FACILITATE THE DEVELOPMENT, IMPLEMENTATION AND MAINTENANCE OF A SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT SYSTEM

5 CPD CREDITS

LEARNER GUIDE

UNIT STANDARD 244283 ALIGNED.

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Saiosh South African Institute of Occupational Safety and Health
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BASIC SAFETY & TRAINING SOLUTIONS

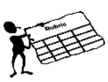
INDEX

Learner Information:

Details	Please Complete this Section
Name & Surname:	
Organisation:	
Unit/Dept:	
Facilitator Name:	
Date Started:	
Date of Completion:	

Key to Icons

The following icons may be used in this Learner Guide to indicate specific functions:

 **Books**	**This icon means that other books are available for further information on a particular topic/subject.**
 **References**	**This icon refers to any examples, handouts, checklists, etc…**
 **Important**	**This icon represents important information related to a specific topic or section of the guide.**
 **Activities**	**This icon helps you to be prepared for the learning to follow or assist you to demonstrate understanding of module content. Shows transference of knowledge and skill.**
 **Exercises**	**This icon represents any exercise to be completed on a specific topic at home by you or in a group.**
 **Tasks/Projects**	**An important aspect of the assessment process is proof of competence. This can be achieved by observation or a portfolio of evidence should be submitted in this regard.**
 **Workplace Activities**	**An important aspect of learning is through workplace experience. Activities with this icon can only be completed once a learner is in the workplace**
 **Tips**	**This icon indicates practical tips you can adopt in the future.**
 **Notes**	**This icon represents important notes you must remember as part of the learning process.**

Learner Guide Introduction

About the Learner Guide…	This Learner Guide provides a comprehensive overview of the **FACILITATE THE DEVELOPMENT, IMPLEMENTATION AND MAINTENANCE OF A SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT SYSTEM,** and forms part of a series of Learner Guides that have been developed for **NATIONAL CERTIFICATE: OCCUPATIONAL SAFETY ID 58625 LEVEL 5 – 145 CREDITS** The series of Learner Guides are conceptualized in modular's format and developed for **NATIONAL CERTIFICATE: OCCUPATIONAL SAFETY ID 58625 LEVEL 5 – 145 CREDITS** They are designed to improve the skills and knowledge of learners, and thus enabling them to effectively and efficiently complete specific tasks. Learners are required to attend training workshops as a group or as specified by their organization. These workshops are presented in modules, and conducted by a qualified facilitator.
Purpose	The purpose of this Learner Guide is to provide learners with the necessary knowledge related to **FACILITATE THE DEVELOPMENT, IMPLEMENTATION AND MAINTENANCE OF A SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT SYSTEM**
Outcomes	Learners credited with this Unit Standard will be capable of: • Discussing fundamental issues pertaining to occupational safety, health and environment. • Demonstrating an understanding of Safety Theories and Principles. • Applying the fundamentals of Risk Management. • Applying safety, health, and environment management systems.
Assessment Criteria	The only way to establish whether a learner is competent and has accomplished the specific outcomes is through an assessment process. Assessment involves collecting and interpreting evidence about the learner's ability to perform a task. This guide may include assessments in the form of activities, assignments, tasks or projects, as well as workplace practical tasks. Learners are required to perform tasks on the job to collect enough and appropriate evidence for their portfolio of evidence, proof signed by their supervisor that the tasks were performed successfully.
To qualify	To qualify and receive credits towards the learning programme, a registered assessor will conduct an evaluation and assessment of the learner's portfolio of evidence and competency
Range of Learning	This describes the situation and circumstance in which competence must be demonstrated and the parameters in which learners operate
Responsibility	The responsibility of learning rest with the learner, so: • Be proactive and ask questions, • Seek assistance and help from your facilitators, if required.

Learning Unit 1		Facilitate the development, implementation and maintenance of a Safety, Health and Environment management system
UNIT STANDARD NUMBER	:	244283
LEVEL ON THE NQF	:	5
CREDITS	:	10
FIELD	:	Health Sciences and Social Services
SUB FIELD	:	Preventive Health

PURPOSE	This Unit Standard requires learners to be able to apply Safety, Health and Environment principles which will enable them to design, implement and maintain quality management programmes related to health, safety, and environment. Learners credited with this Unit Standard will be capable of: • Discussing fundamental issues pertaining to occupational safety, health and environment. • Demonstrating an understanding of Safety Theories and Principles. • Applying the fundamentals of Risk Management. • Applying safety, health and environment management systems.
LEARNING ASSUMED TO BE IN PLACE:	
Communication skills at NQF Level 4.	

SESSION 1: Discuss fundamental issues pertaining to occupational safety, health and environment.
Learning outcomes
• Fundamental issues pertaining to occupational safety in the workplace are explained. • Fundamental issues pertaining to occupational health in the workplace are explained in terms of specified requirements. • Fundamental issues pertaining to the environment are explained according to specified requirements.

Discuss fundamental issues pertaining to occupational safety, health, and environment.
Occupational safety and health (OSH) also commonly referred to as occupational health and safety (OHS) or workplace health and safety (WHS) is an area concerned with the safety, health and welfare of people engaged in work or employment. The goals of occupational safety and health programs include to foster a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. In the United States the term occupational health and safety is referred to as occupational health and occupational and non-occupational safety and includes safety for activities outside work.

Occupational safety and health can be important for moral, legal, and financial reasons. In common-law jurisdictions, employers have a common law duty (reflecting an underlying moral obligation) to take reasonable care for the safety of their employees, Statute law may build upon this to impose additional general duties, introduce specific duties and create government bodies with powers to regulate workplace safety issues: details of this will vary from jurisdiction to jurisdiction. Good OSH practices can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs.

Workplace hazards
Although work provides many economic and other benefits, a wide array of workplace hazards also present risks to the health and safety of people at work. These include but are not limited to, "chemicals, biological agents, physical factors, adverse ergonomic conditions, allergens, a complex network of safety risks," and a broad range of psychosocial risk factors.

Physical and mechanical hazards

At-risk workers without appropriate safety equipment

Physical hazards are a common source of injuries in many industries. They are perhaps unavoidable in certain industries, such as construction and mining, but over time people have developed safety methods and procedures to manage the risks of physical danger in the workplace. Employment of children may pose special problems.

Falls are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance.

Key principles in occupational health and safety

A number of key principles underpin the field of occupational health and safety. These principles, which are discussed in detail in subsequent chapters, and the provisions of international labour standards are all designed to achieve a vital objective: that work should take place in a safe and healthy environment. Core occupational health and safety principles Occupational health and safety is an extensive multidisciplinary field, invariably touching on issues related to, among other things, medicine and other scientific fields, law, technology, economics and concerns specific to various industries. Despite this variety of concerns and interests, certain basic principles can be identified, including the following:

All workers have rights. Workers, as well as employers and governments, must ensure that these rights are protected and foster decent conditions of labour. As the International Labour Conference stated in 1984: (a) work should take place in a safe and healthy working environment; (b) conditions of work should be consistent with workers well-being and human dignity; (c) work should offer real possibilities for personal achievement, self-fulfilment and service to society.

- Occupational health and safety policies must be established. Such policies must be implemented at both the governmental and enterprise levels. They must be effectively communicated to all parties concerned.

- There is need for consultation with the social partners (that is, employers and workers) and other stakeholders. This should be done during formulation, implementation, and review of such policies.
- Prevention and protection must be the aim of occupational health and safety programmes and policies. Efforts must be focused on primary prevention at the workplace level. Workplaces and working environments should be planned and designed to be safe and healthy.
- Information is vital for the development and implementation of effective programmes and policies. The collection and dissemination of accurate information on hazards and hazardous materials, surveillance of workplaces, monitoring of compliance with policies and good practices, and other related activities are central to the establishment and enforcement of effective policies.
- Health promotion is a central element of occupational health practice.
- Efforts must be made to enhance workers' physical, mental, and social well-being.
- Occupational health services covering all workers should be established.
- Ideally, all workers in all categories of economic activity should have access to such services, which aim to protect and promote workers health and improve working conditions.
- Compensation, rehabilitation, and curative services must be made available to workers who suffer occupational injuries, accidents and work-related diseases. Action must be taken to minimize the consequences of occupational hazards.
- Education and training are vital components of safe, healthy working environments. Workers and employers must be made aware of the importance and the means of establishing safe working procedures.
- Trainers must be trained in areas of special relevance to different industries, which have specific occupational health and safety concerns

Scope and purpose of OSH standards

Conventions and Recommendations on occupational safety and health may serve several purposes, acting as:

- Fundamental principles to guide policies for promotion, action and management.
- General protection measures, for example, guarding of machinery, medical examination of young workers or limiting the weight of loads to be transported by a single worker.

- Protection in specific branches of economic activity, such as mining, the building industry, commerce, and dock work.
- Protection of specific professions (for example, nurses and seafarers) and categories of workers having occupational health needs (such as women or young workers).
- protection against specific risks (ionizing radiation, benzene, asbestos); prevention of occupational cancer; control of air pollution, noise and vibration in the working environment; measures to ensure safety in the use of chemicals, including the prevention of major industrial accidents.
- Organizational measures and procedures relating, for example, to labour inspection or compensation for occupational injuries and diseases.

Key features of a national policy on occupational safety and health

- The formulation of the policy should reflect tripartite participation, i.e., there should be inputs from employers' and workers' organizations as well as from government and others involved in occupational safety and health;
- The policy should be consistent with national development objectives and policies.
- The policy should promote the right of workers to decent, safe, and healthy working conditions and environment;
- The policy should include ways of promoting adequate public awareness and eliciting political endorsement at the highest level of government;
- The policy should promote the development of a national preventive safety and health culture that includes information, consultation, and training;
- The policy should include a plan for mobilizing the necessary institutional and financial resources;
- Coordination among all concerned institutions should be fostered as an inherent element of the policy;
- All available means of action should be used consistently;
- The policy should encourage voluntary compliance at enterprise level;
- The policy should be reviewed regularly.

SESSION 2 **Demonstrate understanding of safety theories and principles.**
Learning outcomes
• Fundamental theories of occupational safety are applied in a proposed occupational safety management programme.

2.1 Demonstrate understanding of safety theories and principles.

Workplace Safety Plan

A **Workplace Safety Plan** is a simple written document that outlines how an organisation intends to manage safety in the workplace. All involved must have access to it and should understand and comply with the requirements included in the plan.

It must be a dynamic document that is continually updated as new information becomes available.

Issues to be covered include:

1. Electrical safety

All electrical equipment to be used in the workplace should be regularly and properly maintained – and should be appropriate for its intended use.

2. Use of equipment

Everyone must be trained to use electrical and mechanical equipment safely and with the appropriate protective guards in place. This should be regularly monitored.

3. Materials handling

Proper training should be given in the correct way to lift and stack materials and equipment, whether this is done manually or mechanically. This also applies to the use of vehicles such as forklift trucks and lifting equipment.

4. Control of hazardous substances

Some substances are explosive or flammable – and some chemicals can cause asthma, dermatitis, or worse. Care must be taken to ensure that these substances are moved, stored and used safely.

5. Fire plan

Adequate fire prevention methods should be in place and regular fire drills should be held to ensure that evacuation procedures are clear.

6. Emergency plan

This will include the fire plan as in (5) above and other issues like disaster planning, etc. when applicable.

7. Personal protective clothing and equipment

This could include waterproof clothing or footwear as well as clothing or equipment for the protection of the head, eyes, face, lungs, ears, body, arms, hands, legs and feet.

8. Structural safety

Attention should be paid to support columns, foundations, Spalding of concrete elements, condition of staircases and any aspect that may threaten the stability of a building or similar structure.

9. First aid

There should be adequate first-aid facilities in place for every shift. Everyone should be informed where the first-aid kit is and of any appointed “first-aiders”.

10. Ergonomics

Employees’ workstations should be assessed to make sure they are using them correctly. Incorrect use or positioning of equipment can result in injuries such as carpal tunnel syndrome and eye and back problems.

11. Stress

There is a legal limit on working hours, rest periods, and breaks that must be adhered to.

12. Environmental and personal monitoring

Medical surveillance such as lung function tests and audiometric testing should be undertaken where workers are exposed to pollution and noise.

13. Other considerations

Attention should be paid to temperature, ventilation, and noise levels. Lighting should be adequate for the job being done. Dust and fumes should be kept under control – and there must be hygienic, sanitary, washing and rest facilities.

2.3 Essential principles

These principles are intended to underpin the actions in this guidance and so lead to good health and safety performance.

Strong and active leadership from the top

- visible, active commitment from the board;
- establishing effective 'downward' communication systems and management structures;
- integration of good health and safety management with business decisions.

Worker involvement

In an effective safety and health program, all workers:

- Are encouraged to participate in the program and feel comfortable providing input and reporting safety or health concerns.
- Have access to information they need to participate effectively in the program.
- Have opportunities to participate in all phases of program design and implementation.
- Do not experience retaliation when they raise safety and health concerns; report injuries, illnesses, and hazards; participate in the program; or exercise safety and health rights.

Worker participation is vital to the success of safety and health programs. Where workers are represented by a union, it is important that worker representatives also participate in the program, consistent with the rights provided to worker representatives under the Occupational Safety and Health Act of 1970 and the National Labour Relations Act.

- **Action item 1: Encourage workers to participate in the program**
- **Action item 2: Encourage workers to report safety and health concerns**
- **Action item 3: Give workers access to safety and health information**
- **Action item 4: Involve workers in all aspects of the program**
- **Action item 5: Remove barriers to participation**

Action item 1: Encourage workers to participate in the program

By encouraging workers to participate in the program, management signals that it values their input into safety and health decisions.

How to accomplish it

- Give workers the necessary time and resources to participate in the program.
- Acknowledge and provide positive reinforcement to those who participate in the program.
- Maintain an open-door policy that invites workers to talk to managers about safety and health and to make suggestions.

Action item 2: Encourage workers to report safety and health concerns

Workers are often best positioned to identify safety and health concerns and program shortcomings, such as emerging workplace hazards, unsafe conditions, close calls/near misses, and actual incidents. By encouraging reporting and following up promptly on all reports, employers can address issues before someone gets hurt or becomes ill.

How to accomplish it

- Establish a process for workers to report injuries, illnesses, close calls/near misses, hazards, and other safety and health concerns, and respond to reports promptly. Include an option for anonymous reporting to reduce fear of reprisal.[1]
- Report back to workers routinely and frequently about action taken in response to their concerns and suggestions.
- Emphasize that management will use reported information only to improve workplace safety and health and that no worker will experience retaliation for bringing such information to management's attention (see Action Item 5).
- Empower all workers to initiate or request a temporary suspension or shut down of any work activity or operation they believe to be unsafe.
- Involve workers in finding solutions to reported issues.

Action item 3: Give workers access to safety and health information

Sharing relevant safety and health information with workers fosters trust and helps organizations make more informed safety and health decisions.

How to accomplish it

- Give workers the information they need to understand safety and health hazards and control measures in the workplace. Some OSHA standards require employers to make specific types of information available to workers, such as:
  - Safety Data Sheets (SDS)
  - Injury and illness data (may need to be redacted and aggregated to eliminate personal identifiers)
  - Results of environmental exposure monitoring conducted in the workplace (prevent disclosure of sensitive and personal information as required)
- Other useful information for workers to review can include:
  - Chemical and equipment manufacturer safety recommendations
  - Workplace inspection reports
  - Incident investigation reports (prevent disclosure of sensitive and personal information as required)
  - Workplace job hazard analyses

Action item 4: Involve workers in all aspects of the program

Including worker input at every step of program design and implementation improves your ability to identify the presence and causes of workplace hazards, creates a sense of program ownership among workers, enhances their understanding of how the program works, and helps sustain the program over time.

How to accomplish it

- Provide opportunities for workers to participate in all aspects of the program, including, but not limited to helping:
  - Develop the program and set goals.
  - Report hazards and develop solutions that improve safety and health.
  - Analyse hazards in each step of routine and nonroutine jobs, tasks, and processes.
  - Define and document safe work practices.
  - Conduct site inspections.
  - Develop and revise safety procedures.
  - Participate in incident and close call/near miss investigations.
  - Train current co-workers and new hires.
  - Develop, implement, and evaluate training programs.
  - Evaluate program performance and identify ways to improve it.

- Take part in exposure monitoring and medical surveillance associated with health hazards.

Action item 5: Remove barriers to participation

To participate meaningfully in the program, workers must feel that their input is welcome, their voices will be heard, and they can access reporting mechanisms. Participation will be suppressed if language, education, or skill levels in the workplace are not considered, or if workers fear retaliation or discrimination for speaking up (for example, if investigations focus on blaming individuals rather than the underlying conditions that led to the incident or if reporting an incident or concern could jeopardize the award of incentive-based prizes, rewards, or bonuses).

How to accomplish it

- Ensure that workers from all levels of the organization can participate regardless of their skill level, education, or language.
- Provide frequent and regular feedback to show employees that their safety and health concerns are being heard and addressed.
- Authorize sufficient time and resources to facilitate worker participation; for example, hold safety and health meetings during regular working hours.
- Ensure that the program protects workers from being retaliated against for reporting injuries, illnesses, and hazards; participating in the program; or exercising their safety and health rights. Ensure that other policies and programs do not discourage worker participation.

Assessment and review

- identifying and managing health and safety risks;
- accessing (and following) competent advice;
- monitoring, reporting and reviewing performance.

2.2 What critical safety and health issues should be addressed, and allocated adequate resources, in the safety and health policy?

Critical safety and health issues, which should be addressed and allocated resources, in the safety and health policy, include the:

- design, provision and maintenance of a safe place of work for all employees

- design, provision and maintenance of safe means of access to and egress from each part of the workplace
- design, provision and maintenance of any article, plant, equipment or machinery for use at work in a safe manner provision of systems of work that are planned, organised, performed, maintained or revised, so as to be safe, particularly for safety critical process operations or services
- performance of ongoing hazard identification and risk assessments, and compliance with the general principles of prevention as set out in the legislation
- provision and maintenance of welfare facilities and PPE
- preparation of emergency plans and the provision of first-aid training
- reporting of accidents and dangerous occurrences to the Authority and their investigation
- provision and dissemination of safety and health information, instruction, training and supervision as required
- operation of safety and health consultation, employee participation and safety representation programmes
- review and keeping up-to-date the safety and health policy in order to prevent adverse effects on the safety and health of employees from changing processes, procedures and conditions in the workplace
- appointment of people responsible for keeping safety and health control systems in place and making them aware of their responsibilities
- establishment of monitoring arrangements, including safety and health inspections and audits, which should be used by the employer to ensure ongoing compliance with legal duties, responsibilities and controls
- development of in-house safety and health competence
- employment of external safety and health experts as required
- use of standards, codes of practice, guidelines or industry practices
- co-operation required from employees and disciplinary procedures for non-compliance.

However, this list is not exhaustive and the critical safety and health issues that could be covered by the policy will depend on the risks in the organisation. If the above issues are adequately covered elsewhere in the safety statement or in the safety and health management system, they might need only to be referred to in the safety and health policy. Backup documentation may also be referred to in the policy.

2.3 Auditing and reviewing performance

The organisation should review and improve its safety and health management system continuously, so that its overall safety and health performance improves constantly. The organisation can learn from relevant experience and apply the lessons. There should be a systematic review of performance based on data from monitoring and from independent audits of the whole safety and health management system. These form the basis of complying with the organisation's responsibilities under the 2005 Act and other statutory provisions. There should be a strong commitment to continuous improvement involving the development of policies, systems and techniques of risk control. Performance should be assessed by:

- internal reference to key performance indicators
- external comparison with the performance of business competitors and best practice in the organisation's employment sector.

Many companies now report on how well they have performed on worker safety and health in their annual reports and how they have fulfilled their responsibilities with regard to preparing and implementing their safety statements. In addition, employers have greater responsibilities under section 80 of the 2005 Act on 'Liability of Directors and officers of undertakings' that requires them to be in a position to prove they have pro-actively managed the safety and health of their workers. Data from this 'Auditing and reviewing performance' process should be used for these purposes.

2.4 Should the management of safety and health be audited in addition to monitoring performance?

Monitoring provides the information to let the organisation review activities and decide how to improve performance. Auditing and performance review are the final steps in the safety and health management control cycle. They constitute the 'feedback loop' that enables an organisation to reinforce, maintain and develop its ability to reduce risks to the fullest extent and to ensure the continued effectiveness of its safety and health management system. Audits, by the organisation's own staff or outsiders, *complement* monitoring activities by looking to see if the safety and health management systems are actually achieving the right results. Combine the results from measuring performance with information from audits to improve the organisation's overall approach to safety and health management.

The organization should establish and maintain a programme and procedures for periodic safety and health management system audits to be carried out to enable a critical appraisal of all the elements of the safety and health management system to be made. Auditing is the structured process of collecting independent information on the efficiency, effectiveness and reliability of the total safety and health management system and drawing up plans for corrective action. These audits should be carried out in addition to routine monitoring, inspection and surveillance of the safety and health management system. The purpose of these audits is to ensure the continued suitability, adequacy and effectiveness of the safety and health management system. The audit process should ensure that the necessary information is collected to allow management to carry out this evaluation adequately. The organisation should establish and maintain audit records consistent with the safety and health management system records. Their retention times should be established and must comply with legal requirements.

What should be contained in audit protocols and procedures?

Audit protocols and procedures should include the following:

- allocation of resources to the process
- personnel requirements, including that of the audit team, i.e., competence required for auditors (auditors should have the appropriate training and skills so that they can assess physical, human and other factors and the use of procedures as well as documents or records - wherever possible, auditors should be independent of the activity being audited and include support from a wider range of specialists if necessary)
- methodologies for conducting and documenting the audits, which may include checklists, questionnaires, interviews, measurement and direct observation
- procedures for reporting audit findings to those responsible to facilitate timely corrective action and improvement a system for auditing and tracking the implementation of audit recommendations to include addressing the possible need for changes to safety and health policy, objectives and other elements of the safety and health management system.

The Occupational Health and Safety Act aims to provide for the health and safety of persons at work and for the health and safety of persons in connection with the activities of persons at work and to establish an advisory council for occupational health and safety.

Application

The Occupational Health and Safety Act applies to all employers and workers, but not to -

- mines, mining areas or any mining works (as defined in the Minerals Act);
- load line ships, fishing boats, sealing boats, whaling boats (as defined in the Merchant Shipping Act) and floating cranes; whether in or out of the water; and
- People in or on these areas or vessels.

SESSION 3
Apply the fundamentals of risk management.
Learning outcomes
• The fundamental principles of risk management are explained. • The fundamental principles of risk management are applied during the implementation of risk management strategies in the workplace.

Apply the fundamentals of risk management.

Risk is a probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through pre-emptive action. Risk is the potential of losing something of value, weighed against the potential to gain something of value. Values (such as physical health, social status, emotional well-being or financial wealth) can be gained or lost when taking risk resulting from a given action, activity and/or inaction, foreseen or unforeseen. Risk can also be defined as the intentional interaction with uncertainty. Risk perception is the subjective judgment people make about the severity of a risk, and may vary person to person. Any human endeavour carries some risk, but some are much riskier than others.

Risk is part of every human endeavour. From the moment we get up in the morning, drive or take public transportation to get to school or to work until we get back into our beds (and perhaps even afterwards), we are exposed to risks of different degrees. What makes the study of risk fascinating is that while some of this risk bearing may not be completely voluntary, we seek out some risks on our own (speeding on the highways or gambling, for instance) and enjoy them. While some of these risks may seem trivial, others make a significant difference in the way we live our lives. On a loftier note, it can be argued that every major advance in human civilization, from the caveman's invention of tools to gene therapy, has been made possible because someone was willing to take a risk and challenge the status quo.

The fundamental principles of risk management are explained.

Principles of risk management

Risk management should:

- create value – resources expended to mitigate risk should be less than the consequence of inaction, or (as in value engineering), the gain should exceed the pain
- be an integral part of organizational processes
- be part of decision-making process
- explicitly address uncertainty and assumptions
- be systematic and structured process
- be based on the best available information
- be tailor able
- take human factors into account
- be transparent and inclusive
- be dynamic, iterative and responsive to change
- be capable of continual improvement and enhancement
- be continually or periodically re-assessed

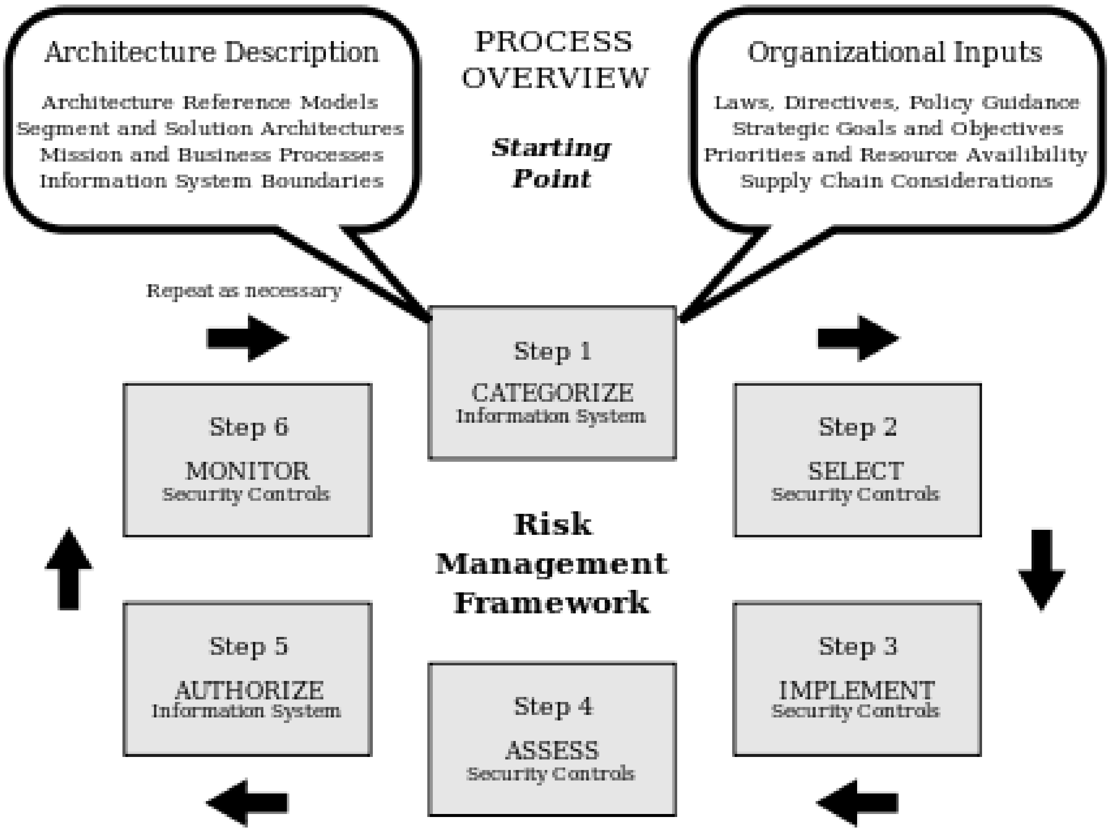
Establishing the context

This involves:

1. identification of risk in a selected domain of interest
2. planning the remainder of the process
3. mapping out the following:
    - the social scope of risk management
    - the identity and objectives of stakeholders
    - The basis upon which risks will be evaluated, constraints.
4. defining a framework for the activity and an agenda for identification
5. developing an analysis of risks involved in the process
6. Mitigation or solution of risks using available technological, human and organizational resources.

The fundamental principles of risk management are applied during the implementation of risk management strategies in the workplace.

Workplace health and safety risk management



What is a risk management strategy?

A risk management strategy provides a structured and coherent approach to identifying, assessing and managing risk. It builds in a process for regularly updating and reviewing the assessment based on new developments or actions taken. A risk management strategy can be developed and implemented by even the smallest of groups or projects or built into a complex strategy for a multi-site international organisation.

The process of identifying and reviewing the risks that you face is known as risk assessment. By assessing risks, you are able to be actively aware of where uncertainty surrounding events or outcomes exists and identifying steps that can be taken to protect the organisation, people and assets concerned. How this is achieved and the level of detail which is considered can vary between organisations. In many circumstances, where staff or volunteers have a more hands-on role in the organisation, the Management Committee may not carry out the risk assessment themselves.

Example 1:

Implementing a risk management strategy in a small organisation

Lone Fathers Action Group set aside one committee meeting per year to review the major risks faced by the group. One committee member has responsibility for risk management and facilitates the discussion. They ensure that the discussion is documented and use subsequent meetings to check progress against actions are then followed up in subsequent meetings. Every 6 months this committee member reports to the committee on any changes in the levels of risk faced.

Example 2:

Implementing a risk management strategy in a large organisation

In Tree Conservation International, risk management is one of the key responsibilities of the Assistant Director. They provide training for each manager within the organisation to ensure that risk assessment is built into their working practices and to enable them to carry out annual risk assessments of each project, using the organisation's templates. These are then collated by the Assistant Director to enable Senior Managers to discuss and assess the overall risks to the organisation. A prioritised profile of the top 30 risks is then presented to the Management Committee for their consideration to ensure they are happy to accept the risks to the organisation and approve the actions being taken. This process usually takes 2 months. Progress is reviewed after 6 months with a report sent to the Management Committee. Risks are reassessed annually.

Conducting risk assessment

Regardless of who carries it out, risk assessment should be:

- systematic;
- recorded; and
- Regularly reviewed.

As a Management Committee, you will want to concern yourself most with identifying and managing major risks.

"Major risks are those risks which have a high likelihood of occurring and would, if they occurred, have a severe impact on operational performance, achievement of aims and objectives or could damage the reputation of the charity, changing the way management committee members, supporters or beneficiaries might deal with the charity."

However, it is sensible and good practice to ensure that risk assessment forms an integral part of management and planning for the whole organisation and its projects.

SESSION 4
Apply SHEQ Management systems.
Learning outcomes
• The various elements and general requirements of SHEQ Management systems are explained and demonstrated. • The process of planning, implementing and maintaining SHEQ Management systems is explained and demonstrated.

Apply SHEQ Management systems.

SHEQ Management System is a tool to enable the design and implementation of management systems based on the ISO or other standards relative to your business. Whether you are only using one management system, or a combination of two or more systems, SHEQ Management Systems provides an easy-to-use system which will eliminate duplication of processes and procedures, and ensure easy navigation through the documents, processes and procedures.

The ISO 14000

The **ISO** 14000 **environmental management** standards exist to help organizations minimize the impact of their operations on the environment in which they operate. It specifies requirements for establishing an environmental policy, determining **environmental** aspects and impacts of products/ activities/services, planning **environmental** objectives and measurable targets, implementation and operation of programs to meet objectives and targets, checking and corrective action, and **management** review.

An **environmental management system** can do the following for your business:

- Improves your image;
- Improves your environmental performance;
- Enables your business to comply with present and future environmental regulations;
- Helps to reduce waste at source;
- Increases your profits and saves you money; and
- Enhances your overall productivity.

Quality Management

A **Quality Management System** (QMS) can be described as the formal record of the way an organization manages the quality of its various services and products. The ISO 9001 quality standard is the internationally accepted standard for **quality management systems**. In order for organizations to consistently achieve their objectives they need to have a **quality management system** in place that has been consciously established rather than evolving by chance. This requires top management to view the organization as a complete system; a set of interrelated processes which includes tasks, resources, and consistent behaviours, all working towards organizational objectives.

The benefits of using SHEQ Management Systems include;

- Duplication of processes and procedures is eliminated.
- Reduced administrative costs
- The potential for reduced insurance and liability costs.
- The systematic approach makes it easier to manage and comply with regulations.
- The company benefits from an improvement in quality.
- There is a lower impact on the environment due to lower levels of waste.

Key SHEQ Requirements

In order of priority:

1. Develop a culture where safety, good housekeeping, caring for our environment is second nature.
2. Develop an organisational structure for construction phase and later operations identifying roles, responsibilities and key performance objectives which must include safety, health and environmental measures.
3. Systematically identify hazards and potential impacts and consequences;
4. Evaluate the risks from the identified hazards against screening criteria, taking into account the likelihood of occurrence and severity of the consequences. Compare these risks against SHE objectives and targets set for the project;

5. Implement management measures to eliminate the risk or reduce it to acceptable levels. Measures can include reducing the probability of occurrence and/or the consequences of the hazard.
1. Management measures include steps to prevent escalation of the aspect and to reduce the effects; and
6. Establish recovery preparedness measures (including emergency procedures) as well as restoration and compensation procedures.
7. Develop a comprehensive training system.
8. Carry out auditing to confirm "that we are doing what we say" and ensure any deficiencies are closed in a timely manner

The process of planning, implementing and maintaining SHEQ Management systems is explained and demonstrated.

Develop and implement a company Occupational Health & Safety management system as part of the overall management system, which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the OHS policy, and so managing the OHS risk associated with the business of the organization.

The OHS Management system should not only identify all hazards and risks to be managed, but provides guidelines for how they are to be managed, who is responsible for implementation actions, what resources are required, and the level of training required to properly implement the plans. They must also identify the monitoring and reviewing requirements necessary to keep the system effective and appropriate.

The Health & Safety Manager will be responsibilities to develop, implement, managed and oversee:

- Implement a Safety Maturity culture within the organization by engaging all staff to develop co-operation and commitment to improving safety closely followed by develop consistency and fight complacency.
- Manage the elements of the safety management system, which includes: Health & Safety, Risk management, Training & competence, information control, system evaluation.
- Manage risk via the process of identification of potential hazards, assess the level of risk, develop and implementation of controls necessary to reduce the risk to an

acceptable level. Monitoring of the effectiveness of controls and assessment and monitoring of the level of residual risk.

- Provide an environment in which employees are not exposed to hazards, and where this cannot be eliminated; provide information, instructions, training and supervision of such conditions.
- Instil a culture amongst the employees to take responsible care for their own safety and health, and that of other fellow workers.
- Interact with suppliers to instil a duty of care to supply equipment, goods and services that are not only fit for purposes but also do not adversely affect the safety and health of workers.
- Bring to management's attention any condition of OHS that could pose a threat and liability to the company for immediate action and remedy.
- Invite and participate in external, independent audits of the company's OHS Management system.

SHEQ Management System Documentation

This procedure describes the interrelation of the core elements of the SHEQ Management System. Related documentation is referred to per core element. Further reference to recent documentation shall be addressed in each procedure.

The core elements are the key areas of the SHEQ Management System and are documented through the following procedures and applicable processes:

- SHEQ Management System Manual;
- SHEQ Policy
- Risk/Aspect Assessment
- Legal and Other Requirements
- Objectives, targets and Management Plans (MP's)
- Implementation and Operation – including various Standard Operating Procedures (SOP's)
- Department within the Operations
- Roles, Resources, and Responsibility
- Training and Awareness
- Communication
- Document Control
- Emergency Preparedness

- Monitoring and Measurement
- Non-conformance, Corrective and Preventive Action
- Record Control
- Evaluation of Compliance
- Internal Audits
- Management Review

Operational Control

All processes within operation's are identified and defined in the SHEQ Management System software, Operation's business overview and departmental or the process system descriptions. The standard operating procedures (SOP's) or plans defined to manage the processes include:

- Activities within the processes
- Identification, assessment and mitigation of risk/impacts (Risk/Aspect Assessment register)
- Corrective and preventative actions (MP's and corrective and preventative procedure refers)
- Opportunities and actions for process improvements
- Control of changes to processes, including maintenance

Documented standard operating procedures (SOP's) covering situations/actions which could lead to the deviation from the SHEQ Policy and objectives and targets are included in the SHEQ Management System as part of the standard operating procedures.

Control of Records

This procedure is developed to ensure records are identifiable, stored for easy retrieval, protected, adhere to retention periods and disposed of when obsolete as per the Record Control Procedure.

Records kept as part of the Operation's SHEQ include, but are not limited to:

- Waste records
- Calibration records
- Noise survey records
- Medical records

- Audit records
- Legal register
- Risk register
- Objectives, Targets and SHEQ Management Plans (MP's)
- Incident Investigations
- Communication internal and external
- Training Records

Module 1 - Incident and Accident Causation Theories

1. Introduction

Millions of rand are annually spent on recovering after incidents and accidents in the work place. The crux of the issue is that recovery from incidents is never without some kind of permanent loss. The loss could be loss of property, loss of production and income and even loss of life.

Loss of property and income can, to some extent, be recovered, although this may cause severe setback to the achievement of company goals and objectives. On the other hand, loss of health or life of workers will never be recovered.

The South African Constitution Section 7 (also known as the Bill of Rights) guarantees all South African citizens a safe environment to work in. Thus, the government has the responsibility to ensure that this constitutional right is enforced through legislation. The Inspectors of the Department of Labour is the body that are tasked to "police" and enforce labour laws similar to the task of the South African Police Services to enforce adherence to criminal laws of the country.

Health and Safety Management thus have three objectives. These are (in sequence of priority):

a) Primarily to Prevent loss of life or limb, injury and ill-health of persons;
b) Secondly to ensure that employers, workers and contractors do not overstep the law; and
c) To ensure that the country's economy and the financial wellbeing of employers is not negatively affected by expensive incidents accidents.

To enable us to manage incidents and accidents in the work place we are required to know what causes them. So, without further ado, let's move on and study the causes and consequences of incidents and accidents in the work place.

2. Definitions

Let's define some of the critical terms that we need to use in the management of Health and Safety.

2.1 Accident

An accident is defined as an unplanned, uncontrolled event that is caused by unsafe acts and unsafe conditions.

2.2 As Low As Reasonably Practicable (Acronym ALARP)

As Low As Reasonably Practicable means that we will not accept a tolerable risk as risk that requires no further control. We must still exercise control over that hazards and manage it to the lowest level possible (ALARP). A low risk ranking only means that the priority in exercising control over the hazard is not high.

2.3 Consequence

Consequence is the effect of an incident on property, production, equipment and people. A consequence of an incident could be damage to a vehicle, Interruption to a process, disease or injury or death of a person.

2.4 Hazard

A hazard (or otherwise known as a danger) is any object or condition that has the potential to initiate the chain reaction and lead to an incident that can result in damage to property and equipment, interruption in production and ill health and injury to people if it is not controlled.

2.5 Incident

An incident is a single occurrence that is caused by a chain of events. It can lead to loss of property, equipment, production, human health, limb or life. Incidents with this type of consequence are called accident type incidents and are always associated with costs.

Another type of incident can have all the elements of the chain of events of an accident type incident but did not result in any kind of loss. This means that neither the timing nor the position of the chain of events was incorrect and therefore it did not result in an accident per say. This type of incident is referred to as “close calls”.

2.6 Incident Causation

Incident causation is the culmination of circumstantial and other factors that may give rise to an incident. In Health and Safety Management we need to know all the factors that have the potential to combine and cause incidents so that we can focus and control them.

2.7 Incident Investigation

Incident Investigation is the process followed to determine the underlying and root causes of incidents and accidents.

2.8 Risk

Risk is the probability (or chance) that a hazard (or danger) poses to start the chain reaction and lead to an incident that can result in damage to property, interruption in production and ill health and injury to people if it is not controlled.

2.9 Risk Assessment

Risk assessment is a generally accepted process that is followed to analyse the hazards to determine the risk attached to facing the hazard and its consequences in reality.

2.10 Risk control

Risk control is the management strategy applied over working conditions, plant, equipment, working practices and people behaviour with the intent to prevent them from starting the chain reaction and lead to incidents.

2.11 Safe

Safe means free from risk. It is important to realise that nothing or no one is ever totally free from risk.

2.12 Tolerable

Tolerable means the willingness of management to accept the level of risk that a hazard poses to operations within the organisation.

3. Incidents and accidents

3.1 Basic causes of incidents and accidents

Many a time accidents happens to someone else and we tend to say, "oh he is so unlucky. It happened to him because…."!! We never realise that accidents don't ask who you are or what your social status are. It happens because someone did something wrong or someone caused unsafe conditions purely because they did not appreciate the consequences of their actions.

All incidents (and accidents) are caused by three basic factors. These are:

a) Human factors (88%)
b) Job factors (Physical conditions) (10%)
c) Inevitable (Act of God) (2%)

3.1.1 Human Factors

As can be seen from the above figures between brackets, human factors are by far the largest contributing factor towards incidents and accidents. Typical human factors are:

(a) Knowledge

Worker's knowledge (or lack thereof) or appreciation with respect to the hazards attached to the work being done contributes largely towards incidents in the work place. In many cases workers does not realise the consequences of their actions.

(b) Skills

Skills deficiencies are closely linked to the knowledge component. If a worker does not have the required knowledge about the performance of the work activities, he might not be able to develop the required skills. Skills deficiency also contributes largely towards the occurrence of incidents in the workplace.

(c) Physical ability

Physical ability (lack of bodily power) is also responsible for injuries due to overexertion in an attempt to perform tasks that requires physical strength. Typical injuries incurred from this are back injuries, sprains, strains, hernia etc.

(d) Psychological ability

Many workers arrive at work psychologically stressed out because of personal problems over which they do not want to elaborate. These problems tend to distract their attention from the work, causing them to lose focus and cause accidents. Typical causes of psychological stress are debt, worries about ill family members, relationship problems etc.

(e) Physiological stress

Physiological stress is also causing workers to lose concentration which in turn is a major contributor towards work place incidents and accidents. Typical examples of physiological stress are overtime, sleep deficiency etc.

(f) Emotional disturbances

In many cases a person's emotional endurance are pushed to the limits causing irrational behaviour. Irrational behaviour causes persons to act reckless which is another major cause of incidents and accidents.

(g) Substance abuse

Unhealthy social habits such as drug and alcohol abuse are often the cause of dangerous and reckless behaviour.

3.1.2 Engineering factors

Engineering factors are the second largest factor that contributes positively towards work place incidents and accidents. Typical engineering factors are:

- malfunction or failure of structures, systems or equipment and tools
- deficient maintenance of structures, systems equipment and tools.

3.1.3 Inevitable

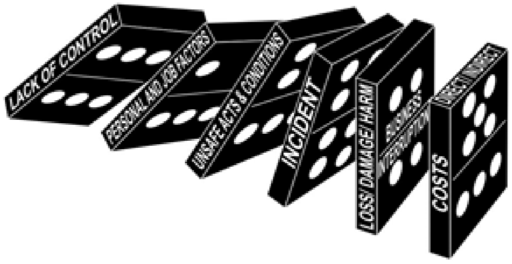
The inevitable accounts for environmental and natural disasters which cannot be avoided but we have to take the necessary precautionary measures to counteract their effects to the best of our ability to minimise damage to and loss of property and equipment, disease, injury and death.

The natural disasters that normally cause incidents are:

3.3.1 Wind, rain and hail storms
3.3.2 Floods
3.3.3 Drought
3.3.4 Earth quakes
3.3.5 Epidemics etc.

3.2 The domino theory

An accident or incident is never a single event. There is always a sequence of events that leads to an incident. One event is dependent on the other and one event happens because of the other. The accident is never the first event in the sequence but the fourth. There are thus three events before the actual incident. The first event is necessary to trigger the sequence and this could perhaps be best illustrated by the domino effect.



3.2.1 Lack of control

The first domino represents control of the work environment. This means that we must maintain control over certain “things” to prevent the sequence of events to be triggered. Once control is lost, the sequence starts. The control that we refer to is:

a) Self-control
b) Systems control
c) Standards control
d) Supervisory control

3.2.2 Personal and job factors

The second domino represents personal and job factors that play a role in the causation of incidents.

3.2.2.1 Personal factors

Personal factors to consider are:

a) Lack of skill;
b) Lack of motivation;
c) Lack of knowledge;
d) Lack of physical and cognitive ability;
e) Psychological instability;
f) Lack of Physiological ability etc.

3.2.2.2 Job factors to consider are:

a) Substandard mechanical and physical environment;
b) Inadequate work standards;
c) Inadequate or substandard maintenance;
d) Purchasing standards; and

e) Work station design etc.

3.2.3 Unsafe acts and unsafe conditions

The third domino represents unsafe acts and unsafe conditions.

3.2.3.1 Unsafe Acts

Unsafe acts are the things persons do without having due regard for the consideration of their own safety or that of their fellow workers. Unsafe acts could be:

a) Tampering with safety devices;
b) Taking unnecessary short cuts;
c) Operating equipment without authority/licence;
d) Using incorrect or defective tools;
e) Ignoring safety rules;
f) Failure to use Personal Protective Equipment;
g) Horseplay;
h) Work under the influence of alcohol and/or drugs; and
i) Improper lifting etc.

3.2.3.2 Unsafe conditions

Unsafe conditions are the conditions created by persons due to ignorance, or purely because of negligence and lack of appreciation of the consequences of their acts. Typical unsafe conditions include:

a) Inadequate machine guarding;
b) Poor housekeeping;
c) Improper stacking and storage;
d) Noise;
e) Heat;
f) Cold;
g) Radiation;
h) Flammable and explosive substances;
i) Water environments;
j) Hazardous environments;
k) Heights; and
l) Excavations etc.

3.3 Cost of incidents

When an incident occurs, it may result in injury to personnel and/or damage to plant and property. When this occurs, there are definite financial implications. These can be divided into:

a) direct costs; and
b) indirect costs.

3.3.1 Direct costs

Direct costs are represented by the part of the iceberg that is visible above the waterline. These expenses for medical treatment, compensation, lost time and other costs normally covered by insurance.

3.3.2 Indirect costs

Indirect costs are the expenses represented by the part of the iceberg that is below the waterline. These are referred to as uninsured costs and may be divided into two categories namely:

3.3.2.1 Uninsured miscellaneous costs

These are operational losses which are not covered by insurance which must normally be paid by the employer and can add up to R5 for every R1 paid out by insurance. This could be expenses to recover from:

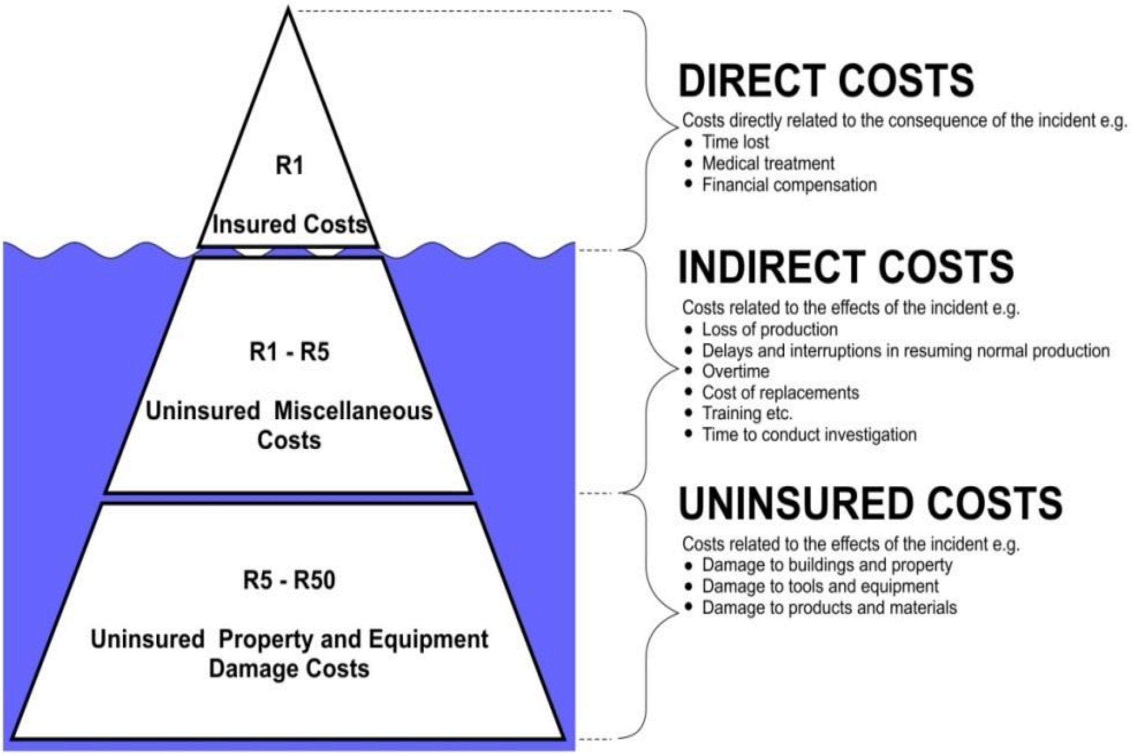
a) production delays and interruptions;
b) Cost of resources to conduct the investigation;
c) Overtime worked;
d) Training etc.

3.3.2.2 Uninsured property damage costs

Uninsured property damage cost can amount to R50 rand for every R1 paid out by insurance. These costs could be for:

a) Repair of damage to property;
b) Replacement of damaged materials; and
c) Tools and other equipment damage.

This could be illustrated in the iceberg theory as follows:



The following table is a detailed breakdown of the costs category of incidents.

COST CATEGORY BREAKDOWN OF INCIDENTS

Compensation and Benefits	**Legal/Litigation**	**Time/Productivity and Production**	**Material, Equipment and Property**	**Miscellaneous**
Medical and Rehabilitation	Legal fees	Product Replacement	Loss of Customers and returned Products	Consulting fees
Pension and lump sum payments	Penalties	Observing the accident and accompanying the victim to the hospital	Equipment replacements	PR Activities
Replaced wages	Fines and Citations	Investigators Time	Capital expenditure	Transportation costs of victims
Death Benefits	Expert Witness	Clean up and Salvage	Rental costs for replacement Equipment	
Long Term Disability	Settlement	Laboratory Costs	Process material down time and loss	
	Union Grievances	Repair Of Equipment and Facilities	Emergency supplies	
		Training of replacement Workers	Clean up materials	
		Overtime		
		Product Reject		
		Light duty Costs		
		Clean up Materials		
		Set up and Start-up costs		

3.4 Incident prevention theory

An investigation into a large number of incidents which occurred over a broad spectrum in modern day industrial operations revealed a definite relationship between incidents that involved people and other incident that result in loss or damage of plant equipment and production.

Bird's ratio (named after the scientist Frank E Bird Junior) clearly illustrates the results from the analysis of the investigation mentioned above.

The base of the pyramid is where we ought to concentrate our efforts of identification and anticipation. This is done through systematic incident reporting and investigation. Unfortunately, we are inclined to ignore the many warning signals, and often only concentrate our efforts on the loss incurring events i.e., "after the event". This is because we have the incorrect attitude to the "near misses", due perhaps to the fact that we fail to realise the potential or the possible

The 600 incidents which occur without (visible) loss are in fact 600 warnings that there is a lack of control which allowed these "near misses" to happen.

In many instances the difference between a "near miss" and a disabling incident may be only a few millimetres. The saw which is unguarded or used without a push stick may today result in the wood being thrown clear by a kick-back; tomorrow the operator's finger may just make contact with the blade and a plaster dressing is all that is needed. Next week the same operator may lose his finger in the same machine, doing the same job, in the same manner.

How can we know when the ratio is going to change? Should we not look at the unsafe act and / or unsafe condition when the first incident is identified?

The 30 property damage incidents result in losses of or damage to materials, unscheduled repairs and downtime – and the ratio is now much higher. The costs increase, and so does the likelihood of the next occurrence involving physical damage.

The 10 minor injuries are often minor purely by "luck". What factor(s) prevented this being a disabling injury or a fatality, or even for that matter involving more than one person?

The one disabling injury? How many times have the acts or conditions related to that specific job been **nearly** identical? How many warnings have we already had?

(Note: Disabling injury – any injury which results in the employee losing one or more shifts from the day following the incident; or where the employee is unable to resume normal duties.)

Notes:

Module 2 - Theories of Management and Management Systems

1. Introduction

Management in all business and organisational activities is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively. Management comprises planning, organising, staffing, leading or directing, and controlling an organisation (a group of one or more people or entities) or effort for the purpose of accomplishing a goal. Resourcing encompasses the deployment and manipulation of human, financial, technological and natural resources.

2. Management

2.1 Basic functions of Management

Management operates through various functions, often classified as planning, organising, staffing, leading/directing, controlling/monitoring and motivation.

2.1.1 Planning

Planning involves deciding what needs to happen in the future (today, next week, next month, next year, over the next five years, etc.) and generating plans for action.

2.1.2 Organising

Organising involves establishing the pattern of relationships among workers and management and making optimum use of the resources required to enable the successful carrying out of plans.

2.1.3 Staffing

Staffing involves analysing of jobs, recruitment and hiring for appropriate workers to perform the work.

2.1.4 Leading/directing

Leading or directing involves determining what needs to be done in a situation and getting people to do it.

2.1.5 Checking/controlling/monitoring

Checking involves measuring progress against plans. If any deviation from the plan is noted, corrective action must immediately be instituted.

2.1.6 Motivating

Motivation is also a basic function of management, because without motivation, employees cannot work effectively. If motivation does not take place in an organisation, then employees may not contribute to the other functions (which are usually set by top-level management).

2.2 Basic roles of Management

The basic role that management must fulfil in the organisation is threefold:

a) **Interpersonal**: roles that involve coordination and interaction with employees.

b) **Informational**: roles that involve handling, providing/sharing, and analysing information.

c) **Decisional**: roles that require decision-making.

2.3 Management skills

An effective manager must be skilled in different areas to be successful in executing his day-to-day managerial function. The required skills are:

a) **Political**: used to build a power base and establish connections.

b) **Conceptual**: used to analyse complex situations.

c) **Interpersonal**: used to communicate, motivate, mentor and delegate.

d) **Diagnostic**: the ability to visualise most appropriate response to a given situation.

2.4 Levels of management

Most organisations have three management levels: first-level, middle-level, and top-level managers. These managers are classified in a hierarchy of authority, and perform different management tasks. In many organisations, the number of managers in every level resembles a pyramid. Each level is explained below in relation to their different responsibilities and most likely job titles.

2.4.1 Top-level Management

Top level Management usually consists of the board of directors, president, vice-president, CEOs, etc. They are responsible for controlling and overseeing strategic management of the entire organisation. They develop goals, strategic plans, company policies, and make decisions on the direction of the business. In addition, top-level managers play a significant role in the mobilisation of outside resources and are accountable to the shareholders and general public.

2.4.2 Middle-level Management

Middle-level Management consists of general managers, branch managers and department managers. They are accountable to the top management for their department's function. They devote more time to organisational and directional functions. Their roles can be emphasised as executing organisational plans in conformance with the company's policies and the objectives of the top management, they define and discuss information and policies from top management to lower management, and most importantly they inspire and provide guidance to lower-level managers towards better performance. Some of their functions are as follows:

a) Designing and implementing effective group and intergroup work and information systems.
b) Defining and monitoring group-level performance indicators.
c) Diagnosing and resolving problems within and among work groups.
d) Designing and implementing reward systems supporting cooperative behaviour.

2.4.3 First-level management

First-level Management consists of supervisors, section heads, foremen, etc. They focus on controlling and directing. They usually have the responsibility of assigning employees' tasks, guiding and supervising employees on day-to-day activities, ensuring quality and quantity production, making recommendations, suggestions, and up-channelling employee problems, etc.

First-level managers are role models for employees that provide:

a) Basic supervision.
b) Motivation.
c) Career planning.
d) Performance feedback.

3. Occupational Health and Safety Management Systems (OHSMS)

The Occupational Health and Safety Management System that we will be discussing in this part of the course is based on the fundamentals of the OHSAS 18002 (Occupational Health and Safety Audit Systems) developed and published by BSI (British Standards Institute). This is the international standard generally accepted around the globe for setting standards for OHS management.

The Plan, Do, Check, Act approach achieves a balance between the systems and behavioural aspects of management. It also treats health and safety management as an integral part of good management generally, rather than as a stand-alone system.

Plan

- Think about where you are now and where you need to be
- Say what you want to achieve, who will be responsible for what, how you will achieve your aims, and how you will measure your success. You may need to write down this **policy** and your plan to deliver it
- Decide how you will measure performance. Think about ways to do this that go beyond looking at accident figures - look for leading as well as lagging indicators. These are also called active and reactive indicators
- Consider fire and other emergencies. Co-operate with anyone who shares your workplace and co-ordinate plans with them
- Remember to plan for changes and identify any specific legal requirements that apply to you

Do

- **Identify your risk profile**
  - Assess the risks**,** identify what could cause harm in the workplace, who it could harm and how, and what you will do to manage the risk
  - Decide what the priorities are and identify the biggest risks
- **Organise your activities to deliver your plans**
  In particular, aim to:
  - Involve workers and communicate, so that everyone is clear on what is needed and can discuss issues - develop positive attitudes and behaviours
  - Provide adequate resources, including competent advice where needed
- **Implement your plan**
  - Decide on the preventive and protective measures needed and put them in place
  - Provide the right tools and equipment to do the job and keep them maintained
  - Train and instruct, to ensure everyone is competent to carry out their work
  - Supervise to make sure that arrangements are followed

Check

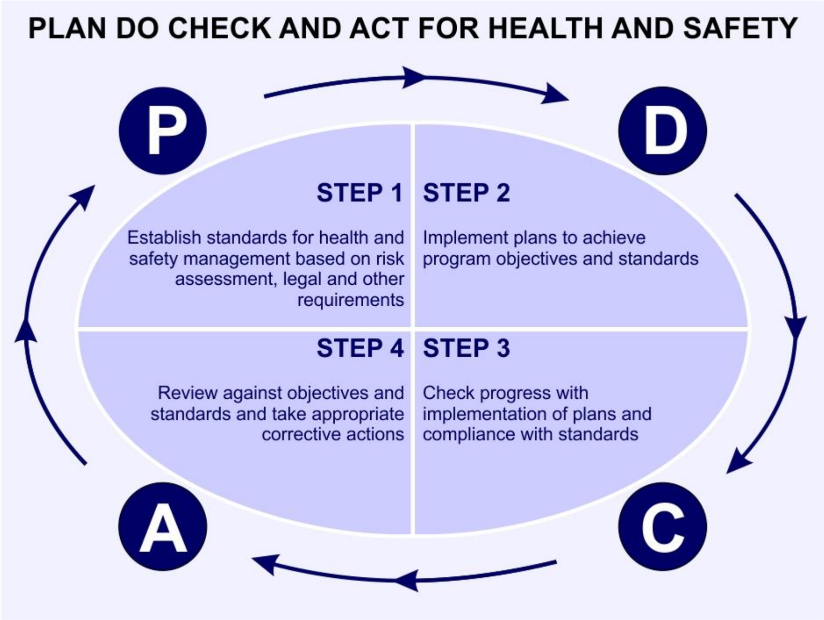
- **Measure your performance**
  - Make sure that your plans have been implemented, 'paperwork' on its own is not a good performance measure
  - Assess how well the risks are being controlled and if you are achieving your aims. In some circumstances formal audits may be useful
- **Investigate the causes of accidents, incidents or near misses**

Act

- **Review your performance**
  - Learn from accidents and incidents, ill-health data, errors and relevant experience, including from other organisations
  - Revisit plans, policy documents and risk assessments to see if they need updating
- **Take action on lessons learned, including from audit and inspection reports**

You can find more detailed guidance on the Plan, Do, Check, Act approach in delivering effective arrangements.

The OH&S management system is best illustrated by the following model.



Many organisations manage their operations via the application of a system of processes and their interactions, which can be referred to as the "process approach". ISO 9001 promotes the use of the process approach.

Since PDCA can be applied to all processes, the two methodologies are considered to be compatible.

The OHSAS Standard contains requirements that can be objectively audited; however, it does not establish absolute requirements for OH&S performance beyond the commitments, in the OH&S policy, to comply with applicable legal requirements and with other requirements to which the organisation subscribes, to the prevention of injury and ill health and to continual improvement. Thus, two organisations carrying out similar operations but having different OH&S performance can both conform to its requirements.

The OH&S Standard does not include requirements specific to other management systems, such as those for quality, environmental, security, or financial management, though its elements can be aligned or integrated with those of other management systems. It is possible for an organisation to adapt its existing management system(s) in order to establish an OH&S management system that conforms to the requirements of the OHSAS Standard. It is pointed out, however, that the application of various elements of the management system might differ depending on the intended purpose and the interested parties involved.

The level of detail and complexity of the OH&S management system, the extent of documentation and the resources devoted to it depend on a number of factors, such as the scope of the system, the size of the organisation and the nature of its activities, products and services, and the organisational culture. This may be the case in particular for small and medium-sized enterprises.

4. Occupational Health and Safety Management Series requirements

OHSAS 18001 Text

Companies must establish, document, implement, maintain and continually improve an OH&S management system in accordance with the requirements of the OHSAS 18001 Standard and determine how it will fulfil the requirements.

The organisation shall define and document the scope of its OH&S management system.

"Establish" implies a level of permanency and the system should not be considered established until all its elements have been demonstrably implemented. "Maintain" implies that, once established, the system continues to operate. This requires active effort on the part of the organisation. Many systems start well but deteriorate due to lack of maintenance. Many of the elements of OHSAS 18001 (such as checking and corrective action and management review) are designed to ensure active maintenance of the system.

An organisation seeking to establish an OH&S management system that conforms to OHSAS 18001 should determine its current position with regard to its OH&S risks by means of an initial review. In determining how it will fulfil the requirements of OHSAS 18001 the organisation should consider the conditions and factors that affect, or could affect, the health and safety of persons, what OH&S policies it needs, and how it will manage its OH&S risks.

The level of detail and complexity of the OH&S management system, the extent of documentation and the resources devoted toit are dependent on the nature (size, structure, complexity) of an organisation and its activities.

4.1 Initial review

An initial review should compare the organisation's current management of OH&S against the OHSAS 18001 requirements (including those for applicable legal or other requirements), in order to determine the extent to which these requirements are being met.

The initial review will provide information which an organisation can use in formulating plans for implementing and prioritising improvements to the OH&S management system.

The aim of an initial review should be to consider all OH&S risks faced by the organisation as a basis for establishing the OH&S management system. An organisation should consider, but not limit itself to, the following items within its initial review:

a) legal and other requirements;
b) identification of the OH&S hazards and evaluation of risks faced by the organisation;
c) OH&S assessments;
d) an examination of existing systems, practices, processes and procedures;
e) evaluations of OH&S improvement initiatives;
f) an evaluation of feedback from the investigation of previous incidents, work related ill health, accidents and emergencies;
g) relevant management systems and available resources.

A suitable approach to the initial review can include the use of:
a) checklists, interviews, direct inspection and measurement;
b) the results of previous management system audits or other reviews, depending on the nature of the organisation's activities;
c) the results of consultations with workers, contractors or other relevant external interested parties.

Where hazard identification and risk assessment processes already exist, they should be reviewed for adequacy against the requirements of OHSAS 18001.

It is emphasised that an initial review is not a substitute for the implementation of the structured systematic approach to hazard identification, risk assessment and determining controls.

However, an initial review can provide additional inputs into planning these processes.

4.1.1 Scope of the OH&S management system

An organisation can choose to implement an OH&S management system with respect to the entire organisation, or to a subdivision of the organisation, provided this is consistent with its definition of its workplace. However, once the workplace is defined, all the work-related activities and services of the organisation, or subdivision, within that workplace need to be included in the OH&S management system.

Care should be taken in defining and documenting the scope of the OH&S management system, to determine who, what and where, are to be covered. The scope should not be limited so as to exclude an operation or activity that can impact on the OH&S of an organisation's employees and other persons under its control in the workplace.

***NOTE**: The ILO-OSH:2001 Guidelines recommend that employees are consulted when defining the scope, or when changes to the scope are considered.*

4.2 Occupational Health and Safety Management Policy

OHSAS 18001 Text

Senior management shall define and authorise the organisation's OH & S policy and ensure that within the defined scope of its OH & S management system it:

a) is appropriate to the nature and scale of the organisation's OH&S risks;
b) includes a commitment to prevention of injury and ill health and continual improvement in OH&S management and OH&S performance;
c) includes a commitment to at least comply with applicable legal requirements and with other requirements to which the organisation subscribes that relate to its OH&S hazards;
d) provides the framework for setting and reviewing OH&S objectives;
e) is documented, implemented and maintained;
f) is communicated to all persons working under the control of the organisation with the intent that they are made aware of their individual OH&S obligations;
g) is available to interested parties;
h) is reviewed periodically to ensure that it remains relevant and appropriate to the organisation; and
i) is signed by the management team to illustrate commitment by all.

Top management should demonstrate the leadership and commitment necessary for the OH&S management system to be successful and to achieve improved OH&S performance.

An OH&S policy establishes an overall sense of direction and is the driver for implementing and improving an organisation's OH&S management system so that it can maintain and potentially improve its OH&S performance.

It should enable persons under the control of the organisation to understand the overall commitment of the organisation and how this can affect their individual responsibilities.

The responsibility for defining and authorising an OH&S policy rest with the organisation's top management. The on-going and proactive involvement of top management in developing and implementing an OH&S policy is crucial.

The organisation's OH&S policy should be appropriate to the nature and scale of its identified risks and should guide the setting of objectives. In order to be appropriate, the OH&S policy should:

a) be consistent with a vision of the organisation's future, and
b) be realistic, neither overstating the nature of the risks the organisation faces, nor underestimating them.

In developing its OH&S policy, an organisation should consider:

a) its mission, vision, core values and beliefs,
b) coordination with other policies (corporate, integrated, etc.),
c) the needs of persons working under the control of the organisation,
d) the OH&S hazards of the organisation,
e) legal and other requirements to which the organisation subscribes that relate to its OH&S hazards,
f) historical and current OH&S performance by the organisation,
g) opportunities and needs for continual improvement and the prevention of injury and ill health,
h) the views of interested parties,
i) what is needed to establish realistic and achievable objectives?

The policy is, as a minimum, required to include statements about the commitment of an organisation to:

a) prevent of injury and ill health;
b) continually improve in OH&S management;
c) continually improve in OH&S performance;
d) comply with applicable legal requirements, and
e) comply with other requirements to which the organisation subscribes.

The OH&S policy can be linked with other policy documents of the organisation and should be consistent with the organisation's overall business policies and with its policies for other management disciplines, e.g., quality management or environmental management.

The communication of the policy should assist in:

a) demonstrating the commitment of top management and the organisation to OH&S;
b) increasing awareness of the commitments made in the policy statement;
c) explaining why the OH&S system is established and is maintained;

d) guiding individuals in understanding their OH&S responsibilities and accountabilities.

In communicating the policy, consideration should be given to how to create and maintain awareness in both new and existing persons under the control of the organisation. The policy can be communicated in various forms to the policy statement itself, such as through the use of rules, directives and procedures, wallet cards, posters, etc. In communicating the policy, account should be taken of issues such as diversity in the workplace, literacy levels, language skills, etc.

It is for the organisation to determine how it wishes to make the policy available to its interested parties, e.g., through publication on a website, or by providing printed copies on request.

The OH&S policy should be reviewed periodically to ensure that it remains relevant and appropriate to the organisation.

Change is inevitable, as legislation and societal expectations evolve; consequently, the organisation's OH&S policy and OH&S management system need to be reviewed regularly to ensure their continuing suitability and effectiveness. If changes are made to the policy, the revised policy should be communicated to all persons working under the control of the organisation.

4.2.1 Benefits of a well-defined OH&S Policy

Effective health and safety policies contribute to business performance by:

a) supporting human resource development;
b) minimising the financial losses which arise from avoidable unplanned events;
c) recognising that accidents, ill health and incidents result from failures in management control and are not necessarily the fault of individual employees;
d) recognising that the development of a culture supportive of health and safety is necessary to achieve adequate control over risks;
e) ensuring a systematic approach to the identification of risks and the allocation of resources to control them; and
f) supporting quality initiatives aimed at continuous improvement.

A common characteristic is that policies accurately reflect the values and beliefs of those who devise and implement them. Effective policies are not simply examples of management paying lip service to improved health and safety performance but a genuine commitment to action. In this manual, "policy" defines the general intentions, approach and objectives – the vision – of an organisation and the criteria and principles which is the basis of its action. These form the basis for managing health and safety which shape the written statement of policy required by section 7 of the Occupational Health and Safety Act (Act 85 of 1993).

4.3 Management system planning

<u>OHSAS 18001 Text</u>

Planning according to the standard involves establishing the extent of the risk to which the organisation is subjected.

The most important is the establishment of system procedures of which risk assessment is at the top of the list.

The procedure(s) for hazard identification and risk assessment shall take into account:

(a) routine and non-routine activities;

(b) activities of all persons having access to the workplace (including contractors and visitors);

(c) human behaviour, capabilities and other human factors;

(d) identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of the organisation within the workplace;

(e) hazards created in the vicinity of the workplace by work-related activities under the control of the organisation;

NOTE 1: The hazard referred to in (e) above may be more appropriate to be assessed as an environmental aspect.

(f) infrastructure, equipment and materials at the workplace, whether provided by the organisation or others;

(g) changes or proposed changes in the organisation, its activities, or materials;

(h) modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;

(i) any applicable legal obligations relating to risk assessment and implementation of necessary controls;

(j) the design of work areas, processes, installations, machinery/equipment, operating procedures and work organisation, including their adaptation to human capabilities.

The organisation's methodology for hazard identification and risk assessment shall:

(a) be defined with respect to its scope, nature and timing to ensure it is proactive rather than reactive; and
(b) provide for the identification, prioritisation and documentation of risks, and the application of controls, as appropriate.

For the management of change, the organisation shall identify the OH&S hazards and OH&S risks associated with changes in the organisation, the OH&S management system, or its activities, prior to the introduction of such changes.

The organisation shall ensure that the results of these assessments are considered when determining controls.

When determining controls, or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy:

(a) elimination;
(b) substitution;
(c) engineering controls;
(d) signage/warnings and/or administrative controls;
(e) personal protective equipment.

The organisation shall document and keep the results of identification of hazards, risk assessments and determined controls up-to-date.

The organisation shall ensure that the OH&S risks and determined controls are taken into account when establishing, implementing and maintaining its OH&S management system.

4.4 Operational risk management

Operational risk control is a process that needs to be adopted and rigorously implemented and followed consistently to ensure that a true reflection of the risks facing the organisation.

Hazards have the potential to cause human injury or ill health. Hazards therefore need to be identified before the risks associated with these hazards can be assessed and, if no controls exist or existing controls are inadequate, effective controls should be implemented according to the hierarchy of controls:

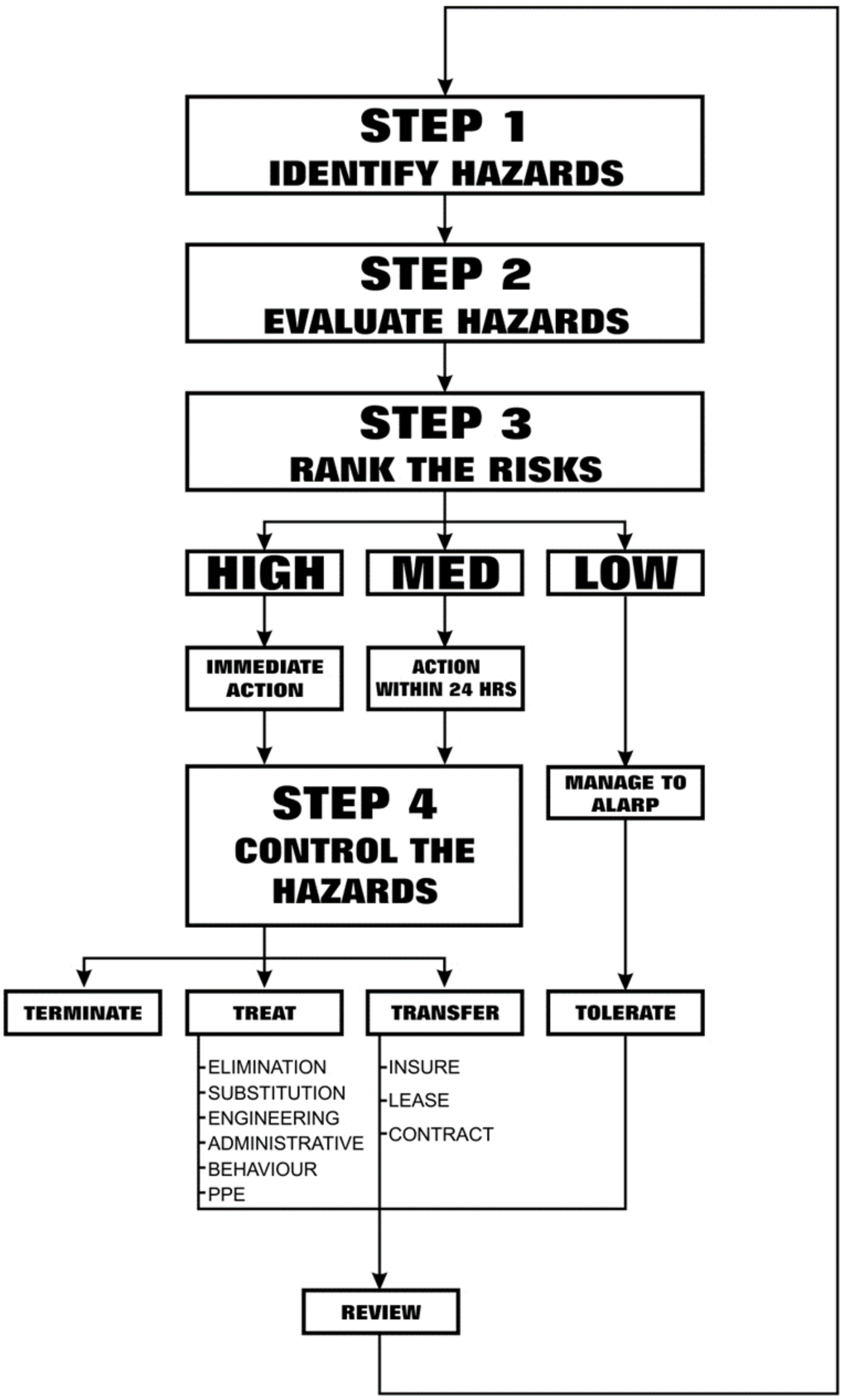
An organisation must apply the process of hazard identification and risk assessment to determine the controls that are necessary to reduce the risks of incidents. The overall purpose of the risk assessment process is to recognise and understand the hazards that might arise in the course of the organisation's activities and ensure that the risks to people arising from these hazards are assessed, prioritised and controlled to a level that is acceptable.

