

INTERNATIONAL LABOUR ORGANIZATION  
Sectoral Activities Programme

**Code of practice on safety and  
health in the iron and steel  
industry**

Geneva, 2005



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industry**

**Meeting of Experts to Develop a Revised  
Code of Practice on Safety and Health in  
the Iron and Steel Industry**

Geneva, 2005

This code is dedicated to the memory of iron and steelworkers in all countries who have lost their lives from occupational injuries and disease. It is offered in the hope that it will help prevent such tragedies in the future.

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## Glossary

In this code of practice, the following terms have the meanings hereby assigned to them:

*Active monitoring:* The ongoing activities which check that hazard identification, risk assessment and the appropriate preventive and protective measures, as well as the arrangements to implement the occupational safety and health (OSH) management system, conform to defined criteria.

*Asbestos:* The fibrous form of mineral silicates belonging to rock-forming minerals of the serpentine group, i.e. chrysotile (white asbestos), and of the amphibole group, i.e. actinolite, amosite (brown asbestos), anthophyllite, crocidolite (blue asbestos), tremolite, or any mixture containing one or more of these.

*Asbestos dust:* Airborne particles of asbestos or settled particles of asbestos that are liable to become airborne in the working environment.

*Asphyxiant:* A substance that causes injury by decreasing the amount of oxygen available to the body. Asphyxiants may act by displacing air from an enclosed space, or by interfering with the body's ability to absorb and transport oxygen.

*Audit:* A systematic, independent and documented process for obtaining evidence and evaluating it objectively to determine the extent to which defined criteria are fulfilled. Audits should be conducted by competent persons internal or external to the facility who are independent of the activity being audited.

*Competent authority:* A minister, government department or other public authority with the power to issue regulations, orders or other instructions having the force of law. Under national laws or regulations, competent authorities may be appointed with responsibilities for specific activities, such as for the implementation of national policy and procedures for the protection of iron and steel workers.

*Competent person:* A person with suitable training, and sufficient knowledge, experience and skill, for the performance of the specific work.

*Contractor:* A person or an enterprise providing services to an employer at the facility in accordance with national laws and regulations, or with agreed specifications, terms and conditions. For the purpose of this code of practice, contractors include principal contractors, subcontractors and labour supply agents.

*Dangerous occurrence:* Readily identifiable event, as defined under national laws and regulations, with potential to cause injury or disease to people at work or the general public, for example a "near miss" or a "near hit".

*Employer:* Any physical or legal person that employs one or more workers.

*Engineering controls:* Use of technical measures such as enclosure, ventilation and workplace design to minimize exposure.

*Engulfment:* The condition of being swallowed up or overwhelmed by loose material, for example in the cave-in of an unshored trench. Engulfment usually causes injury by asphyxiation or crushing.



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*Exposure limit:* An exposure level specified or recommended by a competent authority to limit injury to health. 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 exposure values”.

*Hazard:* The inherent potential to cause physical injury or damage to the health of people.

*Hazard identification:* The systematic process of identifying hazards in the workplace. See Annex I for a description of the process that should be considered.

*Hazardous ambient factor:* Any factor in the workplace which may in some or all normal conditions adversely affect the safety and health of the worker or other person.

*HEPA filter:* High-efficiency particulate air filter that is capable of filtering out particles of 0.3 microns or less, such as bacteria.

*ILO-OSH 2001: ILO Guidelines on occupational safety and health management systems, ILO-OSH 2001* (Geneva, 2001).

*Incident:* An unsafe occurrence arising out of or in the course of work where no personal injury is caused.

*Insulation wools:* That group of products which includes glass wool, rock wool, refractory ceramic fibres (RCFs), refractory fibres other than RCFs and special-purpose glass fibres.

*Labour inspectorate:* The body established according to national laws and regulations to secure the enforcement of the legal provisions relating to the conditions of work and the protection of workers while engaged in their work.

*Labour supply agent:* Supplier or provider of workers.

*Occupational accident:* An unexpected occurrence, including acts of violence, arising out of or in the course of work which results in a fatal or non-fatal occupational injury.

*Occupational disease:* Disease known, under prescribed conditions, to arise out of exposure to substances or dangerous conditions in processes, trades or occupations, including but not limited to those specified in the List of Occupational Diseases Recommendation, 2002 (No. 194).

*Occupational health services:* Services entrusted with essentially preventive functions and responsible for advising the employer, the workers and their representatives in the facilities on:

- (a) the requirements for establishing and maintaining a safe and healthy working environment which will facilitate optimal physical and mental health in relation to work;
- (b) the adaptation of work to the capabilities of the workers in the light of their state of physical and mental health.

*OSH:* Occupational safety and health.

*OSH management system:* A set of interrelated or interacting elements to establish OSH policy and objectives, and to achieve those objectives.

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*Reactive monitoring:* The process of identifying gaps or failures in prevention control measures, including OSH management systems, that arise from accidents, injuries, diseases, ill health and incidents, and correcting such deficiencies.

*Recording:* A procedure, specified in national laws and regulations, for ensuring that the employer maintains information on:

- (a) occupational accidents and diseases;
- (b) dangerous occurrences and incidents.

*Reporting:* A procedure, specified by the employer, in accordance with national laws and regulations and with the practice of the enterprise, for the submission by workers to their immediate supervisor, the competent person, or any other specified person or body, of information on:

- (a) any occupational accident or injury to health which arises in the course of or in connection with work;
- (b) suspected cases of occupational diseases;
- (c) dangerous occurrences and incidents.

*Risk:* A combination of the likelihood of an occurrence of a hazardous event and the severity of injury or damage to the health of people caused by this event.

*Risk assessment and control:* A process used to determine the level of risk of injury or illness associated with each identified hazard, for the purpose of control. All risks should be assessed and have control priorities assigned, based on the established level of risk. See Annex I for a description of the process that should be considered.

*Safety and health committee:* A committee with representation of workers' safety and health representatives and employers' representatives, established and functioning at facility level according to national laws, regulations and practice.

*Social security:* The protection that a society provides to individuals and households to ensure access to health care and to guarantee income security, particularly in cases of old age, unemployment, sickness, invalidity, work injury, maternity or loss of a breadwinner.

*Supervisor:* A person responsible for the day-to-day planning, organization and control of a function.

*Surveillance of the working environment:* A generic term which includes the identification and evaluation of environmental factors that may affect workers' health. It covers assessments of sanitary and occupational hygiene conditions, factors in the organization of work that may pose risks to the health of workers, collective and personal protective equipment (PPE), exposure of workers to hazardous agents, and control systems designed to eliminate and reduce them. From the standpoint of workers' health, the surveillance of the working environment may focus on, but not be limited to, ergonomics, accident and disease prevention, occupational hygiene in the workplace, work organization, and psychosocial factors in the workplace.

*Welfare:* Statutory procedure or social effort designed to promote the basic physical and material well-being of people in need.

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*Worker:* Any person who performs work, either regularly or temporarily, for an employer.

*Workers' health surveillance:* A generic term which covers procedures and investigations to assess workers' health in order to detect and identify any abnormality. The results of surveillance should be used to protect and promote the health of the individual, collective health at the workplace, and the health of the exposed working population. Health assessment procedures may include, but are not limited to, medical examinations, biological monitoring, radiological examinations, questionnaires or a review of health records.

*Workers and their representatives:* Where reference is made in this code of practice to workers and their representatives, the intention is that, where representatives exist, they should be consulted as the means to achieving appropriate worker participation. In some instances, it may be appropriate to involve all workers and all representatives.

*Workers' representative:* In accordance with the Workers' Representatives Convention, 1971 (No. 135), any person who is recognized as such by national law or practice, whether they are:

- (a) trade union representatives, namely, representatives designated or elected by trade unions or by members of such unions; or
- (b) elected representatives, namely, representatives who are freely elected by the workers of the enterprise in accordance with provisions of national laws or regulations or of collective agreements and whose functions do not include activities which are recognized as the exclusive prerogative of trade unions in the country concerned.

*Workplace:* Area where workers need to be, or to go to, on the instruction of an employer to carry out their work. A workplace need not be a fixed location.

*Work-related injury:* Death or any personal injury resulting from an occupational accident.

*Work-related injuries, ill health and diseases:* Negative impacts on health arising from exposure to chemical, biological, physical and organizational factors at work.

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## Introduction

In accordance with the decision taken by the Governing Body of the ILO at its 288th Session in November 2003, a Meeting of Experts on Safety and Health in the Iron and Steel Industry was convened in Geneva from 1 to 9 February 2005 to draw up and adopt a revised code of practice on safety and health in the iron and steel industry. The Meeting was composed of seven experts appointed following consultations with Governments, eight experts appointed following consultations with the Employers' group and eight experts appointed following consultations with the Workers' group of the Governing Body.

The original code of practice on safety and health in the iron and steel industry was adopted at a meeting of experts in 1981. This new code, which reflects the many changes in the industry, its workforce, the roles of the competent authorities, employers, workers and their organizations, and on the development of new ILO instruments on occupational safety and health, focuses on the production of iron and steel and basic iron and steel products, such as rolled and coated steel, including from recycled material. It does not deal with the mining of raw materials for iron and steel production, which is covered by the Safety and Health in Mines Convention, 1995 (No. 176), and by codes of practice on safety and health in coal mines (1986) and safety and health in opencast mines (1991), nor does it deal with the fabrication of commercial steel products.

This code of practice is based on principles established in international instruments relevant to the protection of workers' safety and health. The first two chapters deal with the objectives and application of the code. The next two chapters address, within a national framework, the responsibilities, duties and rights of the competent authority, the labour inspectorate, employers, workers and their organizations, suppliers, manufacturers and designers, and contractors, and occupational safety and health (OSH) management systems and services and OSH reporting.

Part II of the code addresses different operations commonly used in the production of iron and steel – from coke ovens to steel furnaces and foundries, to rolling mills, coating lines and recycling. It also covers transport, competence and training, personal protective equipment, emergency preparedness, and special protection and hygiene issues. Each section describes hazards, assesses risk and provides guidance on eliminating or controlling risk.

Where appropriate, the code draws on relevant parts of existing ILO instruments, including: *Occupational safety and health in the iron and steel industry* (Geneva, 1983); *Safety in the use of chemicals at work* (Geneva, 1993); *Management of alcohol- and drug-related issues in the workplace* (Geneva, 1996); *Technical and ethical guidelines for workers' health surveillance* (Geneva, 1998); *Guidelines on occupational safety and health management systems* (Geneva, 2001); *Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)* (Geneva, 2001); *Ambient factors in the workplace* (Geneva, 2001); *HIV/AIDS and the world of work* (Geneva, 2001); and *Safety and health in the non-ferrous metals industries* (Geneva, 2003). The annexes include information on hazard identification, risk assessment and control and, drawn from relevant ILO instruments, information on workers' health surveillance, surveillance of the working environment and on establishing an OSH management system. As these instruments are updated, the references to them in electronic versions of this code will be adjusted accordingly. There is also information on exposure limits and on chemicals used in the iron and steel industry.

The practical recommendations of ILO codes of practice are intended for the use of all those, both in the public and private sectors, who have responsibility for safety and

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health management in relation to specific occupational hazards (e.g. chemicals, heat, noise and vibration), sectors of activity (e.g. forestry, mining), or equipment. Codes of practice are not intended to replace national laws or regulations or accepted standards. They are drawn up with the objective of providing guidance, in accordance with the provisions of national laws and regulations, to all those who may be engaged, through social dialogue, in the framing of provisions of this kind or in elaborating programmes of prevention and protection at the national or enterprise levels. They are addressed in particular to governmental and public authorities, employers and workers and their organizations as well as management and safety and health committees in related enterprises.

Codes of practice are primarily designed as a basis for prevention 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; record-keeping; the role and duties of the competent authority, employers, workers, manufacturers and suppliers; and consultation and cooperation.

The provisions of this code of practice should be read in the context of the conditions in the country proposing to use the guidance it contains, the scale of operation involved and technical possibilities. In this regard, the needs of developing countries are also taken into consideration.

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# 1. General provisions

## 1.1. Objectives

1.1.1. This code of practice, which is a revision of the one adopted in 1981, should contribute:

- (a) to protecting workers in the iron and steel industry from workplace hazards and to preventing or reducing work-related injuries and diseases, ill health and incidents;
- (b) to assisting and facilitating the improved management of occupational safety and health (OSH) issues at the workplace;
- (c) to promoting effective consultation and cooperation between governments and employers' and workers' organizations in the improvement of OSH in the production of iron and steel.

1.1.2. This code of practice should assist in:

- (a) establishing a coherent national policy and principles on the occupational safety and health and welfare of workers in iron- and steel-making facilities and on the protection of the general working environment;
- (b) establishing the respective duties and responsibilities of the authorities, employers, workers and others involved and making arrangements for a structured cooperation between them;
- (c) improving knowledge and competence;
- (d) promoting the implementation and integration of consistent OSH management systems with a view to improving working conditions.

1.1.3. This code of practice provides practical guidance on the role and obligations of the competent authorities and the responsibilities, duties and rights of employers, workers and all other parties involved, with regard to workplace hazards. In particular it covers:

- (a) the setting up of legal, administrative and effective frameworks for the prevention and reduction of hazards and risks;
- (b) the aims of any mechanisms for identifying, eliminating, minimizing and controlling hazards;
- (c) the assessment of risks and hazards to the safety and health of workers and the measures that need to be taken;
- (d) the surveillance of the working environment and workers' health;
- (e) emergency procedures and first aid;
- (f) the provision of information and training to workers;
- (g) the establishment of a system to record, report and monitor occupational accidents and diseases, and dangerous occurrences.

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## 1.2. Application

1.2.1. This code of practice should provide guidance, in accordance with the provisions of national laws and regulations, to:

- (a) all those government authorities, workers' and employers' organizations and industry associations, whether legislative or advisory, whose activities influence the safety, health and welfare of workers in the iron and steel industry;
- (b) all those individuals at the level of the iron- and steel-making facilities, i.e. employers, persons in control of premises, and workers and contractors, as appropriate to their duties and responsibilities for safety and health;
- (c) all operations in the iron and steel industry.

1.2.2. A number of OSH measures implemented to protect workers' health and safety in the iron and steel industry may have an effect, directly or indirectly, on the general environment. This relationship should be taken into account by both the competent authorities and employers in designing and implementing their respective policies and programmes.

1.2.3. The provisions of this code should be considered as a minimum. They are not intended to replace applicable laws, regulations or accepted standards laying down higher requirements. More stringent applicable requirements should have priority over the provisions of this code. In the absence of national laws and regulations on a particular OSH issue, guidance should be drawn from this code of practice, as well as from other relevant nationally and internationally recognized instruments.

1.2.4. The code contains references to those institutions responsible for the delivery and award of vocational qualifications. Such institutions are urged to review existing curricula in the light of the code's recommendations for training and the allocation of worksite responsibilities.

## 1.3. Reference to other ILO instruments

1.3.1. In the establishment, implementation and review of policies and programmes on OSH in the iron and steel industry under this code of practice, competent authorities, employers and workers' organizations should take account of the provisions of other relevant ILO instruments, including Conventions, Recommendations, codes of practice and guidelines. A list of these is contained in the Bibliography at the end of this code.

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## **2. Industry characteristics**

### **2.1. Iron- and steel-making**

2.1.1. For most iron-making, the essential features are coke ovens and the blast furnace, where coke is produced from coal and iron ore is melted (reduced) to produce pig iron, respectively. The furnace is charged from the top with iron ore, coke and limestone; hot air, frequently enriched with oxygen, is blown in from the bottom; and the carbon produced from the coke transforms the iron ore into pig iron containing carbon, with the generation of carbon monoxide and carbon dioxide. The limestone acts as a flux. At a temperature of 1,600°C, the pig iron melts and collects at the bottom of the furnace. The furnace is tapped (i.e. the pig iron is removed) periodically, and the pig iron is cast into pigs for later use (e.g. in foundries), or is poured into ladles where it is transferred, still molten, to the steel-making plant. The waste gas from the blast furnace, which is rich in carbon monoxide, is burned in blast furnace stoves to heat the air blown into the furnace and may be used as a fuel elsewhere in the steel plant.

2.1.2. Some pig iron is also produced in foundry cupola furnaces. Various processes exist or are under development for producing iron through the direct reduction of iron ore, using reducing gases. Such processes may become more important in the future.

2.1.3. The purpose of steel-making operations is to refine the pig iron which contains large amounts of carbon and other impurities. The carbon content must be reduced, the impurities oxidized and removed, and the iron converted into a highly elastic metal that can be forged and fabricated. Alloying agents may be added at this stage. Different types of melting furnace are used in this process.

2.1.4. Some steel is produced directly from scrap or other iron-containing materials, most often in electric arc furnaces, without the need for iron ore or coke.

2.1.5. Steel is cast into slabs, billets, bars, ingots and other shapes. Subsequent steps may include scarfing, pickling, annealing, hot and cold rolling, extrusion, galvanizing, surface coating, cutting and slitting, and other operations designed to produce a variety of steel products.

### **2.2. Occupational hazards**

2.2.1. Operations in the iron and steel industry may expose workers to a wide range of hazards or workplace activities or conditions that could cause incidents, injury, death, ill health or diseases. These are discussed in the following chapters.



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## **PART I. NATIONAL FRAMEWORK**

### **3. General duties**

#### **3.1. Cooperation**

3.1.1. This code recognizes that an effective safety and health system requires joint commitment between the competent authority, employers, workers and their representatives. The parties should cooperate in a constructive manner to ensure that the objectives of this code of practice are achieved.

3.1.2. Measures for cooperation should be taken relating to the elimination or control of hazards or risks to safety and health from the production of iron and steel. These measures should include the following:

- (i) employers, in discharging their responsibilities, should cooperate as closely as possible with workers and/or their representatives;
- (ii) workers should cooperate as closely as possible with their fellow workers and their employers in the discharge by the employers of their responsibilities, and should comply with all prescribed procedures and practices;
- (iii) suppliers should provide employers with all necessary information as is available and required for the evaluation of any unusual hazards or risks to safety and health that might result from a particular hazardous factor in the production of iron and steel.

#### **3.2. Competent authority**

3.2.1. The competent authority should, in the light of national conditions and practice and the provisions of this code, in consultation with the most representative organizations of employers and workers concerned:

- (i) devise and maintain a national policy on OSH; and
- (ii) consider making new, or updating existing, statutory provisions for eliminating or controlling hazards in the production of iron and steel.

3.2.2. Statutory provisions should include regulations, approved codes of practice, exposure limits and procedures for consultation and dissemination of information.

3.2.3. The competent authority should establish:

- (i) systems, including criteria, for classifying substances that may be hazardous to health, i.e. raw materials, intermediary products, final products and by-products that are used and produced in the production of iron and steel;
- (ii) systems and criteria for assessing the relevance of the information required to determine whether one of the substances listed above is hazardous;
- (iii) requirements for marking and labelling substances provided for use in the production of iron and steel, taking into account the need to harmonize such systems internationally;

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- (iv) criteria for the information contained in the substance safety data sheets received by employers; and
  - (v) systems and criteria for identifying safety hazards and appropriate risk control measures relating to machinery, equipment, processes and operations used in the production of iron and steel.

The competent authority should set out the necessary rules to determine these criteria and requirements, but is not necessarily expected to undertake technical tasks or laboratory tests itself.

3.2.4. The competent authority should secure the enforcement of national laws and regulations concerning the policy mentioned above through an adequate and appropriate system of inspection. The system of enforcement should provide for corrective measures and adequate penalties for violations of national laws and regulations concerning the policy.

3.2.5. If justified on safety and health grounds, the competent authority should:

- (i) prohibit or restrict the use of certain hazardous processes or substances in the production of iron and steel; or
- (ii) require advance notification and authorization before such processes and substances are used; or
- (iii) specify categories of workers who, for reasons of safety and health, are not allowed to use specified processes or substances, or are allowed to use them but only under conditions prescribed in accordance with national laws or regulations.

3.2.6. The competent authority should ensure that guidance is provided to employers and workers to help them comply with their legal obligations under the policy. The competent authority should provide assistance to employers, workers and their representatives.

### **3.3. Labour inspectorates**

3.3.1. Labour inspectorates should, in a manner prescribed by national laws and regulations:

- (a) periodically carry out inspections in the presence of the employers' and workers' representatives, and monitor compliance with and enforce all relevant laws and regulations at iron- and steel-making facilities;
- (b) assist employers, workers and their representatives with respect to their occupational safety and health responsibilities, duties and rights;
- (c) monitor the safety and health requirements and performance of comparable national or international iron- and steel-making facilities to provide feedback for further development and improvement of safety measures;
- (d) participate, in cooperation with the recognized organizations of employers and workers, in formulating and updating safety rules and measures to be adopted at national and enterprise levels.

3.3.2. Labour inspectors should, in a manner prescribed by national laws and regulations:

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- (a) be competent to deal with the safety and health issues associated with the iron and steel industry and be able to provide support and advice;
  - (b) notify the employer, the workers concerned and their representatives, as well as safety and health committees, of the findings of inspections for the implementation of required remedial action;
  - (c) have the authority to remove workers from situations involving an imminent and serious danger to life or health;
  - (d) periodically determine whether an existing OSH management system or OSH elements are in place, adequate and effective.

3.3.3. The authority, rights, procedures and responsibilities of labour inspectors should be communicated to all affected parties.

### **3.4. Employers**

3.4.1. Employers have a duty to protect and promote the safety and health of workers. Employers should comply with the measures to be taken regarding hazards or risks to safety and health from the production of iron and steel, including appropriate standards, codes and guidelines as prescribed, approved or recognized by the competent authority.

3.4.2. Employers should provide and maintain workplaces, plant, equipment, tools and machinery, and should organize work so as to eliminate or, if this is not possible, control hazards and risks in the production of iron and steel, and be consistent with national laws and regulations.

3.4.3. Employers should set out in writing their respective programmes and arrangements as part of their general policy in the field of OSH, and the various responsibilities exercised under these arrangements. This information should be clearly communicated to their workers by oral, written or other suitable means, commensurate with the ability of the workers.

3.4.4. Employers, in consultation with workers and their representatives, should:

- (i) make an assessment of the hazards and risks to the safety and health of workers arising from the production of iron and steel, requesting and making effective use of the information provided by the supplier of equipment or materials and from other reasonably available sources; and
- (ii) take all necessary measures to reduce exposure to eliminate or, if this not possible, control risks to safety and health identified in the above risk assessment.

3.4.5. In taking preventive and protective measures, the employer should address the hazardous factor or risk in accordance with the hierarchy set out in paragraph 11.5 of Annex IV. If the employers, workers or their representatives cannot agree, the issue should be referred to the competent authorities in accordance with paragraph 3.2.6.

3.4.6. Employers should make the necessary arrangements to provide for:

- (i) regular surveillance of the working environment, and health surveillance;
- (ii) adequate and competent supervision of work and work practices;

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- (iii) the application and use of appropriate control measures and the periodic review of their effectiveness;
  - (iv) education and training to managers, supervisors and workers, and to workers' safety and health representatives, on issues relating to hazards in the production of iron and steel; and
  - (v) where necessary, measures to deal with emergencies and accidents, including first-aid arrangements.

3.4.7. OSH measures should not involve any expenditure for the workers.

3.4.8. Employers should have in place arrangements to:

- (i) deal with accidents, dangerous occurrences and incidents that may involve hazards or risks to safety and health from the production of iron and steel; and
- (ii) eliminate or control any risk to the safety and health of workers, and thereby to the public and the environment.

3.4.9. When an employer is also a national or multinational enterprise with more than one establishment, the employer should provide safety and health measures relating to the prevention and control of, and protection against, injuries and risks to safety and health from the production of iron and steel to all workers without discrimination.

3.4.10. In accordance with the Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy (1977, Rev. 2000), in all countries in which they operate, multinational enterprises should make available to their workers and to the representatives of the workers at the facility and, on request, to the competent authorities and the workers' and employers' organizations, information on the standards related to injuries and risks to safety and health from the production of iron and steel, relevant to their local operations, which they observe in other countries. The findings of any safety and health studies should be disclosed.

3.4.11. Employers should initiate and maintain a process of consultation and cooperation with workers and their representatives concerning all aspects of safety in the production of iron and steel specified in this code, in particular as regards the measures of prevention and protection listed in paragraphs 3.4.1 to 3.4.10. This process should be carried out within the framework of safety and health committees, as recommended by Convention No. 155, through another mechanism determined by the competent authority or by voluntary agreements.

3.4.12. Employers should verify:

- (i) compliance with safety regulations;
- (ii) maintenance of safe working techniques;
- (iii) the care taken of machines and equipment, particularly any devices provided in the interest of safety;
- (iv) training in the use of and the care taken of personal protective equipment (PPE); and
- (v) the competence of managers, supervisors and workers

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for their tasks.

3.4.13. Managers and supervisors should implement the enterprise's safety and health policy, including through the selection of safe equipment, work methods and work organization, and the maintenance of high levels of skill. They should endeavour to reduce risks and hazards to safety and health in the activities for which they are responsible to as low a level as possible.

3.4.14. Managers and supervisors should ensure that workers receive adequate information and training on safety and health regulations, policies, procedures and requirements, and satisfy themselves that this information is understood.

3.4.15. Managers and supervisors should assign tasks to their subordinates in a clear and precise way. They should satisfy themselves that workers understand and implement the OSH requirements.

