrations; but this relation was not consistent between different occupational groups, nor was there any detectable correlation when mass and fibre concentrations were considered on an individual basis." (WHO: *Man-made mineral fibres*, op. cit.)

² Two World Health Organization (WHO) publications deal with the established reference method using a phase contrast optical microscope (PCOM) to monitor number concentration of airborne insulation wool fibres in the workplace: *Reference methods for measuring airborne man-made mineral fibres*, Environmental Health Series 4 (Copenhagen, WHO Regional Office for Europe, 1985); *Determination of airborne fibre number concentrations: A recommended method, by phase-contrast optical microscopy (membrane filter method)* (Geneva, 1998).

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7.3.2. The measurement of airborne dust concentrations (in mg/m³) in the workplace air should be made by an approved gravimetric method.¹ Dust concentrations should be assessed in the light of the potential for the presence of dusts other than those from insulation wools, particularly on construction sites, in attics, and during removal of insulation wool products.

7.3.3. When required, workplace monitoring should be conducted in a systematic way according to a monitoring programme developed after consultation with workers and their representatives.

7.3.4. The monitoring strategy should aim to ensure that:

- (i) specific operations where exposures may occur are identified and levels of exposure are quantified;
- (ii) exposures to fibres and dust do not exceed exposure limits set or approved by the competent authority;
- (iii) preventive measures are effective in their implementation for all applications and in all jobs;
- (iv) any changes in manufacturing, use or work practices have not led to increased exposures to fibres and dusts; and
- (v) supplementary preventive measures are developed as necessary.

7.3.5. At the time of monitoring, a qualitative assessment should be made of general working conditions and the potential for exposures to other workplace contaminants, including cigarette smoke, as well as an assessment of the level of observance of the general and specific preventive measures as set out in Chapters 4 and 5 of this code.

7.4. Record-keeping

7.4.1. The results of workplace and personal monitoring should be collected in a systematic way, and retained by employers for at least 20 years, or for a longer time as determined by the competent authority. Whenever practicable, it is recommended that the records be stored in electronic format. Arrangements should be made by the competent authority for their conservation when an enterprise closes down.

7.4.2. Records should include all relevant data such as details of the site, product, manufacturer, methods of use including the engineering control measures, and availability and wearing of personal protective clothing and equipment.

¹ For example, standard methods include: Standards Australia: A53640-1989: *Workplace atmospheres: Method for sampling and gravimetric determination of inspirable dust*, 1989; and P.M. Eller and M.E. Cassinelli (eds.): *NIOSH manual of analytical methods*, DHSS (NIOSH) Publication 94-113 (Washington, DC, 4th edn., Aug. 1994).

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7.4.3. A worker or a person acting on his or her behalf should have access to his or her own personal monitoring record and to workplace monitoring data relevant to his or her own exposure. Workers and their representatives should be provided with general information and collective data on workplace monitoring results. They should have access to data which are relevant to the purpose of prevention and protection.

7.4.4. Taking into account that workplace monitoring is conducted for the purpose of prevention and protection, collective data should be used to improve work practices, engineering control methods, choice of technology, and epidemiological and scientific knowledge. Databases should be established and operated under conditions and in a manner consistent with these objectives. Manufacturers, employers and other interested parties should be encouraged to communicate workplace monitoring data for incorporation into these databases. All relevant parties should have access to such databases for the purpose of prevention and protection at the workplace.

7.5. Interpretation and application of monitoring data

7.5.1. The interpretation of the results of workplace monitoring should include consideration of the working conditions and engineering controls at the time of the monitoring, and whether they were typical or atypical.

7.5.2. The results should be compared with the exposure limits determined by the competent authority, as well as with the results of previous monitoring carried out during the same or similar operations, at the same workplace, or under similar conditions of exposure.

7.5.3. The results of workplace monitoring should be considered as levels requiring action, if:

- (i) any measurement of insulation wool fibres or dust is greater than the exposure limits determined by the competent authority (see paragraph 2.4.3); or
- (ii) any measurement is greater than those measured previously during the same or similar operations, at the same workplace, or under similar conditions of exposure (see paragraph 2.4.4).

7.5.4. When workplace monitoring results have been interpreted as requiring corrective action, the necessary action should be taken in a timely manner in consultation with the workers and their representatives. Follow-up monitoring should be carried out when the necessary corrective and preventive measures have been implemented.

7.5.5. When the results of workplace monitoring have been considered as consistently satisfactory, the need for future monitoring, if any, should be determined in consultation with the workers and their representatives, and the competent authority if required.

8. Surveillance of workers' health

8.1. General principles

8.1.1. Health surveillance programmes for workers exposed to insulation wools should be consistent with:

- (i) the aims of occupational health as defined by the Joint ILO/WHO Committee on Occupational Health at its 12th Session, 1995;
- (ii) the requirements of the Occupational Health Services Convention (No. 161) and Recommendation (No. 171), 1985; and
- (iii) the *Technical and Ethical Guidelines for Workers 'Health Surveillance'*¹ adopted by the ILO in 1997.

8.1.2. The establishment of workers' health surveillance programmes should be based on sound scientific and technical knowledge and in accordance with the requirements of the competent authority. A linkage should be established between the surveillance of workers' health and the surveillance of occupational hazards, including insulation wools, present at the workplace.

8.1.3. The surveillance of workers' health should be appropriate to the occupational risks at the workplace. The assessment of the level and type of surveillance appropriate to workers' potential exposure to fibres and dusts from insulation wools should be based on a thorough investigation of all work-related factors which may affect workers' health.