This is achieved by:

a) developing a methodology for hazard identification and risk assessment;
b) identifying hazards;
c) estimating the associated risks, taking into account the adequacy of any existing controls (it could be necessary to obtain additional data and perform further analysis in order to achieve a reasonable estimation of the risks);
d) determining whether these risks are acceptable; and
e) determining the appropriate risk controls, where these are found to be necessary (workplace hazards and the way they are to be controlled are often defined in regulations, codes of practice, guidance published by regulators, and industry guidance documents).

The results of risk assessments enable the organisation to compare risk reduction options and prioritise resources for effective risk management and risk reduction.

The outputs from the hazard identification, risk assessment and determining control processes must be used throughout the development and implementation of the OH&S management system.



Overview of Hazard Identification and risk Assessment Process

4.5 Developing a methodology and procedures for hazard identification and risk assessment

Hazard identification and risk assessment methodologies vary greatly across industries, ranging from simple assessments to complex quantitative analyses with extensive documentation. Individual hazards can require that different methods be used, e.g., an assessment of long-term exposure to chemicals can need a different method than that taken for equipment safety or for assessing an office workstation. Each organisation should choose approaches that are appropriate to its scope, nature and size, and which meet its needs in terms of detail, complexity, time, cost and availability of reliable data. In combination, the chosen approaches should result in an inclusive methodology for the on-going evaluation of all the organisation's OH&S risks.

The management of change needs to be considered for changes in assessed risks, determination of controls, or the implementation of controls. Management review should be used to determine whether changes to the methodology are needed overall.

To be effective, the organisation's procedures for hazard identification and risk assessment should take account of the following:

a) hazards,
b) risks,
c) controls,
d) management of change,
e) documentation,
f) on-going review.

To ensure consistency of application, it is recommended that these procedure(s) be documented.

The procedure(s) for hazard identification and risk assessment shall, as a minimum, take into account:

a) routine and non-routine activities;
b) activities of all persons having access to the workplace (including contractors and visitors);
c) human behaviour, capabilities and other human factors;
d) identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of the organisation within the workplace;

e) hazards created in the vicinity of the workplace by work-related activities under the control of the organisation;

NOTE 1: It may be more appropriate for such hazards to be assessed as an environmental aspect.

f) infrastructure, equipment and materials at the workplace, whether provided by the organisation or others;
g) changes or proposed changes in the organisation, its activities, or materials;
h) modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;
i) any applicable legal obligations relating to risk assessment and implementation of necessary controls;
j) the design of work areas, processes, installations, machinery/equipment, operating procedures and work organisation, including their adaptation to human capabilities.

4.5.1 Hazard Identification

Hazard identification should aim to determine proactively all sources, situations or acts (or a combination of these), arising from an organisation's activities, with a potential for harm in terms of human injury or ill health. Examples include:

a) sources (e.g., moving machinery, radiation or energy sources),
b) situations (e.g., working at heights etc), or
c) activities (e.g., manual lifting etc).

Hazard identification should consider the different types of hazards in the workplace, including physical, chemical, biological and psychosocial.

The organisation should establish specific hazard identification tools and techniques that are relevant to the scope of its OH&S management system.

The following sources of information or inputs should be considered during the hazard identification process:

a) OH&S legal and other requirements e.g., those that prescribe how hazards should be identified;
b) OH&S policy;
c) monitoring data (Checking);
d) occupational exposure and health assessments;
e) records of incidents;

f) reports from previous audits, assessments or reviews;
g) input from employees and other interested parties;
h) information from other management systems (e.g., for quality management or environmental management);
i) information from employee OH&S consultations;
j) process review and improvement activities in the workplace;
k) information on best practice and/or typical hazards in similar organisations;
l) reports of incidents that have occurred in similar organisations;
m) information on the facilities, processes and activities of the organisation, including the following:
   - workplace design, traffic plans (e.g., Pedestrian walkways, vehicle routing), site plan(s);
   - process flowcharts and operations manuals;
   - inventories of hazardous materials (raw materials, chemicals, wastes, products, sub-products);
   - equipment specifications;
   - product specifications, material safety data sheets, toxicology and other OH&S data.

Hazard identification processes should be applied to both routine and to non-routine (e.g., periodic, occasional, or emergency) activities and situations.

Examples of non-routine activities and situations that should be considered during the hazard identification process include:
a) facilities or equipment cleaning;
b) temporary process modifications;
c) non-scheduled maintenance;
d) plant or equipment start-ups/shut-downs;
e) off-site visits (e.g., field trips, customer supplier visits, prospecting, excursions);
f) refurbishment;
g) extreme weather conditions;
h) utility (e.g., power, water, gas, etc.) disruptions;
i) temporary arrangements;
j) emergency situations.

Hazard identification should consider all persons having access to the workplace (e.g., customers, visitors, service contractors, delivery personnel, as well as employees) and:

a) the hazards and risks arising from their activities;
b) the hazards arising from the use of products or services supplied to the organisation by them;
c) their degree of familiarity with the workplace, and
d) their behaviour.

Human factors, such as capabilities, behaviours and limitations, have to be taken into account when evaluating the hazards and risks of processes, equipment and work environments. Human factors should be considered whenever there is a human interface and take into account issues such as ease of use, potential for operational errors, operator stress and user fatigue.

In considering human factors, the organisation's hazard identification process should consider the following, and their interactions:

a) the nature of the job (workplace layout, operator — information, work load, physical work, work patterns);
b) the work environment (heat, lighting, noise, air quality);
c) human behaviour (temperament, habits, attitude);
d) psychological capabilities (cognition, attention);
e) physiological capabilities (biomechanical, anthropometrics/physical variation of people).

In some instances, there can be hazards which occur or originate outside the workplace that can have an impact on individuals within the workplace (e.g., releases of toxic materials from neighbouring operations). Where such hazards are foreseeable, these should be addressed.

The organisation could be obliged to give consideration to hazards created beyond the boundary of the workplace, particularly where there is a legal obligation or duty of care concerning such hazards. In some legal jurisdictions such hazards are instead addressed through the organisation's environmental management system.

For the hazard identification to be effective the organisation should use an approach that includes information from a variety of sources, especially inputs from people who have knowledge of its processes, tasks or systems, e.g.:

a) observations of behaviour and work practices and analyses of the underlying causes of unsafe behaviour;
b) benchmarking;
c) interviews and surveys;
d) safety tours and inspections;
e) incident reviews and subsequent analyses;
f) monitoring and assessment of hazardous exposures (chemical and physical agents);
g) workflow and process analysis, including their potential for creating unsafe behaviour.

Hazard identification should be conducted by a person(s) with competence in relevant hazard identification methodologies and techniques and appropriate knowledge of the work activity.

Checklists can be used as a reminder of what types of potential hazards to consider and to record the initial hazard identification; however, care should be taken to avoid over reliance on the use of checklists. Checklists should be specific to the work area, process or equipment being evaluated.

4.5.2 Risk Assessment

Risk is the combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s).

Risk assessment is a process of evaluating the risk(s) arising from a hazard(s), taking into accounts the adequacy of any existing controls, and deciding whether the risk(s) is acceptable.

An acceptable risk is a risk that has been reduced to a level that the organisation is willing to assume with respect to its legal obligation, its OH&S policy and its OH&S objectives.

NOTE: *Some reference documents use the term “risk assessment” to encompass the entire process of hazard identification, risk assessment and determining controls; OHSAS 18001 and*

OHSAS 18002 refer to the individual elements of this process separately and use the term "risk assessment" to refer explicitly to the second stage of this process.

4.5.2.1 Risk assessment inputs

Inputs to the risk assessment processes can include, but are not be limited to information or data on the following:

a) details of location(s) where work is carried out;
b) the proximity and scope for hazardous interaction between activities in the workplace;
c) security arrangements;
d) the human capabilities, behaviour, competence, training and experience of those who normally and/or occasionally carry out hazardous tasks;
e) toxicological data, epidemiological data and other health related information;
f) the proximity of other personnel (e.g., cleaners, visitors, contractors, the public) who might be affected by hazardous work;
g) details of any work instructions, systems of work and/or permit-to-work procedures, prepared for hazardous tasks;
h) manufacturers or suppliers' instructions for operation and maintenance of equipment and facilities;
i) the availability and use of control measures e.g., for ventilation, guarding, personal protective equipment (PPE), etc.;
j) abnormal conditions (e.g., the potential interruption of utility services such as electricity and water, or other process failures);
k) environmental conditions affecting the workplace;
l) the potential for failure of plant and machinery components and safety devices or for their degradation from exposure to the elements or process materials;
m) details of access to, and adequacy/condition of emergency procedures, emergency escape plans, emergency rescue plans emergency equipment, emergency escape routes (including signage), emergency communication facilities, and external emergency support, etc.;
n) monitoring data related to incidents associated with specific work activities;
o) the findings of any existing assessments relating to hazardous work activity;
p) details of previous unsafe acts either by the individuals performing the activity or by others (e.g., adjacent personnel, visitors, contractors, etc.);

q) the potential for a failure to induce associated failures or disabling of control measures;
r) the duration and frequency at which tasks are carried out;
s) the accuracy and reliability of the data available for the risk assessment;
t) any legal and other requirements which prescribe how the risk assessment has to be performed or what constitutes an acceptable risk, e.g., sampling methods to determine exposure, use of specific risk assessment methods, or permissible exposure levels.

Risk assessment should be conducted by a person(s) with competence in relevant risk assessment methodologies and techniques and appropriate knowledge of the work activity.

In cases where the competent person does not have all the knowledge, a risk assessment team must be established consisting of members that have the required knowledge and skills pertaining to the job being assessed.

Other procedures that need to be prepared for implementation are:

a) Purchasing
b) Incident investigation;
c) Emergency;
d) System monitoring;
e) System review; and
f) Audit

4.5.2.2 Risk Assessment methodologies

An organisation can use different risk assessment methods as part of an overall strategy for addressing different areas or activities. When seeking to establish the likelihood of harm, the adequacy of existing control measures should be taken into account. A risk assessment should be detailed enough to determine appropriate control measures.

Some risk assessment methods are complex and appropriate to special or particularly hazardous activities.

For example, risk assessment of a chemical process plant might require complex mathematical calculations of the probabilities of events that could lead to a release of agents that might affect individuals in the workplace or the public.

In many countries, sector-specific legislation specifies where this degree of complexity is required. In many circumstances, OH&S risk can be addressed using simpler methods and can be qualitative. These approaches typically involve greater degree of judgment, since they place less reliance on quantifiable data. In some cases, these methods will serve as initial screening tools, to determine where a more detailed assessment is needed.

The risk assessment should involve consultation with, and appropriate participation by workers and take into account legal and other requirements. Regulatory guidance should be taken into account where applicable.

The organisation should consider limitations in the quality and accuracy of the data used in the risk assessments and the possible effect this could have on the resulting calculation of risk. The higher the level of uncertainty in the data, the greater is the need for caution in determining whether the risk is acceptable.

4.5.2.3 Other considerations for risk assessment

Some organisations develop generic risk assessments for typical activities that can occur in several different sites or locations. Such generic assessments can be useful as a starting point for more specific assessments, but could need to be customised to be appropriate to the particular situation. This approach can improve the speed and efficiency of the risk assessment process and improve the consistency of risk assessments for similar tasks.

When the organisation's risk assessment method uses descriptive categories for assessing severity or likelihood of harm, they should be clearly defined, e.g., clear definitions of terms such as "likely" and "unlikely" are needed to ensure that different individuals interpret them consistently.

The organisation should consider risks to sensitive populations (e.g., pregnant workers) and vulnerable groups (e.g., inexperienced workers), as well as any particular susceptibilities of the individuals involved in performing particular tasks (e.g., the ability of an individual who is colour-blind to read instructions).

The organisation should evaluate how the risk assessment will take into account the number of persons that might be exposed to a particular hazard. Hazards that could cause harm to large numbers of persons should be given careful consideration even when it is less likely for such severe consequences to occur.

Risk assessments to evaluate the harm from exposure to chemical, biological and physical agents might require measurement of exposure concentrations with appropriate instruments and sampling methods. Comparison of these concentrations should be made to applicable occupational exposure limits or standards. The organisation should ensure that the risk assessment considers both the short-term and long-term consequences of exposure and the additive effects of multiple agents and exposures.

In some cases, risk assessments are performed using sampling to cover variety of situations and locations. Care should be taken to ensure that the samples used are sufficient and adequately represent all the situations and locations being assessed.

4.5.2.4 Change Management

The organisation should manage and control any changes that can affect or impact its OH&S hazards and risks.

This includes changes to the organisation's structure, personnel, management system, processes, activities, use of materials, etc. Such changes should be evaluated through hazard identification and risk assessment prior to their introduction.

The organisation should consider hazards and potential risks associated with new processes or operations at the design stage as well as changes in the organisation, existing operations, products, services or suppliers. The following are examples of conditions that should initiate a management of change process:

a) new or modified technology (including software), equipment, facilities, or work environment;
b) new or revised procedures, work practices, designs, specifications or standards;
c) different types or grades of raw materials;
d) significant changes to the site's organisational structure and staffing, including the use of contractors;

e) modifications of health and safety devices and equipment or controls.

The management of change process should include consideration of the following questions to ensure that any new or changed risks are acceptable:

a) have new hazards been created?
b) what are the risks associated with the new hazards?
c) have the risks from other hazards changed?
d) could the changes adversely affect existing risk controls?
e) have the most appropriate controls been chosen, bearing in mind
f) usability, acceptability and both the immediate and long-term costs?

4.5.2.5 Determining the need for controls

Having completed a risk assessment and having taken account of existing controls, the organisation should be able to determine whether existing controls are adequate or need improving, or if new controls are required.

If new or improved controls are required, their selection should be determined by the principle of the hierarchy of controls, i.e., the elimination of hazards where practicable, followed in turn by risk reduction (either by reducing the likelihood of occurrence or potential severity of injury or harm), with the adoption of personal protective equipment (PPE) as a last resort.

The following provides examples of implementing the hierarchy of controls:

a) Elimination – modify a design to eliminate the hazard, e.g., introduce mechanical lifting devices to eliminate the manual handling hazard;
b) Substitution – substitute a less hazardous material or reduce the system energy (e.g., lower the force, amperage, pressure, temperature, etc.);
c) Engineering controls – install ventilation systems, machine guarding, interlocks, sound enclosures, etc.;
d) Signage, warnings, and/or administrative controls – safety signs, hazardous area marking, photo-luminescent signs, markings for pedestrian walkways, warning sirens/lights, alarms, safety procedures, equipment inspections, access controls, safe systems of working, tagging and work permits, etc.;
e) Personal protective equipment (PPE) – safety glasses, hearing protection, face shields, safety harnesses and lanyards, respirators and gloves.

In applying the hierarchy consideration should be given to the relative costs, risk reduction benefits, and reliability of the available options.

An organisation should take into account:

a) the need for a combination of controls, combining elements from the above hierarchy (e.g., engineering and administrative controls),
b) established good practice in the control of the particular hazard under consideration,
c) adapting work to the individual (e.g., to take account of individual mental and physical capabilities),
d) taking advantage of technical progress to improve controls,
e) using measures that protect everyone [e.g., by selecting engineering controls that protect everyone in the vicinity of a hazard in preference to personal protective equipment (PPE),
f) human behaviour and whether a particular control measure will be accepted and can be effectively implemented,
g) typical basic types of human failure (e.g., simple failure of a frequently repeated action, lapses of memory or attention, lack of understanding or error of judgement, and breach of rules or procedures) and ways of preventing them,
h) the need to introduce planned maintenance of, for example, machinery safeguards,
i) the possible need for emergency/contingency arrangements where risk controls fail,
j) the potential lack of familiarity with the workplace and existing controls of those not in the direct employment of the organisation, e.g., visitors, contractor personnel.

Once the controls have been determined the organisation can prioritise its actions to implement them. In the prioritisation of actions, the organisation should take into account the potential for risk reduction of the planned controls. It is preferable that actions addressing a high-risk activity or offering a substantial reduction of risk take priority overactions that have only limited risk reduction benefit.

In some cases, it is necessary to modify work activities until risk controls are in place or apply temporary risk controls until more effective actions are completed. For example, the use of hearing protection as an interim measure until the source of noise can be eliminated, or the work activity segregated to reduce the noise exposure. Temporary controls should not be regarded as a long-term substitute for more effective risk control measures.

Legal requirements, voluntary standards and codes of practice can specify appropriate controls for specific hazards. In some cases, controls will need to be capable of attaining "as low as reasonably practicable" (ALARP) levels of risk.

The organisation should conduct on-going monitoring to ensure that the adequacy of the controls is being maintained.

NOTE: *The term "residual risk" is often used to describe the risk that remains after controls have been implemented.*

4.5.2.6 Recording and documenting the results

The organisation should document and keep the results of hazard identification, risk assessments and determined controls.

The following types of information should be recorded:

a) identification of hazards,
b) determination of the risks associated with the identified hazards,
c) indication of the levels of the risks related to the hazards,
d) description of, or reference to, the measures to be taken to control the risks,
e) determination of the competency requirements for implementing the controls.

When existing or intended controls are used in determining OH & S risks, these measures should be clearly documented so that the basis of the assessment will be clear when it is reviewed at a later date.

The description of measures to monitor and control risks can be included within operational control procedures. The determination of competency requirements can be included within training procedures.

4.5.2.7 On-going review

It is a requirement that hazard identification and risk assessment be on-going. This requires the organisation to consider the timing and frequency of such reviews, as affected by the following types of issues:

a) the need to determine whether existing risk controls are effective and adequate;
b) the need to respond to new hazards;

c) the need to respond to changes that the organisation itself has made;
d) the need to respond to feedback from monitoring activities, incident investigation, emergency situations or the results of testing of emergency procedures;
e) changes in legislation;
f) external factors, e.g., emerging occupational health issues local and globally;
g) advances in control technologies;
h) changing diversity in the workforce, including contractors; and
i) changes proposed by corrective and preventive action.

Periodic reviews can help ensure consistency across risk assessments carried out by different people at different times. Where conditions have changed and/or better risk management technologies have become available, improvements should be made as required.

It is not necessary to perform new risk assessments when a review can show that the existing or planned controls remain valid.

Internal audits can provide an opportunity to check that hazard identifications, risk assessments and controls, are in place and up-to-date. Internal audits can also be a useful opportunity to check whether the assessment reflects actual workplace conditions and practice.

4.5.3 Legal and other requirements

OHSAS 18001 Text
Organisations must establish, implement and maintain a procedure(s) for identifying and accessing the legal and other OH & S requirements that are applicable to it.

The organisation shall ensure that these applicable legal requirements and other requirements to which the organisation subscribes are taken into account in establishing, implementing and maintaining its OH & S management system. The organisation shall keep this information up-to-date and communicate relevant information on legal and other requirements to persons working under the control of the organisation, and other relevant interested parties.

The organisation should have made a policy commitment to compliance with applicable legal and other OH&S requirements that relates to its OH&S hazards.

These legal requirements can take many forms, such as:

a) legislation, including statutes, regulations and - codes of practice,
b) decrees and directives,
c) orders issued by regulators,
d) permits, licences or other forms of authorisation,
e) judgements of courts or administrative tribunals,
f) treaties, conventions, protocols.

Examples of "other requirements" can include:

a) contractual conditions,
b) agreements with employees,
c) agreements with interested parties,
d) agreements with health authorities,
e) non-regulatory guidelines,
f) voluntary principles, best practices or codes of practice, charters,
g) public commitments of the organisation or its parent organisation, and
h) corporate/company requirements.

Some of these commitments or agreements can address a range of issues in addition to OH&S matters. The OH&S management system need only address such commitments or agreements to the extent that they relate to the organisation's OH&S hazards.

To meet its policy commitments, the organisation should have a structured approach to ensure that the legal and other requirements can be identified, evaluated for applicability, accessed, communicated and be kept up-to-date.

Depending on the nature of its OH&S hazards, operations, equipment, materials, etc., an organisation should seek out relevant applicable OH & S legislative or other requirements. This can be achieved through the use of knowledge within the organisation and/or through the use of external sources such as:

a) the internet,
b) libraries,
c) trade associations,
d) regulators,
e) legal services,
f) OH&S institutes,
g) OH&S consultants,

h) equipment manufacturers,
i) materials suppliers,
j) contractors, and/or
k) clients.

From the results of the initial review, the organisation should consider the legal and other requirements that are applicable toits:

a) sector,
b) activities,
c) products, processes, facilities, equipment, materials, personnel, and
d) location.

External resources, such as those previously listed, can be helpful in locating and evaluating these requirements.

Having identified what is applicable, the organisation's procedure needs to include information on how it can access the legal and other requirements. There is no requirement to maintain a library; itis sufficient that the organisation and its employees be able to access the information when needed.

The organisation's procedure should ensure that it can determine any changes that affect the applicability of legal and other requirements relevant to its OH&S hazards.

The organisation's procedure needs to identify who should receive information on legal and other requirements, and ensure that relevant information is communicated to them.

4.5.4 Objectives and programme(s)

OHSAS 18001 Text

The organisation shall establish, implement and maintain documented OH & S objectives, at relevant functions and levels within the organisation.

The objectives shall be measurable, where practicable, and consistent with the OH&S policy, including the commitments to the prevention of injury and ill health, to compliance with applicable legal requirements and with other requirements to which the organisation subscribes, and to continual improvement.

When establishing and reviewing its objectives, an organisation shall take into account the legal requirements and other requirements to which the organisation subscribes, and its OH&S risks. It shall also consider its technological options, its financial, operational and business requirements, and the views of relevant interested parties.

The organisation shall establish, implement and maintain a programme(s) for achieving its objectives. Programme(s) shall include as a minimum:

a) designation of responsibility and authority for achieving objectives at relevant functions and levels of the organisation; and
b) the means and time-frame by which the objectives are to be achieved.

The programme(s) shall be reviewed at regular and planned intervals, and adjusted as necessary, to ensure that the objectives are achieved.

4.5.4.1 Setting objectives

Setting objectives is an integral part of the planning of an OH & S management system. An organisation should set objectives to fulfil the commitments established in its OH&S policy, including its commitments to the prevention of injury and ill health.

The process of setting and reviewing objectives, and implementing programmes to achieve them, provides a mechanism for the organisation to continually improve its OH&S management system and to improve its OH&S performance.

When setting OH&S objectives the organisation needs to take into account the legal and other requirements and its OH&S risks that it has identified. The organisation should make use of the other information obtained from the planning process (e.g., a prioritised list of OH&S risks) to determine whether it needs to set specific objectives in relation to any of its legal and other requirements, or its OH&S risks. However, the organisation is not required to establish OH&S objectives for each legal and other requirement or OH&S risk identified.

The organisation should also determine what other issues and factors it needs to consider, such as:

a) technological options, financial, operational and business requirements;
b) policy and objectives relevant to the organisation's business as a whole;
c) results of hazard identification, risk assessment and existing controls;
d) evaluations of the effectiveness of the OH&S management system (e.g., from internal audits);
e) views of workers (e.g., from employee perception or satisfaction surveys);
f) information from employee OH&S consultations, reviews and improvement activities in the workplace (these activities can be either reactive or proactive in nature);
g) analysis of performance against previously established OH & S objectives;
h) past records of OH&S nonconformities and incidents;
i) the results of the management review; and
j) the need for and availability of resources.

Objectives that are specific, measurable, achievable, relevant, and timely can enable progress against the attainment of the objectives to be measured more readily by the organisation (sometimes such objectives are referred to as being "SMART").

It is also advisable that the organisation records the background and reasons for setting the objectives, in order to facilitate their future review.

Examples of types of objectives can include:

a) objectives to increase or reduce something that specify a numerical figure (e.g., to reduce handling incidents by 20%);
b) objectives to introduce controls or eliminate hazards (e.g., for noise reduction in a workshop);
c) objectives to introduce less hazardous materials in specific products;
d) objectives to increase worker satisfaction in relation to OH&S (e.g., for a reduction of workplace stress);

e) objectives to reduce exposures to hazardous substances, equipment or processes (e.g., the introduction of access controls, or guarding);

f) objectives to increase awareness or competence in performing work tasks safely; and

g) objectives that are put in place to meet impending legal requirements prior to their enactment.

During the establishment of OH&S objectives, particular attention should be given to information or data from those people most likely to be affected by individual OH&S objectives, as this can assist in ensuring that the objectives are reasonable and more widely accepted. It is also useful to consider information or data from sources external to the organisation, e.g., from contractors or other interested parties.

The OH&S objectives should address both broad corporate OH&S issues and OH&S issues that are specific to individual functions and levels within the organisation.

OH&S objectives can be broken down into tasks, depending on the size of the organisation, the complexity of the OH&S objective and its time-scale. There should be clear links between the various levels of tasks and the OH&S objectives.

Specific OH&S objectives can be established by different functions and at different levels within the organisation. Certain OH&S objectives, applicable to the organisation as a whole, can be established by top management. Other OH&S objectives can be established by, or for, relevant individual departments or functions. Not all functions and departments are required to have specific OH&S objectives.

NOTE*: Objectives are sometimes given associated "targets". For the purpose of the OHSAS standards "targets" are viewed as being a sub-setof objectives.*

4.5.4.2 Programme(s)

In order to achieve the objectives a programme(s) should be established.

A programme is an action plan for achieving all the OH&S objectives, or individual OH&S objectives. For complex issues more formal project plans can also need to be developed as part of the programme(s).

In considering the means necessary to establish the programme(s)the organisation should examine the resources required (financial, human, infrastructure) and the tasks to be performed. Depending on the complexity of the programme established to achieve a particular objective, the organisation should assign responsibility, authority and completion dates for individual tasks to ensure that the OH&S objective can be accomplished within the overall timeframe.

The OH&S objectives and programme(s) should be communicated (e.g., Via training and/or group briefing sessions, etc.) to relevant personnel.

Reviews of programme(s) need to be conducted regularly, and the programme(s) adjusted or modified where necessary. This can be as part of management review, or more frequently.

4.6 Implementation and operation

4.6.1 Resources, roles, responsibility, accountability and authority

OHSAS 18001 Text

Top management shall take ultimate responsibility for OH&S and the OH&S management system.

Top management shall demonstrate its commitment by:

a) ensuring the availability of resources essential a) to establish, implement, maintain and improve the OH&S management system;

NOTE 1 Resources include human resources and specialised skills, organisational infrastructure, technology and financial resources.

b) defining roles, allocating responsibilities and accountabilities, and delegating authorities, to facilitate effective OH & S management; roles, responsibilities, accountabilities, and authorities shall be documented and communicated.

The organisation shall appoint a member(s) of top management with specific responsibility for OH&S, irrespective of other responsibilities, and with defined roles and authority for:

a) ensuring that the OH&S management system is established, implemented and maintained in accordance with the OHSAS Standard;

b) ensuring that reports on the performance of the OH&S management system are presented to top management for review and used as a basis for improvement of the OH&S management system

NOTE 2 The top management appointee (e.g., in a large organisation, a Board or executive committee member) may delegate some of their duties to a subordinate management representative(s) while still retaining accountability.

The identity of the top management appointee shall be made available to all persons working under the control of the organisation.

All those with management responsibility shall demonstrate their commitment to the continual improvement of OH&S performance.

The organisation shall ensure that persons in the workplace take responsibility for aspects of OH&S over which they have control, including adherence to the organisation's applicable OH&S requirements.

NOTE "Accountability" means ultimate "responsibility", and relates to the person who is held to account if something is not done, does network, or fails to achieve its objective.

The successful implementation of an OH&S management system calls for a commitment from all persons working under the control of the organisation. This commitment should begin at the highest levels of management.

Top management should:

a) determine and make available, in a timely and efficient manner, all the resources needed to prevent injuries and ill health in the workplace,
b) identify who needs to do what with respect to the management of OH&S and make sure they are aware of their responsibilities and what they are accountable for,
c) ensure that those members of the organisation's management with OH&S responsibilities have the necessary authority to fulfil their roles,
d) ensure there is clarity of responsibilities at the interfaces between different functions (e.g., between departments, between different levels of management, between workers, between the organisation and contractors, between the organisation and its neighbours),
e) appoint one of its members as the person responsible for the OH&S system and reporting on its performance.

When determining the resources needed to establish, implement and maintain the OH&S system, an organisation should consider:

a) the financial, human and other resources specific to its operations,
b) the technologies specific to its operations,

c) infrastructure and equipment,
d) information systems, and
e) the need for expertise and training.

Resources and their allocation should be reviewed periodically, via management review, to ensure they are sufficient to carry out OH&S programmes and activities, including performance measurement and monitoring. For organisations with established OH&S management systems, the adequacy of resources can be at least partially evaluated by comparing the planned achievement of OH&S objectives with actual results. In evaluating adequacy of resources, consideration should also be given to planned changes and/or new projects or operations.

OHSAS 18001 requires that the responsibilities and authority of all persons who perform duties that are part of the OH&S management system have to be documented. These can be described and included in:

a) OH&S management system procedures,
b) operational procedures or work station procedures,
c) project and/or task descriptions,
d) job descriptions,
e) induction training packages.

However, the organisation is free to choose whatever format(s) best suits its needs. Such documentation can, among others, be required for the following people:

a) the top management appointee for OH&S,
b) management at all levels in the organisation, including top management,
c) safety committee/safety teams,
d) process operators and the general workforce,
e) those managing the OH&S of contractors,
f) those responsible for OH&S training,
g) those responsible for equipment that is critical for OH&S,
h) those responsible for managing facilities used as a workplace,
i) employees with OH&S qualifications, or other OH&S specialists, within the organisation,
j) employee OH&S representatives on participative/consultative forums.

OHSAS 18001 requires that the OH&S management appointee has to be a member of top management. The OH&S management appointee can be supported by other personnel who have delegated responsibilities for monitoring the overall operation of the OH&S function. However, the management appointee should be regularly informed of the performance of the system, and should retain active involvement in periodic reviews and the setting of OH&S objectives.

It should be ensured that any other duties or functions assigned to the top management appointee do not conflict with the fulfilment of their OH&S responsibilities.

The role and responsibilities of any specialist OH&S function within the organisation should be appropriately defined to avoid conflicting with those of management at all levels (as managers would usually be expected to have responsibility for ensuring that OH&S is managed effectively in their area of control). This should include arrangements to resolve any conflict between OH&S issues and operational considerations including, where appropriate, escalation to a higher level of management.

All managers should provide visible demonstration of their commitment to continual improvement of OH&S performance.

Means of demonstration can include visiting and inspecting sites, participating in incident investigation, and providing resources in the context of corrective action, attendance and active involvement at OH&S meetings, communicating the status of safety activities, and acknowledging good OH&S performance.

The organisation should communicate and promote that OH&S the responsibility of everyone in the organisation, not just the responsibility of those with defined OH&S management system responsibilities. In taking responsibility for aspects of OH&S over which they have control, all persons in the workplace need to consider not only their own safety but also the safety of others.

4.6.2 Competence, training and awareness

OHSAS 18001 Text

The organisation shall ensure that any person(s) under its control performing tasks that can impact on OH&S is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

The organisation shall identify training needs associated with its OH&S risks and its OH&S management system. It shall provide training or take other action to meet these needs, evaluate the effectiveness of the training or action taken, and retain associated records.

The organisation shall establish, implement and maintain a procedure(s) to make persons working under its control aware of:

a) the OH&S consequences, actual or potential, a) of their work activities, their behaviour, and the OH&S benefits of improved personal performance;
b) their roles and responsibilities and importance in achieving conformity to the OH&S policy and procedures and to the requirements of the OH&S management system, including emergency preparedness and response requirements (see **4.4.7**);
c) the potential consequences of departure from specified procedures.

Training procedures shall take into account differing levels of:

a) responsibility, ability, language skills and literacy; and
b) risk.

4.6.2.1 General

To enable persons under the organisation's control to work and/or act safely, the organisation should ensure that they:

a) are aware of its OH&S risks,
b) are aware of their roles and responsibilities,
c) have the necessary competence to perform tasks that can impact on OH&S, and
d) are, where necessary, trained to achieve the required awareness/competence.

The organisation should require that contractors are able to demonstrate that their employees have the competence and/or appropriate training to work safely.

NOTE Competence and awareness do not mean the same thing. Awareness is to be conscious of something, e.g., OH&S risks and hazards. Competence is the demonstrated ability to apply knowledge and skills.

4.6.2.2 Competence

In determining what activities or tasks could impact on OH&S the organisation should consider those which:

a) the organisation's risk assessment has determined, creates an OH&S risk in the workplace,
b) are intended to control OH&S risks,
c) are specific to the implementation of the OH&S management system.

Management should determine the competence requirements for individual tasks. The organisation can seek external advice in defining competence requirements.

When determining the competence required for a task, the following factors should be considered:

a) roles and responsibilities in the workplace (including the nature of the tasks to be performed, and their associated OH&S risks),
b) the complexity and requirements of operating procedures and instructions,
c) the results from incident investigations,
d) legal and other requirements,
e) individual capability (e.g., literacy, language skills, etc.).

The organisation should give specific consideration to the competency requirements for those people(s) who will be:

a) top management appointees,
b) performing risk assessments,
c) performing exposure assessments,
d) performing audits,
e) performing behavioural observations,
f) performing incident investigations,
g) performing tasks identified by risk assessment that can introduce hazards.

The organisation should ensure that all personnel, including top management, are competent prior to permitting them to perform tasks that can impact on OH&S.

An organisation should determine and assess any differences between the competence needed to perform an activity and that possessed by the individual required to perform the activity. These differences should be addressed through training or other actions, e.g., additional education and skills development, etc., taking into account the existing capabilities of the individual.

OH&S competence requirements should be considered prior to recruiting new personnel, and/or the reassignment of those already working under the control of the organisation.

Records used by the organisation for ensuring that personnel are competent should be maintained.

4.6.2.3 Training

The organisation should consider the roles, responsibilities and authorities, in relation to its OH&S risks and the OH&S management system, in determining its training or other actions needed for those persons working under its control (including contractors, temporary staff, etc.)

The training or other actions should focus on both competency requirements and the need to enhance awareness.

Training programmes and procedures should take account of OH&S risks and individual capabilities, such as literacy and language skills.

For example, it could be preferable to use pictures and diagrams or symbols that can be easily understood. The organisation should determine if the training materials are needed in multiple languages or if the use of translators is necessary.

The organisation should evaluate the effectiveness of the training or actions taken. This can be done in several ways, e.g., by written or oral examination, practical demonstration, observation of behavioural changes over time, or other means that demonstrate competency and awareness. Training records should be maintained.

NOTE The ILO-OSH:2001 guidelines in clause 3.4.4recommend that “Training should be provided to all participants at no cost and should take place during working hours where possible”.

4.6.2.4 Awareness

To ensure they work or act safely, the organisation should make persons working under its control sufficiently knowledgeable of:

a) emergency procedures,
b) the consequences of their actions and behaviour in relation to OH&S risks,
c) the benefits of improved OH&S performance, the potential consequences of departing from procedures,

d) the need to conform to OH&S policies and procedures,

e) any other aspects that might impact on OH&S.

Awareness programmes should be provided for contractors, temporary workers and visitors, etc., according to the OH&S risks to which they are exposed.

4.6.3 Communication, participation and consultation

OHSAS 18001 Text

Communication

With regard to its OH&S hazards and OH&S management system, the organisation shall establish, implement and maintain a procedure(s) for:

a) internal communication among the various levels and functions of the organisation;

b) communication with contractors and other visitors to the workplace;

c) receiving, documenting and responding to relevant communications from external interested parties.

Participation and consultation

The organisation shall establish, implement and maintain a procedure(s) for:

(a) the participation of workers by their:

- appropriate involvement in hazard identification, risk assessments and determination of controls;
- appropriate involvement in incident investigation;
- involvement in the development and review of OH&S policies and objectives;
- consultation where there are any changes that affect their OH&S;
- representation on OH&S matters.

Workers shall be informed about their participation arrangements, including who is their representative(s) on OH&S matters.

(b) consultation with contractors where there are changes that affect their OH&S.

The organisation shall ensure that, when appropriate, relevant external interested parties are consulted about pertinent OH&S matters.

4.6.3.1 General

The organisation, through the processes of communication and consultation, should encourage participation in good OH&S practices and support for its OH&S policy and OH&S objectives from those affected by its activities or interested in its OH&S management system.

The organisation's communication processes should provide for the flow of information upwards, downwards and across the organisation. It should provide for both the gathering and the dissemination of information. It should ensure that OH&S information is provided, received and understood by all relevant persons.

Consultation is the process by which management and other persons, or their representatives, jointly consider and discuss issues of mutual concern. It involves seeking acceptable solutions to problems through the general exchange of views and information.

Examples of those who could be interested in or affected by an organisation's OH&S management system include employees at all levels of the organisation, employee representatives, temporary workers, contractors, visitors, neighbours, volunteers, emergency services, insurers and government or regulatory inspectors.

4.6.3.2 Communication Procedures for internal and external communication

The organisation should develop procedures for internal communication among various functions and levels of the organisation and for external communication with interested parties.

The organisation should effectively communicate information concerning its OH&S hazards and its OH&S management system to those involved in or affected by the management system, in order for them to actively participate in, or support the prevention of injury and ill health, as applicable.

When developing procedures for communication, the organisation should consider the following:

- the target audience and their information needs,

- appropriate methods and media,
- local culture, preferred styles and available technologies,
- organisational complexity, structure and size,
- barriers to effective communication in the workplace such as illiteracy or language,
- legal and other requirements,
- the effectiveness of the various modes and flows of communication across all functions and levels of the organisation,
- evaluation of the effectiveness of the communication.

OH&S issues can be communicated to employees, visitors and contractors via means such as:

- OH&S briefings and meetings, induction/orientation talks, etc.,
- newsletters, posters, emails, suggestion boxes/schemes, websites and notice boards containing information on OH&S issues.

4.6.3.3 Internal communication

It is important to effectively communicate information about OH&S risks and the OH&S management system at various levels and between various functions of the organisation.

This should include information:

- relating to management's commitment,
- to the OH&S management system (e.g., programmes undertaken and resources committed to improving OH&S performance),
- concerning the identification of hazards and risks (e.g., Information on process flows, materials in use, equipment specifications and observation of work practices),
- about OH&S objectives and other continual improvement activities,
- relating to incident investigation (e.g., the type of incidents that are taking place, factors that can contribute to the occurrence of incidents, results of incident investigations),
- relating to progress in eliminating OH&S hazards and risks (e.g., Status reports showing progress of projects that have been completed or are underway),
- relating to changes that can impact on the OH&S management system.

4.6.3.4 Communication with contractors and other visitors

It is important to develop and maintain procedures for communicating with contractors and other visitors to the workplace.

The extent of this communication should be related to the OH&S risks faced by these parties.

The organisation should have arrangements in place to clearly communicate its OH&S requirements to contractors. The procedure(s)should be appropriate to the OH&S hazards and risks associated with the work to be performed. In addition to communicating performance requirements, the organisation should communicate the consequences associated with nonconformity with OH&S requirements.

Contracts are often used to communicate OH&S performance requirements. There can be a need to supplement contracts with other on-site arrangements (e.g.-project OH&S planning meetings) to ensure that appropriate controls are implemented to protect individuals at the workplace.

The communication should include information about any operational controls related to the specific tasks to be performed or the area where the work is to be done. This information should be communicated before the contractor comes on-site and then supplemented with additional or other information (e.g., a site tour), as appropriate, when the work starts. The organisation should also have procedures in place for consultation with contractors when there are changes that affect their OH&S.

In addition to the specific OH&S requirements for activities carried out on-site the following could also be relevant to the organisation when developing its procedure(s) for communications with contractors:

- information about individual contractors' OH&S management systems (e.g., their established policies and procedures to address pertinent OH&S hazards);
- legal and other requirements that impact on the method or extent of communication, — previous OH&S experience (e.g., OH&S performance data);
- the existence of multiple contractors at the worksite and cooperation between them;

- staffing for accomplishing OH&S activities (e.g., Exposure monitoring, equipment inspections);
- emergency response;
- the need for alignment of the contractor's OH&S policies and practices with those of the organisation and other contractors at the worksite;
- the need for additional consultation and/or contractual provisions for high-risk tasks;
- requirements for the assessment of conformance with agreed OH&S performance criteria;
- processes for incident investigation, reporting of nonconformities and corrective action; and
- arrangements for day-to-day communications.

For visitors (including delivery people, customers, members of the public, service providers, etc.), communication can include warning signs and security barriers, as well as verbal or written communication.

Information that should be communicated includes:

- OH&S requirements relevant to their visit;
- evacuation procedures and responses to alarms;
- traffic controls;
- access controls and escort requirements;
- any personal protective equipment (PPE) that needs to be worn (e.g., safety glasses) during the visit.

4.6.3.5 Communication with external interested parties

The organisation needs to have a procedure(s) in place for receiving, documenting and responding to relevant communications from external interested parties.

The organisation should provide appropriate and consistent information about its OH&S hazards and its OH&S management system in accordance with its OH&S policy and applicable legal and other requirements. This can include information concerning its normal operations or potential emergency situations.

External communication procedures often include the identification of designated contact individuals such as a Public Relations Official (PRO). This allows for appropriate information to be communicated in a consistent manner. This can be especially important in emergency situations where regular updates are requested and/or a wide range of questions need to be answered to the national media.

4.6.3.6 Procedures for worker participation

The organisation's procedure(s) should address the need for the active and on-going participation of workers in the development and review of OH&S practices and, where appropriate, the development of the OH&S management system. The participation arrangements should take account of any legal and other requirements.

Workers should be informed about the arrangements that have been made for their participation and the individual who represents them on OH&S matters. OH&S representatives should have defined roles.

The organisation's procedure(s) for the involvement of workers could include:

a) consultation in the selection of appropriate controls, including discussion of the benefits or adverse outcomes of alternative options for controlling specific hazards or preventing unsafe behaviour;
b) involvement in recommending improvements to OH&S performance;
c) consultation concerning changes that affect OH&S, particularly before the introduction of new or unfamiliar hazards, e.g.:
   i. the introduction of new or modified equipment;
   ii. the construction, modification or change of use of buildings and facilities;
   iii. the use of new chemicals or materials;
   iv. re-organisation, new processes, procedures or work patterns.

In developing its procedure(s) for worker participation, the organisation should consider potential incentives and barriers to participation (e.g., language and literacy issues, the fear of reprisal), confidentiality and privacy issues.

NOTE 1*The ILO-OSH:2001 guidelines in clause* ***3.2.3*** *recommend that "The employer should make arrangements for workers and their safety and health representatives to have the time and resources to participate actively in the processes of organising, planning and implementation, evaluation and action for improvement of the OH&S management system."*

NOTE 2 *"Workers" can include employees, voluntary workers, temporary workers and contracted personnel.*

NOTE 3 *Legislative requirements pertaining to worker participation in OH&S decision making must be strictly applied as the minimum standard.*

4.6.3.7 Procedures for consultation with contractors and external interested parties

The organisation should have a procedure(s) for consulting with contractors and other external interested parties, where appropriate.

There can be a need for the organisation to consult with regulators concerning certain OH&S matters (e.g., applicability and interpretation of OH&S legal requirements), or with emergency services.

In considering the need for consultation with contractors on changes that can affect their OH&S, the organisation should take account of the following:

a) new or unfamiliar hazards (including those that can be introduced by the contractor);
b) reorganisation;
c) new or amended controls;
d) changes in materials, equipment, exposures, etc.;
e) changes in emergency arrangements; and
f) changes in legal or other requirements.

For consultation with external parties, the organisation should give consideration to factors such as:

a) changes in emergency arrangements,
b) hazards that can impact neighbours, or hazards from neighbours,
c) changes in legal or other requirements.

4.6.4 Documentation

<u>OHSAS 18001 Text</u>

The OH&S management system documentation shall include:

a) the OH&S policy and objectives;
b) description of the scope of the OH&S management system;
c) description of the main elements of the OH&S management system and their interaction, and reference to related documents;
d) documents, including records, required by this OHSAS Standard; and

e) documents, including records, determined by the organisation to be necessary to ensure the effective planning, operation and control of processes that relate to the management of its OH&S risks.

NOTE: *It is important that documentation is proportional to the level of complexity, hazards and risks concerned and is kept to the minimum required for effectiveness and efficiency.*

The organisation should maintain up-to-date documentation that is sufficient to ensure that its OH&S management system can be adequately understood and effectively and efficiently operated.

Typical inputs include the following items:

a) details of the documentation and information systems the organisation develops to support its OH&S management system and OH&S activities, and to fulfil the requirements of OHSAS 18001 and applicable legislation,
b) details of responsibilities and authorities,
c) information on the local environments in which documentation or information is used; and
d) constraints that this can put on the physical nature of documentation, or the use of electronic or other media.

The organisation should review its documentation and establish additional information needs for the OH&S management system, before developing the documentation necessary to support its OH&S processes.

In deciding what documentation is required the organisation should determine where there is any risk that a task, through lack of written procedures or instructions, will not be performed in the required manner.

There is no requirement to develop documentation in a particular format in order to conform to OHSAS 18001, nor is it necessary to replace existing documentation such as manuals, procedures, or work instructions where these adequately describe required arrangements.

If the organisation already has an established, documented OH&S management system, it can prove more convenient and effective for it to develop, for example, an overview document describing the inter-relation between its existing procedures and the requirements of OHSAS 18001.

Account should be taken of the following:

a) the responsibilities and authorities of the users of the documentation and information, as this should lead to consideration of the degree of security and accessibility that needs to be imposed (particularly with electronic media) and maintenance/change controls;

b) the manner in which physical documentation is used, and the environment in which it is used, as this can require consideration of the format in which it is presented (e.g., an instruction could be incorporated into a sign rather than a paper document). Similar consideration should be given concerning the environment for the use of electronic equipment for information systems.

4.6.5 Control of documents

OHSAS 18001 text

Documents required by the OH&S management system and by this OHSAS Standard shall be controlled. Records are a special type of document and shall be controlled in accordance with the requirements given in **4.5.4**.

The organisation shall establish, implement and maintain a procedure(s) to:

(a) approve documents for adequacy prior to issue;
(b) review and update as necessary and re-approve documents;
(c) ensure that changes and the current revision status of documents are identified;
(d) ensure that relevant versions of applicable documents are available at points of use;
(e) ensure that documents remain legible and readily identifiable;
(f) ensure that documents of external origin determined by the organisation to be necessary for the planning and operation of the OH&S management system are identified and their distribution controlled; and
(g) prevent the unintended use of obsolete documents and apply suitable identification to them if they are retained for any purpose.

All documents and data containing information required for the operation of the OH&S management system and the performance of the organisation's OH&S activities must be identified and controlled.

The organisation must give consideration to items such as the following:

i. the details of the document and data systems that support its OH&S management system and OH&S activities, and which enable it to fulfil the requirements of OHSAS 18001; and
ii. the OH&S details of its assigned responsibilities and authorities.

Written procedures should define the controls for the identification, approval, issue and removal of OH&S documentation, together with the control of OH&S data These procedures should clearly define the categories of documents and data to which they apply.

Documents and data should be available and accessible when required, under routine and non-routine conditions, including emergencies. This could include ensuring that up-to-date plant engineering drawings, hazardous material data sheets, procedures and instructions, etc., are available to those persons who require them in an emergency.

The organisation should establish procedures for identifying any documents of external origin required for planning and implementing its OH&S management system. The distribution of these documents needs to be controlled to ensure that the most current information is used in making decisions impacting OH&S. For example, the organisation should establish procedures for managing the safety data sheets developed for hazardous substances used by the organisation. Responsibility for this task should be assigned. The person charged with this task should ensure that all persons in the organisation are kept informed of any relevant changes to such information that affects their duties or working conditions.

The development of an organisation’s document control process will typically result in items such as the following:
(a) a document control procedure, including assigned responsibilities and authorities;
(b) document registers, master lists or indexes;
(c) a list of controlled documentation and its location;
(d) archive records (some of which should be held in accordance with legal or other time requirements).

Documents should be reviewed from time to time to ensure that they are still valid and accurate. This can be performed as a dedicated exercise, and could also be necessary:
i. as part of a review of risk assessment of processes,
ii. as part of a response to an incident,
iii. as part of the management of change procedure, and

iv. following changes in legal and other requirements, processes, installation, workplace layout, etc.

Obsolete documents retained for reference can present a particular concern, and great care should be taken to ensure that they do not return back into circulation. However, it is sometimes necessary to retain obsolete documents as part of the records relating to the development or performance of the OH&S management system.

4.6.6 Operational control

OHSAS 18001 text

The organisation shall determine those operations and activities that are associated with the identified hazard(s) where the implementation of controls is necessary to manage the OH&S risk(s). This shall include the management of change (modifications).

For those operations and activities, the organisation shall implement and maintain:

a) operational controls, as applicable to the organisation a) and its activities; the organisation shall integrate those operational controls into its overall OH&S management system;
b) controls related to purchased goods, equipment and services;
c) controls related to contractors and other visitors to the workplace;
d) documented procedures, to cover situations where their absence could lead to deviations from the OH&S policy and the objectives;
e) stipulated operating criteria where their absence could lead to deviations from the OH&S policy and objectives.

Once it has gained an understanding of its OH&S hazards, the organisation should implement the operational controls that are necessary to manage the associated risks and comply with applicable OH&S legal and other requirements. The overall objective of OH&S operational controls is to manage the OH&S risks to fulfil the OH&S policy.

Information to be considered when establishing and implementing operational controls includes:
a) OH&S policy and objectives;
b) results of hazard identification, risk assessment, evaluation of existing controls and determination of new controls;
c) management of change processes;
d) internal specifications (e.g., for materials, equipment, facilities layout);

e) information on existing operating procedures;
f) legal and other requirements to which the organisation subscribes;
g) product supply chain controls related to purchased goods, equipment and services;
h) feedback from participation and consultation;
i) the nature of, and extent to which, tasks are to be performed by contractors and other external personnel;
j) access to the workplace by visitors, delivery personnel, service contractors, etc.

When developing operational controls, priority should be given to control options with higher reliability in preventing injury or ill health, consistent with the hierarchy of controls, i.e. this should start with redesign of equipment or processes to eliminate or reduce hazard(s),improved signage/warnings for hazard avoidance, improved administrative procedures and training to reduce the frequency and duration of the exposure of persons to inadequately controlled hazards, and lastly the use of personal protective equipment (PPE) to reduce the severity of injury or exposure.

The operational controls need to be implemented, evaluated on anon-going basis to verify their effectiveness, and integration into the overall OH&S management system.

4.6.6.1 Establishing and implementing operational controls

Operational controls should be established and implemented as necessary to manage the OH&S risks to an acceptable level, for operational areas and activities, e.g., purchasing, research and development, sales, services, offices, off-site work, home based working, manufacturing, transportation and maintenance.

Operational controls can use a variety of different methods, e.g., Physical devices (such as barriers, access controls), procedures, work instructions, pictograms, alarms and signage.

NOTE *It is preferable that warning signage is based on accepted design principles, emphasising standardised graphical symbols and minimizing the use of text, and that when text is required, accepted signal words, e.g., “danger” or “warning” are used. For further guidance use the relevant international or national standards.*

The organisation should establish operational controls to eliminate, or reduce and control the OH&S risks that could be introduced into the workplace by employees, contractors, other external personnel, members of the public and/or visitors. Operational controls can also need to take into account situations where OH&S risks extend into public areas or areas controlled by other parties (e.g., when employees of the organisation are working at a client's site). It is sometimes necessary to consult with external parties in such circumstances.

Examples of areas in which OH&S risks typically arise, and examples of their associated control measures, include:

a) general control measures
   i) regular maintenance and repair of facilities, machinery and equipment to prevent unsafe conditions from developing,
   ii) housekeeping and maintenance of clear walkways,
   iii) traffic management (i.e., the management of the separation of vehicle and pedestrian movements),
   iv) provision and maintenance of workstations,
   v) maintenance of the thermal environment (temperature, air quality),
   vi) maintenance of the ventilation systems and electrical safety systems,
   vii) maintenance of emergency plans,
   viii) policies related to travel, bullying, sexual harassment, drug and alcohol abuse, etc.,
   ix) health programmes (medical surveillance programmes),
   x) training and awareness programmes relating to the use of particular controls (e.g., permit-to-work systems),
   xi) access controls;

b) performance of hazardous tasks
   i) use of procedures, work instructions, or approved working methods,
   ii) use of appropriate equipment,
   iii) pre-qualification and/or training of personnel or contractors for hazardous tasks,
   iv) use of permit-to-work systems, pre-approvals, or authorizations,
   v) procedures controlling the entry and exit of personnel to hazardous work sites,
   vi) controls to prevent ill health;

c) use of hazardous materials
   i) established inventory levels, storage locations and storage conditions,
   ii) conditions of use for hazardous materials,
   iii) limitations of areas where hazardous materials can be used,
   iv) secure and safe storage provisions and control of access,
   v) provision of and access to material safety data and other relevant information,
   vi) shielding of radiation sources,
   vii) isolation of biological contaminants,
   viii) knowledge in the use of and availability of emergency equipment;

d) facilities and equipment
   i) regular maintenance and repair of facilities, machinery and equipment to prevent unsafe conditions from developing,
   ii) housekeeping and maintenance of clear walkways, and traffic management,
   iii) provision, control and maintenance of personal protective equipment (PPE),
   iv) inspection and testing of OH&S equipment, such as guarding, fall arrest systems, shutdown systems, rescue equipment for confined spaces, lock-out systems, fire detection and suppression equipment, exposure monitoring devices, ventilation systems and electrical safety systems,
   v) inspection and testing of material handling equipment (cranes, forklifts, hoists and other lifting devices);

e) purchase of goods, equipment and services
   i) establishment of OH&S requirements for goods, equipment and services to be purchased,
   ii) communication of the organisation’s owns OH&S requirements to suppliers-approval requirements for the purchase or transport/transfer of hazardous chemicals, materials and substances,
   iii) pre-approval requirements and specifications for the purchase of new machinery and equipment,
   iv) pre-approval of procedures for the safe operation of machinery, equipment, and/or the safe handling of materials prior to their use,
   v) selection and monitoring of suppliers,

vi) inspection of received goods, equipment and services, and (periodic) verification of their OH&S performance,

vii) approval of the design of OH&S provisions for new facilities;

f) contractors

i) establish criteria for the selection of contractors,

ii) communication of the organisation's owns OH&S requirements to contractors,

iii) evaluation, monitoring and periodic re-evaluation, of the OH&S performance of contractors;

g) other external personnel or visitors in the workplace.

As the knowledge and capabilities of visitors or other external personnel vary greatly, this should be considered when developing controls. Examples can include:

i) entry controls,

ii) establishing their knowledge and capabilities prior to permitting the use of equipment,

iii) provision of advice and training as necessary,

iv) warning signage/administrative controls,

v) methods for monitoring visitor behaviour and supervising their activities.

4.6.6.2 Stipulating operating criteria

The organisation should stipulate operating criteria where they are necessary for the prevention of injury or ill health. Operating criteria should be specific to the organisation, its operations and activities, and be related to its own OH&S risks, where their absence could lead to deviation from the OH&S policy and objectives.

Examples of operating criteria can include:

a) for hazardous tasks

i) use of specified equipment, and procedures/work instructions for its use,

ii) competency requirements,

iii) use of specified entry control processes and equipment,

iv) authorities/guidelines/instructions/procedures for individual risk assessment prior to immediate commencement of the task;

b) for hazardous chemicals
   i) approved chemical lists,
   ii) exposure limits,
   iii) specific inventory limits,
   iv) specified storage locations and conditions;

c) for task involving entry into hazardous areas
   i) specification of personal protective equipment (PPE) requirements,
   ii) specified conditions for entry,
   iii) health and fitness conditions;

d) for tasks involving work performed by contractors
   i) specification of OH&S performance criteria,
   ii) specification of competency and/or training requirements for contractor personnel,
   iii) specification/inspection of contractor provided equipment;

e) for OH&S hazards to visitors
   i) entry controls (sign-in/sign-out, access limitations),
   ii) personal protective equipment (PPE) requirements,
   iii) site safety briefings,
   iv) emergency requirements.

4.6.6.3 Maintaining operational controls

Operational controls should be reviewed on a periodic basis to evaluate their on-going suitability and effectiveness. Changes that are determined to be necessary should be implemented.

In addition, procedures should be in place to determine circumstances where new controls and/or modifications of existing operational controls are needed. Proposed changes to existing operations should be evaluated for OH&S hazards and risks before they are implemented. When there are changes to operational controls, the organisation should consider whether there are new or modified training needs.

4.6.7 Emergency preparedness and response

OHSAS 18001 text

The organisation shall establish, implement and maintain a procedure(s):

a) to identify the potential for emergency situations;

b) to respond to such emergency situations.

The organisation shall respond to actual emergency situations and prevent or mitigate associated adverse OH&S consequences.

In planning its emergency response, the organisation shall take account of the needs of relevant interested parties, e.g., emergency services and neighbours.

The organisation shall also periodically test its procedure(s) to respond to emergency situations, where practicable, involving relevant interested parties as appropriate.

The organisation shall periodically review and, where necessary, revise its emergency preparedness and response procedure(s), in particular, after periodical testing and after the occurrence of emergency situations.

The organisation should assess the potential for emergency situations that impact on OH&S and develop a procedure(s) for an effective response(s). This may be a stand-alone procedure(s) or be combined with other emergency response procedure(s). The organisation should periodically test its emergency preparedness and seek to improve the effectiveness of its response activities and procedure(s).

NOTE: *Where the procedure is combined with other emergency response procedure(s), the organisation needs to ensure that it addresses all potential OH&S impacts and should not presume that the procedures relating to fire safety, or environmental emergencies, etc., will be sufficient.*

4.6.7.1 Identification of potential emergency situations

Procedures to identify potential emergency situations that could impact on OH&S should consider emergencies that can be associated with specific activities, equipment or workplaces.

Examples of possible emergencies, which vary in scale, can include:

a) incidents leading to serious injuries or ill health,

b) fires and explosions,

c) release of hazardous materials/gases,

d) natural disasters, bad weather,

e) loss of utility supply (e.g., loss of electric power),
f) pandemics/epidemics/outbreaks of communicable disease,
g) civil disturbance, terrorism, sabotage, workplace violence,
h) failure of critical equipment,
i) traffic accidents.

When identifying potential emergency situations, consideration should be given to emergencies that can occur during both normal operations and abnormal conditions (e.g., operation start-up or shut-down, construction or demolition activities).

Emergency planning should also be reviewed as a part of the on-going management of change. Changes in operations can introduce new potential emergencies or necessitate those changes be made to emergency response procedures. For example, changes in facility layout can impact emergency evacuation routes.

The organisation should determine and assess how emergency situations will impact all persons within and/or in the immediate vicinity of workplaces controlled by the organisation.

Consideration should be given to those with special needs, e.g., people with limited mobility, contract employees, visitors, neighbours or other members of the public.

The organisation should also consider potential impacts on emergency services personnel while at the workplace (e.g., fire-fighters).

Information that should be considered in identifying potential emergency situations includes the following:

a) the results of hazard identification and risk assessment activities performed during the OH&S planning process,
b) legal requirements,
c) the organisation's previous incident (including accident) and emergency experience,
d) emergency situations that have occurred in similar organisations,
e) information related to accident and/or incident investigations posted on the websites of regulators or emergency response agencies.

4.6.7.2 Establishing and implementing emergency response procedures

Emergency response should focus on the prevention of ill health and injury, and on the minimisation of the adverse OH&S consequences toa person(s) exposed to an emergency situation.

A procedure(s) for responding to emergency situations should be developed and should also take into account applicable legal and other requirements.

The emergency procedure(s) should be clear and concise to facilitate their use in emergency situations. They should also be readily available for use by emergency services. Emergency procedure(s) that is stored on a computer or by other electronic means might not be readily available in the event of a power failure, so paper copies of emergencies procedure(s) ought to be maintained in readily accessible locations.

Consideration should be given to the existence and/or capability of the following, in developing emergency response procedure(s):

a) inventory and location of hazardous materials storage,
b) numbers and locations of people,
c) critical systems that can impact on OH&S,
d) the provision of emergency training,
e) detection and emergency control measures,
f) medical equipment, first aid kits, etc.,
g) control systems, and any supporting secondary or parallel/multiple control systems,
h) monitoring systems for hazardous materials,
i) fire detection and suppression systems,
j) emergency power sources,
k) availability of local emergency services and details of any emergency response arrangements currently in place,
l) legal and other requirements,
m) previous emergency response experience.

When the organisation determines that external services are needed for emergency response (e.g., specialist experts in handling hazardous materials and external testing laboratories), pre-approved(contractual) arrangements should be put in place. Particular attention should be paid to staffing levels, response schedules and emergency service limitations.

Emergency response procedure(s) should define the roles, responsibilities and authorities of those with emergency response duties, especially those with an assigned duty to provide an immediate response. These personnel should be involved in the development of the emergency procedure(s) to ensure they are fully aware of the type and scope of emergencies that they can be expected to handle, as well as the arrangements needed for coordination. Emergency service personnel should be provided with the information required to facilitate their involvement in response activities.

Emergency response procedures should give consideration to the following:

a) identification of potential emergency situations and locations,
b) details of the actions to be taken by personnel during the emergency (including actions to be taken by staff working off-site, by contractors and visitors),
c) evacuation procedures,
d) responsibilities, and authorities of personnel with specific response duties and roles during the emergency (e.g., fire-wardens, first-aid staff and spill clean-up specialists),
e) interface and communication with emergency services,
f) communication with employees (both on-site and off-site), regulators and other interested parties (e.g., family, neighbours, local community, media),
g) information necessary for undertaking the emergency response (plant layout drawings, identification and location of emergency response equipment, identification and location of hazardous materials, utility shut-off locations, contact information for emergency response providers).

4.6.7.3 Emergency response equipment

The organisation should determine and review its emergency response equipment and material needs.

Emergency response equipment and materials can be needed to perform a variety of functions during an emergency, such as evacuation, leak detection, fire suppression, chemical/biological/radiological monitoring, communication, isolation, containment, shelter, personal protection, decontamination, and medical evaluation and treatment.

Emergency response equipment should be available in sufficient quantity and stored in locations where it is readily accessible; it should be stored securely and be protected from being damaged.

This equipment should be inspected and/or tested at regular intervals to ensure that it will be operational in an emergency situation.

Special attention should be paid to equipment and materials used to protect emergency response personnel. Individuals should be informed of the limitations of personal protective devices and trained in their proper use.

The type, quantity and storage location(s) for emergency equipment and supplies should be evaluated as a part of the review and testing of emergency procedures.

4.6.7.4 Emergency response training

Personnel should be trained in how to initiate the emergency response and evacuation procedures.

The organisation should determine the training needed for personnel who are assigned emergency response duties and ensure that this training is received. Emergency response personnel should remain competent and capable to carry out their assigned activities.

The need for retraining or other communications should be determined when modifications are made that impact on the emergency response.

4.6.7.5 Periodic testing of emergency procedures

Periodic testing of emergency procedures should be performed to ensure that the organisation and external emergency services can appropriately respond to emergency situations and prevent or mitigate associated OH&S consequences.

Testing of emergency procedures should involve external emergency services providers, where appropriate, to develop an effective working relationship. This can improve communication and cooperation during an emergency.

Emergency drills can be used to evaluate the organisation's emergency procedures, equipment and training, as well as increase overall awareness of emergency response protocols. Internal parties (e.g., workers) and external parties (e.g., fire department personnel) can be included in the drills to increase awareness and understanding of emergency response procedures.

The organisation should maintain records of emergency drills. The type of information that should be recorded includes a description of the situation and scope of the drill, a timeline of events and actions and observations of any significant achievements or problems. This information should be reviewed with the drill planners and participants to share feedback and recommendations for improvement.

4.6.7.6 Reviewing and revising emergency procedures

Inorganizations review its emergency preparedness and response procedure(s) periodically.

Examples of when this can be done are:

a) according to schedules defined by the organisation;
b) during management reviews;
c) following organisational changes;
d) as a result of management of change, corrective action, or preventive action;
e) following an event that activated the emergency response procedures;
f) when deficiencies are evident in the emergency response;
g) following changes to legal and other requirements,
h) following external changes impacting the emergency response.

When changes are made in emergency preparedness and response procedure(s), these changes should be communicated to the personnel and functions that are impacted by the change; their associated training needs should also be evaluated.

4.7 Checking

4.7.1 Performance measurement and monitoring

OHSAS 18001 text

The organisation shall establish, implement and maintain a procedure(s) to monitor and measure OH&S performance on a regular basis. This procedure(s) shall provide for:

a) both qualitative and quantitative measures, appropriate to the needs of the organisation;
b) monitoring of the extent to which the organisation's OH&S objectives are met;
c) monitoring the effectiveness of controls (for health as well as for safety);
d) proactive measures of performance that monitor conformance with the OH&S programme(s), controls and operational criteria;
e) reactive measures of performance that monitor ill health, incidents (including accidents, near-misses, etc.), and other historical evidence of deficient OH&S performance;
f) recording of data and results of monitoring and measurement sufficient to facilitate subsequent corrective action and preventive action analysis.

If equipment is required to monitor or measure performance, the organisation shall establish and maintain procedures for the calibration and maintenance of such equipment, as appropriate. Records of calibration and maintenance activities and results shall be retained.

An organisation should have a systematic approach for measuring and monitoring its OH&S performance on a regular basis, as an integral part of its overall management system. Monitoring involves collecting information, such as measurements or observations, over time, using equipment or techniques that have been confirmed as being fit-for-purpose. Measurements can be either quantitative or qualitative.

Monitoring and measurements can serve many purposes in an OH&S management system, such as:

a) tracking progress on meeting policy commitments, achieving objectives and targets, and continual improvement,
b) monitoring exposures to determine whether applicable legal and other requirements to which the organisation subscribes have been met,
c) monitoring incidents, injuries and ill health,

d) providing data to evaluate the effectiveness of operational controls, or to evaluate the need to modify or introduce new controls
e) providing data to proactively and reactively measure the organisation's OH&S performance,
f) providing data to evaluate the performance of the OH&S management system, and
g) providing data for the evaluation of competence.

To achieve these purposes, an organisation should plan what will be measured, where and when it should be measured, what measurement methods should be used, and the competence requirements for the persons who will perform the measurements. To focus resources on the most important measurements, the organisation should determine the characteristics of processes and activities that can be measured and the measurements that provide the most useful information. The organisation needs to establish a procedure(s) for performance measurement and monitoring to provide consistency in measurements and enhance the reliability of all data produced.

The results of measurement and monitoring should be analysed and used to identify both successes and areas requiring correction or improvement.

The organisation's measuring and monitoring should use both reactive and proactive measures of performance, but should primarily focus on proactive measures in order to drive performance improvement and injury reduction.

a) Examples of proactive measures include:
   i) assessments of compliance with legal and other requirements,
   ii) the effective use of the results of workplace safety tours or inspections,
   iii) evaluation of the effectiveness of OH&S training,
   iv) use of OH&S behaviour-based observations,
   v) use of perception surveys to evaluate OH&S culture and related employee satisfaction,
   vi) the effective use of the results of internal and external audits,
   vii) completion of legally required and other inspections as scheduled,
   viii) the extent to which programme(s) have been implemented,
   ix) the effectiveness of the employee participation process,
   x) the use of health screening,
   xi) exposure modelling and monitoring,
   xii) benchmarking against good OH&S practices,

xiii) work activity assessments.

b) Examples of reactive measures include:
   i) monitoring of ill health,
   ii) occurrences and rates of incidents and ill health,
   iii) lost time incident rates, lost time ill health rates,
   iv) actions required following assessments by regulators,
   v) actions following receipt of comments from interested parties.

4.7.2 Monitoring and measuring equipment

OH&S monitoring and measurement equipment should be suitable, capable and relevant for the OH&S performance characteristics to be measured.

To assure the validity of results, monitoring equipment used to measure OH&S conditions (e.g., sampling pumps, noise meters, toxic gas detection equipment, etc.) should be maintained in good working order and calibrated or verified, and adjusted, if necessary, against measurement standards, traceable to international or national measurement standards. If no such standards exist, the basis used for calibration should be recorded.

Where computer software or computer systems are used to gather, analyse, or monitor data, and can affect the accuracy of OH&S performance results, they should be validated to test their suitability, prior to use.

Appropriate equipment should be selected and be used in a way that will provide accurate and consistent results. This could involve confirming the suitability of sampling methods or sampling locations or specifying that the equipment be used in a specific way.

The calibration status of measuring equipment should be clearly identified to the users. OH&S measuring equipment whose calibration status is unknown, or which is known to be out of calibration, should not be used. Additionally, it should be removed from use, and be clearly labelled, tagged, or otherwise marked, to prevent misuse.

Calibration and maintenance should be performed by competent personnel.

4.7.3 Evaluation of compliance

OHSAS 18001 text Consistent with its commitment to compliance the organisation shall establish, implement and maintain a procedure(s) for periodically evaluating compliance with applicable legal requirements.

The organisation shall keep records of the results of the periodic evaluations.

NOTE: *The frequency of periodic evaluation may vary for differing legal requirements.*

The organisation shall evaluate compliance with other requirements to which it subscribes. The organisation may wish to combine this evaluation with the evaluation of legal compliance referred or to establish a separate procedure(s).

The organisation shall keep records of the results of the periodic evaluations.

NOTE: *The frequency of periodic evaluation may vary for differing other requirements to which the organisation subscribes.*

An organisation should establish, implement and maintain a procedure for periodically evaluating its compliance with the legal or other requirements that are applicable to its OH&S risks, as part of its commitment to compliance.

Evaluation of the organisation's compliance should be performed by competent persons, either from within the organisation and/or using external resources.

A variety of inputs can be used to assess compliance, including:

a) audits,
b) the results of regulatory inspections,
c) analysis of legal and other requirements,
d) reviews of documents and/or records of incidents and risk assessments,
e) interviews,
f) facility, equipment and area inspections,
g) project or work reviews,
h) analysis of test results from monitoring and testing,
i) facility tours and/or direct observations.

The organisation's processes for the evaluation of compliance can depend on its nature (size, structure and complexity). A compliance evaluation can encompass multiple legal requirements or a single requirement. The frequency of evaluations can be affected by factors such as past compliance performance or specific legal requirements.

The organisation can choose to evaluate compliance with individual requirements at different times or at different frequencies, or as appropriate.

A compliance evaluation programme can be integrated with other assessment activities. These can include management system audits, environmental audits or quality assurance checks.

Similarly, an organisation should periodically evaluate its compliance with other requirements to which it subscribes. An organisation can choose to establish a separate process for conducting such evaluations or it can choose to combine these evaluations with its evaluations of compliance with legal requirements (see above), its management review process or other evaluation processes.

The results of the periodic evaluations of compliance with legal or other requirements need to be recorded.

4.8 Incident investigation, nonconformity, corrective action and preventive action

4.8.1 Incident investigation

OHSAS 18001 text

The organisation shall establish, implement and maintain a procedure(s) to record, investigate and analyse incidents in order to:

a) determine underlying OH&S deficiencies and other factors that might be causing or contributing to the occurrence of incidents;
b) identify the need for corrective action;
c) identify opportunities for preventive action;
d) identify opportunities for continual improvement; and
e) communicate the results of such investigations.

The investigations shall be performed in a timely manner.

Any identified need for corrective action or opportunities for preventive action shall be dealt with in accordance with the relevant parts of **4.8.2**.

The results of incident investigations shall be documented and maintained.

Incident investigation is an important tool for preventing reoccurrence of incidents and identifying opportunities for improvements. It can also be used for raising the overall OH&S awareness in the workplace.

The organisation should have a procedure(s) for reporting, investigating and analysing incidents. The purpose of the procedure(s) is to provide a structured, proportionate and timely approach for determining and dealing with the underlying (root) cause(s) of the incident.

All incidents should be investigated. The organisation should seek to prevent the under-reporting of incidents. In determining the nature of the investigation, the resources needed, and the priority to be given to investigation of an incident, account should be taken of:

a) the actual outcome and consequences of the incident, and
b) the frequency of such incidents and their potential consequences.