3.4.16. Managers and supervisors should ensure that work is planned, organized and carried out in such a way as to eliminate or, if this is not possible, reduce the risk of accidents and the exposure of workers to conditions that may lead to injury or damage their health (see below for guidance).

3.4.17. In consultation with workers and/or their representatives, managers and supervisors should assess the need for additional instruction, training and education of workers by monitoring compliance with safety requirements.

3.4.18. When managers or supervisors observe non-compliance with safety and health regulations or codes of practice by any person, they should take corrective action immediately. If such action is unsuccessful, the problem should be referred to a higher level of management immediately.

### **3.5. Workers' duties and rights**

3.5.1. Workers should have the duty to cooperate with the employer to achieve compliance with the duties and responsibilities placed on the employer pursuant to this code.

3.5.2. When workers or their representatives observe non-compliance with safety and health regulations or codes of practice by any person, they should take corrective action immediately. If such action is unsuccessful, the problem should be referred to a higher level of management immediately.

3.5.3. Workers should have the duty, in accordance with their training, and the instructions and means given by their employers, to:

- (i) comply with prescribed OSH measures;
- (ii) take all steps to eliminate or control hazards or risks to themselves and to others arising during the production of iron and steel, including the proper care and use of protective clothing, facilities and equipment placed at their disposal for this purpose;
- (iii) report forthwith to their immediate supervisor or safety and health representative any unusual conditions at the workplace or affecting installations and equipment which they believe could present a hazard or risk to their safety or health or that of other people arising from the production of iron and steel, and which they cannot deal with effectively themselves;

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- (iv) cooperate with the employer and other workers to permit compliance with the duties and responsibilities placed on the employer and workers.

3.5.4. Workers should participate in instruction and training programmes provided by the employer or required by the competent authority, and should demonstrate such acquired knowledge and understanding of safety and health measures on the job. Workers and their representatives should review the instruction and training programmes for effectiveness. Where they determine that these programmes are ineffective, they should make recommendations to the employer to improve their effectiveness.

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

3.5.6. Workers and their representatives should participate in the process of consultation and cooperate with employers concerning all aspects of safety in the production of iron and steel specified in this code, and in particular as regards measures of protection and prevention listed in 3.4.1 to 3.4.10.

3.5.7. Workers and their representatives should have the right to:

- (i) be consulted regarding any hazards or risks to safety and health from the production of non-ferrous metals;
- (ii) inquire into and receive information from the employer regarding any hazards or risks to safety and health arising from the production of iron and steel, including information from suppliers. This information should be provided in forms and languages easily understood by the workers;
- (iii) take adequate precautions, in cooperation with their employer, to protect themselves and other workers against hazards or risks to safety and health from the production of iron and steel; and
- (iv) request, and be involved in, the assessment of hazards and risks to safety and health from hazardous factors to be conducted by the employer and/or by the competent authority. They should also have the right to be involved in relevant control measures and investigations.

3.5.8. Workers and their representatives should be involved in the introduction and development of workers' health surveillance, and should participate and cooperate with occupational health professionals, with their employers and with occupational health professionals in its implementation.

3.5.9. Workers should be informed in a timely, objective and comprehensible manner:

- (i) of the reasons for the examinations and investigations relating to the safety and health hazards involved in their work;
- (ii) individually of the results of medical examinations, including pre-assignment medical examinations, and of the respective health assessments. The results of medical examinations should be kept confidential in accordance with national legislation and should not be used to discriminate against workers.

3.5.10. Workers should have the right:

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- (i) to bring to the attention of their representatives, the employer or the competent authority hazards or risks to safety and health arising from the production of iron and steel;
  - (ii) to appeal to the competent authority if they consider that the measures taken and the means used by the employer are inadequate for the purpose of ensuring OSH at work;
  - (iii) to remove themselves from danger resulting from the production of iron and steel when they have reasonable justification to believe that there is an imminent and serious risk to their safety and health and that of other people. Such workers should inform their supervisor and/or safety and health representative immediately.
  - (iv) in the case of a safety or health condition that places them at increased risk of harm, to be transferred to alternative work not exposing them to that increased risk, if such work is available and if the workers concerned have the qualifications or can reasonably be trained for such alternative work;
  - (v) to receive adequate compensation if the case referred to in (iv) above results in loss of employment;
  - (vi) to be provided with adequate medical treatment and compensation for occupational injuries and diseases resulting from the production of iron and steel; and
  - (vii) to refrain from using or to shut down equipment or a process, or to refrain from using a substance which can reasonably be expected to be hazardous, if the relevant information is not available to assess the hazards or risks to safety and health.

3.5.11. Workers who remove themselves from danger in accordance with the provisions of paragraph 3.5.10(iii) should be protected against undue consequences in accordance with national conditions and practice.

3.5.12. Workers who justifiably take those actions specified in paragraph 3.5.10(i), (ii) and (vii) should be protected from unwarranted discrimination, for which there should be recourse in national laws and practice.

3.5.13. Workers and their elected safety and health representatives should receive appropriate education and training and, where necessary, retraining in the most effective methods available for minimizing risks to safety and health from the production of iron and steel, in particular in those areas referred to in Chapters [7-15] of this code.

3.5.14. Women workers should have the right, in the case of pregnancy or when breastfeeding, to alternative work not hazardous to the health of the unborn or nursing child, where such work is available, in order to prevent exposure to hazards during the production of iron and steel, and to return to their previous jobs at the appropriate time.

### **3.6. General responsibilities of suppliers, manufacturers and designers**

3.6.1. Measures should be taken to ensure that those who design, manufacture, import, provide or transfer machinery, equipment or substances for use in the iron and steel industry:

- (a) satisfy themselves that the machinery, equipment or substances do not entail dangers for the safety and health of those using them correctly;

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- (b) make available:
    - (i) information concerning the correct installation and use of machinery and equipment and the correct use of substances;
    - (ii) information concerning the hazards of machinery and equipment, the dangerous properties of hazardous substances and physical agents or products;
    - (iii) instructions on how known hazards are to be avoided.

### **3.7. General responsibilities and rights of contractors**

3.7.1. Contractors should comply with the arrangements established by the iron- and steel-making facility on site, which should:

- (a) include OSH criteria in procedures for evaluating and selecting contractors;
- (b) establish effective ongoing communication and coordination between appropriate levels of the facility and the contractor prior to commencing work, which should include provisions for communicating hazards and the measures to prevent and control them;
- (c) include arrangements for reporting work-related injuries and diseases, ill health and incidents among the contractors' workers while performing work for the facility;
- (d) provide relevant workplace safety and health hazard awareness and training to contractors or their workers prior to commencing work and as work progresses, as necessary;
- (e) regularly monitor OSH performance of contractor activities on site; and
- (f) ensure that on-site OSH procedures and arrangements are followed by the contractor(s).

3.7.2. When using contractors, the commissioning party should ensure that:

- (a) the same safety and training requirements apply to the contractors and their workers as to the workers in the establishment;
- (b) where required, only such contractors are used that have been duly registered or hold licences;
- (c) contracts specify safety and health requirements as well as sanctions and penalties in case of non-compliance. Contracts should include the right for supervisors mandated by the commissioning party to stop work whenever a risk of serious injury is apparent and to suspend operations until the necessary remedies have been put in place;
- (d) contractors who repeatedly violate their contractual obligations are excluded from future bidding.



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## **4. Occupational safety and health management systems; reporting, recording and notification of work-related injuries and diseases, ill health and incidents; occupational health services**

### **4.1. Introduction**

4.1.1. Numerous other principles contained in existing ILO instruments – too lengthy to reproduce in this text – are relevant to OSH in the iron and steel industry. These address: occupational safety and health management systems; reporting, recording and notification of work-related injuries and diseases, ill health and incidents; and occupational health services. The relevant instruments are listed and summarized in Annexes II, III and IV. They may be updated from time to time and users of this code should check for updated versions.

### **4.2. OSH management systems**

4.2.1. The process of improving working conditions in the iron and steel industry should be approached systematically. With a view to achieving acceptable environmentally sound conditions of OSH, it is necessary to invest in permanent structures for their continuous review, planning, implementation, evaluation and action. This should be done through the implementation of OSH management systems. The systems should be specific to the facilities and appropriate to their size and the nature of activities. Their design and application at national and facility levels should be guided by the ILO *Guidelines on occupational safety and health management systems*, ILO-OSH 2001.

4.2.2. Typically, an OSH management system should contain the following main elements:

- (a) OSH policy;
- (b) necessary conditions for the executing organization, i.e. establishment of responsibility and accountability, competence and training, documentation, communication and information;
- (c) hazard and risk assessment, planning and implementation of OSH activities;
- (d) evaluation of OSH performance and action for improvement.

### **4.3. Reporting, recording and notification of work-related injuries and diseases, ill health and incidents**

4.3.1. Likewise, in the establishment, review and application of systems for the reporting, recording and notification of work-related injuries and diseases, ill health and incidents (see Glossary for the assigned meanings), the competent authority should take account of the Employment Injury Benefits Convention, 1964 (No. 121), and its Schedule I, as amended in 1980, the ILO Protocol of 2002 to the Occupational Safety and Health Convention, 1981 (No. 155), the List of Occupational Diseases Recommendation, 2002 (No. 194), and the ILO code of practice *Recording and notification of occupational accidents and diseases*.

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4.3.2. Reporting, recording, notification and investigation of work-related injuries and diseases, ill health and incidents are essential for reactive monitoring and should be undertaken to:

- (a) provide reliable information about occupational accidents and diseases at facility and national level;
- (b) identify major safety and health problems arising from iron- or steel-making activities;
- (c) define priorities of action;
- (d) evolve effective methods for dealing with occupational accidents and diseases;
- (e) monitor the effectiveness of measures taken to secure satisfactory levels of safety and health.

#### **4.4. Occupational health services**

4.4.1. Consistent with the Occupational Health Services Convention, 1985 (No. 161), and Recommendation, 1985 (No. 171), the competent authority should make provision for the establishment of occupational health services –

- (a) by laws or regulations; or
- (b) by collective agreements or as otherwise agreed upon by the employers and workers concerned; or
- (c) in any other manner approved by the competent authority after consultation with the representative organizations of employers and workers concerned.

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## **PART II. SAFE IRON- AND STEEL-MAKING OPERATIONS**

### **5. Industry-specific prevention and protection**

#### **5.1. Hazards and health**

5.1.1. The choice and the implementation of specific measures for preventing workplace injury and ill health in the workforce of the iron and steel industry depend on the recognition of the principal hazards, and the anticipated injuries and diseases, ill health and incidents. Below are the most common causes of injury and illness in the iron and steel industry:

- (i) slips, trips and falls on the same level;
- (ii) falls from height;
- (iii) unguarded machinery;
- (iv) falling objects;
- (v) engulfment;
- (vi) working in confined spaces;
- (vii) moving machinery, on-site transport, forklifts and cranes;
- (viii) exposure to controlled and uncontrolled energy sources;
- (ix) exposure to asbestos;
- (x) exposure to mineral wools and fibres;
- (xi) inhalable agents (gases, vapours, dusts and fumes);
- (xii) skin contact with chemicals (irritants (acids, alkalis), solvents and sensitizers);
- (xiii) contact with hot metal;
- (xiv) fire and explosion;
- (xv) extreme temperatures;
- (xvi) radiation (non-ionizing, ionizing);
- (xvii) noise and vibration;
- (xviii) electrical burns and electric shock;
- (xix) manual handling and repetitive work;
- (xx) exposure to pathogens (e.g. legionella);

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- (xxi) failures due to automation;
  - (xxii) ergonomics;
  - (xxiii) lack of OSH training;
  - (xxiv) poor work organization;
  - (xxv) inadequate accident prevention and inspection;
  - (xxvi) inadequate emergency first-aid and rescue facilities;
  - (xxvii) lack of medical facilities and social protection.

## **5.2. Physical hazards**

### **5.2.1. Noise**

#### **5.2.1.1. Hazard description**

5.2.1.1.1. Exposure to noise levels exceeding those set by the competent authorities may result in noise-induced hearing loss. Exposure to high noise levels may also interfere with communication and may result in nervous fatigue with an increased risk of occupational injury.

#### **5.2.1.2. Assessment of risk**

5.2.1.2.1. The level of noise and/or duration of exposure should not exceed the limits established by the competent authority or by other recognized standards. The assessment should, as appropriate, consider:

- (a) the risk of hearing impairment;
- (b) the degree of interference to communications essential for safety purposes; and
- (c) the risk of nervous fatigue, with due consideration to the mental and physical workload and other non-auditory hazards or effects.

5.2.1.2.2. In order to prevent adverse effects of noise on workers, employers should:

- (a) identify the sources of noise and the tasks that give rise to exposure;
- (b) seek the advice of the competent authority and/or the occupational health service about exposure limits and other standards to be applied;
- (c) seek the advice of the supplier of processes and equipment about expected noise emission; and
- (d) if this advice is incomplete or otherwise of doubtful value, arrange for measurements by people who are competent to undertake these in accordance with current nationally and/or internationally recognized standards and regulations.

5.2.1.2.3. Noise measurements should be used to:

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- (a) quantify the level and duration of exposure of workers and compare it with exposure limits, as established by the competent authority or internationally recognized standards to be applied (see also Annex IV, section 8);
  - (b) identify and characterize the sources of noise and the exposed workers;
  - (c) create a noise map for the determination of risk areas;
  - (d) assess the need both for engineering noise prevention and control, and for other appropriate measures and their effective implementation; and
  - (e) evaluate the effectiveness of existing noise prevention and control measures.

### 5.2.1.3. Control strategies

#### 5.2.1.3.1. *General*

5.2.1.3.1.1. Based on the assessment of the exposure to noise in the working environment, the employer should establish a noise-prevention programme with the aim of eliminating the hazard or risk, or reducing it to the lowest practicable level by all appropriate means.

#### 5.2.1.3.2. *Workers' health surveillance, training and information*

5.2.1.3.2.1. Workers who may be exposed to noise levels exceeding occupational standards should receive regular audiometric testing.

5.2.1.3.2.2. Employers should ensure that workers who may be exposed to significant levels of noise are trained in:

- (a) the effective use of hearing-protection devices;
- (b) identifying and reporting on new or unusual sources of noise that they become aware of; and
- (c) the role of audiometric examination.

5.2.1.3.2.3. Employers should ensure that workers in noisy environments are informed of:

- (a) the results of their audiometric tests;
- (b) the factors leading to noise-induced hearing loss and the consequences for the victim, including non-auditory effects and social consequences, especially for young workers;
- (c) the precautions necessary, especially those requiring workers' intervention or the use of hearing-protection devices;
- (d) the effects that a noisy environment may have on their general safety; and
- (e) the symptoms of adverse effects of exposure to high levels of noise.

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### 5.2.1.3.3. *Isolation, substitution, engineering controls*

5.2.1.3.3.1. In the case of new processes and equipment, employers should, where feasible:

- (a) specify low noise output of the processes and equipment as a condition of purchase alongside production-related specifications; and
- (b) arrange the workplace layout to minimize noise exposure to the workers.

5.2.1.3.3.2. In the case of existing processes and equipment, employers should first consider whether the noisy process is necessary at all, or whether it could be carried out in another way without generating noise. If the elimination of the noisy process as a whole is not practicable, employers should consider replacing its noisy parts with quieter alternatives.

5.2.1.3.3.3. If the elimination of noisy processes and equipment as a whole is impracticable, their individual sources should be separated out and their relative contribution to the overall sound pressure level identified. Once the causes or sources of noise are identified, the first step in the noise-control process should be to attempt to control it at source. Such measures may also be effective in reducing vibration.

5.2.1.3.3.4. If prevention and control at source do not reduce exposure sufficiently, enclosure of the noise source should be considered as the next step. In designing enclosures, several factors should be taken into consideration if the enclosure is to prove satisfactory from both an acoustical and a production point of view, including workers' access and ventilation. Enclosures should be designed and manufactured in accordance with the requirements and needs indicated by the user, consistent with internationally recognized plant and equipment standards and regulations.

5.2.1.3.3.5. If enclosure of the noise source is impracticable, employers should consider an alternative sound transmission-path treatment using a barrier to block or shield the worker at risk from the noise hazard resulting from the direct path of the sound. Barriers should be designed and manufactured in accordance with the requirements and needs indicated by the user, consistent with internationally recognized plant and equipment standards.

5.2.1.3.3.6. If reducing the noise at source or intercepting it does not sufficiently reduce workers' exposure, then the final options for reducing exposure should be to:

- (a) install an acoustical booth or shelter for those job activities where workers' movement is confined to a relatively small area;
- (b) minimize by appropriate organizational measures the time workers spend in the noisy environment;
- (c) provide hearing protection;
- (d) offer audiometric testing.

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## **5.2.2. Vibration**

### 5.2.2.1. Hazard description

5.2.2.1.1. Exposure of workers to hazardous vibration is mainly known as:

- (a) whole-body vibration, when the body is supported on a surface that is vibrating, which occurs in all forms of transport and when working near vibrating industrial machinery; or
- (b) hand-transmitted vibration, which enters the body through the hands and is caused by various processes in which vibrating tools or work pieces are grasped or pushed by the hands or fingers.

5.2.2.1.2. Exposure limits should be established according to current international knowledge and data. Further detailed information can be found in Annex V, section 9.

### 5.2.2.2. Assessment of risk

5.2.2.2.1. If workers or others are frequently exposed to hand-transmitted or whole-body vibration, and obvious steps do not eliminate the exposure, employers should assess the hazard and risk to safety and health resulting from the conditions, and the prevention and control measures to remove them or to reduce them to the lowest practicable level by all appropriate means.

5.2.2.2.2. For the prevention of adverse effects of vibration on workers, employers should:

- (a) identify the sources of vibration and the tasks that give rise to exposure;
- (b) seek the advice of the competent authority about exposure limits and other standards to be applied;
- (c) seek the advice of the supplier of vehicles and equipment about their vibration emissions; or
- (d) if this advice is incomplete or otherwise of doubtful value, arrange for measurements by a technically capable person, to be carried out in accordance with recognized standards and regulations and currently available knowledge.

5.2.2.2.3. Vibration measurements should be used to:

- (a) quantify the level and duration of exposure of workers, and compare it with exposure limits as established by the competent authority or other standards to be applied;
- (b) identify and characterize the sources of vibration and the exposed workers;
- (c) assess the need both for engineering vibration control and for other appropriate measures, and for their effective implementation;
- (d) evaluate the effectiveness of particular vibration-prevention and vibration-control measures; and
- (e) if possible, determine the resonance frequencies.

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5.2.2.2.4. The assessment should identify the ways in which vibrating tools are used, and determine in particular whether:

- (a) the high-risk use of tools can be eliminated;
- (b) workers have had sufficient training in the use of the tools; and
- (c) the use of tools can be improved by supports.

5.2.2.2.5. With a view to establishing appropriate prevention and control measures, the assessment should take into account:

- (a) exposure to cold at the workplace, which can bring on symptoms of vibration white finger (Raynaud's phenomenon) in those exposed to vibration;
- (b) vibration of the head or eyes, as well as vibration of the displays themselves, which can affect the perception of displays; and
- (c) body or limb vibration which can affect the manipulation of controls.

### 5.2.2.3. Control strategies

#### 5.2.2.3.1. *Training and information*

5.2.2.3.1.1. Employers should ensure that workers who are exposed to significant vibration hazards are:

- (a) informed about the hazards and risks of prolonged use of vibrating tools;
- (b) informed about the measures within the workers' control which will minimize risk, particularly the proper adjustment of seating and working positions;
- (c) instructed in the correct handling and use of hand tools with a light but safe grip; and
- (d) encouraged to report finger blanching, numbness or tingling, without unwarranted discrimination, for which there should be recourse in national law and practice.

#### 5.2.2.3.2. *Isolation, substitution, engineering controls*

5.2.2.3.2.1. Manufacturers should:

- (a) provide vibration values for their tools;
- (b) redesign processes to avoid the need to use vibrating tools;
- (c) provide information to ensure that vibration is controlled by correct installation;
- (d) avoid resonance frequencies of the component parts of machinery and equipment; and
- (e) use, as far as practicable, anti-vibration handles.

5.2.2.3.2.2. When purchasing equipment and industrial vehicles, employers should ascertain that the vibration exposure to the user is within prescribed national standards and regulations.



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5.2.2.3.2.3. Where old machinery is still in use, sources of vibration that present a risk to safety and health should be identified and suitable modifications made by employing current knowledge of vibration-damping techniques.

5.2.2.3.2.4. Seating in vehicles, including static plant with integral seating, should be designed to minimize transmission of vibration to the rider, and should permit an ergonomically good working position.

5.2.2.3.2.5. Where workers are directly or indirectly exposed to vibration transmitted via the floor or other structures, the vibrating machines should be mounted on vibration isolators (anti-vibration mounts), installed according to the manufacturer's instructions or designed and manufactured according to internationally recognized plant and equipment standards.

5.2.2.3.2.6. Machinery or vibrating tools should be maintained regularly because worn components may increase vibration levels.

5.2.2.3.2.7. Where the exposure might lead to injury if workers continue work for a longer period, and reduction of the vibration is impracticable, the work should be rearranged to give rest periods or job rotation sufficient to reduce the overall exposure to a safe level.

### **5.2.3. Heat and cold stress**

#### 5.2.3.1. Hazard description

5.2.3.1.1. Risks arise in special conditions:

- (a) temperature and/or humidity are unusually high;
- (b) workers are exposed to high radiant heat;
- (c) high temperatures and/or humidity occur in combination with heavy protective clothing or a high work rate;
- (d) temperature is unusually low;
- (e) high wind speed (>5m/s) prevails with low temperature; work with bare hands is carried out for extended periods of time at low temperatures.

#### 5.2.3.2. Assessment of risk

5.2.3.2.1. If workers are exposed in all or some of their tasks to any conditions listed in paragraph 5.2.3.1, and the hazard cannot be eliminated, employers should assess the hazards and risks to safety and health from extreme temperatures, and determine the controls necessary to remove the hazards or risks or to reduce them to the lowest practicable level.

5.2.3.2.2. Workers should be allowed sufficient time to acclimatize to a hot environment, including major changes in climatic conditions.

5.2.3.2.3. The assessment for the thermal environment should take into account the risks arising from working with hazardous substances in work situations such as:

- (a) the use of protective clothing against hazardous substances, thereby increasing the risk of heat stress;

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- (b) a hot environment that makes respiratory protectors uncomfortable and less likely to be used, and necessitates restructuring of jobs in order to reduce the risks, for example by:
    - (i) minimizing exposure to the hazardous substances so that there is less need for protective clothing;
    - (ii) changing the tasks so that the work pace is reduced in hot conditions; and
    - (iii) increasing the number of rest periods and job rotation.

5.2.3.2.4. In assessing the hazards and risks, employers should:

- (a) make comparisons with other similar workplaces where measurements have been made;
- (b) where this is not practicable, arrange for measurements to be performed by a technically capable person, using appropriate and properly calibrated equipment;
- (c) seek the advice of the occupational health service or a competent body about exposure standards to be applied (see also Annex V, section 7); and
- (d) bear in mind that the quality of fine work done by hand is adversely affected by cold temperatures.

### 5.2.3.3. Control strategies

#### 5.2.3.3.1. *Training and information*

5.2.3.3.1.1. Workers exposed to heat or cold, as well as their supervisors, should be trained:

- (a) to recognize symptoms which may lead to heat stress or hypothermia, in themselves or others, and the steps to be taken to prevent onset and/or emergencies;
- (b) in the use of rescue and first-aid measures; and
- (c) in action to be taken in the event of increased risks of accidents because of high or low temperatures.

5.2.3.3.1.2. Workers should be advised of:

- (a) the importance of physical fitness for work in hot or cold environments; and
- (b) the importance of drinking sufficient quantities of suitable liquid and the dietary requirements providing intake of salt and potassium and other elements that are depleted due to sweating.

#### 5.2.3.3.2. *Isolation, substitution, engineering controls*

5.2.3.3.2.1. When the assessment reveals that the workers may be at risk of heat stress or hypothermia, employers should, if practicable, eliminate the need for work in such conditions or, if this is not feasible, take measures to reduce the risks from extreme temperatures.

5.2.3.3.2.2. Where workers are at risk from exposure to radiant heat by working near hot surfaces:

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- (a) the employer may increase the distance between the equipment (taking care not to do so to the detriment of other workplaces) and the exposed workers;
  - (b) when this is not practicable, the employer should reduce the temperature of the surface by changing plant-operating temperatures, insulating the surfaces or reducing the emissivity of the surface.

5.2.3.3.2.3. Where the reduction of surface temperature is not practicable, employers should consider:

- (a) the use of radiation barriers (of low conductivity and high emissivity) between the surface and the workplace, and maintain them in a clean state;
- (b) water-cooling the hot surfaces, where practicable;
- (c) the use of portable reflective shielding; or
- (d) arranging for remote control operations.

5.2.3.3.2.4. Where the assessment shows that unhealthy or uncomfortable conditions arise from increased air temperature, the employer should implement means to reduce air temperature, which may include ventilation or air cooling.

5.2.3.3.2.5. Employers should take particular care with ventilation design where work is undertaken in enclosed spaces or areas. When fail-safe systems are not in operation, there should be adequate supervision of workers at risk to ensure that they can be removed from danger.