8.1.4. The design and implementation of workers' health surveillance programmes should be carried out in consultation with workers and their representatives.

8.2. Medical examinations

8.2.1. As medical examinations are the most common means of health assessment for individual workers, it is clear that they should not be carried out as a perfunctory routine. If the provisions of this code are followed, the health surveillance of workers exposed to insulation wools should not call for medical examinations in addition to those required for general occupational health purposes such as lung function tests for workers wearing respirators.

8.2.2. Workers should have the right to request a health assessment (i.e. a medical examination or other tests, as appropriate) if a disorder occurs which they believe to be due or related to work with insulation wools. Employers may request a medical examination for workers in their employment, but there should be justification

¹ Published as Occupational Safety and Health Series No. 72 (Geneva, ILO, 1998).

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for such an examination. In the case of recruitment, the examination should be conducted at the end of the process, when a decision about employment of the person has been taken in principle, but subject to the result of the medical examination and any further restrictions on recruitment examinations laid down by the competent authority.

8.2.3. Workers should have the right of access to their own personal health and medical files, including at the time of retirement and thereafter.

9. Glossary

For the purposes of this code, the following definitions apply:

Amorphous:

Non-crystalline, glassy in character, having no molecular lattice structure; synonym for vitreous.

Application:

A practice involving the use of synthetic vitreous fibre insulation wools.

Binder:

A substance that glues together otherwise loose fibres so that the product can be shaped into batts, rolls, and so on; usually a phenol-formaldehyde or urea-formaldehyde resin.

Biopersistence:

The ability of a fibre to remain in the lung. Biopersistence is a function of the solubility of the fibre in the lung, and the biological ability of the lung to clear the fibre from the lung.

Building clients:

Owners or tenants of buildings where insulation work is to be carried out.

Carcinogen:

A substance or agent that has the potential to produce or incite cancer.

Competent authority:

Any official service or public authority with the power to issue or approve decrees, orders, regulations or other provisions having the force of law concerning the health and safety of workers.

Employer:

A legal person who manufactures, uses or removes insulation wools, with recognized responsibility, commitment and duties towards a worker in his or her employment by virtue of a mutually agreed relationship. (A self-employed person is regarded as having the duties of an employer and a worker.)

Engineering controls:

The use of technical measures such as enclosure, ventilation and workplace design to minimize exposure.

Exposure limits:

Airborne concentrations of workplace contaminants, such as fibres or dust, determined as appropriate for control purposes by the competent authority. The terms adopted by the competent authority vary from country to country and include: administrative control levels; maximum allowable concentrations; permissible exposure limits; occupational exposure limits; and threshold limit values.

Glass wool:

A synthetic vitreous fibre insulation wool made by melting sand and other inorganic materials, and then physically forming the melt into fibres.

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Hazard:

The inherent potential of a substance to cause illness or injury from exposure to the substance.

Hazard assessment:

A systematic evaluation of the intrinsic properties of substances, including the extent of the inherent potential to cause illness or injury.

Installers:

Workers who carry out an application of insulation wools.

Insulation wools:

See synthetic vitreous fibre insulation wools.

Manufacturer:

A person who has the responsibility of both an employer who produces insulation wools and a supplier of these insulation wools for use.

Material safety data sheet:

A document containing information about a product, including chemical and physical properties, and health and safety considerations (similar to the chemical safety data sheets mentioned in the Chemicals Convention (No. 170) and Recommendation (No. 177), 1990).

Personal protective equipment:

Includes personal protective clothing.

Respirable fibres:

Defined by the WHO as those fibres with a diameter of less than 3 μm , a length greater than 5 μm and a length/diameter ratio of at least 3:1.

Risk:

The likelihood that exposure to a hazard will cause illness or injury.

Risk assessment:

A systematic evaluation and/or quantification of risk arising from exposure to a hazard, taking into account the severity of the consequences of exposure and available control measures.

Rock wool:

A synthetic vitreous fibre insulation wool made by melting natural igneous rocks and other inorganic materials, and then physically forming the melt into fibres. Rock wool is also known as stone wool.

Slag wool:

A synthetic vitreous fibre insulation wool made by melting blast furnace slag and other inorganic materials, and then physically forming the melt into fibres.

Specifier:

A person, including an architect, developer or owner, responsible for determining the type and quantity of insulation wools to be installed.

Statutory provisions:

Regulations and all provisions given force of law by the competent authority.

Stone wool:

See rock wool.

Supplier:

A person, including a manufacturer, who obtains insulation wools and supplies them for use.

Synthetic vitreous fibre insulation wool dust:

Defined as airborne or settled non-fibrous particles of synthetic vitreous fibre insulation wools (see synthetic vitreous fibre insulation wools).

Synthetic vitreous fibre insulation wools (glass wool, rock wool and slag wool):

Fibrous materials manufactured from glass, rock or slag with nominal diameters ranging from 2 to 9 μm , and a variable amorphous silicate chemical composition consisting mostly of the oxides of silicon, aluminium, calcium, sodium, magnesium, boron, barium and potassium.

Time weighted average (TWA) concentration:

The concentration of a contaminant which has been weighted for the time duration of the sample. High exposures of short sample duration do not “weigh” as heavily in the calculation as do moderate levels for extended periods. Most exposure limits are eight-hour TWA limits.