In developing those procedures, the organisation should give consideration to the following:

a) the need for a common understanding and acceptance of what constitutes an "incident") and the benefits that can be gained from its investigation,
b) that reporting should capture all types of incidents, including major and minor accidents, emergencies, near-misses, instances of ill health and those that take place over a period of time (e.g., Exposure),
c) the need to meet any legal requirements relating to the reporting and investigation of incidents, e.g., maintenance of a register of accidents,
d) defining the assignment of responsibilities and authorities for the reporting of incidents and subsequent investigations,
e) the need for immediate action to deal with imminent risks,
f) the need for investigation to be impartial and objective,
g) the need to focus on determining causal factors,
h) the benefits of involving those with knowledge of the incident,
i) defining the requirements for the conduct and recording of the various phases of the investigation process, such as:
    i) gathering facts and collecting evidence, in a timely manner,
    ii) analysing the results,
    iii) communicating the need for any identified corrective action and/or preventive action,
    iv) providing feedback into the processes for hazard identification, risk assessment, emergency response, OH&S performance measurement and monitoring and management review.

Those assigned to conduct incident investigations should be competent.

4.8.2 Nonconformity, corrective action and preventive action

OHSAS 18001 text

The organisation shall establish, implement and maintain procedure(s) for dealing with actual and potential nonconformity(is) and for taking corrective action and preventive action. The procedure(s) shall define requirements for:

a) identifying and correcting nonconformity(is) and taking action(s) to mitigate their OH&S consequences;
b) investigating nonconformity(is), determining their cause(s) and taking actions in order to avoid their recurrence;
c) evaluating the need for action(s) to prevent nonconformity(is) and implementing appropriate actions designed to avoid their occurrence;
d) recording and communicating the results of corrective action(s) and preventive action(s) taken; and
e) reviewing the effectiveness of corrective action(s) and preventive action(s) taken.

Where the corrective action and preventive action identifies new or changed hazards or the need for new or changed controls, the procedure shall require that the proposed actions shall be taken through a risk assessment prior to implementation.

Any corrective action or preventive action taken to eliminate the causes of actual and potential nonconformity(is) shall be appropriate to the magnitude of problems and commensurate with the OH&S risk(s) encountered.

The organisation shall ensure that any necessary changes arising from corrective action and preventive action are made to the OH&S management system documentation.

For an OH&S management system to be effective on an on-going basis, an organisation should have a procedure(s) for identifying actual and potential nonconformity(is), making corrections and taking corrective and preventive action, preferably preventing problems before they occur. The organisation can establish individual procedures to address corrective and preventive action, or a single procedure to address both.

Nonconformity is a non-fulfilment of a requirement. A requirement can be stated in relation to the OHSAS 18001 management system or in terms of OH&S performance. Examples of issues that can give rise to nonconformities include:

a) for OH&S management system performance

i) failure of top management to demonstrate commitment,
ii) failure to establish OH&S objectives,
iii) failure to define responsibilities required by an OH&S management system, such as responsibilities for achieving objectives,
iv) failure to periodically evaluate compliance with legal requirements,
v) failure to meet training needs,
vi) documentation being out of date or being inappropriate,
vii) failure to carry out communications;

b) for OH&S performance
   i) failure to implement the planned programme to achieve improvement objectives,
   ii) consistent failure to achieve performance improvement objectives,
   iii) failure to meet legal or other requirements,
   iv) failure to record incidents,
   v) failure to implement corrective action in a timely manner,
   vi) consistent high rates of illness or injury that are not being addressed,
   vii) deviations from OH&S procedures,
   viii) introduction of new materials or processes without appropriate risk assessments being conducted.

Inputs into corrective action and preventive action can be determined from the results of:

- periodic tests of emergency procedures,
- incident investigations,
- internal or external audits,
- the periodic evaluations of compliance,
- performance monitoring,
- maintenance activities,
- employee suggestion schemes and feedback from employee opinion/satisfaction surveys,
- exposure assessments.

Identification of nonconformities should be made part of individual responsibilities, with individuals closest to the work being encouraged to report potential or actual problems.

Corrective actions are actions taken to eliminate the underlying (root)cause(s) of identified nonconformity or incidents in order to prevent recurrence.

Once nonconformity is identified, it should be investigated to determine the cause(s), so that corrective action can be focused on the appropriate part of the system. An organisation should consider what actions need to be taken to address the problem, and/or what changes need to be made to correct the situation. The response and timing of such actions should be appropriate to the nature and scale of the nonconformity and the OH&S risk.

Also, preventive actions are actions taken to eliminate the underlying (root)cause(s) of the potential nonconformity or potential undesirable situations, in order to prevent occurrence.

When a potential problem is identified but no actual nonconformity exists, preventive action should be taken using a similar approach as for corrective action. Potential problems can be identified using methods such as extrapolating corrective action of actual nonconformities to other applicable areas where similar activities occur, or hazard analysis.

The organisation should ensure that:

a) where new or changed hazards or the need for new or changed controls have been determined, the proposed corrective or preventive actions will be taken through a risk assessment, prior to implementation,
b) corrective actions and preventive actions are implemented,
c) the results of corrective action and preventive action are recorded and communicated,
d) there is follow-up to review the effectiveness of the actions taken.

4.8.3 Control of records

OHSAS 18001 text

The organisation shall establish and maintain records as necessary to demonstrate conformity to the requirements of its OH&S management system and of this OHSAS Standard, and the results achieved.

The organisation shall establish, implement and maintain a procedure(s) for the identification, storage, protection, retrieval, retention and disposal of records.

Records shall be and remain legible, identifiable and traceable.

Records should be maintained to demonstrate that the organisation is operating its OH&S management system effectively and is managing its OH&S risks.

Records that can demonstrate conformance to the requirements include: records of the evaluation of compliance with legal and other requirements, hazard identification, risk assessment and risk control records, records of the monitoring of OH&S performance, calibration and maintenance records for equipment used to monitor OH&S performance, records of corrective action and preventive action, reports of OH&S inspections, training and associated records that support evaluations of competence,

OH&S management system audit reports, participation and consultation reports, incident reports, incident follow-up reports,

OH&S meeting minutes, health surveillance reports, personal protective equipment (PPE) maintenance records, reports of emergency response drills, management review records.

The integrity of records and data should be maintained to facilitate their subsequent use, e.g., for monitoring and review activities, for the identification of trends for preventive action, etc.

In determining the appropriate controls for records the organisation should take into account any applicable legal requirements, confidentiality issues (particularly those relating to personnel), storage/access/disposal/back-up requirements, and the use of electronic records.

For electronic records the use of antivirus systems and off-site backup storage should be considered.

4.9 Internal audit

OHSAS 18001 text

The organisation shall ensure that internal audits of the OH&S management system are conducted at planned intervals to:

a) determine whether the OH&S management system:
   i) conforms to planned arrangements for OH&S management including the requirements of this OHSAS Standard; and
   ii) has been properly implemented and is maintained; and
   iii) is effective in meeting the organisation's policy and objectives;

b) provide information on the results of audits to management.

Audit programme(s) shall be planned, established, implemented and maintained by the organisation, based on the results of risk assessments of the organisation's activities, and the results of previous audits.

Audit procedure(s) shall be established, implemented and maintained that address:

a) the responsibilities, competencies, and requirements for planning and conducting audits, reporting results and retaining associated records; and
b) the determination of audit criteria, scope, frequency and methods.

Selection of auditors and conduct of audits shall ensure objectivity and the impartiality of the audit process.

Audits can be used by an organisation to review and evaluate the performance and effectiveness of its OH&S management system.

An internal OH&S management system audit programme should be established to review the conformity of the organisation's OH&S management system to OHSAS 18001.

Planned OH&S management system audits should be carried out by personnel from within the organisation and/or by external personnel selected by the organisation, to establish whether the OH&S management system has been properly implemented and maintained.

Individuals selected to conduct the OH&S management system audits should be competent and be selected in a manner to ensure objectivity and impartially in the audit process.

NOTE: *The general principles and methodology described in ISO 19011are appropriate to OH&S management system auditing.*

4.9.1 Establishing an audit programme

The implementation of an internal audit programme should address the following:

a) communication of the audit programme to relevant parties,
b) establishing and maintaining a process for the selection of auditors and audit teams,
c) providing the resources necessary for the audit programme,
d) planning, coordinating and scheduling audits,
e) ensuring that audit procedures are established implemented and maintained,
f) ensuring the control of records of audit activities,
g) ensuring the reporting of audit results and audit follow-up.

NOTE: *The above has been adapted from ISO 19011:2002,* ***5.4****.*

The audit programme should be based on the results of risk assessments of the organisation's activities and the results of previous audits. The results of the risk assessments should guide the organisation in determining the frequency of audits of particular activities, areas or functions and what parts of the management system should be given attention.

The OH&S management system audits should cover all areas and activities within the scope of the OH&S management system and assess conformity to OHSAS 18001.

The frequency and coverage of OH&S management system audits should be related to the risks associated with the failure of the various elements of the OH&S management system, available data on the performance of the OH&S management system, the output from management reviews, and the extent to which the OH&S management system or the organisational activities are subject to change.

4.9.2 Internal audit activities

OH&S management system audits should be conducted according to the audit programme. The organisation should consider conducting additional audits:

a) as changes occur in the hazards, or risk assessment,
b) when indicated by the results of previous audits,
c) depending on the type of incidents or increased frequency of incidents, or

d) when circumstances indicate that they are necessary.

An internal audit typically consists of the following activities:

a) initiating the audit,
b) conducting document review and preparing for the audit,
c) conducting the audit,
d) preparing and communicating the audit report,
e) completing the audit and conducting audit follow-up.

NOTE: *The above has been adapted from ISO 19011:2002,* ***6.1****.*

4.9.3 Initiating an audit

The following activities are typically done to initiate an audit:

a) defining the audit objectives, scope and criteria for the audit,

NOTE*: Audit criteria are the references against which audit evidence is compared, OHSAS 18001, OH&S policy and procedures.*

b) selection of appropriate auditors and audit team for the audit taking into account the need for objectivity and impartiality,
c) determining the audit methodology,
d) confirming audit arrangements with the auditee and other individuals who will take part in the audit.

Determination of any applicable workplace OH&S rules is an important part of this process. In some cases, auditors could need additional training and/or be required to conform to additional requirements [e.g., the wearing of specialized personal protective equipment (PPE).

4.9.4 Selection of auditors

One or more persons can undertake OH&S management system audits. A team approach can widen involvement and improve cooperation. A team approach can also allow a wider range of specialist skills to be utilised and allow for individual auditors to have specific competencies.

In order to maintain independence, objectivity and impartiality, auditors should not audit their own work.

Auditors need to understand their task and be competent to carry it out. Auditors should be familiar with the OH&S hazards and risks of the areas they are auditing and any applicable legal or other requirements. They need to have the experience and knowledge of the relevant audit criteria and activities they are auditing to enable them to evaluate performance and determine deficiencies.

4.9.5 Conducting document reviews and preparing for an audit

Prior to conducting an audit, the auditors should review appropriate OH&S management system documents and records, and the results of prior audits. This information should be used by the organisation in making its plans for an audit.

The documentation that can be reviewed includes:

a) information on roles responsibilities and authorities — (e.g., an organisation chart),
b) OH&S policy statement,
c) OH&S objectives and programme(s),
d) OH&S management system audit procedures,
e) OH&S procedures and work instructions,
f) hazard identification, risk assessment and risk control results,
g) applicable legal and other requirements,
h) incident, nonconformity and corrective action reports.

The amount of documentation to be reviewed and the detail provided in the plans for the audit should reflect the scope and complexity of the audit. The plans for the audit should cover the following:

a) audit objectives,
b) audit criteria,
c) audit methodology,
d) audit scope and/or location,
e) audit schedule,
f) roles and responsibilities of the various audit parties.

The audit planning information can be contained in more than one document. The focus should be on providing adequate information to implement the audit.

If other parties need to be included in the audit process (e.g., employee representatives) this should be included in the plans for the audit.

4.9.6 Conducting an audit

The following activities are typically part of the audit:

a) communication during the audit,

b) collecting and verifying information,
c) generating audit findings and conclusions.

Depending on the scope and complexity of the audit, it can be necessary to make formal arrangements for communication during the audit. The audit team should communicate to the auditee in a timely manner:

a) the plans for the audit,
b) the status of the audit activities,
c) any concerns raised during the audit, and
d) the audit conclusions.

Communication of the plans for the audit can be achieved through the use of an opening meeting. Audit findings and conclusions should be reported during a closing meeting.

Evidence collected during the audit which suggests an imminent risk that requires immediate action should be reported without delay.

During the audit, information relevant to the audit objectives, scope and criteria should be collected by appropriate methods. The methods will depend on the nature of the OH&S management system audit being undertaken.

The audit should ensure that a representative sample of the important activities is audited and that relevant personnel are interviewed. This can include interviews of personnel such as individual workers, employee representatives and relevant external personnel, e.g., contractors.

Relevant documentation, records and results should be examined.

Wherever possible, checks should be built into the OH&S management system audit procedures to help to avoid misinterpretation or misapplication of collected data, information, or other records.

Audit evidence should be evaluated against the audit criteria to generate the audit findings and conclusions. Audit evidence should be verifiable. Audit evidence should be recorded.

4.9.7 Preparing and communicating the audit report

The results of the OH&S management system audits should be recorded and reported to management, in a timely manner.

The content of the final OH&S management system audit report should be clear, precise and complete. It should be dated and signed‐off by the auditor.

It should contain the following elements:

a) the audit objectives and scope,
b) information about the plans of the audit (identification of the members of the auditing team and the audited representatives, dates of audit and identification of the areas subject to audit),
c) the identification of reference documents and other audit criteria used to conduct the audit (egoists 18001, OH&S procedures),
d) details of identified nonconformities,
e) any relevant remarks on the extent to which the OH&S management system:
    i) conforms to planned arrangements,
    ii) is being properly implemented and maintained,
    iii) achieves the stated OH&S policy and objectives.

The results of OH&S management system audits should be communicated to all relevant parties as soon as possible, to allow corrective actions to be taken.

Confidentiality should be considered when communicating the information contained within the OH&S management system audit reports.

4.9.8 Completing the audit and conducting audit follow-up

A review of the results should be carried out and effective corrective action taken, where necessary.

Follow-up monitoring of audit findings should be established to ensure that identified nonconformities are addressed.

Top management should consider OH&S management system audit findings and recommendations, and take appropriate action as necessary within an appropriate time.

4.10 Management review

OHSAS 18001 text

Top management shall review the organisation's OH&S management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. Reviews shall include assessing opportunities for improvement and the need for changes to the OH&S

management system, including the OH&S policy and OH&S objectives. Records of the management reviews shall be retained.

Input to management reviews shall include:

a) results of internal audits and evaluations of compliance with applicable legal requirements and with other requirements to which the organisation subscribes;
b) the results of participation and consultation
c) relevant communication(s) from external interested parties, including complaints;
d) the OH&S performance of the organisation;
e) the extent to which objectives have been met;
f) status of incident investigations, corrective actions and preventive actions;
g) follow-up actions from previous management reviews;
h) changing circumstances, including developments in legal and other requirements related to OH&S; and
i) recommendations for improvement.

The outputs from management reviews shall be consistent with the organisation's commitment to continual improvement and shall include any decisions and actions related to possible changes to:

a) OH&S performance;
b) OH&S policy and objectives;
c) resources; and
d) other elements of the OH&S management system.

Relevant outputs from management review shall be made available for communication and consultation.

Management reviews should focus on the overall performance of the OH&S management system with regard to:

a) suitability (is the system appropriate to the organisation; dependent on its size, the nature of its risks, etc.?),
b) adequacy (is the system fully addressing the organisation's OH&S policy and objectives?), and
c) effectiveness (is it accomplishing the desired results?).

Management reviews should be carried out by top management, on a regular basis (e.g., quarterly, semi-annually, or annually) and can be carried out by meetings or other communication means. Partial management reviews of the performance of the OH&S management system can be held at more frequent intervals, if appropriate.

Different reviews can address different elements of the overall management review.

The management appointee has the responsibility for ensuring that reports on the overall performance of the OH&S management system are presented to top management, for review.

In planning for a management review, consideration should be given to the following:

a) the topics to be addressed,
b) who needs to participate to ensure the effectiveness of the review (top management, managers, OH&S specialist advisors, other personnel),
c) responsibilities of individual participants in respect of the review,
d) information to be brought to the review,
e) how the review will be recorded.

In relation to the OH&S performance of the organisation, and to show evidence of progress on the policy commitments to prevent injury and ill health, the following inputs could be considered:

a) reports of emergencies (actual or exercises),
b) worker satisfaction surveys,
c) incident statistics,
d) results of regulatory inspections,
e) results and/or recommendations from monitoring and measurement,
f) OH&S performance of contractors,
g) OH&S performance of supplied products and services,
h) information on changes in legal and other requirements.

In addition to the specific inputs for management review required by OHSAS 18001, the following inputs can also be considered:

a) reports from individual managers on the effectiveness of the system locally,
b) reports of on-going hazard identification, risk assessment and risk control processes,
c) progress in the achievement of OH&S training plans.

In addition to the outputs required by OHSAS 18001, details of the following issues can also be considered:

a) the suitability, adequacy and effectiveness of current hazard identification, risk assessment and risk control processes,
b) current levels of risk and the effectiveness of existing control measures,
c) adequacy of resources (financial, personnel, material),
d) the state of preparedness for emergency,
e) an assessment of the effects of foreseeable changes to legislation or technology.

Depending on the decisions and actions agreed at a review, the nature and types of communication of the results of the review, and to whom they will be communicated, should also be considered.

Notes:

Module 3 - The creation and promulgation of legislation

1. Introduction

Legislation (or "statutory law") is law which has been promulgated (or "enacted") by a legislature or other governing body. Another source of law is judge-made law or case law.

Before an item of legislation becomes law, it may be known as a bill, and may be broadly referred to as "legislation" while it remains under consideration to distinguish it from other business. Legislation can have many purposes. These could be to:

a) regulate (control);
b) authorise (approve);
c) proscribe (forbid);
d) provide (make responsible);
e) sanction (endorse);
f) grant (contribute);
g) declare (pronounce); or
h) restrict (confine).

Under the Westminster system, an item of primary legislation is known as an Act of Parliament after enactment.

Legislation is usually proposed by a member of the legislature (e.g., a member of Congress or Parliament), or by the executive, whereupon it is debated by members of the legislature and is often amended before passage. Most large legislatures enact only a small fraction of the bills proposed in a given session. Whether a given bill will be proposed and enter into force is generally a matter of the legislative priorities of government.

Legislation is regarded as one of the three main functions of government, which are often distinguished under the doctrine of the separation of powers. Those who have the formal power to create legislation are known as legislators; a judicial branch of government will have the formal power to interpret legislation (see statutory interpretation); the executive branch of government can act only within the powers and limits set by the law.

2. General

The Constitution of the Republic of South Africa, 1996 (Act 108 of 1996) (“the Constitution”), is the supreme law of the Republic of South Africa and provides, among others, how the three branches of Government, namely the Legislature (Parliament, provincial legislatures and municipal councils), the Executive Authority and the Judicial Authority should conduct their business. Chapter 4 of the Constitution sets out the national legislative process and determines that Parliament is the national legislature (law-making body) of the Republic. Both Houses of Parliament, namely the National Assembly and the National Council of Provinces (NCoP) each play a unique role in this process.

3. Legislative authority

3.1 Parliament, as the national legislature, has legislative authority (the power to make laws) in the national sphere of government. Consequently, Parliament has the power to pass new laws, to amend existing laws, and to repeal old laws. The same power is exercised by Provincial legislatures in the provincial sphere of government in respect of provincial laws, and by municipal councils in the local sphere of government in respect of municipal by-laws.

3.2 Schedules 4 and 5 to the Constitution provide a list of functional areas in which Parliament and the Provincial legislatures are competent to make laws. Schedule 4 lists those functional areas in which Parliament and the Provincial legislatures jointly have the power to make laws (for example matters relating to agriculture, consumer protection, health, housing, public transport and regional planning and development). Schedule 5 lists the functional areas in which the Provincial legislatures may make laws (for example matters relating to provincial planning, liquor licensing, provincial roads and traffic and provincial sport). Municipal Councils may make and administer by-laws for the administration of local government matters listed in Part B of Schedule 4 (for example building regulations, municipal health services and trading regulations) and Part B of Schedule 5 (for example control of public nuisances, fencing and fences, local amenities and street trading) to the Constitution.

4. The law-making process

4.1 Preparing draft legislation

Parliament, as the national legislature, considers draft pieces of legislation in order to exercise its power to make laws. A draft piece of legislation (called a Bill) must formally be submitted to Parliament before Parliament can consider making it a law. Most Bills are prepared by government departments under the direction of their Ministers or Deputy Ministers. The preparation of a Bill involves a number of steps, for example the investigation and evaluation of the legislative proposals (which can either be proposed amendments to existing legislation or proposed new legislation) and consultation with interested parties.

4.2 Cabinet approval

The next step is for the relevant government department to submit a Cabinet memorandum and draft Bill (containing the legislative proposals that are supported) to the Minister in order to obtain Cabinet approval for the introduction of the Bill in Parliament.

4.3 Role of State Law Advisers

After Cabinet has approved the introduction of a Bill in Parliament the relevant Minister must submit a copy of the draft Bill to the Speaker of the National Assembly and the Chairperson of the National Council of Provinces. However, before a Bill can be formally submitted to Parliament the State Law Advisers must be approached to certify the draft Bill. The role of the State Law Advisers in this regard is to ensure that a draft Bill is in line with the existing law and the provisions of the Constitution. If the State Law Advisers are satisfied that the Bill is technically correct and its provisions are legally sound, they approve the Bill (called the certification of a Bill). The relevant Bill is then ready to be formally submitted to Parliament.

4.4 Introduction of Bill in Parliament

4.4.1 Submitting a Bill to Parliament is better known as “introducing a Bill in Parliament”. Although any Bill may be introduced in the National Assembly, only certain Bills may be introduced in the National Council of Provinces (NCoP). Only a Cabinet member (Minister), a Deputy Minister, a Committee or an individual Member of the National Assembly may introduce a Bill in the National Assembly, and only a Committee or an individual Member of the NCoP may introduce a Bill in the NCoP.

4.4.2 At least 30 days before a Constitution Amendment Bill is introduced in Parliament, it must be published in the *Gazette* for public comment and submitted to the Provincial legislatures for their views. Furthermore, a Constitution Amendment Bill must also be submitted to the NCoP for a public debate if the Bill is not a Bill that is required to be passed by the NCoP. Comments from the public and the Provincial legislatures must be tabled together with the Bill. All other Bills may be introduced in Parliament only after prior notice of the introduction of the Bill has been given in the *Gazette*, which notice must be accompanied by an explanatory summary of the Bill. If the Bill itself (instead of an explanatory summary thereof) is published in the *Gazette*, the notice must contain an invitation to interested persons to submit written representations on the Bill to the Secretary of Parliament.

4.4.3 The Constitution distinguishes between four categories of Bills, namely:

a) section 74 Bills – Bills amending the Constitution;
b) section 75 Bills – ordinary Bills not affecting the provinces;
c) section 76 Bills – ordinary Bills affecting the provinces; and
d) section 77 Bills – money Bills (that is Bills that deal with appropriations, taxes, levies or duties).

The Constitution also prescribes the Parliamentary processes through which each of these categories of Bills must go before they can be passed by Parliament and become law (an Act of Parliament).

4.4.4 The first important step, after a Bill has been introduced, is for the relevant Bill to be referred to the Joint Tagging Mechanism ("JTM") for classification into one of the above categories. If a Bill does not clearly fit into one category, or if it fits into more than one category, it is usually redrafted or split into more than one Bill.

4.4.5 The next step in the Parliamentary process is for the Bill to be referred to the relevant Portfolio Committee for consideration. If there is great public interest in a Bill, the Portfolio Committee may organise public hearings to allow interested parties to submit written comments and sometimes make oral representations on the provisions of the Bill. The members of the relevant Portfolio Committee are then tasked with considering and debating the Bill in order to determine whether they are satisfied with the provisions of the Bill.

If the Portfolio Committee is not satisfied with the provisions of the Bill, the Bill is amended to reflect the version which the Portfolio Committee prefers. At the conclusion of its work the Portfolio Committee submits the Bill, together with a report, to the National Assembly for debate (called the second reading debate) and a vote. If the National Assembly passes the Bill, it is referred to the NCoP for its consideration.

4.5 Section 74 Bill

A Constitution Amendment Bill which aims to affect changes to the basic values of the Constitution requires a supporting vote of at least 75% of the members of the National Assembly and at least six provinces in the NCoP in order to be passed. Proposed changes to the Bill of Rights require a supporting vote of at least two-thirds of the members of the Assembly and of at least six provinces in the NCoP in order to be passed. If a Constitution Amendment Bill affects the NCoP; or changes the boundaries, powers, functions or institutions of a province; or amends a provision specifically dealing with a provincial matter, such a Bill requires a supporting vote of at least two thirds of the members of the Assembly and of at least six provinces in order to be passed; any other proposed amendment of the Constitution only requires a supporting vote of at least two-thirds of the members of the National Assembly in order to be passed. If a Constitution Amendment Bill affects specific provinces, the NCoP may not pass the Bill unless it has been approved by the relevant Provincial legislatures.

4.6 Section 75 Bill

Once an ordinary Bill that does not affect the provinces has been passed by the National Assembly, it is referred to the NCoP. The Council must pass the Bill subject to amendments proposed by the Council or reject the Bill. If the Council passes the Bill without proposed amendments, the Bill must be submitted to the President for assent. If the NCOP passes a Bill subject to proposed amendments or if the NCoP rejects a Bill, it goes back to the National Assembly. The National Assembly must then reconsider the Bill by taking any amendments proposed by the NCoP into account and may pass the Bill again (with or without the NCoP proposed amendments) or may decide not to proceed with the Bill. A Bill that has been passed by the National Assembly must then be submitted to the President for assent.

4.7 Section 76 Bill

Once an ordinary Bill that affects the provinces has been passed by the National Assembly, it must be referred to the NCoP. The Council must pass the Bill, pass an amended Bill or reject the Bill. A section 76 Bill must, if it was passed by the Council without any amendment, be submitted to the President for assent. If the Council passes an amended Bill, it goes back to the National Assembly and if the National Assembly passes the amended Bill, it must then be submitted to the President for assent. If the Council rejects a Bill or if the National Assembly refuses to pass the

NCoP amended version of the Bill, the matter must be referred to the Mediation Committee. If the Committee is unable to secure an agreement on a section 76 Bill introduced in the National Assembly within 30 days, the Bill may be passed by the National Assembly with a two-thirds majority. If the Committee is unable to secure an agreement on a Bill that was introduced in the NCoP the Bill lapses.

4.8 Section 77 Bill

A money Bill (Bills that deal with appropriations, taxes, levies or duties) must be introduced in Parliament by the Minister of Finance. All money Bills must be considered in accordance with the procedure established by section 75 of the Constitution.

5. Signing a Bill into law

5.1 A Bill is referred to the President after it has passed through the National Assembly and NCoP. The Constitution requires that the President must assent to and sign a Bill. However, if the President has reservations about the constitutionality (whether the provisions of a Bill are in line with the Constitution or not) of a Bill, he or she may refer it back to the National Assembly for reconsideration. If the Bill affects the provinces, the NCoP must participate in the reconsideration of the relevant Bill. If a reconsidered Bill accommodates the President’s reservations, the President must assent to and sign the Bill. However, if a reconsidered Bill does not fully accommodate the President’s reservations, the President must either assent to and sign the Bill or refer it to the Constitutional Court for a decision on its constitutionality. If the Constitutional Court decides the Bill is constitutional, the President must sign it.

5.2 A Bill that has been assented to and signed by the President becomes an Act of Parliament and must be published shortly thereafter in the *Gazette*. An Act takes effect (becomes binding on everyone) when it is published in the *Gazette* or on a date determined in terms of the Act. Sometimes an Act may require certain actions to be taken by the Department before it can be implemented, for instance subordinate legislation (regulations, determinations, rules etc.) may have to be prepared and promulgated to further regulate aspects in terms of an Act. In such instances an Act contains a provision that provides that the Act comes into operation on a date determined by the President by proclamation in the *Gazette*. Once the necessary actions have been finalised, the President is approached and requested to put the Act into operation on a certain date. After the President has assented to the implementation of the Act, a proclamation is published in the *Gazette* and the Act comes into operation on a date determined in the proclamation.

Notes:

Module 4 - Legislative Compliance

1. Introduction

When a law is passed in parliament and comes into effect, citizens who is affected by the law becomes criminally liable if they do not abide with the directions thereof.

2. Characteristics of law

We can say that law is legal rules set out about what must be done and what must not be done - e.g., you must pay taxes and you may not kill other people - (normative rules) and they also set out how things must be done - e.g., you must apply for a licence using a particular form before you can start trading - (prescriptive rules).

The court system assists in the enforcement of legal rules. Failure to obey rules should result in a sanction of some sort. The sanction may be criminal, as for theft etc.

3. Civil and Criminal Liability

Crime against the state for which an officer of the state can bring legal action. Society is harmed by an individual breaking the laws of the state. Usually there is no statute of limitations for criminal liability. Property and casualty insurance is not designed to provide coverage for the criminal acts of an insured individual.

3.1 Civil Jurisdiction

A district magistrates' court cannot try civil cases where the amount in dispute is more than R100 000. But the parties may agree to the jurisdiction of the court when a larger amount is involved. Also, a person bringing a civil action (a “plaintiff”) can

“abandon” a portion of his or her claim against the “defendant” to bring the matter within the jurisdiction of the district magistrates' court.
Certain civil matters are completely excluded from the court's jurisdiction, such as divorces, the interpretation of wills, the mental capacity or status of a person.

3.2 Criminal Jurisdiction

A district magistrate's court cannot try criminal cases where the 'accused' is alleged to have committed treason, murder or rape and may not impose a sentence of imprisonment for longer than 3 years or a fine of more than R60 000.

Regional Magistrate's Courts have criminal jurisdiction over an area made up of a number of magisterial districts.

The regional courts do not deal with civil matters. They have jurisdiction to hear all criminal matters except for treason. But the jurisdiction of a regional magistrates' court is limited to imprisonment for a period of 15 years or a fine of up to R300 000.

3.3 Court Procedures

In South Africa there is no jury system for civil or criminal matters.

There are two types of court procedures known as:

a) Civil procedure, and
b) Criminal procedure

3.3.1 Civil Procedure

Civil (non-criminal) legal proceedings can be of two types:

a) Trial actions, and
b) Applications

3.3.1.1 Trial Actions

This procedure allows for the written definition of the issues in dispute, in a process known as 'pleadings' and then for the presentation of oral evidence and argument to enable the court to decide the facts and the law applicable.

Based on its finding of fact and law the court makes a decision called a “judgment”. This is the normal form of civil action and it starts with the issue of a summons in the appropriate court.

The summons sets out the 'plaintiff's' case in sufficient detail to allow the 'defendant' to understand and respond in terms of a “plea”.

If the defendant does not wish to dispute the claim he or she can “consent to judgment” and thus avoid the trial and the cost associated with it.

If the defendant decides to dispute the plaintiff's claim a “Notice of intention to Defend” is lodged with the court and thereafter the defendant lodges a plea in which each allegation made by the Plaintiff is admitted or denied.

3.3.1.2 Applications

Court actions that require no oral evidence are known as "applications".

All the evidence is put in writing in the form of sworn statements known as "affidavits". At the hearing the affidavits are supplemented by legal argument by the lawyers for each side.

The "Notice of Motion" sets out the relief claimed and is supported by affidavits by and supporting the applicant. The "respondent" files answering affidavits refuting aspects of the applicant's allegations. The "applicant" may respond by way of an answering affidavit.

3.3.2 Criminal Proceedings

Criminal proceedings are always trial actions except on appeal. The State, represented by a "prosecutor" formulates a "charge sheet" which is served on the "accused".

The accused appears before a court after being arrested or having a criminal summons served upon him or her. The charge sheet, a list of the alleged offences, is read to the accused and he or she is asked to "plead" to the charges.

If the accused pleads "guilty" to a charge he or she will be found guilty and convicted without the hearing of evidence. But if the accused pleads "not-guilty", evidence is lead first by the prosecutor and then for the accused.

Each witness brought for either side is first allowed to give evidence and then subjected to cross-examination by the opposing side. Finally, the witness may be "re- examined" by the side that called him or her.

An accused cannot be compelled to give evidence at the trial, but a court will usually draw a negative inference from the fact that a person is unwilling to participate in the process.

A person can only be convicted of a crime if the state proves "beyond reasonable doubt" that he or she has committed the crime. Note that in civil matters the test is a "balance of probabilities".

If an accused is found guilty; the magistrate or judge must determine an appropriate sentence. The court will attempt to balance the needs of society, the victim and the criminal in "handing down" a sentence. The state and the defence will argue, bringing up "aggravating" and "mitigating" circumstances.

An accused may appeal both against the finding of the court and against any sentence imposed. But an appeal against sentence can result in the imposition of a more severe punishment.

4. Penalties for non-compliance

Legislation in all spheres of society was implemented to control people behaviour to be acceptable to society. Different laws are enforced in different ways by various institutions and government bodies. In the case of Occupational health and safety, law enforcement is done by the Inspector from the department of labour (see 4.1 below).

So, compliance with legislation also becomes a moral issue to accept and comply. If the morality of a person compels him to contravene the requirements of legislation, he must also accept that, should he be found reckless or negligent, there will be some kind of punishment to face in the form of a fine if the contravention is less serious. A person contravening any law in a more serious way will be criminally charged in a court of law and might face more severe penalties such as jail sentences. It is also important to know that in most cases each charge is penalised separately. Only in a few instances are criminals allowed to serve sentences simultaneously.

Should a victim die as a result of an incident in the workplace, the responsible person will be charged with culpable homicide.

If he is found to have conducted business negligently, the charge will be changed to murder in the first degree and he will receive the appropriate punishment depending on mitigating or aggravating circumstances. If he was found not guilty, the charges against him will be dropped.

Should any person be criminally charged in a court of law and found to be negligent in his actions or lack thereof, he may in addition be charged civilly for damages and losses incurred by the victim or his family resulting from the incident. In this case, the charges will be pressed against the responsible individual and not the company.

4.1 Enforcement by the Department of labour

4.1.1 Powers of inspectors

If an inspector finds dangerous or adverse conditions at the workplace, he or she may enforce minimum requirements on the employer by issuing a:

a) Contravention notice
When any section of the act is not complied with.

b) Improvement notice
To notify the employer of any improvements required of substandard physical conditions in the work place for example, if the employer only have 2, SHE representatives and the Inspector is of the opinion that an additional quantity of SHE Representatives is required in the interest of Health and Safety, he will issue an improvement notice and provide 60 days to comply.

c) Prohibition notice
Usually issued when either and improvement or contravention notice did not have the desired effect.

A prohibition notice requires all work in the workplace to be halted until such time as the conditions is sufficiently addressed to satisfy the inspector. If satisfied he will rescind the prohibition notice and only then may work continue.

It is important to abide by the restrictions of a notice issued by an Inspector as it has the same legal capacity as a court order issued by a Magistrates court. If an employer or any of his employees fail to comply with such notice, the employer is liable to be prosecuted in a court of law for contempt of court.

Other powers that inspectors have are to:

a) question or serve a summons on persons to appear before him during an inquest or formal investigation;

b) request that any documents be submitted to him;

c) examine documents and make copies thereof;

d) demand an explanation about any entries in such documents;

e) inspect any condition or article and take samples of it;

f) seize any article that may serve as evidence;

NOTE:
The above-mentioned powers of inspectors are not absolute. Any person, who disagrees with any decision taken by an inspector, may appeal against that decision by writing to The Chief Inspector Occupational Health and Safety.

4.1.2 Appeals against the decisions of the Inspector (OHS Act Section 35)
Employers have the right to appeal against the decision of an inspector, but:

a) They are not allowed to ignore any notices, even if he deems it unreasonable.

b) Appeal within the 60-day period to the chief inspector.

c) If one feels aggrieved by the decision of the Chief Inspector, a further appeal can be made to the Labour Court within 60 days.

5. Objectives of Health and Safety Legislation

The main objectives of the Health and Safety Act are to set labour standards in order to promote working conditions that will secure the Health and Safety of people while they are at work. This will be achieved through:

a) Encouraging employers to Identify workplace hazards and evaluate the risk that it poses to the safety of workers, contractors, visitors, and the general public and then to use various to eliminate or at the least control the hazards to minimise its effect.
b) Encouraging workers to take reasonable care for their own health and safety as well as that of their fellow workers;
c) Fostering close cooperation and consultation between employers, their employees and other interested parties; and
d) Regulating specific hazardous conditions and tasks through sub-ordinate legislation.

6. Occupational Health and Safety Act (Act 85 of 1993) and Regulations

There are a number of laws that regulate health and safety. Together these laws attempt to achieve two objectives. Firstly, it establishes procedures, structures and standards that try to protect workers from injury and diseases at work. Laws that achieve this objective are known as prevention legislation. Secondly, it deals with compensation which comes into effect when protection fails and workers are injured or suffer from occupational diseases. These types of laws are known as compensation legislation.

For factory and office workers in South Africa, the Occupational Health and Safety Act (Act 85 of 1993) tries to prevent injury and diseases while the Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993) deals with questions of compensation once a worker has been injured or contracted an occupational disease. Mineworkers have a different law called the Minerals Act (Act 50 of 1991). Mineworkers are also governed by the Compensation for Occupational Injuries Act (Act 130 of 1993). In addition, they also fall under the Occupational Diseases in Mines and Works Act.

The Occupational Health and Safety Act (or OHS Act for short) was passed by parliament in 1993 but only came into operation on the 1st of January of 1994. It replaced another prevention law that used to be known as the Machinery and Occupational Safety Act (MOS Act).

The MOS Act was replaced because it contains some major inadequacies that were affecting the ability of the law to improve health and safety conditions at work.

In fact, MOS Act replaced another law in 1983 that was known as the Factories Act. The Factories Act was passed in 1918 and was amended a number of times before it was repealed in 1983.

The Factories Act was replaced because of recommendations made by the Erasmus Commission of Inquiry into Occupational Health and Safety. The Erasmus commission was established by government in 1974 and completed its work in 1976. The MOS Act made provision for the appointment of safety representatives.

The system of appointment of safety representatives was not successful and this resulted in the provision for elected health and safety representatives under OHS Act.

The OHS Act contains other improvements which include expanding the scope of the Act to include health matters, an increase in the responsibility of employers in providing health and safety care in the workplace, and responsibility on manufacturers and designers to ensure that materials and articles provided by them are without health and safety risks. The Act has also made provision for greater union involvement in Health and Safety through the Advisory Council in deciding how safety representatives are elected.

The Occupational Health and Safety Act (Act 85 of 1993) is closely related with a set of regulations that is intended to regulate certain issues within the workplace. These regulations are usually compiled by technical committees knowledgeable on the subject that needs to be addressed in terms of Section 43 of the Act. Technical Committees are convened from time to time by the Advisory Council established by the Minister of Labour in terms of Sections 2, 3, 4 and 5 of the Occupational Health and Safety Act (Act 85 of 1993).

Regulations and Notices promulgated by the Department of Labour include:

a) Asbestos Regulations 2001
b) Certificate of Competency
c) Construction Regulations 2003
d) Diving Regulations
e) Driven Machinery regulations
f) Electrical Installation Regulations
g) Electrical Machinery Regulations
h) Environmental Regulation for Workplaces
i) Explosives Regulation
j) Ergonomic Regulations
k) Facilities Regulations
l) General Administrative Regulations
m) General Machinery Regulations
n) General Safety Regulations
o) Hazardous Biological Agents
p) Hazardous Chemical Substances
q) Lead Regulations
r) Lift Escalator and Passenger Conveyor Regulations
s) Major Hazard Installation
t) Noise Induced Hearing Loss
u) Pressure Equipment Regulations

The purpose of the Act is to provide for the health and safety of persons at work or in connection with the use of plant and machinery. It further provides for the protection of persons other than persons at work from hazards arising out of or in connection with the activities of persons at work.

Various regulations, on specific topics, are incorporated into the Act from time to time by the Minister of Labour.

The Act or Regulations can be purchased from the Government Printer in Gazette format or bound format from various publishers.

The requirements of the Act are enforced by the department of labour under the guidance of the Minister of Labour and administered by the Chief Directorate of Occupational Health and Safety.

In order to ensure the health and safety of workers, provincial offices have been established in all the provinces. To this end, occupational health and safety inspectors from these provincial offices carry out inspections and investigations at workplaces.

Inspections are usually planned on the basis of accident statistics, the presence of hazardous substances or the use of dangerous machinery in the workplace.

Unplanned inspections usually arise from requests or complaints by workers, employers, or members of the public. These complaints or requests are treated confidentially.

Notes:

Module 5 - SHE System Policies and Procedures

1. Introduction

Administering Safety Health and Environmental Management Systems is diverse for every industry because the way things get done in a car factory is very much different from what happens with the processes in a power station. Even cultures are diverse and every employer must therefore develop unique policies and procedures that suit the operations of his own organisation.

2. Policy

2.1 Definition

A policy is typically described as a principle or rule to guide decisions and achieve rational outcome(s). The term is not normally used to denote what is actually done this is normally referred to as either procedure or protocol. Policies are generally adopted by the Board of or senior governance body within an organisation whereas procedures or protocols would be developed and adopted by senior executive officers. Policies can assist in both subjective and objective decision making. Policies to assist in subjective decision making would usually assist senior management with decisions that must consider the relative merits of a number of factors before making decisions and as a result are often hard to objectively test e.g., work-life balance policy. In contrast policies to assist in objective decision making are usually operational in nature and can be objectively tested e.g., Health and Safety policy.

A Policy can be considered as a "Statement of Intent" or a "Commitment". For that reason, at least, the decision-makers can be held accountable for their "Policy".

2.2 SHE system policy development

The development of specific policies may be required by law e.g., a Health and Safety policy as required by the Occupational Health and Safety Act (Act 85 of 193) Section 7. This is not compulsory but may be requested by the inspector. The British Standard Institute (BSI) makes policies as part of a SHE management system compulsory if an organisation subscribes to the OHSAS 18001/2 standard (See 4.2 on page 22).

Other system policies may make it easier for executive managers and supervisors to regulate through administration certain issues within a SHE system for example to establish a Personal Protection Equipment Policy whereby every employee will be made aware of the intent of management's principles for managing the issue. This Policy must however be fair and must not discriminate unfairly against workers and other affected parties.

Policies that might feature in a SHE system includes, but is not limited to:

a) Hazardous substance control policy;

b) Explosives and explosive devices policy;

c) HIV Policy;

d) Confined spaces management policy;

e) First aid treatment policy;

f) Risk Control policy;

g) Incident management policy etc.

It is important to note that, when an employer have committed through policy to do something, he is morally obliged to comply. Should any policy be violated by any worker, the contents of company policy may become the issue around which legality may be argued.

2.3 Policy content (Typical)

At the very least, a policy should include statements about:

a) Management commitment;
b) Continual improvement;
c) Compliance with legislation;
d) Involvement of workers.

The policy should also include some of the following. The list is not necessarily in any order of importance.

2.3.1 A statement of your clear commitment to the establishment of a healthy and safe workplace, and to the integration of health and safety with all company activities;

2.3.2 A statement naming the senior person responsible for seeing that the policy is followed;

2.3.3 A statement that it is management's responsibility to take all reasonable precautions to prevent illness and injury;

2.3.4 An assertion that all levels of management will be held accountable for their health and safety responsibilities, in the same way that they are accountable for any other management function;

2.3.5 A statement that it is everyone's responsibility to maintain a healthy and safe workplace;

2.3.6 An emphasis on the importance of consultation and cooperation between managers and workers for the effective implementation of policy objectives;

2.3.7 A reference to your health and safety program and its related procedures for implementing your policy objectives;

2.3.8 A statement of your commitment to an on-going review and continual improvement and, where required, revision of the policy and program. This is in addition to the legal requirement to review the policy annually.

The above are guidelines for the content of a health and safety policy. The specifics of your own policy will depend on circumstances in your company, its size, and whether it is a corporate or local policy.

Your policy should be dated, and signed by the Employer who in most cases is the Chief Executive official of the organisation. A copy must be posted at a location in your workplace, where it will be easily seen by all employees.

It is important that your policy is clearly written and that it can be understood by all employees. No matter how impressive the policy may sound, it is meaningless if it cannot be understood.

2.4 Policy review and update

Any policy must be reviewed and if necessary updated at least once per year. If change in the operations governed by the policy occur in the organisation or any incident occurs, this also calls for review.

3. Procedure

3.1 Definition

A **procedure** is a set of actions or operations which have to be executed in the same manner in order to always obtain the same result under the same circumstances (for example, emergency procedures). Procedures are often referred to as company protocol.

3.2 Procedure development

Usually, a procedure results from a risk assessment in an effort to control risks through administrative procedure, describing the way in which things must be done to ensure that no one or nothing is endangered.

Procedures are usually written in a logical sequence in which the task should be executed. It can be done in number sequence or in table format. The steps in a work procedure usually also provides the basis upon which Job observations can be performed. This implies that the two documents (Procedure and Job Observation) can be effectively combined.

3.3 Procedure content (Typical)

To make a procedure effective it should contain at least:

3.3.1 An introduction

The introduction must provide introductory information around the operation for which the procedure is written. Just enough information is required to set the trend for the operational application of the procedure.

3.3.2 Purpose

The purpose for the procedure must be clearly described e.g., "The purpose of this procedure is to ensure that replacing of batteries in the ABC device is done correctly in order to prevent injury to workers and to ensure the ABC device is not damaged."

3.3.3 Scope of application

The scope of application of the procedure must stipulate the extent of its applicability e.g., "This procedure is applicable to the battery-operated ABC, ABD and ACD testing device only".

3.3.4 Definitions and abbreviations

Provide a list of definitions of operational terminology that could cause confusion of misinterpretation of information.

List all abbreviations used in the document. Where possible the use of abbreviations must be avoided.

3.3.5 Responsibilities

Describe the responsibilities of each individual designation that have to apply the contents of the procedure in practice.

3.3.6 Procedure

Describe the procedure step by step ensuring that all critical information is addressed.

3.3.7 List of Appendices

Any procedure that has drawings or any other information that does not form part of the body of the procedure must be captured in the Annexure of the procedure. List the Annexure and the headings in this section.

3.3.8 Distribution List

Provide a list of all the persons affected by and that are required to be issued with a copy of the procedure.

3.4 Procedure review and update

All procedures must be reviewed and if necessary updated at least once per year. If change in the operations governed by the procedure occur in the organisation or any incident occurs, this also calls for review.

3.5 Communication

Communication of procedure contents to the workforce is of utmost importance. Communication channels must therefore be utilised as described in 4.6.3.2 on page 77.

Notes:

Module 6 - South African Qualifications Authority (SAQA) and the National Qualifications Framework (NQF)

1. The South African Qualifications Authority

The South African Qualifications Authority (SAQA) is a statutory body established through an Act of Parliament and is based in Pretoria, South Africa. SAQA is the custodian of the South African National Qualifications Framework (NQF) and oversees the further development and implementation of the NQF.

SAQA was established in 1995 through the SAQA Act which was also the first piece of post-apartheid education and training legislation to be passed in a democratic South Africa. The SAQA Act was subsequently replaced by the NQF Act in 2008 which further strengthened the role of SAQA, while introducing innovative changes to the original design of the NQF.

Since SAQA's establishment the organisation has served as a model statutory body with impeccable financial and operational management – in 2011 SAQA received its 14th successive unqualified audit since its inception from the Auditor General. Over the years SAQA has come to the fore as an important intellectual resource to the country, but also to the Southern African region, Africa and even further afield. SAQA is internationally recognised as a contributor to the development of qualifications systems and is often called upon to share the South African experience and offer expert advice.

SAQA has been effectively led by its first Chief Executive Officer, Samuel Isaacs, since 1998. As the longest standing CEO of a qualification's authority in the world, Mr. Isaacs retires in 2012, and will be succeeded by Mr Joe Samuels who has served as the Deputy CEO since 2005. The SAQA Board is appointed by the Minister of Higher Education and Training and provides strategic direction to SAQA. The current Chairperson of the SAQA Board is Mr JJ Njeke. Previous chairpersons include Prof. Shirley Walters, Prof Mokobung Nkomo, Mr David Adler and Mr Samuel Isaacs.

SAQA has a staff complement of 150 people organised in 12 directorates, each of which is led by a Director. SAQA has been able to attract talented and experienced individuals into several key positions. Strategic support functions for Human Resources, Informational Technology and Finances are well developed and make an important contribution to the effectiveness of the organisation.

SAQA's main areas of responsibility include the registration of qualifications and professional designations on the NQF, the recognition of professional bodies, the management of information of the education and training system in respect of qualifications and learner achievements, the development of a national career development and advice service (a Higher Education and Training Ministerial flagship project), as well as the evaluation of foreign qualifications.

2. Purpose of SAQA

The primary purpose of the work of SAQA, as it oversees the further development and implementation of the NQF, is to serve the many learners that are in the South African education and training system. In a country where the system historically favoured a few at the expense of the many, there is much to be done to redress imbalances and to ensure that qualifications are accessible to all levels of society. At the same time, it is important to ensure that international benchmarking takes place to ensure global competitiveness and as a result, also the recognition of South African qualifications abroad.

Mandated by Parliament, SAQA through the NQF has introduced far-ranging reforms in the South African education and training system since 1995. Notably all providers, be they public or private, are now required to meet the same minimum standards. All formal education and training programmes must be based on quality qualifications registered on the NQF. International providers and the qualifications they offer must meet the same requirements as local providers. Through these and several other initiatives SAQA works to eradicate the exploitation of learners by unscrupulous providers (also referred to as degree mills), while also ensuring that qualifications meet the needs of society, including industry and employers. While these reforms have been based on the most recent international trends, the most important driver has been the extent to which the learner benefits from the changes.

SAQA is committed to the development of an NQF that facilitates articulation, recognition, access and redress across education, training and workplace learning; where learners, especially the youth in rural and the poorest of poor communities, are adequately served by the SAQA through its NQF advocacy, qualification and career development and advice services. Much more needs to be done; this is an ongoing priority for SAQA.

3. Quality Assurance of qualifications

The quality of South African qualifications is a key objective of SAQA. In the increasingly globalised world, qualifications provide a ‘passport’ through which skills and competencies can be recognised and transported. For this reason, SAQA has strived to develop the NQF in such a manner that it is internationally comparable – in essence, that we use the same language to describe the skills and competencies of learners as that which is used internationally. With more than 150 qualifications frameworks developing across the world today, notably in key regions of the world, the option to develop and implement an NQF were clearly the right decision taken by the first democratic government in South Africa.

In order to improve the quality of qualifications SAQA requires all formal qualifications to be registered on the NQF. Registration is only possible if the minimum requirements set by SAQA are met. In this regard SAQA works closely with the three Quality Councils responsible for different parts of the South African education and training system: the Council on Higher Education (CHE) for qualifications in the higher education sector; Umalusi for qualifications in adult education, Further Education and Training colleges, private providers and schools; and the Quality Council for Trades and Occupations (QCTO) for workplace-orientated qualifications offered in post-school institutions and/or workplaces.

SAQA also offers a verification service through which the authenticity of a South African qualification can be checked against the records held by SAQA. Confidentiality is maintained in the process based on permission from the individual learner. Increasingly this verification service is being used for the appointment of all public officials.

The work of SAQA is based on partnerships with local, regional and international stakeholders. This collaborative model has served SAQA well since 1995 and has ensured that the NQF has become an integral and sustainable component of the South African education and training system.

SAQA's partnerships have included amongst others: the establishment of standards generating bodies responsible to develop new qualifications, which were made up of expert stakeholders from the various sectors; close collaboration with the three Quality Councils in a wide range of areas; a joint initiative with the Department of Higher Education and Training to establish a national career advice centre; working with support from the European Union to establish SAQA; joint implementation projects with several Sector Education and Training Authorities (SETAs) to develop workplace qualifications; the establishment of the National Learners' Records Database (NLRD) with support from the Canadian International Development Agency; long-term research between SAQA and leading universities in South Africa; as well as working with the OECD, the Commonwealth Secretariat, the SADC Secretariat, and UNESCO on a variety of projects.

SAQA has built a reputation as an agency with organising power, that is able to bring together key stakeholders in various sectors, and importantly, that is able to see through the realisation of innovative ideas to the realm of public policy and ultimately, to practice. SAQA's partners play an integral role in this regard.

4. The National Qualifications Framework (NQF)

Qualifications frameworks have become a global phenomenonas they provide a common currency through which qualifications, and by implication, the skills and competencies of individuals, can be recognised. While not all NQFs have the same design or purpose, they all provide a sense of the 'macro indicators' of an education and training system. Just as GDP or employment rates are used to measure the development of an economy, so too can NQFs be used to provide an indication of the development of the education and training system.

The development and implementation of the NQF in South Africa is overseen by SAQA in collaboration with a wide range of partners. SAQA is primarily funded by Parliament through the Department of Higher Education and Training. The three Quality Councils are each responsible for their specific sectors. In this regard the NQF has been designed with three sub-frameworks, one for each of the sectors namely; higher education, general and further education and training and trades and occupation.

In order to enhance coordination within the NQF system, SAQA convenes an NQF Forum that includes the most senior leaders from each of the organisations involved. The forum meets quarterly and is supported by a smaller committee that comprises the CEOs of SAQA and the Quality Councils.

The NQF is made up of 10 levels described by a set of level descriptors. Different qualifications types are registered on each of the levels as determined by the three Quality Councils.

Qualifications registered on the NQF can be offered by any provider that meets the requirements of the Quality Councils. SAQA aims to ensure that articulation and mobility across the different sub-frameworks is taken into account when qualifications are registered on the NQF.

The architecture of the South African NQF has changed since 1995to better suit the South African context, notably by changing from 8 to 10 levels, and by accommodating the three sub-frameworks. SAQA has ensured that the NQF is flexible enough to facilitate the changes, while holding the core design stable to ensure continuity and stability in the system.

SAQA is responsible to recognise professional bodies involved in education and training and for the registration of their professional designations on the NQF. This is a relatively new area of responsibility and the rules of engagement have been developed by SAQA in close consultation with the professional body community and the Quality Councils since 2006.

At present SAQA is working with ten professional bodies to refine the policy and criteria, after which the recognition process will commence in the second half of 2012.

The formal inclusion of professional bodies within the NQF is a bold and innovative move that will ensure greater cohesion with the education and training system by coordinating the involvement of these bodies in the development of professional qualifications and the quality assurance of the delivery of the qualifications.

Importantly, their inclusion provides important national oversight into employment and skills development trends. Overseas partners are watching the South African developments closely as they recognise the innovation that SAQA is pioneering.

The NQF is thus a framework i.e., it sets the boundaries - a set of principles and guidelines which provide a vision, a philosophical base and an organisational structure - for construction, in this case, of a qualifications system. Detailed development and implementation are carried out within these boundaries. It is national because it is a national resource, representing a national effort at integrating education and training into a unified structure of recognised qualifications. It is a framework of qualifications i.e., records of learner achievement.

In short, the NQF is the set of principles and guidelines by which records of learner achievement are registered to enable national recognition of acquired skills and knowledge, thereby ensuring an integrated system that encourages life-long learning. (Explanation of the 8 NQF levels is discussed on the next page).

4.1 Objectives of the NQF

The objectives of the NQF as outlined in the NQF Act No 67 of 2008 are as follows:

a) To create a single integrated national framework for learning achievements;

b) Facilitate access to, and mobility and progression within, education, training and career paths;

c) Enhance the quality of education and training;

d) Accelerate the redress of past unfair discrimination in education, training and employment opportunities.

The objectives of the NQF are designed to contribute to the full personal development of each learner and the social and economic development of the nation at large.

NATIONAL QUALIFICATIONS FRAMEWORK (NQF)			
EDUCATION BAND	**NQF LEVEL**	**QUALIFICATION**	**INSTITUTIONS**
HIGHER EDUCATION	LEVEL 8+ LEVEL 8 LEVEL 7 LEVEL 6 LEVEL 5	Doctor's Degrees Masters Degrees Honours & 4 yr degrees First degrees Higher Certificates	Universities Technikons Colleges Private providers In-house / Work place
FURTHER EDUCATION	LEVEL 4 (Gr 12) LEVEL 3 (Gr 11) LEVEL 2 (Gr 10)	Further education and training certificates	Schools Colleges Private providers Training centres NGO's In-house / Work place
GENERAL EDUCATION	LEVEL 1 (Gr 9)	General education and training certificates ABET Levels 1 – 4 Early childhood development	Schools ABET Providers Independent schools NGO's Nursery schools Private providers

5. The National Learner's Records Database (NLRD)

One of the features of a quality system is the ability to manage and report information about the system accurately. The National Learners' Records Database (NLRD) is an electronic management information system to facilitate the management of the NQF and enable SAQA to report accurately on most aspects of the education and training system of South Africa.

6. Unit Standards and Qualifications

A unit standard is a statement, registered by SAQA, of specific education and training outcomes and the assessment criteria. A qualification is a combination of learning outcomes that have a defined purpose.

Learners are found Competent or Not Yet Competent against the Specific Outcomes.

7. Credits

A credit is a value assigned to a unit standard. One credit equals 10 hours of notional learning time required to master the capability described in a unit standard.

8. Career Guidance

A flagship project of the Ministry of Higher Education and Training is a multi-channel career development and advice service structured to particularly benefit youth especially those in poor and deep rural areas of the country. SAQA has been instrumental in realising this vision through the 'NQF and Career Advice Helpline' which constitutes one component of the service that can be accessed by phone, SMS, website, email, letter, or in person. This initiative exploits the influence of diverse media to provide career guidance and advice. Media includes newspapers, radio and the dynamic and ever-expanding social network platforms such as Facebook and Twitter. Intermediaries help to provide a network of career advisers. The service targets students, workers, the unemployed, people with disabilities, and the informal sector. Through the service SAQA provides advice to the public for informed and sound career choices, as well as a way to manage their career paths effectively.

A website, www.careerhelp.org.za, targeted at learners, parents, school-leavers and others interested in careers, is populated with a wealth of valuable information on learning options, skills in demand and financing of studies.

Under the Khetha campaign banner, SAQA broadcasts career guidance advice across the SABC airwaves in nine official South African languages. With the slogan 'Make the right choice.

Decide your future', the programmes comprise in-depth discussions on various careers and advice on school subject choice, available qualifications and sources of funding. SAQA endeavours seriously to reach the marginalised and deep rural communities.

Career guidance and advice constitutes an integral part of any education and training system. In South Africa a public service of this nature does not exist. SAQA, with the Department of Higher Education and Training, has taken the initiative to realise this vision.

9. Recognition of prior learning

In a country such as South Africa, where many people never had the opportunity to study as a result of repressive laws, there is a great need to now provide opportunities to obtain formal recognition for learning that took place in non-formal and informal environments.

To this end SAQA has championed the implementation of the recognition of prior learning (RPL) as part of the development of the NQF. In this regard both policy and guidelines were developed to support providers to establish RPL capacity.

Between 2006 and 2008 SAQA collaborated with the OECD as part of an international study to determine the effectiveness and extent of RPL practices across 22 countries. The study showed that while South Africa had made progress in this area, such progress was limited to 'islands of good practice'. The exercise gave SAQA the opportunity to benchmark South African RPL practices against those of counterparts in countries such as Australia, Canada, Denmark, the United Kingdom, Mexico and Austria.

More recently SAQA has undertaken a number of RPL-related initiatives, including hosting a national RPL conference in 2010, and a long-term research project that is considering RPL as a specialised pedagogy. An RPL Working Document was developed during the 2010 conference and now forms an important reference point for further actions to be taken by SAQA and other role-players.

Taking RPL to scale is a key challenge in South Africa (as it is in many other countries). SAQA is committed to taking on this challenge and will be working closely with a Ministerial RPL Task Team during 2012.

10. Evaluation of foreign qualifications

SAQA's work touches not only the citizens of South Africa, but also the increasing number of people that enter or return to South Africa in the hope of jobs and brighter prospects for their families. They are assisted to have qualifications obtained outside the Republic of South Africa evaluated, as a first step towards securing employment. The service extends to South Africans that studied abroad and foreign professionals wishing to settle in South Africa.

SAQA compares foreign qualifications with local qualifications registered on the NQF and then offers advice on the corresponding level of the foreign qualification. This information is used by the applicants to apply for work permits as well as for further study.

In this area SAQA evaluates qualifications originating from more than 100 countries on five continents and across a wide spectrum of disciplines, from arts and culture to engineering and technology. At present SAQA receives more than 20,000 applications per year.

An online application system enables access from outside of South Africa and is currently utilised by close to 40% of applicants. SAQA also contributes to the global network of credential evaluation agencies, in particular with regard to the location of the service within the NQF environment in South Africa.

Notes:

Module 7 - Workplace Safety Practices

PART 1 – HOUSEKEEPING

1. General

Efficient production and a good working environment are complementary. The elimination of inefficiencies and accident hazards caused by unfavourable conditions in and about the workplace is essential in getting the job done properly and safely.

The attention to these important details—which may be overlooked when management's attention is concentrated upon such amenities as good cloakrooms, canteens, rest rooms, recreational facilities, etc. is widely referred to as "good housekeeping".

Good housekeeping involves every phase of industrial operations and should apply throughout the entire premises, indoors and out. It is more than mere cleanliness. It requires orderly conditions, the avoidance of congestion, and attention to such details as an orderly layout of the whole workplace, the marking of aisles, adequate storage arrangements, and suitable provision for cleaning and maintenance.

2. Purpose for workplace housekeeping

A clean, well-ordered, attractive work environment sets the tone of your establishment. It encourages tidy work habits in employees. It helps reduce fatigue. It promotes good worker-management relations. It also gives a lift to morale, which is reflected in the quality of production and overall efficiency.

Good housekeeping is also a good advertisement for your company. Customers and clients have more confidence in an organisation when they we work being carried out efficiently in clean, pleasant, well-ordered surroundings.

There's an even more important reason why good housekeeping matters — it makes the undertaking a safer place to work in.

3. Eliminate accidents through good housekeeping

Good housekeeping is a vital factor in preventing accidents. The great majority of all work accidents are caused during the handling of goods or materials, and by people falling, being hit by falling objects, or striking against objects in the workplace. All these causes can be reduced by good housekeeping practices—in fact, good housekeeping is the only cure for hundreds of accidents that occur.

Here are some kinds of accidents commonly caused by *bad* housekeeping:

- Tripping over loose objects on floors, stairs and platforms;
- Articles dropping from above;
- Slipping on greasy, wet or dirty surfaces;
- Striking against projecting, poorly stacked, or misplaced material;
- Tearing the hands or other parts of the body on projecting nails, wire, steel strapping on bales or crates, etc.

Typical examples of poor housekeeping that lead to these accidents are:

- Excessive material, waste or chips in the working area;
- Congested aisles;
- Tools left on machines;
- Waste containers overflowing;
- Lockers and workrooms in disorder;
- Acids in open containers;
- Broken glass;
- Electric leads or air lines across aisles;
- Dirty light fittings, windows and skylights.

Where housekeeping is bad, fire is a constant threat and can be caused by many housekeeping problems such as:

- oil-soaked rags and clothing igniting from spontaneous combustion;
- dust collectors not being properly or frequently cleaned; or
- piles of paper and other packing materials being allowed to accumulate.

Poor housekeeping can also lead to infestation by pests such as rodents and cockroaches and create serious health risks.

4. Elements of a good housekeeping campaign

The following are the basic elements of a good housekeeping campaign that need attention:

4.1 Aisles

Wide enough for traffic movements, marked off by floor lines from work positions and storage areas.

4.2 Space

Sufficient room for the individual to work.

4.3 Storage

Adequate and convenient space for materials and tools.

4.4 Materials Handling

Layout planned for materials flow, with efficient methods and equipment.

4.5 Ventilation

Good general ventilation plus local exhaust ventilation to remove air contaminants at the source.

4.6 **Floors** and **Walls**

Of construction and materials that are easy to keep clean and in good repair.

4.7 Lighting

Well-distributed artificial light and effective use of available daylight.

4.8 Amenities

Clean, up-to-date washrooms and lockers for clothing. A clean, inviting lunch room for employees to eat their meals.

4.9 Waste Removal

Adequate facilities to prevent congestion and disorder. Let us look at some of these elements in detail.

KEEP AISLES CLEAR: Aisle space should be reserved for the movement of personnel, products and materials. It should be kept clean and clear and should never be used for “bottleneck” or “overflow’ ’storage. This also applies to passageways and emergency exits. Blind corners should be eliminated or be adequately protected by warning signs.

Aisle boundary markings should be drawn to show clearly the space which has been reserved for traffic.

Markings should be sufficiently wide (say a minimum of 30 mm) and of a colour to make them clearly visible. Paint or durable plastic strips can be used.

IMPROVE STORAGE FACILITIES: Tidiness and order are essential in overcoming storage problems, both in storerooms and in the yard. Good storage utilises air space instead of floor space, and also saves time-wasting delays. It’s important to prevent stores and scraps accumulating on the floor and around machines. Never keep more stores and materials than necessary near machines and provide proper facilities (such as bins, shelves, boxes, racks, etc.) in which to store them.

KEEP FLOORS CLEAN: Every year thousands of work injuries are caused by people falling. Floor conditions are responsible for many of these accidents. When floors are given the right treatment, they are much easier to keep clean and hygienic.

Spilt oil and other liquids should be cleaned up at once. Chips, shavings, dust, and similar wastes should never be allowed to accumulate. They should be removed frequently, or better still, be suitably trapped before they reach the floor.

PAINT THE WALLS: Paint is one of the cheapest means of renovating walls, and a fresh coat of paint can give a boost to morale. Light-coloured walls reflect light. Dirty or dark-coloured walls absorb light.

Dirty walls have a depressing effect and encourage dirty habits and sloppy attitudes. Choose suitable colours to paint walls, ceilings and working surfaces.

See that the paintwork is cleaned down periodically.

Colour can be harnessed to assist with safety. For example, it can be used to warn of physical hazards and to mark obstructions such as pillars. Painting handrails, machine guards and other safety equipment renders them distinctive and also prevents rust. Colour can be used to highlight the hazardous parts of machinery but it can never substitute for a needed guard.

MAINTAIN THE LIGHT FITTINGS: Attention to light fittings should be an integral part of any good housekeeping programme. Dirty lamps and shades, and lamps whose output has deteriorated with use, deprive employees of essential light.

It’s been found that lighting efficiency may be improved by 20 to 30percent simply by cleaning the lamps and reflectors.

CLEAN THE WINDOWS: Clean windows let in natural light; dirty ones keep it out. Insufficient light causes eyestrain and leads to accidents because employees are unable to see properly.

Ensure that windows are not blocked by stacked materials, equipment or articles on the ledges.

DISPOSE OF SCRAP AND PREVENT SPILLAGE: It's a common practice to let the floor catch all the waste and then spend time and energy cleaning it up. It is obviously better to provide convenient containers for scrap and waste and educate employees to use them. Safety will benefit, expense will be saved, and the factory will be a better place in which to work.

Oily floors are a common accident and fire hazard. Splash guards and drip pans should be installed wherever oil spills or drips may occur. Prevent accidents by keeping oil and grease off the floor.

GET RID OF DUST AND DIRT: In some jobs, dust, dirt, chips, etc., are unavoidable. If they can't be collected as part of the process (e.g., by enclosure and exhaust methods) you need a way to clean them up. Vacuum cleaners are suitable for removing light dust and dirt. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery, and other hard-to-reach places where dust and dirt collect.

If light dust is removed by sweeping, floors should be dampened first rather than swept dry. Oiling floors occasionally with a light oil helps to lay the dust but take care that slipping hazards do not occur.

Remember, it is not only floors that need sweeping. Dust and grime also collect on ledges, shelves, piping, conduits, lamps, reflectors, windows, cupboards, lockers, and so on—and all these places need regular cleaning.

MAINTAIN A HIGH STANDARD IN MEAL ROOMS, REST ROOMS, ETC: No housekeeping programme should ignore the facilities provided for meals, rest and sanitation, where cleanliness is essential for walls, floors, and fixtures.

A light-coloured paint can work wonders in these places and set a standard to which employees will try to conform. Soap and towels should be renewed regularly and wash basins properly cleaned.

KEEP TOOLS TIDY: Tool housekeeping is very important, whether in the tool room, on the rack, out in the yard, or on the bench. Suitable fixtures for tools are required to provide orderly arrangement, both in the tool room and near the work bench, and a regular system of inspecting, cleaning, and repairing is an essential part of any programme.

LOOK AFTER YOUR FIRST AID EQUIPMENT: First aid facilities and equipment should be kept under spotlessly clean conditions and fully stocked so that they are always ready in the event of accidents or illness.

INSPECT FIRE EQUIPMENT: It is essential to ensure that all fire-fighting equipment such as extinguishers and fire hoses is regularly inspected and kept in good working order. Fire protection facilities — fire doors and exits, automatic alarms, etc.— should be in good working order. Doors and exits should always be kept clear of obstructions.

ATTEND REGULARLY TO MAINTENANCE: Perhaps the most important element of good housekeeping is the attention paid to maintenance of buildings and equipment. If something gets broken or damaged it should be replaced or fixed as quickly as possible (e.g., defective ladders, broken handrails, steps, etc.). Apart from the possibility of causing accidents, a workplace can take on a very neglected appearance if broken windows, damaged doors, defective plumbing, leaking gutters, broken floor surfaces and the like are allowed to remain in that condition. Employees may take the hint in a neglectful attitude to their jobs.

A good maintenance programme will make provision for the inspection, lubrication, upkeep and repair of tools, equipment, machines and processes.

ASSIGN RESPONSIBILITY FOR CLEANING: Where practicable, the cleaning of the workplace should be the responsibility of a special cleaning staff and not an additional job for employees engaged in production. Where this is not possible, adequate time during working hours should be allowed for cleaning up to be done. Responsibility should be clearly assigned as to who is to do the cleaning and what area is to be cleaned.

If this is not done, out-of-the-way places such as shelves, yards, small buildings, sheds, cellars, basements, and boiler rooms are overlooked until they get into a deplorable state.

PREPARE HOUSEKEEPING CHECK LISTS: A sound method to ensure that housekeeping is done is for management to prepare check lists to suit the requirements of the workplace. The following can serve as a guide for nearly all industries.

Check off your housekeeping programme against this checklist. Better still, make a more comprehensive list of your own.

BUILDINGS

- Walls clean.
- Windows clean.
- Walls free of unnecessary hangings.
- Proper light provided.
- Platforms in good condition.
- Stairs clean and well lit. Handrails and steps of sound construction and well maintained.

FLOORS

- Good floor surface.
- Kept clean and free of loose material. Clean in corners, behind radiators, along walls, and around pillars or columns.
- Free of oil, grease, etc.
- Operating floors, or work positions free of loose scrap, metal or other materials.
- Free of unnecessary articles.
- Bins provided for refuse.

AISLES

- Free of obstructions.
- Safe and free passage to fire-fighting equipment and fire exits.
- Safe and free access to work positions.
- Clearly defined.

MACHINERY AND EQUIPMENT

- Clean and free of unnecessary material.
- Free of unnecessary dripping of oil or grease.
- Area around machines clean and free of rags, paper, etc.
- Lockers and cupboards clean and free of unnecessary material both on top and inside.
- Benches and seats clean and in good condition.
- Drinking fountains clean.

- Toilet facilities clean and well ventilated.
- Proper guards provided and in good condition.
- First-aid facilities and equipment fully stocked and in clean condition.

STOCK AND MATERIAL

- Properly piled and arranged
- Kept in storage areas.

TOOLS

- Properly arranged in place.
- Free of oil and grease.
- Inspected and maintained in good order.
- Tool rooms and racks in clean and orderly condition.

GROUNDS

- Yard and building surrounds free of refuse such as fruit peelings, scrap, wood, Iron, etc.
- Grounds kept free of weeds and overgrown vegetation.
- Wastes and refuse removed frequently.

5. Planning a good housekeeping program

A good housekeeping program plans and manages the orderly storage and movement of materials from point of entry to exit. It includes a material flow plan to ensure minimal handling. The plan also ensures that work areas are not used as storage areas by having workers move materials to and from work areas as needed. Part of the plan could include investing in extra bins and more frequent disposal.

The costs of this investment could be offset by the elimination of repeated handling of the same material and more effective use of the workers' time. Often, ineffective or insufficient storage planning results in materials being handled and stored in hazardous ways. Knowing the plant layout and the movement of materials throughout the workplace can help plan work procedures.

Worker training is an essential part of any good housekeeping program. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet – Slippery Floor") and reporting any unusual conditions.