5.2.3.3.2.6. Where part of the risk arises from the metabolic heat produced during work, and other methods of eliminating the risk are impracticable, employers should arrange a work-rest cycle for exposed workers, either in the workplace or in a cooler restroom. The rest periods should be as prescribed by the competent authority and sufficient to allow the worker to recover (see Annex V, paragraph 7.2). Employers should ensure that appropriate mechanical aids are available to reduce workloads and that tasks performed in hot environments are well designed ergonomically to minimize physical stress.

5.2.3.3.2.7. Where other methods of controlling thermal risk, including a work-rest regime, are not practicable, employers should provide protective clothing. In the selection of protective clothing, consideration may be given to the following:

- (a) reflective clothing where heat gain is mostly by radiation;
- (b) insulated clothing with reflective surfaces during simultaneous exposure to high radiant heat and hot air (allowing freedom of movement to perform tasks); or
- (c) air-, water- or ice-cooled clothing in other instances as a possible complement to (a) and (b) above.

5.2.3.3.2.8. Where failure of the protective clothing could expose the worker to extremes of temperature, the clothing should be carefully selected and its use monitored by a technically capable person, taking account of the environmental conditions. A system should be installed to ensure that any failure of the cooling system is immediately detected and the worker removed from the environment.

5.2.3.3.2.9. For hydration maintenance, employers should make available sufficient quantities of drinking water, with the proper electrolytes, where appropriate.

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5.2.3.3.2.10. Where a residual risk of heat stress remains even after all the control measures have been taken, workers should be adequately supervised so that they can be withdrawn from the hot conditions if symptoms occur. Employers should ensure that first-aid facilities, and staff trained in the use of such facilities, are available.

5.2.3.3.2.11. Extra care should be taken when workers are required to move from a very hot working environment to a much colder one, especially when exposed to strong wind, as the “wind-chill factor” can result in exposed flesh cooling very rapidly.

5.2.3.3.2.12. Workers should be protected against the severest forms of cold stress, hypothermia and cold injury.

5.2.3.3.2.13. The core body temperature should not be allowed to fall below 36°C (96.8°F). Suitable protection should be provided to prevent injury to bodily extremities.

## **5.2.4. Ionizing radiation**

5.2.4.1. Ionizing radiation is produced when atoms break up. The energy released in this process takes a number of forms which have typical wavelength and frequency, energy and penetrating power (see definition in Annex V, section 6). Alpha, beta and gamma radiation have sufficient energy to alter other atoms and are termed ionizing radiation.

5.2.4.2. All exposure to ionizing radiation should be kept as low as possible, as there is evidence that damage caused by radiation may be permanent, and that there is a significant increase in the incidence of cancer and some types of malignancies, as a consequence of even low doses of ionizing radiation.

### **5.2.4.3. Hazard description**

5.2.4.3.1. Materials with levels of radiation above the normal background level come particularly from: nuclear power stations; military scrap; radiographic sources; industrial radiography; medical isotopes; and other research equipment, etc. Exposure to these materials may lead to serious illnesses, including cancer.

5.2.4.3.2. Other sources of potential concern include: luminous gauges; gas/smoke detectors; depleted uranium ballast from old aircraft; scrap arising from offshore drilling work; and the pipes or tubes used in the extractive industries, usually referred to as “normally occurring radioactive materials (NORM)”. The inhalation of dust from furnaces may, if containing radioactive particles, cause fatal diseases.

### **5.2.4.4. Assessment of risk**

5.2.4.4.1. Employers should take the necessary steps to protect workers from being exposed to levels of radiation above the normal background level as a result of the illegal disposal of contaminated scrap.

### **5.2.4.5. Control strategies**

#### **5.2.4.5.1. Training and information**

5.2.4.5.1.1. Workers should be instructed so as to be able to operate the appropriate detection equipment and identify any suspect material.

5.2.4.5.1.2. Workers should be trained in the hazards of exposure to radiation and the measures to be taken if they encounter material they suspect to be radioactive.

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#### 5.2.4.5.2. *Isolation, substitution, engineering controls*

5.2.4.5.2.1. Employers who receive recycled scrap should be equipped with the means to detect radiation. Suppliers should also verify that they have the necessary systems to ensure that scrap supplies are not contaminated with radioactive material. The competent authority should determine the conditions or manner in which radioactive scrap material is present in scrap to be recycled.

5.2.4.5.2.2. Any materials that are suspected to be radioactive should be isolated, and plans for appropriate disposal through the requirements established by the competent authority should be strictly adhered to.

#### 5.2.4.5.3. *Work practices and procedural controls*

5.2.4.5.3.1. Large-scale recycling operations should monitor incoming raw scrap for radioactivity prior to it entering the factory. All recycling enterprises should purchase their scrap material through reliable suppliers.

5.2.4.5.3.2. Suspected radioactive material should not be handled but should be left in place for disposal by a competent service. The competent authority should be contacted immediately for advice on handling and disposal.

### **5.2.5. Non-ionizing radiation**

#### 5.2.5.1. Hazard description

5.2.5.1.1. Non-ionizing radiation is usually referred to as ultraviolet (UV), visible and infrared (IR) radiation (see definition in Appendix V, section 5).

5.2.5.1.2. Absorption in the UV and visible portions of the spectrum produces photochemical reactions. In the IR region, all of the absorbed radiant energy is converted into heat. Exposure to some radio-frequency and microwave radiation can result in the formation of cataracts of the eye.

5.2.5.1.3. Exposure of the eyes to visible and IR radiation can cause thermal injury to the retina and damage to the lens, which may result in the formation of cataracts.

5.2.5.1.4. The greatest source of UV radiation is solar radiation and overexposure may lead to cancer. Artificial sources include incandescent, fluorescent and discharge types of light sources, electric arc welding equipment, plasma torches and lasers.

5.2.5.1.5. Exposure of the eyes to UV radiation can result in inflammation of the conjunctiva and cornea.

#### 5.2.5.2. Assessment of risk

5.2.5.2.1. Exposure limits (ELs) for optical radiation are to be established for the various kinds of radiation. The publication, *Threshold limit values for chemical substances and physical agents and biological exposure indices* (Cincinnati, Ohio, American Conference of Governmental Industrial Hygienists, ACGIH, 1997), recommends that:

- (a) ELs for UV radiation be in terms of the radiant flux density (or irradiance) of the radiation at the eye, in  $\text{mW}/\text{cm}^2$ , weighted according to the wavelength of the radiation;

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- (b) ELs for visible light be in terms of the radiance of the source, i.e. the energy output per unit area of the source into each solid angle, weighted according to the wavelength of the radiation; and
  - (c) ELs for IR radiation be in terms of the radiant flux density at the eye, in  $\text{mW}/\text{cm}^2$ , and unweighted for wavelength. However, for IR heat lamps there is also a limit in terms of the source's radiance.

5.2.5.2.2. The *Guidelines on protection against non-ionizing radiation* (Fonteny-aux-Roses, France, International Radiation Protection Association (IRPA), 1991) include ELs for lasers to protect the eye and skin. They are generally in terms of the energy density reaching the eye or skin (that is, in  $\text{J}/\text{m}^2$ , equal to the radiant flux density in  $\text{W}/\text{m}^2$  multiplied by the exposure time in seconds). The ELs vary with wavelength, and for visible and IR wavelengths are relaxed slightly as exposure time increases. Guidance on their use and further references on limits of exposure to laser radiation are given in the practical guide, *The use of lasers in the workplace*, Occupational Safety and Health Series, No. 68 (Geneva, ILO, 1993). Control measures, however, are more easily specified in terms of the class of laser used than in terms of the ELs. The laser classification is specified in IEC 60 825-1: *Safety of laser products – Part 1: Equipment classification, requirements and users' guide* (Geneva, International Electrotechnical Commission (IEC), 1993).

5.2.5.2.3. Electrical and magnetic fields are found around all equipment that passes an electric current. Static charges are created around a fixed charge, such as a visual display unit screen, or a fixed magnetic field.

5.2.5.2.4. Some studies have shown that exposure to magnetic fields can cause certain types of cancers and brain tumours. They can also affect a person's mood, alertness, heart function, and the immune and reproductive systems; some individuals suffer from skin irritation in the presence of electrical fields. Workers who rely on pacemakers should not be employed in areas where they may be exposed to magnetic fields, based on a risk assessment.

5.2.5.2.5. Unlike electric fields, magnetic fields cannot be easily screened off, as they can pass through all materials. However, the power of the field rapidly diminishes as the distance from the source of the magnetic field increases. Consequently, where risk assessment indicates that it involves an unacceptable risk, it is advisable to shut down all electrical equipment when not in use. Fixed installations which generate high-strength fields, such as transformers and switching stations, should be sited as far away from workstations as possible. Encapsulating the source using an alloy that is a good magnetic conductor can also reduce the effects of strong magnetic fields, as can shielding the workstation with a suitably absorbent material such as aluminium that has been welded into a continuous or single sheet.

5.2.5.2.6. Employers should identify all the sources and potential risk of exposure by "mapping" the field strength in the workplace.

## **5.3. Chemical hazards**

### **5.3.1. Chemicals in the workplace**

#### **5.3.1.1. Hazard description**

5.3.1.1.1. A chemical substance is a compound or mixture which may be present in the workplace in the form of a liquid, solid (including particles) or gas (vapour). These

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substances may present a hazard as the result of contact with the body or absorption into the body. Absorption can occur through the skin, by ingestion or by inhalation.

5.3.1.1.2. Chemicals can have acute (short-term) and/or chronic (long-term) health effects.

5.3.1.1.3. Chemicals may present a safety hazard as a result of their chemical and physical properties.

#### 5.3.1.2. Assessment of risk

5.3.1.2.1. Workers may be exposed to chemicals in production work by addition to the process, as well as to chemicals generated by the process or used in maintenance activities, and to chemicals actively during their use in laboratory work.

5.3.1.2.2. Exposure may occur passively due to the presence of chemicals in the workplace environment.

5.3.1.2.3. The advice of the competent authority and workers' representatives should be sought regarding exposure limits and other standards to be applied.

5.3.1.2.4. Material safety data sheets that include advice on the safe handling of any chemical to ensure adequate prevention and protection should be readily available. All those concerned with the storage and handling of chemicals, and with general housekeeping, should be trained and should adopt safe systems of work at all times. The *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS) (United Nations, 2003) provides guidance on the preparation of labels, material safety data sheets and the provision of information to workers.

5.3.1.2.5. The production of material safety data sheets in electronic format should be encouraged. Chemical safety data sheets should, as a minimum, meet the requirements of the competent authority and are recommended to contain the following core information:

- (a) identification of manufacturer, product and ingredients;
- (b) physical and chemical properties, and information on the health effects, physical hazards, environmental impact and relevant exposure limits; and
- (c) recommendations concerning safe work practices; transport, storage and handling; waste disposal; protective clothing and PPE; first aid, fire-fighting and chemical spills.

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

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

5.3.1.2.7. The ILO code of practice *Safety in the use of chemicals at work* (Geneva, 1993) provides comprehensive guidance on the above issues for chemicals and their use.

5.3.1.2.8. For further information on chemical hazards, see Annex VI.

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### 5.3.1.3. Control strategies

#### 5.3.1.3.1. *Training and information*

5.3.1.3.1.1. Employers should ensure that:

- (a) workers involved are trained and competent in terms of proper laboratory techniques;
- (b) workers are informed about the hazards related to the chemicals which they use, or to which they may be exposed;
- (c) current material safety data sheets for those chemicals found in the workplace are readily available; and
- (d) workers and/or trained first-aid personnel are aware of emergency procedures related to exposure to hazardous chemicals.

#### 5.3.1.3.2. *Isolation, substitution, engineering controls*

5.3.1.3.2.1. The employer should ensure:

- (a) proper storage of chemicals by: (i) storing separately chemicals which react with one another; (ii) minimizing volumes of stored chemicals; (iii) providing for containment of spills; and (iv) ventilating storage areas;
- (b) that, where hazardous chemicals are used, handled or stored, measures are in place to minimize workers' exposure (e.g. ventilated fume hoods, remote handling);
- (c) that, where necessary, appropriate PPE is provided and workers are trained in its correct use, and it is used properly;
- (d) that emergency showers and eyewash stations are available where hazardous chemicals are used and/or stored;
- (e) the cleaning of work clothes that have been polluted by chemicals; and
- (f) the provision of appropriate hygienic conditions in facilities where food is consumed.

### **5.3.2. Inhalable agents (gases, vapours, dusts and fumes)<sup>1</sup>**

#### 5.3.2.1. Hazard description

5.3.2.1.1. The production of iron and steel involves the consumption and generation of a variety of inhalable agents including, but not limited to, gases, vapours, dusts, fumes, smokes and aerosols. These agents comprise a variety of toxicological hazards including irritants, chemical asphyxiants, fibrogens, allergens, carcinogens and systemic toxicants.

5.3.2.1.2. The pulmonary system (lungs) can be affected by exposure to harmful agents through acute (short-term) injury to lung tissue, the development of pneumoconiosis, pulmonary dysfunction and the development of lung cancer. Certain

<sup>1</sup> Further specific information and recommendations for different gases and other compounds can be found in Annex VI.



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harmful agents that are inhaled through the lungs can cause target organ damage and/or systemic toxic effects. Certain asphyxiants can cause death in a matter of seconds at high concentrations by displacing oxygen.

5.3.2.1.3. Specific agents that may be found in the iron and steel industry include heavy metals (e.g. lead, chromium, zinc, nickel and manganese) in the form of fumes, particulates and adsorbates on inert dust particles. Acid mists from pickling areas can cause skin, eye and respiratory irritation. For further information, see sections 5.3.3 and 5.3.4 for a detailed review of asbestos and insulation wool, respectively. It is important to consider the solubility of metals and their compounds when addressing risk.

### 5.3.2.2. Assessment of risk

5.3.2.2.1. The assessment of risk should begin with a review of production and maintenance processes in order to understand the content, form and volume of inhalable agents associated with the production of iron and steel, including intermediates, by-products and waste. This should include information acquired from suppliers for materials brought on site through the use of material safety data sheets (see section 5.3.1.2).

5.3.2.2.2. The potential for exposure should be assessed according to the provisions of the ILO codes of practice *Safety in the use of chemicals at work* and *Ambient factors in the workplace*, or another protocol of equal or greater value, such as the application of an exposure assessment protocol from a competent authority.

5.3.2.2.3. Exposure assessment activities should be conducted by competent persons.

5.3.2.2.4. Employers should provide information to workers and their representatives regarding the risk assessment process, and inform them of the results of risk assessments.

5.3.2.2.5. When necessary, employers should seek the advice of the competent authority about exposure limits relating to inhalable agents.

### 5.3.2.3. Control strategies

#### 5.3.2.3.1. *Training and information*

5.3.2.3.1.1. Workers and their representatives should be made aware of the toxicological properties, technical means of prevention, safe working procedures, protective equipment and emergency procedures necessary to eliminate exposure. Where it is not possible, exposure to harmful inhalable agents with which they work or may come in contact should be minimized.

5.3.2.3.1.2. Training should be provided in advance of the work, including production or maintenance process changes that result in the use or generation of different inhalable agents.

5.3.2.3.1.3. Training should specify special precautions to be taken for workers who perform work in confined spaces that might contain harmful inhalable agents. See section 5.4.1 for additional information on safe work practices involving confined spaces.

#### 5.3.2.3.2. *Isolation, substitution, engineering controls*

5.3.2.3.2.1. Employers should develop and implement engineering controls for harmful inhalable agents. Such controls include, but are not limited to: the substitution of more harmful agents by less harmful agents; isolating processes that generate such airborne contaminants; and the use of local and general ventilation systems.

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5.3.2.3.2.2. See the ILO codes of practice *Safety in the use of chemicals at work* and *Ambient factors in the workplace* for additional direction in the development and implementation of engineering controls.

#### 5.3.2.3.3. *Work practices and procedural controls*

5.3.2.3.3.1. When engineering controls are not feasible or sufficiently effective to ensure that exposure to inhalable agents is maintained at or below exposure limits, work practices and procedural controls should be applied. These might include, but are not limited to: altering temperature, pressure and other process settings; and minimizing the length of time that workers are potentially exposed to inhalable agents.

5.3.2.3.3.2. See the ILO codes of practice *Safety in the use of chemicals at work* and *Ambient factors in the workplace* for additional direction in the development and implementation of engineering controls.

### **5.3.3. Asbestos**

#### 5.3.3.1. Hazard description

5.3.3.1.1. Exposure to asbestos may cause diseases of the respiratory and digestive tracts, through inhalation or ingestion, and may cause secondary disease in a number of vital organs.

5.3.3.1.2. The effects of exposure to asbestos may not become apparent for two or three decades, or even longer. However, the diseases caused by exposure to these substances, such as asbestosis and mesothelioma, once diagnosed are irreversible, disabling and frequently fatal.

#### 5.3.3.2. Assessment of risk

5.3.3.2.1. If a worker could be exposed to asbestos, the employer should develop and implement an exposure control plan.

5.3.3.2.2. The employer should ensure that the administration of this plan is undertaken by a competent person in accordance with the requirements of the competent authority.

5.3.3.2.3. The employer should ensure that an inventory of all known asbestos-containing materials at the facility is prepared and kept current, and that these materials are identified by signs, labels or, when this is not practicable, other effective means. Where the presence of asbestos is not known, the material should be tested before it is touched.

5.3.3.2.4. The employer should ensure that a risk assessment on asbestos-containing material identified in the inventory is conducted by a competent person. Regard should be given to the condition of the material, its friability, accessibility, and likelihood of damage, and the potential for fibre release and exposure of workers.

#### 5.3.3.3. Control strategies

5.3.3.3.1. The employer should ensure that asbestos-containing material is controlled by removal, enclosure or encapsulation, to prevent the release of asbestos fibre.

5.3.3.3.2. The employer should not allow any work that would disturb asbestos-containing material, unless necessary precautions have been taken to protect workers.

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5.3.3.3.3. If a worker may be exposed to asbestos, the employer should ensure that:

- (a) a survey is conducted to assess the potential for exposure;
- (b) if the survey reveals that workers may be at risk of exposure to asbestos, air sampling is conducted to assess the potential for exposure;
- (c) workplace exposure monitoring and assessment are conducted using occupational hygiene methods and in laboratories that are acceptable to the competent authority;
- (d) the results of the monitoring and assessment, or a summary of the results, are provided to the workers and their representatives without undue delay; and
- (e) workers exposed to asbestos are given periodic medical examinations.

5.3.3.3.4. The employer should retain all records of asbestos-containing materials inventories and risk assessments, inspections, and air monitoring results.

#### 5.3.3.3.5. *Training and information*

5.3.3.3.5.1. The employer should ensure that any worker who may be at risk of exposure is adequately instructed and trained in:

- (a) the hazards of asbestos;
- (b) the means of identifying asbestos-containing material;
- (c) the work procedures to be followed, which should be approved by the competent authority, and provided to the workers and their representatives in written or other suitable form;
- (d) the correct use of the operation of engineering controls and PPE; and
- (e) the purpose and significance of any required health monitoring.

#### 5.3.3.3.6. *Isolation, substitution, engineering controls*

5.3.3.3.6.1. The employer should ensure that procedures for handling or using asbestos-containing material prevent or minimize the release of asbestos fibres. The procedures should address:

- (a) the containment of asbestos;
- (b) the control of the release of asbestos, particularly sweeping, grinding and blowing material that is known to contain asbestos;
- (c) the provision, use and maintenance of PPE and clothing;
- (d) means of decontamination of workers; and
- (e) the removal of asbestos waste and clean-up of asbestos waste material.

5.3.3.3.6.2. The procedures should provide the workers with task-specific work direction that addresses hazards and necessary controls.

5.3.3.3.6.3. Asbestos should not be used where it is banned by law or regulation. In countries where asbestos is allowed the employer should, nonetheless, substitute asbestos by less hazardous materials. If such substitution is not practicable, the employer should

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document the reasons why substitution cannot be made and make this documentation available to the workers, their representatives and the competent authority.

5.3.3.3.6.4. The employer should establish and ventilate containment areas where asbestos may be present, so that:

- (a) air flows only from clean outside areas into the contaminated area; and
- (b) exhaust air from the contaminated area is directed through a high-efficiency particulate air (HEPA) filter.

5.3.3.3.6.5. The employer should provide local exhaust ventilation with exhaust air discharge through a HEPA filter for all dust-producing activities outside containment areas where asbestos-containing dust is present.

5.3.3.3.6.6. Asbestos-containing material that is to be disturbed should be effectively wetted before and during the work, whenever practicable.

#### **5.3.4. Insulation wools**

5.3.4.1. The term “insulation wool” refers to that group of products that includes glass wool, rock wool, refractory ceramic fibres (RCFs), refractory fibres other than RCFs and special-purpose glass fibres.

##### **5.3.4.2. Hazard description**

5.3.4.2.1. Insulation wools have mechanical irritant properties and may pose a threat of disease to the eyes, skin and upper respiratory tract. However, some of the effects of exposure to insulation wools may not become apparent for two or three decades, or even longer.

5.3.4.2.2. RCFs, particularly those containing amorphous silica, have the potential to be converted to crystalline silica where they have been exposed to heat in excess of 1,000°C (1,800°F), for an extended period of time. Where RCFs have been exposed to heat, they should be treated with the same precautions as if they had undergone conversion to crystalline silica. Respirable RCFs may also cause cancer in exposed workers.

##### **5.3.4.3. Assessment of risk**

5.3.4.3.1. Employers in the user and removal industries 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.

5.3.4.3.2. 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.

5.3.4.3.3. 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 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 PPE.

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#### 5.3.4.4. Control strategies

5.3.4.4.1. Employers should provide the equipment, including PPE, necessary for the handling of insulation wools, and offer appropriate washing and changing facilities for workers exposed to insulation wools.

5.3.4.4.2. Employers should ensure periodic medical examinations for workers exposed to insulation wools.

5.3.4.4.3. 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.

5.3.4.4.4. Where reasonably practicable, respirable RCFs should be replaced by less hazardous materials.

5.3.4.4.5. 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.

5.3.4.4.6. Whenever two or more employers undertake activities simultaneously at one workplace, they should cooperate in applying these provisions, without prejudice to the responsibility of each employer for the safety and health 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.

5.3.4.4.7. 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 here and in the ILO code of practice *Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)* (Geneva, 2001).

5.3.4.4.8. Material safety data sheets and labels, as well as other product information on safety and health 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.

5.3.4.4.9. Suppliers and importers, as the link between manufacturers and users, 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.

5.3.4.4.10. Employers should provide exposed workers information and training on the hazards and health risks of insulation wools and on safe handling procedures.

5.3.4.4.11. 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.

5.3.4.4.12. Specifiers should choose insulation wools which:

- (a) meet the necessary insulation requirements; and

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- (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.

5.3.4.4.13. 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.

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

## **5.4. Safety hazards**

### **5.4.1. Confined space**

#### **5.4.1.1. Hazard description**

5.4.1.1.1. A confined space is one that is large enough for the worker to enter bodily, has limited or restricted means of entrance or exit and is not designed for continuous employee occupancy, on a space which may accumulate a hazard which is present. Examples of temporary occupancy might entail a person performing repairs on a furnace or servicing a fuel tank or trailer, sump, silo or bunker. Employers should be especially vigilant about all OSH hazards that may exist in a confined space, in particular the build-up of toxic or flammable gases, oxygen displacement and engulfment. Confined spaces require additional safety and health precautions because their configurations hinder the activities of any workers who must enter, work in and exit from them. A confined space often has poor air quality. In addition, many fatalities occur to rescue personnel who respond without adequate planning and protection.

#### **5.4.1.2. Assessment of risk**

5.4.1.2.1. The employer should:

- (a) seek the advice of an OSH service or of the competent authority regarding compliance with national legislation and regulation;
- (b) identify, test and inspect the confined spaces in the workplace and determine if workers are required to enter and work in them;
- (c) where entry is not required, prevent unauthorized or inadvertent entry into a confined space by posting warning signs, locking and securing, or other measures as necessary, to ensure that people do not enter without proper protection and supervision;
- (d) where entry is required by a person, fully characterize, through testing and inspection, all existing and potential hazards in the confined space (hazards can be classified as mechanical, electrical, oxygen depletion or enrichment, flammable or combustible vapours and gases, and toxic gases and vapours), including blanking off or bleeding all supply systems to the confined space; and
- (e) where there is a reason to believe that conditions have changed, re-evaluate the confined space.

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### 5.4.1.3. Control strategies

#### 5.4.1.3.1. *Training and information*

5.4.1.3.1.1. The employer should:

- (a) inform and train workers entering and working in the confined space of the hazards, protective measures and emergency rescue procedures;
- (b) inform the other employers (contractors) on site that the workplace contains hazardous confined spaces and of any precautions and protective measures that are necessary to protect workers in or near the space; and
- (c) train workers in the vicinity about confined space entry and about rescue procedures.

#### 5.4.1.3.2. *Isolation, substitution, engineering controls*

5.4.1.3.2.1. The employer should:

- (a) where entry is required by a worker, ensure that all hazards in the space are eliminated or controlled, and provide PPE, including appropriate rescue devices, to ensure adequate protection of the worker; and
- (b) purge, flush or ventilate the hazardous confined space, as necessary, to eliminate or control the hazards, and take adequate measures to ensure that no hazardous substances can enter the confined space while people are working there.