Ventilation:

Can be either local or general. Local ventilation usually involves mechanical devices or means to capture and remove ambient air contaminants. General ventilation refers to the removal of contaminants by renewing all the air in the workplace.

Vitreous:

Non-crystalline, glassy in character, having no molecular lattice structure; synonym for amorphous.

Worker:

Any person who works, whether full time, part time or temporarily, for an employer as defined above and who has recognized rights and duties in this respect. (A self-employed person is regarded as having the duties of a worker and an employer.)

Workplace:

Covers all places where workers as defined above need to be or to go by reason of their work.

Appendix A

Systems of classification

1. General

1.1. There are many systems of classification of chemicals (e.g. toxic chemicals, carcinogenic chemicals), materials (e.g. flammable or radioactive materials) and equipment (e.g. lasers) at the national and international levels.

1.2. The systems of classification may have many different purposes, such as hazard communication in relation to transport, environmental protection, waste disposal, establishing a process of licensing (e.g. for pesticides), enacting special rules concerning the storage of hazardous materials (e.g. flammable and explosive materials) and establishing safe work practices (e.g. work permits). Such systems may be prescribed by statutory provisions or contained in national or international standards.

1.3. As regards chemicals or other substances such as fibres, these systems of classification concern irritancy, toxicity, carcinogenicity and other hazardous properties. The classification of chemicals or other substances, such as a fibre, is an important parameter among others for the labelling of insulation wool products, and for preparing their material safety data sheets.

1.4. The systems of classification are also used for risk management purposes and administrative measures such as: (i) prohibition or exemption; (ii) licensing or registration; and (iii) certification or accreditation.

1.5. Insulation wools have, for example, been: (i) evaluated by an agency of the WHO, namely the International Agency for Research on Cancer (IARC), as regards their carcinogenicity; (ii) classified by an official union of European governments, namely the European Union (EU) as regards irritancy and carcinogenicity; and (iii) classified by an independent professional organization, namely the American Conference of Governmental Industrial Hygienists (ACGIH) as regards their carcinogenicity. A brief description of the criteria used for these evaluations and classifications is given in sections 2 to 4 of this appendix.

2. Evaluation by the IARC

2.1. The IARC provides for the following categories of carcinogenicity:

- (i) Group 1: the agent is carcinogenic to humans
- (ii) Group 2A: the agent is probably carcinogenic to humans
- (iii) Group 2B: the agent is possibly carcinogenic to humans
- (iv) Group 3: the agent is unclassifiable as to its carcinogenicity to humans
- (v) Group 4: the agent is probably not carcinogenic to humans.

2.2. Insulation wools (glass wool, rock wool and slag wool) have been evaluated by the IARC as Group 2B.¹

2.3. Group 2B is generally used for agents for which there is limited evidence in humans in the absence of sufficient evidence in experimental animals. It may also be used when there is inadequate evidence of carcinogenicity in humans or when human data are non-existent, but there is sufficient evidence of carcinogenicity in experimental animals. In some instances, an agent for which there is inadequate evidence or no data in humans but limited evidence of carcinogenicity in experimental animals, together with supporting evidence from other relevant data, may be placed in this group.

3. Classification by the European Union

3.1. The EU has a series of Directives relating to the classification, packaging and labelling of dangerous substances, which provide for a multifaceted classification with a number of categories, including “irritants”, and an entry as regards the classification of substances as carcinogens.

3.2. The category Xi comprises five entries identified by reference phrases:

- (i) R38: irritating to skin;
- (ii) R36: irritating to eyes;
- (iii) R41: risk of serious damage to eyes;
- (iv) R43: may cause sensitization by skin contact;
- (v) R37: irritating to respiratory system.

3.3. Mineral woofs [man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide ($\text{Na}_2\text{O} + \text{K}_2\text{O} + \text{CaO} + \text{MgO} + \text{BaO}$) content greater than or equal to 18 per cent by weight] are classified as Xi "irritant" with the standard phrase R38: "irritating to skin".

3.4. Substances are considered to be skin irritant (R38) if:

- (i) when applied to healthy intact animal skin for up to four hours, significant inflammation occurs which is present 24 hours or more after the end of the exposure period ; or
- (ii) practical experience shows that they are capable of causing inflammation in a substantial number of persons.

3.5. In the EU classification, substances are determined to be hazardous on account of carcinogenic effects if they fall into the following categories

- (i) Category 1: substances known to be carcinogenic to humans
- (ii) Category 2: substances regarded as if they were carcinogenic to humans

¹ IARC: *Man-made mineral fibres and radon*, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 43 (Lyons, 1998).

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- (iii) Category 3: substances which cause concern for humans owing to possible carcinogenic effects, but in respect of which the available information is not adequate for making a satisfactory assessment.

3.6. The placing of a substance in Category 1 is done on the basis of epidemiological data. The placement of substances in Category 2 and Category 3 is based primarily on animal experiments.

3.7. Insulation woofs (as specified under paragraph 3.3), subject to the exemption mentioned in paragraph 3.10, have been classified as Category 3 with the reference phrase R40: "possible risks of irreversible effects".

3.8. A substance is included in Category 3 and classified as harmful (R40) if there is some evidence from appropriate animal studies that human exposure can result in the development of cancer, but this evidence is insufficient to place the substance in Category 2. Category 3 substances comprise two subcategories:

- (i) substances which are well investigated, but for which the evidence of tumour-inducing effects is insufficient for classification in Category 2 ; additional experiments would not be expected to yield further relevant information with respect to classification ;
- (ii) substances which are insufficiently investigated; the available data are inadequate, but they raise concern for humans; this classification is provisional and further experiments are necessary before a final decision can be made.