Housekeeping order is "maintained" not "achieved." Cleaning and organisation must be done regularly, not just at the end of the shift. Integrating housekeeping into jobs can help ensure this is done. A good housekeeping program identifies and assigns responsibilities for the following:

- clean-up during the shift;
- day-to-day clean-up;
- waste disposal;
- removal of unused and scrap materials;
- inspection to ensure clean-up is complete.

Do not forget out-of-the-way places such as shelves, basements, sheds, and boiler rooms that would otherwise be overlooked. The orderly arrangement of operations, tools, equipment and supplies is an important part of a good housekeeping program.

The final element of any housekeeping program is inspection. It is the only way to check for deficiencies in the program so that changes can be made. The documents on workplace inspection checklists provide a general guide and examples of checklists for inspecting offices and manufacturing facilities.

PART 2 - STACKING AND STORAGE

1. Stacking and storage practices

Stacking refers to the process of packing material on top of each other with the intention of storing the material. The following practices should be stick to with regards to stacking:

a) materials shall be stacked on stable and level areas capable of handling the weight of the items being stacked;
b) for vibration protection, unsupported material shall not be stacked above six feet unless properly designed supports are used;
c) the total height of any unsupported stack should not exceed three times the narrowest base dimension;
d) the maximum weight of any stack shall be determined by the ability of the lower items to support the weight of the items above;
e) tiers of stacked materials shall be stepped back half the depth of a single article every fifth tier unless positive support is supplied;
f) unless positively supported, tiers shall be stacked so that items are locked together (care must be taken to ensure that comers are securely bonded);

g) adjacent stacks shall not lean against each other for support (for this reason, space should be left between stacks);
h) walkways and aisles shall be provided and kept free of obstructions;
i) supplies shall not be stacked or stored in a condition which creates a tripping hazard;
j) when stacks are located next to walkways, roadways, etc. where vehicles are used, precautions shall be taken to ensure that collisions will not jeopardize the stability of the stack;
k) no materials shall be stacked in such a way as to obstruct firefighting equipment, lighting, electrical panels, or ventilation;
l) stacking and reclamation of materials from stacks shall be carried out only by people task trained in the correct procedures;
m) any unsafe condition involving stacks shall be corrected immediately (this shall be accomplished by task-trained personnel);
n) climbing on stacked materials is strictly prohibited;
o) material or equipment shall not be stacked within two metres of any railroad track and not stacked to obscure the views of personnel operating or directing rail-mounted vehicles;
p) circular items, such as pipe, shall be stored in suitably designed racks or must be chocked with proper chocks designed for the purpose; and
q) pallets used for stacking shall be in good condition (those doing the stacking are responsible for ensuring pallet quality).

2. Storage Practices

Storage practices refers to storing items for an extend period of time. The following should be adhered to:

a) storage of items shall be neat and tidy;
b) storage must provide safe, easy access for people and equipment;
c) aisles, loading, and unloading areas shall be clearly marked by a 50mm wide yellow safety border;
d) all items stored shall be clearly labelled with labelling information such as safety hazard warnings, if any (Example: "DANGER - ACID - CORROSIVE");
e) shelves shall not be overloaded;
f) when the height of storage shelves exceeds four times the depth, it shall be attached to the building and bolted to the floor and racks bolted to each other;

g) when small storage bins are placed on shelves, the shelve must have an outer lip to keep bins from falling;

h) heavy items shall be stored at the lowest possible level;

i) ladders shall be provided for access to shelves above 2 meters in height;

j) climbing on shelves for any reason is prohibited;

k) chemical substances, including concentrated acids and alkalis, shall be stored to prevent inadvertent contact with each other or with other substances;

l) items must be stored away from fences to protect fencing when moving material and to enhance plant security;

m) gas cylinders must be secured in an upright position with valves protected by covers (storage facilities for gas cylinders must comply with applicable safety standards);

n) electrical rooms shall not be used as storage areas;

o) storage of liquid material in tanks and storage of hazardous substances shall be approved by the Environmental Department; and

p) storage of flammable products must be accomplished in approved containers and cabinets.

3. Stacking of sawn timber

This discussion contains practical guidance on safe stacking and storage of sawn timber and board materials and does not deal with stacking on vehicles or stacking of round timber (logs).

3.1 Stack stability factors

Consider the following as part of your risk assessment:

3.1.1 Ground and environmental conditions

a) Prepare the ground carefully where stacks are to be assembled. It should be flat and even with a slope of no more than 2°, ideally with a top surface of asphalt, tarmac or concrete. It must be well maintained with no potholes.

b) The ground should be strong enough to withstand the load of both stacks and machinery, be well consolidated, and its stability should not be affected by weather conditions such as heavy rain. Good drainage must be provided.

c) Clear any obstacles such as waste timber or unused bearers from the stacking area as they may make stacks unstable.

d) Stacks which are outside may be affected by wind. Where possible, construct them so a small cross section is facing the prevailing wind direction. Check external stacks after high winds. Securely attach any protective sheeting.

3.1.2 Bearers

Bearers are used to support packs of timber, keeping them off the ground and allowing space for fork-lift trucks to lift the pack. They also support the timber within the pack.

a) Select bearers carefully. Ideally, they should be straight and identical in length and cross-section (preferably square). If they are rectangular in section, they are most stable when the long edge is placed horizontal.

b) The length of the bearer should be equal to the width of the pack. If it is too long, they protrude and encourage climbing of the stack, or can be easily struck by passing vehicles. Short or offset bearers do not fully support the pack above and increase the load on banding.

c) Bearers should be in good condition and should be destroyed if rotten, damaged or split. They should be made of a material strong enough to withstand the environment where the stack is constructed.

d) Position bearers carefully to prevent timber in the supported pack from sagging and to avoid offsets in the stack. Figure 8 shows the effect of a short or offset bearer. The tip line of the stack moves inwards from the edge since part of the width of the stack is not supported. The schematic in Figure 1 shows the movement of the tip line and tip point due to a short or offset bearer.

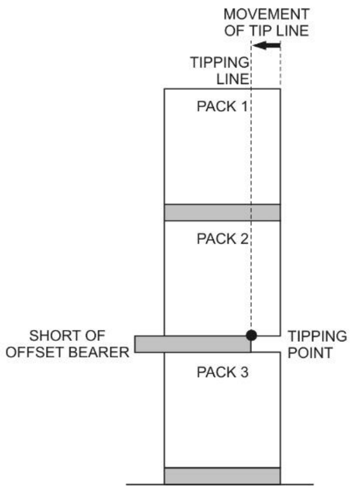


FIGURE 8: SCHEMATIC SHOWING THE MOVEMENT OF THE TIP LINE AND TIP POINT DUE TO A SHORT OR OFFSET BEARER

e) The same problem occurs if bearers are placed to run the length of the pack as shown in Figure 9. In this case the supported width of the pack is from the outside edge to outside edge of the bearers and the stack is less likely to be stable.

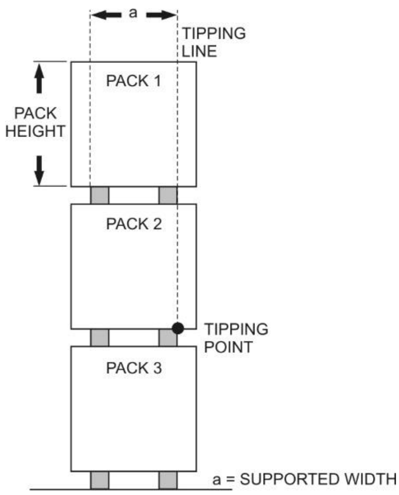


FIGURE 9: SUPPORTED WIDTH

3.1.3 Banding

Before banding look at the requirements of the band and what will happen to the banded pack. Consider whether the timber is likely to expand or contract due to the surrounding storage conditions or treatment (i.e., timber with a high moisture content will shrink and the banding may come loose and need to be reapplied).

a) Select a banding material that is suitable for the demands to which it will be subjected. For example, 12mm wide polypropylene banding should **not** be used to band timber packs with cross-sections of greater than 0.5 m^2 and masses greater than 400kg. Use polyester or steel instead.

b) To ensure that a tight and secure pack is achieved, assemble packs carefully by minimising the space between timbers.

c) Take care when applying bands. Apply them squarely (i.e., parallel to the plane of the end face) close to columns of sticks within the pack. They should be tight to the face of the pack and not be applied over the ends of protruding sticks or bearers. Banding fasteners also need to be suitable for the pack and banding material.

d) Wear eye protection when banding is being removed. When cutting tensioned metal banding, use safety cutters.

e) Periodic inspection will highlight deficiencies in the banding, for example, loose bands and loss of pack shape. If problems are detected, the packs concerned should be re-banded or the banding re-tensioned. If the same problems occur on a regular basis, the type of banding being used should be reviewed, for example, a stronger band may be needed or a different type of fastener.

3.1.4 Pack characteristics

Individual packs of sawn timber are the building blocks of the stack. Generally, good packs make good stacks.

a) Where possible the timber in the pack should all be of the same cross-section and length. Do not leave timber protruding from the end faces of the pack for the purpose of climbing the stack.

b) Out-of-square or lozenge-shaped packs affect the stability of the stack and cause an increase in tension in the banding material. Figure 10 shows how a lozenge pack shifts the centre of gravity of packs above.

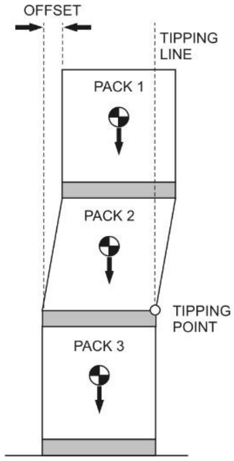


FIGURE 10: THE EFFECT OF OUT-OF-SHAPE PACKS ON STABILITY – LOZENGE PACKS

Packs can also ball or roll (Figure 11), moving the tipping line inwards. This has the effect of reducing the width of the pack (i.e., only part of the width of the pack is supported). This makes the stack far less stable.

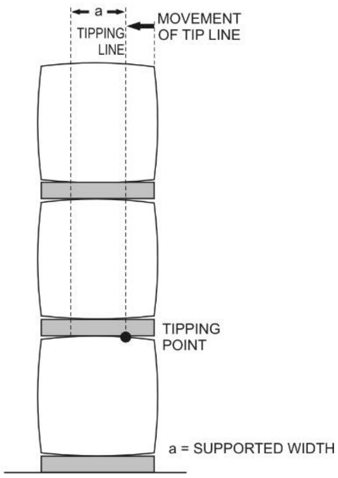


FIGURE 11: EFFECT OF OUT-OF-SHAPE PACKS – BALLED PACKS

Do not stack collapsed or partially collapsed packs or transport them off site. If identified in a stack, remove and rectify them using an established safe system of work.

Keep the tops of packs level which will help to form a vertical stack. If the top row is not complete, any bearer placed on top should be flat and supported by timbers placed at the edge of the pack.

Separating sticks (dunnage) can be beneficial within the pack, helping to form a tight square pack and preventing balling or rolling. Like bearers, stick length should equal pack width. Sticks may increase the tendency for the pack to lozenge and this should be monitored.

3.1.5 Stack height and stacking practices

In an indoor environment, the maximum height of the stack should not be more than four times the shortest width of the pack (i.e., a ratio of 4:1). Outside where wind may affect the stack, the ratio should be reduced to 3:1.

These ratios are general guidelines - the actual stacking height should be determined after considering the results of your risk assessment. For example, where there is a risk of vehicle striking against the stack, the stack is on a slope of more than 2°, or there is frequent public access, then the ratios should be reduced to 3:1 indoors and 2:1 outside. However, if these and other risks are absent (e.g., in a tightly packed kiln or outside on level concrete in a sheltered area) these ratios may be increased.

Short or offset bearers, and balled or rolled packs, may result in the supported width of the stack being less than it appears and the stack height should be reduced.

4. Safe Working Practices

4.1 Un-stacking

Before un-stacking, examine the stack to see how it was constructed and to check for signs of instability or faults such as broken bands, bearers or sticks, and pack balling. It is important to identify any packs which are bridging other stacks or packs.

Take down packs tier by tier. Move only one at a time. Do not leave isolated single stacks. Do not remove individual pieces of timber from packs until they are on the ground and the working area is safe.

If you need access to the top of the stack, use a mobile elevating work platform, suitable work platform on a fork-lift truck or secured ladder. It should not be necessary to work at height directly on top of the stack. If such work has to be done then it must be strictly controlled and only done when all other options are not reasonably practicable.

4.2 Stacking timber and board material

Position centres of gravity of stacked packs directly above one another. Packs should not be offset so they protrude from the stack.

Consider the size and shape of packs before stacking. Place smaller/lighter packs on top of larger/heavier packs. Packs should not bridge across two stacks or across other packs. Do not allow loose material on top of stacks.

Stacks should not lean against or be supported by other stacks.

If fork-lift truck or side-loader forks protrude beyond the load being lifted, they may strike packs behind. If this may happen, take steps to exclude people from all areas at risk from falling material.

Ideally, store boards and similar flat articles (i.e., doors or windows) flat on a level surface. Use suitable pallets, wood or chipboard battens, or a purpose-built racking system.

Never stack boards on edge without adequate support as they can tip out of control from a vertical position. It is common for boards that have just been delivered, and propped up temporarily, to topple before they are moved to the storage area. Staff, especially those receiving deliveries, should be told about the dangers of propping boards without support, and erecting warning signs in the delivery area may help.

An alternative to storing the materials flat is the 'pigeon hole' or 'toast rack' system (Figure 12). Boards are stored in compartments preventing sideways movement and allowing the removal of individual boards.

Fix racking securely to the floor, mark it with maximum load information and regularly check it for damage. Protect exposed comers at the ends of aisles with, for example, bollards or stanchions.

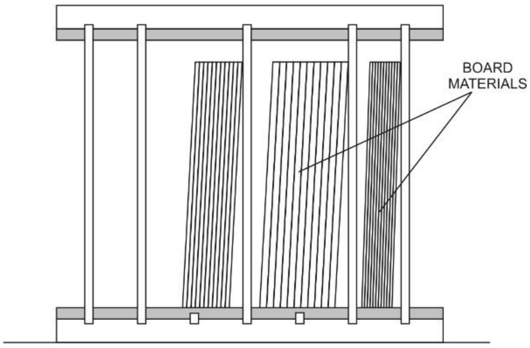


FIGURE 12: PIGEON HOLE STACKING

4.3 Public protection

Where there is a risk of public access to the stacking area, provide appropriate fencing to keep out children and other unauthorised people.

5. Storage management

Your risk assessment should consider how fork-lift trucks and other vehicles operate in and around the storage area.

Arrange storage areas to give good visibility for pedestrians and vehicles. It may be necessary to position mirrors around the area or provide extra mirrors on vehicles to reduce blind spots. Pedestrians should use designated walkways, separate from vehicles where possible, and be excluded from active stacking areas. Stacking areas should have adequate lighting.

A one-way traffic system and speed restrictions may add to site safety.

Roadways or aisles should be clearly defined and strong enough to withstand the weight of loaded vehicles.

Make sure roads/aisles are maintained, i.e., repair pot holes. Fit reversing alarms to vehicles with restricted rear vision.

Stack condition should be regularly monitored by adequately trained staff that can identify stack faults.

6. Personal Protective Equipment

Hard hats, gloves and safety footwear will normally be required to protect employees. High-visibility clothing is required where there are frequent vehicle movements.

6.1 Safety All the Way

Every material handling operation is different. Each part of the construction industry must take care to ensure safety practices are in place at every stage of handling various materials.

Every worker and supervisor have a safety role to play in handling and storing materials. Good housekeeping, proper lifting and loading procedures, and proper packaging are all important.

7. Pallet safety

Use of pallets for loading and handling materials is extensive throughout the industry. Be sure the pallets you are using are in good condition. Cross piling and other safe loading techniques are required. Tie and secure any unstable loads and repack them if necessary.

Make sure you find out what type and size of pallets will be used on loads you expect to receive. They must be suitable for the type of equipment you use to unload the materials.

7.1 Planning Each Move for Safety

Materials should be moved only when necessary. When you plan to move, ship, or receive materials consider all parts of the operation:

a) How will it be transported?
b) Are the workers experienced enough?
c) Do you have enough workers to do the job right?
d) Is the vehicle operator skilled enough for the job at hand?
e) Is the package or load size appropriate?

7.2 Safety and Materials Handling Equipment

When you think about how to handle materials or place them in storage properly, think about equipment that can assist you. Whenever possible use:

a) trucks;
b) truck mounted cranes;
c) forklifts;
d) dollies;
e) carts;
f) wheelbarrows; and
g) hoists.

Save your back and increase job efficiency by using the right tool for the right job. When manual assistance is required at any stage, ensure that there are enough workers to share the work. By improving your handling procedures your safety record will improve.

7.3 Safe Stacking and Storage

Proper stacking and storage are an essential part of materials handling and good housekeeping no matter what kind of worksite you're at. When storing or stacking materials, check if:

a) stacks are restricting access;
b) they interfere with visibility;
c) they are stable and secured;
d) they are too high (do they pose a danger of toppling over);
e) there is a danger of contact with power lines;
f) single packages or items in a pile will drop from the top if it is bumped at a lower level;
g) barrels and bags - has removal of any items created instability?
h) there is safe working space for workers, pallet jacks, forklifts, or trucks; and
i) there is any fire risk -keep flammables away from potential ignition sources.

7.4 Safety while in Transport

Many accidents and mishaps occur during transport of materials. The following should be checked:

a) if the speed limit is being observed;
b) if the load is balanced and loaded properly; and
c) if the vehicle used is for its designed purpose.

On arrival, check for any spillage or leakage. Check to see that hazardous materials are properly labelled. A Material Safety Data Sheet (MSDS) must be readily available.

7.5 Home Storage Safety

Using proper and efficient storage techniques at home will reduce chances of back injuries while at the same time easing your "home workload".

As at work, use wall brackets, shelving and other storage systems in order to put materials at the correct height. This will reduce bending, stretching, or twisting to get at something.

When you lift materials, always bend your knees and transfer more of the weight of the package to your leg muscles. This will reduce the strain on your back. When lifting and storing groceries, you and family members should take care to share the work, move carefully and take your time. Many injuries and household accidents occur when the task is being hurried.

For major jobs around the home, or while doing outside jobs such as building a garage, rent or hire equipment that will ease the workload. Keep children away and make sure the operator has safety in mind.

For lighter jobs, use tools that may help including dollies, wheelbarrows, ropes, or belts. For example, don't move that filing cabinet down the stairs unless you have helpers and/or the right equipment.

Whatever the task, don't let your family see you doing it the wrong way. Remember, you know the rules best - so bring your safety attitude home with you from work.

7.6 A Good Safety Record

Manual material handling accidents and falls are frequent and claims in this area are high. Improved materials handling leads to better productivity and a good safety record. Don't let equipment accidents ruin your record. For example, don't exceed the recommended load limits of vehicles used in handling materials. Make sure that all vehicle operators in your area follow the regulations and operating procedures required. By improving materials handling and storage, we can improve our safety record too.

PART 3 - COLOUR CODING

1. Pipe colour coding

Identification and colour coding for the pipelines is essential to avoid potential hazards, accidents. Giving a colour code and maintaining the uniformity for colour coding in industrial piping will eliminate accidental chances, reduces operational errors. Moreover, it enhances the safety aspects.

The use of colour codes is subject to the following requirements:

1.1 Uniform colour codes applied throughout

All colour codes in the plant should be standardised to reflect the same meaning throughout. If the pipelines for drinking water in the workshop are bottle green with a blue band, the same colour should be used for drinking water in other parts of the plant. This method diminishes the risk of workers getting confused while moving about the plant.

1.2 Colour code boards posted prominently

Display boards, explaining the colour codes used in the plant in simple terms, should be placed in prominent places and in such a way that workers have free access to it. Only the colours used in a particular area of a plant should be displayed in that area. At strategic points of the terrain there should be a complete board with all the colours used in the plant and all new workers should be introduced to the various colour codes on the board during their induction programme.

1.3 Knowledge of colours

It is unrealistic to expect workers to know and to remember all the colours on the colour code board. Workers should know, however, that different colours have different meanings and if there is any doubt, know where to go to find out what the meaning of the colours is. Important colours should be learnt and understood.

1.4 Maintenance of colours

Colours used should be clearly recognisable. As soon as colours begin to fade as a result of exposure, the colours should be renewed. Colours on high pipelines can easily be obliterated by dust and a cleaning programme for pipelines should be implemented.

It is the responsibility of the health and safety representatives to determine, during inspection, whether the colours are visible, clearly recognisable and understood.

1.5 Company's own colours are acceptable

A company may use its own colours and is not obliged to use the SABS colour codes. If a company uses its own-colour codes, the user should make sure that it complies with the requirements set out above.

1.6 Identification colour marks on pipelines

The labour force may represent a variety of cultures and the need may arise for a form of communication that is not bound by language. (A labour force without a common language increases the need for the standardisation of a system that does not require words, but should still be able to transfer information and warnings.)

The use of colour codes (identifying colour marks) as an aid to quick recognition and/or as a warning against risks, makes a valuable contribution to the prevention of incidents. Established systems need not be replaced by this system, but should be used in conjunction with the system, to its advantage. The number of identifying colour marks in the field of vision of the worker should, however, be controlled to eliminate confusion.

Workers should be trained in the meaning of the colour codes and should at least be able to interpret colour boards.

1.7 Definition of terms

a) ***Ground-colour:*** a colour used to identify the basic nature of the contents of pipelines.

b) ***Colour code-indicator:*** a colour or combination of two (at the most three) used to identify the specific nature of the contents of a pipeline.

c) ***Description code-indicator:*** a description in the shape of a chemical formula or symbol, or words that are used (or in the place of or supplementary to a colour code-indicator) to identify the specific contents of a pipeline.

1.8 Application of identifying colour marks

Apply colours according to one of the following methods:

a) paint over the full length of the pipeline;

b) paint in strips of at least 150 cm wide, which are clearly visible from the working levels. Wrap adhesive tape of at least 150 cm wide around the pipe instead of paint bands; and

c) every valve in the pipeline should be painted in the ground-colour.

1.9 Colour code indicators

Colour code indicators should be applied, according to one of the following methods, in strips of 150 cm:

a) in the case of a pipe painted with the ground-colour over its entire length (apply over the ground-colour);

b) apply between strips of ground-colour; and

c) wrap adhesive tape around pipeline instead of the above method.

1.10 Description code-indicators

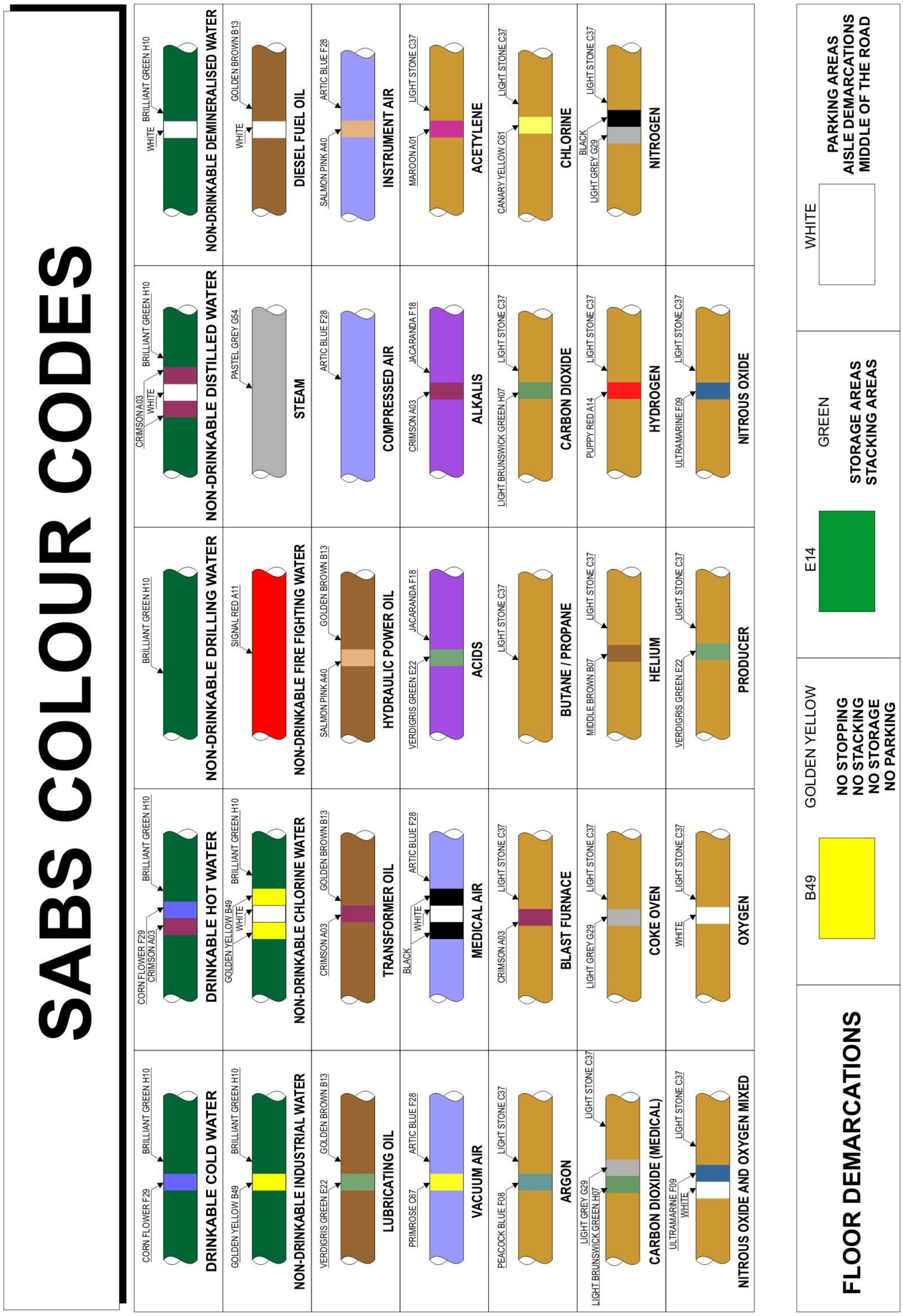
If the diameter of the pipeline is too small to make the colour code indicator possible, the indicator should be applied to a plaque (or some similar surface) and firmly fixed to the pipeline.

1.11 Pipe lines with hazardous contents

If there are any risks attached to the contents of pipe lines, e.g., toxicity, corroding, radioactive or high pressure, the ground-colour plus the colour code indicator or a descriptive code-indicator or both should be applied, apart from the appropriate special warning identification in the shape of a 150 mm (minimum) bright yellow strip with diagonal black lines, or, in the case of contents where ionising rays are present, a black three-point leaf pattern.

1.12 Placing of identification marks

Unless only a ground-colour is applied, identification marks should be placed at all connections, service equipment, points of entry into walls, on all sides of valves and at any other place where identification is deemed necessary. Place a descriptive code indicator, which is used with a colour code-indicator, next to the latter. If the pipeline is above the field of vision, the visibility of the descriptive code-indicator should be ensured by placing it so that maximum legibility is provided from the working level.


SABS COLOUR CODES
CORN FLOWER F29
BRILLIANT GREEN H10
DRINKABLE COLD WATER
CORN FLOWER F29
CRIMSON A03
BRILLIANT GREEN H10
DRINKABLE HOT WATER
BRILLIANT GREEN H10
NON-DRINKABLE DRILLING WATER
CRIMSON A03
WHITE
BRILLIANT GREEN H10
NON-DRINKABLE DISTILLED WATER
WHITE
BRILLIANT GREEN H10
NON-DRINKABLE DEMINERALISED WATER
GOLDEN YELLOW B49
BRILLIANT GREEN H10
NON-DRINKABLE INDUSTRIAL WATER
GOLDEN YELLOW B49
WHITE
BRILLIANT GREEN H10
NON-DRINKABLE CHLORINE WATER
SIGNAL RED A11
NON-DRINKABLE FIRE FIGHTING WATER
PASTEL GREY G54
STEAM
WHITE
GOLDEN BROWN B13
DIESEL FUEL OIL
VERDIGRIS GREEN E22
GOLDEN BROWN B13
LUBRICATING OIL
CRIMSON A03
GOLDEN BROWN B13
TRANSFORMER OIL
SALMON PINK A40
GOLDEN BROWN B13
HYDRAULIC POWER OIL
ARTIC BLUE F28
COMPRESSED AIR
SALMON PINK A40
ARTIC BLUE F28
INSTRUMENT AIR
PRIMROSE C67
ARTIC BLUE F28
VACUUM AIR
BLACK
WHITE
ARTIC BLUE F28
MEDICAL AIR
VERDIGRIS GREEN E22
JACARANDA F18
ACIDS
CRIMSON A03
JACARANDA F18
ALKALIS
MAROON A01
LIGHT STONE C37
ACETYLENE
PEACOCK BLUE F08
LIGHT STONE C37
ARGON
CRIMSON A03
LIGHT STONE C37
BLAST FURNACE
LIGHT STONE C37
BUTANE / PROPANE
LIGHT BRUNSWICK GREEN H07
LIGHT STONE C37
CARBON DIOXIDE
CANARY YELLOW C61
LIGHT STONE C37
CHLORINE
LIGHT GREY G29
LIGHT BRUNSWICK GREEN H07
LIGHT STONE C37
CARBON DIOXIDE (MEDICAL)
LIGHT GREY G29
LIGHT STONE C37
COKE OVEN
MIDDLE BROWN B07
LIGHT STONE C37
HELIUM
PUPPY RED A14
LIGHT STONE C37
HYDROGEN
BLACK
LIGHT GREY G29
LIGHT STONE C37
NITROGEN
ULTRAMARINE F09
WHITE
LIGHT STONE C37
NITROUS OXIDE AND OXYGEN MIXED
WHITE
LIGHT STONE C37
OXYGEN
VERDIGRIS GREEN E22
LIGHT STONE C37
PRODUCER
ULTRAMARINE F09
LIGHT STONE C37
NITROUS OXIDE
FLOOR DEMARCATIONS
B49
GOLDEN YELLOW
NO STOPPING
NO STACKING
NO STORAGE
NO PARKING
E14
GREEN
STORAGE AREAS
STACKING AREAS
WHITE
PARKING AREAS
AISLE DEMARCATIONS
MIDDLE OF THE ROAD

1.13 Demarcation with the aid of colours

Demarcation with colour codes is used only because there is a need to distinguish between certain areas of a plant. During the implementation of such demarcation lines, the person responsible for the planning of this should make a thorough study of what is to be attained and how the demarcation will affect the flow of personnel and material.

The requirements for colour codes on the floors are the same as for the general use of colour codes.

2. Demarcation of floors

The advantage of demarcation on floors becomes more and more evident every day and the advantages connected with it are numerous. This method saves costs as a relatively cheap method is used instead of expensive dividing material. No unnecessary obstruction is formed and the criteria for good planning are complied with.

The demarcation of floors is done by e.g., marking the walking areas in a passage with a predetermined colour. The same method could be employed for the demarcation of machines, working, stacking and keep-clear areas.

Demarcation should be adhered to, otherwise it serves no purpose. Supervisors as well as health and safety representatives should ensure that workers adhere to demarcation.

2.1 Demarcation under equipment

The purpose of demarcation under equipment is to ensure that such equipment is always accessible.

Equipment referred to include firefighting equipment, electrical gear, alarms or any other equipment, which should be accessible in an emergency situation.

Two general guidelines are:

a) the demarcation under the various types of equipment mentioned above need not be different; and
b) there must be strict control over the keep-clear areas.

PART 4 - SYMBOLIC SIGNS

1. Safety Signs

A safety sign is one which gives a **specific message** to those who may be exposed to hazards in the work environment. They may be to **prevent accidents**, signify **health hazards**, indicate the location of **safety and fire protection** equipment, or for giving guidance and instruction in an **emergency**.

The most effective signs are **clear and consistent**, and use **diagrams** and **simple language**. Where there is a major language group other than English in the workplace, signs should be in bilingual form.

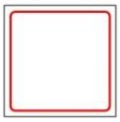
The meaning of all signs should be taught during induction, but the provision of safety signs does not replace or reduce the need for proper, ongoing prevention measures.

The purpose of symbolic safety signs, as with colour coding, is to convey a message without the use of a specific language. In this way instant recognition takes place or the worker can receive a message, order or warning. Furthermore, symbolic safety signs are designed so that language, ethnic group or literacy makes no difference. A good example that is used worldwide is the "stop" sign.

A symbolic safety sign consists of the following parts:

a) geometric shape;
b) pictogram (picture or writing); and
c) background colour.

Five different types of symbolic signs, each unique in colour and shape, are used for the various methods of recognition.

SIGN TYPE	GEOMETRIC SHAPE	BACKGROUND COLOUR
WARNING		YELLOW
PROHIBITORY		WHITE
MANDATORY		BLUE
GENERAL INFORMATORY		GREEN
FIRE FIGHTING INFORMATORY		WHITE

2. Symbolic safety sign positioning

Symbolic safety signs are put up according to the **needs** of the specific company. The **sizes** are determined by the **distance** from which it should be visible. Symbolic signs should be placed conspicuously and should always give the reader a message.

Workers should be trained in the interpretation of symbolic signs.

All signs as well as the explanation of the signs should be placed at all entrances to the plant. At the entrance to a particular workshop, only the signs applicable to that department should be displayed. If specific equipment requires the use of protective clothing, the appropriate sign should also be displayed at the equipment.

2.1 Notices

The purpose of notices is to convey a specific message to the labour force. Only the most recent information should be displayed on a notice board. Notices should be attractive and be kept that way. Writing and language used on the notice board should be simple and easy to read.

Another form of safety notices is safety posters. Safety posters should not have a double meaning and should convey the message in a simple way.

Posters should be rotated on a regular basis and the meaning of every poster should be explained to the workers. Colours used on the posters should be attractive in order to appeal to the passer-by and attract attention.

Notices should never be used as a substitute for verbal communication between the management and workers on any level, but should simply be regarded as an aid to convey certain messages.

PART 5 – HAND AND POWER TOOL SAFETY

1. Responsibilities

Environment, Health & Safety: EHS is normally responsible for reviewing hazards associated with hand and portable power tools during annual workshop inspections. The tools will be reviewed to make sure they are in good working order and suitable for the jobs they are used for and also that they do not pose a hazard to the operator. EHS is responsible for reviewing and updating the Hand & Portable Power Tools Policy. EHS & Supervisors also work jointly in the development of Job Safety Analysis for hand tools that present a unique hazard to the employee.

Supervisor & Employee: Supervisor led coaching is required upon employment for employees who operate hand and portable power tools. An excellent means of conducting this training is to develop a JSA that covers the pertinent information on how to properly and safely use these types of tools and equipment.

Select the Right Tool for the Job: Examples of unsafe practices are: Striking hardened faces of hand tools together (such as using a carpenter's hammer to strike another hammer, hatchet, or metal chisel), using a file for a pry, a wrench for a hammer, using a 'cheater', and pliers instead of the proper wrench.

Keep Tools in Good Working Condition: Wrenches with cracked work jaws, screw drivers with broken points or broken handles, hammers with loose heads, dull saws, and extension cords or electric tools with broken plugs, improper or removed grounding prongs, or split insulation are examples of tools in poor conditions. Tools that have deteriorated in this manner must be taken out of service.

Use Tools the Right Way: Screw drivers applied to objects held in the hand, knives pulled toward the body, and failure to ground electrical equipment are common causes of accidents.

Place/Keep/Store Tools in a Safe & Secure Place: Many accidents have been caused by tools falling from overhead and by knives, chisels, and other sharp tools carried in pockets or left in tool boxes with cutting edges exposed. Tools should be kept away from work bench edges

The following procedures are excellent workshop practices for Supervisors and Employees to follow in order to promote a safe working environment where hand and portable power tools are used:

a) Establish regular tool inspection procedures
b) provide good repair facilities to ensure that tools will be maintained in safe condition.
c) Establish a procedure for control of tools such as a check-out system at tool stores.
d) Provide proper storage facilities in the tool store and on the job.

The employer is responsible for the safe condition of tools and equipment used by employees, but the employees have the responsibility for properly using and maintaining tools.

Failure to observe safe work practices when using hand and portable power tools accounts for most hand and power tool accidents.

Supervisors must make a complete check of his/her operations to determine the need for special tools that will do the work more safely than ordinary tools. This can be completed by developing a Job Safety Analysis which can be used to identify the hazards associated with the job and the appropriate tools that should be used.

The tool room attendant should be qualified through training and experience to pass judgment on the condition of tools for continued use. Dull or damaged tools shall not be returned to stock.

Employees shall not continue the use of damaged tools if damage is noticed or damage occurs while the job is being done.

Proper maintenance and repair of tools requires adequate facilities, work benches, vises, a forge or furnace for hardening and tempering, tempering baths, safety goggles, repair tools, grinders, and good lighting. Employees specifically trained in the care of tools should be in charge of these facilities. If this service is not available, tools should be sent out for repairs.

2. Carrying tools

The employee must never carry tools that could interfere with the free use of both hands while on a ladder or while climbing a structure. A strong bag, bucket, or similar container must be used to hoist tools from the ground to the job level.

Tools are to be returned to ground level in the same manner. Employees should never carry tools down by hand, carry in pants/shirt pockets, or dropped tools to the ground.

Loose tools and tools laid inappropriately causes a substantial portion of hand tool injuries. Tools should not be left above areas where employees are moving or walking. This presents a falling object hazard.

Chisels, screwdrivers, and pointed tools shall never be carried in an employee's pocket. They are to be carried in a tool box/cart, a carrying belt (sharp/pointed end down) like those used by electricians and steel employees, a pocket tool pouch, or in the hand with points and cutting edges pointed away from the body.

Employees carrying tools on their shoulders should pay close attention to clearances when turning around. Tools should also be handled so that they will not strike other employees or pedestrians.

3. Personal Protective Equipment

Appropriate personal protective equipment (i.e.: safety glasses, face shields, safety goggles, gloves, etc.) should be worn to protect workers from hazards that may be encountered while using portable power tools and hand tools.

Employees that use hand and power tools and are exposed to the hazards of falling, flying, abrasive and splashing materials, or exposed to harmful dusts, fumes, vapors, or gases shall be provided with the specified personal protective equipment necessary to protect them from the hazard.

4. Proper use of Hand Tools

Hand tools are non-powered, which includes axes, wrenches, screw drivers, hammers, etc. The greatest hazards posed by hand tools results from misuse and improper maintenance.

Employee instruction/training programs shall provide detailed training in the proper use of hand tools for the specific area of operations in which they will be working in. Attention will be given to tool selection, tool use, and proper personal protective equipment that is required to be used when operating the specific tool as outlined in the following sections:

4.1 Metal-Cutting Hand Tools

4.1.1 Chisels

Factors determining the selection of cold chisels are the materials to be cut, the size and shape of the tool, and the depth of the cut to be made.

The chisel should be made heavy enough so that it will not buckle or spring when struck.

A chisel no larger than the material should be selected so that the blade is used rather than the point or corner. Also, a hammer heavy enough to do the job should be used.

Employees are required to wear safety goggles when using a chisel and should set up a shield or screen to prevent injury to other employees from flying chips. If a shield does not give protection to all exposed employees, then all employees in the work area are required to wear glasses with side protection.

4.1.2 Taps and Dies

Tap and die work pieces should be firmly mounted in a bench vise.

Only a T-handle wrench or adjustable tap wrench should be used.

When threads are being cut with a hand die, hands and arms should be kept clear of the sharp threads coming through the die, and metal cuttings should be cleared away with a brush.

4.1.3 Hack Saws

Hacksaws should be adjusted in the frame to prevent buckling and breaking, but should not be tight enough to break off the pins that holds the blade.

Install blade with teeth pointing forward.

Pressure should be applied on the forward stroke not on the back stroke.

If the blade is twisted or too much pressure is applied, the blade may break and cause injury to the hands or arms of the user.

4.1.4 Files

Selection of the correct type of file for the job will prevent injuries and lengthen the life of the file.

The file should never be cleaned by being struck against a vise or other metal object due to file chips becoming possible flying debris.

A file-cleaning card or brush should be used.

A file is not to be hammered or used as a pry. Use of a file in this manner frequently results in the file chipping or breaking causing injury to the user.

A file should not be used as a center punch, chisel, or any other type of tool because the hardened steel may fracture and cause serious injury.

Under some conditions, a clamp-on raised offset handle may be useful to give extra clearance for the hands.

Files are not to be used on lathe stock turning at high speed (faster than three turns per file stroke) because the end of the file may strike the chuck, dog, or face plate and throw the file (or metal chip) back at the operator hard enough to inflict serious injury.

4.1.5 Tin/Sheet Metal Snips

Tin snips should be heavy enough to cut the material so easily that the employee needs only one hand on the snips and can use the other to hold the material.

The material is to be well supported before the last cut is made so that cut edges do not press against the hands.

Jaws of snips are to be kept tight and well lubricated.

Employees are required to wear safety goggles when trimming corners or slivers of metal because small particles often fly with considerable force.

Employees are also required to wear gloves when making cuts.

4.1.6 Cutters

Cutters used on wire, reinforcing rods, or bolts should have ample capacity for the stock; otherwise, the jaws may be sprung or spread.

Chips may fly from the cutting edge and injure the user.

Frequently lubricate cutters.

To keep cutting edges from becoming nicked or chipped, cutters are not to be used as nail pullers or pry bars.

Cutter jaws should have the hardness specified by the manufacturer for the particular kind of material to be cut.

By adjustment of the bumper stop behind the jaws, cutting edges are to be set to have a clearance of 0.08mm when closed.

4.2 Wood Cutting Hand Tools

Edged tools are to be used so that if a slip should occur, the direction of force will be away from the body. For efficient and safe work, edged tools are to be kept sharp and ground to the proper angle. A dull or blunt tool does a poor job and may stick or bind.

4.2.1 Wood Chisels

Inexperienced employees shall be instructed in the proper method of holding and using chisels. Handles are to be free of splinters.

The wood handle of a chisel struck by a mallet is to be protected by a metal or leather cap to prevent it from splitting.

The work to be cut must be free of nails to avoid damage to the blade or cause a chip to fly into the user's face or eye.

4.2.2 Saws

Saws should be carefully selected for the job they will be used for.

For crosscut work on green wood, a coarse saw (2 to 3 points per cm) is to be used.

A fine saw is better for smooth, accurate cutting when using dry wood.

Saws are to be kept sharp and well set to prevent binding with the workpiece.

4.2.3 Axes

The employee must make sure that there is a clear circle in which to swing the axe before chopping materials.

All vines, brush, and shrubbery within the range should be removed, especially overhead vines that may catch or deflect the axe.

Axe blades are required to be protected with a sheath or metal guard wherever possible.

When the blade cannot be guarded, it is safer to carry the axe at one's side.

The blade on a single-edged axe shall be pointed down.

4.2.4 Hatchets

Hatchets shall not be used for striking hard metal surfaces since the tempered head may injure the user or others by flying chips.

When using a hatchet in a crowded area, employee shall take special care to prevent injury to themselves and other employees.

Using a hatchet to drive nails is prohibited.

4.3 Miscellaneous Cutting Hand Tools

Cutting hand tools are to be used only by experienced employees.

These tools are to be kept sharp and in good condition.

The principal hazard in the use of knives is that hands may slip from the handle onto the blade or that the knife may strike the body or the free hand.

A handle guard or a finger ring (and swivel) on the handle eliminates these hazards and is required to be used.

Employees who must carry knives with them on the job shall keep them in sheaths or holders.

Never carry a sheathed knife on the front part of a belt, but carry it over the right or left hip, toward the back. This will prevent severing a leg artery or vein in case of a fall.

Knives should be stored safely and must never be left lying on benches or in other places such as being hidden under a product, under scrap paper or wiping rags, or among other tools in work boxes or drawers where they may cause hand injuries. Safe placing and storing of knives are one of the most important keys to knife safety.

Supervisors must make certain that employees who handle knives have ample room in which to work so they are not in danger of being bumped by other employees.

Knives are to be kept separate from other tools to protect the cutting edge of the knife as well as to protect the employee.

Horseplay such as throwing knives, "fencing", trying to cut objects into smaller and smaller pieces, and similar practices are prohibited around any knife operations.

Supervisors shall assure that nothing is cut that requires excessive pressure on the knife.

Knives shall not be used as a substitute for can openers, screwdrivers, or ice picks.

4.4 Torsion Tools

4.4.1 Open-End or Box Wrenches

Open-end or box wrenches shall be inspected to make sure that they fit properly and that the jaws are not sprung or cracked.

When defective, the wrench is required to be taken out of service until repaired.

4.4.2 Socket Wrenches

Socket wrenches are safer to use than adjustable or open-end wrenches.

Socket wrenches give great flexibility in hard-to-reach places. The use of special types shall be encouraged where there is danger of injury.

4.4.3 Adjustable Wrenches

Adjustable wrenches are used for many purposes, but are not intended to take the place of standard open-end, box or socket wrenches.

They are used mainly for nuts and bolts that do not fit a standard wrench.

Pressure must always be applied to the fixed jaw.

4.4.4 Pipe Wrenches

Pipe wrenches, both straight and chain tong, shall have sharp jaws and be kept clean to prevent slipping.

The adjusting nut of the wrench is to be inspected frequently and taken out of service if cracked. A cracked nut may break under strain, causing complete failure of the wrench and possible injury to the user.

A piece of pipe slipped over the handle shall not be used to give added leverage because this can strain a pipe wrench to the breaking point. The handle of every wrench is designed to be long enough for the maximum allowable safe pressure.

A pipe wrench should never be used on nuts or bolts, the corners of which will break the teeth of the wrench, making it unsafe to use on pipe and fittings, and it also damages the nuts/bolts.

A pipe wrench shall not be used on valves, struck with a hammer, nor used as a hammer.

4.4.5 Pliers

Side-cutting pliers sometimes cause injuries when short ends of wires are cut.

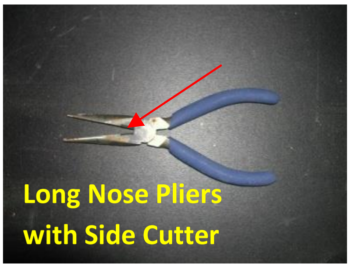
A guard over the cutting edge and the use of safety glasses will help prevent eye injuries.

The handles of electricians' pliers are to be insulated. In addition, employees shall wear the proper electrical rated gloves if they are to work on energized lines.

Pliers shall not be used as a substitute for a wrench.

4.4.6 Special Cutters for Banding Wire/Strap

Special cutters include those for cutting banding wire and strap. Claw hammers and pry bars shall not be used to snap metal banding material.

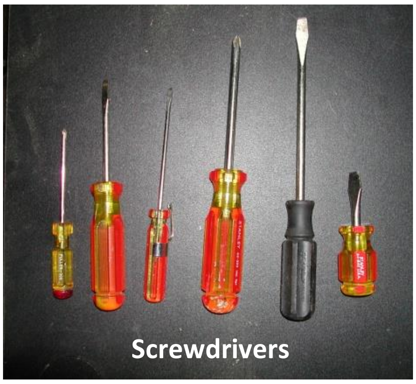


4.4.7 Pipe Tongs

Employees must neither stand nor jump on the tongs nor place extensions on the handles to obtain more leverage. Larger tongs should be used if an employee encounters either scenario.

4.4.8 Screwdrivers

The practice of using screwdrivers for punches, wedges, pinch bars, or pry-bars shall not be allowed.



Cross-slot (Phillips head) screwdrivers are safer than the square bit type, because they have fewer tendencies to slip. The tip must be kept clean and sharp, however, to permit a good grip on the head of the screw.

The part to be worked upon must never be held in the hands; it should be laid on a bench or flat surface or held in a vise.

No screwdriver used for electrical work shall have the blade or rivet extending through the handle. Both blade and handle shall be insulated except at the tip.

4.5 Shock Tools

4.5.1 Hammers

A hammer is to have a securely wedged handle suited to the type of head used. The handle shall be smooth, without cracks or splinters, free of oil, shaped to fit the hand, and of the specified size and length. Employees shall be warned against using a steel hammer on hardened steel surfaces. Instead, a soft-head hammer or one with a plastic, wood, or rawhide head should be used. Safety goggles or safety glasses shall be worn to protect against flying chips, nails, or scale.

4.5.2 Riveting Hammers

Riveting hammers, often used by sheet metal employees, must have the same kind of use and care as ball pen hammers and should be watched closely for cracked or chipped faces.

4.5.3 Carpenter's or Claw Hammers

The faces shall be kept well-dressed at all times to reduce the hazard of flying nails while they are being started into a piece of wood. A checker-faced head is sometimes used to reduce this hazard.

**When nailing is being conducted in a work area, eye protection is advised to be used by all employees nailing and all employees working in the same area.

4.6 Spark-Resistant Hand Tools

Around flammable substances, sparks produced by iron and steel hand tools can be a dangerous ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum, or wood will provide for safety.

5. General Power Tool Safety

Power tools can be classified according to the power medium to operate the tool as follows:

a) Electric
b) Pneumatic
c) Hydraulic
d) Explosive (Powder actuated)
e) Liquid fuel (Petrol, diesel or paraffin)

Power tools can be hazardous when improperly used. The following general precautions should be observed by power tool users:

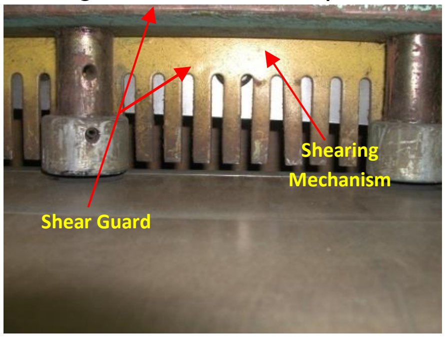
a) Never carry a tool by the cord or hose.
b) Never yank the cord or the hose to disconnect it from the receptacle.
c) Keep cords and hoses away from heat, oil, and sharp edges.
d) Cords are required to be free of frays/cuts. If the cord is damaged, the equipment shall be removed from service immediately.
e) Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
f) All observers should be kept at a safe distance away from the work area.
g) Secure work with clamps or a vise, freeing both hands to operate the tool.
h) Avoid accidental starting. The employee should not hold a finger on the switch button while carrying a plugged-in tool.
i) Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
j) Be sure to keep good footing and maintain good balance.
k) The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts.
l) All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use".
m) Do not check for hydraulic leaks with bear hands.
n) Do not use air to clean yourself.
o) Cool down liquid fuel driven engines before refueling.
p) Refuel engines in a well-ventilated area.
q) Do not smoke or cause open flames in refueling area.

r) Arrange for adequate ventilation when operating internal combustion engines in buildings and confined spaces.

s) Do ongoing air monitoring when operating internal combustion engines in buildings and confined spaces.

5.1 Guards

Hazardous moving parts of a power tool need to be safeguarded. For example, belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded if such parts are exposed to contact by employees. Guards, as necessary, should be provided to protect the operator and others from the following:



a) point of operation,

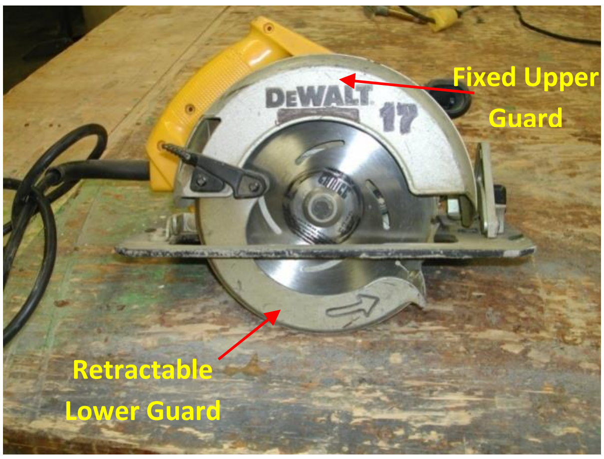
b) in-running nip points,

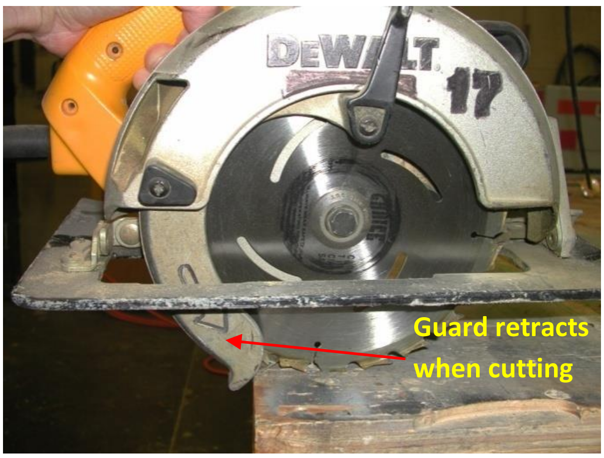
c) rotating parts, and

d) flying chips and sparks.

Safety guards shall never be removed when a power tool is being used.

Example with pictures to illustrate: A portable circular saws must be equipped with guards. An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw except when it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work.





5.2 Safety Switches

The following tools are required to be equipped with a constant pressure switch or control that will shut off the power when the pressure is released:

a) All hand-held powered circular saws having a blade diameter greater than 50mm.
b) Electric, hydraulic or pneumatic chain saws.
c) Percussion tools.

All hand-held petrol-powered chain saws shall be equipped with a constant pressure throttle control that will shut off the power to the saw chain when the pressure is released.

The following tools are required to be equipped with a constant pressure switch or control, and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on:

a) All hand-held powered drills.
b) Tappers.
c) Fastener drivers.
d) Horizontal, vertical, and angle grinders with wheels greater than 50mm in diameter.
e) Disc sanders with discs greater than 50mm in diameter.
f) Belt sanders, reciprocating saws, saber, scroll, and jig saws with blade shanks greater than a nominal 8mm.

Other hand-held powered tools such as circular saws having a blade diameter greater than 50mm, chain saws, and percussion tools without positive accessory holding means must be equipped with a constant pressure switch that will shut off the power when the pressure is released.

6. Safe use of Power tools

6.1 Electric Power Tools

Employees using electric tools must be aware of several dangers. The most serious of these dangers is the possibility of electrocution.

Among the main hazards of electric-powered tools are burns and light shocks which can lead to serious injuries or even heart failure. Under certain conditions, even a small amount of current can result in fibrillation of the heart and eventual death. A shock also can cause the user to fall off a ladder or other elevated work surface.

To protect the user from shock, tools must have a three-wire cord with a ground prong and be grounded, double insulated, or powered by a low-voltage isolation transformer.

Three-wire cords: These cords contain two current-carrying conductors and a grounding conductor. One end of the grounding conductor connects to the tool's metal housing. The other end is grounded through a prong on the plug.

Anytime an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong should never be removed from the plug.

Double insulation: This is a more convenient method. The user and the tools are protected in two ways: by normal insulation on the wires inside, and by a housing that cannot conduct electricity to the operator in the event of a malfunction.

The following general practices should be followed when using electric tools:

a) Electric tools should be operated within their design limitations.
b) Gloves and safety footwear are recommended during use of electric tools.
c) When not in use, tools should be stored in a dry place.
d) Electric tools should not be used in damp or wet locations.
e) Work areas should be well lighted.
f) Frayed cords are required to be taken out of service and replaced.
g) Electric cords shall be inspected periodically and kept in good condition.
h) Heavy-duty plugs that clamp to the cord should be used to prevent strain on the current-carrying parts when the cord is accidentally pulled.

6.1.1 Angle Grinders

A Work Area

1. Keep your work area clean and well lit. Cluttered benches and dark areas invite accidents.

2. Do not operate power tools in explosive atmospheres, such as in the presence of flammable liquids, gases, or dust. Power tools create sparks which may ignite the duster fumes.

3. Keep bystanders, children, and visitors away while operating a power tool. Distractions can cause you to lose control.

B Electrical Safety

Refer to paragraph 9.1 above.

C Specific Safety Rules

1. Always use proper guard with grinding wheel. A guard protects operator from broken wheel fragments.
2. Accessories must be rated for at least the speed recommended on the tool warning label. Wheels and other accessories running over rated speed can fly apart and cause injury.
3. Hold tool by insulated gripping surfaces when performing an operation where the cutting tool may contact hidden wiring or its own cord. Contact with a “live” wire will make exposed metal parts of the tool “live “and shock the operator.
4. When using depressed centre grinding wheels, be sure to use only fiberglass reinforced wheels.
5. Always use safety glasses or goggles. Ordinary eye or sun glasses are NOT safety glasses.
6. Check the wheel carefully for cracks or damage before operation. Replace cracked or damaged wheel immediately. Run the tool (with guard) at no load for about a minute, holding tool away from others. If wheel is flawed, it will likely separate during this test.
7. Use only flanges specified for the tool.
8. Be careful not to damage the spindle, the flange (especially the installing surface) or the lock nut. Damage to these parts could result in wheel breakage.
9. NEVER use tool with wood cutting blades or other saw blades. Such blades when used on a grinder frequently kick and cause loss of control leading to personal injury.
10. Hold the tool with a firm grip.

11. Keep hands away from rotating parts.

12. Make sure cord is clear of wheel. Do not wrap cord around your arm or wrist. If control of tool is lost, the cord may become wrapped around you and cause serious personal injury.

13. Make sure the wheel is not contacting the work piece before the switch is turned on.

14. Before using the tool on an actual work piece, let it run for a while. Watch for vibration or wobbling that could indicate poor installation or a poorly balanced or damaged grinding or cutting wheel.

15. Use the specified surface of the wheel to perform the grinding.

16. Watch out for flying sparks. Hold the tool so that sparks fly away from you and other persons or flammable materials.

17. Do not leave the tool running. Operate the tool only when hand-held.

18. Do not touch the work piece immediately after operation; it may be extremely hot and could burn your skin.

19. ALWAYS wear proper apparel including long sleeve shirts, leather gloves and shop aprons to protect skin from contact with hot grindings.

20. Use of this tool to grind or sand some products, paints and wood could expose user to dust containing hazardous substances. Use appropriate respiratory protection.

21. Strictly follow the manufacturer's instructions when changing grinding wheels.

15. When using an angle grinder outside a workshop, follow hot work procedures.

6.1.2 Electric Impact Drill

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

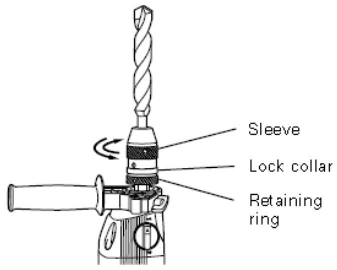
A Specific Safety Rules

1. Mounting the bit

Turn the lock collar in the direction "UNLOCK" and open the chuck. After inserting the drill bit into the chuck as far it will go, turn the lock collar in the "LOCK" direction. Grip the retaining ring and close the chuck by turning the sleeve clockwise as viewed from the front.

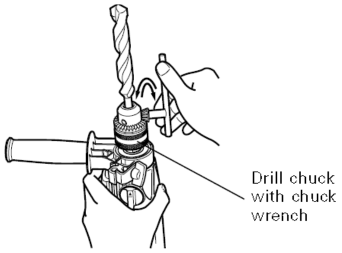
2. Dismounting the bit

   Turn the lock collar in the direction "UNLOCK" to release the chucking force. Grip the retaining ring and open the chuck by turning the sleeve counter-clockwise.



3. Mounting and dismounting of the bit for Drill chuck with chuck wrench

   Fit the drill bit into the chuck and use the chuck wrench to secure it, tightening the chuck by each of the three holes in turn.



4. Selecting the appropriate drill bit

   - When drilling concrete or stone, use the tungsten carbide drill bits.
   - When drilling metal or plastic, use an ordinary metal working HSS drill bit.
   - When drilling wood, use an ordinary woodworking drill bit.
   - However, when drilling 6.5 mm or smaller holes, use a metalworking drill bit.

5. Ensure that the side handle is appropriately fitted for left-handed or right-handed operation to suit your own preference.

6. Select a suitable operating speed for the size and type of drill bit being used and the type of material being drilled into.

7. Use the hammer action only for drilling with tungsten carbide drilling into concrete.

   You cannot drill holes more quickly even if you push the drill with a stronger force than necessary. It not only damages tip of drill bit and decreases the efficiency of operation, but also shortens the life of the drill bit tungsten carbide tip.

8. In case of penetrating holes drill bits are likely to break when the material being drilled is penetrated. It is important to decrease pushing force just before penetrating.

9. Inspection of the drilling machine shall include:

   - Condition of the chuck
   - Condition of the chuck wrench
   - Condition of the electric cord
   - Condition of the plug
   - Condition of the switch
   - General condition of the machine body

10. Although no guards are available for drill bits, some protection is afforded if drill bits are carefully chosen for the work to be done, such as being no longer than necessary to do the work.

    Where the operator must guide the drill by hand, the drill is required to be equipped with a sleeve that fits over the drill bit.

    Oversized bits shall not be ground down to fit small electric drills; instead, an adapter should be used that will fit the large bit and provide extra power through a speed reduction gear; however, this again is an indication of improper drill size. When drills are used, the pieces of work are to be clamped or anchored to prevent whipping.

6.1.3 Magnetic Base Drilling Machine

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A Specific Rules for use

NOTE: These rules may change depending on the manufacturer.

1. Occasionally apply a few drops of oil to the rack gear teeth.

2. The bearings of the feed shaft are self-lubricating and must not be greased.

3. Grease the sliding surface of the carriage with MOLYCOTE grease.

4. When not in use or being transported the unit should be kept in the case supplied.

5. After use ensure unit is clean of swarf and dirt.

6. Parts that are worn or damaged should be replaced immediately with original Manufacturers replacement parts.

7. Ensure all cutting edges are sharp when in operation. Using blunt cutting tools may lead to an overload of the motor.

8. Store Idle Tools

   When not in use, tools should be stored in a dry, high and locked-up place, out of unauthorised reach.

9. Do Not Force Tool

10. Use Right Tool

11. Dress Properly

12. Wear Safety Glasses

13. Secure Work Pieces

12. Do Not Overreach - Keep proper footing and balance at all times.

11. Inspection of the drilling machine shall include:

    - Condition of the tool holder
    - Condition of the electric cord
    - Condition of the plug
    - Condition of the control switch
    - General condition of the machine body
    - Condition of the magnetic base

6.1.4 Cut-off saw

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A Specific Rules for use

1. Work pieces for cutting must be securely clamped onto the machine.

2. The machine must be placed on a level surface for safe operation.

3. Avoid allowing anything to dangle. This includes your clothing, gloves, or any types of jewellery. In addition, always take steps to remove these objects so they won't obstruct the saw's blade.

4. Keep your fingers and hands clear of the blade's path. When operating a chop saw never reach into the fence's back.

   This will help to further protect your fingers and hands when operating various types of chop saws.

5. Ensure that all guards are functional and in position. This applies for all types of saw blades whether it is a carbide chop saw blade or another brand.

   If the guard of the saw seems sluggish in returning to its regular position, or frequently hangs up, then either make necessary adjustments or fix it quickly. Before doing any repairs, always unplug the power first.

6. Wear vital safety equipment. This includes safety glasses and a (full) face shield. It is important to always wear both of these pieces of equipment, rather than only one or the other.

7. Never cut small pieces again. This is true for all types of chop saws, including a steel chop saw. Also, make sure to support lengthy material at a height that is equal with the saw table's height.

8. Secure materials correctly when operating chop saws. This will help to prevent losing control during the power tool's operation or your hands getting in the way of the blade. Hold the material adjacent to the fence during cutting.

9. Always use the appropriate blade size. Use the correct size of blades and RPM. Also, check the blade and blade-attachment frequently, and make sure to tighten them. Carefully change the blades of the saws according to what is indicated on the manual. In addition, be sure to put the right type of blade. For instance, if you are using a circular chop saw, place a blade intended for this type of saw. Remember to unplug the power tool before changing its blade. After changing the saw blade, verify if the blade along with its associated fasteners as well as washers are properly secured and positioned on the Arbor of the saw.

10. Take the right steps after finishing a cut. First, release the switch on the trigger, and allow the blade to stop completely. Then gradually lift the saw's blade from the workplace.

11. Often clean up the lower guard - This will improve your visibility, as well as the movement of the saw. It is vital that you unplug the power tool before performing the cleaning.

12. Use the break when it is available - Even after you have used it on the saw, wait for the blade to stop completely before you reach into the cutting area. This is definitely applicable to all types of blades including the jet chop saw.

13. Wear eye, face and hand protection when operating the saw.

14. Beware of sparks being thrown directly on your overhauls as this can put your clothing on fire.

15. When using a cut-off machine outside a workshop, follow hot work procedures.

6.1.5 Extension leads

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A Specific Rules for use

1. Worn cords can cause short circuits, shocks and fires.
2. Always be sure you are using the right type of cord for the right job. Use heavy-duty cords for tools, moisture resistant for outdoors, and always use the 3 core wire cords.
3. Extension cords must never be affixed to a wall with metal staples.
4. Never place cords under rugs or across a driveway because damage can occur to the insulation.
5. Never wrap cords around steam pipes, metal, or warm appliances. Protect them from heat and water.
6. Never use extension cords that are defective.
7. Regularly check the continuity.
8. To disconnect from a wall outlet socket, pull the plug and not the cord.
9. Check the cord regularly for wear at the plugs and connections.
10. Unwind the cord completely while it is in use.
11. Make sure that the cord is not causing a tripping hazard for another person.

6.1.6 Pipe Groove cutting Machine

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A Specific Rules for use

At the time of writing this manual no information was available on the safe use of this machine.

6.1.7 Pipe Threading Machine

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A General Rules for use

1. Use clamp or other practical way to secure and support the work piece to a stable platform. Holding the work by hand or against your body is unstable and may lead to loss of control.

2. Do not force tool. Use the correct tool for your application. The correct tool will do the job better and safer at the rate for which it is designed.

3. Do not use tool if switch does not turn it ON or OFF. Any tool that cannot be controlled with the switch is dangerous and must be repaired.

4. Disconnect the plug from the power source before making any adjustments, changing accessories, or storing the tool. Such preventive safety measures reduce the risk of starting the tool accidentally.

5. Store idle tools out of the reach of children and other untrained persons. Tools are dangerous in the hands of untrained users.

6. Maintain tools with care. Keep cutting tools sharp and clean. Properly maintained tools with sharp cutting edges are less likely to bind and are easier to control.

7. Check for misalignment or binding of moving parts, breakage of parts, and any other condition that may affect the tool's operation. If damaged, have the tool serviced before using. Many accidents are caused by poorly maintained tools.

8. Use only accessories that are recommended by the manufacturer for your model. Accessories that may be suitable for one tool may become hazardous when used on another tool.

9. Inspect tool and extension cords periodically and replace if damaged. Damaged cords increase the risk of electrical shock.

10. Keep handles dry and clean; free from oil and grease. Allows for better control of the tool.

11. Store tools in dry place. Such measures reduce the risk of electrical shock.

12. Foot Switch Safety

    The foot switch is for your safety. It lets you SHUT OFF the motor by removing your foot. If clothing should become caught in the machine, it will continue to wind up, pulling you into the machine.

    Because the machine has high torque, the clothing itself can bind around your arm or other body parts with enough force to crush or break bones.

B Threading Machine Safety

1. Machine is made to thread and cut pipe or bolt. Follow instructions in Operator's Manual on machine uses. Other uses may increase the risk of injury.

2. Secure machine to bench or stand. This will keep the machine from tipping over.

3. Keep covers in place. Do not operate the machine with covers removed. Exposure to moving parts may result in entanglement and serious injury.

4. Support long heavy pipe with pipe supports. This will prevent tipping of the machine.

5. Do not wear gloves or loose clothing. Keep sleeves and jackets buttoned. Do not reach across the machine or pipe. Clothing can be caught by the pipe resulting in entanglement and serious injury.

6. Do not use machine if foot switch is broken. Foot switch is a safety device to prevent serious injury.

7. Lock foot switch when not in use. This will avoid accidental starting.

8. Operate machine from switch side only.
9. Do not block or disconnect foot switch.
10. Make sure switch is in the OFF position before plugging power cord or when using nipple chuck wrench.
11. Keep hands away from rotating pipe and fittings.
12. Stop machine when screwing fittings on pipe or wiping thread.

6.1.8 Pressure washer

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A General Rules for use

1. Never point or aim the gun/wand at yourself or anyone else.
2. Never put your hand, fingers or body directly in front of the spray nozzle.
3. Do not operate your power washer until you completely understand and can follow all operating instructions, precautions and safety rules.
4. Restrict the use of your power washer to users who have read, understand and can follow all operating instructions, precautions and safety rules.
5. Always wear ear protection to cut noise and eye protection and / or face shield to prevent debris from flying or ricocheting into eyes and face which could result in serious injury.
6. Dress safely in long pants and wear gumboots. Other protective equipment is advisable when using chemicals, cleaning detergents or other corrosive or abrasive substances.
7. Do not operate pressure washing equipment if you have consumed alcohol or taken medication.
8. Keep pets, children and bystanders a safe distance away from your work area. A minimum of 15 Meters is recommended.

9. Do not spray directly at glass or fragile objects.

CAUTION: After turning off your pressure washer and water supply, there is still high-pressure water trapped in the system. You must release the pressure by triggering the gun after the engine/motor has completely stopped.

10. Know what chemicals you are using and read precautions.

6.1.9 Welding Machines

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A General Rules for use

1. Must have PPE gauntlets, welding goggles, or welding mask, safety footwear, long sleeved overalls, apron if required, protective headgear.

2. Must have appropriate tools and equipment for task (ensure equipment in good condition and safe to use), portable LEV if required.

3. Consider risks and hazards in work area and refer any concerns to supervisor. Ensure hot work permits in place.

4. Ensure fire extinguisher to hand at work area.

B Hazards associated with welding

1. Fire and explosion from ignition of flammable gases and/or other flammable materials.

2. Asphyxiation from gases, fumes etc.

3. Hot materials e.g., metal spatter and hot work pieces.

4. Exposure to Ultra Violet and Infra-Red radiation, leading to severe eye and skin damage.

5. Electrocution from arc welding equipment

6. Manual handling of equipment and work pieces.

C On completion

1. Ensure all work pieces etc. cooled down before leaving the work area.
2. Tidy up, clear away debris and dispose to appropriate site.
3. Check area 30 minutes after end of work, sign off permit and report completion to supervisor.
4. Monitor site for 1 hour at end of days' work.
5. Sign off relevant work permits.

6.1.10 Electric Reciprocating Metal Saw

The work area safety and electrical safety discussed in 9.1.1 above also applies here.

A General Rules for use

1. Secure the workpiece to a work bench or table with a visa or with clamps.
2. Make sure the saw blade is clear of any foreign material and that the power cord and extension cord are out of the blade path.
3. Hold the saw firmly in front of and clearly away from you.
4. Mark the line of cut clearly.
5. Depress the trigger switch to start the cutting action.
6. Set the base assembly against the work piece.
7. Move the blade into the work piece.

NOTE: Do not force. Use only enough pressure to keep the saw cutting. Let the blade and saw do the work. Keep pressure on the base, against the work piece.

B PLUNGE CUTTING

Follow these directions to plunge cut.

1. Secure the workpiece to a work bench or table with a vise or with clamps.
2. Make sure the saw blade is clear of any foreign material and that the power cord and extension cord are out of the blade path.
3. Hold the saw firmly in front of and clearly away from you.
4. Mark the line of cut clearly.
5. Choose a convenient starting point inside the cutting area and place the tip of the blade over that point.
6. Rest the front edge of the shoe assembly on the work piece and hold it firmly in position during the cut.
7. Depress the trigger switch and allow the saw blade to reach full cutting speed.
8. Tilt the saw downward until the tip of the blade starts cutting the work piece.
9. Allow the saw to penetrate the workpiece.
10. Tilt the saw until the blade is perpendicular to the work piece.

C PERSONAL SAFETY

1. **ALWAYS WEAR SAFETY GLASSES.** Everyday eyeglasses have only impact resistant lenses, they are not safety glasses.
2. **PROTECT YOUR LUNGS.** Wear a dust mask if operation is dusty.
3. **PROTECT YOUR HEARING.** Wear hearing protection during extended periods of operation.
4. **DON'T OVERREACH.** Keep proper footing and balance at all times. Do not use tool on a ladder or unstable support. Secure tools when working at elevated levels.

5. **MAINTAIN TOOLS WITH CARE.** Keep tools sharp and clean for better and safer performance. Follow instructions for lubricating and changing accessories.

6. **REMOVE ADJUSTING KEYS AND WRENCHES.** Form a habit of checking to see that keys and adjusting wrenches are removed from tool before turning it on.

7. **NEVER USE IN AN EXPLOSIVE ATMOSPHERE.** Normal sparking of the motor could ignite fumes.

8. **KEEP HANDLES DRY, CLEAN AND FREE FROM OIL GREASE.** Always use a clean cloth when cleaning. Never use brake fluids, gasoline, petroleum-based products, or any strong solvents to clean your tool.