#### 5.4.1.3.3. *Work practice and procedural controls*

5.4.1.3.3.1. The employer should:

- (a) develop a comprehensive programme and procedures to address work in a confined space;
- (b) be aware of any work task to be performed in a confined space, and implement the necessary procedures to monitor the work and its completion;
- (c) provide adequate work permits for workers; and
- (d) supervise compliance with mandatory working procedures.

5.4.1.3.3.2. In the iron and steel industry, many foundries have confined spaces where concentrations of harmful agents in the air may be significantly higher than the permissible exposure levels if controls in the workplace are inadequate. Both furnace operators and maintenance personnel are at increased risk of exposure in confined spaces.

5.4.1.3.3.3. Potentially hazardous confined spaces should be clearly marked with warning notices prohibiting unauthorized entry.

5.4.1.3.3.4. Because of the explosion hazard inherent in some confined spaces, compressed air should not be used for artificial ventilation if there is a potential for sources of ignition. Compressed gas cylinders should be excluded from these spaces for the same reason.

5.4.1.3.3.5. All potential sources of ignition should be prevented from entering a confined space that may contain a flammable/combustible atmosphere. In particular, the

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precautions should include clothing, tools, lighting, smoking materials and electrical apparatus.

5.4.1.3.3.6. Where a potential for a flammable/combustible atmosphere exists, only certified non-sparking electrical apparatus and fixtures should be used.

5.4.1.3.3.7. An appropriate system, including tags and locks, should be used to ensure that no personnel enter a confined space without authorization, and that no personnel or equipment remain in the confined space before any openings are resealed or power and process piping reconnected.

5.4.1.3.3.8. Employers should develop and ensure implementation of emergency procedures, including provision for prompt rescue from the hazardous confined space, to address any foreseeable accidents.

5.4.1.3.3.9. Workers in the hazardous confined space should be closely monitored by personnel outside the space to ensure that safe entry conditions are maintained. Such personnel should have the training and equipment to effect a safe rescue or to initiate a prompt and safe rescue by others.

#### **5.4.1.3.4. Personal protective equipment and respirators**

5.4.1.3.4.1. Employers should provide workers entering a confined space with appropriate respirators and other PPE to control hazards in the confined space, and training on PPE use in confined spaces.

### **5.4.2. Control of hazardous energy**

5.4.2.1. The iron and steel industry regularly uses different sources of energy (electric, mechanical, hydraulic, pneumatic, etc.). The safe control of energy should be addressed by procedure and carried out by appropriately trained personnel in accordance with the nature of the energy source and the characteristics of the facilities. To the extent possible, the source of energy itself should be isolated rather than the control mechanism. Energy sources for equipment should be turned off or disconnected or de-energized and the switch locked or labelled with a warning tag.

5.4.2.2. Employers should identify and implement specific procedures for the control of hazardous energy. These procedures should include:

- (a) preparation for shutdown;
- (b) shutdown;
- (c) equipment isolation;
- (d) lock-out or tag-out application;
- (e) release of stored energy and safe positioning of workers;
- (f) verification of isolation;
- (g) appropriate tools and protective equipment;
- (h) performing the work;
- (i) planning for re-energizing;



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- (j) accounting for exposed workers; and
  - (k) removal of lock-out/tag-out device.

5.4.2.3. Workers working in the hazard area should be trained in the hazard and the protective measures in place.

5.4.2.4. Contractors working on equipment or systems should be informed of lock-out/tag-out procedures, and be required to follow the predominant lock-out/tag-out procedures in the facility. Contractors should report to the plant supervision before starting their job.

5.4.2.5. All electrical installations should be appropriately designed and should include appropriate protection systems, such as automatic shut-off systems, interlocks and emergency controls.

5.4.2.6. All electrical installations should be installed or maintained by certified personnel.

5.4.2.7. Facilities should be installed and used in accordance with the requirements of the manufacturer and in compliance with the competent authority.

5.4.2.8. The energy distribution facilities should be appropriately situated and protected, and access limited to authorized personnel only.

5.4.2.9. Energy sources and facilities should be appropriately labelled.

5.4.2.10. A risk assessment should be conducted before isolating the energy source to ensure that the consequences have been evaluated.

5.4.2.11. All facilities and equipment undergoing servicing, renovation or maintenance should be appropriately isolated, locked out and labelled to ensure that all persons are protected.

5.4.2.12. There should be the appropriate documentation on pipes and cables and they should be properly labelled. Pipes and cables not in use should be removed as soon as possible.

### **5.4.3. Work equipment and machinery guarding**

#### 5.4.3.1. Hazard description

5.4.3.1.1. The use of work equipment, including machinery and hand and portable power tools, may result in accidents, many of which are serious and some fatal. Of the many factors that can cause risk, particular areas of concern include:

- (a) a lack of guards or inadequate guards on machines which can lead to accidents caused by entanglement, sheering, crushing, trapping, cutting, etc.;
- (b) failure to keep guards, safety devices, controls, etc., properly maintained and in place so that the machines or equipment become unsafe;
- (c) the lack of appropriate safety systems, interlocks or other automatically functioning safety devices and emergency stopping devices;
- (d) insufficient strength of materials and inappropriate design of machines;

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- (e) failure to provide the right information, instruction and training for those using the equipment;
  - (f) hammers with broken or cracked handles, chisels and punches with mushroom heads, bent or broken wrenches and wrenches with sprung jaws should not be used by employees;
  - (g) most hand-held electrical power tools should be equipped with a “dead man” or “quick release” control, so that the power is automatically shut off wherever the operator releases the control;
  - (h) all hand-held portable electrical equipment should have its frame earthed or be doubly insulated and identified as such;
  - (i) all power tools should be used with appropriate shields, guards and attachments and in accordance with the recommendations of the manufacturers. Workers should be trained in the use of power tools and safety requirements;
  - (j) pneumatic power tools should be positively secured to the hose to prevent the tool from becoming disconnected; also, a tool retainer should be used on tools to prevent the attachment from being disconnected;
  - (k) nailers, staplers, and similar equipment with automatic feed should have a muzzle to prevent the tool from ejecting material unless the muzzle is in contact with the work surface.

5.4.3.1.2. Industrial robots present special hazards, in that they may move in unanticipated ways owing to complex or faulty programming.

#### 5.4.3.2. Role of employer

5.4.3.2.1. Controlling risks often means guarding those parts of machines and equipment that could cause injury. Many accidents happen because of the failure to select the right equipment for the work to be done. Planning ahead can control risks and ensure that suitably protected equipment or machinery is available. Moreover, there are many machines, parts of machines or parts of work equipment which if not properly guarded can cause injury to the operator. The objective is to make sure that machines are made safe by eliminating sources of harm. However, this is not always possible; therefore, risks have to be controlled.

5.4.3.2.2. Employers should ensure that:

- (a) fixed guards should be used wherever necessary, and properly fastened in place with appropriate fasteners including, but not limited to, screws or nuts and bolts which need tools to remove them;
- (b) if workers need regular access to parts of the machine and a fixed guard is not possible, an interlocked guard should be used. This will ensure that the machine cannot start before the guard is closed and will stop if the guard is opened while the machine is operating. If access is required to parts that are guarded, the machinery should be shut down;
- (c) they should establish systems for inspection to ensure that guards are properly maintained and defects are rectified; and
- (d) workers should be trained to operate equipment before they are directed to do so.

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5.4.3.2.3. Other control measures to be aware of include the following:

- (a) risks can be reduced by the careful selection and location of controls for machinery and equipment;
- (b) regular maintenance of machinery and equipment is required to ensure that they are in a safe condition, and maintenance records are kept;
- (c) maintenance work on energizing equipment should be carried out safely;
- (d) workers should be instructed and trained, and their level of skill and training should be evaluated periodically; and
- (e) supervisors should not permit the use of any unsafe or faulty equipment.

#### 5.4.3.3. Role of workers

5.4.3.3.1. Workers should:

- (a) know how to operate the machine (following the operating manual instructions), including the emergency stopping procedures, before commencing operation;
- (b) receive relevant training on potentially dangerous equipment and to never use a machine unless they are trained to do so;
- (c) check that the guards are in position and all protective devices are working; and
- (d) be authorized to immediately stop the machine if it is not working safely or if any guards or protective devices are faulty, and inform the supervisor as soon as possible.

### **5.4.4. Cranes and hoists**

5.4.4.1. Training should be given for crane operators to ensure proper and safe operation of the crane and rigging of the loads.

5.4.4.2. All machinery used to lift and/or transport equipment, materials, molten metal or slag should be designed, constructed and erected, inspected, maintained and operated as specified by the manufacturer. All machinery should meet all the standards specified by the competent authority to enable it to fulfil all its designated tasks, without posing any foreseeable risk to those who work within its designated scope of operations or operate the machines.

5.4.4.3. The rated capacity and/or legible load chart, where appropriate, of a crane or a hoist should be permanently marked on the structure and clearly visible. The rated capacity should not be exceeded.

5.4.4.4. The rated capacity of a hoist should not exceed the capacity of the structure supporting the hoist.

5.4.4.5. Cranes and hoists should be regularly inspected and maintained to ensure that every component is capable of carrying out its original design function, and records should be kept.

5.4.4.6. A crane or hoist should not be used until any condition that could endanger workers is remedied. All installations, modifications and repairs to load-bearing equipment

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should be certified by a competent person or authorized organization in accordance with the original design and safety standard, and the requirements of the competent authority.

5.4.4.7. All cranes or hoists with a boom that is movable in the vertical plane should have a device that can be clearly read by the operator, to indicate the boom angle, if the rated capacity is affected.

5.4.4.8. All modifications that affect the rated capacity of a crane or hoist should be assessed, and the rated capacity adjusted by the original equipment manufacturer or a competent person or authorized organization.

5.4.4.9. There should be a safe means of access and egress to the operator's position and to maintenance locations for all cranes and hoists.

5.4.4.10. If a normal safe means of egress is not always available to the operator, then an alternative safe means should be provided to get from the operating position to a safe area in the event of a power failure or other emergency.

5.4.4.11. Effective audible and visual communication devices should be installed on a crane or hoist. The crane or hoist operator should sound a warning signal when it is necessary to alert workers.

5.4.4.12. A crane or hoist handling molten metal or slag should have two holding brakes on the hoist mechanism. The hooks, cables and other equipment should be designed for use under conditions of high thermal load.

5.4.4.13. All controls on a crane or hoist should be clearly identified and should return to neutral when released, and an automatic braking system should be activated.

5.4.4.14. The operator of a crane or hoist should be protected against hazardous conditions such as airborne contaminants, falling or flying objects, and excessive heat or cold.

5.4.4.15. The operator's seat on a crane or hoist should be of an ergonomic design that allows the operator to operate the equipment safely.

5.4.4.16. All the hooks, hook guards/latches, wire ropes, chains and other attachments and fittings that may be safety critical should be maintained and inspected on a regular basis.

5.4.4.17. Following the release of a crane or hoist from maintenance, it should be inspected by a competent person or authorized organization to verify that it can continue to operate at its original safe working load.

5.4.4.18. The operator of a crane or hoist should perform a check at the start of each shift and test the limit switch and a record of the check should be kept.

5.4.4.19. Transport routes for cranes should be clear of obstructions, and in the case of molten metal, free of water. Transport routes for wheeled or tracked cranes should be level. If irregular surfaces are inherent in the layout of the plant, the equipment should be designed to cope with this.

5.4.4.20. The speed of the transporting vehicle or device should be limited (e.g. not to exceed walking pace).

5.4.4.21. The load should be lowered slowly and smoothly (e.g. not more than 20 cm/sec.).

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### **5.4.5. Falling objects**

5.4.5.1. Falling materials are a dangerous hazard. The employer should control the risk by adopting the following measures to protect people working in any area where there is a danger of injury that may be caused by falling material:

- (a) take all necessary steps to prevent materials or objects falling;
- (b) keep areas clean, in good working order and well maintained to prevent the accumulation of process materials that could subsequently fall;
- (c) ensure the use of covered walkways or alternative safeguards such as safety nets;
- (d) schedule required overhead maintenance when there is the fewest number of people present and ensure that access to the area is prevented by cordoning off all areas where there is a potential risk from falling objects and providing warning signs; and
- (e) prevent access to areas where there is a risk of falling objects, except in an emergency.

5.4.5.2. If people are required to have emergency access to any area where there is a danger of injury from falling material, extreme caution should be taken to avoid injury. All such people should be provided with appropriate PPE, such as hard hats, etc. The use of such equipment should be mandatory.

### **5.4.6. Slips, trips and falls**

5.4.6.1. Floors should be of robust construction, and use non-combustible materials in furnace areas.

5.4.6.2. Floor surfaces should be maintained regularly, and kept clean and free of oil spills, other slippery fluids or materials and obstructions.

5.4.6.3. Floors adjoining tracks in the foundry should be level with the tops of the track rails.

5.4.6.4. Steel floor plates should be made slip resistant through the use of appropriate materials or surface design.

5.4.6.5. Pits and other floor openings should be covered or cordoned off with clear warning signs when not in use. Such areas should always be well lit.

5.4.6.6. Furnaces with elevated points of access should be provided with suitable platforms or walkways equipped with handrails and protective barriers. The platforms and walkways should be clearly marked.

5.4.6.7. Platforms and walkways should be accessible via permanent, fire-resistant elevators, stairways or ladders.

5.4.6.8. Open-mesh walkways or platforms should be constructed so that any apertures in the mesh are small enough to prevent objects from falling through and causing injury to people below. They should also be fastened securely.

5.4.6.9. Platforms, walkways and stairways with open sides should be provided with railings with panelling up to the height of the railings. Alternatively, they should have kick boards or toe boards extending part-way up the railings.

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5.4.6.10. Hinged covers should be provided at openings in elevated walkways or platforms, and should be kept closed when not in use, and suitably guarded when in use. Covers should be strong enough to sustain the loads in the iron and steel industry.

## **5.5. Ergonomics**

### **5.5.1. Hazard description**

5.5.1.1. The risk of musculoskeletal injuries is common in iron- and steel-making facilities. Manual carrying and lifting of large, bulky and/or heavy objects is common despite the high degree of mechanization and remedy devices and can cause musculoskeletal injuries.

5.5.1.2. Long-lasting repetitive work movements and awkward postures may cause musculoskeletal injuries. Maintaining the same posture for extended periods causes excessive fatigue.

5.5.1.3. Repetitive work and tasks with little variety and/or few events may lead to boredom and errors being made.

5.5.1.4. Confusing and/or missing information may lead to errors being made.

5.5.1.5. Too high a physical load may cause excessive fatigue, especially in a hot environment (see 5.2.3).

5.5.1.6. The conveying of visual and acoustic information may be degraded because of environmental factors, poor design of machinery and equipment and PPE, and may lead to dangerous incidents and accidents.

### **5.5.2. Assessment of risk**

5.5.2.1. Measures should be taken to ensure the appropriate selection and design of tools, machines, equipment and work stations, including PPE.

5.5.2.2. The competent authority, after consulting the representative organizations of employers and workers concerned, should establish OSH requirements for repetitive work, working postures, physical load and the handling and transport of materials, particularly manual handling. Such requirements should be based on risk assessment, technical standards and medical opinion, taking account of all the relevant conditions in which the work is performed.

5.5.2.3. It should be verified that workers get all the necessary information about the process, machinery and their co-workers in correct form and in due time. Temporary work phases should be checked and temporary workers informed.

### **5.5.3. Control strategies**

5.5.3.1. An appropriate ergonomic study should be undertaken to investigate jobs and tasks while workers are carrying out various operations. The study should focus on heavy physical work, work postures, work movements (especially repetitive movements), lifting and pushing/pulling heavy loads. The impact of the working environment on the worker and the functional design of the machinery should be explored.

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5.5.3.2. To the extent possible, the task should be adapted to the worker, and jobs and tasks with unacceptable ergonomic problems should be eliminated by redesigning work procedures, work stations, tools and machinery.

5.5.3.3. If complete elimination is not practicable, the time that workers are required to spend in such conditions should be as short as possible. The workload may be brought to a tolerable level with sufficient rest periods and job rotation. Changes in posture should be possible.

5.5.3.4. Workers should be trained in using correct work techniques.

5.5.3.5. Workers should be informed about the hazards related to physical work, work postures, repetitive movements and lifting and carrying loads.

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## **6. Coke ovens and by-product plants**

### **6.1. Hazard description**

6.1.1. Most coke is produced from coal. The coal is charged into an oven, which is then sealed. A by product coke battery contains twenty or more tall, wide and narrow ovens, arranged side by side like slices in a loaf of bread. After charging, a coke oven is heated for 12 hours or more, during which time a variety of volatile chemicals are driven off. In a by-product battery, these chemicals are collected and refined into a wide range of products. The remaining coke oven gas is used as a fuel. In a non-recovery battery, the ovens are typically low, broad structures, and the chemicals are burned in the headspace above the coke or in the flues which heat the oven. Some new systems are under development, but most involve similar hazards. Coke can also be produced from petroleum.

6.1.2. Most health hazards in coke production arise from the volatile chemicals driven off the coal during coking. Coke oven emissions contain cancer-causing polynuclear aromatic hydrocarbons, along with toxic gases and vapours such as benzene, hydrogen sulphide, carbon monoxide and ammonia. Workers in the coal preparation plant are exposed to coal dust, which can cause lung damage. Coke ovens must be kept hot to maintain their structural integrity, so production and maintenance operations pose the risk of heat stress.

6.1.3. Safety hazards in coke production include mobile equipment, burns, fire and explosion. Coke batteries are served by large tracked mobile equipment, including larry cars used in charging, pusher machines used to remove the coke, and door machines used to remove the oven doors when the coke is ready to be pushed. Visibility can be poor if emissions are badly controlled, especially if the “coke side,” where hot coke is extracted, is under a shed. Workers can suffer severe burns if they come into contact with hot coke, doors or jambs, or if they step through a loose charging lid on the top of the battery. Coke oven gas is flammable and explosive, as are many of the chemicals collected in by-product plants.

### **6.2. Hazard control on by-product coke batteries**

6.2.1. Coke oven doors, jambs and other equipment should be designed so as to minimize the occurrence and magnitude of leaks.

6.2.2. Leaks from coke oven doors, lids, and other equipment should be eliminated or reduced through a comprehensive operation and maintenance programme designed for that purpose.

6.2.3. Leaking doors and jambs should be identified through a 24-hour inspection programme, and repaired at the conclusion of the coking cycle. Other leaks should be eliminated as soon as practicable.

6.2.4. Coke should not be pushed from the oven before the coking process is complete.

6.2.5. Sealants for doors, lids and other equipment should be free of asbestos and other hazardous materials.

6.2.6. Larry cars, pusher machines, door machines and similar equipment should be operated from enclosed cabs equipped with filtered, conditioned air systems.



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6.2.7. A periodic air monitoring system should be instituted, in order to establish “regulated areas” where the exposure limit for coke oven emissions is exceeded.

6.2.8. A respiratory protection programme should be instituted for workers in regulated areas.

6.2.9. Clean air stations with appropriate ambient temperature control should be designated or provided for workers in regulated areas, where they can take breaks or go when they are not needed for a particular task. Lunchrooms and break rooms should be provided with facilities for washing, and clean filtered air.

6.2.10. The employer should supply and launder the work clothing for coke oven workers, and provide secure and well-maintained locker rooms with showers and separate lockers for street and work clothes, in order to avoid exposing persons outside the facility to contaminants on clothing.

6.2.11. Coke oven workers should receive regular medical surveillance, particularly focusing on the early detection of cancer, with appropriate follow-up.

6.2.12. Mobile coke oven machines should be designed for safe entry and exit, and provided with travel alarms. Windows should be kept clean and free of obstructions. Where necessary, cameras or other devices should be installed to allow the operator to see all sides of the machine.

6.2.13. In so far as is practicable, walkways on coke batteries should be designed so as not to cross the path of mobile equipment. Walkways and work areas should be well lit, with multiple escape routes in case of emergency.

6.2.14. When maintenance is performed on or near mobile coke oven machines, the machines should be locked out, or appropriate interlocks or trips should be provided to stop the machine before it enters the area.

6.2.15. Workers exposed to hot surfaces or radiant heat from open ovens should be provided with appropriate protective equipment, and covered by a heat stress prevention programme.

6.2.16. A programme should be instituted to ensure that explosive atmospheres are not created in offtakes, mains and other equipment that transports coke oven gas. In most cases, this requires keeping the gas concentration above the upper explosive limit. Special attention should be given to maintenance procedures.

### **6.3. Hazard control in non-recovery batteries**

6.3.1 Many of the control measures applicable to by-product batteries also apply to non-recovery batteries. However, this technology is evolving, and the employer should perform an engineering assessment to determine which of the measures listed in 6.2 are applicable to the particular battery.

6.3.2. In addition:

- (a) Uncontrolled “beehive” ovens should be replaced by newer and safer designs.
- (b) Most current non-recovery batteries are designed to operate under negative pressure. The negative pressure system should be maintained in order to prevent the release of coke oven emissions into the working environment.

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- (c) Where necessary, the stacks or flues of non-recovery batteries should be equipped with desulphurization systems and systems for the collection of heavy metals and dust.

## **6.4. Hazard control in by-product recovery plants**

6.4.1. An engineering assessment should be performed to identify potential points from which benzene, ammonia and other hazardous substances might leak. The result of this assessment should be used to design a programme for eliminating such leaks.

6.4.2. Measures should be taken to eliminate or reduce the escape of hazardous substances during maintenance operations, when samples must be taken for laboratory analysis, and during barge, truck and railcar loading.

6.4.3. Sumps should be enclosed and blanketed with nitrogen or some other gas to reduce leaks.

6.4.4. Coke oven gas contains high levels of carbon monoxide and hydrogen sulphide, and is lethal in sufficient concentrations. Alarms should be installed in all areas where coke oven gas might build up in a release. A gas programme, similar to the one described in chapter 9 for furnaces, should be instituted in the by-product plant and in all areas where coke oven gas is transported, used as a fuel, or for blanketing.

6.4.5. A programme should be instituted to ensure that explosive atmospheres are not created in equipment that transports coke oven gas and other flammable materials. In most cases this requires keeping the gas concentration above the upper explosive limit. Special attention should be given to maintenance procedures.

6.4.6. A periodic air monitoring programme should be instituted, particularly for benzene.

6.4.7. A respiratory protection programme should be instituted for workers exposed to benzene or other hazardous substances above the relevant exposure limits.

6.4.8. The employer should supply and launder the work clothing for by-product workers, and provide secure, well maintained locker rooms with showers and separate lockers for street and work clothes, to avoid exposing persons outside the facility to contaminants on clothing.

6.4.9. Coke by-product workers should receive regular medical surveillance, particularly focusing on the early detection of leukaemia and other blood disorders caused by benzene, with appropriate follow-up.

6.4.10. Work areas and walkways should be well lit, with multiple escape routes in case of emergency.

## **6.5. Other methods of producing coke**

6.5.1. Alternate methods for producing coke are under development, or may be in the future. These methods should be thoroughly evaluated for their impact on OSH before they are instituted, and periodically thereafter. The results of the evaluation should be used to design or update an appropriate control strategy.

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## 7. Iron and steel-making

### 7.1. General

7.1.1. The iron and steel industry uses a range of furnaces. For iron-making operations, the essential feature is the blast furnace. For steel-making operations, there are three types of furnaces: the open-hearth furnace, the basic-oxygen process converter and the electric arc furnace.

7.1.2. Furnaces may cause glare that can injure the eyes unless suitable eye protection is provided and worn. Manual operations, such as furnace bricklaying, and hand-arm vibration from using pneumatic tools and grinders may cause ergonomic problems.

7.1.3. Only authorized persons should be allowed near furnaces.

7.1.4. There should be suitable and sufficient general and local exhaust ventilation with dust- and fume-collecting devices incorporated into the design of the exhaust ventilation systems.

7.1.5. The effectiveness and adequacy of general and local exhaust-ventilation systems to remove fumes and gases from the furnace area should be tested regularly. Collection bags for dusts should be replaced when indicated.

7.1.6. Ultraviolet (UV) and/or infrared light-resistant goggles or face shields should be provided where there is a requirement for the authorized visual inspection of furnaces.

7.1.7. Continuous detectors should be installed to provide early warning of raised levels of dangerous gases.

7.1.8. Positive pressure self-contained breathing apparatus should be available to enable rapid rescue in the event of a build-up of dangerous gases. The breathing apparatus should be checked and maintained regularly, and should only be used by people who have been trained to do so.

7.1.9. People working in and around the furnace and oven areas should be provided with suitable PPE to protect them against molten metal burns, noise, and physical and chemical hazards (see also Chapter 5). PPE should be to molten metal standard for casters and others exposed to molten metal. Specific PPE should include, but not be limited to:

- (a) molten metal resistant jackets and trousers;
- (b) face shields or vented goggles;
- (c) molten metal resistant gloves;
- (d) safety footwear insulated against heat;
- (e) respiratory protective equipment;
- (f) protective helmets;
- (g) hearing protection; and
- (h) eye protection.