3.9. For a distinction between Category 3 and no classification, arguments are relevant which demonstrate that the available animal data are not relevant to humans, for example:

- (i) a substance should not be classified in any of the categories if the mechanism of experimental tumour formation is clearly identified, with good evidence that this process cannot be extrapolated to humans ;
- (ii) if the only available tumour data are liver tumours in certain sensitive strains of mice, without any supplementary evidence, the substance may not be classified in any of the categories;
- (iii) particular attention should be paid to cases where the only available tumour data are the occurrence of neoplasms at sites and in strains where they are well known to occur spontaneously with a high incidence.

3.10. Commission Directive 97/69/EC¹ contains two notes (Notes Q and R) and a remark (Article 2) which apply to insulation wools. They are worded as follows:

¹ Commission Directive 97/69/EC of 5 December 1997 adapting to technical progress for the 23rd time Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, *Official Journal of the European Communities*, L 343, 13 December 1997, pp. 19-24.

- (i) Note Q: The classification as a carcinogen need not apply if it can be shown that the substance fulfils one of the following conditions:
- a short-term biopersistence test by inhalation has shown that the fibres longer than 20 µm have a weighted half-life less than ten days, or
 - a short-term biopersistence test by intratracheal instillation has shown that the fibres longer than 20 µm have a weighted halflife less than 40 days, or
 - an appropriate intraperitoneal test has shown no evidence of excess carcinogenicity, or absence of relevant pathogenicity or neoplastic changes in a suitable long-term inhalation test.
- (ii) Note R: The classification as a carcinogen need not apply to fibres with a length weighted geometric mean diameter less two standard errors greater than 6 µm.
- (iii) During the period of five years after entry into force of this Directive, the Commission shall evaluate scientific developments and adopt measures to delete or amend Note Q.

4. Classification by the ACGIH

4.1. The ACGIH¹ provides for the following categories of carcinogenicity

- A1: Confirmed human carcinogen
- A2: Suspected human carcinogen
- A3: Animal carcinogen
- A4: Not classifiable as human carcinogen
- A5: Not suspected as human carcinogen

4.2. Insulation woofs (synthetic vitreous fibres: glass wool, rock wool and slag wool) have been classified by ACGIH as Category A3. Category A3 is defined as follows: The agent is carcinogenic in experimental animals at a relatively high dose, by routes) of administration, at site(s), of histologic type(s), or by mechanisms) that are not considered relevant to worker exposure. Available epidemiologic studies do not confirm an increased risk of cancer in exposed humans. Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

5. Proposed harmonized classification criteria under the Globally Harmonized System for the classification and labelling of chemicals

5.1. Harmonized classification criteria have been proposed under the Globally Harmonized System for the classification and labelling of chemicals. Within the context

¹ American Conference of Governmental Industrial Hygienists (ACGIH): *Threshold limit values for chemical substances and physical agents and biological exposure indices* (Cincinnati, Ohio, 1997).

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of the ongoing efforts to implement the recommendations made by the United Nations Conference on Environment and Development (UNCED) in its Agenda 21 (Chapter 19, concerning environmentally sound management of toxic chemicals), the ILO has initiated and is leading the process to elaborate and implement, at the international and national levels by the end of 2000, a Globally Harmonized System (GHS) for the classification and labelling of chemicals. This work is carried out under the joint UNEP/ILO/WHO International Programme on Chemical Safety (IPCS), the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) and the Intergovernmental Forum on Chemical Safety (IFCS).

5.2. Proposals have been made for classifications of skin irritation, eye irritation and serious damage of the eye, and carcinogens:

- (i) Irritant class and subclass – (a) irritant; (b) mild irritant.
- (ii) Eye irritation and serious damage of the eye – (a) an eye irritant Category A (irritating to eyes); (b) an eye irritant Category B (irreversible effects on the eyes).
- (iii) Classification of carcinogens – (a) Class 1: known or presumed human carcinogens; (b) Class 1A: known to have carcinogenic potential for humans; (c) Class 1B: presumed to have carcinogenic potential for humans; (d) Class 2: suspected human carcinogens.

Appendix B

Exposure limits in various countries (as of October 2000)