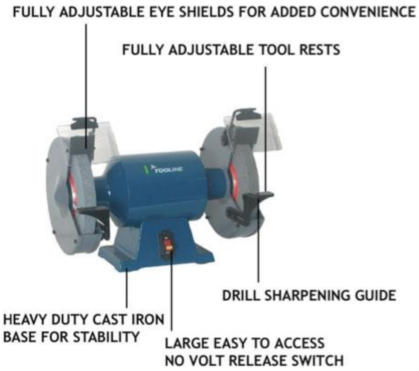
9. **STAY ALERT AND EXERCISE CONTROL.** Watch what you are doing and use common sense. Do not operate tool when you are tired. Do not rush operation of tool.

10. **CHECK DAMAGED PARTS.** Before further use of the tool, a guard or any other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, binding of moving parts, breakage of parts, mounting and any other conditions that may affect its operation. A guard or any other part that is damaged should be properly repaired or replaced by an authorised service centre.

11. **DO NOT USE TOOL IF SWITCH DOES NOT TURN IT ON AND OFF.** Have defective switches replaced by authorised service centre.

12. **DO NOT OPERATE THIS TOOL WHILE UNDER THE INFLUENCE OF DRUGS, ALCOHOL OR ANY MEDICATION.**

6.1.11 Bench Grinders



The work area safety and electrical safety discussed above also applies here.

Powered abrasive grinding, cutting, polishing, and wire buffing wheels create special safety problems because they may throw off flying fragments.

Before an abrasive wheel is mounted, it should be inspected closely and sound- or ring-tested to be sure that it is free from cracks or defects. To test, wheels should be tapped gently with a light non-metallic instrument. If they sound cracked or dead, they could fly apart in operation and so must not be used. A sound and undamaged wheel will give a clear metallic tone or "ring."

To prevent the wheel from cracking, the user should be sure it fits freely on the spindle. The spindle nut must be tightened enough to hold the wheel in place, without distorting the flange. Follow the manufacturer's recommendations. Care must be taken to assure that the spindle wheel will not exceed the abrasive wheel specifications.

Due to the possibility of a wheel disintegrating (exploding) during start-up, the employee should never stand directly in front of the wheel as it accelerates to full operating speed.

Portable grinding tools need to be equipped with safety guards to protect employees not only from the moving wheel surface, but also from flying fragments in case of breakage.

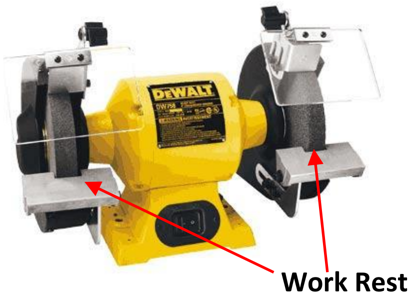
In addition, when using a powered grinder:

a) Always use eye protection.
b) Turn off the power when not in use.

c) Never clamp a hand-held grinder in a vise.

An Abrasive wheel uses

Floor stand and bench mounted abrasive wheels, used for external grinding shall be provided with safety guards (protection hoods).



The maximum regular exposure of the grinding wheel periphery and sides shall be not more than 90°except that, when work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 125°.

Safety guards shall be strong enough to withstand the forces of a bursting wheel.

Floor and bench-mounted grinders shall be provided with work rests which are rigidly supported and readily adjustable. Such work rests shall be kept at a distance not to exceed 3mm from the surface of the wheel.

The top of the guard that covers the abrasive wheel should be no more than 6mm from the abrasive wheel.

Cup type wheels used for external grinding shall be protected by either a revolving cup guard or a band type guard. All other portable abrasive wheels used for external grinding shall be provided with safety guards (protection hoods), except as follows:

a) When the work location makes it impossible, a wheel equipped with safety flanges shall be used.
b) When wheels 50mm or less in diameter which are securely mounted on the end of a steel mandrel are used.

Portable abrasive wheels used for internal grinding shall be provided with safety flanges (protection flanges) except as follows:

a) When wheels 50mm or less in diameter which are securely mounted on the end of a steel mandrel are used.
b) If the wheel is entirely within the work being ground while in use.

When safety guards are required, they shall be so mounted as to maintain proper alignment with the wheel, and the guard and its fastenings shall be of sufficient strength to retain fragments of the wheel in case of accidental breakage.

The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180°.

When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage, shall be used.

All abrasive wheels shall be closely inspected and ring-tested before mounting to ensure that they are free from cracks and defects.

Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place.

All employees using abrasive wheels shall wear dust-type safety goggles or plastic face shields. If dust is created, a respirator may be required.

B Lifespan of grinding wheels

Grinding wheels are subject to deterioration if stored in damp or humid conditions. The effects are a reduction in bond strength caused by the ingress of moisture; this affects the balance and causes surface growth, which reduces the bursting speed.

The life limits stated in this annex are mandatory. Older stock is to be issued first and if there is any doubt, or if wheels have been in stock for more than 3 years (1 year for Magnetise bonded wheels) the manufacturer should be consulted about their suitability for use. For wheels that are not individually date marked by the manufacturer, it is recommended that they be marked with the date they are received from the supplier.

On reaching their limits, all grinding wheels are to be removed from service and destroyed.

Where, however, sufficiently large quantities of unused wheels are in store, they may be returned to the manufacturer for inspection and life extension. Workshops holding or using grinding wheels are to maintain a register specifying the life limit date and location of each wheel.

Inorganically bonded, vitreous abrasive wheels are identified by the letter "V". They are not subject to deterioration, do not have a life limit and are not subject to any special conditions.

If a sander is used steadily, it should be dismantled periodically, as well as thoroughly cleaned every day by being blown out with low-pressure air. If compressed air is used the operator shall wear safety goggles or work with a transparent chip guard between his body and the air blast.

Because wood dust presents a fire and explosion hazard, keep dust to a minimum; sanders can be equipped with a dust collection or vacuum bag. Electrical equipment shall be designed to minimize the explosion hazard. Fire extinguishers approved for Class A, B and C (general) fires should be available.

6.2 Pneumatic tools

Pneumatic tools are powered by compressed air and include chippers, drills, nail/staple/screw 'guns', hammers, and sanders.

There are several dangers encountered in the use of pneumatic tools. The main one is the danger of getting hit by one of the tool's attachments or by some kind of fastener the employee is using with the tool.

Eye protection is required and face protection (i.e.: Face Shield) is recommended for employees working with pneumatic tools.

Noise is another hazard. Working with noisy tools such as jackhammers requires proper, effective use of hearing protection as well as vibration absorbing gloves.

When using pneumatic tools, employees must check to see that they are fastened securely to the hose to prevent them from becoming disconnected.

A short wire or positive locking device attaching the air hose to the tool will serve as an added safeguard.

A safety clip or retainer must be installed to prevent attachments, such as chisels on a chipping hammer, from being unintentionally shot from the barrel.

Screens must be set up to protect nearby employees from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

Compressed air guns should never be pointed toward anyone. Users should never "dead-end" it against themselves or anyone else.

The operating trigger on portable hand-overrated utilization equipment shall be so located as to minimize the possibility of its accidental operation and shall be arranged to close the air inlet valve automatically when the pressure of the operator's hand is removed.

All pneumatically driven mailers, staplers, and other similar equipment provided with automatic fastener feed, which operate at more than 700kPa pressure at the tool shall have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.

Compressed air shall not be used for cleaning purposes except with an air blow gun limited to 200kPa. static pressure at the outlet nozzle and then only with effective chip guard and personal protective equipment.

The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fitting shall not be exceeded.

The use of hoses for hoisting or lowering tools shall not be permitted.

All hoses exceeding 12mm inside diameter shall have a safety device at the source of supply or branch line to reduce pressure in case of hose failure.

Airless spray guns of the type that atomize paints and fluids at high pressures (6MPa) shall be equipped with automatic or visible manual safety devices which will prevent pulling of the trigger thereby in turn preventing release of the paint or fluid until the safety device is manually released.

In lieu of the above, a diffuser net which will prevent high pressure, high velocity release, while the nozzle tip is removed, plus a nozzle tip guard which will prevent the tip from coming in contact with the operator, or other equivalent protection shall be provided.

6.3 Liquid fuel powered tools

All fuel powered tools shall be stopped while being refueled, serviced, or maintained, and fuel shall be transported, handled, and stored in approved safety facilities.

Fuel Powered Chop Saw

Leakage or spillage of flammable or combustible liquids shall be disposed of promptly and safely.

When fuel powered tools are used in enclosed spaces, the applicable requirement for concentrations of toxic gases and use of personal protective equipment shall apply.

6.3.1 Petrol Generators

a) Use petrol generators outdoors only
b) If they are required to be used indoors, make sure that the carbon monoxide gases are well ventilated by means of mechanical ventilation.
c) Do not allow the generator to operate in rainy conditions. Keep it well protected against the elements.
d) Do not use the generator to power domestic mains unless it is designed for that purpose.
e) Stop the generator and allow cooling down before refueling.
f) Do not smoke while refueling is in progress.
g) Clean up spilt fuel immediately.
h) Do not operate the generator in hazardous atmospheres.

6.4 Hydraulic Powered Tools

The fluid used in hydraulic powered tools shall be fire-resistant and shall retain its operating characteristics at the most extreme temperatures to which it will be exposed.

The manufacturer's safe operating pressures for hoses, valves, pipes, filters, and other fittings shall not be exceeded.

6.4.1 Jacks

All jacks - lever and ratchet jacks, screw jacks, and hydraulic jacks - must have a device that stops them from jacking up too high. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack and should not be exceeded.

A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Use wooden blocking under the base if necessary to make the jack level and secure. If the lift surface is metal, place a 25mm-thick hardwood block or equivalent between it and the metal jack head to reduce the danger of slippage.

To set up a jack, make certain of the following:

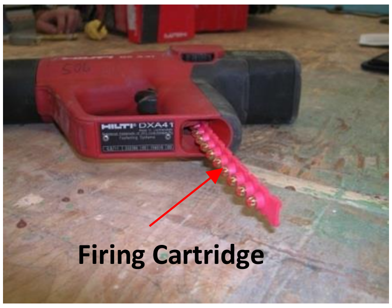
a) The base rests on a firm level surface.
b) The jack is correctly centered.
c) The jack head bears against a level surface.
d) The lift force is applied evenly.

Proper maintenance of jacks is essential for safety. All jacks must be inspected before each use and lubricated regularly. If a jack is subjected to an abnormal load or shock, it should be thoroughly examined to make sure it has not been damaged. Hydraulic jacks exposed to freezing temperatures must be filled with adequate antifreeze liquid.

6.5 Explosive powered Tools

Explosive Powered Tools should not be used in an explosive or flammable atmosphere.

Only employees who have been trained in the operation of the particular tool in use shall be allowed to operate an explosive powered tool.



The tool shall be tested each day before loading to see that safety devices are in proper working condition. The method of testing shall be in accordance with the manufacturer's recommended procedure.

Any tool found not in proper working order or one that has developed a defect during use shall be removed from service immediately and not used until properly repaired.

Adequate eye, head, face and/or personal protective equipment as necessitated by working conditions shall be utilized by the operators and persons working in the area.

The tool shall be designed so that it cannot be fired unless it is equipped with a standard protective shield or guard or a special shield, guard, fixture, or jib.

The firing mechanism shall be designed so that the tool cannot fire during loading or preparation to fire or if the tool is dropped while loaded. Firing of the tools shall be dependent upon at least two separate and distinct operations of the operator, with the final firing movement being separate from the operation of bringing the tool into the firing position.

The tool shall be designed so as not to be operable other than against a work surface and unless the operator is holding the tool against the work surface with force at least 22 Newtons greater than the weight of the tool.

The tool shall be designed so that it will not operate when equipped with the standard guard indexed to the center position if any bearing surface of the guard is tilted more than 8 degrees from contact with the work surface.

The tool shall be designed so that positive means of varying the power are available or can be made available to the operator as part of the tool or as an auxiliary, to facilitate selection of a power level adequate to perform the desired work without excessive force.

The tool shall be designed so that all breeching parts will be reasonably visible to allow a check for any foreign matter that may be present.

Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any employees. Hands shall be kept clear of the open barrel end.

Loaded tools shall not be left unattended.

Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile.

Driving into materials easily penetrated shall be avoided unless such materials are backed by a substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side.

No fastener shall be driven into a spalled (cracked/deteriorated) area caused by an unsatisfactory fastening.

Power-assisted and hammer-driven tools are used for the same purposes as explosive powered tools and generally the same precautions are to be followed.

If an explosive powered tools misfires, the employee should wait at least 30 seconds before trying to firing it again. If it still doesn't fire, the user should wait another 30 seconds so that the faulty cartridge is less likely to explode before carefully removing the load. The bad cartridge should be placed in water.

PART 6 - LIFTING TACKLE

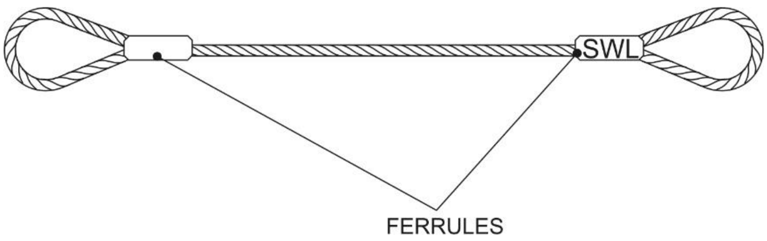
1. Wire Rope Slings

All slings are required to be clearly marked for identification purposes. This enables the Rigger to easily identify any sling that is needed for a specific job.

The following information must be indicated on slings. Should any of this information not be found on the sling it must be reported. It is strictly prohibited to use slings without the required markings:

1.1 The safe working load of the sling (SWL)

The SWL indicated on the sling is applicable when it is used in a vertical plane. The SWL of a sling decrease as the angle in which it is applied increases.



SLING SHOWING POSITION WHERE SWL IS INDICATED

1.2 Identification Number (ID)

The identification number is used to register the existence of the sling in an appropriate inventory. This inventory is used to ensure that all slings that are used on a specific site are inspected by a person who is trained and appointed to carry out inspections.

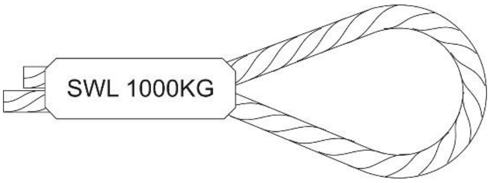
1.3 Date of Issue

Date of issue is for the inspector to see when to do three-monthly inspections.

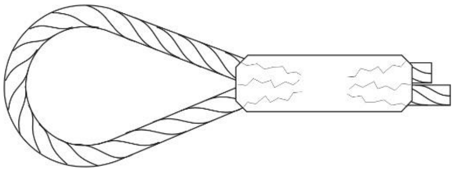
NOTE: Although the slings are inspected every 3 months by a competent person, you must do inspection on the slings every time before you use it.

1.4 Inspection

Check and ensure that the SWL of the sling is indicated on the ferrule or on an identification tag.



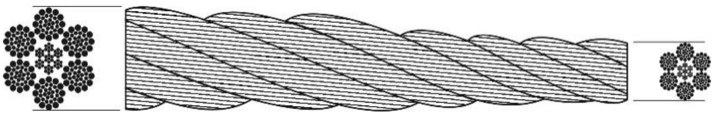
Inspect and ensure that the splice ends of the ferrules are free from cracks.



Check for kinks. A bad kink reduces the rope strength by 50%.

Check for core failure.

Core failure is very dangerous and can lead to complete failure of the sling. The sling must be discarded immediately according to the prescribed procedure.



Check for rust.

Check for broken wires.

NOTE: If you are in any doubt of the condition of a sling after inspection, ask the competent person or Supervisor for assistance.

1.5 Discarding of unsafe lifting tackle

The OCCUPATIONAL HEALTH AND SAFETY ACT 85 (1993) Driven Machinery Regulations, 2015 states:

Lifting machines and lifting tackle

18.(1) No user shall use or permit the use of a lifting machine unless -

(a) it has been designed and constructed in accordance with a generally accepted technical standard;

(b) it is conspicuously and clearly marked with the maximum mass load which it is designed to carry with safety: Provided that when this mass load varies with the conditions of use a table showing the maximum mass load with respect to every variable condition shall be posted up by the user in a conspicuous place easily visible to the operator; and

(c) it has at all times at least three full turns of rope on the drum of each winch which forms part of such a machine when such winch has been run to its lowest limit.

(2) The user shall, where practicable, provide every power-driven lifting machine with-

(a) a brake or other device capable of holding the maximum mass load should the power supply fail, or which is such that it will automatically prevent the uncontrolled downward movement of the load when the raising effort is interrupted; and

(b) a limiting device which will automatically arrest the driving effort when -

(i) the hook or load attachment point of the power-driven lifting machine reaches its highest safe position; and

(ii) in the case of a winch-operated lifting machine with a lifting capacity of 5000 kg or more, the load is greater than the rated mass load of such machine.

(3) The user shall cause every chain or rope which forms an integral part of a lifting machine to have a factor of safety as prescribed by the standard to which such machine was manufactured: Provided that in the absence of such prescribed factor of safety, chains, steel-wire ropes and fibre ropes shall have a factor of safety of at least four, five and ten, respectively, with respect to the rated carrying capacity of the lifting machine.

(4) The user shall cause every hook or any other load-attaching device which forms and integral part of a lifting machine to be so designed or proportioned that accidental disconnection of the load under working conditions cannot take place.

(5) The user shall cause the whole installation and all working parts of every lifting machine to be thoroughly examined and subjected to a performance test, as prescribed by the standard to which the lifting machine was manufactured, by a person who has knowledge and experience of the erection and maintenance of the type of lifting machine involved or similar machinery and who shall determine the serviceability of the structures, ropes, machinery and safety devices, before they are put into use following every time they are dismantled and re-erected, and thereafter at intervals not exceeding 12 months: Provided that in the absence of such

prescribed performance test the whole installation of the lifting machine shall be tested with 110 % of the rated mass load, applied over the complete lifting range of such machine and in such a manner that every part of the installation is stressed accordingly.

(6) Notwithstanding the provisions of sub regulation (5), the user shall cause all ropes, chains, hooks or other attaching devices, sheaves, brakes and safety devices forming an integral part of a lifting machine to be thoroughly examined by a person contemplated in sub regulation (5) at intervals not exceeding six months.

(7) Every user of a lifting machine shall at all times keep on his premises a register in which he shall record or cause to be recorded full particulars of any performance test and examination prescribed by sub regulation (5) and (6) and any modification or repair to the lifting machine, and shall ensure that the register is available on request for inspection by an inspector.

(8) No user of machinery shall require or permit any persons to be moved or supported by means of a lifting machine, unless such machine is fitted with a cradle approved for that purpose by an inspector.

(9) No user shall use or permit any person to use a jib-crane with a lifting capacity of 5 000 kg or more at minimum jib radius, unless it is provided with -

(a) a load indicator that will indicate to the operator of the jib-crane the mass of the load being lifted: Provided that such a device shall not require manual adjustment, from application of a load to the jib crane until the release of that load, using any motion or combination of motions permitted by the crane manufacturer to ensure safe lifting; or

(b) a limiting device which will automatically arrest the driving effort whenever the load being lifted is greater than the rated mass load of the jib-crane, at that particular radius, using any motion or combination of motions permitted by the crane manufacturer to ensure safe lifting: Provided that such a device shall not arrest the driving effort when the jib-crane is being operated into a safer condition.

(10) No user shall use or allow the use of any lifting tackle unless the following conditions are complied with, namely that -

(a) every item of lifting tackle is well constructed of sound material, is strong enough and is free from patent defects and is in general constructed in accordance with a generally accepted technical standard;

(b) every lifting assembly consisting of different items of lifting tackle is conspicuously and clearly marked with identification particulars and the maximum mass load which it is designed to lift with safety;

(c) ropes of chains have a factor of safety with respect to the maximum mass load they are designed to lift with safety of-

(i) ten for natural-fibre ropes;

(ii) six for man-made fibre ropes or woven webbing;

(iii) six for steel-wire ropes except for double part spliced endless sling legs and double part endless grommet sling legs made from steel-wire rope, in which case the factor of safety shall be at least eight;

(iv) five for steel chains; and

(v) four for high-tensile or alloy steel chains:

Provided that when the load is equally shared by two or more ropes or chains the factor of safety may be calculated in accordance with the sum of the breaking strengths taking into consideration the angle of loading;

(d) steel-wire ropes are discarded and not used again for lifting purposes if the rope shows signs of excessive wear, too many broken wires, corrosion or other defects that have made its use in any way dangerous;

(e) such lifting tackle is examined at intervals not exceeding three months by a person contemplated in sub-regulation (5) who shall enter and sign the result of each such inspection in a book kept for this purpose; and

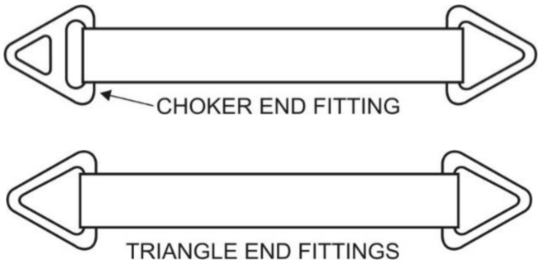
(f) such lifting tackle is stored or protected so as to prevent damage or deterioration when not in use.

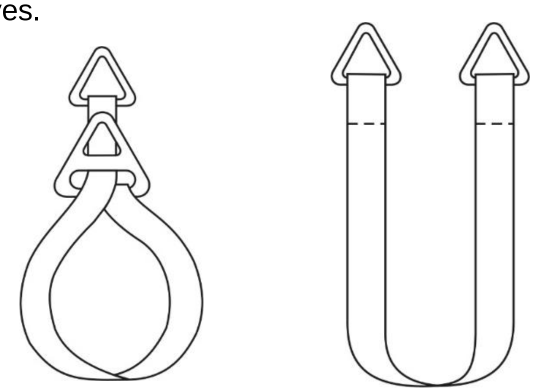
(11) The user shall ensure that every lifting machine is operated by an operator specifically trained for a particular type of lifting machine: Provided that in the case of a lift truck with a lifting capacity of 750 kg or more and jib-cranes with a lifting capacity of 5000 kg or more at minimum jib radius, the user shall not require or permit any person to operate such a lifting machine unless the operator is in possession of a certificate of training, issued by a person or organization approved for the purpose by the Chief Inspector.

[Date effective 10 October 1993 - G.N.R.2483 of 4 September 1992]

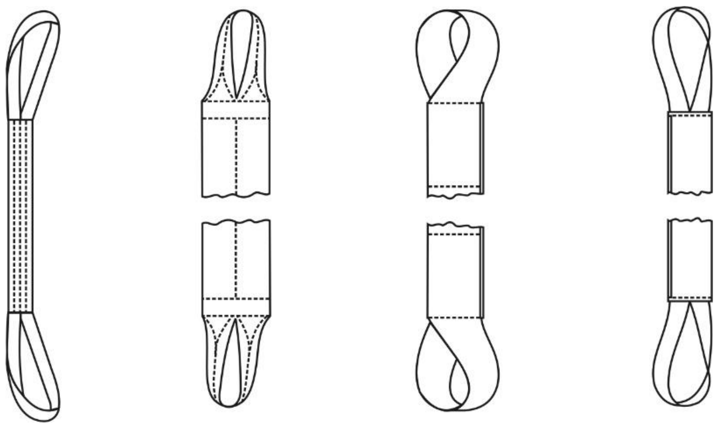
The following illustrations show different end fittings and eyes.

METAL END SLINGS: Good on big size slings. They fit better on the hook and less wear in the eyes.

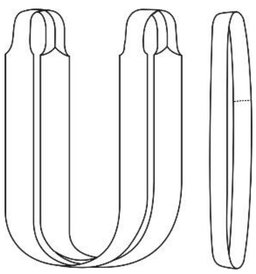


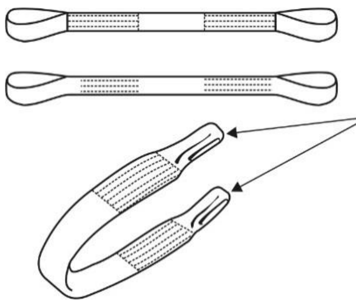


TWISTED EYE SLINGS: The reason for the twisted eyes is that they fit better in a hook and do not twist the slings.



ENDLESS GROMMET SLING: It is not easy to use on every load.





STANDARD EYE AND EYE SLINGS:

2.1 Inspection of webbing slings

The danger with webbing slings is that a person who uses them daily may not notice the warning signs of wear, tear and damage.

Before each use, check web slings for:

a) worn eyes or fittings;
b) bent, corroded or twisted fittings;
c) frayed or torn webbing;
d) cuts and holes, especially along edges;
e) worn or broken stitching;
f) wear from abrasion; and
g) heat charring or burns.

Webbing slings showing any of these signs should be taken out of service and cut up or destroyed so that they cannot be used by anyone else.

NOTE: A red filler yarn is being developed for Colour-Lift slings as a wear indicator.

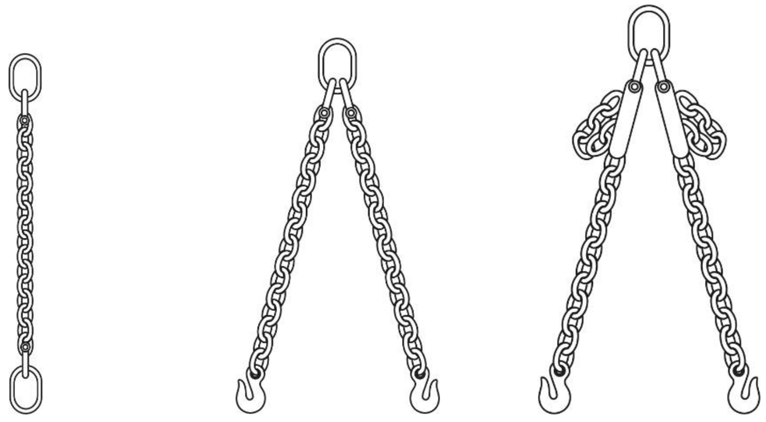
When the webbing has been worn or damaged to the extent that these red yarns become visible, it is an indication that the webbing sling should be withdrawn from service and discarded.

2.2 Material sling safety

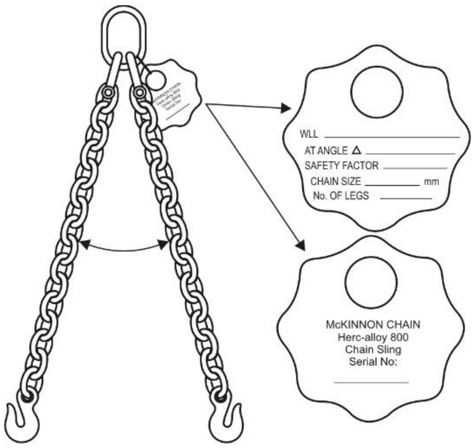
a) Do not shorten or lengthen Material slings by knotting, hitching, or other methods.
b) Use softeners to protect web slings from sharp corners and edges on the load. Heavy lifts often require rounded padding in addition to softeners.
c) Do not pull material slings out from under a load that is resting on the slings.
d) Do not drag material slings on the ground or let them snag, twist, or kink.
e) Material chokers should choke up on the material and not on the fittings.
f) Slings must be stored properly where they cannot be damaged!

3. Chain Slings

There are various types of chain slings and combinations but we are only dealing with the 2 most commonly used types namely single and double leg slings.



The following is what every chain sling must have on it. If it does not have this information on it, DO NOT USE IT.



3.1 Inspection of chain slings

a) check SWL of slings;
b) never over load a sling;
c) never use a chain in which the links are locked, stretched, or are without free movement;
d) never hammer a chain or hook into position;
e) never use an excessively pitted, corroded or worn sling;
f) do not carry a load on the point of the hook or insert the point into a chain link;
g) do not drag a sling from beneath a load;
h) do not allow loads to fall onto a sling;
i) do not cross, twist, kink or knot a sling;
j) do not drag a sling along the ground;
k) do not use a sling over sharp corners without protective padding; and
l) do not insert bolts or spikes to shorten slings.

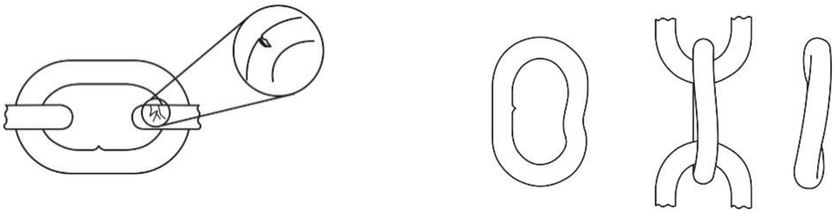
REMEMBER:

A damaged link means a damaged chain. A link-by-link inspection should be done to detect the following:

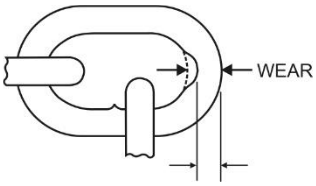
a) Check first for the SWL. If not shown, DO NOT USE the sling.

b) Check for twisted or bent links!

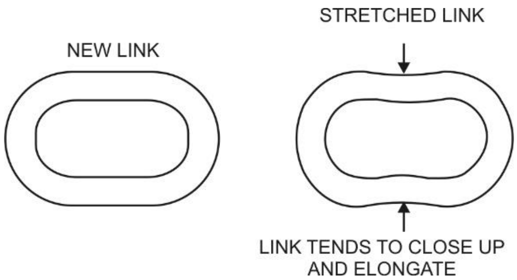
c) Check for gouges, chips and cuts



d) Inspect links for abnormal wear at the bearing surfaces



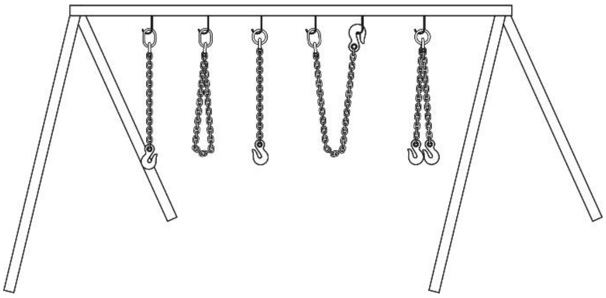
e) Look for link stretch during inspections



f) If any of the abovementioned faults are found, DO NOT USE the sling.

3.2 Storage of chain slings

Proper storage of lifting equipment is a legislative requirement.



'A' Frames provide an excellent method of storage.

Chain slings are often damaged even when not in use. For example, if thrown on the floor, they collect grit and should be cleaned occasionally to remove this damaging abrasive grit which may become ground between the links and cause undue wear when the chain sling is being used.

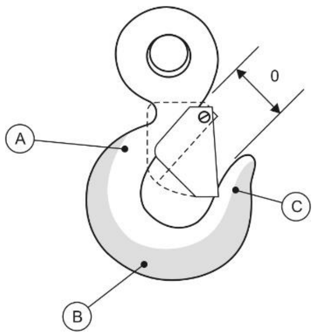
4. Hooks

There are a few points one must remember when using hooks:

a) all hooks used on lifting tackle must have a safety latch; and

b) hooks must be regularly inspected as follows:

When a hook is new, 3 centre punch marks are made on the hook (see sketch below: A, B and C). The distance between A and B must be the same as the distance between A and C.



Example: Distance between A and B = 50mm
Distance between A and C = 58mm

15% of 50mm = 7,5mm
Difference between AB and AC = 8mm

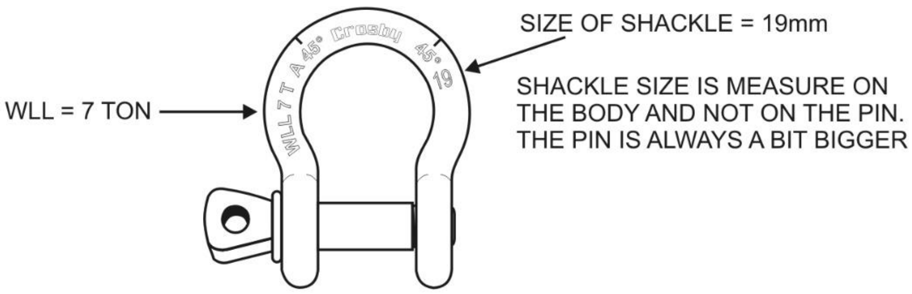
The hook must thus be replaced.

5. Shackles

A shackle is one of the safest items of lifting equipment you can use. However, the right shackle for the load must be used and in the correct way.

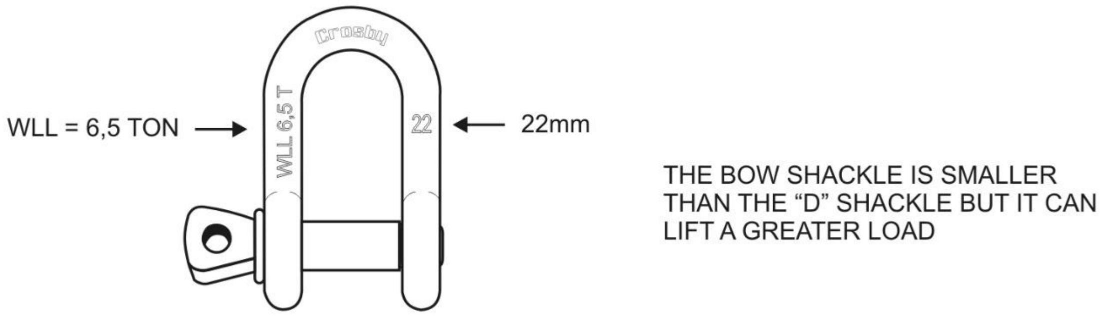
There are two types of shackles used in rigging:

a) The Bow shackles
b) The D shackle – also known as the chain shackle



SCREW PIN BOW SHACKLE

Because a shackle is used for lifting, the WLL (Work Load Limit) or SWL (Safe Working Load) must be indicated on it.



SCREW PIN "D" SHACKLE OR CHAIN SHACKLE

IMPORTANT:
If the SWL is not on a shackle, DO NOT USE IT!

6. Eye Bolts

One must be very careful when lifting with eye bolts – especially on electrical equipment. Most of the eye bolts on electrical equipment are for assembly purposes only and not to lift the whole load. The same applies to gear boxes. Eye bolts on a gear box is to lift the top cover level and not the whole gear box.

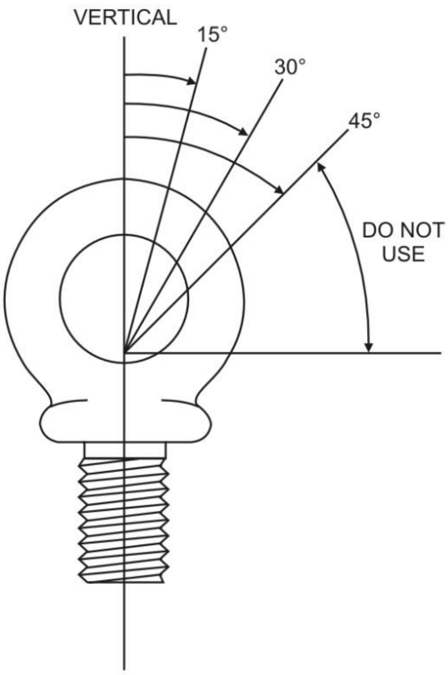
So, when lifting on an eye bolt, make sure it can take the load.

An eyebolt is a lifting device and must have its SWL on it. If the SWL does not appear on the eye bolt, DO NOT USE IT!

As can be seen on the sketch, it is marked M24. This is the shank thread size. The SWL appears on the other side.

Collared metric eye bolt

On the sketch below is the maximum angels allowed on an eyebolt, that is if the eyebolt is used correctly, the correct size and is fitted 100% correctly.



REMEMBER: The SWL on lifting equipment is when it is in a good condition and used under normal conditions. No shock loading.

PART 7 - LIFTING MACHINES

1. Cranes

Cranes have numerous applications in industrial activities, construction, docks, shipbuilding and on railways. The principal hazard associated with any crane operation is the risk of collapse or overturning of the crane which can be caused by a variety of factors such as overloading, incorrect slewing or even incorrect construction of the crane.

One of the principal causes of crane overturning is associated with the crane operator exceeding the maximum permitted moment which is the product of the load and the radius of operation of the crane. (The radius of operation is the horizontal distance between the crane's centre of rotation and a vertical line drawn through the crane hook.) If the maximum permitted moment is exceeded, the crane is in danger of overturning or collapse.

There are many types of cranes in use. A few of the more common forms of crane are discussed below.

1.1 Fixed cranes

This type of crane is permanently fixed in one location, such as wharf, loading bay, dock or rail siding. It may incorporate a fixed angle or adjustable angle jib, and may rotate through 360 degrees.

Accidents involving fixed cranes with resultant crane collapse or fall of the load and / or injury to operators can occur in many ways. One principal cause of accidents is the failure to lift vertically. This may arise through the physical impossibility of getting the load directly below the lifting point, or the use of a fixed crane in a deliberate attempt to drag a load sideways which is a very dangerous practice. Loads treated in this way can overstress the crane and cause collapse, or the load may start to swing violently, crushing people and damaging property.

Alternatively, loads being raised or lowered may catch in a fixed structure causing damage. The “snatching” of loads, instead of operating a slow and steady lifting action, can cause crane failure. Moreover, attempting to pull an object from under other material can impose loads of up to one hundred times that anticipated often with disastrous results.

Cranes with adjustable angle jibs have collapsed through the operator's failure to observe the reduction in the safe working load as the jib moves towards the horizontal.

Similar observations apply in the case of rotational cranes. Accidents are caused by incorrect lifting and slewing, failure of the rotating gear when slewing and, more commonly, slewing too fast. Variations in wind speed, particularly while slewing, have a direct effect on the strength and stability of this type of crane.

1.2 Tower cranes

These cranes are often covered by the Lifting Operations and Lifting Machines Regulations and are highly complex items of plant. Accidents are caused through incorrect assembly of the crane and insufficient access to the jib, mast and driver's cab. The need for the driver to reach the cab safely is well recognised, but safe access to other parts of the crane is necessary during inspection, maintenance and repair, and in the course of erection or dismantling.

Modifications to tower cranes may affect their strength and stability, and the manufacturer's advice should be sought prior to any modification.

Rail-mounting arrangements and the system for maintenance of such cranes must be considered in any assessment of safe working operations.

1.3 Mobile cranes

Mobile cranes are used increasingly for lifting heavy items into specific locations. Some incorporate a telescopic or articulated boom and rotate through 360 degrees on the chassis of a purpose-built road vehicle. In addition to the precautions outlined previously for fixed cranes, it is imperative that any lift takes place on solid level ground, using the vehicle's outriggers fully extended to spread the load through the vehicle to the ground. The principal cause of accidents is the use of cranes on uneven sloping ground, where the centre of gravity of the load combined with that of the crane has fallen outside the wheel base of the vehicle, resulting in overturning.

1.4 Overhead travelling cranes

The most common application of this crane is in heavy fabrication shops and foundries where the crane runs along a fixed traverse. The crane may be fixed to operate in one position or to rotate through 360 degrees.

The main hazards are derailment due to overloading, obstructions on the traverse or rail track, and the absence of adequate stops at each end of the traverse or rails. With rail-mounted cranes, either the crane must be fitted with effective brakes for the travelling motion, or sprags, scotches or chocks must be provided and used.

Many accidents are attributed to overhead travelling cranes crushing or striking operators working in the vicinity of the track. Effective measures must be taken to prevent a crane approaching within about six metres of any place where a person may be working on or near the wheel track of such a crane. The only reliable "effective measures" are the complete isolation and locking off of the electrical supply to the crane, coupled with the issue of a permit to work indicating that the isolation procedure has been carried out and that it is safe for work to proceed in the vicinity of the crane tract. The mere switching off of the electrical supply at a control box, even with the display of a cautionary notice on the switchbox itself, is not considered sufficient. The starter switch should be physically locked in the OFF position, or where this is not possible, the fuses removed from the operating circuit and barriers locked in the closed position.

PART 8 – MACHINE GUARDING

1. Guard types

The Occupational Health and Safety Act (Act 85 of 1993) require that dangerous parts of machinery or plant must be effectively guarded by any one of the following types of methods or by a combination of them:

a) a fixed guard,
b) an interlocking guard,
c) an automatic guard,
d) a trip guard,
e) a two-hand control device.

1.1 Fixed guards

A fixed guard by its design and construction prevents access to the dangerous part for which it is provided. Such a guard has no moving parts associated with or dependent upon the machine to which it is fitted. It is a reliable guard and requires little maintenance. Its application, however, is limited to guarding prime movers, transmission machinery and points of operation where feeding of material and withdrawing of components are achieved mechanically or by means of specially designed aids. However, if manual feeding and withdrawal are necessary, the opening in the fixed guard must be limited in size relative to the distance between such an opening and the dangerous part of the machinery. The following specifications must be observed.

Minimum distance between the opening in the fixed guard and the dangerous part	Maximum size of the opening measured at the widest point
40 mm	10 mm
65 mm	12 mm
90 mm	15 mm
140 mm	20 mm
165 mm	22 mm
190 mm	30 mm
320 mm	40 mm
400 mm	50 mm
450 mm	55 mm
800 mm	150 mm

1.2 Interlocking guards

An interlocking guard is designed to operate in such a manner that the machine on which it is installed cannot be operated unless the interlocking guard is in a closed position; and the guard cannot be opened unless the machine is not in motion or its removal from a closed position causes the machine to cease its motion at once.

The interlocking features are normally achieved by means of a combination of electrical interlock to control the operation of the machinery and mechanical interlock to control the opening of the guard. An interlocking guard is most useful for guarding points of operation where feeding of material and withdrawing of components are required in every cycle of operation and for guarding heavy rotating parts of a machine to which access is required on regular occasions. The interlocking devices should be so constructed and located that they cannot be readily tampered with or defeated. If a component of the interlocking mechanism fails, the machine should not be capable of being set in motion. Certain electrical limit switches can easily be defeated by depressing a contact button. Interlocking arrangements which are not reliable are known as 'fail to danger type' and those which are reliable are known as 'fail to safety type'. Interlocking guards require a high degree of maintenance and a reliable system of regular testing and inspection.

1.3 Automatic guards

An automatic guard is designed to automatically prevent an operator or his hands from coming into contact with the dangerous part of a machine when that part is in motion. The movable part of the guard should be positively actuated by the movement of the dangerous part of the machinery. It may take the form of a sweeping motion from side to side in front of the point of operation, or of an outward and upward push-away motion from the side of the machine, or of a pull-out action which removes an operator's hands from the point of danger.

An automatic guard is suitable for use on a machine whose cycles of operation are interspaced by manual feeding of materials, e.g., power presses and drop hammers. It relies on a mechanical linkage which derives its motion from the movement of the point of operation. The movement, so transmitted, is multiplied so that the guard moves at a rate faster than the point of operation.

The mechanisms of automatic guards must be carefully adjusted in relation to the movement and physical characteristics of the dangerous parts, and frequently examined to ensure that the safeguard is properly maintained and used. In certain fast acting machine, it is not advisable to adopt this type of guard because of the high speed with which the guard is inevitably involved, thus becoming a potential danger in itself.

1.4 Trip guards

A mechanical trip guard consists essentially of a pivoted grid or frame connected to a mechanism which can stop the machine by throwing out the clutch or belt-striking gear and applying a brake. The frame is mounted in front of the point of operation of the machine so that if any part of the hand or arm is in the danger zone as the point of operation begins its motion, the frame will be struck and will stop the machine.

Another form of a trip guard is the photoelectric safety device (electronic eye) – itis a light beam or beams, arranged as a curtain across the space between the operator and the dangerous part of machinery. The photoelectric safety device is so arranged that the interruption of the beam will activate an electrical relay which in turn sets a mechanism into action to prevent starting or further movement of the point of operation.

Trip guards are most suitable for use on machines which are normally in continuous motion where the hands (or other parts of a person) have temporarily to enter a space swept by the dangerous part, or where entangling may occur in an article or material which is being fed to a machine. The effective performance of a trip guard is greatly dependent upon the stopping characteristics of the machine which must be controlled within defined limits. An efficient brake is normally a necessity. The design of mechanical trip guards should be such that the machinery cannot again be set in motion unless and until the guard has been reset.

1.5 Two-hand control devices

A two-hand control device is so designed that the operator's hands must continuously engage the controls of the machine in order that its cycle of operation can be completed and if one or both of the operator's hands cease to engage the controls, the machine stops immediately.

A two-hand control system can be pneumatic, hydraulic, electric or mechanical. For guarding against the perverse ingenuity of some operators, it is important to install a timer mechanism in a two-hand control device so that the controls must be engaged simultaneously before a cycle of operation can be set in motion. Timer mechanisms which permit no more than a few milliseconds are readily available for this purpose.

2. Construction of guards

Every guard must be rigid and of substantial construction, and the materials incombustible. Wherever practicable, guards should be made from solid material in preference to perforated or open mesh construction. If sheet steel is used, the minimum thickness should be S.W.G.18 (1.2mm). Where open mesh guarding is chosen, the apertures should be such that finger access to the dangerous parts is not possible. Wing nuts or similar fastenings should not be used to secure the various sections of guard because they are too easily removed. The sections should be bolted or riveted.

3. Maintenance of guards

Guards should be secured in position, and regular and frequent checks should be made to ensure that they are in a good state of repair and kept in position. On many machines, guarding is by enclosure with hinged sections or access doors. Secure locking devices should be fitted to them and measures should be taken to ensure that they are kept in the closed and locked position whenever the machinery is in motion.

In cases where a section of a guard has to be removed frequently to gain access, it is good practice to interlock the section of the guard with the machine starting mechanism.

Investigations into machinery accidents confirm the need for regular inspection and testing of all interlocking guards, automatic guards, trip guards and two-hand control devices. It is strongly recommended that inspections and testing should be carried out at regular intervals by a responsible person, and that a record should be kept of the results and any action taken.

4. Dangerous Parts of Machinery or Plant

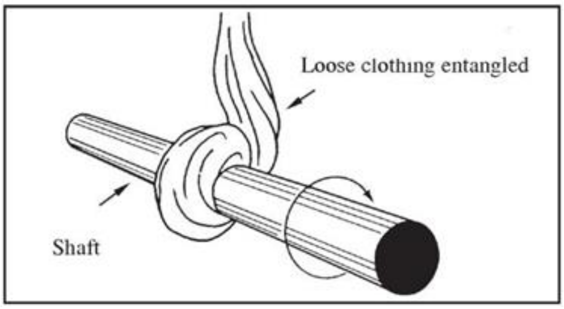
The following discussion contains examples and illustrations of the 17 groups of dangerous parts of machinery or plant and effective guarding for them.

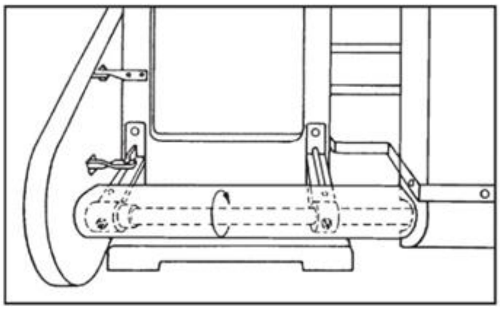
4.1 Group 1: Revolving shafts, couplings, spindles, mandrels, bars and flywheels

A shaft may be smooth or rough, may rotate slowly or rapidly, and may be small or large in diameter. It is dangerous when revolving unless it is covered.

Shafting which appears to be smooth can grip clothing or hair and cause serious accident.
Shafts, couplings, spindles, mandrels and bars can be effectively guarded by fixed enclosure guards.

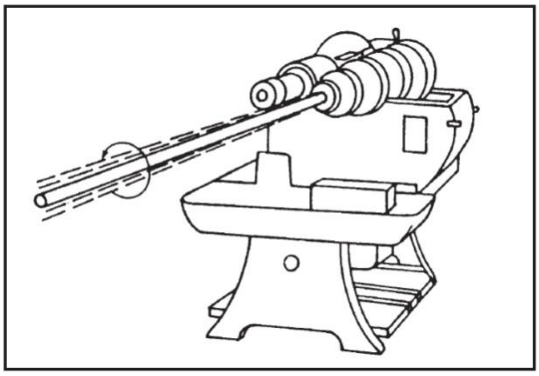
REVOLVING SHAFT

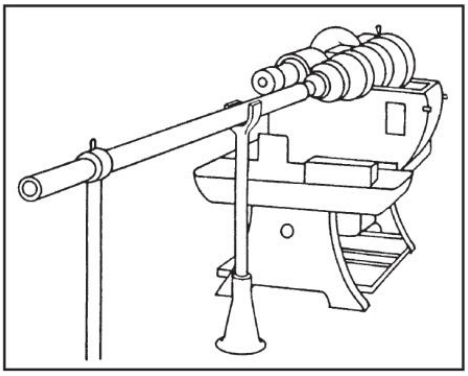




UNGUARDED **GUARDED**

REVOLVING STOCK BAR





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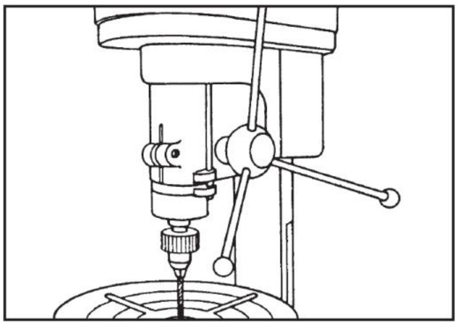
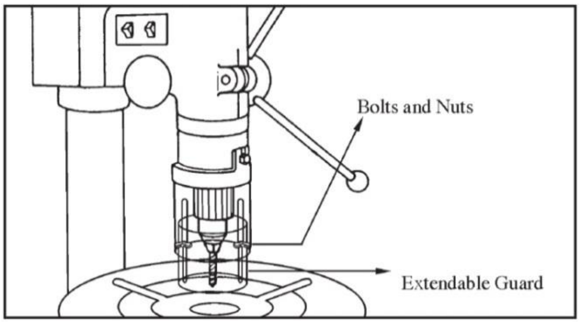
DRILL SPINDLE





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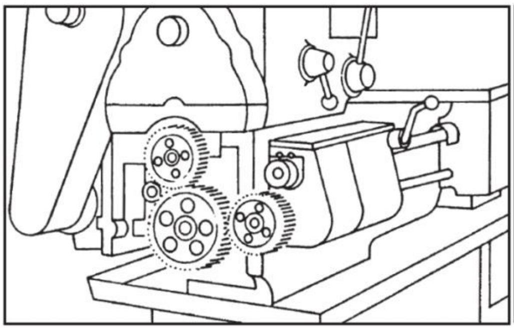
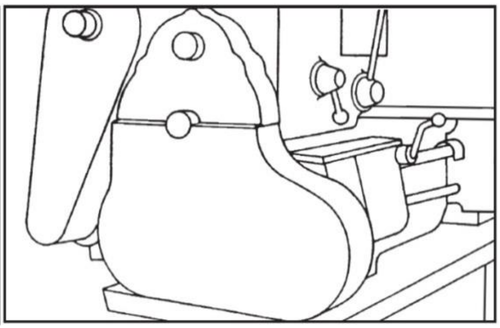
4.2 Group 2: In-running nips between pairs of rotating parts

An in-running nip exists when a pair of rotating parts such as shafts or rolls rotates in opposite direction. The pair of rotating parts may rotate in close contact or very near to one another so that there is a trapping danger between the two rotating parts. In-running nip points of this nature are found on steel rolling mills, PVC rolls, calendars and rolls in the rubber, paper and printing industries.

Gear wheels and friction wheels can be effectively guarded by fixed enclosure guards while many close contact rolls or non-contact rolls can be guarded by specially designed nip guards.

RUNNING IN NIP POINT





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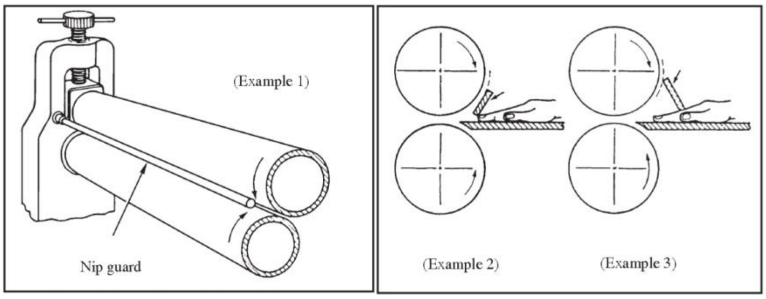
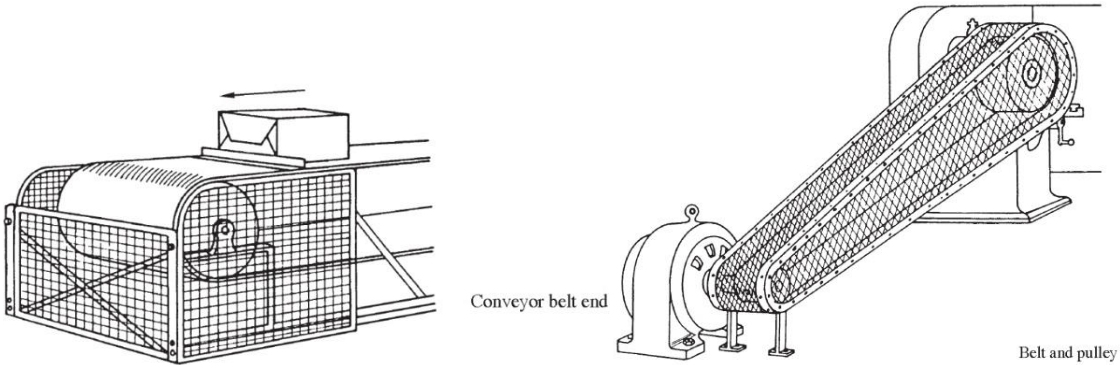
4.3 Group 3: In-running nips of the belt and pulley type

Nip points are found on the points of contact between belts and pulleys, between chains and sprocket wheels etc. The danger of in-running nips is that they can, for example, draw in an operator's hand or fingers and crush them. Once the hand or finger is drawn in, it is difficult to withdraw it.

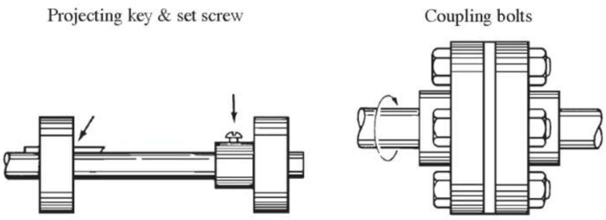
Fixed guards, either of sheet metal or wire mesh, can effectively guard the pinpoints of the belt and pulley type.





4.4 Group 4: Projections on revolving parts

Typical examples are coupling bolts, set screws on a revolving shaft or bar. Their potential for causing serious injuries is higher than the shafts, bars, etc. in Group 1. They can effectively be guarded by fixed enclosure guards or in the case of set screws, having them countersunk in the shaft or bar.



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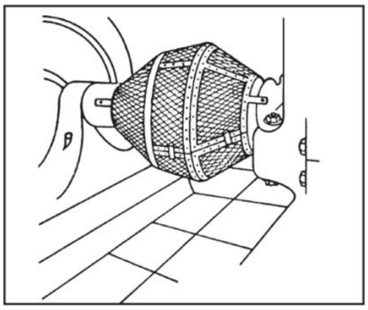
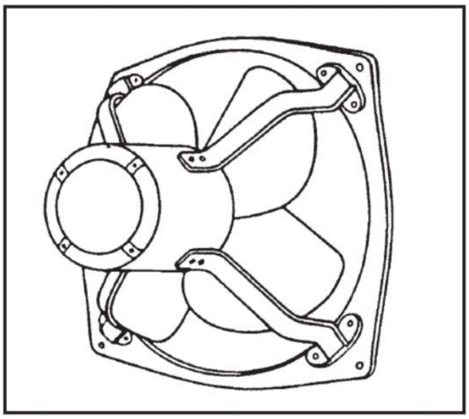


GUARDED

4.5 Group 5: Discontinuous rotating parts

Open-arm pulleys, fan blades, spoked flywheels etc. are examples of discontinuous rotating parts and they are dangerous. They can trap and twist or lacerate a person's hand or arm.

Such parts can also grip clothing and through mere skin contact can force an arm or hand into a dangerous position, thus causing severe injury. They can be effectively guarded by fixed guards either of sheet metal or strong wire mesh construction.



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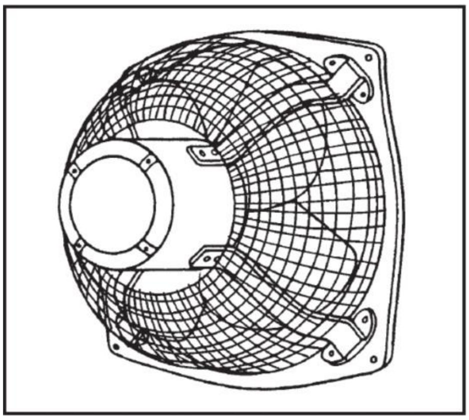
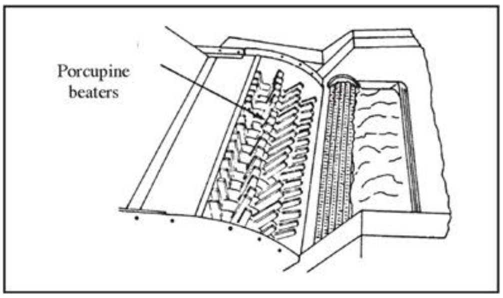


GUARDED

4.6 Group 6: Revolving beater, spiked cylinders, and revolving drums

Revolving beaters, spiked cylinders and revolving drums are highly dangerous. In the case of revolving beaters and spiked cylinders, the danger is formed by the combination of rotary and cutting action of the moving parts in the machines. The revolving drums are dangerous due to the size and speed the rotating parts. They can be effectively guarded by fixed enclosure guards.



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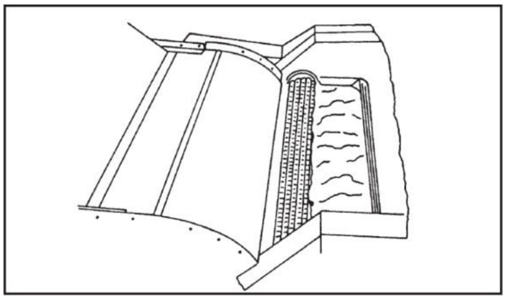
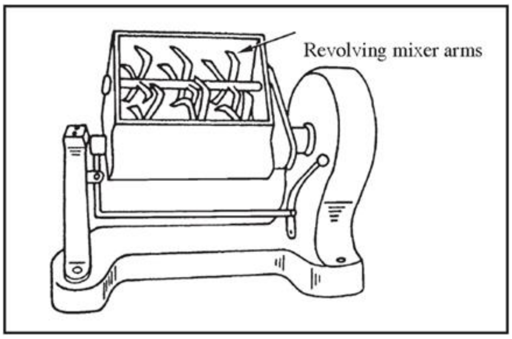


GUARDED

4.7 Group 7: Revolving mixer arms in casings fitted with openings

Revolving mixer arms are dangerous due to their rotary and beating action of the arms. They can cause very serious accident if a hand or arm is trapped by the revolving mixer arms. Loose clothing can be caught and it may then drag a person into a dangerous area.

The guarding example given in the figure on page 45 is an interlocking guard. It ensures that the machine cannot start until the cover is closed and that the machine is stopped when the guard cover is opened.



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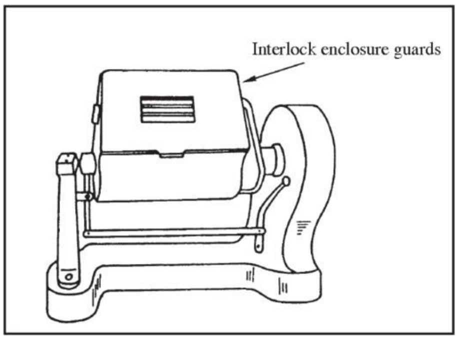
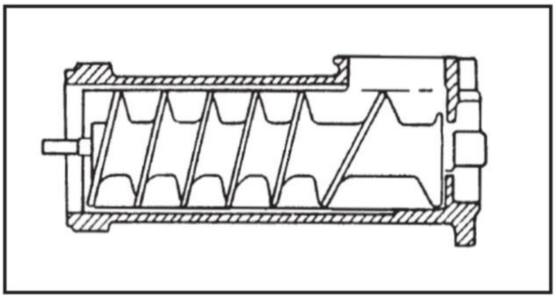


GUARDED

4.8 Group 8: Revolving worms and spirals in casings fitted with openings

In screw or worm mechanisms, the danger lies in the shearing action between the moving screw and the fixed parts of the machine. The screw action can drag, mangle and crush a hand or arm. This can sometimes lead to major amputation.

The figures show that the dangerous part of a meat mincer can be guarded by a hopper guard or by an inverted bell guard. Entrance of fingers into the trapping area of the screw is not possible in both cases. The figures also show the guarding of the worm of a plastic extruder by a hopper guard.



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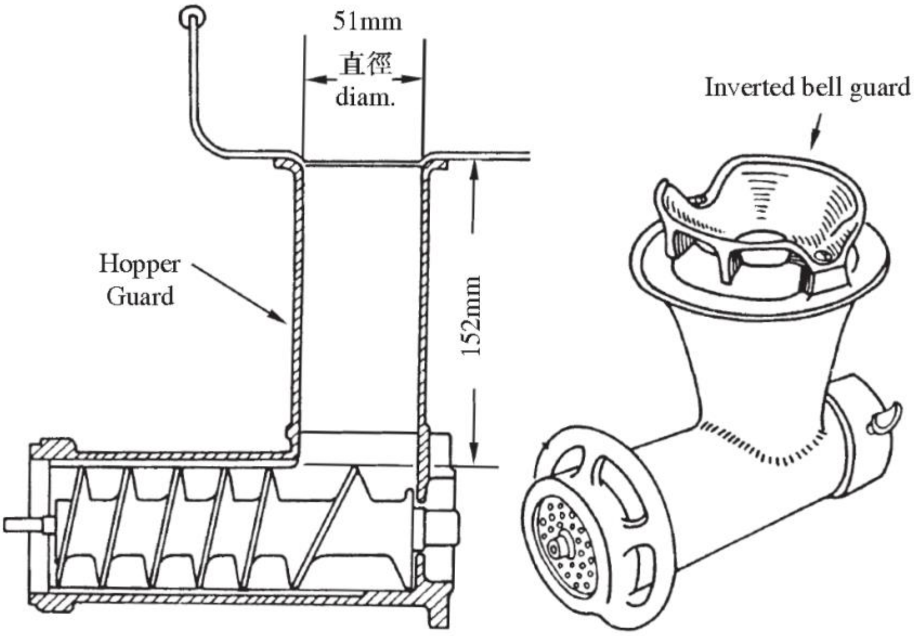
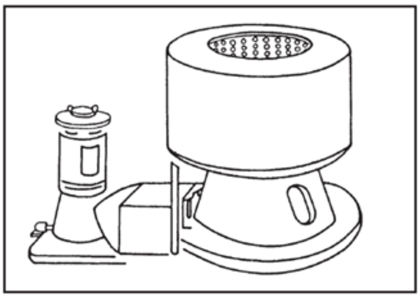


GUARDED

4.9 Group 9: Revolving high-speed cages in casings fitted with openings

High-speed revolving cages are extremely dangerous because of the centrifugal force especially if the cage is over-loaded or unevenly loaded. Bursting of the cage may occur particularly when it has not been properly maintained. Loose clothing of the operative may be dragged by the revolving cage when in contact and lead to serious accidents.

The figures show a hydro-extractor which is fitted with an interlocking guard. Reliance on a loose or hinged cover alone does not satisfy the requirement of providing effective guarding.



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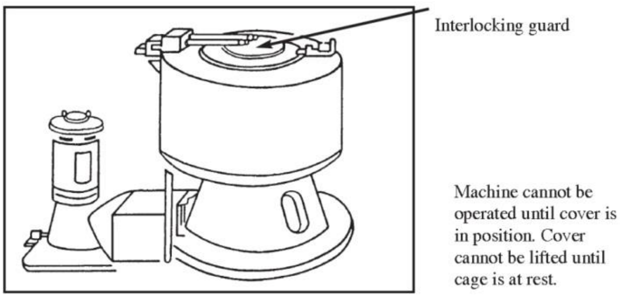
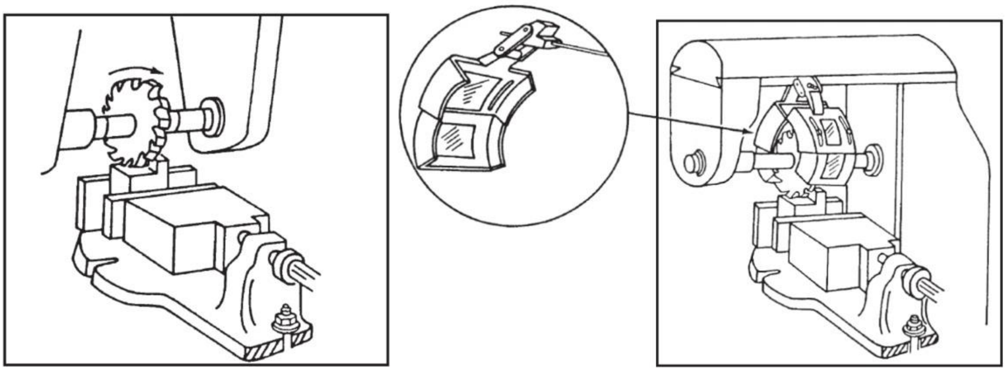


GUARDED

4.10 Group 10: Revolving cutting tools

Examples of this type of dangerous parts are circular cutters, circular shears, etc. The danger of cutting action exists at the cutting edge of the tool. Major amputation may result.

The figures show how a milling cutter can be securely fenced by a fixed guard and a plastic granulator can be fenced either by a “goose neck” hood guard or by a hopper fitted with a rotary feeding device.

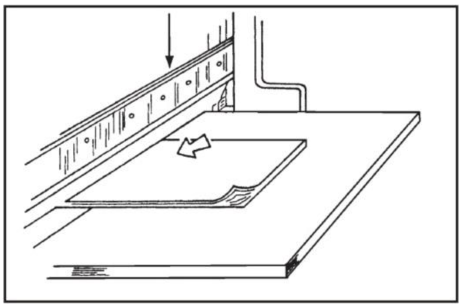


UNGUARDED **GUARDED**

4.11 Group 11: Reciprocating cutting tools

The guillotine is a dangerous machine when used in an unguarded state. The guillotine blade is particularly dangerous when operated by power. Even momentary inattention of the operator can result in serious accidents. Lack of care by the operator and absence of proper training also contribute to guillotine accidents.

The illustrations for this group show how a paper guillotine can be guarded by an adjustable Perspex fixed guard or by a photoelectric safety device, and how a metal guillotine can be guarded by a fixed metal guard.



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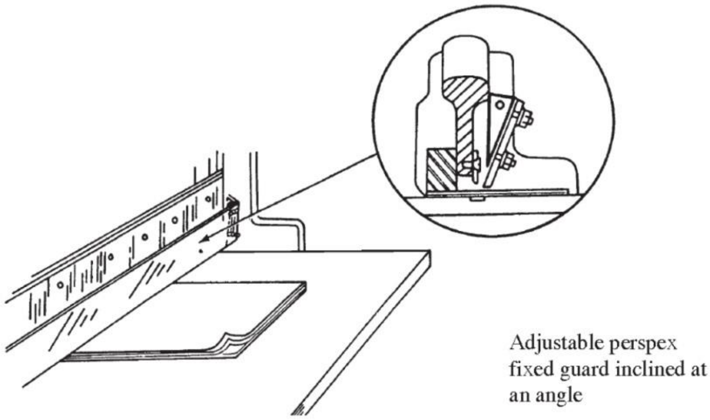
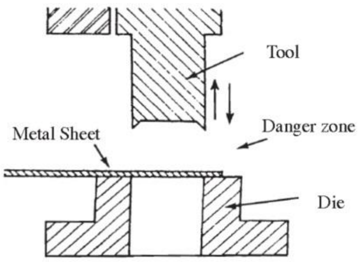


GUARDED

4.12 Group 12: Reciprocating press tools and dies

The cutting, forming, and bending action of the tools and dies of power presses, hydraulic and pneumatic presses account for numerous serious hand and finger injuries. These machines are universally recognised as dangerous and have posed many serious problems in accident prevention as well as in designing and developing reliable and sound mechanical methods in the safe guarding of the tools and dies of these machines.

The fitting and maintenance of effective guards on power presses is a skilled job, and a sound knowledge of the machine as well as the causes of press accidents is necessary to ensure safe operation. Even for power presses which have been fitted with suitable guards, accidents still occur because of improper adjustment or poor maintenance of the guards.



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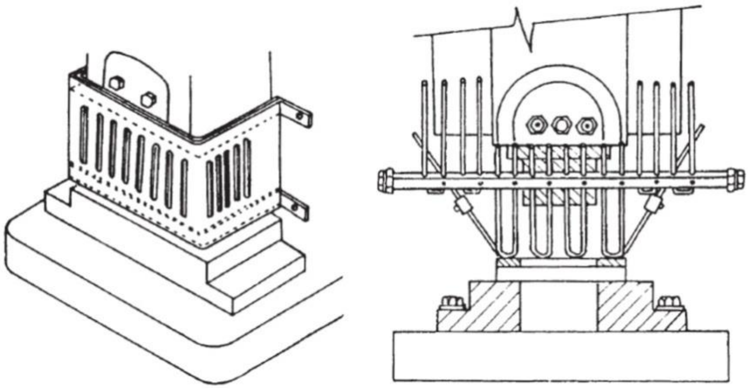

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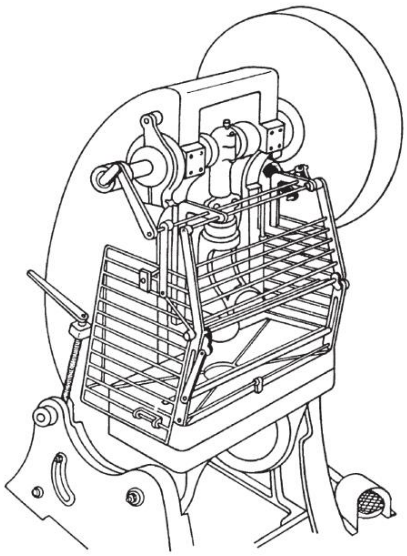
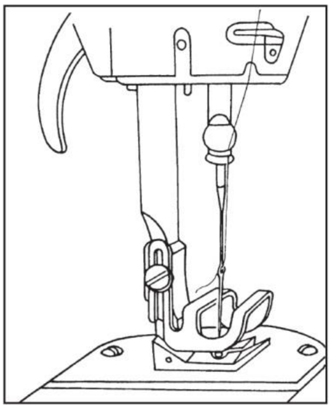


Power press (guarded with interlocking guard)

4.13 Group 13: Reciprocating needles

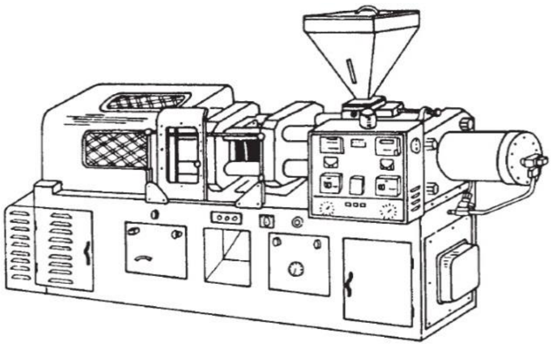
Sewing machines are typical examples of the reciprocating needles group. These machines are responsible for numerous finger injuries in the garment industry, especially when mass production of garment goods requires the use of very high-speed power-driven sewing machines. The fast sewing speed, plus the close proximity of the operator's fingers manoeuvring near the danger zone, is the major cause of many sewing needle injuries. Although the nature of such injuries may not be serious, the pain involved is considerable.

The figure shows a sewing needle can be satisfactorily guarded.



4.14 Group 14: Closing nips between platen motions

The trapping area between closing moulds of plastic injection moulding machines has caused many serious accidents resulting in the mutilation of a hand or an arm. Accidents often occur when the operator is trying to use his hand to remove a moulded article jammed on a mould and accidentally triggers off the photoelectric device controlling the closing cycle of the mould platen, or is trying to reach the mould area when the platen is closing



Plastic injection moulding machine

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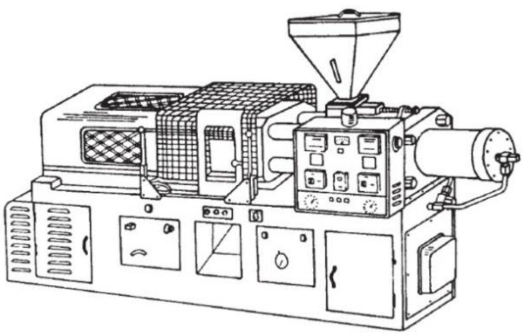
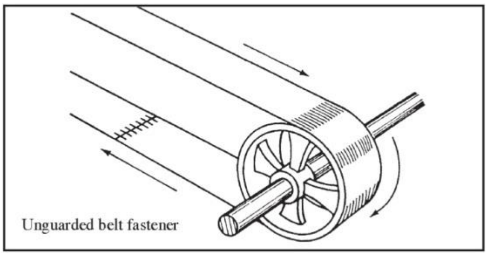


GUARDED

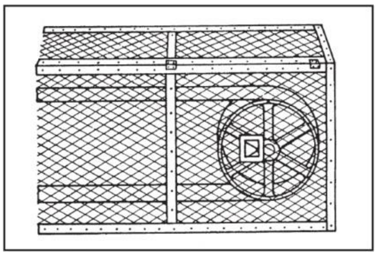
It is not uncommon that the opened platen may suddenly close due to faults developing in micro switches on these machines. If the operator cannot withdraw his hand in time, it will be seriously injured. Other examples are platen presses, paper-embossing machines and die casting machines.