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## **7.2. Preventing fires and explosions**

7.2.1. Fires and explosions in furnaces most often result from water coming into contact with molten metal. The water may be present in scrap material, damp moulds, from leaks in the furnace cooling systems or leaks in the building.

7.2.2. Fires and explosions in furnaces can also result from the ignition of volatile materials and fuels.

7.2.3. The most hazardous procedures are during the firing-up and shutting-down procedures. Gas-fired furnaces should have safeguards to ensure that unspent fuel does not accumulate and ignite. The fuel supply to gas- or oil-fired furnaces should be fitted with an automatic shut-off mechanism.

7.2.4. Operators should be trained in safe systems of work. The building should be designed to be non-combustible, with automatic fire suppression engineered or designed into the process where appropriate.

7.2.5. Risk assessments should be carried out to consider the potential dispersal of toxic chemicals from non-furnace processes and combustion products, and the potential impact of an explosion on the surrounding area.

7.2.6. Regular safety audits should be undertaken to ensure that hazards are clearly identified and risk-control measures maintained at an optimum level.

7.2.7. Refractories (e.g. crucibles, troughs, ladles) and tools should be preheated and dried before use to minimize the risk of explosion. Refractory linings should be regularly inspected for wear.

7.2.8. Furnaces should not be operated beyond their safe lives.

## **7.3. Lighting furnaces**

7.3.1. Before a furnace is lit, fittings and appliances should be inspected to ensure that they are in working order. Particular attention should be paid to the furnace control settings, the air supply, the emission stacks, the fuel supply and its associated pipe work.

7.3.2. Hand-held torches used to light small furnaces should have a handle of adequate length, and the operator should use a suitable protective shield and heat-insulated gloves to prevent possible burns.

7.3.3. A slight draught should be allowed via the air supply to support ignition when the fuel has been switched on and the flame applied.

7.3.4. People responsible for operating the furnace should keep a close watch on the fuel supply, on the possible escape of fuel and on continuing ignition.

## **7.4. Dusts and fibres**

7.4.1. When a furnace is stripped for maintenance purposes, particular care should be taken to avoid inhaling dusts or fibres from the insulating material. Dust and fume collectors should be incorporated into the furnace design (see section 5.3.2. for further information).

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## **7.5. Preventing carbon monoxide poisoning**

7.5.1. Special precautions should be taken to protect workers who may be potentially exposed to gases containing large concentrations of carbon monoxide, such as blast furnace gas and coke oven gas.

7.5.2. The employer, in cooperation with workers and their representatives, should conduct a hazard analysis and risk assessment process to determine areas from which gas containing carbon monoxide could escape and accumulate, especially in areas using new technologies.

7.5.3. Workers who may be exposed to these gases should be appropriately trained in order to recognize the symptoms of carbon monoxide poisoning.

7.5.4. Areas where carbon monoxide might collect in such a way as eventually to enter work areas should be equipped with continuous automatic carbon monoxide sensors and alarms to provide adequate early warning of dangerous gas releases.

7.5.5. Continuous monitoring of exposure levels should be carried out. Workers who enter areas with gas hazards should carry portable gas monitors. Workers who enter areas where immediate danger to life or health (IDLH) exists should also be equipped with self-contained breathing apparatus (SCBA).

7.5.6. Self-contained breathing apparatus and resuscitation equipment should be maintained in readiness for the emergency rescue team, and operators should be instructed in their use.

7.5.7. Gas area rescue drills should be held on a regular basis.

## **7.6. Preventing steam explosion**

7.6.1. Molten slag (the unwanted debris removed from the melt with the aid of the limestone additives) and metal should be prevented from coming into contact with water, which will cause a steam explosion.

7.6.2. Equipment and piping for furnace gas cleaning, and piping carrying gas in the air preheating system of the dry dust catchers, should be built in such a way that they can be ventilated and cleaned.

## **7.7. Handling molten metal, dross or slag**

### ***7.7.1. Hazard description***

7.7.1.1. Burns may occur at many points in the steel-making process: at the front of the furnace during tapping from molten metal or slag; from spills, spatters or eruptions of hot metal from ladles or vessels during processing, teeming (pouring) or transporting; and from contact with hot metal as it is being formed into a final product.

7.7.1.2. Tap holes should be checked regularly for damage and build-up of corundum, to prevent molten metal splashes.

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## **7.7.2. Assessment of risk**

7.7.2.1. The likelihood of injury in the handling of molten metal should be assessed at all stages in the process. This includes the integrity, stability and use of the furnace and transport ladles, the nature and use of vehicle/crane transport, and the systems in place for pouring molten metal.

## **7.7.3. Control strategies**

### 7.7.3.1. Training

7.7.3.1.1. Personnel handling molten metal should have been trained in the proper procedures to adopt, and in the relevant safety and health precautions, including use of appropriate PPE.

7.7.3.1.2. Completion of training should be documented, and training repeated as necessary.

7.7.3.1.3. Persons who are untrained should not be employed in the transport of molten metal.

## **7.7.4. Work practices**

### 7.7.4.1. General provisions

7.7.4.1.1. Only essential personnel should be in the vicinity of pouring operations.

7.7.4.1.2. Moulds and tundishes should not be damp, nor should there be any means whereby water could enter the melt because of the risk of explosion.

7.7.4.1.3. The area should be cordoned off prior to the transport of molten metal if there is a possibility of spillage.

### 7.7.4.2. Safety inspection of ladles

7.7.4.2.1. A competent person should regularly inspect ladle buckets and their supporting, locking and tipping mechanisms.

7.7.4.2.2. Before each filling, the pouring of, or transport of slag ladles and their related appliances should be visually inspected.

7.7.4.2.3. Test results, including remedies for cracks and other defects, should be recorded.

7.7.4.2.4. Corrective repair measures that are recommended should be planned and implemented on a timely basis.

7.7.4.2.5. There should be a system for checking and ensuring that the corrective measures have been completed.

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### 7.7.4.3. Personal protective equipment

7.7.4.3.1. Appropriate PPE, such as helmets, gloves, aprons and boots should be provided and used. Where appropriate, molten metal resistant clothing should be provided and used.

### 7.7.4.4. First aid

7.7.4.4.1. Injuries caused by molten metal, dross or slag or exposure to alkaline dust should receive immediate medical attention.

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## 8. Surface preparation

### 8.1. Hazard description

8.1.1. Various methods are used to remove defects, scale, oxides, and other impurities from the surface of steel at different points in the process. These include:

- (a) scarfing, which uses fixed or hand-held torches or lances to burn away the impurities;
- (b) surface grinding;
- (c) degreasing, which uses detergents or solvents to remove grease; and
- (d) pickling, which uses acids or hydrogen peroxide to dissolve scale and oxides.

8.1.2. Each of these operations has its own hazards. Scarfing may expose workers to metal fumes and dust, noise, and burns from scarfing lances. Alloying agents in the steel may increase the hazard of the fumes or dust. Surface grinding also generates dust, and involves machinery hazards. Degreasing solvents may be toxic. Acids can cause acid burns. Degreasing and pickling of steel sheet and strip involves large tanks with coiling machinery at each end. The coiling machinery has many nip points which need to be risk-assessed.

### 8.2. Hazard control

8.2.1. Scarfing and surface grinding should be done in enclosures, with good exhaust ventilation. Workers should be provided with respiratory protection where the ventilation does not reduce exposure to levels below the appropriate exposure limits. Where necessary, workers involved in scarfing should be provided with hearing protection.

8.2.2. Workers who handle pickling acids or hydrogen peroxide should be provided with acid or chemical-resistant clothing, goggles and face shields, footwear and leggings, and respiratory protection where necessary. Hydrofluoric acid should be handled with extreme care, since it can cause severe poisoning in addition to acid burns.

8.2.3. To the extent practicable, acid pickling tanks and solvent degreasing tanks should be covered, and provided with exhaust ventilation to control the vapours.

8.2.4. Care should be taken to prevent the inadvertent mixing of acids with hydrogen peroxide or solvents. Acids should not be stored next to solvents or hydrogen peroxide.

8.2.5. Appropriate machine guarding should be provided for coiling apparatus and other equipment used in surface preparation operations.

8.2.6. Metallic residues from surface preparation should be recycled or disposed of in a manner that minimizes exposure to dust.



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## 9. Iron and steel foundries

### 9.1. General

9.1.1. Many of the specific hazards found in iron and steel making are also found in foundries. These include:

- lighting furnaces;
- dust and fibres;
- carbon monoxide;
- steam explosions;
- crystalline silica dust from shakeout and fettling;
- handling molten metal, dross and slag (see section 7.7 for more details).

9.1.2. Each furnace should have operating instructions giving data about operation, maintenance, possible faults and actions to be taken in the event of faults. The employer should ensure that operators are aware of the contents of these instructions.

9.1.3. The danger arising from the presence of hot metal is common to most foundries. Hazards may also be specific to particular foundry processes. For example, the use of magnesium presents flare risks not encountered in other metal-founding industries.

### 9.2. Safety specifications for hand-tilted transport ladles

9.2.1. Hand-tilted transport ladles should have an integral locking device to prevent accidental tipping. Large transport ladles (>500kg) should have a self-restraining anti-tipping device.

9.2.2. Casting ladles with rigid ladle bails should have safety devices to prevent the bails from swinging or overturning. The ladle bails should be insulated against radiant heat.

9.2.3. Ladles that are transported by forklift truck should have fittings to ensure their stability in forklift devices.

9.2.4. Ladles should not be suspended from a crane or other lifting device during filling unless there are specially designed installations to isolate the workers from potential spillage.

9.2.5. Ladles should not be overfilled.

9.2.6. Locking devices on casting and transport ladles should be engaged prior to filling to prevent accidental spillage; they should only be released immediately before tipping the ladles.

9.2.7. Only appropriate lubricants should be used for locking devices and self-restraining drives.

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9.2.8. Ladles and other equipment used on molten metal should be dry and, ideally, preheated before use.

9.2.9. Stopper-operating mechanisms on bottom-pouring ladles should be secured prior to transport to ensure they do not accidentally operate while in motion.

### **9.3. Safety inspection of ladles**

9.3.1. A competent person should regularly inspect ladle buckets and their supporting, locking and tipping mechanisms.

9.3.2. Before each filling, the pouring of, or transport of slag ladles and their related appliances should be visually inspected.

9.3.3. Test results, including remedies for cracks and other defects, should be recorded.

9.3.4. Corrective repair measures that are recommended should be planned and implemented on a timely basis.

9.3.5. There should be a system for checking and ensuring that the corrective measures have been completed.

### **9.4. Tapping**

9.4.1. Workers tapping cupolas should observe rigorous personal protection measures. Eye protection and protective clothing are essential.

9.4.2. Tappers and supervisors should ensure that any person not involved in the operation of the cupola remains outside the defined danger area.

### **9.5. Bottom drop**

9.5.1. Dropping the cupola bottom is a dangerous operation that requires skilled and trained workers and appropriate supervision.

9.5.2. A refractory floor or layer of dry sand on which to drop the debris is essential.

### **9.6. Protective equipment**

9.6.1. Workers in metal and pouring sections of the foundry should be provided with appropriate PPE, such as hard hats, tinted eye protection and face shields, and aluminized clothing such as aprons, gaiters or spats and boots.

9.6.2. In delineated areas, the use of protective equipment should be mandatory, and there should be adequate instruction in its use and maintenance.

9.6.3. A readily available eyewash fountain should be located in any foundry area where sodium silicate is used.

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## 9.7. Preventing fire and explosion

9.7.1. Extreme care should be taken especially where amines are stored in bulk.

9.7.2. Leakage from the core box is the principle cause of high exposure, as well as off-gassing of amine from manufactured cores. Great care should be taken at all times when handling this material, and suitable exhaust ventilation equipment should be installed to remove vapours from the working areas.

## 9.8. Abrasive blasting

9.8.1. Abrasive blasting should always be carried out in an isolated, enclosed space.

9.8.2. All abrasive blasting enclosures should be inspected at regular intervals to ensure that the dust extraction system is functioning and that there are no leaks through which shot or water could escape into the foundry.

9.8.3. It is advisable to post a notice on the door to the booth, warning employees that abrasive blasting is under way and that unauthorized entry is prohibited.

9.8.4. Silica, sand and other toxic materials should not be used.

## 9.9. Abrasive wheels

9.9.1. All dangerous parts of machinery should have adequate guarding, with automatic lockout if the guard is removed during processing.

9.9.2. Dangerous gaps between the wheel and the rest at pedestal grinders should be eliminated, and close attention should be paid to all precautions in the care and maintenance of abrasive wheels and the regulation of their speed.

9.9.3. Strict maintenance of all electrical equipment and proper grounding arrangements should be enforced.

## 9.10. Process and waste gases

9.10.1. *Moulding.* Resin-bonded sand is coated with phenol- or urea-formaldehyde resin and heated until the mould has set. In hot-box moulding, the resin-sand mix is forced over a heated pattern to produce the mould. In cold-box moulding (or “no-bake” moulding), curing takes place at room temperature. Gas catalysts (e.g. carbon dioxide, sulphur dioxide) are sometimes used to facilitate curing. Carbon dioxide causes hyperpnoea at concentrations of 3 per cent and above. At a concentration exceeding 10 per cent, rapid loss of consciousness occurs, which can be reversed if the worker is quickly removed from the source and allowed to breathe oxygen. When sulphur dioxide is dissolved in water, it produces sulphuric acid, which, if inhaled, causes acute irritation of the mucous membranes. In extreme cases, this leads to severe pulmonary oedema and death. Exposure to sulphur dioxide can induce asthma in susceptible individuals.

9.10.2. *Pattern making.* Mould patterns are produced using wood, reinforced polyester, plastics, foam or wax. The wax material often contains colophony, a respiratory sensitizer, that is given off during the heated aspects of pattern making.

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9.10.3. *Core making.* Where a central design or opening is required in the moulded item, cores made of refractory materials are incorporated into the mould. The refractory materials often consist of synthetic fibres, which are skin irritants. Carbon dioxide and sulphur dioxide are often given off from “binders” during the core-making process.

9.10.4. *Shell moulding.* Resin-bonded sand is used to produce moulds. These phenol- or formaldehyde-based resins are a hazard if they are inhaled, ingested or come into contact with the skin. The individual characteristics of the chemical binder should be obtained from the supplier, who should advise on precautions for general use, handling and storage.

9.10.5. *Hot-box moulding.* Workers are at risk from exposure to a number of agents that are hazardous to health, including phenol-formaldehyde, urea-formaldehyde, furfuryl alcohol-urea, formaldehyde, ammonia, hydrogen cyanide, benzene and toluene.

9.10.6. *Cold-box or no-bake moulding.* Core-box heating is avoided by the use of sand-resin catalyst systems that cure at room temperature, or urethane systems that use a gas catalyst. The potentially hazardous by-products of these catalysts include urea-formaldehyde, furfuryl alcohol-urea, formaldehyde, phosphoric acid, sulphuric acids, phenol-formaldehyde and isocyanate.

## **9.11. First aid**

9.11.1. Injuries caused by molten metal, dross or slag or exposure to alkaline dust should receive immediate medical attention.

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## 10. Rolling mills

### 10.1. Hazard description

10.1.1. Mechanization has reduced the number of trapping points at machinery, but they still exist, especially in cold-rolling plants and in finishing departments.

10.1.2. In any rolling mill, there is a risk of trapping between the rolls.

10.1.3. Severe injuries may be caused by shearing, cropping, trimming and guillotine machines, unless the dangerous parts are securely guarded.

10.1.4. Injuries may occur, especially in hot-rolling, if workers attempt to cross roller conveyors at unauthorized points.

10.1.5. The use of large quantities of oils, rust inhibitors and so on, which are generally applied by spraying, is one of the hazards commonly encountered in sheet-rolling mills.

10.1.6. Even in automated works, accidents occur in conversion work while changing heavy rollers in the stands.

10.1.7. In hot-rolling, burns, eye injuries or other injuries may be caused by flying mill scale and dust particles or by whipping of cable slings. Eyes may also be affected by glare.

10.1.8. Cuts may occur when workers contact the edge of thin steel sheets or strip.

10.1.9. Cobbles occur when material catches in a roll and escapes into the work area with the potential for severe injury to workers.

10.1.10. When lead-alloyed steel is rolled or cutting-off discs containing lead are used, toxic particles may be inhaled. It is therefore necessary constantly to monitor lead concentrations at the workplace, and workers liable to be exposed should regularly undergo medical examination.

10.1.11. Butt welding is associated with the formation of ozone, which may cause, when inhaled, irritation similar to that due to (NO<sub>x</sub>). Pit-furnace and reheating-furnace attendants may be exposed to harmful gases, the composition of which depends on the fuel used (blast-furnace gas, coke-oven gas, oil) and generally includes carbon monoxide and sulphur dioxide.

### 10.2. Control strategies

10.2.1. Nips of rolls should be effectively guarded based on an appropriate risk assessment, and strict supervision exercised to prevent any work which is in motion.

10.2.2. Dangerous parts should be securely guarded to prevent severe injuries caused by shearing, cropping, trimming and guillotine machines.

10.2.3. An effective lockout/tag out programme should be planned, implemented and monitored for maintenance and repair.

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10.2.4. Attention should be paid to the hazard of cuts to workers in strip- and sheet-rolling mills.

10.2.5. An adequate number of bridges with appropriate guardrails should be installed and their use enforced.

10.2.6. Gratings, absorbent materials and boots with slip-resistant soles should be provided, in addition to regular cleaning of the floor to prevent slips, trips and falls.

10.2.7. Good planning often reduces the number of roll changes required. The change of heavy rollers in the stands should not be done with time pressure and without suitable tools.

10.2.8. Water-based rolling oils, lubricants and coolants should be replaced on a regular basis in order to avoid bacterial contamination. Where biocides are used for this purpose, they should not be toxic to workers, either in themselves or in combination with other ingredients.

10.2.9. Operating pulpits should be ergonomically designed.

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## **11. Coating lines**

### **11.1. Hazard description**

11.1.1. Coating lines apply different types of materials to the surface of steel. They include, but are not limited to, zinc, zinc alloy, tin, chromium and plastic, in the form of liquids, powders, solids or molten metals which are subsequently cured or sintered by heating, or in the form of fabricated sheets which are laminated to the metal surface with an adhesive. Some of the plasticizers are skin sensitizers. Metal fumes, for example, chromium and zinc may be toxic.

11.1.2. Many coating lines have annealing furnaces, heated solutions in cleaning sections, electrolytic or hot-dip sections and robots that handle the coils being loaded on to and off the line as well as the related strapping functions.

11.1.3. There are usually many coil storage fields near coating lines. The edges of the coils are usually sharp.

### **11.2. Assessment of risk**

11.2.1. The use of furnaces, open flames, ovens, heated solutions and molten metals presents the risk of excessive heat exposure, which is compounded in hot humid climates and, particularly, by protective garments and gear.

11.2.2. Zinc pots may be heated electro-magnetically by induction. Strong magnetic fields may exist in these areas.

### **11.3. Control strategies**

11.3.1. Guards, railings, enclosures and signs should be used to protect production and maintenance personnel from dangers such as chemical baths, hot surfaces and molten metal.

11.3.2. Worker education and training is essential both when new to the job or when there have been changes in the equipment or the process.

11.3.3. Workers should be provided with the appropriate PPE.

11.3.4. Care must be taken when entering a coil field or when just walking by a coil. Only authorized people should enter the coil fields.

11.3.5. Material safety data sheets should be provided for each of the hazardous chemicals to explain the chemical and physical hazards, in languages and at educational levels that ensure they will be understood by the workers.

11.3.6. Workers and supervisors should be trained in the recognition of heat stress symptoms.

11.3.7. Areas which have strong electromagnetic fields should have warning signs posted and persons with a pacemaker or metal implant should avoid them.

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11.3.8. All chemicals should be evaluated for potential toxicity and physical hazards, and less hazardous materials should be substituted where possible.

11.3.9. Metal coating processes that generate hazardous contaminants may require local exhaust ventilation that is strategically placed to draw the contaminants away from the worker. Fresh-air intakes should be located away from exhaust vents so that potentially toxic gases are not recirculated.

#### **11.4. Work practices**

11.4.1. The workplace should be designed to allow the delivery of raw materials and supplies and the removal of the finished product without interfering with safe processing.

11.4.2. Safe separation in storage and in transit should be maintained.



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## 12. Heat treating

### 12.1. Hazard description

12.1.1. In heat treating, steel products are heated and cooled in a controlled way to change their physical or mechanical properties without changing their shapes. Heat treating is used to relieve stresses in the metal created during cold rolling, to improve its hardness or strength, or to change its electromagnetic properties. Some heat treating is done by quenching, in which heated steel is plunged into a cold bath of water or oil to rapidly cool it. The most common heat-treating process is annealing, in which the steel is slowly heated, maintained at temperature, then cooled. Often this takes place in a closed furnace, using an inert gas to prevent oxidation, or a gas that conveys desired properties to the steel.

12.1.2. Hazards in heat treatment include burns and scalding, mechanical hazards from steel handling, and hazards arising from the annealing gases, including nitrogen, hydrogen and carbon monoxide. Furnace insulation wools can expose workers to hazardous fibres.

### 12.2. Hazard control

12.2.1. The work area and the flow of material through it should be designed so as to minimize the possibility of worker contact with hot steel, or to scalding in the case of quenching operations.

12.2.2. Inert annealing gases should be handled in a way that prevents their build-up in enclosed spaces other than the furnace itself, so as to prevent asphyxiation. Annealing furnaces should be considered to be hazardous confined spaces.

12.2.3. The system for handling flammable annealing gases like hydrogen should minimize the possibility of an explosive build-up.

12.2.4. Carbon monoxide should not be used for carburizing (a process for adding carbon to the surface) where safer processes are practicable.

12.2.5. The safest practicable furnace insulation should be used. In general, this means using insulation wools with a low content of respirable fibres, and which do not convert to silica when heated. Compressed air should never be used to clear away residual insulation wool gasketing used around box annealing furnaces.

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## **13. Internal transport**

### **13.1. Hazard description**

13.1.1. Internal transport, such as road and rail vehicles used in the transport of raw materials, intermediates, products, waste and people, has the potential to cause injuries to workers and other people, as well as damage to the workplace environment.

13.1.2. The hazards can be caused by interaction between vehicles, vehicles and other objects and personnel, or by loads falling off or from the vehicle.

### **13.2. Control strategies**

#### ***13.2.1. Training and information***

13.2.1.1. Operators of vehicles should receive and maintain adequate training and the required certification according to the regulations established by the competent authority.

13.2.1.2. Operators of certain types of vehicles may require regular medical surveillance.

13.2.1.3. Operators should have the necessary knowledge of the hazards and potential risks concerning the transportation of cargo.

13.2.1.4. Contractors and other visitors should be appropriately instructed about the hazards and potential risks. They should be instructed about the rules of how to move in the area.

#### ***13.2.2. Prevention and control***

13.2.2.1. Transport routes should be planned and constructed to minimize the risk of collision and with sufficient safe clearance to allow for aisles and turns, or other types of control area. Where appropriate, maps showing the proposed route should be provided.

13.2.2.2. Transport routes should be clear of obstructions and, where possible, without irregular surfaces.

13.2.2.3. Transport routes and work areas containing transport vehicles should be visibly marked and segregated from waterways to the greatest extent possible.

13.2.2.4. The safe operating speed for vehicles should be posted and enforced.

13.2.2.5. Vehicles should be used and maintained in accordance with the requirements of the competent authorities and, as appropriate, be equipped with safety devices such as fire-fighting equipment and warning devices for reversing operations.

13.2.2.6. The operator should be protected from cargo, such as molten metal splashes, chemicals and unsecured cargo.

13.2.2.7. Loads should be lowered slowly and smoothly.

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13.2.2.8. Vehicles should be equipped with ventilated cabins to protect workers from hazardous materials.

13.2.2.9. Vehicles should be kept clean and tidy, and operators should report critical faults and deficiencies immediately to the employer.

13.2.2.10. Forklift controls should be designed to stop if released.

13.2.2.11. Forklift trucks used to transport molten material should have solid tyres and their fuel tanks should be protected and insulated from ignition. The driver's station should have rigid splashguards fitted.

13.2.2.12. Lifting devices should be made of steel that is not prone to hydrogen embrittlement and should be shielded from radiant heat.

13.2.2.13. Workstations should not be located underneath the path of molten material.

13.2.2.14. With regard to overhead ladles, no fixtures that might cause spillage en route should be within a short distance (approximately 50 cm) of their external limit of travel.

13.2.2.15. The operator of a vehicle should perform a check on the vehicle at the start of each shift, and a record should be kept.

13.2.2.16. Vehicles should not be moved unless the operator has a clear field of view in the direction of travel, to the rear, above and to either side, or is in communication with another person who does.

13.2.2.17. Rail stops or other blocking devices should be used to protect workers required to perform work on tracks or in vehicle travel areas.

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## 14. Recycling iron and steel

14.1. Iron and steel are recycled from factory offcuts, from salvaged materials and from foundry slag, ashes and dross. The range of processes used to reclaim metals from scrap depends on the donor source and the desired product. Recycling iron and steel involves different processes and presents different OSH hazards and risks. The following special provisions apply.