Examples of exposure limits (EL) and related comments in various countries

Country	EL ¹ f/ml	EL ² mg/m ³	Related comments
Australia	0.5	2.0	Exposure standard: a TWA ³ exposure standard of 0.5 f/ml (respirable fibres) for all forms of synthetic mineral fibres and a secondary exposure standard of 2 mg/m ³ (TWA) for inspirable dust in situations where almost all the airborne material is fibrous.
Austria	0.5	–	EL: 0.5 f/ml for respirable fibres measured by the WHO method.
Denmark	1.0	–	Classified as a carcinogen due to IARC 2B, and included in the general environmental list of hazardous substances with designations according to Commission Directive 97/69/EC. Specific health and safety regulations, on installation and demolition of insulation materials containing synthetic vitreous fibres, state that: <ul style="list-style-type: none"> – insulation wools are not considered hazardous in the health and safety regulations on hazardous substances, meaning that there are no obligations for substitution by other products; – insulation wools which generate the least dust should be used; and – general and specific provisions for preventive measures are to be followed.
Finland	–	10.0	Insulation wools are classified according to rules based on Commission Directive 97/69/EC. EL: Inhalable dust as eight-hour average (EN 481: 1993 CEN/TC 137)).
France	1.0	–	EL: 1.0 f/ml for glass wool, rock wool and slag wool, measured as an eight-hour TWA value.
Germany	–	6.0	Exemption criteria according to the Dangerous Substances Ordinance (<i>Gefahrstoffverordnung</i>), Annex V, No. 7.1(1): <ul style="list-style-type: none"> – a suitable intraperitoneal test has not shown indications of significant carcinogenicity; or – the half-life time after intratracheal instillation of 2 mg of a fibre suspension of fibres with a length greater than 5 µm, a diameter smaller than 3 µm and a length-to-diameter ratio greater than 3:1 (respirable fibres measured by the WHO method) is less than or equal to 65 days (40 days from 1 October 2000); or – the carcinogenicity index KI, which is calculated from the difference between the sum of the mass content (as a percentage) of the oxides of sodium, potassium, boron, calcium, magnesium, barium and twice the mass content (as a percentage) of aluminium oxide, is greater than or equal to 40.
	0.25	–	EL: 0,25 f/ml for non-exonerated insulation wool fibres. ⁴
Italy	<1.0	5.0	EL: total dust: 5 mg/m ³ ; fibre diameter less than 3 µm: less than 1 f/ml.

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Examples of exposure limits (EL) and related comments in various countries (cont.)

Country	EL ¹ f/ml	EL ² mg/m ³	Related comments
Japan	–	2.9	The Ministry of Labour guidelines for glass wool and rock wool recommend measuring the airborne fibres or respirable dust concentration. The administrative control level (ACL) ⁵ is 2.9 mg/m ³ for respirable dust, but no fibre concentration has been set. Fibre counting method: JIS K3850.
Netherlands	2.0	–	EL: 2 f/ml eight-hour TWA. No occupational exposure limit for non-respirable fibres with a diameter greater than 4-5 µm.
Norway	1.0	–	No official classification, but the Directorate of Labour Inspection cites the IARC 2B classification. In the TLV list, wool insulation is labelled with a K, which refers to IARC 2B. EL: 1 f/ml.
Sweden	1.0	–	Insulation wools are classified according to the National Chemicals Inspectorate rules based on Commission Directive 97/69/EC, and Sweden has issued specific rules for handling synthetic vitreous fibres.
Switzerland	0.5	–	The EL of 0.5 f/ml is for respirable fibres measured by the WHO method.
United Kingdom	2.0	5.0	EL: 5 mg/m ³ total inhalable dust eight-hour TWA, or 2 f/ml eight-hour TWA. Both are maximum exposure limits. The 2 f/ml eight-hour TWA applies when fibres are measured or calculated by a method approved by the Health and Safety Executive.
United States	1.0	–	Manufacturers are required to identify fibreglass as a potential carcinogen on warning labels and provide information in the form of Material Safety Data Sheets, under the US Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, based on epidemiological studies which demonstrated an increased mortality rate for lung cancer. The US OSHA also cites the IARC 2B classification, as well as the listings of the US National Toxicology Program (NTP). ⁶ EL: 1 f/ml eight-hour TWA. This non-statutory limit has been agreed to in a partnership programme between the US OSHA, the North American Insulation Manufacturers' Association (NAIMA) and the users. The Health and Safety Partnership Programme (HSPP) established a 1.0 f/ml eight-hour TWA exposure limit for respirable synthetic vitreous fibre insulation wools. "Where worker exposures can readily be reduced below 1 f/cc, NAIMA recognizes that it is prudent to do so."

Notes: ¹Exposure limit for the airborne concentration of respirable fibres expressed as fibres per millilitre of air (f/ml). ²Exposure limit for the airborne mass of dust expressed as milligrams per cubic metre (mg/m³). ³Time-weighted average. ⁴For production and use of exempted insulation wool fibres, appropriate hygiene measures ("good industrial practice") have to be applied; see "Technische Regeln für Gefahrstoffe: TRGS 500 – Schutzmassnahmen: Mindeststandards", in Bundesarbeitsblatt, No. 3, 1998, p. 57. ⁵The administrative control level (ACL), according to the Japanese Government, has a different concept from exposure limits, even though it was developed on that basis. The ACL is the concentration of an airborne hazardous substance providing a standard for judging the condition of the working environment, and assumes the implementation of engineering control measures. Taking account of the technical feasibility to secure the workplace, the work environment is evaluated in three categories safe zone, grey zone and unsafe or hazardous zone – by statistical comparison of the measured concentration of an airborne substance with an ACL. ⁶The NTP has listed "glass wool (respirable size)", which includes special-purpose glass fibres, as "reasonably anticipated to be a human carcinogen". Mineral wools (rock wool and slag wool) have not been classified by the NTP.

Appendix C

Exposures in manufacture and use

1. Historical data

1.1. The following exposure data have been published by the International Programme on Chemical Safety (IPCS).¹ They are consistent with workplace monitoring carried out in manufacturing and user industries during the past ten years. The available data on levels of airborne insulation wool in the manufacturing industries include both mass concentrations of particulate matter, and respirable fibre levels.²

1.2. The average concentrations measured by phase contrast optical microscope (PCOM) during the manufacture of glass wool insulation were of the order of 0.03 f/ml; and concentrations in mineral wool (rock and slag) plants in the United States ranged up to one order of magnitude higher. Corresponding concentrations in European rock-wool plants were of the order of 0.1 f/ml.