4.15 Group 15: Projecting belt fasteners and fast running belts

Projecting belt fasteners cause abrasion injuries when any part of a person's body comes into contact with them. They can also hook onto the person's loose clothing, thus dragging him onto and around the belt's pulleys and shafts. Fast running belts have similar potential for causing serious accidents and injuries. They can be effectively guarded by fixed guards which may also be single-piece guards for the parts in Group 3.



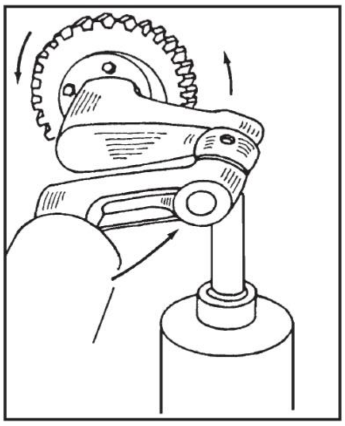
UNGUARDED

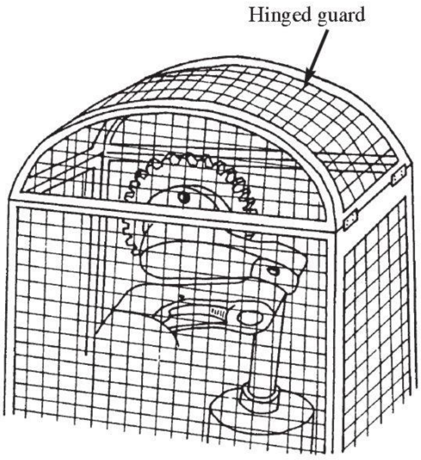


GUARDED

4.16 Group 16: Nips between connecting rods or links, and rotating wheel cranks or discs

The nips between the connecting rods / links and rotating wheel cranks /discs are dangerous points and can lead to serious injury. Such areas can be guarded effectively by fixed guards which can be designed to have interlocking hinged sections so that access to parts requiring frequent lubricating can be made when the machine has been switched off.



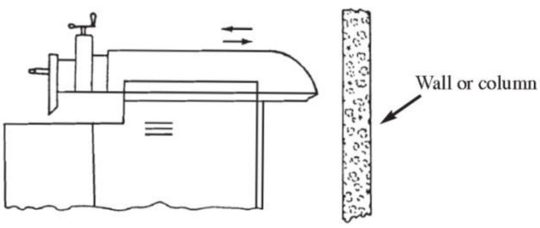


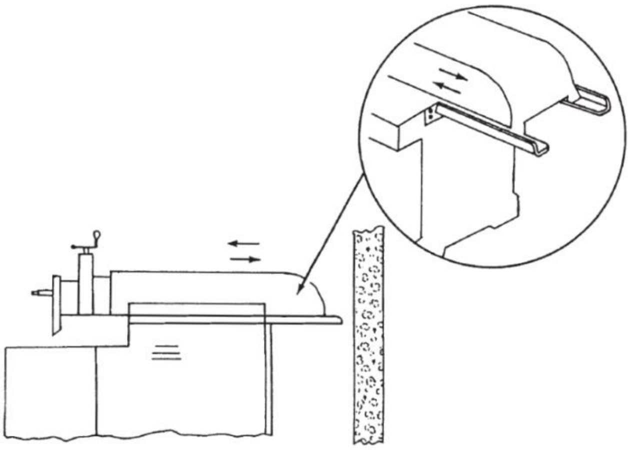
UNGUARDED **GUARDED**

4.17 Group 17: Traps arising from the traversing carriages of self-acting machines

In the planning stage, it is important that the layout of the machinery does not cause a trapping area between a traversing carriage of self-acting machine and a fixed object such as wall or column. There is a point of danger where the moving part of the machine approaches a fixed object (e.g., a column). Always try to spot and eliminate such danger during planning or re-planning of layout.

Should such trapping danger be found afterwards, guard bars (or guides) can bead so that no person can go in between the pinch point created by the reciprocating slide when approaching the fixed object.





Reciprocating mechanism creating pinch point at fixed object

UNGUARDED **GUARDED**

PART 9 – LADDERS

1. Purpose of a ladder

The purpose of a ladder is to perform work in an elevated position safely.

2. Management responsibility

In terms of the occupational health and safety act and the occupational health and safety regulations the responsibility is placed on the employer to ensure that:

a) Ladders purchased are suitable for the purpose for which it is used,
b) Ladders are constructed of sound material,
c) Ladders are maintained in a safe condition according to supplier's specifications. and
d) Ladders are used safely.
e) A suitable sheath or receptacle is provided in which hand tools shall be kept when not being used.

3. Types of portable ladders

Essentially a ladder is a climbing device consisting of two side rails called stiles, joined at regular intervals by crosspieces called steps, rungs or cleats, on which a person may step in ascending or descending manner. Portable ladders are designed as "one-man" working devices with sufficient strength to support the person as well as his tools and materials.

Two basic types or classes of ladders are addressed in this module namely trestle ladders also called free standing ladders and straight ladders.

3.1 Trestle ladders

Trestle ladders are free standing ladders and come in various shapes and sizes. The design and use of the ladder determines the name of the ladder. Typical trestle ladders are:

Typical trestle ladder

Steel type domestic ladder

Mobile access ladder

Domestic access ladder/stool combination

3.2 Straight ladders

Straight ladders consists of two side rails called stiles, joined at regular intervals by crosspieces called steps, rungs or cleats. Straight ladders are not free standing and must be leaned against a structure for support. Straight ladders are categorised into single and extension ladders.

Straight Ladders

Shelf ladder

Multi-purpose z-fold ladder (Used as an extension ladder and a trestle ladder)

Extension ladder – This type can also be used as a trestle ladder

4. Construction materials for ladders

The materials used for the construction of ladders are determined by price and usage. The primary consideration in the selection of a ladder should be to select the ladder best suited for the job.

Ladders are constructed from the following basic materials namely:

a) Aluminium;
b) Wood;
c) glass fibre;
d) reinforced plastic or epoxy; and
e) steel.

Table 1 – Properties of ladders made from different materials.

Construction material	Uses/Environment	Advantages	Disadvantages
Aluminium	General purpose	Light weight Good weight to strength ratio	Expensive Less durable if not maintained properly. Conductive
Wood	General purpose	Relatively inexpensive Non conductive	High maintenance
Glass fibre	Corrosive environment. Live electrical environment	Non corrosive Non conductive	Expensive Not as durable as wood and aluminium
Reinforced plastic	Corrosive environment. Live electrical environment	Non corrosive Non conductive	Expensive Not as durable as wood and aluminium
Steel	Mobile or wheeled ladders	Relatively inexpensive	Conductive May be heavy depending on construction

5. Selection of ladders

To select a ladder that is suitable for its use consider the following:

a) The construction of the ladder meets safety standards.(See "Inspection of ladder before use")

b) The duty cycle of the ladder, i.e. the frequency of use of the ladder.

c) The combined weight of the user and his equipment.

d) The environment in which the ladder is to be used, i.e. a corrosive or electrical alive environment.

e) The reach of the ladder.

6. Inspection of ladders before use

As a safety precaution, ladders need to be inspected before use. The following need to be looked at:

6.1 Non-slip devices (feet)

Non-slip devices must be in a good condition and securely bolted, riveted in place to the stiles. Non-slip devices are strongly recommended when there is any danger of the bottom of the ladder slipping or skidding during use and is particularly important on metal, glass fibre, reinforced plastic or epoxy resin ladders.

6.2 Rungs

Rungs are fastened to the stiles only by means of nails, screws, spikes or in like manner. Where Rungs have not been properly let into the stiles in the case of welded ladders or ladders of which the rungs are bolted or riveted to the stiles, the rungs need not be let into the stiles.

6.3 Wooden ladders

Wooden ladders are constructed of straight grained wood, free from defects, and with the grain running in the length of the stiles and rungs. Wooden ladders should never be painted or covered in any manner, unless it has been established that there are no cracks or other inherent weaknesses. It is better not to buy or use a painted wooden ladder. Ladders may be treated with oil or covered with clear varnish or wood preservative.

6.4 Styles

Ladders with damaged stiles or damaged or missing rungs must be removed from service.

6.5 Loose fasteners

Ladders with loose fasteners must be removed from service.

6.6 Working parts

All working parts like the hinges must be in good working order (lubricate if necessary).

6.7 Cleaning

Clean ladder of all foreign material (wet paint, mud, snow, grease, oil, etc.).

7. Proper use of ladders

Before using any ladder consider the following:

a) Inspect thoroughly for missing or damaged components.
b) Metal ladders conduct electricity. Keep away from electrical circuits.
c) Consult manufacturer for use in chemical or other corrosive environments.
d) Use ladder only as outlined in instructions from manufacturer.
e) Ladders are designed for one person only.
f) Do not overload.
g) Do not use in high winds or during storm.
h) Do not use in poor health, if taking drugs or alcoholic beverages, or if physically handicapped.
i) Keep shoes clean.
j) Leather soles should not be worn.
k) Never leave ladder set up and unattended.
l) Pay close attention to what you are doing.
m) Never use a damaged ladder and never make temporary repair.
n) Destroy ladder if damaged, worn or exposed to fire or chemicals.

8. Positioning and use of trestle ladders

If incorrectly used, a ladder can be dangerous. To minimize the risk of incidents, follow the instructions for the proper positioning and use of portable ladders.

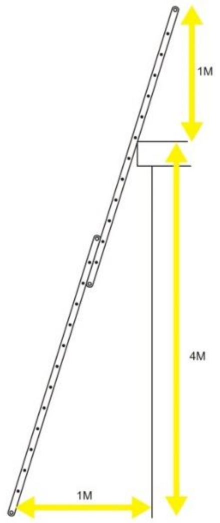
a) Use help in setting up ladder, if possible.
b) Make sure ladder is fully open and spreaders locked.
c) Secure ladder from movement where possible.
d) Set all feet on firm, level surface.
e) Do not place on unstable, loose, or slippery surfaces.
f) Place ladder where access is not obstructed.
g) Do not place in front of unlocked doors.
h) Ladders are not intended to be used on scaffolds.
i) Climb only front side of ladder.

j) Face ladder when climbing up or down.
k) Maintain a firm grip.
l) Use both hands in climbing.
m) Keep body centered between side rails.
n) Maintain a three point contact, i.e. Two hands and one foot or two feet and one hand
o) Do not over-reach, you may lose balance and fall from the ladder. Rather get down and move the ladder to new position.
p) Do not climb, stand or sit above second step from top.
q) Do not climb, stand or sit on spreader braces, ladder top or pail shelf.
r) Do not straddle front and back.
s) Do not climb from one ladder onto another.
t) Avoid pushing or pulling on the side of a ladder.
u) Do not 'walk' or 'shift' ladder while on it.

9. Positioning and safe use of straight ladders

a) Set base of ladder on firm, level surface.
b) Ladder leveling devices are available for use on uneven ground.
c) Place ladder where access is not obstructed.
d) Do not place on unstable, loose, or slippery surfaces.
e) Do not place in front of unlocked doors.
f) Ladders are not intended to be used on scaffolds.
g) Erect ladder with 700mm to 900mm extending above the roof line or working surface.
h) A single straight ladder which is required to be leaned against an object for support be used which is longer than 9 m.
i) Secure top and bottom of ladder movement where possible.
j) Ensure the ladder is fitted with non-skid devices at the bottom ends and hooks or similar devices at the upper ends of the stiles which shall ensure the stability of the ladder during normal use, or is so lashed, held or secured whilst being used as to ensure the stability of the ladder under all conditions and at all times
k) Check that top and bottom of ladder are properly supported.
l) Make sure rung locks are engaged before climbing.
m) Face ladder when climbing up or down. Maintain a firm grip. Use both hands in climbing.
n) Keep body centered between side rails.

o) Do not overreach.
p) Get down and move ladder as needed.
q) Do not climb above top support point.
r) Do not climb from one ladder to another.
s) Do not straddle or sit on rungs.
t) Avoid pushing or pulling off to side of ladder.
u) Do not “walk” or “shift” ladder while on it.



10. Setting up an extension ladder

a) Recommend tying bottom fly rung to adjacent base rung.
b) Extend and retract fly section only from ground and when no one is on ladder.
c) Do not overextend.
d) A minimum overlap of sections is required as follows:
   i. Ladder size up to and including 32 = 900mm overlap
   ii. Over 32 up to and including 36 = 1 200mm overlap
   iii. Over 36 up to and including 48 = 1 500mm overlap
   iv. Sizes over 48 = 1 800mm overlap.

e) Secure base section before raising ladder to upright position.
f) Do not raise or lower with fly section extended.
g) Extend fly section and engage rung locks.
h) Make sure rope does not create a tripping hazard or interfere with activity near ladder.

10.1 Positioning an extension ladder

a) Position ladder against upper support surface.
b) Make sure ladder does not lean to side.
c) Ladder must make an angle of approximately 75 degrees with the ground.
d) To establish if ladder is at proper angle determine the distance along the rail between the top and bottom support points of the ladder.
e) Divide this distance by 4.
f) The result will be the horizontal distance between the top and bottom support points.

11. Proper care and storage of ladders

Hang ladder on racks at intervals of 1,8m for support. Never store materials on ladder. Never drop or apply an impact load to ladder. Securely support ladder in transit.

12. Personal protective equipment

PPE required when working on ladders are largely dictated by the environment in which the work is being done.

PART 10 – WELDING

1. Introduction

Welding can be dangerous and unhealthy if the proper precautions are not taken. However, with the use of new technology and proper protection, risks of injury and death associated with welding can be greatly reduced. Since many common welding procedures involve an open electric arc or flame, the risk of burns and fire is significant; this is why it is classified as a hot work process. To prevent injury, welders wear personal protective equipment in the form of heavy leather gloves and protective long sleeve jackets to avoid exposure to extreme heat and flames.

Additionally, the brightness of the weld area leads to a condition called arc eye or flash burns in which ultraviolet light causes inflammation of the cornea and can burn the retinas of the eyes. Goggles and welding helmets with dark UV-filtering face plates are worn to prevent this exposure. Since the 2000s, some helmets have included a face plate which instantly darkens upon exposure to the intense UV light. To protect bystanders, the welding area is often surrounded with translucent welding curtains. These curtains, made of a polyvinyl chloride plastic film, shield people outside the welding area from the UV light of the electric arc, but cannot replace the filter glass used in helmets.

Welders are often exposed to dangerous gases and particulate matter. Processes like flux-cored arc welding and shielded metal arc welding produce smoke containing particles of various types of oxides. The size of the particles in question tends to influence the toxicity of the fumes, with smaller particles presenting a greater danger. This is due to the fact that smaller particles have the ability to cross the blood brain barrier. Fumes and gases, such as carbon dioxide, ozone, and fumes containing heavy metals, can be dangerous to welders lacking proper ventilation and training. Exposure to manganese welding fumes, for example, even at low levels (<0.2 mg/m^3), may lead to neurological problems or to damage to the lungs, liver, kidneys, or central nervous system. The use of compressed gases and flames in many welding processes poses an explosion and fire risk. Some common precautions include limiting the amount of oxygen in the air, and keeping combustible materials away from the workplace.

1.1 Fires and explosions

These are an ever-present hazard with many welding processes.

1.2 Burns

Welding causes items to become hot – creating a risk of burns and fires from hot metal and welding spatter.

1.3 Fumes

Fumes generated by different welding processes may range from being of nuisance value to highly toxic. Health effects can occur very soon after exposure (e.g., Exposure to cadmium fumes can be fatal within hours) or may not result until after many years. Fume control requires appropriate ventilation equipment and may require advice from a specialist.

1.4 Electric shock

Welding processes that use electricity pose both obvious and subtle hazards of electric shock – which can be fatal. Standard precautions, as explained in this book, need to be taken during the use of welding equipment, and expert assistance can be needed in some circumstances to identify subtle hazards. Equipment selection, set-up and maintenance is important and may require specialist advice to ensure safety.

1.5 Hazardous substances

Hazardous substances used during some welding processes can require highly specialised methods of control (e.g., the extremely toxic hydrofluoric acid.)

1.6 Toxic gases

Toxic gases may be:

a) used in, or generated by, the process (e.g., acetylene, ozone, nitrogen oxides, carbon monoxide)
b) generated when coatings on metal surfaces are heated (e.g., epoxy resins, degreasing agents, paint)
c) generated when the arc flash and some degreasing chemicals or paints react (e.g., phosgene or phosphine).

1.7 Suffocation

Inert gases used during welding can flood an area and lower its oxygen content, especially in confined spaces. Suffocation can result.

1.8 Non-ionised Radiation

Arc flash is a well-known hazard of welding. Standard precautions (see part 15) should be used to prevent eye and skin exposure – both for the worker and for people in the vicinity. Reflecting surfaces make exposure to radiation more likely.

1.9 Heat stress

Working for long periods in hot environments can lead to distress and in an extreme, fatal heat stroke. Specialist advice must be sought if welders work in hot environments. (See TN7 chapter 23.)

1.10 Dust

Associated processes (grinding) may generate hazardous levels of dust.

1.11 Noise and vibration

Noise and vibration levels during some welding processes can be high and should be controlled and/or appropriate hearing protection should be worn.

1.12 Manual handling

Some welding processes may involve heavy and or repetitive handling.

1.13 Other welding processes

Several processes, not covered by this course are:

a) thermit welding
b) laser welding
c) electroslag welding
d) plasma cutting
e) resistance welding
f) electron beam welding
g) brazing and soldering
h) thermal lancing.

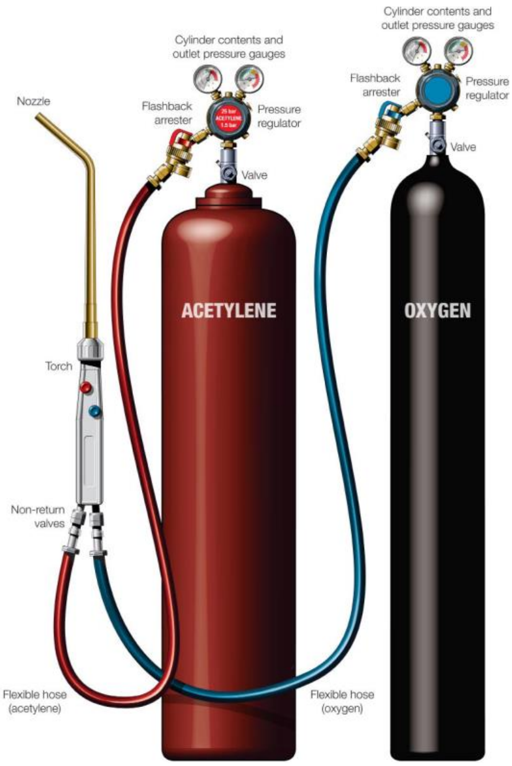
PART 11 - FLAME CUTTING AND WELDING

1. Introduction

Oxy/acetylene gas equipment has many uses - welding, cutting, heating, straightening, and descaling. The equipment is versatile, easy to move and cheap. It is so widely used that sometimes people forget about the dangers. Many people are injured each year by the incorrect or careless use of oxy/acetylene gas equipment. Some people die. This section describes the hazards associated with portable oxy/acetylene gas equipment and the precautions for avoiding injury and damage to property.

The main hazards are:

a) fire caused by heat, sparks, molten metal or direct contact with the flame;
b) explosion when cutting up or repairing tanks or drums which contain or may have contained flammable materials;
c) fire/explosion caused by gas leaks, backfires and flashbacks;
d) fumes created during flame cutting;
e) fire/burns resulting from misuse of oxygen;
f) burns from contact with the flame or hot metal;
g) crushing or impact injuries when handling and transporting cylinders.



2. Preventing fire from heat, sparks, molten metal or direct contact with flame

The flame from an oxy/acetylene gas torch (often called a 'blowpipe') is a very powerful source of ignition. Careless use of oxy/acetylene torches has caused many fires. The flame will quickly set light to combustible material such as wood, paper, cardboard, textiles, rubber, and plastics. Many processes also generate sparks and hot spatter which can also ignite these materials.

The following precautions will help prevent fire:

a) move the workpiece to a safe location for carrying out hot work;
b) remove nearby combustible materials (such as flammable liquids, wood, paper, textiles, packaging or plastics);
c) protect nearby combustible materials that cannot be moved. Use suitable guards or covers such as metal sheeting, mineral fibre boards or fire-retardant blankets;
d) check that there are no combustible materials hidden behind walls or in partitions, particularly if the welding or cutting will go on for some time. Some wall panels contain flammable insulation materials, egg polystyrene;
e) use flame-resistant sheets or covers to prevent hot particles passing through openings in floors and walls (doorways, windows, cable runs, etc);
f) if the consequences of a fire are severe, e.g., work inside ships, you may need to appoint a fire watch during and after the work finishes. It is normal to maintain fire watch for 30 minutes after hot work finishes;
g) prevent flame, heat, sparks or hot spatter from landing on the hoses;
h) keep fire extinguishers nearby.

3. Fire/explosion caused by gas leaks

Acetylene, LPG and other fuel gases are highly flammable, and form explosive mixtures with air and oxygen. Even small leaks can cause a flash fire or explosion, particularly if they are leaking into a poorly ventilated room or confined space where the gases can accumulate.

Gas leaks are often the result of damaged or poorly maintained equipment, poor connections or not closing valves properly after use.

The following precautions will help to prevent leaks:

a) turn the gas supply off at the cylinder when the job is finished or before the cylinders are moved or transported;
b) isolate and purge or remove hoses and equipment from enclosed or poorly ventilated spaces when there is a break in work;

c) keep hoses away from sharp edges and abrasive surfaces or where vehicles can run over them;
d) do not allow hot metal or spatter to fall on hoses;
e) maintain all equipment and regularly check its condition.

3.1 Checking for leaks

Regularly check all connections and equipment for faults and leaks. Equipment used in aggressive conditions such as demolition work or heavy engineering will normally need more frequent checks, e.g., weekly.

a) Use a proprietary leak detecting spray or solution suitable for use with oxy/fuel systems. Do not use soapy water or solutions containing grease or oils on oxygen systems.
b) Never look for gas leaks with a naked flame.
c) Immediately repair or replace leaking components.

Leaking hoses should not be repaired, but they can be shortened to remove a damaged section. Refit hose tails using crimp clips designed for that task. Screw tightened crimps (jubilee clips) are not recommended. There is a risk of leaks due to over-tightening or under-tightening them.

3.2 If a cylinder leaks when the valve is closed

If it is safe to do so, move the cylinder outside and away from sources of ignition (naked flames, sparks, electric motors, etc.). Prevent unauthorised access and notify the cylinder supplier immediately.

4. Backfires and flashbacks

4.1 Backfires

A backfire is when the flame burns back into the torch, often with a sharp bang. This may happen when the torch is held too close to the workpiece, or if the nozzle is partly blocked. The flame may go out or it may reignite at the nozzle. Sometimes the flame burns back into the torch, and burning continues inside it. Backfires do not usually cause injury or damage, but they can indicate a fault in the equipment.

If a backfire does occur:

a) shut off the torch valves, oxygen first (usually coloured blue) and then the fuel gas (usually coloured red);
b) shut off the oxygen and fuel gas cylinder valves;
c) cool the blowpipe with water if necessary;

d) check the equipment for damage or faults, particularly the nozzle.

4.2 Flashbacks

Flashbacks are commonly caused by a reverse flow of oxygen into the fuel gas hose (or fuel into the oxygen hose), producing an explosive mixture within the hose. The flame can then burn back through the torch, into the hose and may even reach the regulator and the cylinder. Flashbacks can result in damage or destruction of equipment, and could even cause the cylinder to explode.

The following precautions will help to prevent flashbacks:

a) Use the correct lighting-up procedure. Purge the hoses before lighting the torch to remove any potentially explosive gas mixtures. Use a spark igniter and light the gas quickly after turning it on.
b) Make sure the blowpipe is fitted with spring-loaded non-return valves.
c) Use the correct gas pressures and nozzle size for the job.
d) Maintain the equipment in good condition.

These measures will reduce the risk of a flashback but will not completely eliminate it. Non-return valves will not stop a flashback once it has occurred.

4.2.1 Protecting cylinders from flashbacks

Fit flashback arresters to both the oxygen and fuel gas hoses near to the regulators. For long lengths of hose, fit arresters on both the torch and the regulator.

The fitting of a flashback arrester is not a substitute for safe working practice.

If a flashback does occur:

a) if it is safe to do so, close the cylinder valves on both fuel gas and oxygen;
b) if the fire cannot be put out at once, evacuate the area and call the emergency fire services.

After a flashback, carefully check for damage to the torch, hoses, regulators, flashback arresters and other components. Replace parts if you need to. If in doubt, consult your supplier.

4.3 Acetylene cylinders

You should pay particular attention to any acetylene cylinder which has been involved in a flashback or affected by fire. There is a risk that the acetylene could start to decompose, and the cylinder could explode. If an acetylene cylinder becomes hot or starts to vibrate, you must evacuate immediately and call the emergency fire services.

5. Flame cutting risks

5.1 Fumes created during flame cutting

The fume from welding and flame cutting metals is harmful. You may need fume extraction and/or filtering respirators (respiratory protective equipment or RPE) to reduce the risk of ill health.

Dirt, grease and other contamination increases the amount of fume generated and can introduce very toxic substances to it. Hot work on items with lead paint, chromium (chromate) paint or cadmium plating is particularly hazardous.

a) If you flame cut outdoors and the metal is clean and unpainted you will not normally need Respiratory Protection Equipment (RPE). Try to work in a position where the wind blows the fume cloud away from you and other people.

b) If you flame cut indoors or in conditions were there is little air movement, the need for extraction and/or RPE depends on how much cutting you are going to do.

c) Automated flame cutting machines, particularly multi-head machines, will normally need fume extraction fitted to them.

d) Work on materials coated with lead or chromate paints, galvanised or cadmium plated or metal contaminated with oil, grease etc. are likely to require fume control such as extraction and/or RPE.

5.2 Fire/burns from misuse of oxygen

Oxygen leaks also increase the fire risk. Clothing contaminated with oxygen, even fire-retardant clothing, will catch fire easily and burn very fiercely. Oxygen can cause explosions if used with incompatible materials. In particular, oxygen reacts explosively with oil and grease.

You must take the following precautions:

a) never use oxygen to blow dust off clothing;
b) never attempt to improve air quality inside confined spaces by releasing oxygen in the space;
c) never allow oil or grease to come into contact with oxygen valves or cylinder fittings;
d) only use equipment designed for use with oxygen. In particular, check that the regulator is safe for oxygen and for the cylinder pressure.

5.3 Contact burns

The following precautions will help to prevent burns from contact with the flame, hot metal, sparks and molten slag:

a) work in a safe location away from other people;
b) wear protective clothing, boots, gauntlets and eye protection;
c) shut off the torch when not in use. Do not leave a lighted torch on a bench or the floor as the force of the flame may cause it to move;
d) clamp the workpiece, avoid holding it by hand.

5.4 Crushing or impact injury

The following precautions will help prevent injury when handling and transporting cylinders:

a) Prevent cylinders from falling or being knocked over by securing them with a stout chain or strap. It is normal to chain them to a wheeled trolley or against a wall.
b) Avoid moving a cylinder by tilting it on its base and rolling it. It is better to use a trolley.
c) If transported in a road vehicle, the cylinders should be secured so they don't come loose in an accident.

6. Permit-to-work

The potential for injury and property damage are such that many companies want to control hot work very closely. One way to achieve this is to operate a written permit system for welding and flame cutting work. Sometimes called hot work permits, they aim to ensure that welding and flame cutting does not start until after the risks for that particular task are identified and measures to eliminate or control risk are in place. A permit should specify:

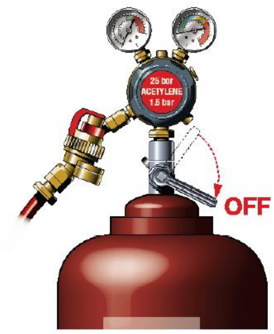
a) what work will be done;
b) how and when it is to be done;

c) what safety and health precautions are needed;
d) who is responsible for checking it is safe to start;
e) who will check the work is done safely;
f) who is responsible for confirming that work is complete and there is no longer a risk from, or to, the people doing the work.

7. Preventing fire or explosion when storing and transporting cylinders

Small leaks may not be detected immediately. If they leak into a poorly ventilated room, a van or confined space, a dangerous concentration of gas may accumulate. To prevent gas accumulating:

a) close the cylinder valves when the equipment is not in use;
b) always provide adequate ventilation during welding and cutting operations;
c) store gas cylinders outside whenever possible, or in a well-ventilated place;
d) avoid taking gas cylinders into poorly ventilated rooms or confined spaces.



The most important safety measure when transporting cylinders in vehicles is to close the cylinder valve. It is preferable to carry cylinders in an open-backed, pick-up style van. Fitting cages to the load bed may help prevent theft of the equipment. If cylinders are carried in enclosed load spaces then there should be additional ventilation fitted.

PART 12 – COMPRESSED GAS CYLINDERS

1. Introduction

Due to the nature of gas cylinders, special storage and handling precautions are necessary. The hazards associated with compressed gases include oxygen displacement, explosion hazards, toxic effect of some gases, as well as the physical hazards of a ruptured cylinder. There are almost 200 different types of materials in gas cylinders including atmospheric gases, fuel gases, refrigerant gases, poison gases and miscellaneous gases. Compressed gases are usually divided into six basic categories, with some gases falling into more than one classification. The categories are as follows:

a) Flammable Gases;
b) Oxygen and Oxidizing Gases;
c) Acid and Alkaline Gases;
d) Highly Toxic Gases;
e) Cryogenic Liquefied Gases; and
f) Inert Gases.

A sudden release of these gases can cause a cylinder to become a missile-like projectile, destroying everything in its path. Cylinders have been known to penetrate concrete-block walls. To prevent such a dangerous situation, there are several general procedures to follow for safe storage and handling of a compressed gas cylinder.

2. Identification of Contents of Compressed Gas Cylinders

a) The contents of any compressed gas cylinder should be identified clearly so as to be easily, quickly, and completely determined by any laboratory worker.
b) A durable label should be provided that cannot be removed from the compressed gas cylinder.
c) No compressed gas cylinder should be accepted for use that does not identify its contents legibly by name.
d) Color-coding is not a reliable means of identification; cylinder colours vary from supplier to supplier, and labels on caps have no value because many caps are interchangeable.
e) Tags should be attached to the gas cylinders on which the names of the users and dates of use can be entered.
f) If the labelling on the gas cylinder becomes unclear or defaced so that the contents cannot be identified, the cylinder should be marked "contents unknown" and the manufacturer contacted regarding appropriate procedures.

3. Transporting gas cylinders

a) Cylinders transported by truck must be fastened securely in an upright position so that they will not fall or strike each other.
b) Cylinders should not be transported without safety caps. A cylinder's cap should be screwed all the way down on the cylinder's neck ring and should fit securely. Do not lift cylinders by the cap. The cap is for valve protection only.
c) Cylinders must never be transported with the regulator attached to the cylinder.

d) Always use a cylinder cart to move compressed gas cylinders. Refrain from sliding, dragging or rolling cylinders on edge.

e) Only one cylinder should be handled (moved) at a time unless it is done using a cylinder cradle.

4. Storage of Compressed Gas Cylinders

a) Cylinders should not be allowed to drop nor be struck violently.

b) Cylinders should be properly secured at all times whether attached to a wall, cylinder truck, cylinder rack, or post.

c) Liquefied flammable gas cylinders should be stored in an upright position or such that the pressure relief valve is in direct communication with the vapour space of the cylinder.

d) Caps used for valve protection should be kept on the cylinders at all times except when the cylinder is actually being used or charged.

e) Cylinders should not be used for rolling, supports, or any purpose other than the transportation and supply of gas.

f) Cylinders should be stored in a well-ventilated area away from flames, sparks, or any source of heat or ignition. Keep cylinders away from electrical circuits.

g) Cylinders should not be exposed to an open flame or to any temperature above 50°C.

h) Oxygen cylinders (empty or full) in storage should be separated from fuel-gas cylinders and combustible materials by a minimum distance of 6m or by a barrier at least 1.5m high having a fire-resistance rating of at least one-half hour.

i) Flammable gas cylinders should not be stored with oxygen or nitrous oxide cylinders or adjacent to oxygen charging facilities.

j) Full and empty cylinders of all gases should be stored separately and identified by signs to prevent confusion.

k) Cylinders may be stored outdoors but should be protected from the ground to prevent bottom corrosion. Where extreme temperatures prevail, cylinders should be stored so they are protected from the direct rays of the sun.

l) Cylinders should not be exposed to continuous dampness, stored near salt or other corrosive chemicals or fumes. Corrosion may damage cylinders and cause their valve protection caps to stick.

m) Do not charge, ship, or use any cylinder which is not provided with a legible decal that identifies its contents.

5. Use of Compressed Gas Cylinders

a) Know and understand the properties, uses, and safety precautions of the gas before using the cylinder.

b) Always use the proper regulator for the gas in the cylinder. Always check the regulator before attaching it to a cylinder. If the connections do not fit together readily, the wrong regulator is being used.

c) Before attaching cylinders to a connection, be sure that the threads on the cylinder and the connection mate are of a type intended for the gas service.

d) Do not permit oil or grease to come in contact with cylinders or their valves.

e) Wipe the outlet with a clean, dry, lint-free cloth before attaching connections or regulators. The threads and mating surfaces of the regulator and hose connections should be cleaned before the regulator is attached.

f) Attach the regulator securely before opening the valve wide. Always use a cylinder wrench or another tightly fitting wrench to tighten the regulator nut and hose connections.

g) Open cylinder valves SLOWLY. Do not use a wrench to open or close a hand wheel type cylinder valve. If it cannot be operated by hand, the valve should be repaired.

h) Stand to the side of the regulator when opening the cylinder valve.

i) Do not attempt to repair cylinder valves or their relief devices while a cylinder contains gas pressure. Tag leaking cylinders or cylinders with stuck valves and move to a safe, secure outdoor location.

j) Close valves on empty cylinders and mark the cylinder "empty" with the initials "M.T."

6. Things not to do when handling compressed gas cylinders

a) Never roll a cylinder to move it.

b) Never carry a cylinder by the valve.

c) Never leave an open cylinder unattended.

d) Never leave a cylinder unsecured.

e) Never force improper attachments on to the wrong cylinder.

f) Never grease or oil the regulator, valve or fittings of an oxygen cylinder.

g) Never refill a cylinder yourself.

h) On welding gases, never use hoses longer than 6m.

i) Never use a cylinder until it is completely empty.

PART 13 – WORKING AT HEIGHTS

1. Purpose

The purpose of this inspection register, check list and task instruction is to provide an inspection tool to ensure that fall arrest and protection equipment is well maintained.

2. Working at Heights

In the construction industry, falls are responsible for more deaths than any other type of accident. Even a fall from as little as 1 meter can injure or kill you. Most often, work is done at much higher levels.

Fall protection can minimise the risk of injury from a fall, but only if it is used and maintained properly. Many injuries and deaths are the result of fall protection failing because it was worn incorrectly, or because it was damaged and could not do its job.

3. Personal Protective Equipment (PPE)

The prescribed PPE shall be worn when working at heights on industrial sites. This include but is not limited to:

a) Foot Protection
b) Head Protection
c) Hand Protection
d) Eye Protection
e) Body Protection
f) Fall Protection

4. Fall Protection Systems

Fall protection systems can be regarded as devices that have the potential to prevent a worker from falling from an elevated position.

Fall protection systems thus include devices such as:

a) Guardrails
b) Anchorages
c) Lifelines
d) Positioning Devices
e) Floor Hole Covers

One of these is required whenever you are working two metres or more above the ground, but the system used depends on the working conditions, and on which system will provide the most protection.

No matter which system is in use, you are responsible for working with the system safely to protect yourself and your co-workers.

4.1 Guardrail Systems

Guardrail systems are established to prevent falls from happening. They must be high enough to prevent a fall from an elevated work area, and strong enough to take your weight if you fall against it.

OHS Act regulations require guardrails to be 1, 2 metres high, with a mid-rail at 550mm and a toe board that extends 100mm above the walking surface. Guardrail systems must also withstand a side force of 90 kilograms.

If a guardrail is made of wire rope, flags must be placed at 2 metre intervals to make it more visible, and guardrails of any material must be smooth to prevent snags on clothes or skin.

4.2 Anchorages

When hooking up to an anchorage, always use a locking snap hook at the end of the lanyard. Locking snap hooks require a separate button to be pushed to open the snap, preventing accidental opening of the hook during a fall.

Never join two hooks. It takes only 140 kilograms of force to blow out the keepers.

The best location for an anchorage is directly above where you are working.

The higher the anchorage, the less distance you will fall before your lanyard stops you. It's also important to keep your anchorage directly over you to prevent "swing" falls. In a swing fall, your body will not only fall downward, but also sideways until it is under the anchorage. The greater the sideways distance you travel, the more you will swing and possibly collide with objects around you.

Finally, check below your work area to make sure you will not hit anything before your fall protection stops you.

4.3 Lifelines

Lifelines are a fall protection system designed for use with personal fall protection. Horizontal lifelines are stretched between two anchorages, allowing you to hook up anywhere along the line. Vertical lifelines hang from a single anchorage.

To be safe, a lifeline must withstand the force created by you and your tools falling 2 metres. In most cases, the required breaking strength is 2000 kilograms, which includes a safety factor. To maintain the safety factor, only one worker at a time is allowed to hook up to a lifeline unless it has been designed for use by more than one.

Anchorages for lifelines follow the same rules as anchorages for personal fall protection.

4.4 Positioning Devices

A positioning device is used to maintain your position on a vertical surface while you use both of your hands. These devices usually use body belts and a short lanyard which allows a fall of no more than two feet.

4.5 Hole and Trench Covers

Many falls occur in holes or deck openings. Hole covers must be strong enough to support twice the weight of a worker plus equipment and materials, and they must be clearly marked "HOLE" or "COVER." Never move a hole cover.

5. Fall Arrest Systems

A fall arrest system consists of three essential components. These are:

a) Full body harness
b) Connecting device
c) Anchor point

A rescue system must also be incorporated.

5.1 Body Harnesses

There are two typical types of harnesses:

a) the full body harness and
b) the body-belt.

The full body harness is the only permissible harness that may be used as a fall protection device.

5.1.1 Full body harness

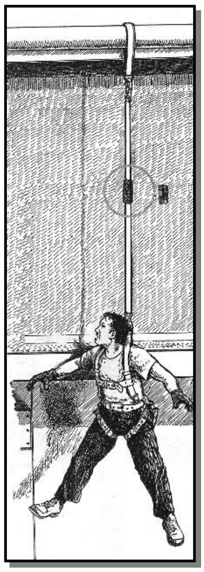
A full body harness is designed to transfer the forces that occur when arresting a fall to the buttocks of the fall victim. In addition the harness will, provided that it is properly fastened and adjusted, ensure that the user remains upright, even if he is unconscious, until he can be rescued.

5.1.2 Body-belt

A body-belt with a D-ring at the back is as a rule used for area limitation or restraint. A body-belt with 2 D-rings on the hips is as a rule used for work positioning only.

Body belts are no longer considered to be safe for application as fall protection or fall arrest systems. These devices are capable of inflicting serious injury when they stop a fall since they do not provide adequate support for the body.

5.2 Connecting device

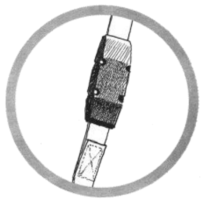


A connecting device is an assembly of components including the necessary connectors and / or subsystems that forms the connection between the anchor point and the full body harness.

The following components are available:

a) lines of fixed length
b) adjustable lines with and without webbing energy absorber
c) fall arrest blocks
d) vertical cable systems with rope grab
e) rail systems and horizontal lanyards

These may be used both separately and in combination. It is also important to follow the manufacturer's instructions.



There are generally two types of lanyards. One is a single length of material which stops a fall suddenly at a distance of two metres from the anchorage. The other type, known as a decelerating lanyard, uses friction or other means to slow the fall, starting at two metres from the anchorage and ending after another metre.

Deceleration devices may not always be used since they need more vertical distance to operate. They are however safer, because they do not bring the body to a sudden stop. Decelerating lanyards also expose the fall victim to potential danger after arresting the fall, since there is a much greater swing distance. This can be especially dangerous in enclosed work areas or near power lines.

5.3 Anchor point

An anchor point consists of two distinct parts:

a) the structure and
b) the anchor device

5.3.1 The structure

The structure is as a rule part of a bigger whole, such as a building, to which the anchor device is fixed.

Structures for vertical systems must be able to absorb the fall velocity without posing any danger of possible failure.

5.3.2 Anchor devices

An anchor point consists essentially of two parts:

a) the structure and

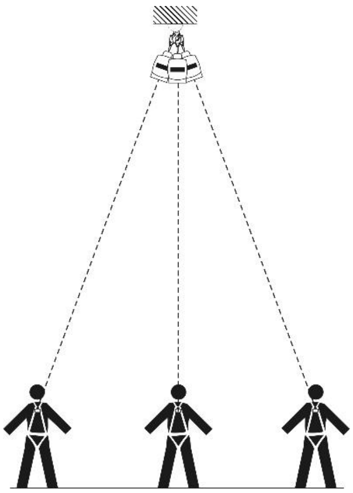
b) the anchor device

The reliability of the system depends partly on the structure (strength) and partly on the rigidity of the fitting. For this reason, a great deal of research has been done to produce a standard for anchor points. It was clear to all those interested that something had to be done. After all, it is strange that all the components of a system are standardised except for the anchor point. On the other hand, this indicates that an anchor point generally depends very much on the work situation on site.

We can in any case make a distinction between two types of anchor points:

a) standard anchor points

b) engineered anchor points



The latter requires an inspection of the work situation and a calculation. The majority of companies supplying safety components and equipment only deals in standards anchor devices. These can be defined as devices for which the reliability is guaranteed if they are used in accordance with the manufacturer's instructions.

It is however stressed that it remains the responsibility of the employer to assess the work situation before such a device is used.

The requirements of the anchoring structure are:

a) It must (as far as possible) be above the head

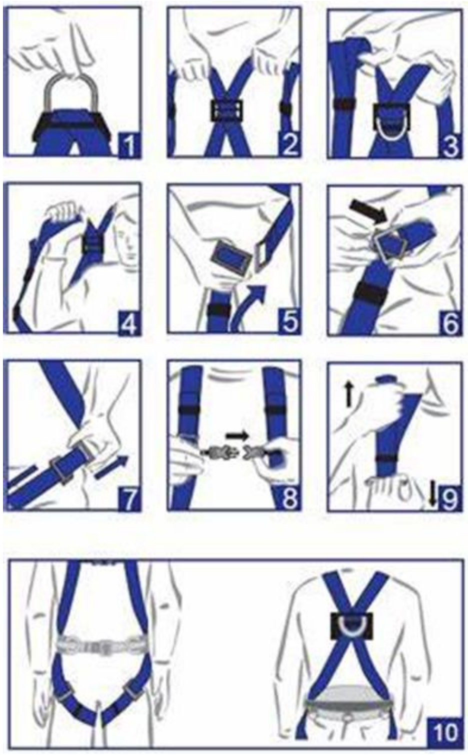
b) It must make it possible for the user to work secured within a radius of 30° (15° with respect to the vertical position). This is to prevent too great a swing fall.

c) It must have a minimum breaking strength of 22kN (2200 kg). This is to prevent it from becoming the weakest link in the chain. If not practically possible, the minimum strength is the same as 2x the impact load caused by a fall. For a fall arrest block this is 2 x 5kN = 12kN.

Note: If the impact load is unknown, 22kN must be adhered to.

6. Fitting and adjusting a full body harness

Harnesses that are too loose may cause serious injury in case of a fall. We also recommend that harnesses are not shared, as there is a chance that a harness will not be readjusted, but also the new user does not know what has happened to the harness previously.



Step 1:

Lift the harness by the D-ring at the back. This can be identified by the black plastic plate.

Note: It is advisable not to store a harness with the fastenings closed. The twisting of the straps can in that case result in a jumble that is difficult to disentangle.

Step 2:

Check that the straps are not twisted. Correct if necessary by smoothing them straight from the D-ring at the back.

Step 3:

Put on the harness as if it were a jacket and put both arms through the loops. Check again that the straps are not twisted.

Step 4:

Fasten the buckle of the chest strap. Then adjust the chest strap. This must be tightly stretched such that a maximum of a clinched fist can pass under it.

Step 5:

The leg straps now hang from the back of the harness. Bend forward and reach through the inside of the legs and grab them. While doing so ensure the straps are not twisted. Fasten the buckle of the leg loops by tilting the buckle of the loose end and passing it through the other (larger) buckle.

Step 6:

Adjust the length of the leg loops by pushing the strap into the loop. Secure the loose ends with the plastic clips.

Step 7:

Check the adjustment of the leg loops. The maximum play can be checked by putting a clinched fist between the loop and the leg. The leg loop must then be taut.

Step 8:

This step is only possible for harnesses where the chest section and the height of the chest strap can be adjusted. Adjust such that the chest strap runs over the centre of the chest.

Note: If the chest strap is too high, this may catch the throat in case of a possible fall. If the chest strap is too low the shoulder loops may slide off the shoulders. Both situations may have serious consequences.

Step 9:

The harness is now adjusted. Check that the plastic plate with the dorsal D-ring is positioned between the shoulder blades. With the correct size harness, this should be the case. If not, push the straps through the plate to reposition it. This requires a bit of effort.

7. Safety nets

Safety nets are erected under the area where you're working to catch you in case you fall. Nets should be inspected daily and cleared of debris regularly. Any damage to a safety net must be repaired immediately.

PART 14 – LOCKOUT AND TAGOUT

1. Introduction

Lockout is defined as "Control of Hazardous Energy - Lockout and Other Methods" as the "placement of a lock or tag on an energy-isolating device in accordance with an established procedure, indicating that the energy-isolating device is not to be operated until removal of the lock or tag in accordance with an established procedure".

In practice, lockout is the isolation of energy from the system (a machine, equipment, or process) which physically locks the system in a safe mode. The energy-isolating device can be a manually operated disconnect switch, a circuit breaker, a line valve, or a block (Note: push buttons, selection switches and other circuit control switches are not considered energy-isolating devices). In most cases, these devices will have loops or tabs which can be locked to a stationary item in a safe position (de-energised position). The locking device (or lockout device) can be any device that has the ability to secure the energy-isolating device in a safe position. See the example of the lock and hasp combination in Figure 1 below.

Tagout is a labelling process that is always used when lockout is required. The process of tagging out a system involves attaching or using an indicator (usually a standardised label) that includes the following information:

a) Why the lockout/tagout is required (repair, maintenance, etc.).
b) Time of application of the lock/tag.
c) The name of the authorized person who attached the tag and lock to the system.

Note: ONLY the authorised individual who placed the lock and tag onto the system is the one who is permitted to remove them. This procedure helps make sure the system cannot be started up without the authorised individual's knowledge.

1.1 Responsibilities

Each party in the workplace has a responsibility in the lockout program. In general:

1.1.1 Management is responsible for:

a) Drafting, periodically reviewing, and updating the written program.
b) Identifying the employees, machines, equipment, and processes included in the program.

c) Providing the necessary protective equipment, hardware and appliances.

d) Monitoring and measuring conformance with the program.

1.1.2 Supervisors are responsible for:

a) Distributing protective equipment, hardware, and any appliance; and ensuring its proper use by employees.

b) Ensuring that equipment-specific procedures are established for the machines, equipment and processes in their area.

c) Ensuring that only properly trained employees perform service or maintenance that require lockout.

d) Ensuring that employees under their supervision follow the established lockout procedures where required.

1.1.3 Employees are responsible for:

a) Assisting in the development of equipment-specific procedures.

b) Following the procedures that have been developed.

c) Reporting any problems associated with those procedures, the equipment, or the process of locking and tagging out.

2. Reasons and importance of lockout/tagout

Safety devices such as barrier guards or guarding devices are installed on systems to maintain worker safety while these systems are being operated. When non-routine activities such as maintenance, repair, or set-up; or the removal of jams, clogs or misaligned feeds are performed, these safety devices may be removed provided there are alternative methods in place to protect workers from the increased risk of injury of exposure to the unintended or inadvertent release of energy.

The main method used and recommended to protect workers from risk of harm in these cases is the use of a lockout/tagout program (LOTO).

3. Purpose of a lockout/tagout program

A lockout/tagout program will help prevent:

a) Contact with a hazard while performing tasks that require the removal, by-passing, or deactivation of safe guarding devices.

b) The unintended release of hazardous energy (stored energy).

c) The unintended start-up or motion of machinery, equipment, or processes.

4. De-energisation

De-energisation is a process that is used to disconnect and isolate a system from a source of energy in order to prevent the release of that energy. By de-energising the system, you are eliminating the chance that the system could inadvertently, accidentally or unintentionally cause harm to a person through movement, or the release of heat, light, or sound.

5. Contents of lockout procedures and work instructions

The written lockout procedures will identify what needs to be done, when it needs to be done, what tools are available to do it, who is supposed to do it, and who needs to be notified.

The document should specify:

a) The actual specific machine, equipment, or process shutdown and isolation process.
b) How and where the lockout devices are installed.
c) How stored energy is controlled and subsequently de-energized.
d) How the isolation can be verified.

Work instructions will identify how the lockout process is to be carried out in a step-by-step manner including how stored energy is controlled and de-energized, how isolation can be verified, and how and where lockout devices are installed. Work instructions are machine, equipment or process specific and include pictures or images of what is being described.

An organisation will have one lockout program document, and as many sets of work instructions as required, depending on the number of systems that require lockout.

6. Basic steps of locking and tagging out a system

Lockout and tagout processes involve more than just putting a lock on a switch. They are comprehensive step-by-step processes that involve communication, coordination, and training.

6.1 Definitions

Affected person - is an employee whose job requires them to operate a system, or work in an area in which servicing or maintenance is being performed under lockout/tagout.

Authorised person - is an individual who is qualified to control hazardous energy sources because of their knowledge, training, and experience and has been assigned to engage in such control.

System - refers to machinery, equipment, or processes.

6.2 Steps of a lockout system

Steps of a lockout/tagout program include:

Step 1 Prepare for shutdown

The authorised person will identify which sources of energy are present and must be controlled; and more importantly, identify what method of control will be used. This step involves completing sets of specific work instructions that outline what controls and practices are needed to lock and tagout a system before performing any activity.

Step 2 Notify all affected employees

The authorised person will communicate the following information to notify affected persons:

a) What is going to be locked/tagged out?
b) Why it is going to be locked/tagged out?
c) For approximately how long will the system be unavailable?
d) Who is responsible for the lockout/tagout?
e) Who to contact for more information?

Step 3 Equipment Shutdown

If the system is operating it should be shut down in its normal manner. Use manufacturer instructions or in-house work instructions.

Equipment shutdown involves ensuring controls are in the off position, and verifying that all moving parts such as flywheels, gears, and spindles have come to a complete stop.

Step 4 Isolation of system from hazardous energy

The exact written instructions will be specific to that system in the workplace. In general, the following are used:

a) Electrical energy - Switch electrical breakers and/or switches to the “Off” position. Visually verify this status. Lock in the “Off” position.

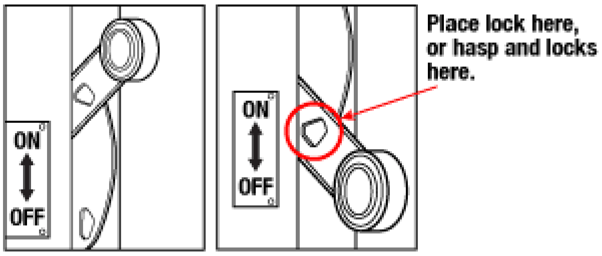


Figure 1: Electrical lockout

b) Hydraulic and Pneumatic potential energy - Set the valves in the closed position and lock them into place. Bleed off the energy by opening the pressure relief valves, then closing the airlines.

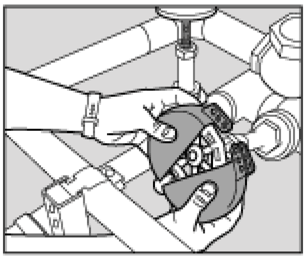


Figure 2: Hydraulic and Pneumatic lockout

c) Mechanical potential energy - carefully release energy from springs that may still be compressed. If this is not feasible, block the parts that may move if there is a possibility that the spring can transfer energy to it.

d) Gravitational potential energy - Use a safety block or pin to prevent the part of the system that may fall or move.

e) Chemical energy - locate chemical supply lines to the system and close and lockout the valves. Where possible, bleed lines and/or cap ends to remove chemicals from the system.

Step 5 Dissipation of residual or stored energy

In general, examples include:

a) Electrical energy - To find a specific method to discharge a capacitor for the system in question, contact the manufacturer for guidance. Many systems with electrical components, motors, or switch gears contain capacitors. Capacitors store electrical energy. In some cases, capacitors hold a charge in order to release energy very rapidly (e.g., similar to the flash of a camera). In other cases, capacitors are used to remove spikes and surges in order to protect other electrical components. Capacitors must be discharged in the lockout process in order to protect workers from electrical shock.

b) Hydraulic and Pneumatic potential energy - Set the valves in the closed position and locking them into place only isolates the lines from more energy entering the system. In most cases, there will still be residual energy left in the lines as pressurized fluid. This residual energy can be removed by bleeding the lines through pressure relief valves. Contact the manufacturer for more specific details, or if no pressure relief valves are available, what other methods are available.

c) Mechanical potential energy - Carefully release energy from springs that may still be compressed. If this is not possible, use blocks to hold the parts that may move if the energy is released

d) Gravitational potential energy - If feasible, lower the part to a height where falling is impossible. If this is not possible, contact the manufacturer for guidance.

e) Chemical energy - If available, “bleed” lines and/or cap ends to remove chemicals from the system.

Step 6 Lockout/Tagout

When the system’s energy sources are locked out, there are specific guidelines that must be followed to ensure that the lock cannot be removed, and the system cannot be inadvertently operated. These guidelines include:

a) Each lock should only have one key (no master keys are allowed).

b) There should be as many locks on the system as there are people working on it. For example, if a maintenance job requires 3 workers, then 3 locks should be present - each of the individuals should place their OWN lock on the system. Locks can only be removed by those who installed them, and should only be removed using a specific process - see step 9 below.

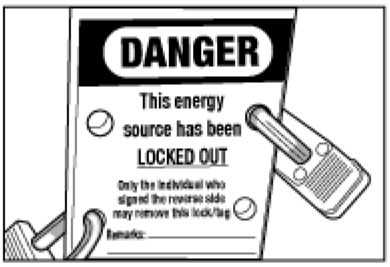


Figure 3: Example of multiple locks on a lockout tag

Step 7 Verify Isolation

To verify that the system is properly locked out, try to restart it with the normal start-up sequence. If the system does not start, the lockout efforts have been successful. When the lockout has been verified, remember to place the control that starts the system into the neutral or off position.

Step 8 Perform Maintenance or Service Activity

Complete the activity that required the lockout process to be started.

Step 9 Remove Lockout/Tagout devices

To remove locks and tags from a system that is now ready to be put back into service, the following general procedure can be used:

a) Inspect the work area to ensure all tools and items have been removed.
b) Confirm that all employees and persons are safely located away from hazardous areas.
c) Verify that controls are in a neutral position.
d) Remove devices and re-energize machine.
e) Notify affected employees that servicing is completed.

Note: it is good practice to ensure any individual who placed a lock on the system should also be present when the system is re-started. This practice helps make sure those employees working on the system are not in a hazardous area when the machine is restarted.

PART 15 –CONFINED SPACES

1. Defining confined spaces

Confined spaces are spaces that have limited or restricted means of entry and exit, and may contain harmful atmospheres or stored substances that pose a risk to employees working in them.

Examples of potential confined spaces can include:

a) vats, tanks and silos
b) pipes and ducts
c) ovens, chimneys and flues
d) reaction vessels
e) underground sewers or wells
f) shafts, trenches, tunnels and pits.

2. Confined space hazards

2.1 Hazardous atmospheres

The atmosphere in a confined space may be hazardous for several reasons. The air may have too little or too much oxygen. The atmosphere may be toxic or explosive.

Once a confined space is identified, its atmosphere must be hazard-rated as HIGH, MODERATE, or LOW. The hazard rating of a confined space must be determined by a qualified person after considering the design, construction, and use of the confined space, the work activities to be performed, and all required engineering controls.

2.1.1 High-hazard atmosphere

An atmosphere that may expose a worker to risk of death, injury, or acute illness, or otherwise impair a worker's ability to escape unaided from a confined space if the ventilation system or respirator fails.

2.1.2 Moderate-hazard atmosphere

An atmosphere that is not clean, respirable air but is not likely to impair a worker's ability to escape unaided from a confined space if the ventilation system or respirator fails.

2.1.3 Low-hazard atmosphere

An atmosphere that is shown by pre-entry testing or is otherwise known to contain clean, respirable air immediately prior to entry into a confined space, and that is not likely to change during the work activity.

Lack of oxygen is a leading cause of death among workers entering confined spaces. Low oxygen levels cannot be detected by sight or smell. You must test the air for this hazardous condition. A very low level of oxygen can damage the brain and cause the heart to stop after a few minutes.

The following are some common causes of oxygen deficiency (not enough oxygen) in a confined space:

a) Oxygen is used up when metals rust.
b) Oxygen is used up during combustion for example, by propane space heaters, during cutting or welding, and by internal combustion engines.
c) Oxygen can be replaced by other gases for example, welding gases or gases forced into the space to prevent corrosion.
d) Micro-organisms use up oxygen for example, in sewer lines and fermentation vessels.

Too much oxygen is not as common a hazard as low oxygen, but it is also dangerous. It greatly increases the risk of fire or explosion in the confined space. Materials that would not normally catch fire or burn in normal air may do so extremely quickly and easily where there is a high level of oxygen.

The only way to know how much oxygen is present in a confined space is to use an oxygen monitor. The monitor must be in good working order and properly maintained and calibrated. The alarm must be set at the right level. Someone trained to use the monitor must test the air before anyone enters the confined space.

An oxygen monitor shows oxygen levels as a percentage of the air. Air contains 20.9% oxygen.

NOTE: As the elevation increases, the amount of oxygen in the air decreases. However, the percentage reading on the oxygen monitor does not change with elevation. Therefore, always consult with a qualified person to determine safe entry procedures. The qualified person will take elevation into account.
The monitor should be tested in clean outside air. If the reading is above or below 20.9% oxygen, there may be a problem with the oxygen sensor or with the calibration of the unit.

Do not use this monitor for testing inside the confined space, and do not enter the confined space until a properly calibrated monitor is used.

Clean outside air contains 20.9% oxygen. If the air in the confined space is anything other than 20.9%, the reason should be investigated by a qualified person to ensure the space is safe to enter. It is vitally important to understand what is causing the change in oxygen level.

The reason must be identified before workers are allowed to enter the space. For example, many toxic gases present a high hazard to workers even when the concentration is low enough to cause only a very small displacement of oxygen. With some common solvents, a 0.1% change in the oxygen reading could mean the presence of enough toxic gas to cause death or serious injury.

Working in an atmosphere with oxygen levels between14% and 17% can produce impaired judgment, dizziness, fatigue, and collapse. In oxygen levels lower than this, the one breath you take could have so little oxygen that your muscles can't respond and you won't have enough strength to escape even if you are still conscious. The only safe way to find out whether air in a confined space has enough oxygen is to use a properly calibrated and maintained monitor.

Workers must not enter a confined space containing less than 19.5% oxygen without taking appropriate precautions, including the use of supplied-air respirators.

As a result of liquids and solids inside the confined space liquids may produce hazardous atmospheres if they evaporate for example, liquid fuel in a tank producing vapours. Dangerous conditions can develop when pockets of gas in waste materials are disturbed during cleaning. For example, an organic material such as manure sludge can release the toxic gas hydrogen sulphide when manure pits are cleaned out. Rotting pulp in tanks also creates hydrogen sulphide. If grains in silos ferment, they use up oxygen and produce deadly gases.

In a large number of incidents involving harmful gases or lack of oxygen, the condition was not present in the confined space when the worker first entered it. Rather, the work in the confined space created the hazardous atmosphere.

Activities that may lead to the release of harmful substances into the air include grinding, descaling, insulation removal, metal spray applications, rubber lining, painting, fibre-glassing, cutting, welding, and the use of internal combustion engines.

Cleaning agents may be toxic, may react with tank residues, or may release a deadly gas from porous surfaces inside the space.

Cleaning a tank that contains dusts can cause the dust to become airborne and create hazardous atmosphere.

A confined space may be located next to a source of a hazardous contaminant. The contaminant could enter the confined space through porous walls, such as those that may be found in sewers or trenches, or through difficult-to-seal openings such as conduits.

Normally, mechanical ventilation is set up to bring outside air into the confined space. If the intake hose is located beside a running vehicle or equipment with an internal combustion engine, the intake hose brings in exhaust fumes.

2.1.4 Explosive atmospheres

Three elements are necessary for a fire or explosion to occur: oxygen, flammable material (fuel), and an ignition source.

a) Oxygen

Air normally contains 20.9% oxygen, enough oxygen for a fire. However, a higher level of oxygen increases the likelihood of material burning. Air is considered oxygen-enriched at levels above 23%. Enrichment can be caused by improper isolation of oxygen lines, ventilation of the space with oxygen instead of air, or leaks from welding equipment.

b) Fuel

Fires and explosions in confined spaces are often caused by gases or vapours igniting. Coal dust and grain dusts may explode when a certain level of dust in the air is reached.

NOTE: Two or more chemicals may react with each other and become explosive.

Containers of fuels such as petrol and propane should not be taken into a confined space as fuel can easily burn or explode.

The following are some other common substances that can cause explosions or fires in confined spaces:

i. Acetylene gas from leaking welding equipment

ii. Methane gas and hydrogen sulphide gas produced by rotting organic wastes in sewers or tanks
iii. Hydrogen gas produced by contact between aluminium or galvanized metals and corrosive liquids
iv. Grain dusts, coal dust
v. Solvents such as acetone, ethanol, toluene, turpentine, and xylene, which may have been introduced into the space through spills or by improper use or disposal

A trained person must test the atmosphere for gases and vapours that will burn or explode. You cannot always see or smell these dangerous gases and vapours. If any measurable explosive atmosphere is detected, the air must be further evaluated by a qualified person to ensure that it is safe to enter the confined space.

c) Ignition sources

Ignition sources include:

i. Open flames
ii. Sparks from metal impact
iii. Welding arcs
iv. Arcing of electrical motors
v. Hot surfaces
vi. Discharge of static electricity
vii. Lighting
viii. Chemical reaction

Many processes can generate static charge, including steam cleaning, purging, and ventilation procedures. To reduce the risks from these ignition sources, use non-sparking tools and ensure all equipment is bonded or grounded properly.

Gases that may be in your workplace

Contaminant	**What is the MAIN danger**	**What does it look/smell like?**
Argon (Ar)	Displaces oxygen May accumulate at bottom	Colourless, odourless
Carbon dioxide (CO^2)	Displaces oxygen Toxic May accumulate at bottom	Colourless, odourless
Carbon monoxide (CO)	Toxic — asphyxiant (causing suffocation)	Colourless, odourless (NO WARNING)
Chlorine (Cl_2)	Toxic — lung and eye irritant May accumulate at bottom	Greenish yellow colour; sharp pungent odour

Gasoline vapours	Fire and explosion May accumulate at bottom	Fire and explosion Colourless; sweet odour
Hydrogen sulphide (H_2S)	Extremely flammable Very toxic — causes lung failure May accumulate at bottom	Colourless; rotten egg odour*
Methane (CH_4)	Fire and explosion May accumulate at top	Colourless, odourless (NO WARNING)
Nitrogen (N_2)	Displaces oxygen (Inert)	Colourless, odourless (NO WARNING)
Nitrogen dioxide (NO_2)	Toxic — severe lung irritant May accumulate at bottom	Reddish brown; pungent odour
Sulphur dioxide (SO_2)	Toxic — severe lung irritant May accumulate at bottom	Colourless; rotten, suffocating Odour
Oxygen (O_2)	Low levels — asphyxiant High levels — causes spontaneous combustion, explosion	Colourless, odourless

* Exposure deadens the olfactory nerves (sense of smell), which means you could be walking TOWARD rather than AWAY from the source and not know it!

NOTE: Combining chemicals may result in a toxic gas being released. Always read the Material Safety Data Sheet to get the information you need about mixing two products.

2.1.5 Physical hazards

a) Loose and unstable materials

Whenever unstable solids made of small particles likes and or grain is stored in enclosures, there is a danger of the materials flowing onto workers and trapping or burying them. Examples of these confined spaces are sand bins, wood chip or sawdust bins, storage or grain silos, and potash feed systems.

Granular materials, particularly if moist, can form bridges (or shoulders) above workers. If jarred, these can collapse onto a worker. Bins and hoppers in which materials are conveyed or augured into the bin are particularly dangerous. A worker may be trapped or crushed when material is accidentally discharged into an empty bin or hopper.

The design of these confined spaces may increase the danger of being trapped or buried. For example, in an empty hopper with a floor that slopes steeply to a vertical chute, a worker can slide into the chute and become trapped there.

Wherever there are loose, unstable materials that could trap or bury you, a qualified person must inspect the space and assess the hazards. Do not enter until the hazard has been eliminated or controlled. Specific training and safety precautions must be in place before you enter.

b) Slip, trip, and fall hazards

The space you are about to enter may have a hatchway that is difficult to squeeze through, and ladders for ascending or descending. You are therefore at risk of falling while getting into the space as well as while you are inside. In addition, the flooring of tanks or other wet environments or the rungs of a ladder may be very slippery.

If the hazard cannot be eliminated and there is a danger of falling from a height, a fall protection system (such as guardrails or a harness and lifeline) may be needed.

c) Falling objects

In a confined space there may be the danger of being struck by falling objects such as tools or equipment, particularly if access ports or workstations are located above workers.

If workers might be exposed to the hazard of falling objects, safe work procedures must be put in place to prevent this. For example, schedule work activity so that no worker is working above another, and lower equipment and tools into the space before workers enter and remove them after workers leave the space.

d) Moving parts of equipment and machinery

Mechanical equipment such as augers, mixers, or rotating tanks can be dangerous inactivated or not secured. Residual energy, such as gravity or accumulated pressure, may also pose a risk unless the equipment is locked out and de-energised. This must be done by following a written lockout procedure that is specific for each piece of equipment and that states each place where a lock must be applied. Even when the power is shut off and the equipment is locked out at control points, unsecured equipment can move, especially if it is out of balance.

Before doing any work in confined spaces:

i. Isolate the power supply
ii. Ensure that the equipment is locked out at control points
iii. Test the lockout
iv. Secure any equipment that can move, even when it has been locked out

e) Electrical shock

Electrical shock can result from defective extension cords, welding cables, or other electrical equipment. Work done in metal enclosures or in wet conditions can be particularly dangerous. Install ground fault circuit interrupters (GFCIs) or use assured grounding where there may be a danger of electrical shock. All electrical sources that pose a hazard to workers inside the space must be locked out following the written lockout procedure for the particular confined space.

f) Substances entering through piping

Piping adjacent to a confined space could contain liquids or gases or other harmful substances. If these substances enter the confined space, the hazards may include:

i. Toxic gases
ii. Burns from hot substances
iii. Drowning
iv. Being trapped, crushed, or buried

Substances must be prevented from entering the confined space through piping. This is done by “isolating” or “blanking” the piping from the confined space. The method often involves disconnecting the piping or putting solid plates to block off the piping from the confined space. If valves are used to isolate the piping, a special double-block system must be used so that nothing can leak into the confined space.

g) Poor visibility

Poor visibility increases the risk of accidents and makes it harder for a standby person to see a worker who may be in distress. If poor visibility results from inadequate lighting, the light levels should be increased (although area lighting is not always required). If activities such as sandblasting or welding result in poor visibility, appropriate ventilation may be needed to reduce harmful substances in the air.

If portable lighting is used where there may be an explosive atmosphere, the lighting must be “flame proof” or “explosion-proof.”

Emergency lighting such as flashlights or battery-operated area units must be provided where necessary, so that workers can locate exits and escape

h) Temperature extremes
Special precautions are needed before workers enter equipment such as boilers, reaction vessels, and low-temperature systems. A qualified person must provide these procedures. Allow enough time for cooling of confined spaces that have been steam-cleaned.

i) Noise
Noise produced in confined spaces can be particularly harmful because of reflection off walls. Noise levels from a source inside a small confined space can be up to 10 times greater than the same source placed outdoors. If the noise levels cannot be reduced, proper hearing protection must be worn where necessary.

j) Risk of drowning
Confined spaces should be fully drained or dry when entered. Spaces that are not fully drained or dry may pose a risk of drowning. The risk of drowning in a vat or tank with a large amount of liquid is easily recognised.

However, workers have drowned in small pools of liquid. For example, insufficient oxygen, the presence of a toxic gas, or a blow to the head can make workers unconscious. Workers who have fallen face-down into a small pool of water have drowned.

2.2 Confined space entry program

Before workers perform work in a confined space, the employer must prepare and implement a written confined space entry program.

The identification, evaluation, and control of confined space hazards are often quite complex. For assistance in assessing the hazards and preparing a written confined space entry program, consult a qualified occupational health and safety professional.

The health and safety professional can tell you what to do to make it safe to enter a confined space, including providing the appropriate air-testing equipment, and explaining the portable air-moving device and the personal protective equipment to be used.

A well-thought-out rescue plan, proper equipment, and training and practice sessions are key to keeping workers safe if they must enter a confined space.

The confined space entry program must include the following:

a) An assignment of responsibilities.
b) A list of each confined space or group of similar spaces, and a written hazard assessment of those spaces prepared by a qualified person.
c) Written safe work procedures for entry into and work in each of the confined spaces. Each procedure must be written specifically for each of the hazards that exist in each space during each entry.
d) The equipment necessary for each entry must also be provided, including testing devices, air-moving devices, isolation and lockout devices, and personal protective equipment.
e) A signed permit where required.
f) Training of employees.
g) A rescue plan.

REMEMBER!

Every worker has the right to refuse unsafe work. If you believe the space is unsafe, do not expect them to enter. Make sure all the safety precautions are in place.

3. Risks associated with confined spaces

Working in confined spaces can be extremely dangerous.

Some of the risks include:

a) loss of consciousness, injury or death due to **contaminants in the air**;
b) fire or explosion from the **ignition of flammable contaminants;**
c) suffocation caused by a **lack of oxygen**;
d) enhanced **combustibility** and spontaneous combustion; and
e) **suffocation or crushing** after being engulfed by loose materials stored in the space, such as sand, grain, fertiliser, coal or woodchips.

It's not uncommon for incidents involving confined spaces to often result in **multiple fatalities**. Other workers, unaware of the risks, often enter a space to rescue a victim but are then also overcome by toxic vapours or gases.

4. Entry into confined spaces

Confined space hazards are often quite complex and safe entry therefore needs to be meticulously coordinated through the implementation of a well-designed entry permit system.

General requirements for confined spaces include:

a) Identify confined spaces - The employer must identify each confined space in the workplace, and determine whether the spaces will require entry by a worker.

b) Prohibit entry - If a confined space exists at a workplace but no worker entry is required, the employer must ensure that each point of access to the confined space is secured against entry or identified by a sign or other effective means which indicates the nature of the hazard and the prohibition of entry, and that workers are instructed not to enter.

c) Control hazards - Whenever possible engineering solutions should be implemented, such as robotic cameras for the inspection of tanks, to avoid entering confined spaces. Also, measures should be taken to convert spaces containing high or moderate hazard atmospheres to contain low hazard atmospheres. The employer must ensure that all confined space hazards are eliminated or minimised and that work is performed in a safe manner.

d) Prepare and implement a confined space entry program - Before a worker is required or permitted to enter a confined space, the employer must prepare and implement a written confined space entry program which includes:

   i. an assignment of responsibilities,

   ii. a list of each confined space or group of similar spaces and a hazard assessment of those spaces, and

   iii. written safe work procedures for entry into and work in the confined space, that address, where applicable:

      - identification and entry permits;
      - lockout and isolation;
      - verification and testing;
      - cleaning, purging, venting or inserting;
      - ventilation;
      - standby persons;
      - rescue;
      - lifelines, harnesses and lifting equipment;
      - personal protective equipment and other precautions; and
      - coordination of work activities.