14.2. Workers should be informed about the hazards of handling metal scrap.

14.3. Bales of raw scrap received for recycling should be appropriately inspected, and, if necessary opened prior to adding them to the melt. Potential hazards include rainwater, gas cylinders, aerosol cans, airbag inflators and munitions, as well as radioactive-contaminated scrap. Reputable suppliers of scrap should be used to ensure that the specification of raw materials meets these criteria.

14.4. Charge materials should be stored in a secure manner, under cover wherever possible.

14.5. Potential carriers of moisture should be preheated to dry them before charging.

14.6. Tubes and pipes that are closed at one or both ends should not be charged.

14.7. Bins for storing scrap iron and steel should have holes in their base to facilitate drainage.

14.8. Corroded material should not be added to induction furnaces.

14.9. The risk from radioactive sources is dealt with in section 5.2.4.

14.10. General hazards encountered in iron and steel reclamation include: molten metal, dust, fumes, noise, heat and toxic materials.

14.11. The burning and drying process used to separate industrial waste (e.g. lathes, milling and boring machines) exposes the operator to non-specific particulate matter.

14.12. General protection and prevention should be observed for these processes and specific and effective first-aid measures should be available in the event of a serious incident.

14.13. Reputable suppliers of scrap should make efforts to educate new entrants to the market on OSH.

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## 15. Competence, education and training

### 15.1. General

15.1.1. The necessary OSH competence requirements should be defined by the employer based on the provisions of the national laws or regulations, in consultation with workers and their representatives, and appropriate training arrangements established and maintained to ensure that all persons are competent to perform the OSH aspects of their present or planned duties and responsibilities.

15.1.2. Employers should have, or should have access to, sufficient OSH competence to identify and eliminate or control work-related hazards and risks, and to implement the OSH management system. Specific training needs can be identified from the initial and ongoing hazard identification, risk assessment and evaluation of control measures.

15.1.3. Training programmes should:

- (a) cover all workers at the facility, including contractors, as appropriate;
- (b) be conducted by competent persons;
- (c) provide effective and timely initial and refresher training at appropriate intervals, in a manner and language understood by the workers;
- (d) include participant evaluation for comprehension and retention of the training;
- (e) be reviewed periodically by the safety and health committee, where it exists or by the employer in consultation with workers and their representatives, and modified as necessary;
- (f) be documented.

15.1.4. The form and the content of training, particularly for new workers, should be devised and implemented in consultation with workers or their representatives, and should be in accordance with the identified needs, and may include:

- (a) pertinent aspects of OSH legislation and any collective agreement, such as the rights, responsibilities and duties of competent authorities, employers, contractors and workers;
- (b) assessments, reviews and exposure measurements, and the rights and duties of workers in this regard;
- (c) the role of health surveillance, the rights and duties of workers in this regard, and access to information;
- (d) instructions on PPE as may be necessary, its significance, correct use and limitations, and in particular on factors which may show inadequacy or malfunction of the equipment, and the measures which may be required for the workers to protect themselves;
- (e) the nature and degree of hazards or risks to safety and health which may occur, including any factors which may influence that risk, such as appropriate hygiene practices;

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- (f) safe operating procedures such as, for example, confined spaces and isolation of hazardous energy;
  - (g) workers should be trained in the safe handling of metal scrap;
  - (h) the correct and effective use of prevention, control and protection measures, especially engineering controls, and workers' own responsibility for using such measures properly;
  - (i) correct methods for the handling of substances, the operation of processes and equipment, and for storage, transport and waste disposal;
  - (j) procedures to be followed in an emergency;
  - (k) hazard warning signs and symbols for hazardous ambient factors which may occur;
  - (l) emergency measures, fire fighting and fire prevention, and first aid;
  - (m) appropriate hygiene practices to prevent, for example, the transmission of hazardous substances off site;
  - (n) cleaning, maintenance, storage and waste disposal, to the extent that these may cause exposure for the workers concerned.

15.1.5. Training should be provided to all participants at no cost and should take place during working hours. If this is not possible, the timing and other arrangements should be agreed upon between the employer and workers' representatives.

15.1.6. Employers should ensure that training and information requirements and procedures are kept under review, as part of the assessment review and documentation.

## **15.2. Qualifications of managers and supervisors**

15.2.1. Successful management requires the integration of OSH into all the facility's activities, including contractors' activities.

15.2.2. Responsibility for managing OSH within any organization should be placed upon managers and supervisors at each level in the job hierarchy. Managers and supervisors should be in possession of an appropriate qualification and training, or have gained sufficient knowledge, skills and experience to qualify on the basis of competence, to ensure that they are able to:

- (a) plan and organize safe operations, including identification of hazards, assessments of risks and the implementation of preventive measures;
- (b) establish, implement and maintain an OSH management system;
- (c) monitor the status of OSH in those operations for which they are responsible; and
- (d) take corrective action in the event of non-compliance with requirements.

15.2.4. Managers should receive technical and other training to allow them to fulfil their responsibilities for OSH.

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### **15.3. Qualifications, training and skills testing for workers**

15.3.1. Worker education and training is essential for workers new to the job, when hazardous substances are introduced and before changes occur in the equipment or the process. Each employer should ensure that all workers working at the facility for whom they have a responsibility are:

- (a) appropriately educated and trained in the tasks they are assigned to and possess the relevant skills certificates;
- (b) suitably instructed in the hazards connected with their work and in their working environment, as well as trained in the precautions necessary to avoid accidents, injuries and occupational diseases;
- (c) made aware of the relevant laws, regulations, requirements, codes of practice, instructions and advice relating to prevention of accidents and diseases;
- (d) informed of their individual and collective responsibility and that of the employer for OSH;
- (e) sufficiently instructed in the correct use and effects of PPE and its appropriate care, and have training made available to them, as appropriate, incorporating the relevant content, duration and location.

15.3.2. Ergonomic posture and movements, appropriate choice and handling of tools ergonomically should become routine to such an extent that the operator works correctly.

15.3.3. Material safety data sheets should be provided for each of the hazardous chemicals used to explain the chemical and physical hazards, in languages and at educational levels that ensure they will be understood by workers.

15.3.4. Competence testing and periodic retraining should be done in order to ensure that workers have retained the necessary information.

15.3.5. An appropriate level of supervision should be provided to ensure that the proper procedures are being followed.

### **15.4. Qualifications of contractors and other third parties**

15.4.1. The management of OSH with contractors and other third parties should be consistent.

15.4.2. Best practices in OSH at the facility should be applied to contractors.

15.4.3. Only those contractors who can demonstrate good performance and an adequate safety and health management system should be used.

15.4.4. The OSH management systems of contractors and their OSH record should carry similar weight to other performance factors when considering the choice of contractors.

15.4.5. Before commencing work, on-site pre-work briefings need to be completed that cover the scope of work, work method, identification of key hazards and risk assessment. All relevant safety permits need to be completed before the job is begun.

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## 16. Personal protective equipment (PPE)

### 16.1. General provisions

16.1.1. As a supplementary protection against exposure to hazardous conditions in the production of iron and steel where the safety of workers cannot be ensured by other means, such as eliminating the hazard, controlling the risk at source or minimizing the risk, suitable and sufficient PPE, having regard to the type of work and risks, and in consultation with workers and their representatives, should be used by the worker and provided and maintained by the employer, without cost to the workers.

16.1.2. Items of PPE provided should comply with the relevant national standards and criteria approved or recognized by the competent authority.

16.1.3. Those responsible for the management and operation of the personal protection programme should be trained in the selection of the proper equipment, in assuring that it is correctly fitted to the people who use it, in the nature of the hazards the equipment is intended to protect against, and provide adequate comfort, and in the consequences of poor performance or equipment failure.

16.1.4. PPE should be selected considering the characteristics of the wearer and additional physiological load or other harmful effects caused by the PPE. It should be used, maintained, stored and replaced in accordance with the standards or guidance for each hazard identified at the facility and according to the information given by the manufacturer.

16.1.5. PPE should be examined periodically to ensure that it is in good condition.

16.1.6. Different PPE and their components should be compatible with each other when they are worn together.

16.1.7. PPE should be ergonomically designed, and to the extent practicable, should not restrict the user's mobility or field of vision, hearing or other sensory functions.

16.1.8. Employers should ensure that the workers who are required to wear PPE are fully informed of the requirements and of the reasons for them, and are given adequate training in the selection, wearing, maintenance and storage of this equipment.

16.1.9. When workers have been informed accordingly, they should use the equipment provided throughout the time they may be exposed to the risk that requires the use of PPE for protection.

16.1.10. Items of special PPE for use in proximity to molten metal should protect the wearer from heat and should withstand splashes of molten metal. It should be possible to remove these items easily if molten matter gets between the body and the protective clothing.

16.1.11. The PPE should not be used for longer than the time indicated by the manufacturer.

16.1.12. Workers should make proper use of the PPE provided, and maintain it in good condition, consistent with their training and be provided with the proper means for doing so.



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16.1.13. Before reissuing the clothing or equipment, employers should provide for the laundering, cleaning, disinfecting and examination of protective clothing or equipment which has been used and may be contaminated by materials that are hazardous to health.

16.1.14. Protective equipment that may be contaminated by materials hazardous to health should not be laundered, cleaned or kept at workers' homes. Employers should ensure that workers do not take contaminated clothing home and should provide for the cleaning of such clothing at no cost to the worker.

16.1.15. PPE should not contain hazardous substances, such as asbestos.

## **16.2. Head protection**

16.2.1. Helmets intended for use in the iron and steel industry should be subjected to a test for resistance to splashes of molten metal.

16.2.2. Any helmet that has been submitted to a heavy blow, even if there are no evident signs of damage, should be discarded.

16.2.3. If splits or cracks appear, or if a helmet shows signs of ageing or deterioration of the harness, the helmet should be discarded.

16.2.4. Where there is a hazard of contact with exposed conductive parts, only helmets made of non-conducting material should be used.

16.2.5. Helmets for persons working overhead should be provided with chin straps.

16.2.6. In addition to safety, consideration should also be given to the physiological aspects of comfort for the wearer. The helmet should be as light as possible, the harness should be flexible and should not irritate or injure the wearer and a sweatband should be incorporated.

16.2.7. All protective headgear should be cleaned and checked regularly.

## **16.3. Face and eye protection**

16.3.1. Face shields or eye protectors should be used to protect against flying particles, fumes, dust and chemical hazards.

16.3.2. Face shields should be used in furnace operations and other hot work involving exposure to high-temperature radiation sources. Protection is also necessary against sparks or flying hot objects. Face protectors of the helmet type and the face-shield type are preferred.

16.3.3. Goggles, helmets or shields that give maximum eye protection for each welding and cutting process should be worn by operators, welders and their helpers.

16.3.4. Welding and cutting processes of furnaces emit radiation in the ultraviolet, visible and infrared bands of the spectrum, which are all able to produce harmful effects upon the eyes. In welding operations, helmet type protection and hand-shield type protection should be used. Protection is also necessary for the welder's assistant and those who may be exposed to the hazards should be appropriately protected.

16.3.5. With the use of face and eye protectors, due attention should be paid to greater comfort and efficiency.

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16.3.6. The protectors should be fitted and adjusted by a person who has received training in this task.

16.3.7. Comfort is particularly important in helmet and hood type protectors as they may become almost intolerably hot during use. Air lines can be fitted to prevent this.

16.3.8. Face and eye protectors should give adequate protection at all times even with the use of corrective vision devices.

16.3.9. Eye protectors, including corrective lenses, should be made of appropriate high-impact material.

## **16.4. Upper and lower limb protection**

16.4.1. Protective gloves or gauntlets, appropriate barrier creams and suitable protective clothing to protect upper and lower limbs, as required, should be worn when exposed to heat radiation or while handling hot, hazardous or other substances which might cause injury to the skin.

16.4.2. Hands and feet should be protected against physical, chemical and other hazards.

16.4.3. Burns of the lower limbs from molten metals, sparks or corrosive chemicals may occur in the iron and steel industry. Safety footwear and other leg protection should be used where appropriate.

16.4.4. The height to which safety footwear covers the ankle, knee or thigh depends on the hazard, although comfort and mobility should be considered.

16.4.5. Shoes or boots should be without tongues and trouser legs should be pulled over the top of the boot and not tucked inside.

16.4.6. Slip-resistance properties should be taken into account when choosing footwear.

16.4.7. Rubber or metallic spats, gaiters or leggings should be used to protect the leg above the shoe line, especially from risks of burns.

16.4.8. Knee protectors may be necessary, especially where work involves kneeling.

16.4.9. Aluminized heat-protective shoes, boots or leggings should be used near sources of intense heat.

16.4.10. All professional footwear should be kept clean and dry when not in use and should be replaced as soon as necessary.

## **16.5. Respiratory protective equipment**

16.5.1. When effective engineering controls are not feasible, or while they are being implemented or evaluated, respirators, appropriate to the hazard and risk in question, should be used to protect the health of the worker.

16.5.2. When the hazard and risk cannot be assessed with sufficient accuracy to define the appropriate level of respiratory protection, employers should make positive pressure air-supplied respiratory protective devices available.

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16.5.3. When selecting respirators, an appropriate number of sizes and models should be available from which a satisfactory respirator can be selected. Different sizes and models should be available to accommodate a broad range of facial types. Workers should be fit-tested for respirators.

16.5.4. Respirators should be cleaned and sanitized periodically. Respirators intended for emergency use should be cleaned and sanitized after each use.

16.5.5. The user should be sufficiently trained and familiar with the respirator in order to be able to inspect the respirator immediately prior to each use to ensure that it is in proper working condition. Inspection may include the following:

- (a) tightness of connections;
- (b) the condition of the respiratory inlet and outlet covering;
- (c) head harness;
- (d) valves;
- (e) connecting tubes;
- (f) harness assemblies;
- (g) hoses;
- (h) filters;
- (i) cartridges;
- (j) end of service life indicator;
- (k) electrical components;
- (l) shelf life date;
- (m) the proper function of regulators, alarms and other warning systems.

16.5.6. Respirators should be properly stored. Damage may occur if they are not protected from physical and chemical agents such as vibration, sunlight, heat, extreme cold, excessive moisture or damaging chemicals.

16.5.7. Each respirator should be used with an understanding of its limitations, based on a number of factors such as the level and duration of exposure, the characteristics of the chemical and the service life of a respirator.

16.5.8. Workers should be medically evaluated for their ability to wear a respirator safely before they are required to do so.

## **16.6. Hearing protection**

16.6.1. When effective engineering controls are not feasible or while they are being implemented or evaluated, hearing protection should be used to protect the health of workers.

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16.6.2. Hearing loss of speech frequencies may occur with elevated long-term exposure to noise. The use of hearing protectors gives the best results to users who are well informed of the risks and trained in their use. If earplugs are used, special attention should be paid to the proper fitting technique.

16.6.3. Hearing protectors should be comfortable, and the users should be trained to use them properly. Special attention should be paid to possible increased risk of accidents due to the use of hearing protectors. Earmuffs reduce the capacity to locate sound sources and prevent warning signals from being heard. This is especially true for workers with considerable hearing loss.

16.6.4. No model is suitable for all persons. Those wearing hearing protectors should be able to choose from alternative products that meet the attenuation criteria. Earplugs should not be the only solution as not all people can wear them.

16.6.5. Hearing protectors should be made available at the entrance to the noisy area and they should be put on before entering the noisy area. Noisy areas should be indicated by appropriate signs.

16.6.6. The attenuation of hearing protectors works well only if they are well maintained. Good maintenance consists of cleaning, changing replaceable parts such as cushions, and overall monitoring of the state of the hearing protector.

16.6.7. Hearing protectors should be evaluated through an audiometric test programme for exposed workers.

## **16.7. Protection from falls**

16.7.1. When other measures do not eliminate the risk of falling, workers should be provided with and trained in the use of appropriate fall protection equipment, such as harnesses and lifelines. Workplaces and traffic lanes in which there are fall hazards or which border on a danger zone should be equipped with devices which prevent workers from falling into or entering the danger zone.

16.7.2. Devices should be provided to prevent workers from falling through floors and openings.

16.7.3. Safety harnesses should be worn where required and the lifeline should be attached to an adequate anchor point.

16.7.4. Harnesses should be chosen that are safely used with other PPE that may be worn simultaneously.

16.7.5. Appropriate and timely rescue should be provided when using fall-arrest equipment to prevent suspension trauma.

## **16.8. Work clothing**

16.8.1. Where required on the basis of a risk assessment, workers should wear the appropriate protective clothing provided by the employer.

16.8.2. The selection of protective clothing should take into account:

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- (a) the adequacy of the design and the fit of the clothing, allowing freedom of movement to perform tasks, and whether it is suitable for the intended use;
  - (b) the environment in which it will be worn, including the ability of the material from which it is made to resist penetration by chemicals, minimize heat stress, release dust, resist catching fire and not discharge static electricity; and
  - (c) the special requirements of workers exposed to molten metal and associated hazards, such as the need for reflective clothing or insulated clothing with reflective surfaces during exposure to high radiant heat and hot air.

16.8.3. Work clothes contaminated with a chemical substance or substances should be washed (if reusable) or disposed of in a workplace facility.

16.8.4. Before reissuing the clothing, employers should provide for the laundering, cleaning, disinfecting and examination of protective clothing which has been used and may be contaminated by materials that are hazardous to health.

16.8.5. The employer should ensure that a worker removes protective clothing before leaving the containment area or any workplace exposed to asbestos dust, or any other substance that may pose a risk outside the containment area. Contaminated clothing should be disposed of safely.

16.8.6. Inspection of protective clothing should be performed by the user before each use.

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## **17. Contingency and emergency preparedness**

### **17.1. General**

17.1.1. Any comprehensive OSH programme should include plans for emergency response.

17.1.2. The emergency response plans should include, at a minimum, the following:

- (a) the roles and responsibilities of the workers assigned to respond;
- (b) emergency escape routes and procedures;
- (c) procedures to be followed by workers who remain to perform critical operations before they evacuate;
- (d) the evacuation of the worksite;
- (e) procedures to account for all workers after the emergency evacuation is complete;
- (f) rescue, medical and other duties for workers who are assigned to perform them;
- (g) the means for reporting fire and other emergencies;
- (h) provisions for first aid;
- (i) providing relevant information and training to all personnel of the facility, at all levels, including regular exercises in emergency prevention, preparedness and response procedures.

17.1.3. The necessary and most recent information, as well as internal communication and coordination, should be provided to protect all persons in the event of an emergency at the worksite. Alarms should be capable of being seen and heard by everyone; periodic emergency drills should be performed.

17.1.4. Emergency planning, prevention, preparedness and response arrangements should be designed to protect both workers and the public and should be established in cooperation with external emergency services.

### **17.2. First aid and medical care**

17.2.1. Implementing an effective first-aid programme should be a cooperative effort, involving employers, workers and their representatives, occupational health and public health organizations, and the labour inspectorate.

17.2.2. First aid, including the provision of trained personnel, should be available at every facility. First-aid boxes should always be clearly marked, be easily accessible and located near areas where accidents could occur. They should be able to be reached within one or two minutes. They should be made of suitable materials, and should protect the contents from heat, humidity, dust and abuse.

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17.2.3. Written instructions about first aid should be displayed by the employer at strategic places at the facility.

17.2.4. The first-aid programme in each workplace should be designed in coordination with the medical facility which provides the continuing care for its injured workers.

17.2.5. The employer should organize briefings for all workers. The following are essential parts of the briefing:

- (a) the organization of first aid at the facility, including the procedure for access to additional care;
- (b) identification of colleagues who have been appointed as first-aid personnel;
- (c) ways in which information about an accident should be communicated, and to whom;
- (d) location of the first-aid box;
- (e) location of the first-aid room;
- (f) what workers must do in the event of an accident;
- (g) location of the escape routes;
- (h) workers' actions following an accident;
- (i) ways of supporting first-aid personnel in their task.

17.2.6. The content of first-aid boxes should be appropriate to the risks to the workers and for the protection of first-aid providers and should be maintained.

17.2.7. First-aid personnel should be selected carefully, taking into account attributes such as reliability, motivation and the ability to cope with people in a crisis situation.

17.2.8. Where medical care is required, such services should be established in cooperation with external emergency services.

### **17.3. Escape and rescue**

17.3.1. An appropriate escape and rescue plan should be prepared in every plant.

17.3.2. An adequate number of emergency exits should be arranged. The routes to the emergency exits should be free of any materials.

17.3.3. The emergency exit sign should be visible in the nearest pathway of every post.

17.3.4. Where necessary, all persons at the facility should be supplied with equipment necessary to escape, such as emergency escape respirators.

17.3.5. In some emergency situations, specialized rescue equipment to remove or disentangle an accident victim may be necessary and should be provided.

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17.3.6. Rescue equipment should include items such as:

- (a) protective clothing;
- (b) blankets for fire-fighting;
- (c) fire extinguishers;
- (d) self-contained breathing apparatus;
- (e) cutting devices and mechanical or hydraulic jacks;
- (f) ropes, harnesses and specialized stretchers to move the victim;
- (g) equipment required to protect first-aid personnel against becoming casualties themselves in the course of delivering first aid;
- (h) any other protective equipment normally required by workers in the area.

17.3.7. Although initial first aid should be given before moving the patient, simple means should also be accessible for immobilizing an injured or sick person if necessary, for transporting him or her from the scene of the accident.



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## **18. Work organization**

### **18.1. Job safety analysis**

18.1.1. The employer, in consultation with workers and their representatives, should study the work process in order to determine the tasks that make up job or work operation. Each of those tasks should then be analysed to determine the hazards, assess the risks, and devise suitable means for performing the task as safely as possible. Special attention should be given to maintenance tasks.

18.1.2. The results of this analysis should be used to write a set of safe work procedures (SWPs), listing the hazards, required work procedures, appropriate PPE and procedures to be followed in case of unusual circumstances or emergencies.

18.1.3. The SWPs applicable to each task should be readily available to the workers involved. They should be reviewed with each such worker or work crew assigned to the task before the first time they perform it, and frequently thereafter.

18.1.4. SWPs should be reviewed, and revised if necessary, whenever the task or its hazards change, when there is an accident involving the task, and periodically.

### **18.2. Work flow**

18.2.1. As part of the risk-assessment process, the employer, in consultation with workers and their representatives, should chart the flow of raw materials, intermediate and finished products, mobile equipment and workers in the course of operations, noting the hazards that pertain to each step. The results of this analysis should be used to design the overall work process to be as safe as practicable.

### **18.3. Work teams**

18.3.1. Work teams should be resourced adequately to undertake the job safely.

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## 19. Special protection

### 19.1. Social protection

19.1.1. In accordance with national laws and regulations workers should:

- (a) be covered by an employment contract;
- (b) be entitled to adequate workers' compensation in the event of an occupational injury or disease and be entitled to survivors' and dependants' benefits; and
- (c) have access to appropriate services for rehabilitation and return to work.

### 19.2. Working hours

19.2.1. Daily and weekly working hours should be arranged so as to provide adequate periods of rest which, as prescribed by national laws and regulations or approved by labour inspectorates or collective agreements, where applicable, should include:

- (a) short breaks during working hours, especially when the work is strenuous, dangerous or monotonous, to enable workers to recover their vigilance and physical fitness;
- (b) sufficient breaks for meals;
- (c) daily or nightly rest;
- (d) weekly rest.

19.2.2. Extended workdays (above eight hours) should be contemplated only if:

- (a) the nature of the work and the workload permit;
- (b) the shift system is designed to minimize the accumulation of fatigue.

19.2.3. Any changes in work schedules should be preceded by detailed investigation and consultation with the workers and their representatives and followed by evaluation studies.

### 19.3. Alcohol- and drug-related problems

19.3.1. Alcohol- and drug-related problems should be dealt with in the same way as any other health problem at work. The ILO code of practice *Management of alcohol- and drug-related issues in the workplace*, 1996, deals specifically with this issue.

19.3.2. Alcohol and drug policies and programmes should promote the prevention, reduction and management of alcohol- and drug-related problems in the workplace. Employers and workers and their representatives should cooperate in developing such programmes for the facility.

19.3.3. The same restrictions or prohibitions with respect to alcohol should apply to both management personnel and workers.

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19.3.4. Testing of bodily samples for alcohol and drugs in the context of employment involves moral, ethical and legal issues of fundamental importance, requiring a determination of when it is fair and appropriate to conduct such testing.

19.3.5. Workers who seek treatment and rehabilitation for alcohol- or drug-related problems should not be disciplined or discriminated against by the employer and should enjoy normal job security. Any information communicated should be treated with confidentiality.

19.3.6. It should be recognized that the employer has authority to discipline workers for employment-related misconduct associated with alcohol and drugs. However, counselling, treatment and rehabilitation should be preferred to disciplinary action.

## **19.4. HIV/AIDS**

19.4.1. HIV/AIDS should be treated like any other serious illness/condition in the workplace.

19.4.2. The ILO code of practice *HIV/AIDS and the world of work* should be instrumental in helping to prevent the spread of the epidemic, mitigate its impact on workers and their families and provide social protection to help cope with the disease.

19.4.3. The work environment should be healthy and safe in order to prevent transmission of HIV. Employers should take steps to prevent the transmission of HIV and other blood-borne pathogens, particularly with respect to emergency response. Universal precaution should be applied with respect to first aid and other medical procedures and to the handling of other potentially infected material.

19.4.4. There should be no disciplinary action nor discrimination against workers on the basis of real or perceived HIV status.