1.3. Total inspirable dust concentrations were typically of the order of 1 mg/m³, irrespective of the fibre type manufactured. Overall averages were 4-5 mg/m³ for one rock wool and one glass wool plant where manufacturing was reported to be heavy or very heavy. The situation in 13 European plants was similar.

1.4. Available data on airborne fibre concentrations associated with the installation of insulation wool products have demonstrated that concentrations vary considerably, depending on the method of application and the extent of confinement within the workplace. Concentrations during installation were comparable to, or lower than, those found in manufacturing (paragraph 1.2), with the important exceptions of blowing or spraying conducted in poorly ventilated spaces such as attics, and during the use of products without resin binders.

1.5. Concentrations measured during the installation of unbonded glass wool and rock wool insulation in attics have been as high as 1.8 and 8.2 f/ml, respectively. Mean concentrations during the installation of bonded rock-wool blankets in confined spaces on board ships have been reported as less than 0.7 f/ml. It should be noted that the time weighted average (TWA) exposure of insulation workers was probably considerably less than these mean concentrations during application, as insulators often worked with insulation wool products from less than 10 to 100 per cent of their time. It is likely that TWA exposures may have exceeded 1.0 f/ml only for workers insulating attics or

¹ WHO: *Man-made mineral fibres*, op. cit.

² Further examples of historical data have been provided in Note ND 1907.150.93 from the National Research and Safety Institute (INRS, France), which gives dust exposure levels measured between 1978 and 1991 for various types of insulation glass wools and rock wools, when used. From these, the following personal exposure levels were measured:

- handling and blowing of mineral wool in bulk: 2.33-3.71 f/cm³ (five samples);
- laying and cutting of insulation wool: 0.08-1.49 f/cm³, and 1.45-4.92 mg/ m³ for respirable dusts (44 samples);
- for wet spraying: 0.16-0.43 f/cm³, and 1.14-3.66 mg/m³ for respirable dusts (eight samples); and
- insulation of industrial materials: 0.58-1.88 f/cm³ (six samples).

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spraying with unbonded material, and that most user applications should not have exposures greater than 0.5 f/ml TWA.

1.6. Air at construction sites and in some industrial and domestic environments may also contain substantial amounts of dusts other than insulation wools.

1.7. Historical data were summarized by the IARC in table 36 on page 82 of the IARC Monographs, Volume 43,¹ and a modified version of this table is reproduced in table 1.

2. Current exposures

2.1. When general and specific preventive measures, consistent with good industrial practice, have been followed and implemented, airborne concentrations of insulation wool respirable fibres are expected to be less than 0.5 f/ml TWA, and inspirable dust concentrations less than 1.0 mg/m³ TWA are to be expected during manufacture and use of products containing resin binders.

Table 1. Ranges of airborne insulation wool fibre concentrations in typical exposure situations (modified from IARC Monographs, Volume 43, 1988)

Fibre concentration (f/ml)	Location/use
<0.0001*	Outdoor: rural area Buildings: thermal insulation
0.0001–0.001*	Outdoor: large cities Buildings: ceiling boards Ventilation systems
0.001–0.01 Coarse glass fibre Ceiling boards	Production and use Buildings: some damage, some ventilation ducts
0.01–0.1 Glass wool Rock wool Rock/slag wool Ceiling boards	Production and most secondary production Production and most secondary production Production and most secondary production Buildings: severe damage
0.1–1.0 Rock wool Glass wool	Some secondary production and user industry User industry
>1.0 Glass/rock wool, loose Glass/rock wool, without dust suppressants	User industry: blowing into attic Production and use

Note: * Estimated from transmission electron microscopic measurements.

¹ IARC: Man-made mineral fibres and radon, op. cit.

2.2. An unpublished ongoing study by the Insulation Wools Research Advisory Board (IWRAB) of the workplace exposures experienced in the Australian user industries, where a code of practice has applied since 1990, found in 1997 the concentrations recorded in table 2.

Table 2. Australian user industry exposure study, 1997

(a) Glass wool and rock wool: personal samples;
respirable fibres

Type of product	No. of sites	Respirable fibres/ml – No. of results in each category				
		<0.05	0.05–<0.1	0.1–0.5	>0.5	All
Batts	2	–	–	3	–	3
Duct liner	8	13	10	–	–	23
Blanket	2	3	–	1	–	4
Moulding wool	1	3	–	–	–	3
Totals	13	19	10	4	0	33

(b) Glass wool and rock wool: static samples;
respirable fibres

Type of product	No. of sites	Respirable fibres/ml – No. of results in each category				
		<0.05	0.05–<0.1	0.1–0.5	>0.5	All
Batts	2	3	–	–	–	3
Duct liner	8	14	–	–	–	14
Blanket	2	2	–	–	–	2
Moulding wool	1	4	–	–	–	4
Totals	13	23	0	0	0	23

(c) Glass wool and rock wool: static samples;
inspirable dusts

Type of product	No. of sites	Inspirable dust (mg/m ³) – No. of results in each category				
		<0.1	0.1–<1.0	1.0–2.0	>2.0	All
Batts	2	–	3	–	–	3
Duct liner	8	–	13	–	1 *	14*
Blanket	2	–	1	–	–	1
Moulding wool	1	–	3	1	–	4
Totals	13	0	20	1	1 *	22*

* One static dust sample heavily contaminated with sprayed adhesive.