PART 16 – HOT WORK

1. Introduction

Managers and Supervisors must identify, register, risk assess and then eliminate or minimise all risks associated with hot work to as low as reasonably practicable prior to hot work being commenced.

A Safe Work Management System(SWMS) must be developed and documented for all tasks involving hot work based on the results of the risk assessment.

1.1 Examples of hot work

Hot work includes all grinding, welding, thermal or oxygen cutting or heating, and other heat-producing or spark-producing operations.

1.2 Welding and cutting hazards

- Fire and explosion
- Electric shock incidents
- Fumes and gases
- Ultraviolet radiation
- Heat
- Manual handling
- Confined spaces
- Falls from a height

1.3 Hazards associated with grinding

- Sparks
- Abrasive discs
- Disintegrating discs
- Vibration
- Manual handling
- Pneumatics

2. Risk assessment

Risk assessments shall be undertaken for all hot work activities that are to be undertaken at the work site. The risk assessment shall consider the following factors:

- Type of hot work to be undertaken.
- Equipment to be used.
- Flammable and combustible materials located in close proximity.
- The type, extent and location of any utilities in the area.
- Ventilation of the area – both natural and mechanical and surrounding vegetation.

3. Risk controls

All risks identified and assessed through the risk assessment process are required to be eliminated or minimised to as low as reasonably practical through the introduction of risk control measures.

Risk control measures shall be implemented in accordance with the hierarchy of control set ILO.

The following risk control measures shall be undertaken where practicable:

- A person shall be appointed to be in charge of the hot work activity.
- Signage shall be erected at all designated hot work areas.
- Safe access shall be provided to the work area.
- A pre-start check of the worksite shall be undertaken prior to commencing hot work activities.
- Welding screens shall be erected around the hot work area to protect people from exposure to ultraviolet radiation.
- The hot work area shall be provided with adequate natural or mechanical ventilation to protect persons against exposure to atmospheric contaminants.
- The work area shall be kept tidy and free from flammable and combustible materials, tangled leads, discarded off-cuts and electrode stubs.
- Power shall be turned off and electrode stubs removed prior to the welder leaving the work area.

4. Competency Based Training

All personnel required to undertake tasks involving hot work must be trained in safe work methods. The training shall incorporate:

- The induction of all personnel on site in accordance with the OHS management plan.
- The nature of hazards involved, the means adopted to control the risks, and the emergency procedures in place.
- The requirements of the Occupational Health and Safety Act (Act 85 of 1993)
- All plant and equipment required to be used during the hot work.
- Use, care, maintenance and storage of PPE.
- SWMS associated with the hot work.

5. Review

Risk Assessments, SWMS and work procedures must be reviewed and revised when:

- The original assessment is no longer valid or older than 1 year.
- Injury or illness results from hot work.
- A significant change is proposed at the place of work, or in work practices or procedures to which the assessment relates.

6. Personal protective equipment

Fit-for-purpose PPE as prescribed in the risk assessment and SWMS shall be available and:

- Meet the requirements of SABS where applicable.
- Be appropriate for the person and task.
- Be used as per original equipment manufacturer directions.
- Be inspected regularly and before each use for wear, damage and use-by dates.

7. Designated hot work areas

Any areas of the worksite where hot work activities are to be undertaken regularly shall be designated hot work areas. Hot work shall only be undertaken within these areas where practicable.

Designated hot work areas shall:

- Be isolated using appropriate screens and warning barriers.
- Be free from flammable and combustible materials.
- Be free from water and damp conditions.
- Have adequate natural or mechanical ventilation.

If hot work is to be undertaken outside of designated areas a hot work permit shall be used.

8. Emergency preparedness

Emergency provisions are to be determined to minimise the effect of incidents, such as electric shock, contaminated atmospheres and fire. Emergency procedures should be developed that include:

- The need and placement of firefighting and emergency equipment, including emergency drench showers.
- Contact details for external emergency services and the relevant on site personnel.
- Evacuation routes and emergency assembly points.
- The recovery of personnel trapped with a confined space.
- The provision of first aid facilities and officers.

9. Fire safety – hazardous areas

A hazardous area is an area in which flammable liquids, vapours or gases, combustible liquids, dusts or fibres, or other flammable or explosive substances may be present.

If an area is classified as a hazardous area, the following precautions shall be met:

- The work shall be authorised via a hot work permit.
- A responsible person shall be appointed to be responsible for the safe execution of the hot work.
- A firewatcher shall be trained and appointed.
- Hot work shall not be undertaken alone.

10. Fire watchers

If a fire watcher has been appointed for the hot work, the fire watcher shall:

- Be alert for any fire outbreak.
- Inspect adjoining areas if heat transfer is possible.
- Take immediate action to combat any outbreak of fire.
- Not allow hot work to proceed outside the area specified by the hot work permit.
- Immediately stop work if a hazardous condition is observed.
- Monitor changes in wind direction.
- Obtain fire extinguishers prior to the work commencing.
- Not leave the work area.

11. Confined spaces

If hot work activities are required to be undertaken within a confined space, this work shall be completed in accordance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993).

The work must be authorised by a confined space entry permit that takes into account:

- The concentration of flammable vapours or gases in the atmosphere or piping.
- The liquid or solid residues present within the confined space.
- Utilities that are present within the confined space.

Fire prevention measures shall be taken, including:

- Removal of all combustibles from the confined space.
- A fire watch person shall be appointed.
- No compressed gas cylinders, other than those used for SCBA, shall be located within the confined space.

Fumes shall be controlled by the following means:

- All surfaces covered with coatings that may produce toxic or flammable fumes shall be stripped from the area of heat application.
- Means shall be provided to exhaust contaminated air from the confined space.

12. Oxy-acetylene equipment

At minimum, all oxy-acetylene equipment shall meet the requirements of the SABS, and in particular, shall comply with the following requirements:

- The user shall inspect all oxy-acetylene equipment for signs of damage prior to use.
- All oxy-acetylene connections shall be kept free of grit, oil, grease and solvents.
- An appropriate gas pressure regulator shall be fitted.
- Flash-back arrestors shall be fitted at both the regulator and the blowpipe.
- Gas cylinders shall be secured in an upright position in a shaded, cool, dry and well ventilated location.
- Remove pressure regulators prior to transporting gas cylinders to prevent damage.
- All hoses used with oxy-acetylene equipment shall comply with requirements of the SABS.
- All hoses, blowholes, connections and regulators shall be suitable to the particular application.
- When pressurising hoses, open the oxygen and acetylene outlet point isolating valves slowly to avoid damaging the pressure regulators.
- Always use a spark lighter to ignite the blowpipe – do not use a naked flame.
- At any time there is a sign of leakage, fluctuation or starvation of gas supply, or misshapen flame, shut the equipment down immediately.

- After using oxy-acetylene equipment, turn the regulator pressure on both gas cylinders to the zero delivery position, inspect the equipment for damage and, if safe, return the equipment to the storage area.

13. Electric arc equipment

Electric arc welding equipment includes all manual metal arc welding (stick), gas metal arc welding (MIG), and gas tungsten arc welding (TIG) equipment. At minimum, all electric arc welding equipment shall meet the requirements of requirements of the SABS, and, in particular, shall comply with the following requirements:

- The frames of all electric arc welding equipment are to be earthed in accordance with the appropriate standards.
- The user shall inspect all electric arc welding equipment for signs of damage prior to use.
- All electric arc welding equipment shall be fitted with voltage reduction devices that reduce the voltage between the electrode and the work when the machine is not striking an arc.
- Ensure that the current-carrying capacity of the work lead is not less than that of the electrode conductor.
- Securely connect the work lead directly to the work piece, as close as practicable to the where the arc will be struck.
- Avoid using building or other machines to return welding currents.
- Remove all used and unused electrodes from the electrode holder when not welding.

14. Electric welding safety

Before welding, the work area environment shall be assessed and classified for risk of electric shock. The following categories apply:

14.1 Category A: Environments where:

- The risk of an electric shock by arc welding is low.
- Normal work practice is used.
- It is not possible for any welder or any other worker to be in contact with the workpiece, in the event of being in contact with a live part of the welding circuit.

14.2 Category B: Environments where there is a significant risk of the welder contacting the workpiece or other parts of the welding circuit.

14.3 Category C: Environments where the risk of an electric shock by arc welding is greatly increased due to low body impedance of the welder (usually due to the presence of water, moisture or heat—particularly above 32°C) and of the welder contacting parts of the welding circuit.

Minimum risk control measures shall be applied to Category A areas:

- The electrode and workpiece shall be regarded as electrically live.
- Welding gloves shall be sound, dry and used on both hands.
- Welders shall wear appropriate dry fire proof clothing.
- Leather cushions, wooden duckboards or other means shall be used to insulate the welder from damp concrete floors.
- Leads and equipment shall be inspected prior to use.
- While tacking two pieces together, the arc shall be struck on the piece connected to the return lead.
- The electrode holder shall not be placed on the workpiece.

Minimum risk control measures shall be applied to Category B areas:

- Where practicable, efforts shall be made to convert the area to a Category A.
- The open-circuit voltage shall not exceed 68 V AC peak and 48 V AC r.m.s. or 113 V DC
- A competent safety observer shall be assigned to monitor the welder.

Minimum risk control measures shall be applied to Category C areas:

- Every effort shall be made to make the area as dry and cool as possible.
- A competent safety observer shall be assigned to monitor the welder.
- Maintenance of welding equipment shall not be undertaken within this area.
- The open-circuit voltage shall not exceed 35 V AC peak and 25 V AC r.m.s. or 35 V AC.

15. Grinding and abrasive equipment

The use of grinding equipment shall comply with the following requirements:

- The user shall inspect all grinding equipment for signs of damage prior to use.
- The correct type of grinding / cutting wheel or disc shall be used for the application (e.g., size and speed requirements).
- Grinding equipment shall not be used unless correct guards are in place.
- The maximum rotation speeds of grinding discs shall not be exceeded.

PART 17 – CONVEYOR SAFETY

1. Introduction

Belt conveyors are probably the most efficient means of transporting bulk materials. However, they are considered dangerous due to the sheer size of the installation which prevents clear and unimpeded visibility down the length of the system. Conveyors can be one of the most hazardous mine or plant equipment installations if safety regulations are not strictly followed or if the conveyors are not properly maintained.

2. Safety around conveyor belt systems

2.1 Safety Requirements for Maintenance

On a moving conveyor belt, the belt, pulleys and idlers are all in motion, and each idler, chute skirt, belt cleaner or pulley has a potential nip point, depending on its accessibility.

The prohibition of work on moving machinery relates to tasks such as belt cleaning, house-keeping and the removal of spillage at localised points. Where build-up of carry-back material occurs on the face of pulleys and idler shells, the removal of this build-up is only permitted when the conveyor system has stopped and been safely locked out.

In instances where work needs to be carried out on the conveyor while the belt is running, such as belt training or the adjustment of material stream deflectors, it is important that this be performed by competent teams, in accordance with approved risk assessments and safe working procedures pertaining to the task being performed. While undertaking the necessary task, it's important for operators to be on the alert and to stop the conveyor by activating a pull key or an emergency stop button which must be readily accessible. In all cases, except for those mentioned in the previous paragraph, pull keys and 3-phase isolation must be locked out and tagged prior to the commencement of any maintenance, construction or repairs.

2.2 Stored Energy

When maintenance is required on a conveyor system, it is important to remember the danger presented by residual energy stored within the system and to address this adequately.

Thus it is necessary to isolate the stored energy from the work area or to completely release all stored energy from the system, so that work can be performed in a safe environment. This can be done by applying clamps to isolate this energy from the work area or releasing the energy applied by the take-up system. The system tensions may also be relieved by the controlled lifting of the counterweight, or the controlled pay-out of the take-up winch system.

Where belt clamps are utilised, these must be securely anchored to the structure. This applies to both permanent clamps and temporary belt pulling clamps. Belt clamps must be inspected and tested before attachment to ensure that they are able to withstand the belt tensions in the localised area.

It is vital that a competent engineer designs the belt clamps, followed by verification by a Professional Engineer.

2.3 Lockout Systems

When any work is carried out on the conveyor, whether to the belting, components, or to the structure, the responsible person must ensure that the system is properly locked out, following the prescribed lockout procedures.

Where more than one team is required to work on the system concurrently, multiple lockout procedures must be applied in accordance with the regulations and the applicable risk assessment.

2.4 Personnel Training in Safe Working and Operating Procedures

It is mandatory that all maintenance operations have prescribed safe working procedures and policies which must be adhered to. It is important that operating staff be regularly reminded of the necessity to adhere to these safe working procedures.

All new staff, whether temporary or permanent, must be formally instructed in the safe work procedures for a particular task, and records of training must be maintained.

Regular training of the work force is a priority.

2.5 Safe Operating Procedures

- Ensure that all personnel are equipped with the correct Personal Protection Equipment (PPE) relevant to the task and work area. Using PPE shall be strictly monitored by the appropriate safety officer.

- Ensure that all STOP/START and emergency controls are clearly marked and that maintenance staff are familiar with the location of these safety systems.
- Keep the area around the belt clean and tidy and apply good housekeeping practices to minimize potential hazards.
- Lockout, isolate and tag all areas before working on any part of the conveyor.
- Do not climb on, over or crawl under any conveyor.
- Do not ride on any conveyor unless the conveyor is approved and licensed for man-riding purposes.
- The only action that can be undertaken with the belt in motion is tracking of the belt.
- Ensure that pre-start alarm is working correctly and if not, isolate the conveyor and request that it be repaired.

2.6 Basic Check List Prior to Re-starting a Conveyor

Ensure that:

- nobody is working on the belt;
- guards have been re-fitted and that all the safety interlocks are operational;
- the area is clean and clear of equipment and /or debris or spillages;
- all the fire fighting and fire suppression devices and equipment are in place and operational;
- all clamps are removed or released;
- all other sprigging devices have been removed;
- the take-up system is operational.

3. Conveyor system protection devices

The belt conveyor shall be provided with various devices and systems for protecting the system. These devices are used as run-permissive input commands to the general belt control system. The devices must be seen as safety-critical items and for that reason, deserve a high degree of attention and maintenance.

The safety of personnel and the integrity of the conveyor system are largely dependent on the correct specification, installation and operation of these devices.

3.1 Belt Control

Belt control normally consists of the net sum of the belt permissive, the operator start/stop stations, the start warning system, interlock sequencing of individual conveyors and other process controls.

Belt control initiates a run command to the drive controller. Sometimes the belt control issues a running reference speed to the drive controller.

For stopping, the belt control simply removes the positive run signal to the drive controller or initiates a ramped stop command.

3.1.1 Stop/Start

A belt conveyor system is usually provided with one or more control stations for operators. Start stations normally require a momentary operator input to initiate a start sequence. Stop stations monitor a maintained input for a run permissive. Many conveyors are started and stopped from a central control room.

Complex belts have many operator stations distributed at various physical locations.

A stop/start station is a control device and should not be considered a lockout of the conveyor power source.

3.1.2 Pre-Start Warning

All conveyors must be equipped with an audible and visual system that provides a pre-start warning along the entire length of the conveyor. These include horns, sirens, flashing lights or strobes, or a combination of two or more warning signals. The start warnings are activated for a period after a start is requested, but before initiating motion of the conveyor.

3.1.3 Interlock

Classically, interlock is the run permissive for the conveyor to any other unit's run status.

It is the control relationship between adjacent material transferring and interdependent machines.

Interlock normally proceeds through a system in the reverse order of material flow.

For example, a belt conveyor numbered 01 transfers material to another belt conveyor numbered 02. Conveyor 01 is interlocked to 02. If conveyor 02 shuts down, 01 must shut down. Interlock then flows from 02 to 01.

Running a belt *out of interlock* or *in bypass* are common terms for operation of a conveyor with the interlock system disabled or defeated.

Interlock can be performed by physically wiring the conveyor control systems together, by computer coding interlock, by providing a motion sensing switch on the tail of the receiving conveyor and sensing that signal as a run permissive for the feeding conveyor.

An alternative is to signal by telemetry from one conveyor to the next over a distance.

A conveyor may be interlocked to other machinery and devices such as screens, breakers, crushers, magnets or as the process requires.

3.1.4 Telemetry

Telemetry is the distribution of belt control and informational signals over significant distances. Since conveyors transport material over wide areas, some belts require signal telemetry. Signal telemetry can be simply multi-conductor cables with DC digital on/off controls or can involve a multiplex of more than one signal over a single wire path.

Today, telemetry may involve the conversion of electrical signals to computer-based serial transmission of data, to light signals run over fibre optics, or to wireless radio transmission.

Control, remote operator interface and conveyor monitoring can be geographically located a distance away from the physical conveyor location and controlled using commercial telephone networks and modern technology.

3.1.5 Lockout

Lockout of a belt conveyor is the physical lockout of all motive power sources to the conveyor so that people may access the conveyor equipment for service, inspection, clean up or maintenance. Lockout implies security supervision of the lockout elements and involves all sources of power including electrical, hydraulic and pneumatic.

Each drive and conveyor system requires an assessment of lockout requirements which includes any equipment or apparatus that is compliant with owner practices and policies, manufacturer's recommendations, and regulatory requirements.

The lockout system must be interfaced with the belt control system.

A permit system is necessary to monitor the maintenance crew and record exactly what work is carried out. After the system/conveyor is locked out, the system must be tested by attempting to start it to confirm the lockout.

SPECIAL ATTENTION MUST BE PAID TO THE LOCKOUT PROCEDURE OF RING FEED SYSTEMS ON CONVEYOR DRIVES.

3.2 Belt Alignment

It is important that the belt stays aligned with the drive pulleys and the carrying and return idlers. Belt alignment sensors are typically positioned along the edges of the conveyor fabric. They are usually located at the discharge and at the loading areas of the conveyor, but can be distributed along the conveyor at intervals, depending on the conveyor route and the requirement.

Belt alignment switches are often located on the unsupported section of belting in a horizontal take-up system in order to minimise the damage that misalignment can do in this area. Switches consist of roller switches, limit switches, whisker switches, proximity switches or photoelectric switches.

When the edge of the belt trips the alignment switch for a timed period, power to the conveyor is interrupted and the system halts immediately.

An adaptation of alignment sensors for large steel cord belts is the continuous measurement of edge displacement, termed ‘edge tracking'.

Edge tracking in steel cable belts provides an indication of tension distribution within the carcass among the support cables. Upon installation, each steel cable belt exhibits an edge-tracking signature for a belt revolution.

A deviation in the edge tracking displacement at a later time would suggest a problem in the belt cable tension distribution. However, these systems are relatively sophisticated and are usually installed only on extremely strategically sensitive conveyor systems.

3.3 Belt Overload

The belt conveyor system is protected from overload via the overload of the electric drive motors. The motor overload indicator can be a simple bi-metallic or melting eutectic alloy or a complex computer-based motor thermal model.

Alternatively, the motor current can be monitored and any significant deviation from the standard operating signature for a pre-determined time will cause a power interruption.

A belt loading sail or paddle switch senses a belt overload at a specific point. However, such units must be designed to cater for the largest lump likely to be encountered in order to minimise spurious stops.

On the other hand, if a lump is large enough to activate the paddle switch, it makes operating sense to investigate the lump before it causes consequential damage downstream.

Complex belts are sometimes protected from overload by belt weigh scales that measure the belt loading at a given point.

Alternatively, a non-contact belt profile sensor, such as an ultrasonic, radar, laser or video device is used to measure the belt loading depth. Based on an assumed material density, the loading tonnes per hour can be projected. The actions regarding a single large lump apply in these cases as well.

Weigh meter controls are usually coupled to the belt-feeding device, such as a belt, apron or vibrating feeder. The overload sensing signal is then relayed to the feeder controller and the feeder rate is reduced to comply with the requirements of the system.

Of course, unscrupulous operators can bridge, for example, any control and continuous spillage occurrences, despite any other protective measures that are in place. There is often evidence of such bridging or over-riding control of controls found during routine inspections.

Other methods of overload control are fusible plugs on fluid couplings and shear pins on flexible couplings. Electronic sensing has largely overtaken the use of mechanical devices and is less easily tampered with.

3.4 Belt Slip Protection

Belt slip is the loss in transmission of tension from the drive pulley(s) to the belt cover and can destroy a belt or drive pulley, causing a fire hazard.

With the modern high-friction ceramic lagging of drive pulleys, the lagging itself may be destroyed depending on its type, or the belt cover completely stripped in localised areas.

Belt slip protection includes a belt drive speed sensor that compares the measured belt speed with the belt signature or specified design speed. Large conveyors with long ramp times require comparative slip detection during ramping similar to the slip protection applied to variable speed conveyors.

For constant speed belts this normally consists of a slip deco switch with a set point that trips the conveyor drive when the belt speed is below 80 percent of full speed. In order to prevent controller confusion, the belt slip switch is bypassed during starting and stopping and this is usually incorporated in the MCC.

Belt slip in variable speed conveyors consists of a speed sensor that measures belt speed and compares it with the speed reference sent to the drive system. When the belt speed drops below 80 percent of the set speed, the drive is tripped. This type of belt slip is active during starting, running, and stopping.

In multiple pulley adjacent drives, tachometers are provided for each drive motor. The tachometer signals are compared to the normalised belt speed and sense slippage on any one of the multiple drive pulleys.

A method to adjust and test belt slip is normally an integral part of the belt control system.

Slip detectors are often installed at other locations along the line of the belt, particularly at the tail pulley. In the event of the belt breaking for any reason, the tail pulley is usually the first to stop rotating.

3.5 Take-up Over-travel

Over-travel limit switches can be placed at the far extremes of the counterweight or take-up device travel.

In a gravity counterweight take-up, the top-over travel switch trip may suggest a jammed conveyor fabric condition.

A bottom over-travel switch may indicate belt stretch, or a broken belt fabric flight. Excessive take-up motion during starting and stopping indicates an inadequate or malfunctioning drive control.

Alternatively, excessive travel could indicate that one or more splices are failing or have failed.

3.6 Transfer Chute Plug or Blocked Chute

A plugged chute or blocked chute device provides belt protection at the discharge end of the conveyor into a transfer chute. Blocked flow can result in damage to the moving conveyor.

A blocked chute can also cause severe damage to the belt being fed, particularly in the case of a single large lump stuck in the feeding boot and slitting the belt.

Plugged chute switches are used in many configurations depending on the application.

Actuation of the plugged chute switch with time delay normally results in the tripping of the conveyor drive.

Typical devices used are laser, ultrasonic, pressure diaphragm or simple overflow detection.

A popular system is to use a mercury switch unit that interrupts the power in the event of a tilt beyond 15° to the vertical.

Blocked chute sensors require careful maintenance because they are required to operate in extremely harsh conditions, often in the flow of material and in relatively inaccessible locations.

3.7 Bin Level

When conveyors discharge into bins or hoppers, bin level sensors provide protection to the belt in that they shut down the conveyor if the pre-determined level is exceeded.

These can consist of simple hanging tilt switches or analogue measurement devices such as ultrasonic, radar or laser.

3.8 Pull-cord Stations (Emergency trip wires and switches)

Pull-cord stations are distributed stop switches with latching attachments. Pull-cord or pull-wire switches are required on all conveyors.

Where conveyors are able to be accessed from both sides, the pull-switches must be located on both sides of the conveyor. Ingenious crossover systems have been developed to allow the use of pull-cord switches on both sides of the conveyor while utilising only one control system.

Pull-switches are located along the conveyor at intervals not exceeding 100 metres between the individual switch units. The units are interconnected with a pull-wire.

An operator activates the switch by pulling the pull-cord until the switch trips, interrupting power to the conveyor and usually raising a visual indicator flag. The switch remains tripped until reset manually at the switch location. The belt does not restart on reset of the pull-cord for safety reasons.

Tripping of the pull-cord is a controlled stop, and shall not be considered a lockout of the conveyor power source, unless the units are specifically so designed. It is important to note that pull-wires are not substitutes for guards.

The pull force required to operate the switch shall not exceed 70 N when applied at mid span between supports, with a movement of not more than 300 mm when applied at right angles to the wire and must not exceed 270 N when pulled in-line.

Systems available in South Africa range from a simple power switch, with a local isolator knob which is also available as a lockable switch, to sophisticated systems that allow voice communication, diagnostics and other protection devices.

Modern systems use either a standard 5 mm or 6 mm PVC covered steel cable, or weatherproof cables that encase the control lines, communication lines and other instrumentation requirements in one cable.

Pull-wires must be installed in such a way that they are clearly visible and readily accessible from all areas that provide access to the conveyor.

3.9 Belt Rip Detectors

Belt rip detectors indicate rips or tears in the belt fabric, allowing quick action to be taken to protect the belt from further damage.

Simple rip detectors are usually spill switches located below the centre of the belt near the point of belt loading. Note that particularly with steel cord conveyors, a central rip is often undetectable with the naked eye, due to the high closing forces of the troughed belt. For this reason, mechanical systems tend to be unreliable.

Complex belt rip detectors on larger belts involve the embedding of antennae into the belt construction, generally in the bottom cover, about 50 metres apart. The antennae usually consist of looped copper wire, and the sensor on the opposite side of the belt detects, by induction, the transmission of a pulsed signal from the sensor on the other side of the belt. If a rip cuts an antenna, signal sources and detectors located along the edge of the belt detect a broken antenna and shut down the belt.

Complex belt rip detection systems require periodic maintenance, especially to their controllers and sensors.

If a rip has been repaired, the sensors are programmed to skip the broken antenna, thereby preventing erroneous trips. However, in the event of several adjacent broken antennae, there is, in this example, a potential that 150 metres of belting is, essentially, unprotected. It is possible to have the antennae removed by local skiving of the belt covers, with the broken antennae being replaced and re-vulcanised in-situ.

Other electronic systems rely on the ultrasonic transmission of pulses transversely through the conveyor carcass. When the belt is ripped, the signal will change and trip the conveyor.

The major cause of belt loss on overland systems is belt rip. In most cases, simple items such as liner plates coming loose or jumper bars or rods in the material stream passing over the feeding conveyor terminal cause the damage.

In most cases, minimal maintenance carried out on a regular basis prevents the rips occurring.

3.10 Fire Detection

Some belts carrying combustible materials are fitted with fire detection protection systems. The belt material of construction can, however, also burn and give off noxious gasses and is protected in the same way.

These systems include point or distributed thermal trip switches located above the belt fabric, smoke sensors, carbon monoxide sensors, or fibre-optic temperature sensors.

The fire detection systems may be incorporated in the pull-wire switch systems, or may be installed as standalone systems.

3.11 Lightning Protection

All conveyors are prone be being struck by lightning and require protection from being damaged and to protect all operating and maintenance staff.

Earthing and other applicable protection standards need to be installed and adhered to. The conveyor belt protection system shall be electrically isolated from the control system and all other control networks in accordance with the requirements of SANS 10313 or BS 6651. Any equipment or devices that are required to be directly connected to the control system shall be earthed to an acceptable minimum standard.

Underground conveyors are earthed and electrically supplied from cables normally installed in the shaft or through boreholes allowing an electrical lightning path to the underground conveyor.

Lightning within the operational area needs to be monitored such that systems can be shut down in the event of danger levels reaching predetermined limits.

3.12 Dust Suppression

Belts transporting dusty material are equipped with water or chemical based dust suppression systems. These systems spray the belt material at selected transfer and belt loading points. In some instances, dust suppression systems are coupled to ultrasonic spray nozzles**.**

Systems spray a constant amount of dust suppression per unit of time whilst the belt is running. The dust sprays are turned off when the belt is idle or unloaded to prevent puddling, waste and slippage.

The way in which dust suppression mechanisms work is to reduce the size of the water droplets, making them smaller than the dust particles. This enables the dust particles to break the water surface tension, adhering to the water droplet and forming larger drops.

In the case of coal dust, wetting agents are required, since coal dust and water are immiscible under normal conditions.

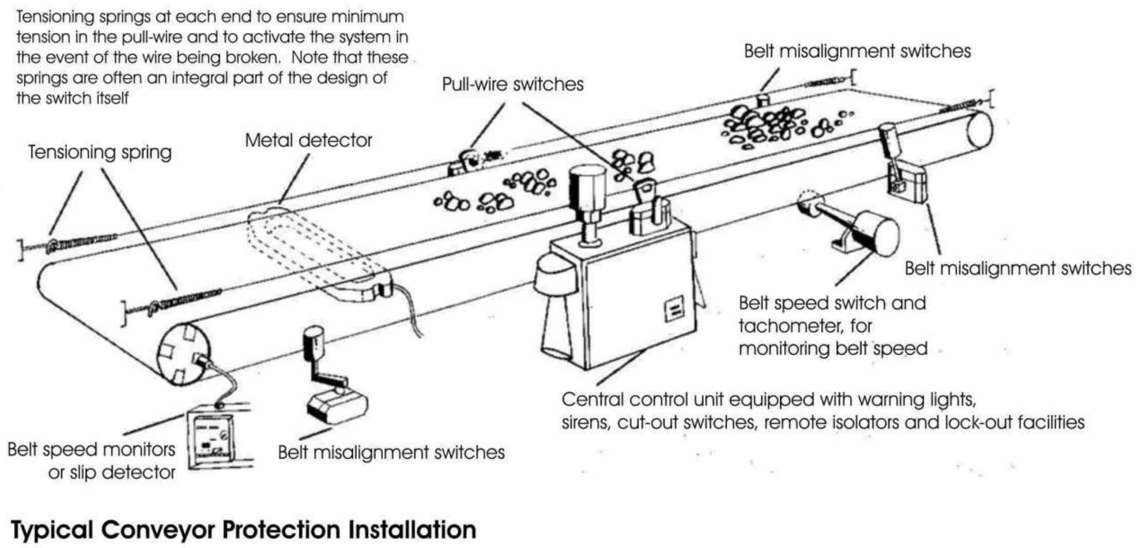


Figure 1 Typical Conveyor Protection Installation

4. Basic Conveyor Guard Design

4.1 Guards & Fences

A guard or fence is only effective if it is constructed to prevent a person from reaching the danger or nip point. A person is capable of reaching upwards, over, into, around or through a guard or fence, and all these aspects must be taken into account when considering the effectiveness of a guard or fence. For belt conveyor installations the so-called ‘nip guard’, examples of which are shown in the sketch below, extend over the whole width of the pulley and are regarded as a reasonable solution to prevent access to the danger points. Installation of this type of guard is strongly recommended but unfortunately it is impossible to install it in such a way that a person is completely prevented from reaching around it. A nip guard alone cannot therefore be regarded as sufficient protection and it is essential that pulleys are further guarded or fenced off to meet the requirements of the regulations.

Figure 2 Pulley Guard

Figure 3 Drive head Guarding

Figure 4 Loop Take-up Guarding

The following may be provisionally accepted as safe in the absence of facts to the contrary:

4.1.1 Upwards

Any pulley or idler, which is 3,5 metres or more in height and therefore beyond an upward reach, may be regarded as being positionally safe and need not be guarded.

The possible reduction of this safe clearance by a build-up of spillage or discharge of material shall, however, be borne in mind.

4.1.2 Over

Head and tail pulleys must be guarded on at least the two sides and the top unless the guards or fences on the sides are extended to a height that makes it impossible to reach over and contact the nip point.

If side guards only are attached with a very small clearance between the edge of the belt and the side guard, this may perhaps be regarded as adequate to prevent reach over the guard to the nip point, but will not necessarily prevent tools or clothing from being caught in the nip point If a top guard is attached it must be high enough above the belt to ensure that the load on the belt will not damage it.

4.1.3 Into

The distance that the guard or fence is placed from the side of the belt determines the distance that these extend away from the nip point along the length of the belt. An acceptable distance is at least 0,85 metres away from the nip point, preferably from the position of the nip guard.

4.1.4 Around

This is similar to 'into' so far as the conveyor pulley guard is concerned, but may also be applied to determine the length of the top section of the guard. The same minimum distance of 0,85 metres applies.

When a V-belt or chain drive is associated with the conveyor installation, a common point of error is that while the V-belts or chains are perfectly guarded around the perimeter and on one side, the guard is installed in such a way that the nip points can easily be touched by reaching around the section forming the perimeter guard.

4.1.5 Through

The protection afforded against injury by reaching through the guard is determined by the shape and size of openings in the material used for construction of the guard or fence.

Square Openings: It may be assumed that there is no reach through an opening of 10 mm x 10 mm or less, as it is too small for fingers. If the opening is such that it will admit one, two or three fingers, the reach is restricted by the roots of the fingers, a distance normally not exceeding 100 mm.

When the opening is sufficient to admit the whole arm and a small portion of the shoulder, the reasonable safe distance is based on the distance from the fingertips to the armpit, which is assumed to be 0,85 metres.

Screening materials with openings in excess of 80 mm x 80 mm shall not be used in the construction of guards or fences. Preference shall be given to materials with openings not exceeding 25 mm x 25 mm.

Elongated Openings (openings with parallel sides): Openings up to 6 mm wide are of no consequence. The guard or fence so constructed may virtually be regarded as a sheet, and a working clearance of approximately 25 mm is all that is required.

Openings greater than 6 mm but less than 13 mm will admit part of a finger and require at least 50 mm clearance from danger points.

Openings in excess of 13 mm but not greater than 80 mm are subject to the following formula:

X = 10Y where:

X = reasonable safe distance from danger point in millimetres.

Y = width of opening in millimetres.

Note: The tail pulley guard shall be closed at the rear.

4.2 Nip Points & Nip Guards

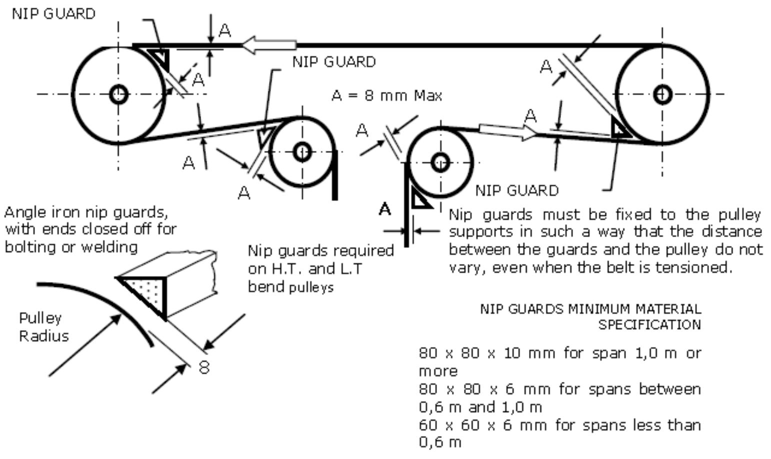


Figure 5 Typical Belt Conveyor Protection Installation Showing Nip Guards

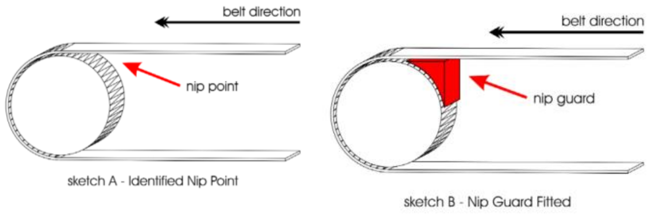


Figure 6 Identified Nip Point & Fitted Nip Guard

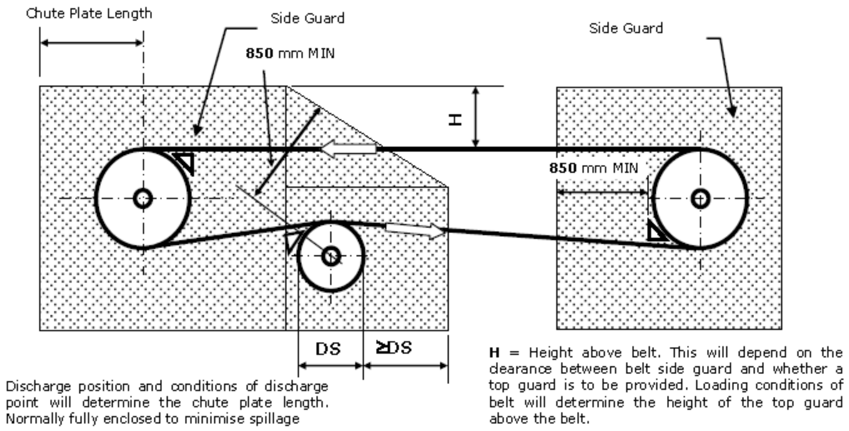
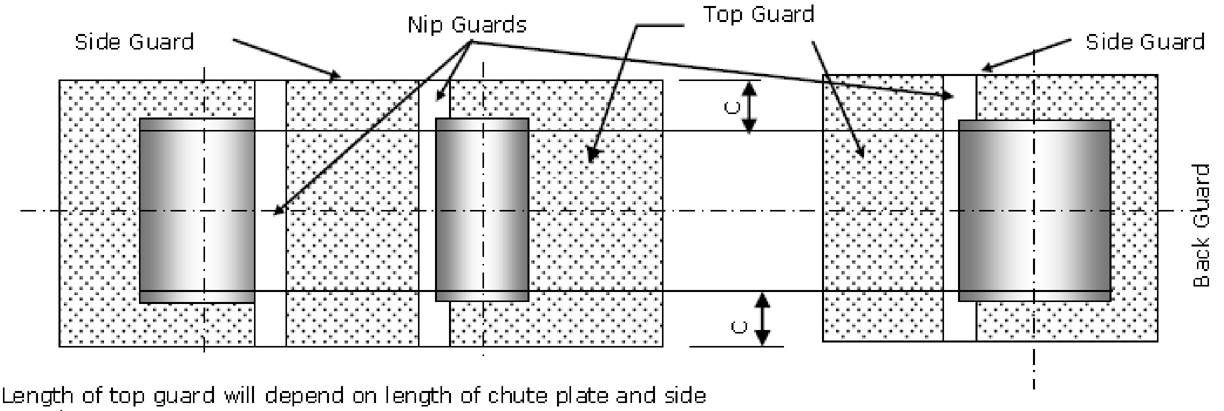


Figure 7a General Nip Guard Configurations – Side Elevation



Length of top guard will depend on length of chute plate and side
C = Clearance between side guard and pulley. Minimum clearance will depend on size of mesh or guard material

Figure 7b General Nip Guard Configuration – Plan View

4.2.1 Carry Idlers

Although it has been stated that it is essential that the head, tail and snub pulleys of belt conveyor installations which are ‘within reach’ shall be guarded, accidents have happened on carrying idlers.

The outcome has frequently been serious particularly where the amount the belt that can lift off the idlers is restricted. The danger at idlers is more serious when fixed hoppers or skirt plates under which the hand can be trapped are fitted directly above the idlers. If this is the case, the danger points must be very carefully guarded or completely enclosed. This also applies, even more so, to belts on which hand sorting is performed.

4.2.2 Return Idlers

On belt conveyors, the return belt or idlers may also present a hazard especially if specific places exist where persons regularly pass underneath the belt. At such places, it is recommended that the underside shall be guarded and crossing at other places shall be discouraged or prevented, even if only two or three strands of eight gauge galvanised wire is used along the outside of the supporting framework to achieve this purpose.

4.2.3 Drive Units

Driving belts, chains and couplings between driving motors and gear boxes or drive pulleys must be effectively guarded. Experience has shown that even when transmissions are apparently inaccessible they can still be a hazard. If the driving mechanism or any other part is fenced off completely in such a way that access thereto can only be gained through a gate or door forming part of the fencing, then this gate or door shall be interlocked so that the conveyor stops when the gate or door is opened.

4.2.4 Trip Wires

When faults, accidents or blockages occur, it is necessary to bring the conveyor to an immediate halt. If pulled, a continuous 'tripwire' stretching the whole length of the conveyor shall be set to actuate the conveyor's stop switch. This is an effective and essential safety device. With such a facility available, the operator will be less tempted to try to rectify faults while the conveyor is running.

The tripwire must, however, extend to the full length of the conveyor, even as far as the inside of the guarded sections. If the belt conveyor is installed in such a way that people can walk along the conveyor avoiding the wire, then a tripwire must be installed on both sides of the conveyor.

It is also recommended that a 'lockout' facility be provided on this trip wire arrangement.

4.2.5 Interlocked Guards

In some applications guards are fitted in conjunction with limit switches interlocked with the safety system such that if a guard is removed, power to the conveyor is immediately cut and the conveyor will coast to a stop.

Equally so, the conveyor will not start up if the guard has not been replaced or re-fitted correctly after maintenance has been done

4.3 Maintenance and Access

Lateral movement of the belt is usually caused by a build-up of material on the head and tail pulleys, the carrying idlers or snub pulleys. The manual removal of build-up is slow and complicated, and frequently dangerous.

To keep the pulleys and rollers clean, suitable mechanical devices must be installed.

The manual removal of build-up shall not be permitted whilst the belt conveyor is in motion. It is often necessary for an attendant to cross a conveyor at various points. It is dangerous to climb onto the moving belt. Where it is impossible to establish safe passageways underneath the belt, crossover bridges with handrails must be provided.

The position of these bridges will depend on conditions at the belt conveyor installation, but unless a sufficient number are installed, they will not always be used.

The crossover bridge must be accessed via stairs equipped with handrails and a 'toe-board' as well as an intermediate or knee rail. Avoid vertical ladders.

In many cases where walkways are fitted on elevated conveyors, no adequate hand and knee rails are installed on the outer sides. This presents a danger, as there is often a large opening between the inside of the walkway and conveyor stringer section at knee height. These areas shall be guarded off with knee rails.

Safety at belt conveyor installations may be further enhanced by creating the optimum working environment including not only adequate ventilation, illumination and absence of undue noise, but also sufficient clearance around the installation and along walkways. Walkways shall have an even, non-slip surface, be properly drained and free from obstructions.

4.4 Ergonomics (Human - Machine Interface).

To prevent accidents on conveyors it is vital to take engineering safety measures. It is possible to increase safety in existing installations at a very low cost. This document suggests ways of solving safety problems.

Good engineering safety measures and an optimum working environment are not the only factors conducive to combating the high annual casualty rate associated with belt conveyors. One of the principal keys to success is an understanding of the human element.

Even a properly guarded belt conveyor installation is not in itself inherently safe but with adequate training and proper awareness of dangers, an operator may use it with perfect confidence.

Operator training is usually the personal responsibility of the staff member in charge of the correct operation and running of the machinery. Awareness of the fact that familiarity with the machine on his part and an over-estimation of the operators' skills and knowledge does not result in an under-estimation of the amount of instruction and degree of supervision necessary for the safe execution of tasks.

Comprehensive training schemes to ensure that operators have the required knowledge and skills to run the relevant equipment, including compulsory re-training opportunities are essential.

PART 18 – HAZARDOUS CHEMICAL SUBSTANCES

1. Introduction

A Management of Hazardous Chemicals Programme is required if any hazardous chemical is used or handled at a workplace. Hazardous chemicals can be classified under the following categories:

- Corrosive substances
- Flammable substances
- Explosives
- Oxidising substances
- Pyrophoric substances
- Gases under pressure
- Organic peroxides
- Self-heating substances
- Self-reactive substances
- Substances which when in contact with water, emit flammable gases
- Toxic substances
- Mutagens
- Carcinogens
- Teratogens
- Sensitizers
- Irritants
- Substances hazardous to aquatic environment

The Management of Hazardous Chemicals Programme must cover the safety and health aspects throughout the life cycle of the hazardous chemicals that are used or produced in a plant, transportation, storage, handling, usage and disposal of the chemicals.

A workplace which uses or handles any hazardous chemical may choose to implement the relevant elements or components of the Management of Hazardous Chemicals Programme depending on the nature of its work, operation or process carried on, and the hazardous chemical(s) used or handled. As a minimum requirement, the programme should cover risk assessment and hazard communication through safety data sheets and labelling as these are essential for chemical safety management.

For workplaces such as petrochemical and pharmaceutical plants, semiconductor wafer manufacturing, and bulk storage of hazardous chemicals premises that are required to implement a Safety and Health Management System, the Management of Hazardous Chemicals

Programme should be an integral part of the Safety and Health Management System.

2. Establishment of Management of Hazardous Chemicals Programme

A team should be formed to establish and implement the Management of Hazardous Chemicals Programme. The composition and size of the team should be proportionate to the size of the company and the risk of exposure to hazardous chemicals. The team could comprise safety and health, procurement, operation and relevant technical personnel.

A senior management staff should take charge of and lead the programme. He/ she should formulate chemical management policy for the plant and delegate the responsibility of various elements or components of the programme to competent persons within the plant.

The person in charge should establish practicable links with internal or external parties such as competent authorities, industrial hygienists, occupational health specialists, safety and health consultants, laboratory and other service providers. In establishing and implementing the programme, the person-in-charge should arrange meetings or discussions to promote collaboration of efforts between management and employees.

The person in charge should coordinate the programme, monitor the progress, assess the performance, evaluate the effectiveness, review the programme at regular intervals, and ensure that the objectives are met.

3. Elements of a Hazardous Chemicals Management Programme

Where toxic, corrosive, explosive, flammable, reactive, oxidising or other hazardous chemicals are used, handled or produced, a Management of Hazardous Chemicals Programme should be established and implemented to safeguard the safety and health of persons who are at risk of exposure to these chemicals and protect the environment.

The Management of Hazardous Chemicals Programme should form part of the workplace safety and health management system. It should cover all stages in the life cycle of the chemicals i.e., during manufacturing, transport, storage, use, handling and disposal. The programme should include the objectives, targets, record-keeping process and written safe work procedures. Senior management staff should oversee the programme to ensure its effectiveness.

The programme should also include the key elements from section 3.1 to 3.12. Individual elements could be delegated to a competent person who has adequate knowledge in managing hazardous chemicals. It is essential to identify the key persons in the early stages of developing the programme, so that they are involved from the start.

3.1 Policy and Strategy

Senior management should issue a statement on hazardous chemical management policy.

The policy should state explicitly the responsibility and commitment of management to ensure the safe use of chemicals, and the protection of employees against chemical hazards.

Management should also outline a broad strategy on managing hazardous chemicals and include the duties and responsibilities of employees.

3.2 Selection and Procurement

A proper chemical selection and procurement procedure should be established with clearly defined requirements. All new processes and chemicals should be evaluated for hazards before acquisition or purchase. This is to minimise the introduction of additional hazards into the workplace.

Information on protection against safety and health hazards should be obtained from suppliers and other sources. Safer chemicals and processes should be considered more favourably.

Factors or information to be considered when selecting a safer chemical include flammability (flash point), fire or explosion rating, toxicity (lethal dose or concentration), health effects, routes of exposure, vapour pressure and permissible exposure level of the chemical.

The majority of the information can be found in the safety data sheets (SDS) of the chemical. In general, chemicals with a higher Globally Harmonised System (GHS) of Classification and Labelling of Chemicals* hazard category number are less hazardous than those with a lower hazard category number within the same GHS hazard class.

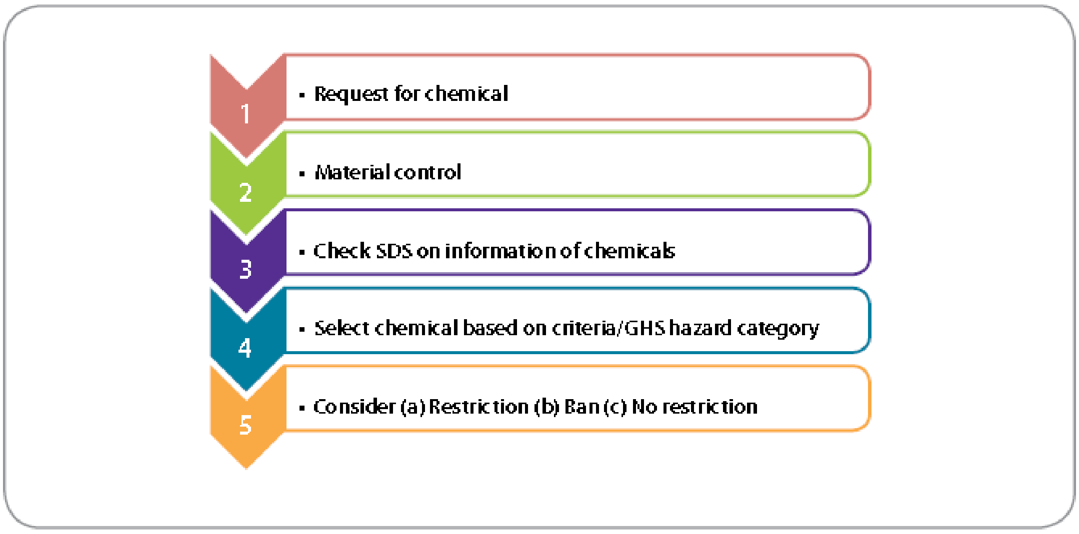


Table 1: Flowchart for selecting chemicals

*The Globally Harmonised System (GHS) of Classification and Labelling of Chemicals is developed by the United Nations. It is a hazard communication system through standardised chemical hazard classification, container labelling and SDS.

3.3 Register of Chemicals and Safety Data Sheets

A register of all hazardous chemicals which are produced, stored, used or handled should be kept. The register should contain information on the inventory (i.e., amount stored), supplier of each chemical, application and location of the chemicals, and movement of the chemicals.

It should also indicate the persons who are at risk or liable to chemical exposure. The register should be kept updated when chemicals are no longer used or new chemicals are introduced.

Safety data sheets (SDS) are the main communication tool between the chemical suppliers and the end users. The SDS of all hazardous chemicals listed in the register should be obtained from the respective suppliers and compiled.

The SDS should contain the following key information:

- identity of the substance;
- safety and health information pertaining to the substance;
- composition of and ingredients used in the substance;
- first aid measures;
- firefighting measures;

- accidental release measures;
- precautions to be taken for safe handling;
- exposure controls and personal protection needed;
- physical and chemical properties;
- stability and reactivity of the substance;
- toxicological information;
- ecological information;
- disposal considerations;
- transport information; and
- regulatory information.

Management should study the information in the SDS and take necessary measures to ensure the safe use of the hazardous chemicals. SDS should be available to persons who are exposed or liable to exposure of hazardous chemicals. Copies of SDS should also be located near the work station and kept in the office.

3.4 Labelling and Warning Signs

All packaged containers containing hazardous chemicals should be labelled in accordance with the GHS.

The label should indicate the identity of the chemical, its hazards and the precautions to take. Persons who are required to handle chemicals should be aware of the hazards and the precautionary measures. Warning signs or notices specifying the nature of the danger of the hazardous chemicals should be prominently displayed in areas where such substances are used or handled. These warning labels should be available in various languages that can be understood by the workers.

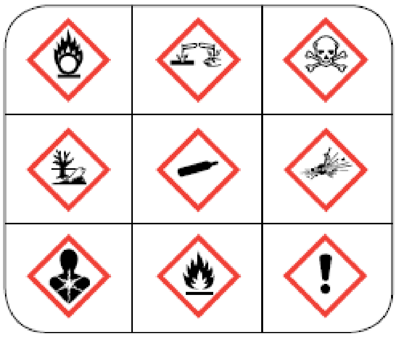


Figure 2: Symbols of GHS for Classification and Labelling of Chemicals

3.5 Storage and Transportation

3.5.1 Storage

The hazards in chemical storage include catastrophic failure of a tank, leaks or fugitive emissions from storage containers. A proper system of storage should be established taking into consideration the properties of the chemicals, any form of incompatibility, quantity to store, operational and environmental conditions.

Different chemicals may require different storage containers. Bulk storage of hazardous chemicals often requires adequate tank separation, and diking or curbing to contain potential spill. Hazardous chemicals should be stored away from heat and direct sunlight, and the containers should be properly labelled. Gas cylinders should be securely strapped or chained to a wall or bench. Poisonous chemicals should be locked up and only the authorised person has access to the key.

Chemical containers should be covered when not in use to prevent evaporation and accumulation of harmful vapours in the storage area.

Design of storage facilities should be based on statutory requirements, safety data or other technical information.

International or national standards should be followed where applicable. Flammable liquids should be stored in a fire-retardant cabinet which has a proper warning label. If the liquids are stored in a room, there should be adequate ventilation to prevent the accumulation of vapour. Large amounts of liquids should be stored in bigger rooms.

3.5.2 Transportation

An accident during the transport of hazardous chemicals can have catastrophic consequences such as fire, explosion and toxic release. Whenever hazardous chemicals are transported within or outside a company, precautionary measures should be taken to ensure that the potential risks are communicated to persons who will come into contact with the chemicals during transportation.

This can be accomplished through marking and labelling of packages or containers to indicate the hazards of the consignment. The relevant information can be included in the transport documents, and by placing or sticking placards on the transport units i.e., vehicles and containers. These labels should conform to the specification for Hazard Communication for Hazardous Chemicals and Dangerous Goods on Transport and Storage of Dangerous Goods.

In addition, the vehicles should be equipped with appropriate firefighting appliances and drivers should be trained in the safe transport of Dangerous Goods as well as in dealing with emergency situations.

Loading, unloading and transfer operations are pronto accidents, and should be managed properly. Control measures should be implemented to reduce the risks.

Safe work procedures should also be established and carried out in order to avoid unnecessary risks.

3.6 Risk Assessment and Control

Management must ensure that a risk assessment (RA) is conducted before the use of any hazardous chemical. The RA should include work on any process, plant, vessel or machinery that is liable to produce or give off any hazardous chemical. The RA should cover:

- identification of the safety and health hazard events;
- determination of the degree of exposure to the hazardous chemicals or the frequency or likelihood of occurrence of the events; and
- analysis of the possible effects of exposure to the hazardous chemicals or the consequences of the events.

A documented RA should be kept and reviewed every year or when there is a significant change in the work process, or there is reason to suspect that the assessment is no longer valid.

If the RA reveals that the risk is not acceptable, control or preventive measures should be implemented to reduce the risk. The hierarchy of control is as follows: hazard elimination, process or chemical substitution, engineering control (e.g., process modification, containment, automation, local exhaust ventilation), administrative measures (e.g., safe work practices, reduction of exposure duration) and personal protection.

Developers of industries using or storing large quantities of hazardous substances are required to conduct a Quantitative Risk Assessment (QRA). The QRA is required to establish health and safety zones to prevent knock-on effects of neighbouring hazardous installations and protect the public from fire, explosion, toxic fumes dispersal hazards, detrimental effects on health, and chemical contamination.

3.7 Safe Work Procedures and Personal Protective Equipment

Any work involving hazardous chemicals should be established and documented through written procedures. The procedures should cover dispensing, transferring, using and disposing of the hazardous chemicals.

During the manufacturing process of the chemicals, written procedures should be put in place for the start-up, during routine operation, at shut down and maintenance work.

The safe work procedures should include the safety and health precautions which are to be taken during the course of work, and the use of personal protective appliances.

Personal protective equipment (PPE) includes respirators, safety glasses, face shields, overalls, aprons, gloves and boots. Fit tests should be conducted for respirators used by the workers, and the fit test certificates should be kept. Workers should also conduct fit checks (positive or negative pressure fit checks) on their respirators before using them. It is a good practice to perform leak tests on PPE such as gloves to check for holes before use.

PPE should be selected properly, used correctly or comfortably fitted and maintained regularly to ensure effective protection. A suitable PPE programme should be implemented with taking the preceding elements (i.e., selection, issue, fitting and maintenance) into consideration.

3.8 Workplace Monitoring and Medical Surveillance

Monitoring of the work environment provides basic information on the extent and magnitude of the hazards, and exposure to the workforce. It also reveals which workers are most at risk or areas of the workplace that contain high levels of airborne contaminants.

Regular monitoring by a competent person should be carried out in areas where hazardous chemicals are used or given off. Appropriate monitoring strategies should be established and followed. The monitoring data should be interpreted correctly and the records should be kept.

Regular medical surveillance helps to detect early signs of overexposure to toxic chemicals which have suitable biological indicators for exposure assessment. A medical surveillance programme should be established where appropriate. Employees exposed to such chemicals should be identified for regular medical examinations. The results of examinations should be evaluated and medical records such as medical examination and laboratory reports should be kept. Competent advice should be sought if necessary.

3.9 Information and Training

Employees who handle hazardous chemicals or may be affected by them should be informed of the hazards and procedures for safe handling, minimising exposure and first aid. They should be trained before being assigned to work with such chemicals. The training programme should be established to ensure that the safe handling procedures are both known and understood by all concerned.

Information on hazardous chemicals and safe handling procedures should be disseminated regularly to employees through group and individual training, SDS and other aids.

A properly conducted training programme will ensure that the workers learn how to read the SDS, understand the information provided in the SDS and chemical labels, where to find important information, understand the risks of exposure and ways to protect themselves.

When workers gain adequate knowledge and can comprehend easily, they are able to carry out proper work practices in the workplace.

3.10 Emergency Planning and First Aid Procedures

Emergency planning is needed to respond to chemical accidents such as fires, explosions, spills, leaks or release of hazardous chemicals as well as release from pipelines and transport vehicles. Emergency procedures should be established so that the source of release can be promptly rectified, and the area of contamination can be contained and decontaminated properly. The procedures should also indicate how contaminated materials should be safely disposed of. Emergency drills should be conducted at suitable intervals to ensure that all employees are trained to take necessary actions during an emergency.

A first aid programme must ensure that emergency treatment for victims of chemical poisoning or excessive exposure to toxic chemicals is in place. This should cover first aid facilities, first aid personnel and types of first aid treatment.

3.11 Waste Disposal

Chemical waste can be classified as liquids, sludge, solids or mixed waste. Waste chemicals are recycled, incinerated, buried or made to undergo a physical and chemical transformation (i.e., neutralisation and separation) or biological treatment. Improper handling of waste may cause pollution and endanger the safety and health of the workers.

Operations that generate hazardous waste should be governed by a hazardous waste management system.

This should include proper labelling of waste according to the national or international codes, proper waste storage and treatment facilities, proper waste transport and disposal facilities e.g., by licensed or toxic waste collectors, and proper emergency action plan to deal with any accidental release of hazardous waste.

3.12 Contract Work

Where contract work involving hazardous chemicals is carried out, the management shouldset up a system to ensure that such work is carried out safely within the plant.

Criteria should be established for the selection of contractors based on their safety and health awareness, management and performance. Clear communication between the management and contractors should be established; and duties, responsibilities, authority and reporting relationships should be defined.

The management and contractor should establish a safe work procedure to ensure the safety and health of both employees and contract workers. Training and health educational programmes on health hazards and prevention measures should be developed for both contract workers and supervisors before they start work.

Rules could be set to penalise misbehaving and obstinate contractors and contract workers, and incentive or award can be given to those who excel in safety and health performance.

3.13 Management of Hazardous Chemicals Programme Review and Audit

Management should conduct a review of its Management of Hazardous Chemicals Programme annually to ensure that it is relevant and up to date.

The programme should be subjected to regular audits to ensure that it has been implemented effectively.

Management should also implement the recommendations of the review and audit to help improve and enhance the programme.

PART 19 – PERSONAL PROTECTIVE EQUIPMENT

1. Introduction

Employers have basic duties concerning the provision and use of Personal Protective Equipment (PPE) at work and this section explains what you need to do to meet the requirements of the Personal Protective Equipment.

2. Definition of PPE

PPE is defined as 'all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health or safety', e.g., safety helmets, gloves, eye protection, high-visibility clothing, safety footwear, safety harnesses and hearing protection.

3. Legal requirements

The main requirement of Occupational Health and Safety act (Act 85 of 1993) is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.

The Act also requires that PPE:

- is properly assessed before use to ensure it is suitable;
- is maintained and stored properly;
- is provided with instructions on how to use it safely; and
- is used correctly by employees.

An employer may not ask for money from an employee for PPE, whether it is returnable or not. This includes agency workers if they are legally regarded as your employees.

However, if employment has been terminated and the employee keeps the PPE without the employer's permission, then, as long as it has been made clear in the contract of employment, the employer may be able to deduct the cost of the replacement from any wages owed. Similarly, if the employee abuse, misuse or treats PPE negligently, an employer may charge the employee for re-issue of such PPE.

4. Assessing suitability of PPE

To allow the right type of PPE to be chosen, carefully consider the different hazards in the workplace. This will enable you to assess which types of PPE are suitable to protect against the hazard and for the job to be done.

Ask your supplier for advice on the different types of PPE available and how suitable they are for different tasks. It may be necessary in a few particularly difficult cases to obtain advice from specialist sources and from the PPE manufacturer.

Consider the following when assessing whether PPE is suitable:

- Is it appropriate for the risks involved and the conditions at the place where exposure to the risk may occur? For example, eye protection designed for providing protection against agricultural pesticides will not offer adequate face protection for someone using an angle grinder to cut steel or stone.
- Does it prevent or adequately control the risks involved without increasing the overall level of risk?
- Can it be adjusted to fit the wearer correctly?
- Has the state of health of those who will be wearing it been taken into account?
- What are the needs of the job and the demands it places on the wearer? For example, the length of time the PPE needs to be worn, the physical effort required to do the job and the requirements for visibility and communication.
- If more than one item of PPE is being worn, are they compatible? For example, does a particular type of respirator make it difficult to get eye protection to fit properly?

5. The hazards and types of PPE

5.1 Eyes

Hazards: chemical or metal splash, dust, projectiles, gas and vapour, radiation.

Options: safety spectacles, goggles, face shields, visors.

5.2 Head

Hazards: impact from falling or flying objects, risk of head bumping, hair entanglement.

Options: a range of helmets and bump caps.

5.3 Breathing

Hazards: dust, vapour, gas, oxygen-deficient atmospheres.

Options: disposable filtering facepiece or respirator, half- or full-face respirators, air-supplied helmets, breathing apparatus.

5.4 Body

Hazards: temperature extremes, adverse weather, chemical or metal splash, spray from pressure leaks or spray guns, impact or penetration, contaminated dust, excessive wear or entanglement of own clothing.

Options: conventional or disposable overalls, boiler suits, specialist protective clothing, e.g., chain-mail aprons, high-visibility clothing.

5.5 Hands and arms

Hazards: abrasion, temperature extremes, cuts and punctures, impact, chemicals, electric shock, skin infection, disease or contamination.

Options: gloves, gauntlets, mitts, wrist cuffs, armlets.

5.6 Feet and legs

Hazards: wet, electrostatic build-up, slipping, cuts and punctures, falling objects, metal and chemical splash, abrasion.

Options: safety boots and shoes with protective toe caps and penetration-resistant-sole, gaiters, leggings, spats.

6. Training

- Make sure anyone using PPE is aware of why it is needed, when it is to be used, repaired or replaced and its limitations.
- Train and instruct people how to use it properly and make sure they are doing this.
- Because PPE is the last resort after other methods of protection have been considered, it is important that users wear it all the time they are exposed to the risk. Never allow exemptions for those jobs which take ‘just a few minutes’.
- Check regularly that PPE is being used and investigate fully any reasons why it is not. Safety signs can be useful reminders to wear PPE.

7. Maintenance

Make sure equipment is:

- well looked after and properly stored when it is not being used, for example in a dry, clean cupboard, or in the case of smaller items, such as eye protection, in a box or case;
- kept clean and in good repair - follow the manufacturer’s maintenance schedule (including recommended replacement periods and shelf lives). Simple maintenance

can be carried out by the trained wearer, but more intricate repairs should only be done by specialists.

Make sure suitable replacement PPE is always readily available.

8. SABS Approval

Ensure any PPE you buy is SABS approved. The SABS marking signifies that the

PPE satisfies certain basic safety requirements and in some cases will have been tested and certified by the South African Bureau of Standards.

9. Key points to remember

Are there ways (other than PPE) in which the risk can be adequately controlled., engineering controls? If not, check that:

- PPE is provided;
- it offers adequate protection for its intended use;
- those using it are adequately trained in its safe use;
- it is properly maintained and any defects are reported;
- it is returned to its proper storage after use.

PART 20 – STAIRWAYS, WALKWAYS AND PLATFORMS

1. Construction and maintenance of Stairs, Walkways and Platforms

Stairways, walkways and platforms are in many cases an essential component of construction sites and they are prone to result in injuries and fatalities among construction workers.

It is therefore essential that special attention needs to be paid to the standard of construction and maintenance of stairs, platforms and walkways in a concerted effort to minimize serious injuries to construction workers.

2. Requirements of Stairways, Walkways and Platforms on construction sites

2.1 Stairs

There must be a stairway or ladder at points of access where there is an elevation break of *300mm* or more. At least one point of access must be kept clear.

All stairways must be provided with a handrail system that is capable to withstand a force of at least 100kg.

Stairways with four or more risers, or higher than 1.2m, must be equipped with at least one handrail.

Stairways with four or more risers or more than 1.2 m high must have a stair rail along each unprotected side or edge.

Stairs must be constructed at an angle ranging between 30 and 50 degrees and must have a uniform riser height and tread depth, with less than an 8mm variation.

For temporary stairs, only use pans if they are filled with filler material to at least the top edge of each pan.

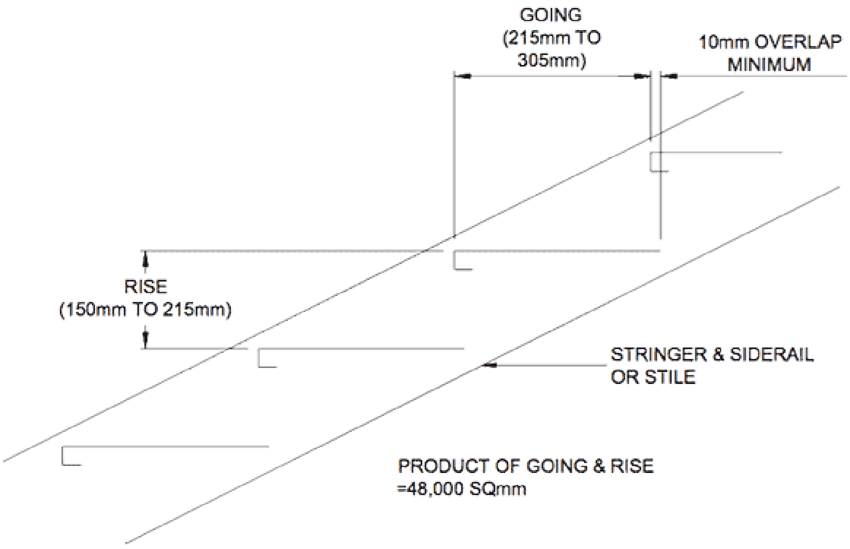
Stairways landings must be at least 760mm deep and 550mm wide at every 3.7 meters or less of vertical rise.

Unprotected sides of landings must have a standard 1 meter guardrail system.

Where doors or gates open directly on a stairway, provide a platform that extends at least 500mm beyond the swing of the door.

Fix slippery conditions before using.

Stairway parts must be free of projections which may cause injuries or snag clothing.

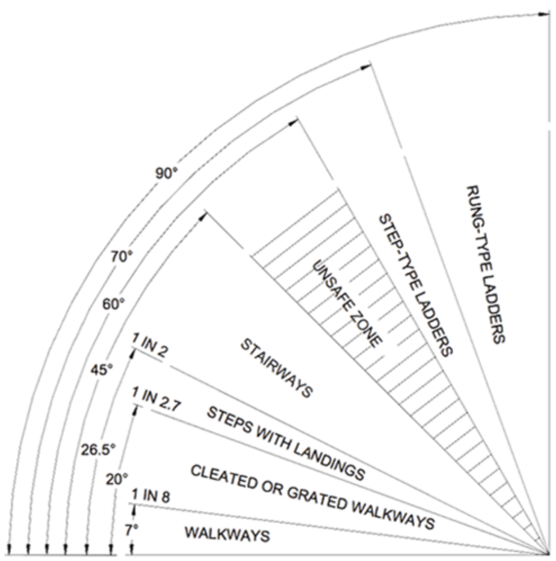


2.2 Walkways and Platforms

These must be at least 550mm wide.

Where walkways and platforms are higher than 1,2m they must be equipped with hand rails which is at least capable to withstand a force of 100kg.

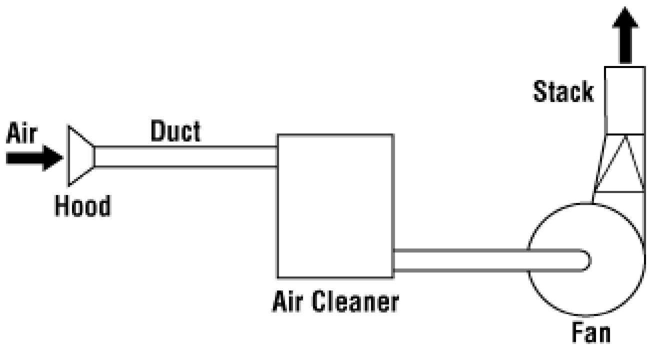
Walkways and platforms must be maintained in good condition at all times.



PART 21 – VENTILATION

1. Introduction to Local Exhaust Ventilation

An LEV is a system that uses extract ventilation to prevent or reduce the level of airborne hazardous substances from being breathed by people in the workplace. LEV draws pollutants away from a process or operation that is likely to release a hazardous substance into the air and which consists of an inlet, such as a hood, slot, booth or cabinet placed around or close to the point of release of the substance. This device is connected via ducting to the inlet of a fan or air mover. The extracted air is usually discharged to the atmosphere or returned elsewhere in the workplace, having first been cleaned to make it safe for release.



Basic components of a local exhaust ventilation system

2. Basic components of a local exhaust system

LEV has an important role to play within the hierarchy of control measures. Although it should always be remembered that Occupational Health and Safety Act strictly requires exposures to hazardous substances to be prevented and control measures only to be introduced where prevention is not reasonably practicable to achieve.

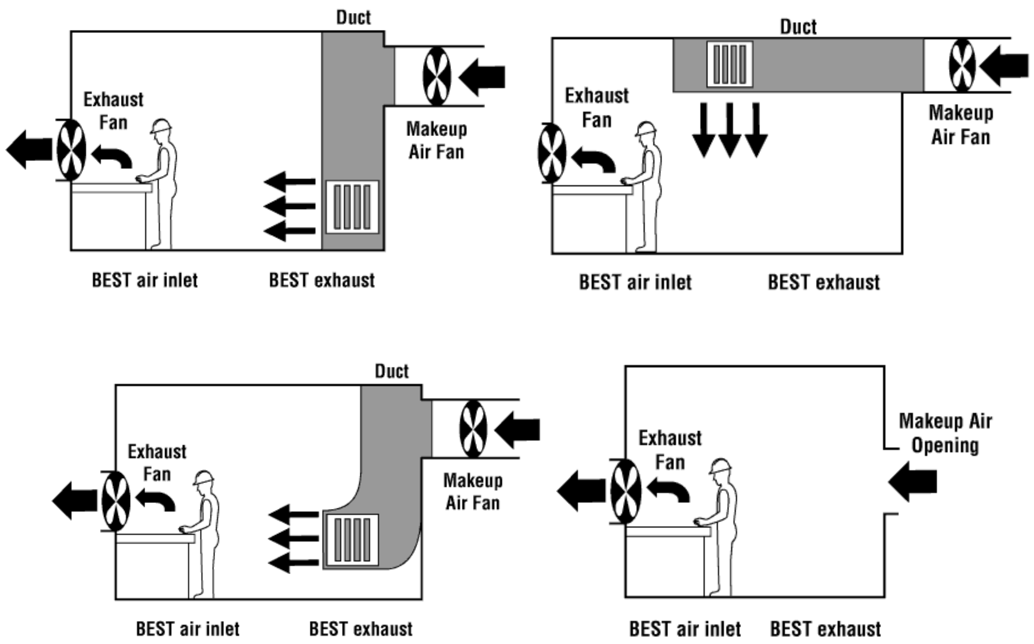
There are two main methods of ventilation, which can be used to control airborne contamination:

2.1 Dilution Ventilation

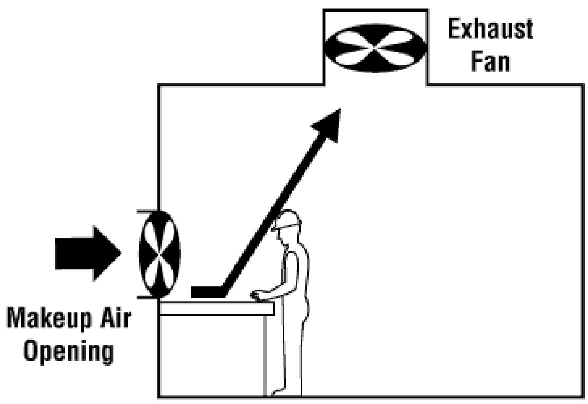
Dilution ventilation provides a flow of air into and out of the working area and does not give any control at the source of the contamination.

Where the quantity of contaminant is small, uniformly evolved and of low toxicity, it may be possible to dilute the contaminant by inducing large volumes of air to flow through the contaminated region.

Dilution ventilation is most successfully used to control vapours from low toxicity solvents, but is seldom successfully applied to dust and fumes.