19.4.5. In workplaces, it is recommended to have an HIV/AIDS policy and programme, the successful implementation of which requires cooperation and trust between employers, workers and their representatives.

19.4.6. There should be no discrimination against workers with HIV/AIDS in access to and receipt of benefits from statutory social security programmes and occupational health services.

## **19.5. Smoking at work**

19.5.1. Smoke-free workplace policies should be established, in consultation with workers and their representatives, for the enclosed area of the facility. These policies should be implemented and enforced by the employer in compliance with applicable laws and regulations.

19.5.2. These policies should also specify where smoking may be permitted during agreed rest breaks without creating hazards for other workers or additional hazards in the external areas of the facility.

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## 20. Personal hygiene

20.1. Adequate washing facilities, including hot and cold or warm running water, together with soap or other cleaning materials and towels or other drying equipment, should be provided.

20.2. The washing facilities should be conveniently accessible but situated so that they are not themselves exposed to contamination from the workplace.

20.3. Suitable toilets should be provided by the employer.

20.4. Toilets, washing facilities and areas set aside for eating should be kept clean and in a hygienic condition by the employer.

20.5. The type of washing facilities should be related to the nature and degree of exposure.

20.6. Facilities for storing personal clothing should be provided when protective clothing is used or when there is a risk of the contamination of personal clothing by hazardous materials.

20.7. Changing facilities should be situated and designed so as to prevent the spread of contamination from protective clothing to personal clothing and from one facility to another.

20.8. To reduce the risk of ingesting materials hazardous to health, workers should not eat, chew, drink or smoke in a work area contaminated by such materials. If it is necessary to prohibit eating or drinking at the workplace, suitable facilities should be set aside for these activities to be carried out in an uncontaminated area, which should be conveniently accessible to the work area.

20.9. Floors should be slip-resistant and well drained.

20.10. Spillages, leaks and splashes should be promptly cleaned up.

20.11. Safe drinking water should be provided and be readily accessible to all workers.

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## Bibliography

The International Labour Conference has adopted a large number of international labour Conventions and accompanying Recommendations directly concerned with OSH issues. The ILO has also developed many codes of practice and technical publications applicable to the iron and steel industry. They represent a body of definitions, principles, obligations, duties and rights, as well as technical guidance reflecting the consensual views of the ILO's tripartite constituents from its 177 member States on most aspects of OSH.

### 1. Relevant ILO Conventions and Recommendations

#### 1.1. *Fundamental ILO Conventions and accompanying Recommendations*

Eight Conventions were included by the International Labour Conference in the ILO Declaration on Fundamental Principles and Rights at Work. These eight Conventions cover the following four areas:

##### Freedom of association

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)

##### The elimination of forced labour

- Forced Labour Convention, 1930 (No. 29)
- Abolition of Forced Labour Convention, 1957 (No. 105)

##### The abolition of child labour

- Minimum Age Convention (No. 138) and Recommendation (No. 146), 1973
- Worst Forms of Child Labour Convention (No. 182) and Recommendation (No. 190), 1999

##### The elimination of discrimination

- Discrimination (Employment and Occupation) Convention (No. 111) and Recommendation (No. 111), 1958
- Equal Remuneration Convention (No. 100) and Recommendation (No. 90), 1951

#### 1.2. *Conventions and Recommendations on occupational safety and health and working conditions*

- Labour Inspection Convention, 1947 (No. 81)
- Radiation Protection Convention (No. 115) and Recommendation (No. 114), 1960

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- Reduction of Hours of Work Recommendation, 1962 (No. 116)
  - Guarding of Machinery Convention (No. 119) and Recommendation (No. 118), 1963\*
  - Employment Injury Benefit Convention (No. 121) and Recommendation (No. 121), 1964
  - Maximum Weight Convention (No. 127) and Recommendation (No. 128), 1967
  - Workers' Representatives Convention, 1971 (No. 135)
  - Benzene Convention (No. 136) and Recommendation (No. 144), 1971\*
  - Occupational Cancer Convention (No. 139) and Recommendation (No. 147), 1974
  - Working Environment (Air Pollution, Noise and Vibration) Convention (No. 148) and Recommendation (No. 156), 1977
  - Occupational Safety and Health Convention (No. 155) and Recommendation (No. 164), 1981
  - Protocol of 2002 (recording and notification of occupational accidents and diseases) to the Occupational Safety and Health Convention, 1981 (No. 155)
  - Occupational Health Services Convention (No. 161) and Recommendation (No. 171), 1985
  - Asbestos Convention (No. 162) and Recommendation (No. 172), 1986
  - Chemicals Convention (No. 170) and Recommendation (No. 177), 1990
  - Night Work Convention (No. 171) and Recommendation (No. 178), 1990
  - Prevention of Major Industrial Accidents Convention (No. 174) and Recommendation (No. 181), 1993
  - Maternity Protection Convention (No. 183) and Recommendation (No. 191), 2000
  - List of Occupational Diseases Recommendation, 2002 (No. 194)

## **2. Selected ILO codes of practice with provisions which are relevant and applicable to the iron and steel industry**

- *Protection of workers against noise and vibration in the working environment, 1977*
- *Occupational safety and health in the iron and steel industry, 1983*
- *Safety in the use of asbestos, 1984*

\* Identified for revision.

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- *Safety, health and working conditions in the transfer of technology to developing countries*, 1988
  - *Prevention of major industrial accidents*, 1991
  - *Safety in the use of chemicals at work*, 1993
  - *Management of alcohol- and drug-related issues in the workplace*, 1996
  - *Recording and notification of occupational accidents and diseases*, 1996
  - *Protection of workers' personal data*, 1997
  - *Ambient factors in the workplace*, 2001
  - *Safety in the use of synthetic vitreous fibre insulation wools (glass wool, rock wool, slag wool)*, 2001
  - *HIV/AIDS and the world of work*, 2001
  - *Safety and health in the non-ferrous metals industries*, 2003

### **3. Relevant publications**

- ILO. 1998. *Declaration on Fundamental Principles and Rights at Work and its Follow-up*, International Labour Conference, 86th Session (Geneva).
- . 1998. *Encyclopaedia of occupational health and safety*, 4th edition (Geneva) (four-volume print version and CD-ROM).
- . 1998. *Technical and ethical guidelines for workers' health surveillance*, Occupational Safety and Health Series, No. 72 (Geneva).
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- . 2004. *Safety and health in shipbreaking: Guidelines for Asian countries and Turkey* (Geneva).
- International Iron and Steel Institute. 1998. *Accident-free steel* (Brussels).
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- United Nations. 2003. *Globally harmonized system of classification and labelling* (Geneva).

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## Annex I

### Hazard identification, risk assessment and control

An organization should establish, implement and maintain documented procedures to ensure that the following are conducted:

1. hazard identification;
2. risk assessment;
3. control of risks; and then
4. evaluation of steps 1-3.

#### ***Hazard identification***

The identification of hazards in the workplace should take into account –

- (a) the situation or events or combination of circumstances that have the potential to give rise to injury or illness;
- (b) the nature of potential injury or illness relevant to the activity, product or service; and
- (c) past injuries, incidents and illness.

The identification process should also include consideration of –

- I. the way work is organized, managed, carried out and any changes that occur in this;
- II. the design of workplaces, work processes, materials, plant and equipment;
- III. the fabrication, installation and commissioning and handling and disposal of materials, workplaces, plant and equipment;
- IV. the purchasing of goods and services;
- V. the contracting of plant, equipment, services and labour including contract specification and responsibilities to and by contractors;
- VI. the inspection, maintenance, testing, repair and replacement of plant and equipment.

#### ***Risk assessment***

Risk assessment is a process used to determine the level of risk of injury or illness associated with each identified hazard, for the purpose of control. All risks should be assessed and have control priorities assigned, based on the established level of risk. The priority for control increases as the established level of risk increases.

The risk assessment process should take account of the likelihood and severity of injury or illness from the identified hazard. There are many established methods and techniques for the purpose of risk assessment.

#### ***Risk control***

Unless a particular hazard is removed, the risk associated with such a hazard can never be completely eliminated.

Organizations should plan the management and control of those activities, products and services that can or may pose a significant risk to health and safety.

The approach most commonly used is referred to as a hierarchy of control, from preferred, to the least desirable as follows:

- (a) elimination;
- (b) substitution;



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- (c) engineering controls;
  - (d) administrative (procedural) controls;
  - (e) personal protective equipment (PPE).

### ***Evaluation***

The processes of hazard identification, risk assessment and control should be subject to a documented evaluation of effectiveness and modified as necessary, and therefore being an ongoing process.

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## Annex II

### Workers' health surveillance

(adapted from the ILO *Technical and ethical guidelines for workers' health surveillance*, 1998)

#### 1. General principles

1.1. Competent authorities should ensure that laws and regulations governing workers' health surveillance are properly applied.

1.2. Workers' health surveillance should be carried out in consultation with workers and/or their representatives:

- (a) with the central purpose of primary prevention of occupational and work-related injuries and diseases;
- (b) under controlled conditions and within an organized framework, as may be prescribed by national laws and regulations and in accordance with the Occupational Health Services Convention, 1985 (No. 161), and Recommendation, 1985 (No. 171), and the ILO *Technical and ethical guidelines for workers' health surveillance*, Occupational Safety and Health Series, No. 72 (Geneva, 1998).

#### 2. Organization

2.1. The organization of workers' health surveillance at different levels (national, industry, enterprise) should take into account:

- (a) the need for a thorough investigation of all work-related factors and the nature of occupational hazards and risks in the workplace which may affect workers' health;
- (b) the health requirements of the work and the health status of the working population;
- (c) the relevant laws and regulations and the available resources;
- (d) the awareness of workers and employers of the functions and purposes of such surveillance;
- (e) the fact that surveillance is not a substitute for monitoring and control of the working environment.

2.2. In accordance with the needs and available resources, workers' health surveillance should be carried out at national, industry, enterprise and/or other appropriate levels. Provided that surveillance is carried out or supervised by qualified occupational health professionals, as prescribed by national laws and regulations, it can be undertaken by:

- (a) occupational health services established in a variety of settings, e.g. within one enterprise or among enterprises;
- (b) occupational health consultants;
- (c) the occupational and/or public health facilities available in the community where the enterprise is located;
- (d) social security institutions;
- (e) worker-run centres;
- (f) contracted professional institutions or other bodies authorized by the competent authority;
- (g) a combination of any of the above.

2.3. A comprehensive system of workers' health surveillance should:

- (a) include individual and collective health assessments, occupational injury and disease recording and notification, sentinel event notification, surveys, investigations and inspections;

- 
- (b) comprise the collection of information from various sources, and the analysis and evaluation with regard to quality and intended use;
  - (c) determine action and follow-up, including:
    - (i) guidance on health policies and occupational safety and health programmes;
    - (ii) early warning capabilities so that the competent authority, employers, workers and their representatives, occupational health professionals and research institutions can be alerted to existing or emerging occupational safety and health problems.

### **3. Assessment**

3.1. Medical examinations and consultations as the most commonly used means of health assessment of individual workers, either as part of screening programmes or on an as-needed basis, should serve the following purposes:

- (a) the assessment of the health of workers in relation to hazards or risks, giving special attention to those workers having specific needs for protection in relation to their health condition;
- (b) detection of pre-clinical and clinical abnormalities at a point when intervention is beneficial to individual health;
- (c) prevention of further deterioration in workers' health;
- (d) evaluation of the effectiveness of control measures in the workplace;
- (e) reinforcement of safe methods of work and health maintenance;
- (f) assessment of fitness for a particular type of work with due regard for the adaptation of the workplace to the worker, taking into account individual susceptibility.

3.2. Pre-assignment medical examinations, where appropriate, carried out before or shortly after employment or assignment, should:

- (a) collect information which serves as a baseline for future health surveillance;
- (b) be adapted to the type of work, vocational fitness criteria and workplace hazards.

3.3. During employment, medical examinations should take place at periodic intervals, as prescribed by national laws and regulations, and be appropriate to the occupational risks of the enterprise. These examinations should also be repeated:

- (a) on resumption of work after a prolonged absence for health reasons;
- (b) at the request of the worker, for example, in the case of change of work and, in particular, change of work for health reasons.

3.4. Where persons have been exposed to hazards and, as a consequence, there is a significant risk to their health in the long term, suitable arrangements should be made for post-employment medical surveillance for the purposes of ensuring the early diagnosis and treatment of such diseases.

3.5. Biological tests and other investigations should be prescribed by national laws and regulations. They should be subject to the workers' informed consent and performed according to the highest professional standards and least possible risk. These tests and investigations should not introduce unnecessary new hazards to the workers.

3.6. Genetic screening should be prohibited or limited to cases explicitly authorized by national legislation, in accordance with the ILO code of practice *Protection of workers' personal data*.

### **4. Use and records of data**

4.1. Workers' personal medical data should:

- (a) be collected and stored in conformity with medical confidentiality, in accordance with the ILO code of practice *Protection of workers' personal data* (Geneva, 1997);

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- (b) be used to protect the health of workers (physical, mental and social well-being) individually and collectively, in accordance with the ILO *Technical and ethical guidelines for workers' health surveillance*.

4.2. The results and records of workers' health surveillance should:

- (a) be clearly explained by professional health personnel to the workers concerned or to persons of their choice;
- (b) not be used for unwarranted discrimination, for which there should be recourse in national law and practice;
- (c) be made available, where requested by the competent authority, to any other party agreed by both employers and workers, to prepare appropriate health statistics and epidemiological studies, provided anonymity is maintained, where this may aid in the recognition and control of occupational injuries and diseases;
- (d) be kept during the time and under conditions prescribed by national laws and regulations, with appropriate arrangements to ensure that workers' health surveillance records are securely maintained for establishments that have closed down.

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## Annex III

### **Surveillance of the working environment** (according to the Occupational Health Services Recommendation, 1985 (No. 171))

1. The surveillance of the working environment should include:
  - (a) identification and evaluation of the hazards and risks which may affect the workers' safety and health;
  - (b) assessment of conditions of occupational hygiene and factors in the organization of work which may give rise to hazards or risks to the safety and health of workers;
  - (c) assessment of collective and personal protective equipment;
  - (d) assessment where appropriate of exposure of workers to hazardous agents by valid and generally accepted monitoring methods;
  - (e) assessment of control systems designed to eliminate or reduce exposure.

2. Such surveillance should be carried out in liaison with the other technical services of the undertaking and in cooperation with the workers concerned and their representatives in the undertaking and/or the safety and health committee, where they exist.

3. In accordance with national law and practice, data resulting from the surveillance of the working environment should be recorded in an appropriate manner and be available to the employer, the workers and their representatives in the undertaking concerned or the safety and health committee, where they exist.

4. These data should be used on a confidential basis and solely to provide guidance and advice on measures to improve the working environment and the safety and health of workers.

5. The competent authority should have access to these data. They may only be communicated to others with the agreement of the employer and the workers or their representatives in the undertaking or the safety and health committee, where they exist.

6. The surveillance of the working environment should entail such visits by the personnel providing occupational health services as may be necessary to examine the factors in the working environment which may affect the workers' health, the environmental health conditions at the workplace and the working conditions.

7. Without prejudice to the responsibility of each employer for the safety and health of workers in his/her employment, and with due regard to the necessity for the workers to participate in matters of occupational safety and health, personnel providing occupational health services should have such of the following functions as are adequate and appropriate to the occupational risks of the undertaking:

- (a) carry out monitoring of workers' exposure to hazards and risks, when necessary;
- (b) advise on the possible impact on the workers' health of the use of technologies;
- (c) participate in and advise on the selection of the equipment necessary for the personal protection of the workers against occupational hazards;
- (d) collaborate in job analysis and in the study of organization and methods of work with a view to securing a better adaptation of work to the workers;
- (e) participate in the analysis of occupational accidents and occupational diseases and in accident prevention programmes;
- (f) supervise sanitary installations and other facilities for the workers, such as drinking water, canteens and living accommodation, when provided by the employer.

8. Personnel providing occupational health services should, after informing the employer, workers and their representatives, where appropriate:

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- (a) have free access to all workplaces and to the installations the undertaking provides for the workers;
  - (b) have access to information concerning the processes, performance standards, products, materials and substances used or whose use is envisaged, subject to their preserving the confidentiality of any secret information they may learn which does not affect the safety and health of workers;
  - (c) be able to take for the purpose of analysis samples of products, materials and substances used or handled.

9. Personnel providing occupational health services should be consulted concerning proposed modifications in the work processes or in the conditions of work liable to have an effect on the safety and health of workers.

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## Annex IV

### Establishing an OSH management system

(adapted from the ILO Guidelines on occupational safety and health management systems, ILO/OSH 2001)

#### 1. Introduction

1.1. The positive impact of introducing occupational safety and health (OSH) management systems at the enterprise level, both on the reduction of hazards and risks and on productivity, is now recognized internationally by governments, employers and workers. The mutual benefits that accrue from the introduction of such systems should not be ignored if progress on improving safety and health and productivity in the iron and steel industry is to be achieved.

While systems need to be specific to an iron or steel-making facility and appropriate to the size and nature of activities, many elements of the ILO-OSH 2001 guidelines are generic and assistance from other industry sectors should not be difficult to obtain when implementing such a system. The design and application of OSH management systems at national and facility levels for iron- and steel-making should be guided by the *ILO Guidelines on occupational safety and health management systems, ILO-OSH 2001*.

1.2. The competent authority should:

- (a) promote the implementation and integration of OSH management systems as an integral part of the overall management of iron- and steel-making facilities;
- (b) elaborate national guidelines on the voluntary application and systematic implementation of OSH management systems based on the *ILO Guidelines on occupational safety and health management systems, ILO-OSH 2001*, or other internationally recognized safety and health management systems compatible with ILO-OSH 2001, taking into consideration national conditions and practice;
- (c) encourage the elaboration by authorized institutions of specific (tailored) guidelines on OSH management systems in iron- and steel-making facilities;
- (d) provide support and technical guidance to labour inspectorates, OSH services and other public or private services, agencies and institutions dealing with OSH, including health-care providers;
- (e) ensure that guidance is provided to employers and workers to assist them to comply with their legal obligations under the policy;
- (f) ensure cooperation between employers whenever two or more facilities engage in activities on the same project;
- (g) recognize the need, so long as the safety and health of workers are not compromised, to protect confidential information that could potentially cause harm to an employer's business.

1.3. With a view to developing, implementing and operating OSH management systems, employers should:

- (a) set out in writing their respective OSH policy, programmes and safety and health protection arrangements as part of the general facility management policy;
- (b) define the various safety and health responsibilities, accountability and authority levels and communicate these clearly to their workers, visitors or any other persons working in the facility, as appropriate;
- (c) ensure effective arrangements for the full participation of workers and their representatives in the fulfilment of the OSH policy;
- (d) define both the necessary OSH competence requirements for all persons and the consequent individual training needs;

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- (e) ensure workers have sufficient information, in a form and language that they understand, to protect their health from hazardous ambient factors;
  - (f) establish and maintain appropriate documentation and communication arrangements;
  - (g) identify the hazards and carry out assessments of the specific risks to safety and health of workers presented in the workplace;
  - (h) establish hazard prevention and control measures including emergency prevention, preparedness and response arrangements;
  - (i) establish procedures for the compliance with OSH requirements in purchasing and leasing specifications and for contractors working on the site;
  - (j) develop, establish and review procedures to monitor, measure and record OSH performance, taking into consideration the results of the investigations of work-related injuries and diseases, OSH compliance audits and reviews of the OSH system by management; and
  - (k) identify and implement preventive and corrective actions and opportunities for continual improvement.

## **2. Occupational safety and health policy**

2.1. The management of safety and health should be considered as a high priority management task. Consistent with the general policy of the iron- or steel-making facility, the employer should set out an OSH policy, which should:

- (a) be specific to the facility and appropriate to its size and the nature of its activities;
- (b) recognize OSH as an integral part of the overall management structure and OSH performance as an integral part of the business performance of the facility.

2.2. The OSH policy should include, as a minimum, the following key principles and objectives to which the facility management is committed:

- (a) recognizing OSH as an integral part of the overall management structure and OSH performance as an integral part of the establishment's business performance;
- (b) protecting the safety and health of all members of the establishment by preventing work-related injuries, ill health, diseases and incidents;
- (c) complying with relevant OSH national laws and regulations, voluntary programmes, collective agreements on OSH and other requirements to which the establishment subscribes or may wish to subscribe;
- (d) ensuring that workers and their representatives are consulted and encouraged to participate actively in all elements of the OSH management system; and
- (e) continual improvement of the performance of the OSH management system.

2.3. The extent and precise nature of a safety and health policy will clearly depend on the size and scope of the iron- or steel-making facility, but certain key components should be incorporated. These are:

- (a) the recruitment and training of personnel;
- (b) the identification of those personnel who have been assigned specific responsibilities in the area of safety and health;
- (c) the provision of equipment and substances in order to ensure a safe and healthy working environment;
- (d) arrangements for liaison with other concerned bodies, for example legislators, workers' organizations, public utilities such as water and electricity authorities, and organizations responsible for environmental conservation;
- (e) the function and constitution of the safety and health committee;
- (f) procedures for the enforcement of safety requirements adopted by the establishment whether by laws and regulations or otherwise;
- (g) procedures for the reporting of accidents, dangerous occurrences and occupational diseases;



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- (h) the means by which the policy will be communicated to all those involved including the date on which the policy will be reviewed and, as necessary, revised;
  - (i) emergency procedures.

### **3. Worker participation**

3.1. Worker participation should be an essential element of the OSH management system in the facility. The employer should ensure that workers and their safety and health representatives are consulted, informed and trained on all aspects of OSH associated with their work, including emergency arrangements.

3.2. The employer should ensure, as appropriate, the establishment and efficient functioning of a safety and health committee and the recognition of workers' safety and health representatives, in accordance with national laws and practice. Safety and health committees should include workers or their representatives, employers' representatives and, as far as practicable, an occupational safety and health expert. Safety and health committees should meet regularly and participate in the decision-making process related to occupational safety and health-related issues.

### **4. Responsibility and accountability**

4.1. The employer should have overall responsibility for the protection of workers' safety and health and provide leadership for OSH activities and initiatives in the facility.

4.2. The employer and senior management should allocate responsibility, accountability and authority among the personnel for the development, implementation and performance of the OSH management system and for OSH matters. These matters should constitute part of their overall responsibilities and be incorporated into job descriptions as part of management tasks. Measures should be taken to ensure that the personnel are competent and have the necessary authority and resources to perform their duties effectively.

4.3. Irrespective of the size and structure of the enterprise, senior managers should be appointed to develop, oversee and control safety and health standards. They should be the focal points to which problems will be addressed, including the recording and notification of occupational accidents and diseases.

4.4. Managers and supervisors should:

- (a) implement the facility's safety and health policy, including through the selection of safe equipment, work methods and work organization and the maintenance of high levels of skill;
- (b) endeavour to reduce risks and hazards to safety and health in the activities for which they are responsible to as low a level as possible;
- (c) ensure that workers and contractors receive adequate information on safety and health regulations, policies, procedures and requirements and satisfy themselves that this information is understood;
- (d) assign tasks to their subordinates in a clear and precise way. Managers and supervisors should satisfy themselves that workers understand and implement the safety and health requirements;
- (e) ensure that work is planned, organized and carried out in such a way as to minimize the risk of accidents and the exposure of workers to conditions that may lead to injury or damage to their health.

4.5. In consultation with workers, managers and supervisors should assess the need for additional instruction, training or further education of workers by monitoring compliance with safety requirements.

4.6. Supervisors should be responsible for monitoring compliance by contractors and their workers with the requirements for occupational safety and health. In the event of non-compliance, supervisors should provide appropriate instruction and advice to contractors and their workers accordingly.

4.7. Workers should be made clearly aware of their rights and individual and collective duties for safety and health matters, as prescribed by national laws and regulations or adapted regulations of the facility.

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4.8. Contractors employing workers for iron- or steel-making should be regarded as employers for the purposes of these guidelines, and the provisions pertaining to the responsibilities and duties of employers should apply accordingly.

4.9. Contractors and labour supply agents should:

- (a) be registered or hold licences where required by national laws or regulations or subscribe to recognized voluntary schemes where they exist;
- (b) make themselves aware of and operate according to the commissioning parties' policies and strategies for the promotion of safety and health and should comply and cooperate with related measures and requirements.

4.10. Contractors should comply with national laws and regulations concerning terms of employment, workers' compensation, labour inspection and occupational safety and health.

## **5. Competence and training**

5.1. The necessary OSH competence requirements should be defined by the employer, and appropriate training arrangements established and maintained to ensure that all persons are competent to perform their present or future safety and health duties and responsibilities.

## **6. Documentation**

6.1. According to the size and nature of activity of the facility, OSH management system documentation should be established and maintained, and may cover:

- (a) the OSH policy and objectives of the establishment;
- (b) the allocated key OSH management responsibilities of management, supervisors, workers and contractors, for the implementation of the OSH management system;
- (c) the significant OSH hazards/risks arising from the activities of the facility, including a list of all hazardous substances in the workplace, and the arrangements for their prevention and control; and
- (d) arrangements, procedures, instructions or other internal documents concerning the safety and health of workers used within the OSH management system.