Appendix D

Example of a format for risk assessments and action plans

1. Introduction

1.1. Risk assessment is the process whereby any hazards which have been identified are assessed for the likelihood that they could cause adverse health outcomes to the workers exposed to the hazards.

1.2. Risk assessments should be carried out before commencing any new work, and should be repeated periodically, particularly whenever there are changes to existing work procedures, equipment or materials. They should be carried out jointly by management and supervisors, the workers and their representatives and, whenever necessary, with the assistance of technical specialists and occupational health professionals.

1.3. In addition to an appropriate choice of technology, built-in safety and good engineering practice, management and housekeeping, risk assessment is a basis upon which appropriate control measures, including safe work practices, should be developed in order to protect workers' health. Risk assessment should be part of the policy and arrangements in the field of occupational safety and health that the employer should adopt, set out in writing and bring to the notice of every worker.

2. Example of a format for risk assessment and action plans

2.1. Risk assessments concerning work with insulation wools should be carried out according to various procedures, which may include risk assessment forms.

2.2. A number of steps can be identified in the risk assessment procedure, in particular:

- (i) recording factual information on the work carried out: site, work area, description of tasks;
- (i) assessing occupational hazards present, or which could be present, at the workplace (e.g. during maintenance work), including consideration of classifications and review of relevant material safety data sheets;¹
- (ii) recording existing work practices and control measures in a systematic manner, including remarks concerning their efficiency or quality, as appropriate;
- (iii) assessing exposures: likelihood of exposures on the basis of measurements at the workplace or of extrapolations, and comparison with exposure limits; estimation of

¹ Material safety data sheets, together with labelling, are tools for hazard communication essential to carry out preventive action and to protect workers' health and safety, as well as to provide reliable information for a timely and appropriate response to accidents (first aid, emergency response).

- the magnitude of the hazard; overall assessment of the risks taking into account both hazards and control measures;
- (iv) making recommendations for improvement in the short and long term, and setting times for their implementation; and
 - (v) communicating the results of the risk assessment, follow-up of recommendations and periodic review, which may be independent or part of the systematic safety audit that employers should undertake from time to time.

2.3. An example of a form used to assist employers and workers in the conduct of a risk assessment and development of an action plan is as follows:

Risk assessment form used in Australia

(example only)

SYNTHETIC VITREOUS FIBRE INSULATION WOOLS		
Site:	Work area/location:	Date:
<p>Task description: < include number of persons doing job, others exposed, shift duration, duration and frequency of tasks, any abnormal conditions, including weather, plant shutdowns, etc. ></p>		

Risk assessment form used in Australia (cont.)

Current work practices and control measures:											
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> Separate storage areas? <input type="checkbox"/> Secure packaging? <input type="checkbox"/> Pre-cut products? <input type="checkbox"/> Surface-coated products? <input type="checkbox"/> Hand tools? <input type="checkbox"/> Power tools? <input type="checkbox"/> Use of compressed air? <input type="checkbox"/> Local exhaust ventilation? <input type="checkbox"/> General ventilation? <input type="checkbox"/> Housekeeping programme? </td> <td style="width: 50%; vertical-align: top; padding: 2px;"> <input type="checkbox"/> Waste disposal containers? <input type="checkbox"/> Maintenance procedures? <input type="checkbox"/> First-aid facilities? <input type="checkbox"/> Safety shower and eyewash? <input type="checkbox"/> Signposting? <input type="checkbox"/> Personal protective equipment (clothing, skin, eye and respiratory)? <input type="checkbox"/> Changing facilities? <input type="checkbox"/> Other _____ </td> </tr> </table> <p style="margin-top: 10px;">Describe:</p>				<input type="checkbox"/> Separate storage areas? <input type="checkbox"/> Secure packaging? <input type="checkbox"/> Pre-cut products? <input type="checkbox"/> Surface-coated products? <input type="checkbox"/> Hand tools? <input type="checkbox"/> Power tools? <input type="checkbox"/> Use of compressed air? <input type="checkbox"/> Local exhaust ventilation? <input type="checkbox"/> General ventilation? <input type="checkbox"/> Housekeeping programme?	<input type="checkbox"/> Waste disposal containers? <input type="checkbox"/> Maintenance procedures? <input type="checkbox"/> First-aid facilities? <input type="checkbox"/> Safety shower and eyewash? <input type="checkbox"/> Signposting? <input type="checkbox"/> Personal protective equipment (clothing, skin, eye and respiratory)? <input type="checkbox"/> Changing facilities? <input type="checkbox"/> Other _____						
<input type="checkbox"/> Separate storage areas? <input type="checkbox"/> Secure packaging? <input type="checkbox"/> Pre-cut products? <input type="checkbox"/> Surface-coated products? <input type="checkbox"/> Hand tools? <input type="checkbox"/> Power tools? <input type="checkbox"/> Use of compressed air? <input type="checkbox"/> Local exhaust ventilation? <input type="checkbox"/> General ventilation? <input type="checkbox"/> Housekeeping programme?	<input type="checkbox"/> Waste disposal containers? <input type="checkbox"/> Maintenance procedures? <input type="checkbox"/> First-aid facilities? <input type="checkbox"/> Safety shower and eyewash? <input type="checkbox"/> Signposting? <input type="checkbox"/> Personal protective equipment (clothing, skin, eye and respiratory)? <input type="checkbox"/> Changing facilities? <input type="checkbox"/> Other _____										
Potential exposures (measured or extrapolated)	Job/area	RF respirable fibre	ID inspirable dust								
Date of testing: / /											
Hazard category: Insignificant <input type="checkbox"/> Potential <input type="checkbox"/> Unacceptable <input type="checkbox"/>											
Overall risk assessment category:	<table style="width: 100%; border: none;"> <tr> <td style="padding: 2px;">1. Insignificant risks</td> <td style="text-align: right; padding: 2px;"><input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px;">2. Significant risks — controlled</td> <td style="text-align: right; padding: 2px;"><input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px;">3. Significant risks — not controlled</td> <td style="text-align: right; padding: 2px;"><input type="checkbox"/></td> </tr> <tr> <td style="padding: 2px;">4. Uncertain about risks — more information required</td> <td style="text-align: right; padding: 2px;"><input type="checkbox"/></td> </tr> </table>			1. Insignificant risks	<input type="checkbox"/>	2. Significant risks — controlled	<input type="checkbox"/>	3. Significant risks — not controlled	<input type="checkbox"/>	4. Uncertain about risks — more information required	<input type="checkbox"/>
1. Insignificant risks	<input type="checkbox"/>										
2. Significant risks — controlled	<input type="checkbox"/>										
3. Significant risks — not controlled	<input type="checkbox"/>										
4. Uncertain about risks — more information required	<input type="checkbox"/>										
(contd. on page 64)											