6.2. OSH records should be established, managed and maintained locally and according to the needs of the establishment. They should be identifiable and traceable, and their retention times should be specified.

6.3. OSH documentation should be available to all workers, workers' representatives, or other parties having an interest in or affected by its contents.

6.4. OSH records may include:

- (a) records arising from the implementation of the OSH management system;
- (b) records of work-related injuries, ill health, diseases and incidents, and relevant costs;
- (c) records arising from the implementation of national OSH laws or regulations;
- (d) records of workers' exposures, surveillance of the working environment and workers' health; and
- (e) the results of both active and reactive monitoring.

## **7. Communication and information**

7.1. Arrangements and procedures should be established and maintained for:

- (a) receiving, documenting and responding appropriately to internal and external communications related to OSH;
- (b) ensuring the internal communication of obligatory or other OSH information between relevant levels and functions of the enterprise in the management framework; and

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- (c) ensuring that the concerns, ideas and inputs of workers and their representatives on OSH matters are received, considered and responded to.

7.2. In order to ensure the full integration of safety and health concerns into iron- and steel-making operations, guidelines on working practices or operations manuals should incorporate safety and health regulations and advice alongside provisions pertaining to quality, productivity, environmental and other aspects.

## **8. Initial review**

8.1. The existing OSH arrangements in a facility should be evaluated by an initial review, as appropriate. In the case where no formal OSH arrangements exist, or if the facility is newly established, an initial review should serve as a basis for establishing an OSH management system. Before conducting the review, three key questions should systematically be answered:

- (a) Where are we now?
- (b) Where do we want to be?
- (c) How do we get there?

8.2. In the context of an iron- or steel-making facility, an initial review in the form of an inventory survey should be completed by competent persons. The inventory or initial review should:

- (a) identify, quantify, locate or anticipate physical, chemical, biological and other hazards and assess risks to safety and health arising from the existing or proposed work environment and work organization; and
- (b) result in the creation of an inventory list of hazardous substances (wastes) and other substances.

8.3. Additional reviews, as appropriate, should:

- (a) identify the current applicable national laws and regulations, national guidelines, tailored guidelines, voluntary schemes and other requirements to which the establishment subscribes;
- (b) determine whether planned or existing controls are adequate to eliminate hazards or control risks; and
- (c) analyse other available data, in particular data provided from workers' health surveillance (see Annex I) and surveillance of the working environment (see Annex II).

8.4. The employer of the iron- or steel-making establishment should establish and maintain procedures to identify, evaluate systematically and record the hazards and risks to safety and health that may affect, or arise from iron- and steel-making activities.

## **9. System planning, development and implementation**

9.1. Based on the results of the initial review, hazard identification and risk assessment and other available data, e.g. the results of workers' health surveillance (see Annex I), surveillance of the working environment (see Annex II), and active and reactive monitoring, the employer should:

- (a) define OSH objectives for the reduction of such risks to as low a level as possible;
- (b) devise and implement corresponding preventive measures, based on an appropriate order of prevention; and
- (c) develop, approve and implement a "safe iron- or steel-making plan" before any operation starts.

These activities should include the routine application of site inspection and planning as well as of the principles of work organization.

9.2. The planning arrangements should contribute to the improved protection of safety and health at work, and should include:

- (a) a clear definition, priority setting and quantification, where appropriate, of the OSH objectives of the establishment;

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- (b) the preparation of a plan for achieving each objective, with defined responsibility and clear performance criteria indicating what is to be done by whom and when and what is the predicted result;
  - (c) the selection of measurement criteria (indicators) for confirming that the objectives are achieved; and
  - (d) the provision for adequate resources, including human and financial resources and technical support, as appropriate.

9.3. Resource allocation should include, among others:

- (a) the facilities, tools and equipment required to meet legislative and other adopted standards;
- (b) an organized infrastructure to respond to and mitigate the effects of accident risks and health hazards;
- (c) availability of management for reviewing and auditing standards and practices;
- (d) assessment of future needs arising from new technical or legal developments.

## **10. Occupational safety and health objectives**

10.1. Consistent with the OSH policy and based on the initial review, subsequent reviews and other available data, measurable OSH objectives should be established, which are:

- (a) specific to the facility, and appropriate to and according to its size and nature of activity;
- (b) consistent with the relevant and applicable national laws and regulations, and the technical and business obligations of the facility with regard to OSH;
- (c) focused towards continually improving workers' OSH protection to achieve the best OSH performance;
- (d) realistic and achievable;
- (e) agreed with those who deliver them;
- (f) set against a suitable timescale;
- (g) documented, and communicated to all relevant functions and levels of the enterprise; and
- (h) periodically evaluated and, if necessary, updated.

## **11. Hazard identification and risk assessment, preventive and protective measures**

11.1. Employers should make arrangements for the identification and periodic assessment of the hazards and risks to safety and health from hazardous ambient factors at each permanent or temporary workplace, generated by the use of different operations, tools, machines, equipment and substances.

11.2. The assessment should be reviewed whenever there has been a significant change in the work to which it relates or when there is reason to suspect that it is no longer valid. The review should be incorporated in a system of management accountability which ensures that control action shown to be necessary by the initial assessment is in fact taken.

11.3. For works which by their very nature expose workers to hazards arising from the use or presence of hazardous chemical, physical or biological factors, psychosocial factors and climatic conditions, appropriate preventive and protective measures should be implemented to prevent those hazards and risks, or to reduce them to the lowest reasonable and practicable level, in conformity with national laws and regulations.

11.4. The employer should take appropriate measures for the prevention and control of, and protection against, occupational hazards in the working environment.

11.5. Hazards and risks to workers' safety and health should be identified and assessed on an ongoing basis. Preventive and protective measures should be implemented in the following order of priority:

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- (a) eliminate the hazard/risk;
  - (b) control the hazard/risk at source, through the use of engineering controls or organizational measures;
  - (c) minimize the hazard/risk by the design of safe work systems, which include administrative control measures; and
  - (d) where residual hazards/risks cannot be controlled by collective measures, the employer should provide for appropriate PPE, including clothing, at no cost, and should implement measures to ensure its use and maintenance.

11.6. The impact on OSH of internal changes (e.g. those in staffing or due to new processes, working procedures, organizational structures or acquisitions) and of external changes (e.g. as a result of amendments of national laws and regulations, organizational mergers, and developments in OSH knowledge and technology) should be evaluated and appropriate preventive steps taken prior to the introduction of changes.

11.7. A workplace hazard identification and risk assessment should be carried out before any modification or introduction of new work methods, materials, processes or machinery.

11.8. Procedures should be established and maintained to ensure that:

- (a) compliance with safety and health requirements for the establishment is identified, evaluated and incorporated into purchasing and leasing specifications;
- (b) national laws and regulations and the own OSH requirements of the establishment are identified prior to the procurement of goods and services; and
- (c) arrangements are made to achieve conformance with the requirements prior to their use.

11.9. Arrangements should be established and maintained for ensuring that the safety and health requirements of the facility, or at least the equivalent, are applied to contractors and their workers.

## **12. Performance monitoring and measurement**

12.1. Safety and health performance should be monitored against predetermined plans and standards and iron- and steel-making enterprises should measure what they are doing to implement their safety and health policy and to assess how effectively they are controlling risks. Monitoring should reinforce management's commitment to safety and health objectives and help in developing and promoting a positive safety and health culture.

12.2. Monitoring should provide:

- (a) feedback on OSH performance;
- (b) information to determine whether the day-to-day arrangements for hazard and risk identification, prevention and control are in place and operating effectively; and
- (c) the basis for decisions about improvement in hazard identification and risk control, and the OSH management system.

12.3. *Active monitoring* should contain the elements necessary to have a proactive system and should include:

- (a) monitoring of the achievement of specific plans, established performance criteria and objectives;
- (b) the systematic inspection of work systems, premises and equipment;
- (c) surveillance of the working environment (see Annex II), including work organization;
- (d) surveillance of workers' health (see Annex I), where appropriate, through suitable medical monitoring or follow-up of workers for early detection of signs and symptoms of harm to health in order to determine the effectiveness of preventive and protective measures; and
- (e) compliance with applicable national laws and regulations, collective agreements and other commitments on OSH to which the establishment subscribes.

12.4. *Reactive monitoring* should include the identification, reporting and investigation of:

- 
- (a) work-related injuries, ill health (including monitoring of aggregate sickness absence records), diseases and incidents;
  - (b) other losses, such as damage to property;
  - (c) deficient safety and health performance, and OSH management system failures; and
  - (d) workers' rehabilitation and health-restoration programmes.

### **13. Investigation of work-related injuries, ill health, diseases and incidents, and their impact on safety and health performance**

13.1. Iron- and steel-making facilities should investigate and document the origin and underlying causes of all work-related injuries, ill health, diseases and incidents to identify any failures in the OSH management system.

13.2. Such investigations should be carried out by identified competent persons (internal or external) along with the appropriate participation of workers and their representatives. All investigations should conclude with a report on the action taken to prevent a recurrence.

13.3. The results of all investigations should be communicated to the worker(s) involved and the safety and health committee, where it exists, to make any appropriate recommendations.

13.4. The results of investigations, in addition to any recommendations from the safety and health committee, should be communicated to:

- (a) appropriate persons for corrective action, included in the management review and considered for continual improvement activities; and
- (b) the competent authority, if so required by national laws and regulations.

13.5. Corrective action resulting from investigations should be implemented, and subsequently checked in order to avoid repetition of the work-related injuries, ill health, diseases and incidents which gave rise to the investigation.

13.6. Reports produced by external investigation agencies, such as inspectorates and social insurance institutions, should be acted upon in the same manner as internal investigations, taking into account issues of confidentiality.

### **14. Audit**

14.1. Arrangements to conduct periodic audits are to be established in order to determine whether the OSH management system and its elements are in place, adequate, and effective in protecting the safety and health of workers and preventing incidents.

14.2. The audit should evaluate all elements of the facility's OSH management system or a subset of these, as appropriate. Its conclusion should determine whether the implemented OSH management system elements or subset:

- (a) are effective in meeting the OSH policy and objectives of the facility;
- (b) are effective in promoting full worker participation;
- (c) respond to the results of OSH performance evaluation and previous audits;
- (d) enable the facility to achieve compliance with relevant national laws and regulations; and
- (e) fulfil the goals for continual improvement and best OSH practice.

14.3. Consultation on selection of the auditor and all stages of the workplace audit, including analysis of results, are subject to worker participation, as appropriate.

### **15. Management review**

15.1. A management review should:

- (a) evaluate the overall strategy of the OSH management system to determine whether it meets planned performance objectives;

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- (b) evaluate the OSH management system's ability to meet the overall needs of the establishment and its stakeholders, including its workers and the regulatory authorities;
  - (c) identify what action is necessary to remedy any deficiencies in a timely manner, including adaptations of other aspects of the management structure and performance measurement of the establishment.

15.2. The findings of a management review should be recorded and formally communicated to:

- (a) the persons responsible for the relevant element(s) of the OSH management system so that they may take appropriate action; and
- (b) the safety and health committee, workers and their representatives.

## **16. Preventive and corrective action**

16.1. Arrangements should be established and maintained for preventive and corrective action resulting from OSH management system performance monitoring and measurement, OSH management system audits and management reviews.

16.2. When the evaluation of the OSH management system or other sources show that preventive and protective measures for hazards and risks are inadequate or likely to become inadequate, the measures should be addressed according to the recognized hierarchy of preventive and protective measures, and completed and documented, as appropriate and in a timely manner.

## **17. Continual improvement**

17.1. Arrangements should be established and maintained for the continual improvement of the relevant elements of the OSH management system and the system as a whole. The safety and health processes and performance of the facility should be compared with others in order to improve safety and health performance.

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## Annex V

### Occupational exposure limits for hazardous substances, electric and magnetic fields, optical radiation, heat, noise and vibration

#### 1. Purpose

1.1. This annex gives a general introduction to exposure limits for the use of employers and others, and indicates where more information can be obtained. Although some illustrative values are quoted, it is not the purpose of this annex to list values, because these change continually as more technical information becomes available, and it is the responsibility of the competent authority to specify which exposure limits should be used and how.

1.2. Certain standard-setting bodies rely on technical expertise only. They do not accurately reflect the views of the social partners, e.g. trade unions. This should be taken into account when referring to the standards mentioned in this annex.

#### 2. General

2.1. An exposure limit (EL) is a level of exposure specified by a competent authority, or some other authoritative organization such as a professional body, as an indicator of the level to which workers can be exposed without serious injury. It is used as a general term and covers the various expressions employed in national lists, such as “maximum allowable concentration”, “threshold limit value”, “permissible level”, “limit value”, “average limit value”, “permissible limit”, “occupational exposure limit”, “industrial hygiene standards”, and so on. The exact definition and intended application of ELs vary widely from one authority to another, and the underlying definitions and assumptions and the requirements of the appropriate competent authority should be taken into account if they are used. For example, some authorities have promulgated ELs that are used as legally permitted “safe” levels of exposure and are intended to protect against injury, not against every health effect. Other authorities provide for limits intended as guidelines or recommendations in the control of potential workplace health hazards.

2.2. Administrative control levels are provided by the competent authority in Japan. These levels are not limits for individual exposure; they constitute an index to determine the control category (level of cleanliness), and to assess the adequacy of control measures in the working environment. The control category is based on the results of working environment measurements in the work area.

2.3. An important example of the caution to be applied in using ELs is provided in the introduction to the annual publication *Threshold limit values for chemical substances and physical agents and biological exposure indices* of the American Conference of Governmental Industrial Hygienists (ACGIH): threshold limit values (TLVs) “represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously”. Consequently, any EL represents a risk that is felt to be acceptable based on a particular criterion, and where such limits are promulgated there is usually an additional requirement to keep exposure as low as practicable, rather than simply below the EL.

2.4. It is also important to take into account the averaging period for which the limit is intended. Some limits are ceiling values to be continuously applied; others apply to average exposures over a period of up to several years. A short-period limit requires stricter control than a longer-period limit at the same exposure value. For example, a limit applying to a month might allow the exposure to range above the value for days at a time, provided there was a compensating period of low exposure that maintained the monthly average. If the same value were applied to 15-minute averages, the control would have to be good enough to keep every 15-minute average below the value.



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2.5. ELs generally limit exposure of the individual, and measurements to be compared with the EL must therefore be taken close to the individual (“personal exposure”), unless the EL in question is clearly stated to be applicable to the general value in the workplace environment. A measurement result sometimes depends on the measurement method, and quality control of measurements is often important; employers should consult the occupational health service, including the competent authority, on these issues.

2.6. Some authorities issue lists of values to be used in biological monitoring or in biological effect monitoring. As with ELs, different lists are derived from different assumptions and are intended to be used in different ways. They include lists of values that are believed to be safe, and values that are not necessarily safe but that represent an acceptable standard of control.

### 3. General sources

3.1. It is the responsibility of the competent authority to specify what ELs should be used, and the responsibility of the employer to obtain this information from the competent authority for any particular hazard and to compare the EL values with exposure levels in workplaces in order to verify whether exposure is being properly controlled. A large number of international, national and other authorities have published lists of legal or recommended ELs of various sorts, but usually only for chemicals. The most wide-ranging is the ACGIH TLV list, updated annually, which includes recommended EL values for airborne chemicals; biological monitoring limits; ionizing, non-ionizing and optical radiation; thermal stress; noise; and vibration. The International Programme on Chemical Safety (IPCS) produces IPCS International Chemical Safety Cards, which are peer-reviewed assessment documents. International organizations, such as the International Organization for Standardization (ISO) and the International Atomic Energy Agency (IAEA), produce technical standards on the measurement and control of several ambient factors with the objective of their being transferred to regional or national legislation.

3.2. For all the ambient factors dealt with in this code of practice, detailed guidance on ELs and other aspects of assessment and control is provided by the ILO *Encyclopaedia of occupational health and safety* (Geneva, 4th edition, 1998). Some references concerning ELs for particular ambient factors are given in the following sections.

### 4. Hazardous substances

4.1. ELs for solids and non-volatile liquids are usually in mg/m<sup>3</sup> (milligrams of the chemical in a cubic metre of air). ELs for gases and vapours are usually in ppm (parts of the substance in a million parts of air, by volume), and also in mg/m<sup>3</sup> at a specified temperature and pressure. A smaller number of lists of ELs is available for biological monitoring.

4.2. Many authorities have issued lists of ELs for airborne chemicals, on various assumptions. The International Occupational Safety and Health Information Centre (CIS) of the ILO maintains a database of the limits from different parts of the world. For the time being, peer-reviewed IPCS International Chemical Safety Cards are available for around 1,300 chemical substances.

4.3. There are European standards for:

- (a) the performance of measurement methods for airborne chemicals: EN 482: *Workplace atmospheres – General requirements for the performance of procedures for the measurement of chemical agents* (1994);
- (b) comparison of the results with ELs: EN 689: *Workplace atmospheres – Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy* (1996).

4.4. Recommended values are given in *Threshold limit values for chemical substances and physical agents and biological exposure indices* (see paragraph 2.3).

4.5. Prominent national standards are:

- (a) EH 40: *Occupational exposure limits* (United Kingdom, Health and Safety Executive (HSE)) (revised annually);
- (b) Technical code of practice TRGS 900 (Technische Regeln für Gefahrstoffe): *Grenzwerte in der Luft am Arbeitsplatz [Limit values relating to air in the workplace]* (Germany) (revised annually);

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- (c) Code of Federal Regulations, 1910. Subpart Z: *Hazardous and toxic substances* (United States Department of Labor, Occupational Safety and Health Administration, 2001).

## 5. **Non-ionizing radiation**

5.1. The term “non-ionizing radiation” is given to those regions of the electromagnetic spectrum where the energies of the emitted photons are insufficient, under normal conditions, to produce ionization in the atoms of absorbing molecules. They are usually referred to as ultraviolet, visible and infrared radiation.

5.2. There are as yet no internationally accepted sets of limits for electric and magnetic fields corresponding to the recommendations on ionizing radiation issued by the International Commission on Radiological Protection (ICRP), although some ELs have been recommended by the International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA), and by its successor, the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Some limits proposed by these and other organizations are in terms of the physical or physiological effects of the radiation, and some in terms of the strengths of the fields. The relations between the units and quantities are complicated, and different quantities have been used in recommended ELs. Many of the recommendations depend on the frequency of the radiation. Units for time-varying quantities usually refer to the root-mean-square (rms) values.

5.3. Guidelines and recommendations can be found in the practical guide on *Protection of workers from power frequency electric and magnetic fields*, Occupational Safety and Health Series, No. 69 (Geneva, ILO, 1994); and in *Human exposure to electromagnetic fields*, ENV 50166-1 (low frequencies) and ENV 50166-2 (high frequencies) (Brussels, European Committee for Electrotechnical Standardization, 1995).

## 6. **Ionizing radiation**

6.1. Ionizing radiation is produced when atoms break up. The energy released in this process takes a number of forms that have typical wavelength and frequency, energy and penetrating power.

6.2. Alpha, beta and gamma radiation have sufficient energy to alter other atoms and are termed “ionizing radiation”.

6.3. Alpha and beta radiation are composed of relatively large particles with very little penetration. While alpha particles travel only a few centimetres in air and are incapable of penetrating the skin, beta particles have a range of more than 1 metre in air and up to 1 centimetre or so in tissue. Alpha and beta radiation cause biological damage, mainly from inhaled or ingested sources of material.

6.4. Gamma radiation or X-rays can pass through tissues from an external source, including plant walls and equipment.

## 7. **Heat**

7.1. A series of international standards, including those of the ISO, is helpful in the assessment and monitoring of the thermal environment. ISO 11399:1995 *Ergonomics of the thermal environment – Principles and application of relevant international standards* is a useful guide to their application.

7.2. In hot environments, ISO 7243:1989 *Hot environments – Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)* gives a rapid method based on the WBGT index, which will be satisfactory under most conditions. It may provide insufficient protection for work in impervious clothing, in high radiant temperature, or a combination of high temperature and high air velocity. Under these more severe conditions, ISO 7933:1989 *Hot environments – Analytical determination and interpretation of thermal stress using calculation of required sweat rate* and ISO 9886:1992 *Ergonomics – Evaluation of thermal strain by physiological measurements* provide guidance for assessing individual response.

7.3. EN 563: *Safety of machinery – Temperatures of touchable surfaces – Ergonomics data to establish temperature limit values for hot surfaces* (1994) is also relevant.

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7.4. The ACGIH publication *Threshold limit values for chemical substances and physical agents and biological exposure indices* (see paragraph 2.3 of this annex) gives details of work/rest regimes and is revised annually.

## **8. Noise**

8.1. Noise is conventionally measured in terms of the pressure of the sound wave. Because the ear responds roughly to the logarithm of the pressure, rather than its linear value, noise intensity is measured in decibels (dB), which are related to the logarithm of the ratio of the pressure of the sound to the pressure of a standardized least detectable sound. Also, the ear is more responsive to some frequencies than others, so measurements and ELs are in terms of dB(A), which takes a frequency weighting into account. All authorities specify an EL in terms of dB(A) applicable to eight-hour exposures, with a formula to deal with other exposure periods, and in most cases a peak EL as well. Some authorities apply stricter standards to particular environments. Users should apply standards that are adopted or recognized by the competent authority. These include a series of ISO standards on acoustics (1999:1990; 4871:1996; 9612:1997; 7196:1995; 11690:1996).

## **9. Vibration**

9.1. ELs for vibration are usually in terms of the root-mean-square (rms) acceleration, frequency weighted to take human response into account. The standard is usually applied to eight-hour exposures, with a formula to account for shorter or longer periods.

9.2. For whole-body vibration, limits are applied to the longitudinal component (through the head and feet), to the two axes at right angles to this, and to a weighted combination of all three (ISO 2631-1:1997).

9.3. For hand-transmitted vibration, limits are applied to frequency-weighted acceleration along three orthogonal axes centred at the point of contact of the hand and the tool (ISO 5349:1986 provides guidelines for measurement).

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## Annex VI

### Additional chemicals used in the iron and steel industry

#### Ammonia

Short-term (acute) inhalation causes severe irritation of the respiratory tract. Skin contact results in burns, blistering and, possibly, permanent scarring of the skin. Eye contact causes irritation and, possibly, corrosive injury.

#### Benzene

Short-term (acute) inhalation causes depression of the central nervous system, marked by drowsiness, dizziness, headache, nausea, loss of coordination, confusion and unconsciousness. Long-term exposure to benzene reduces the number of red and white blood cells and damages bone marrow. Benzene is carcinogenic.

#### Carbon monoxide

Inhalation of carbon monoxide causes symptoms including headache, weakness, dizziness, nausea, fainting, increased heartbeat, irregular heartbeat, loss of consciousness and death.

#### Chlorine

If inhaled, chlorine causes severe breathing difficulties and pulmonary oedema. It can aggravate respiratory diseases, such as bronchitis and asthma.

#### Cyclohexane

Short-term (acute) inhalation can cause headache, nausea, dizziness, drowsiness and confusion. In very high concentrations, unconsciousness and death can result. Ingestion of extremely large doses may cause nausea, vomiting, diarrhoea and headache.

#### Formaldehyde

Short-term (acute) exposure through the inhalation of vapour can cause severe irritation of the nose, throat and windpipe. Formaldehyde solutions can cause primary irritation resulting in tingling, drying and reddening of skin. Eye contact results in irritation and tingling of the eye; concentrated solutions can cause severe eye injury.

Ingestion of formaldehyde causes irritation, severe pain in the mouth, throat, oesophagus and intestinal tract. Later symptoms can include dizziness, depression and coma.

Long-term (chronic) exposure through inhalation causes irritation of mucous membranes and the upper respiratory tract. Long-term skin contact causes skin allergy.

#### Hydrogen cyanide

Short-term (acute) inhalation or ingestion causes weakness, headache, giddiness, dizziness, confusion, anxiety, nausea and vomiting. High concentrations can cause death within minutes or hours. There may be a bitter, pungent, burning taste in the mouth.

Long-term (chronic) exposure causes a persistent runny nose, weakness, dizziness, giddiness, headache, nausea, abdominal pain, vomiting, throat irritation, changes in taste and smell, muscle cramps, weight loss, flushing of the face and enlargement of the thyroid gland.

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## Phenol

Short-term (acute) contact with skin, eye or mucous membranes leads to numbness or slight tingling, then burns, blisters, permanent skin damage and gangrene, damage to the mouth, throat and stomach, internal bleeding, vomiting, diarrhoea and decreased blood pressure. Shock, collapse, coma and death may result.

## Sulphuric acid

Short-term (acute) exposure through inhalation can cause severe irritation or corrosive damage. Symptoms can include severe lung damage, coughing and shortness of breath. Sulphuric acid is corrosive and contact with the skin causes severe irritation and burns that may result in permanent scarring. Eye contact results in severe irritation, redness, swelling, pain and, possibly, permanent damage, including blindness. Ingestion causes burns to the mouth, throat, oesophagus and stomach. Symptoms include difficulty in swallowing, intense thirst, nausea, vomiting, diarrhoea and, in severe cases, collapse and death.

Long-term (chronic) exposure can cause red, itchy, dry skin and dental erosion.

## Toluene

Short-term (acute) exposure through inhalation or ingestion causes central nervous system depression. Irritation of the nose, throat and respiratory tract are minor symptoms.