Note: **Insignificant risk:** A level of risk which is considered sufficiently low not to require any immediate changes (or any further changes) to the situation presenting this risk. Such risks will still require periodic review.
Significant risk: The work is likely to adversely affect the health of workers.

Risk assessment form used in Australia (cont.)

SYNTHETIC VITREOUS FIBRE INSULATION WOOLS			
Recommendations — short term (completion date)	Recommendations — long term (completion date)		
Assessed by:	Site manager	Name:	Date:
	External technician	Name:	Date:
	Consultative committee involved: Yes <input type="checkbox"/> No <input type="checkbox"/>		
Type of review required:	<input type="checkbox"/> Review after recommendations implemented <input type="checkbox"/> Review after dust and fibre monitoring <input type="checkbox"/> Routine review on process change	Date: Date: Date:	

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Other ILO publications

Safety in the use of mineral and synthetic fibres, Occupational Safety and Health Series No. 64.

This book considers the health effects of occupational exposure to fibrous materials other than asbestos, in the light of the provisions of the Asbestos Convention (No. 162), and Recommendation (No. 172), of 1986. It covers man-made mineral fibres, natural mineral fibres other than asbestos, and synthetic organic fibres. Preventive measures are defined, based on adopting safe working practices, controlling the working environment and workers' exposure to mineral and synthetic fibres, and monitoring workers' health.

ISBN 92-2-106443-3 (1990)

15 Swiss francs

Occupational lung diseases: Prevention and control, Occupational Safety and Health Series No. 67.

The inherent dangers of exposure to hazardous materials and substances are a major cause for concern in relation to occupational safety and health. This publication aims to guide the reader through the prevention and control measures of those occupational lung diseases which appear in the Employment Injury Benefits Convention, 1964 (No.121), as well as other acute respiratory diseases classified as occupational injuries.

ISBN 92-2-106463-8 (1991)

17.50 Swiss francs

Technical and ethical guidelines for workers' health surveillance, Occupational Safety and Health Series No. 72.

Using the new definition of occupational health adopted by the Joint ILO/WHO Committee on Occupational Health in 1995 as a starting point, a tripartite ILO Committee of Experts developed these guidelines, which are invaluable for designing, establishing, implementing and managing workers' health surveillance schemes. This book covers practical aspects of organizing such schemes and collecting, processing and communicating health-related data. It also gives guidance on the use of data and on the rights, responsibilities and duties of the different parties.

ISBN 92-2-110828-7 (1998)

15 Swiss francs

Recording and notification of occupational accidents and diseases. An ILO code of practice

The practical recommendations of this code aim to improve occupational safety and health measures by offering detailed and practical guidelines for the recording, notification and investigation of occupational accidents and diseases, especially with a view to developing preventive measures. The provisions cover legal and administrative arrangements, enterprise-level recording, the extension of health and safety measures to the self-employed, the compilation of statistics and the investigation of occupational accidents and diseases. Although they are not legally binding, they should provide valuable guidance to all those who play a role in this area.

ISBN 92-2-109451-0 (1996)

20 Swiss francs

Prices subject to change without notice

Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)

The use of synthetic fibre insulation wools in construction has become increasingly widespread. This ILO code of practice is intended to be applied worldwide, and particularly in countries that do not have, or are in the process of developing, safe work practices in the use of insulation wools. The guidance offered will also benefit small-scale enterprises.

The code sets out the general duties for manufacturers, suppliers, specifiers, employers, workers and competent authorities, all of whom have an important role to play in maintaining the safety of the entire process, from production to waste management and disposal. The provisions of the code cover preventive and protective measures, information, education and training, and surveillance of the working environment and workers' health. The perspective has been enlarged to establish a proper chain of responsibility so that diversified situations in different countries are covered.

The code takes an integrated approach since insulation wools do not appear in their pure forms but rather as products with mixed components. It addresses all the hazards arising from the product (insulation fibres, binders and other materials), with regard to real-life situations, and contains useful appendices on classification systems, exposure data and risk assessment.

Although the code was written for insulation wools (glass wool, rock wool and slag wool), many of its provisions could be applied to other synthetic vitreous fibre materials.