Examples of recommended Dilution Ventilation



UNACCEPTABLE air inlet and exhaust

2.2 Local Exhaust Ventilation System

LEV intercepts the contamination as soon as it is generated and removes it from the workplace before it can be inhaled.

It is important to consider how the air withdrawn from a workplace by a large LEV system to be replaced and also, if necessary, re-heated. Where re-circulation is involved, it is important to ensure that effective filtering is in place in order that all hazardous contamination is removed from the re-circulated air.

2.2.1 Design

When designing an effective LEV system, account must be taken of the nature and size of the airborne contaminates that need to be removed. For example, are they dusts, fumes, smoke, mists, vapours or gases?

a) Inlets

Consideration needs to be given to:

- The size, shape and position of the contaminant source.
- The physical nature of the contaminant.
- The speed and direction of the contaminant as it moves away from the source.
- The rate of generation of the contaminant.
- The nature of the operation being carried out.
- The position and movement of the plant or person involved.
- And local air movements due to general ventilation and the operation of nearby machinery.

It needs to be remembered that inlets can only exert effective control at points fairly close to the inlet itself. Therefore the inlet needs to enclose the source as far as possible if good control is to be achieved. Although, in practice, a compromise has to be reached when constant access to the work is required.

b) Classification of LEV hoods

Hoods have a wide range of shapes, sizes and designs.

While they may look similar, they control contaminant clouds in three different ways. The classification' of hoods highlights their essential features and they fall into three basic categories:

- Enclosing hoods;
- Receiving hoods; and
- Capturing hoods.

The three main types of inlet are enclosing, receiving and capturing.

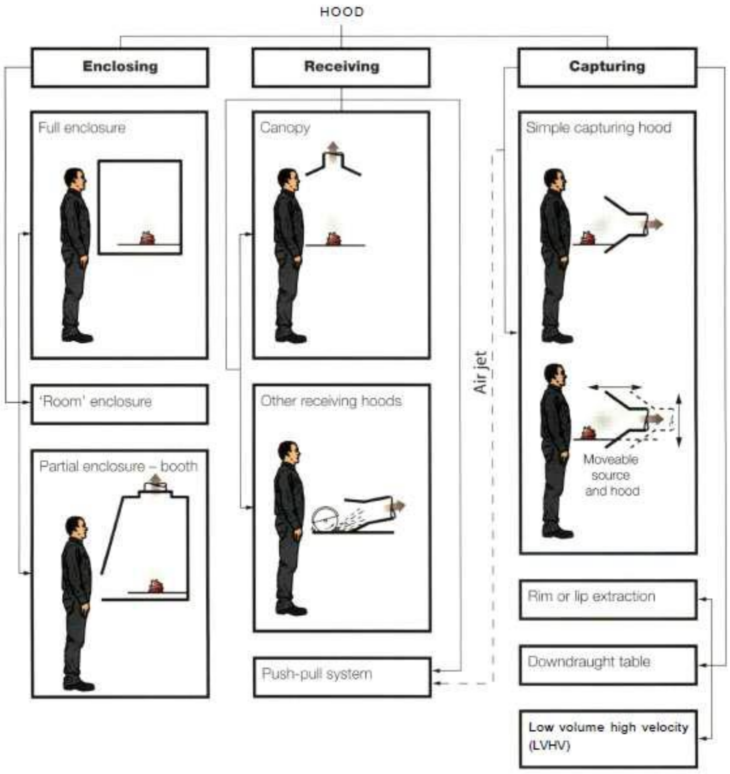


Figure 10 Classification: Types of LEV hood

With partial enclosures the source of contamination is located inside the enclosure.

Airflows from the open face of the enclosure and across the source, to extract openings located in the rear, top or bottom of the enclosure.

Partial enclosures must be large enough to contain the work and the airflow must be capable of guiding the contaminant towards an exact point once the contaminants released into the atmosphere. Along with adequate air velocity the booth must be designed to prevent the contaminant spilling out at the front of the enclosure.

As a general principle operators should never be positioned in the airflow path between the source and the opening of the extractor. The airflow in partial enclosures should be smooth and sudden changes in cross-section and protrusions into the enclosure should be avoided as they may lead to local air turbulence. Large-scale turbulence is less likely in deep enclosures than in shallow enclosures.

LEV hoods should be located as close as possible to the source of contamination and are designed to capture or collect the contaminant and to direct it into the connecting ductwork.

LEV hoods vary in size from small nozzles to large canopies and can be positioned above, below or to the side of the source. They should be located close to the source, enclosing it if possible.

There are two main types of LEV hoods: receptor hoods and capture hoods.

- A receptor hood is used where the contaminant is generated with considerable momentum and the hood is placed in the path of the moving airstream to collect and remove the contaminant.
- A captor hood is used where there is no initial tendency for the contaminant to enter the LEV system and the energy required to provide movement in the right direction is supplied by suction at the hood. The minimum air velocity required being termed the capture velocity. Capture velocity and the degree of enclosure are the two most important features of capture hoods. They determine the volume of air that needs to be extracted to give effective control. The lowest volume flow rate will be achieved with a hood design that encloses the source as much as is possible. Due to not being complete enclosures, operator movement and random air currents can be disturbing influences. These effects can be reduced through use of hoods which enclose the source to a high degree.

c) Ductwork

Ductwork needs to be designed so that the air velocity in the duct is high enough to keep the particles suspended in the airstream, particularly with regard to long horizontal runs of ductwork. Runs of ducting should be provided with access holes for internal cleaning and flexible ducting should be frequently inspected for leaks, partial connection and damage.

d) Multi Inlet LEV Systems

LEV systems with more than one inlet need to be designed and constructed so that each branch extracts the right amount of air through the inlet it serves. This involves consideration of airflow distribution and balancing. The airflow in each branch being determined by the resistance of the inlet, the length, diameter and flow resistance of the branch duct and the flow conditions at the junction with the main duct. Standard procedures exist for balancing ductwork.

e) Air Cleaners

Air cleaners can be classified as: air filters particulate dust and fume collectors and devices to remove mists, gas and vapours.

- Filters are mainly used for cleaning air and are designed to handle large air volumes with low resistance to airflow, although high-resistance high-efficiency filters are used for ultra-clean applications and for the control of hazardous dusts such as asbestos.
- Particulate collectors extract large quantities of dust and fume from an airstream at higher inlet dust concentrations than filters. These collectors include: cyclones, fabric filters, wet collectors and electrostatic precipitators. Mists gases and vapours being removed by chemical absorption, combustion or condensation.

When selecting a suitable air cleaner, obviously the features and properties of the contaminant need to be considered. The following points also need to be taken into account:

- greasy or waxy materials may permanently clog fabric filters,
- abrasive material may cause problems with fabric filters,
- flammable and explosive materials require special precautions,
- corrosive and highly oxidising substances will require special materials of construction and neutralising agents may be needed in wet collectors,
- some dusts may be difficult to wet,
- any gas or vapour components will not be removed by particulate air cleaning and filtration systems for hot processes will need to be suitably temperature resistant.

f) Fans

Fans in LEV systems fall into two main categories- centrifugal and axial flow. Although, for special purposes, turbo-exhausters and compressed air driven movers can be used.

- In a centrifugal fan, air is drawn into the centre of the impeller, picked up by the rotating blades and thrown off at high velocity into the fan casing which collects and guides it towards the discharge opening. In this way, airflows can be delivered against considerable resistance. Fans can utilise radial, forward curved and backward curved blades.

- With axial fans, air passes along the duct and is accelerated by the rotating blades. Asa result, only low resistance can be overcome and they are mainly used as roof mounted extractor units.

  In selecting the correct type of fan, consideration should be given to:

  i. Required airflow.
  ii. The total flow resistance of the system.
  iii. The type of contaminant.
  iv. The flammability of the contaminant.
  v. Space limitations.
  vi. The method of fan mounting and the type of drive to be used.
  vii. Operating temperature and the level of noise and the need for silencers.

g) Discharge Points

Buildings have a surrounding 'boundary layer' of air. The objective is to discharge air beyond the boundary layer, and prevent it entering recirculation eddies. The discharge point should be located well above the highest point of a building.

h) Commissioning

All LEV systems need to be subject to commissioning to ensure that they are capable of meeting their design specifications.

i) Maintenance

Under the Hazardous Substances Regulations all control measures need to be maintained in an efficient state, in efficient working order and in good repair.

Maintenance procedures need to include information on: how frequently maintenance needs to be carried out for each component of the system, what maintenance tasks are necessary and how defects are to be detected and remedied, and who is to be responsible for the maintenance. The maintenance procedures should cover the full range of maintenance activities from simple visual checks to detect obvious defects, to major overhauls for preventative and remedial purposes.

j) Examination & Testing

In addition to effective preventative maintenance, formal inspection and testing of LEV systems are required. It may be sensible for these examinations to be carried out by persons not normally responsible for the system maintenance in order that an independent second opinion can be obtained. For effective examination and testing comprehensive information on the system and its design specification needs to be provided, this is usually known as the Original Equipment Manufacturer's Data.

i. Technical performance testing

It also sets the benchmarks for tests in the logbook for the system. The tests include measurements of:

- The volume flow rate at various points in the system including hood faces (where appropriate), hood ducts and the main duct;
- Static pressures in various parts of the system including hood ducting, and across the filter and fan;
- Hood face velocities (where appropriate);
- The fan speed, motor speed and electrical power consumption.

Thorough inspection and testing of LEV systems must be done at least once every 24 months. However, more frequent thorough inspections and testing is required in the following processes:

Process	**Frequency (Minimum)**
Where blasting is carried out in or incidental to the cleaning of metal castings in connection with their manufacture	1 month
Jute cloth manufacture	1 month
Processes, other than wet processes, in which metal articles (other than gold, platinum or iridium) are ground, abraded or polished using mechanical power, in any room for more than 12 hours per week	6 months
Processes giving off dust or fume in which non-ferrous metal castings are produced	6 months

The aim of inspection and testing being to identify potential problems so that they can be rectified before performance deteriorates. Weekly visual checks should be carried out to identify any obvious defects, although these may need to be more frequent where certain hazardous substances are involved.

The inspection and checking should cover:

- Ensuring that the LEV is always running when hazardous substances are either being emitted or are likely to be emitted.

- Observing the condition of the suction inlet such as the hood or booth to see if it has moved or been damaged.
- Observing the condition of any visible ductwork etc., observing any evidence of control failure such as unusual dust deposits or stronger odours than usual.
- Observing any local instrument fitted to the LEV to indicate its performance and undertaking any minor servicing such as the emptying of filter bins etc.
- A formal system for dealing with verbal reports from employees should be in place in order that details can be recorded into maintenance reports.

Thorough inspection and testing of a LEV system represents a regular audit of the performance of the system and should reveal whether or not the plant is performing correctly and effectively, although it may not reveal the precise cause of the unsatisfactory performance that has been identified.

The thorough inspection and testing will comprise of:

- Visual checks.
- A measurement of plant performance and an assessment of control.
    - An assessment of the performance of the air cleaner or filter where the air is recirculated.

The most common categories of instruments and techniques used for the inspection and testing of LEV systems are:

- Direct measurement of emissions through air monitoring (in the breathing zone close to the source).
- Measurement of plant performance (static pressure and air velocity).
- Visualisation techniques (smoke generators and dust lamps).

The type of information kept in the record for a thorough inspection and test should include:

- The condition of the LEV system at the time.
- The intended performance of the LEV system and the way it should be used.
- Methods used to judge the performance of the LEV system.
- Whether it achieves the intended performance.
- Results of routine ventilation measurements.
- Results of tests of the concentration of airborne material.
- Request for remedial action with details of repair or modifications needed.

- The record should be kept for 5 years with a copy being available at the workplace in which the LEV is located.

Notes:

Module 8 - Environmental Management

1. Introduction

Section 24 of the Bill of Rights in the constitution of the Republic of South Africa guarantees environmental rights for the people of South Africa.

Section 24 states that everyone has the right:

a) To an environment that is not harmful to their health or well-being and,

b) To have the environment protected for the benefit of present and future generations:

   i. Through reasonable legislative and other measures that prevent pollution and ecological degradation;

   ii. Promote conservation; and

   iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Based on this statement in the constitution, the National Environmental Management Act (NEMA) was passed in parliament in 1998. This act ensures that we all have the right to sustainable development; therefore all important environmental factors must be considered before any development decisions are taken. The environmental factors that must be considered are:

a) Not disturbing ecosystems and cultural assets.

b) Not polluting and wasting recourses

c) Being responsible and cautious when using recourses where the effects are uncertain.

   i. All stakeholders have the right to be consulted on impact assessments.

   ii. Everyone has the right to in dispute resolution.

   iii. Everyone has the right to refuse to do hazardous work

   iv. Everyone has the right to report risks

   v. Everyone has the right to information

   vi. Everyone has right to demand that the environment is taken care of

   vii. Everyone has the right to legal standing to enforce environmental laws

   viii. If individuals legal rights are not respected, he can:

      - Take your case to court.
      - Complain to the human rights commission and the public prosecutor
      - Ask advice from the special officer in the national department of environmental affairs and tourism who must deal with complaints

- Ask your local, provincial or national government to appoint a conciliator
- Complain to the police

2. The environment

The earth's environment can be divided into two categories, namely:

a) All living things (the biological environment), and
b) All non-living things (the physical environment).

2.1 The Biological Environment

All living things (everything that that has a life of its own) can be placed within the biosphere. The biosphere is that portion of the earth where life is promoted, that is, where oxygen is available, such as water, on the earth's surface or in the air.

2.2 The Physical Environment

The physical environment is that portion of the earth that does not need oxygen to breathe, e.g., rock, sand, water, ice and air.

The physical environment consists of three spheres:

a) The Hydrosphere: "Hydro" = water which is a liquid
b) The Lithosphere: "Litho" = rock, which is a solid
c) The Atmosphere: "Atmo" = air, which is gas.

The three groups mentioned can also be seen as the three states of matter or the different forms that nature's elements can take namely solid, liquid and gas

Example; water (also known as matter), can be in one of three different phases:

a) Solid phase = ice.
b) Liquid phase = running water
c) Gas phase = steam

3. The Environment as a system

A system is a combination of non-living (air, rock, soil, water) and living (humans, plants, animals) elements, linked together and functioning dependently on each other

The earth with everything on it, (living and non-living) functions as a system. All systems need energy to function.

The earth's energy originates from the sun. The rays of the sun shine through the atmosphere on plants, animals and humans. The energy from the sun stimulates plant to grow. The plants are utilised as food for the animals, the animals serve as food for the humans. The energy we get from eating enables us to live and do our work.

The energy humans receive can also be given back to the earth, e.g., using energy to cultivate the land.

The earth is precious, since all recourses are limited. If we don't care for the earth we (and especially our descendants) will not be able to sustain ourselves and our children for much longer.

3.1 Water

Water is a clear colourless liquid, which consists, or two parts hydrogen and one part oxygen. A more scientific way to represent water is H2O, where we have two hydrogen atoms and one oxygen atom.

a) More than 70% of the earth is covered by water, e.g., the sea, rivers, lakes and dams.
b) About 75% of the human body consists of water.
c) Water can be found as a liquid (in rivers, lakes and the sea), a solid (ice) or a gas (steam, mist).
d) Water is one of the most important life-sustaining elements in nature. All living things are made up of water and depend on water for their survival. The human body can survive only with a sufficient supply of fresh water.

3.1.1 Freshwater reserves in relation to the oceans

Water on earth is available in many different forms – salt water (sea), fresh water (streams), solid water (boreholes) – but humans can survive only on fresh clean water, which may have to been treated with chemicals to make it drinkable.

a) Salt water: (oceans) 97.2%.
b) Fresh water: (clouds/rain) 0,001%
c) Surface water: (rivers, dams, streams, lakes) 0,009%.

d) Underground water: (boreholes) 2, 15%.

3.1.2 Water Temperature

Water found in nature can be hot or cold. The water temperature has a big influence on organisms that live in the water. Any big change in the temperature of the water may kill all the water animals, plants and fish, as could happen if industries discharge heated water into the natural water system.

3.1.3 Responsible use of water

a) We use it for drinking and cooking food
b) Cleaning houses and ourselves
c) Industrial use, e.g., cooling towers
d) Agriculture use – watering crops and for animals to drink

Water is circulated through the atmosphere/ air in a cycle known as the hydrological cycle. The amount of water that circulates in this cycle will always stay the same.

The cycle is driven by the sun's energy. The sun shines on the water and the water evaporates (water vapour). The water vapour changes back to liquid form through condensation and clouds. Clouds will produce rain and water that will flow back into streams, rivers and dams and then eventually back into the ocean.

The hydrological cycle supplies water to nearly all our water resources. The cycle also changes our landscapes, e.g., erosion of soil.

But we are also responsible for changes in the water cycle for example, the building of dams causes water to no longer flow freely to other areas and finally into the ocean. Water becomes less available to humans, due to pollution, as humans cannot use polluted water.

3.1.4 Water pollution

Both surface water (streams, rivers, etc.) and underground water can be polluted. The main causes of water pollution are chemicals from leaking pipe, water, storm water drains with household waste, and soil particles which erode into surface water may block small streams and waterways.

3.1.5 Tips to save water

a) Shower instead of bathing: full baths use more water than is really needed.
b) Fill a basin when shaving: do not leave the tap running.

c) Brush teeth using only a single glass of water: do not leave the tap running.
d) Report or fix any leaking/dripping taps: do not let them drip all day.
e) Turn of lights, TV, heaters and air conditioning when you leave the room. Power plants generate electricity using water. Wasting electricity means wasting water.
f) Industries can save water by recycling water through the factories and by saving electricity

3.2 Air

Air is a mixture of gasses that surround the earth. This layer around the earth is known as the atmosphere. People, animals and plants breathe these gasses in order to survive. We also depend on climatic changes that might occur in the atmosphere.

Air consists of a mixture of which nitrogen, oxygen, carbon dioxide and argon which is the most imported. All these gasses are found in the atmosphere.

The ozone layer is an invisible gas layer within the atmosphere that also surrounds the earth. The function of the ozone layer is to protect all life forms from the sun's harmful ultraviolet rays.

Earth's atmosphere is divided into four layers:
a) Thermosphere.
b) Mesosphere.
c) Stratosphere and ozone layer.
d) Troposphere: place where people life.

3.2.1 Climate change

You might not believe it, but we can actually change the earth's climate. The word climate incorporates temperature (how hot or cold it is), rainfall (the amount of rain that falls every year) and wind (the direction and the speed of the wind).

Scientists believe that pollution creates gasses, which are the release into the atmosphere. Some of these individuals gasses cause acid rain, which makes the plants, become warmer. This is a process known as the greenhouse effect. These changes have certain impacts on our lives, damage our plants and buildings, and even influence our health.

3.2.2 Release of greenhouse gases

Greenhouse gases are released into the air when we:

a) Watch TV
b) Use air conditioning.
c) Play video games.
d) Drive i.e. producing car fumes.
e) Use electrical appliances.
f) Use deodorants.

3.2.3 Plants and the atmosphere

Trees and plants produce oxygen for use to breath. We as humans are using too many trees for furniture and fire wood and creating greater chances for deforestation to occur. Plants remove carbon dioxide from the air and when they die, they are buried into the earth.

After millions of years, their remains turn into coal and oil and this is removed from the earth by mining. By burning these fossil fuels, we send greenhouse gases into the atmosphere and therefore trees would be needed to remove these gases.

3.3 Air pollution

Sources of air pollution are veld-fires, car fumes, domestic fires, chimneys and fugitive emission (leaking valves and pipes).

Air pollution can be divided into different gaseous emissions:

a) Carbon dioxide, sulphur dioxide and other emissions (cars, fires, industry, etc.)
b) Particulate emission (dried airborne dust from slime dams).
c) Bad odours (algae bloom in dams).

3.3.1 Methods to reduce or prevent air pollution

a) Industries have filters in stacks to minimise air pollution.
b) Fires (either veld-fires or fires on waste sites) should be handled with care and kept under close surveillance to prevent runaway fires and excessive air pollution.
c) Certain laws are in place to ensure the minimisation of air pollution.
d) Rehabilitation of slime dams.

3.4 Soil

3.4.1 Regions and the environment

Different regions exist within the land environment. These are:

a) Polar Regions: very cold regions that consist mainly of ice and little vegetation. Only a few animals are found in this region, e.g., polar bears

b) Grasslands: Open areas filled with various types of grass and very few trees.
c) Forests: Woodlands and different trees.
d) Deserts: Very dry regions of the plant with little to no rainfall. Huge areas with mostly sand and little plant life.

3.4.2 Rock cycle

Soil is of great importance to people, since we need to grow food and build houses. For this reason we need to know how soil is formed. The rock cycle produces rock and soil. Rocks are dissolved by acids (formed in presence of carbon dioxide, organic material and water). Rocks break into smaller and smaller pieces and after a period will form soil.

Soil that accumulates over a specific area can once again form rock, the process involving heat and pressure.

3.4.3 Effect on the land/soil when cutting trees

Normal conditions with trees in the area:

a) Trees take water from soil to grow.
b) Trees keep soil moist to prevent it from drying out.
c) Trees roots help keep water in the soil.
d) Trees leaves slowly rot and serve as extra food for trees.
e) Trees absorb water and minerals as food from soil.
f) Roots keep trees in place during heavy rain and prevent erosion

No trees or dead trees in the area:

a) Branches decay rapidly in warm areas with little rain.
b) Soil is no longer protected and dries out.
c) Soil erodes more easily.
d) Water run-off is greater without supporting roots.
e) Rain causes topsoil to run into rivers, thus causing deforestation.
f) After erosion, there is no more fertile topsoil to provide good crop yields.

3.4.4 Soil/land pollution

Pollution ranges from domestic waste, litter, landfills, dumping of waste and spillage from various sources like industrial sites to construction and industrial development. Ground pollution also has the potential to pollute the surface water and groundwater. All this pollution can greatly influence our health- certain diseases evolve from waste sites, and can even the quality of our groundwater can decrease.

3.4.5 Waste

Waste is material that no longer serves a purpose and is thrown away. A lot of waste material can be avoided and most of it can be re-used or recycled. All waste can be hazardous if disposed of carelessly.

The following are explanations of the various types of waste:

a) Chemical/Hazardous Waste

Many industries produce chemical or hazardous waste. Much of this remains poisonous or corrosive for a long time, so it must be transported and disposed of very carefully to avoid harmful effects on us and our environment.

Methods of disposal include high-temperature incinerations and burying at special landfill sites. Whatever methods is used, care has to be taken not to contaminate workers or their surroundings

b) Clinical (Bio-hazardous) waste

This is waste arising from medical, dental or veterinary sources. A great deal of this clinical waste is poisonous, infectious or dangerous as it includes old swabs, syringes and dressing as well as human and animal tissue.

It has to be disposed of carefully to avoid danger of contamination. This is usually done by incineration.

c) Household waste

As long as our dustbins are emptied every week we tend not to worry about the waste we produce at home. However 18 million tons of domestic waste is produced every year – that is half a ton per person. Most of it goes to landfill sites.

It may also contain poisonous substance such as mercury and cadmium from old batteries, old medicine and household chemicals.

A great deal of waste is created by over – packaging of goods and disposable products. A large proportion of this could be avoided as it is unnecessary. Most packaging materials could be re-used or recycled. Many areas are running out of sites to dispose of waste. There is a lot we can do to reduce the quantity of rubbish we produce.

d) Radioactive waste

The main source of radioactive waste is the nuclear power industry. Radioactive waste is also produced by military installations, medical and research institute and other industries.

There are strict controls on the disposal of radioactive waste. Radioactive waste requires special treatment and disposal sites.

e) Industrial waste

Industrial processes often produce waste that cannot be transformed into secondary products and needs to be disposed of. To achieve safe disposal without negatively impact on the environment manufacturers are required to develop and implement and manage detailed waste management programs.

3.4.6 Litter and Illegal Dumping

In the country, on beaches and in rivers- litter is all around us. Much of this is due to our drinking and eating habits. Fast foods and drinks are served in throw away packaging and therefore litter bins often overflows. Dumping is a problem on the countryside and wherever there is an open space. Tyres, shopping trolleys, furniture and even cars are abandoned.

3.4.7 Acceptable methods of waste disposal

a) Bonfires

In the garden, on farms and on industrial and building sites a bonfire often appears to be a quick and easy way to dispose of rubbish. However smoke can annoy neighbours, pollute the air and be a danger if it drifts across roads.

There is other ways of disposing of garden rubbish - it can be composted or taken to a municipal disposal site. Building and industrial waste should be disposed of at a special site.

b) Composting

Kitchen and garden waste and some agricultural and horticultural waste can be composted to produce organic soil conditioners for the garden.

c) Incineration

This is the burning of mainly clinical and industrial waste at high temperatures.

d) Landfill

This is the practice of burying waste in large holes in the ground. Discussed quarries or pits are normally used and the landscape rehabilitated when it is full. Waste often has to be transported over long distances to and from the site. Noise en pests around the site have a negative effect on the environment.

Landfill sites must be properly designed to avoid the build-up of landfill gas (methane) from rotting rubbish. There are a limited numbers of sites suitable for landfill. Pollution of groundwater often occurs near landfill sites, resulting from poor design or mismanagement.

e) Discard Dumps and Slimes dams

Large quantities of waste such as coal ash and gold mine crusher dust are produced by the mining and energy generating industries. These wastes are disposed of on the surface of the land, in dumps attaining heights of up to 50 meters or more and covering many hectares. Sometimes mining waste is disposed of into disused mines.

f) Recycling and Re-use

With a little thought and effort we can cut down on waste in our dustbins and so reduce the amount that has to be incinerated or land-filled. Recycling is the reprocessing of waste into a state which it can be re-used.
Products that can be reused or recycled are, for example:

Glass	Old bottles and jars may be refilled or taken to a bottle bank.
Metals	Metals can be melted for re-use. Ordinary batteries contain both valuable and poisonous metals, Rechargeable batteries widely available and economical to use.
Textiles	Old clothes may be given to charity shops or jumble sales or used as rags. Some can be re-used to make blankets and cloths. Natural fibres can be used for compost.
Plastics	There are numerous types of plastics with different chemical properties, so it is not easy to recycle them, compared to glass or metal. Many plastics do not

	readily degrade and will remain in the environment for years.
Paper	Most of this can be recycled. Recycled paper products are widely available. Paper also comes from sustainable forests-trees are replaces as they are used.
Vegetable waste	This can be composted for use in the garden.
Coal ash	Ash from power stations has many uses. Fly ash is extensively used in the building industry as cement addictive in concrete. It is in the construction of roads and large dam walls and also the manufacturing of bricks.

3.4.8 Rehabilitation

Rehabilitation is the process of reshaping and re-vegetating disturbed areas to its former state for other productive uses.

The mining of raw materials required by industry and the disposal of waste products generated during industrial processes causes disturbance to the land.

At the end of the life cycle of any industrial plant, these disturbed areas, such as ash disposal sites, have to be restored to a condition that has some potential end use.

A site could be turned into grazing land, a golf course could be established or a wildlife area could be created. Commercial forestry can be practiced in some areas.

To create more attractive working environment, rehabilitation is carried out during the operating stage of an industrial plant and not only at decommissioning.

.**What must be done?**

a) The intended end-use of the site is identified by a team, which includes ecologists, geologists, landscape architects, soil scientist and other specialists.

b) When the end-use is determined a landscape plan, indicating the different topographic and vegetation units, is prepared. The plan also indicates the plant species to be used.

c) The area is then landscaped and topsoil is spread where necessary.

d) Trees and grass species that naturally occur in the area or that are adapted to local conditions are used to establish an ecologically stable environment.

Why is it done?

a) Successful re-vegetation of a site effectively reduces dust blow-off in the area, as well as possible air pollution and contributes to good relations with surrounding landowners.

b) Rehabilitation prevents erosion and pollution by water running of the site after heavy rains. Contaminated water from disturbed areas my affect the quality of ground water.

c) An ecological stable area will promote the return of birds and other wildlife.

d) A self-maintaining ecosystem will be able to develop on its own without intensive long-term maintenance inputs. This will depend on the intended end use.

e) An esthetical acceptable environment is created.

4. Environmental Management

The work we do can lead to poisoning or pollution of the land, air and water. We need to prevent or minimise pollution for three main reasons:

a) The national, provincial and local governments have set laws and standards which prohibit pollution.

b) Many customers who bay our products want us to prove to them that we are trying to avoid, reduce and control pollution before they will bay our products.

c) BUT the most important reason for us is that by acting environmentally responsible, we can help ensure that we all live, work and relax in a clean and healthy environment.

A company's intensions are summarised in its ENVIRONMENTAL POLICY, which sets a framework within which to work. The policy must guide all our actions and encourage us to keep improving our environment. Management writes the policy, in conjunction with the unions. Management and the unions have now committed themselves to a cleaner environment.

4.1 Environmental Management Process

4.1.1 Planning - Will start after an environmental management policy has been approved and the company will plan on how to implement this policy.

4.1.2 Implementation and Operations - To ensure that the policy lives up to its promises, all operations of the plant will be monitored/adjusted in such a way as to ensure minimum pollution to the environment.

4.1.3 Check and corrective Action - By setting targets, these monitoring and adjusting actions will be checked

4.1.4 Management review - Reviewed periodically to ensure that we keep striving for a cleaner and better environment for all (continual improvement).

5. Responsible care (Also known as "Duty of Care")

The aim of responsible care or duty is to go beyond what is required by law to reduce pollution as much as possible through pollution prevention measures. This means that we as a company should work every day to find ways of avoiding or preventing pollution before it occurs.

We are responsible for the environment, industry as well as the community. At industrial levels, you are one of the important links that can help prevent huge environmental disasters by keeping a lookout for potential pollution sources. As environmentally aware and responsible employees, everyone should report incidents that could lead to pollution (leaks or malfunctions of equipment that is controlling emissions).

Report all incidents to your superior/ SHE representative and you can help your company in this way to prevent pollution spillages and ensure a cleaner environment for you and your community. Incidents that need to be reported include spillages or leaks in pipes or tanks and any other potential pollution sources.

6. Environmental Risk Assessment (ERA)

Risk assessment provides a valuable tool to inform decision-making about uncertain future outcomes. One of its strengths is that it can explicitly take account of uncertainties about future outcomes. In addition, the risk assessment process can be informed by dialogue with stakeholders, which can aid decision-making. Risk assessment can help sustainable appraisal by providing a framework to evaluate economic, social and physical outcomes (including impacts on human health and the environment) of proposed policies, plans and programmes.

For the purpose of this course, the environmental risk assessment process will not be discussed because this activity is usually performed by professional Environmental management staff.

Seeing that waste management is a key aspect of a SHEQ practitioner's responsibilities we will focus on proposed waste management practices as promulgated by the South African Government.

7. Management of waste

7.1 Approach to waste in South Africa

Waste management in South Africa is governed by the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) which came into effect on 1 July 2009. Following the enactment of the Waste Act, the Minister of Water and Environmental Affairs established the National Waste Management Strategy (NWMS) in terms of Section 6(1) for achieving the objects of the Act.

The NWMS was approved for implementation by the Cabinet in November 2011. The Waste Act supports the waste hierarchy in its approach to waste management, by promoting cleaner production, waste minimisation, reuse, recycling and waste treatment with disposal seen as a last resort in the management of waste.

7.2 Introduction to Waste

7.2.1 Definition of waste

Definition of Waste according to the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

"waste" means any substance, whether or not that substance can be reduced, re-used, recycled and recovered**:**

(a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;
(b) which the generator has no further use of for the purposes of production;
(c) that must be treated or disposed of; or
(d) that is identified as a waste by the Minister by notice in the *Gazette*, and includes waste generated by the mining, medical or other sector, but**:**
    (i) a by-product is not considered waste; and
    (ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste.

7.2.2 Legislation governing waste

Waste in South Africa is currently governed by means of a number of pieces of legislation, including:

- The South African Constitution (Act 108 of 1996)
- Hazardous Substances Act (Act 5 of 1973)
- Health Act (Act 63 of 1977)
- Environment Conservation Act (Act 73 of 1989)
- Occupational Health and Safety Act (Act 85 of 1993)
- National Water Act (Act 36 of 1998)
- The National Environmental Management Act (Act 107 of 1998)
- Municipal Structures Act (Act 117 of 1998)
- Municipal Systems Act (Act 32 of 2000)
- Mineral and Petroleum Resources Development Act (Act 28 of 2002)
- Air Quality Act (Act 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

The President of the Republic of South Africa signed The National Environmental Management: Waste Bill into an Act of Parliament in March 2009, The Act took effect from 01 July 2009. It is the intention of this Act to address the current fragmentation in waste legislation in South Africa.

7.2.3 Waste Classifications as defined in the NEM: Waste Act, 2008

Waste is divided into two classes based on the risk it poses - general waste and hazardous waste.

- "general waste" means waste that does not pose an immediate hazard or threat to health or to the environment, and includes**:**

  (a) domestic waste;

  (b) building and demolition waste;

  (c) business waste; and

  (d) inert waste;

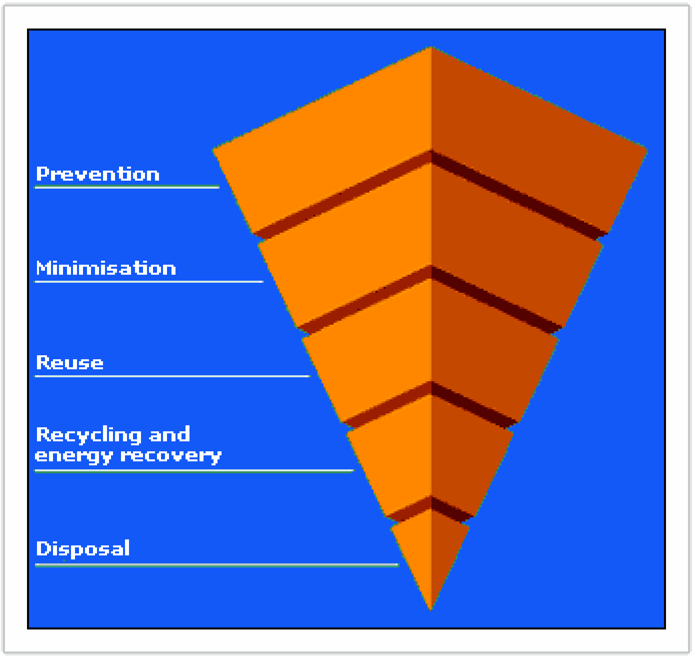
- "hazardous waste" means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.

7.3 Waste prevention

Waste prevention is the first step in the waste management hierarchy. Cleaner Production provides such a mechanism to prevent or reduce the generation of waste. According to DEAT's "Cleaner Production" Background Information Document, Cleaner Production is a business strategy for enhancing productivity and environmental performance for overall socio-economic development. Cleaner production processes are those that use less resources and produce less waste, whether in the form of liquid wastes discharged to waterways, solid wastes going to landfill or gaseous wastes discharged to the air.

The following internet link provides more information on the cleaner production projects proposed: http://www.cleanerproduction.co.za/projects.htm

The waste hierarchy of waste prevention, minimisation, reuse, recycling, treatment and finally disposal, is supported under the South African policy (White Paper and the National Waste Management Strategy).



7.4 Waste recycling and reuse

"Recycling of waste refers to the separation at source of recyclable materials from the general waste stream and the reuse of these materials. The objectives of recycling are to save resources as well as reduce the environmental impact of waste by reducing the amount of waste disposed at landfills. To meet these objectives, waste separation at source is proposed, as the quality of recyclable materials is higher when separated at source. In addition, recycling has the potential for job creation and is a viable alternative to informal salvaging at landfills, which is undesirable due to the problems of health and safety associated with salvaging" (National Waste Management Strategy, 1999)

7.5 Recycling Basics

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community and the environment.

7.5.1 Benefits of Recycling

- Reduces the amount of waste sent to landfills and incinerators;
- Conserves natural resources such as timber, water, and minerals;
- Prevents pollution caused by reducing the need to collect new raw materials;
- Saves energy;
- Reduces greenhouse gas emissions that contribute to global climate change;
- Helps sustain the environment for future generations;
- Helps create new well-paying jobs in the recycling and manufacturing industries in the United States.

7.5.2 Steps to Recycling Materials

Recycling includes the three steps below, which create a continuous loop, represented by the familiar recycling symbol.

Step 1: Collection and Processing

There are several methods for collecting recyclables, including curb side collection, drop-off centres, and deposit or refund programs.

After collection, recyclables are sent to a recovery facility to be sorted, cleaned, and processed into materials that can be used in manufacturing. Recyclables are bought and sold just like raw materials would be, and prices go up and down depending on supply and demand in the United States and the world.

Step 2: Manufacturing

More and more of today's products are being manufactured with recycled content. Common household items that contain recycled materials include:

- newspapers and paper towels;
- aluminium, plastic, and glass soft drink containers;
- steel cans; and
- plastic laundry detergent bottles.

Recycled materials are also used in new ways such as recovered glass in asphalt to pave roads or recovered plastic in carpeting and park benches.

Step 3: Purchasing New Products Made From Recycled Materials

By buying new products made from recycled materials you help close the recycling loop. There are thousands of products that contain recycled content. When you go shopping, look for:

- Products that can be easily recycled, and
- Products that contain recycled content.

Here are some of the terms used:

- **Recycled-content product.** This means the product was manufactured with recycled materials, either collected from a recycling program or from waste recovered during the normal manufacturing process. Sometimes the label will tell you how much of the content was from recycled materials.
- **Postconsumer content.** This is very similar to recycled content, but the material comes only from recyclables collected from consumers or businesses through a recycling program.
- **Recyclable product.** These are products that can be collected, processed and manufactured into new products after they have been used. These products do not necessarily contain recycled materials. Remember not all kinds of recyclables may be collected in your community so be sure to check with your local recycling program before you buy.

Some of the common products you can find that can be made with recycled content include:

- Aluminium cans
- Car bumpers
- Carpeting
- Cereal boxes
- Comic books
- Egg cartons
- Glass containers
- Laundry detergent bottles
- Motor oil
- Nails
- Newspapers
- Paper towels
- Steel products
- Trash bags

7.5.3 Materials for Recycling

(a) Paper

Paper makes up nearly 30 percent of all wastes Americans throw away each year, more than any other material. Americans recycled about 63 percent of the paper they used in 2010. This recovered paper is used to make new paper products, saving trees and other natural resources. Most community or office recycling programs accept paper and paper products. Check what your community or office program accepts before you put it in the bin. When you go shopping, look for products that are made from recycled paper.

(b) Batteries

Some batteries contain heavy metals such as mercury, lead, cadmium, and nickel; therefore, many communities do not allow them to be thrown away with your regular trash. Recycling is always the best option for disposing of used batteries.

- **Lead-Acid Car Batteries** can be returned to almost any store that sells car batteries. The lead and plastics from the batteries can then be recycled and used to manufacture new products. About 96 percent of lead-acid car batteries are recycled.

- **Dry-Cell Batteries** are used in a variety of electronics and include alkaline and carbon zinc (9-volt, D, C, AA, AAA), mercuric-oxide (button, some cylindrical and rectangular), silver-oxide and zinc-air (button), and lithium (9-volt, C, AA, coin, button, rechargeable) batteries. Look for in-store recycling bins or community collection events to dispose of these batteries

(c) Plastics

South Africans generated 3.5 million tons of plastics in 2011 which is about 10 percent of the waste stream. Only five percent of plastics generated are recycled. Some types of plastics are recycled much more than others. Most community recycling programs accept some, but not all, types of plastics. Look for products made from recycled plastic materials.

(d) Glass

Glass, especially glass food and beverage containers, can be recycled over and over again. Making new glass from recycled glass is typically cheaper than using raw materials. Most curb side community recycling programs accept different glass colours and types mixed together, and then glass is sorted at the recovery facility. Check with your local program to see if you need to separate your glass or if it can be mixed together.

(e) Used Oil

Never dump your used motor oil down the drain — the used oil from one oil change can contaminate one million gallons of fresh water. By recycling your used oil you not only help keep our water supply clean, but help reduce South Africa's dependence on foreign oil imports. It takes 160litres of crude oil, but only 3 litres of used oil, to produce 2.3 litres of new motor oil. Many garages and auto-supply stores that sell motor oil also accept oil for recycling.

(f) Household Hazardous Waste

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be household hazardous waste (HHW). Products such as paints, cleaners, oils, batteries, and pesticides that contain potentially hazardous ingredients require special care when you dispose of them. HHW may be dangerous to people or bad for the environment if poured down the drain, dumped on the ground, or thrown out with regular trash.

(g) Tyres

Disease-carrying pests such as rodents may live in tyre piles. Tyre piles can also catch on fire. Most garages are required to accept and recycle your used tyres when you have new ones installed. You may be able to return used tyres to either a tire retailer or a local recycling facility that accepts tyres. Some communities will hold collection events for used tyres.

(h) Other materials for recycling

- Ferrous metals
- Non-ferrous metals
- Fabrics
- Fluorescent light tubes etc.

7.5.4 Recycling programs

All workplaces must have a well-established waste collection and removal program to ensure that they comply with national, provincial and municipal waste management legislation.

A waste management program is illustrated below.

Waste is managed in four steps called Integrated Waste Management

Step 1 Industries should use processes that make the least possible waste. This is called using **Cleaner Technology**.

Step 2 Anything that can be used again should be taken out of the waste. This is called recycling or **Recourse Recovery**.

Step 3 Some waste can be compacted to take up less space, and **treated** so that it is less dangerous.

Step 4 All waste remaining after step 1 to 3 must go to a properly designed and operational landfill (**Sanitary Landfill**).

The first three steps are controlled by the **National Waste Management Strategy**. This strategy makes sure the waste is controlled from its creation to its disposal, which is known as the **Cradle to Grave** principle.

Waste may only be disposed of on a landfill that has a permit from the Department of Water Affairs & Forestry (The environment Conservation Act, Act 73 of 1989).


Paper
Glass
ewaste
Metal
Plastic
Manufacturing facilities
Truck
Recycling Can
Garbage Can
START
Transfer Station
Composting
Stores
Landfill Gas Collection
Landfill
Waste to Energy Plant
Compost

Notes:

Module 9 - Occupational Health and Hygiene

1. Introduction

1.1 Occupational health: a definition

Occupational health is a multidisciplinary activity aimed at:

- the protection and promotion of the health of workers by preventing and controlling occupational diseases and accidents and by eliminating occupational factors and conditions hazardous to health and safety at work;
- the development and promotion of healthy and safe work, work environments and work organizations;
- the enhancement of the physical, mental and social well-being of workers and support for the development and maintenance of their working capacity, as well as professional and social development at work;
- enabling workers to live socially and economically productive lives and to contribute positively to sustainable development.

Occupational health has gradually developed from a mono-disciplinary, risk-oriented activity to a multi-disciplinary and comprehensive approach that considers an individual's physical, mental and social well-being, general health and personal development.

1.2 Interaction between work and health

The social and economic importance of work receives considerable attention because a primary function of work in any society is to produce and distribute goods and services. Far less attention is paid to the importance of work to the individual, yet it is clear from research that work plays a crucial and perhaps unparalleled psychological role in the formation of self-esteem and a sense of order. Work is a powerful force in shaping a person's sense of identity. It can lend sense to existence and establishes the cyclical patterns of day, week, month and year. It is believed that work for which there is no economic gain, such as child care, care for the aged and voluntary work, also has its rewards and contributes to personal gratification.

1.3 Positive health effects of work

1.3.1 Two-way interaction

There is a continuous two-way interaction between a person and the physical and psychological working environment: the work environment may influence the person's health either positively or negatively and productivity is, in turn, influenced by the worker's state of physical and mental well-being. Work, when it is well-adjusted and productive, can be an important factor in health promotion, e.g., partially disabled workers may be rehabilitated by undertaking tasks suited to their physical and mental limitations and, in this way, may substantially increase their working capacity. However, the fact that work can have a positive influence on health has not yet been fully exploited; knowledge of work physiology and ergonomics needs to be further developed and applied to benefit worker's health.

1.3.2 Health hazards

When work is associated with health hazards, it may cause occupational disease, be one of the multiple causes of other disease or may aggravate existing ill-health of non-occupational origin. In developing countries, where work is becoming increasingly mechanized, a number of work processes have been developed that treat workers as tools in production, putting their health and lives at risk. The occupational health lessons learned during the Industrial Revolution should be borne in mind in planning for health in developing countries if such problems are to be avoided.

1.3.3 Unemployment

Job loss may adversely affect a worker's physiological and mental health. If unemployment persists, the person's health continues to decline and chronic disorders can appear. The mental and financial distress caused by the job loss can spread to other family members. In a developing country, job loss can have profound effects that spread beyond the worker's own family since, where there is limited paid employment, a person in a well-paid job exerts an important influence in the community. In addition to having an obvious economic influence and high social standing, such a worker may serve as a good source of health information and set an example with a healthy lifestyle. Loss of employment for such a person can also affect the immediate community as well as the person's family.

A worker's health may also suffer well before the actual job loss. Both feelings of job insecurity and knowledge of impending job loss have been associated with mental and physical health complaints.

Similarly, those who have never had the opportunity to be employed, e.g., because of unavailability of jobs, have no chance to develop an identity or sense of belonging through work which is important for psychological and social well-being. Such people are not accessible to health messages in the workplace and may be unaware of the positive relationship between work and health. In addition, because they have a lot of free time, sometimes associated with anxiety and depression, the never employed are more likely than those in employment to consume alcohol, cigarettes and drugs.

1.4 Health, workplace, economy and sustainable development

The most successful economies have demonstrated that workplaces designed according to good principles of occupational health, safety and ergonomics are also the most sustainable and productive. In addition, a healthy economy, high quality of products or services and long-term productivity are difficult to achieve in poor working conditions where workers are exposed to health and safety hazards.

Principle 1 of the Rio Declaration on Environment and Development (United Nations Conference on Environment and Development, Rio de Janeiro, 1992) states: "Human beings are at the center of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature". Sustainable development is defined as a strategy to "***meet the needs of the present world population without causing adverse effect on health and on the environment, and without depleting or endangering the global resource base, hence without compromising the ability of future generations to meet their needs***".

In terms of occupational health, the above principles mean the satisfaction of material needs through work and other production processes without causing danger to human health, the ecosystem, the resource base or the health of the community, either in the short term or the long term. Occupational health is a basic element and constitutes a social and health dimension of the principle of sustainable development.

Occupational health is at the center of sustainable development in the following ways:

- The prevention of occupational accidents, injuries and diseases and the protection of workers against physical and psychological overload imply appropriate use of resources, minimizing the unnecessary loss of human and material resources.
- The objective of healthy and safe work environments calls for the use of safe, low-energy, low-toxic-emission, low-waste (green) technology, and in many

countries occupational health legislation requires the use of the best available production technology.

- The occupational health approach may facilitate undisturbed production that increases the quality of products, productivity and process management and helps to avoid unnecessary loss of energy and materials and to prevent an unwanted impact on the environment.
- Many environmental hazards and burdens are derived from occupational settings, e.g., industry, agricultural practices, transportation and services. Those responsible for occupational health and safety are well informed of processes and agents that may be hazardous to the environment. Often this information is available to them from the earliest stage of a problem enabling primary prevention which is no longer possible once the hazardous elements are released into the general environment.
- The impact of occupational health on environmental protection from industry is likely to be both effective and cost -effective. In many industrialized countries there are moves to make closer links between occupational health and environmental health approaches.
- Occupational health services aim to ensure workers' health, safety, working capacity and well-being. A healthy, productive and well-motivated workforce is the key agent for overall socioeconomic development. In addition, high-quality and productive work ensures healthy production of materials, goods and services and the consideration and practical implementation of the principles of sustainable development.

Most environmental health hazards that have later been found to affect the health of the general population were first detected in the work environment.

The occupational environment provides an early warning system for certain environmental health hazards just as it also provides effective models for preventive action:

- For many adults the work environment is the most demanding environment in terms of physical, chemical, ergonomic or psychological stresses and physical workload. The principle of the Rio Declaration with regard to a healthy and productive life is particularly relevant to the work environment and calls for occupational health action.

- The state of the general environment and the ecosystem has an impact on the health of workers either directly or indirectly in several occupations, e.g., agriculture, mining, fishery and manufacturing. There is a two-way relationship between occupational health and safety on the one hand, and occupational health and sound environmental development on the other.
- Equally important for personal well-being and for socioeconomic development of communities and countries is an employment policy that ensures access to work for everyone and enables individuals to sustain themselves and their families. Highest possible employment is also a key factor in the safe, stable and sustainable social development of countries, while high unemployment rates and other associated problems endanger such development.
- In developing countries, the health and well-being of the family is critically dependent on the health and productivity of its working member, thus making several members of the community dependent on the health of the worker. In a situation where organized social protection is lacking, the loss of health, life or working capacity of such a key member of the family often means severe crisis for the rest of the family, affecting indirectly the well-being, health and economy of communities at large and of future generations.

Occupational health is a basic element and constitutes a social and health dimension of the principle of overall development. Occupational health practices constitute a set of key activities for such development.

1.5 Work as a factor in health promotion

WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity? According to the WHO Study Group on Early Detection of Health Impairment in Occupational Exposure to Health Hazards:

Health ... signifies rather a way of functioning within one's environment (work, recreation, living). It not only means freedom from pain or disease, but also freedom to develop and maintain one's functional capacities. Health develops and is maintained through interaction between the genotype and the total environment.

The work environment constitutes an important part of man's total environment, so health is to a large extent affected by work conditions.

Health promotion was defined by the Ottawa Charter for Health Promotion, 1986, as:

... the process of enabling people to increase control over, and to improve, their health. To reach a stage of complete physical, mental and social well-being, an individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Therefore, health promotion is not just the responsibility of the health sector, but goes beyond healthy lifestyles to well-being."

Health promotion is a continuum ranging from the treatment of disease to the prevention of disease including protection against specific risks, to the promotion of optimal health. Achieving optimal health includes: improving physical abilities in relation to sex and age; improving mental ability; developing reserve capacities; adaptability to changing circumstances of work and life and reaching new levels of individual achievement in creative and other work. In a work setting these health indicators may be evaluated quantitatively by indices of absenteeism, job satisfaction and work stability.

1.6 Health protection and promotion activities in the workplace

1.6.1 National governments

National governments have an interest in workers' health partly because it has a direct influence on national productivity.

Governments are responsible for establishing and maintaining safe working conditions and ensuring, through legislation, that occupational health services are provided for all workers in all branches of economic activity, including those in the public sector. Health promotion programmes are not usually a statutory requirement but occupational health services can provide a focus for their implementation.

1.6.2 Management

Those responsible for the management of a workplace have an interest in workers' health promotion for the same reason as national governments: healthy workers are essential for optimal productivity. In addition to the humanitarian value of improving workers' health, the economic value is therefore particularly important to employers. This is also true for self-employed workers as their productivity is often completely dependent on their own health.

The prime responsibility for health and safety in a workplace rests with the management, which therefore plays an essential role in the success of any health promotion programme. To ensure the success of a programme, management must allow the necessary resources and time to be dedicated to it, demonstrate its desire for employees to participate and be willing to accept suggestions from employees on what should be done. Management must also have sufficient appreciation of the need for health promotion and disease prevention to be able to assess the relative merits of various programmes, determine priorities and delegate responsibility for achieving programme success.

1.6.3 Workers

The worker stands to benefit from health promotion programmes by having a safe and healthy work environment, a convenient location to learn about and put into practice a healthy lifestyle, readily available opportunities for screening and health care and an opportunity ultimately to achieve optimal health. Health has an all-encompassing impact on the worker's life by affecting his or her ability to interact with others, to work and to be self-reliant.

The worker's contribution to workplace health promotion is essential to any programme's success. Workers should be involved in the programme's design and encourage their co-workers to participate.

1.6.4 Workers' representatives and unions

The role of workers' representatives, organisations and unions is to negotiate with management to ensure that appropriate health programmes are implemented and that an appropriate balance is achieved between the various health programmes. The workers' organisations should also ensure that certain principles are followed, e.g., confidentiality and non-discrimination.

1.6.5 Communities

Health is influenced by many factors outside the workplace. Consequently, health promotion for the workforce cannot be regarded solely as the responsibility of occupational health professionals. The community, through its primary health workers and public health professionals, has clear-cut responsibilities for individual and group health education as a means of health promotion. Wherever possible, health education programmes should be a joint activity of occupational and community health professionals. Mass media can also play an important role in health education.

In developing countries, particularly in rural areas and small workplaces, the primary health worker may be the sole provider of health protection and promotion services for both workers and the rest of the community.

1.6.6 Occupational health professionals

Health promotion is an essential part of the occupational health professional's mandate. Physicians, nurses, safety officers, health educators and Public Health Care (PHC) workers will play different roles in work place health promotion and should be trained accordingly e.g., the role of the occupational health nurse is to educate, screen and counsel workers, whereas that of an occupational hygienist is to assess the control of health hazards while keeping in touch with the development and progress of health promotion programmes.

Together with others, such as ergonomists, nutrition specialists and psychologists, occupational health professionals can:

- protect workers' health by controlling hazards in the workplace and by introducing ergonomics;
- advise workers and managers on health promotion activities and on how to improve working conditions;
- monitor the work environment and workers' health with a view to early identification of health risks and evaluation of the effectiveness of health protection and promotion programmes.

In many circumstances, in developing as well as developed countries, occupational health professionals can cover only a small proportion of workplaces and workers. In such cases, others responsible for providing health care for workers should recognise health promotion as one of their major tasks and should receive some training in occupational health.

2. Occupational Health Management-The work environment

2.1 Objectives

- Detect work hazards as related to occupation, work and work environment
- Inspect workplaces for the discovery of actual hazards and unsafe workers' behaviour
- Use simple methods and techniques for evaluation of work hazards and for testing control measures
- Report work and environmental hazards to concerned bodies
- Know principles of the control of work hazards and work environment and participate in selecting appropriate control measures and optimal use of available resources
- Participate in the management of work emergency plans and in first aid
- Educate workers on the principles of safe conduct at work
- Participate in investigating work complaints, compensation cases, rehabilitation, social welfare, etc.
- Coordinate with other professionals in the occupational multi-disciplinary team: safety officer and committee, occupational hygienist, physician and nurse, sanitarian, first aid attendant, plant engineer and foreman.

2.2 The basic concepts

2.2.1 Occupational hygiene

This is the practice of assessment and control of environmental factors and stresses arising in or from the workplace, which may cause injury, sickness, impaired health and well-being or significant discomfort and inefficiency among workers or among the citizens of the community.

It encompasses the study of:

a) toxicology
b) industrial processes
c) the chemical and physical behaviour of air contaminants
d) environmental sampling techniques and statistics
e) the design and evaluation of ventilation systems
f) noise control
g) radiation protection

h) the health effects of occupational hazards.

Occupational/industrial hygienists use environmental monitoring and analytical methods to detect the extent of worker exposure and employ engineering, work practice controls and other methods to control potential health hazards. Occupational/industrial hygienists must work with physicians to develop comprehensive occupational health programmes and with epidemiologists to perform research on health effects.

2.2.2 Work-site analysis

This is an essential procedure that helps in determining what jobs and workstations are the sources of potential problems. During the work-site analysis: exposures, problem tasks and risks are identified and measured. The most-effective work-site analyses include all jobs, operations and work activities. The occupational/industrial hygienist inspects, researches or analyses how the particular chemicals or physical hazards at the work-site affect worker health. If a situation hazardous to health is discovered, he or she recommends the appropriate corrective action.

Example

An occupational/industrial hygienist might be asked to determine the composition and concentrations of air contaminants in a workplace where there have been complaints of eye, nose and throat irritation. The hygienist in this situation would also determine if the contaminant exposures exceeded the permissible exposure limits required by regulations and standards. If the problem was the result of airborne materials (a conclusion that might be reached in consultation with a physician or epidemiologist), then the hygienist would be responsible for selecting the techniques used to reduce or eliminate the exposure e.g., installing exhaust ventilation around the source of the air contaminants and isolating it from the general work area. Follow-up sampling to verify that the controls had been effective would also be the hygienist's responsibility.

2.3 Recognition of health hazards

2.3.1 Inspection

This is the first step in the process leading to evaluation and control and entails the identification of materials and processes that have the potential to cause harm to workers.

Inspection of the workplace is the best source of directly relevant data about health hazards. There is no substitute for observation of work practices, use of chemical and physical agents, and the apparent effectiveness of control measures. The PHC worker should be able to recognise major and obvious health hazards and distinguish those that require formal evaluation by the industrial hygienist.

2.4 Potential health hazards

2.4.1 Air contaminants

These are commonly classified as either particulate or gas and vapor contaminants

a) Particulate contaminants

i. Dusts

Solid particles generated by handling, crushing, grinding, colliding, exploding, and heating organic or inorganic materials such as rock, ore, metal, coal, wood and grain. Any process that produces dust fine enough to remain in the air long enough to be inhaled or ingested should be regarded as hazardous until proven otherwise.

ii. Fumes

Formed when material from a volatilized solid condenses in cool air. In most cases, the solid particles resulting from the condensation react with air to form an oxide.

iii. Mists

Liquid suspended in the atmosphere. Mists are generated by liquids condensing from a vapor back to a liquid or by a liquid being dispersed by splashing or atomizing.

iv. Aerosols

A form of a mist characterized by highly respirable, minute liquid particles.

v. Fibres

Solid particles whose length is several times greater than their diameter, e.g., asbestos.

b) Gas and vapor contaminants

i. Gases

Formless fluids that expand to occupy the space or enclosure in which they are confined. They are atomic, diatomic or molecular in nature as opposed to droplets or particles, which are made up of millions of atoms or molecules. Through evaporation, liquids change into vapors and mix with surrounding atmosphere.

ii. Vapors

The volatile form of substances that are normally in a solid or liquid state at room temperature and pressure.

2.4.2 Chemical hazards

Harmful chemical compounds in the form of solids, liquids, gases, mists, dusts, fumes and vapors exert toxic effects by inhalation (breathing), absorption (through direct contact with the skin) or ingestion (eating or drinking). Airborne chemical hazards exist as concentrations of mists, vapors, gases, fumes or solids. Some are toxic through inhalation and some of them irritate the skin on contact; some can be toxic by absorption through the skin or through ingestion and some are corrosive to living tissue. The degree of worker risk from exposure to any given substance depends on the nature and potency of the toxic effects and the magnitude and duration of exposure.

2.4.3 Biological hazards

These exist in exposures to bacteria, viruses, fungi and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin.

Occupations that deal with plants or animals or their products, or with food and food processing may expose workers to biological hazards. Laboratory and medical personnel also can be exposed to biological hazards. Any occupations that result in contact with bodily fluids expose workers to biological hazards.

In occupations where animals are involved, biological hazards are dealt with by preventing and controlling diseases in the animal population as well as properly caring for and handling infected animals.

Also, effective personal hygiene, particularly proper attention to minor cuts and scratches especially on the hands and forearms, helps keep worker risks to a minimum. In occupations where there is potential exposure to biological hazards, workers should practice proper personal hygiene, particularly hand washing.

Hospitals should provide proper ventilation, proper personal protective equipment such as gloves and respirators, adequate infectious waste disposal systems and appropriate controls including isolation in instances of particularly contagious diseases, e.g., tuberculosis.

2.4.4 Physical hazards

These include excessive levels of noise, vibration, illumination and temperature, and ionizing and non-ionizing electromagnetic radiation.

Noise, for example, is a significant physical hazard, which can be controlled by:

a) installing equipment and systems that have been engineered, designed and built to operate quietly
b) enclosing or shielding noisy equipment
c) making certain that equipment is in good repair and is properly maintained with all worn or unbalanced parts replaced
d) mounting noisy equipment on special mounts to reduce vibration
e) installing silencers, mufflers or baffles
f) substituting quiet work methods for noisy ones, e.g., welding parts rather than riveting them
g) treating floors, ceilings and walls with acoustic material to reduce reflected or reverberant noise
h) erecting sound barriers at adjacent workstations around noisy operations to reduce worker exposure to noise generated at adjacent workstations
i) increasing the distance between the source and the receiver, e.g., by isolating workers in acoustic booths, limiting workers' exposure time to noise and providing hearing protection.

Occupational hygiene regulations require that workers in noisy surroundings be periodically tested as a precaution against hearing loss.

Ionizing radiation can be controlled by:

a) Reducing exposure time: danger from radiation increases with the amount of time one is exposed to it. The shorter the time of exposure the smaller the radiation danger.

b) Increasing distance: a valuable tool in controlling exposure to both ionizing and non- ionizing radiation. Radiation levels from some sources can be estimated by comparing the squares of the distances between the worker and the source.
c) Shielding: the greater the protective mass between a radioactive source and the worker, the lower the radiation exposure. Similarly, shielding workers from non-ionizing radiation can also be an effective control method.

In some instances, however, limiting exposure to or increasing distance from certain forms of non-ionizing radiation, e.g., lasers, is not effective. An exposure to laser radiation that is faster than the blinking of an eye can be hazardous and would require workers to be miles from the laser source before being adequately protected.

Radiant heat exposure can be controlled by: installing reflective shields and by providing protective clothing in factories such as steel mills.

2.4.5 Ergonomic hazards

The science of ergonomics studies and evaluates a full range of tasks including, but not limited to, lifting, holding, pushing, walking and reaching.

Many ergonomic problems result from technological changes:

a) increased assembly line speeds
b) adding specialized tasks
c) increased repetition.

Some problems arise from poorly designed job tasks. Any of those conditions can cause ergonomic hazards:

a) excessive vibration
b) noise
c) eye strain
d) repetitive motion
e) heavy lifting problems
f) poorly designed tools or work areas.

Repetitive motions or repeated shocks over prolonged periods of time as in jobs involving sorting, assembling and data entry can often cause irritation and inflammation of the tendon sheath of the hands and arms, a condition known as carpal tunnel syndrome.

Ergonomic hazards are avoided primarily by the effective design of a job or job-site and by better designed tools or equipment that meet workers' needs in terms of physical environment and job tasks.

Through thorough work-site analyses, employers can set up procedures to correct or control ergonomic hazards by:

a) using the appropriate engineering controls, e.g., designing or redesigning work stations, lighting, tools and equipment
b) teaching correct work practices, e.g., shifting workers among several different tasks, reducing production demand and increasing rest breaks
c) providing and mandating personal protective equipment where necessary.

Evaluating working conditions from an ergonomic standpoint involves looking at the total physiological and psychological demands of the job on the worker. Overall, the benefits of a well-designed, ergonomic work environment can include increased efficiency, fewer accidents, lower operating costs and more effective use of personnel.

2.4.6 Psychosocial factors

These may include boring, repetitive tasks, production pressure, stress, low pay and lack of recognition.

2.4.7 Accident factors

The main causes of accidents include:

a) unsafe mechanical and physical conditions
b) unsafe acts
c) unsafe personal factors.

2.5 Techniques used in recognising health hazards

2.5.1 Material inventory

A material inventory is used for keeping an account of raw materials, intermediate and end products, waste products and by-products.

It is tailored to meet the specific requirements of local circumstances taking into consideration the following:

a) Who will use the inventory
   i. safety advisers and representatives
   ii. occupational hygienists
   iii. doctors
   iv. nurses
   v. emergency service personnel
   vi. purchasing staff.

b) What information is required
   i. the nature of the material, i.e. composition, physical data, fire and explosion data, basic toxicological and safety data, etc.
   ii. the use of the material, including storage, handling and control procedures, first aid, etc.
   iii. administrative details, i.e. trade and chemical names, company reference numbers, address of manufactures/suppliers, labelling and packing requirements, waste disposal, etc.

c) How the inventory will be updated
   i. any new substances should be considered from a health and safety viewpoint before purchasing, use and inclusion in the inventory
   ii. for existing materials, health and safety staff should have a system for ensuring, through their information sources, that the hazard data contained in the data sheet is the best information currently available
   iii. the availability of computerized data-handling systems augments the use of a materials inventory.

2.5.2 Process inventory

The aim is to document hazards associated with each process and to record how each is being managed and controlled. The process inventory should include details of:

a) the process
b) the materials involved (including intermediate and wastes)
c) points of material entry and exit
d) normal operating procedures

e) potential hazards
f) the potential for emissions into the atmosphere
g) the potential for exposure
h) arrangements for engineering controls
i) other precautions including protective equipment.

The process inventory also provides the opportunity to document hazards other than those associated with chemicals, e.g., heat, noise and radiation, and to include disposal procedures for hazardous waste products.

The inventory could be based on:
a) flow of a particular product or material
b) departmental or equipment flow
c) geographic location.

2.5.3 Walk-through occupational hygiene survey

A walk-through survey of the premises permits observation of all plant operations and is carried out to make a preliminary assessment of potential hazards. Possible sources and potential contaminants from specific types of processes can be identified (see Table 1.1). The walk-through survey provides an important opportunity to meet plant personnel and to interact with engineers, foremen and other workers who know the process problems and are aware of complaints or symptoms among workers.

a) General principles addressed by the walk-through survey
- hazards present in the work place
- estimated/likely scale of the identified hazards
- the control measures currently in force for each hazard
- procedures implemented to maintain the control measures
- the monitoring required.

b) Survey methods
- Surveys are usually carried out without the use of measuring instruments.
- Much of the information required can be assembled in advance of the survey (see an occupational/industrial survey check list in Table 1.2).

The following aids are required to carry out the work:

i. survey report forms
ii. notepad or dictation machine plan of premises
iii. camera
iv. smoke tubes.

- The occupational hygienist (or whoever is nominated to undertake the task by the PHC workers) proceeds through each of the work areas, preferably in accordance with the working functions, often commencing with production from goods inward to dispatch, and preferably accompanied in each area of the premises by either a local supervisor or engineer with general responsibilities.

Sources of information used during the survey are:

i. workers involved in their daily tasks
ii. senses of smell, hearing and touch for detection of odours, heat and noise
iii. photography for documenting the general visual appearance of each environment and any activity deserving further attention
iv. smoke tube test for local exhaust ventilation
v. observation, the key to an effective survey, noting any ergonomics problems, e.g., poorly designed lighting, unsafe working practices, unguarded equipment, etc.

c) Reports

The report should be written clearly and concisely and should be structured as follows:

i. introduction
ii. summary of immediate hazards and action taken or recommended to resolve the problem permanently and/or temporarily pending further evaluation
iii. summary of hazards requiring further monitoring/evaluation
iv. walk-through survey report forms as completed during survey
v. discussions of methods arising from survey
vi. proposed occupational hygiene work plan.

d) Summary of a survey

i. a survey is a preliminary assessment designed to identify hazards and control measures, carried out by competent staff with the help of local supervising staff
ii. it should be comprehensive by location and by time for cyclical/occasional processes
iii. it is a necessary prelude to detailed investigations of specific hazards
iv. it is necessary to gather a range of data pertaining to the subject in order to fully prepare for the survey
v. the two main elements of the survey data source are the workforce and observation
vi. photography is very important
vii. reports should be structured carefully and be concise.

2.5.4 Air-sampling programmes

An air-sampling programme must be designed to answer specific questions otherwise it may not fulfil the need for which it was initiated, e.g., a prospective epidemiological programme requires random sampling in order for statistical predictions to be valid. Sampling for worker protection, on the other hand, will require selection of persons at maximum risk.

Reasons for sampling are varied and may include the following:

a) health risk evaluation: to measure worker exposure in order to estimate the risk of undesirable health effects and the need for control measures
b) environmental protection: to determine the amount of any toxic or hazardous materials released to the environment
c) compliance: to ensure that exposure levels for workers or environmental releases are within regulatory limits and to satisfy legislative monitoring requirements
d) process control: to evaluate the performance of engineering or other process controls and to ensure that contaminant control remains adequate
e) source identification: to find and control contaminant sources
f) documentation of exposure: to maintain records of exposure for prospective studies or for institutional protection against future legal action.

The sampling strategy for each of the stated purposes will require different protocols and sampling systems. The types of samples refer to whether a personal exposure sample should be collected in the breathing zone of a worker, or whether an area, stack or other environmental sample is preferable. Sampling from exhaust stacks is commonly done for process and emission control. Health protection requires personal exposure monitoring.

2.6 Evaluation of health hazards

Evaluation of health hazards within a plant includes measurement of exposures (and potential exposures), comparison of those exposures to existing standards and recommendation of controls if needed.

2.6.1 Exposure measurement techniques

These techniques are based on the nature of hazards and the routes of environmental contact with the worker, e.g.,

a) air sampling can show the concentration of toxic particulates, gases and vapours that workers may inhale
b) skin wipes can be used to measure the degree of skin contact with toxic materials that may penetrate the skin
c) noise dosimeters record and electronically integrate workplace noise levels to determine total daily exposure.

2.6.2 Selection and calibration of instruments

Instruments are generally classified as follows:

a) direct reading instruments
b) sampling instruments which remove the contaminant (for subsequent laboratory analysis) from a measured quantity of air
c) sampling instruments which collect a known volume of air for subsequent laboratory analysis.

All these types of equipment must be calibrated against a standard air flow measuring device before and after use in the field. Furthermore, direct reading instruments must be calibrated against a known concentration of the substance for which they are used.

2.6.3 Establishing proper analytical methods

The use of accurate, sensitive, specific and reproducible analytical methods is as important as the proper calibration of the sampling equipment. Among difficulties that should be overcome in the measurements (sampling/analysis) are:

a) interference and reactions when dealing with mixtures of chemicals, which is often the case
b) fluctuations in concentration.

Other factors affecting a worker's uptake of the contaminants include:

a) routes of entry of material other than respiration, e.g., skin absorption
b) physical activity of workers, which affects the respiration rate
c) whether or not respirators are used in the workplace.

When available, standard methods of analysis should be used such as those recommended by:

- WHO
- International Organization for Standardisation
- European Community
- American Industrial Hygiene Association (AHIA) Analytical Committee
- U.S. National Institute for Occupational Safety and Health (NIOSH)
- U.S. Occupational Safety and Health Administration (OSHA)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- The American Public Health Association (APHA)
- The American National Standards Institute (ANSI).

2.6.4 Strategy of sampling and measurement

Every effort must be made to get measurements (or samples) that represent the workers' exposures. This is achieved by answering the following:

a) Where to sample?
b) Whom to sample?
c) How long to sample?
d) How many samples to take?
e) When to sample?

A sufficient number of samples must be collected or readings made with direct reading instruments, for the proper duration, to permit the assessment of daily, time-weighted average (TWA) exposures and to evaluate peak exposure concentrations when needed.

2.6.5 Interpretation of findings

A great deal of judgement must be used in interpretation and reporting the results. The investigator must have the following facts:

a) nature of substance or physical agents
b) intensity (concentration) of exposure
c) duration of exposure.

The hygienist's decision on whether a hazard is present is based on three sources of information:

a) scientific literature and various exposure limit guides
b) the legal requirements of the national occupational health and safety regulations
c) interactions with other health professionals who have examined the exposed workers and evaluated their health status.

Occupational exposure limits refer to airborne concentrations of substances conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effect. They are based on available information from industrial experience, from experimental human and animal studies; and, when possible, from a combination of the three

2.7 Recommended exposure limits

Many standards have been recommended by different national and international agencies. The most popular and comprehensive however are the list of threshold limit values (TLVs) for chemical substances and physical agents and the biological exposure indices (BEIs) issued by the American Conference of Governmental Industrial Hygienists (ACGIH).

There are three categories of TLV:

a) Time-weighted average (TWA8):
The employee's average airborne exposure in any 8-hour work shift of a 40-hour work week, which shall not be exceeded.

b) Short-term exposure limit (STEL)
The employee's IS-minute TWA exposure, which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the TWA exposure over that time limit shall not be exceeded at any time over a work day.

c) Ceiling-C

The employee's exposure, which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, the ceiling shall be assessed as an IS-minute TWA exposure, which shall not be exceeded at any time over a work day.

Considerations are included for:

- skin notation (for probable skin absorption)
- mixtures (for exposure to mixtures of contaminants)
- total, inhalable, thoracic and respirable particulate matter
- Particulate not otherwise classified (PNOC)
- simple asphyxiates: inert gases or vapours
- Biological exposure indices (BEI)
- physical factors
- unusual work schedules.

2.8 Controlling of Hazards

Occupational/industrial hygienists recognize that engineering, work practice and administrative controls are the primary means of reducing employee exposure to occupational hazards.

2.8.1 Engineering controls

These minimise employee exposure by either reducing or removing the hazard at the source or isolating the worker from the hazard. They include:

a) eliminating toxic chemicals and substituting non-toxic chemicals
b) enclosing work processes or confining work operations
c) installing general and local ventilation systems.

2.8.2 Work practice controls

These alter the manner in which a task is performed. Some fundamental and easily implemented work practice controls include:

a) changing existing work practices to follow proper procedures that minimize exposures while operating production and control equipment
b) inspecting and maintaining process and control equipment on a regular basis
c) implementing good housekeeping procedures
d) providing good supervision

e) prohibiting eating, drinking, smoking, chewing tobacco or gum and applying cosmetics in regulated areas.

2.8.3 Administrative controls

This include controlling employees' exposure by scheduling production and tasks, or both, in ways that minimise exposure levels; e.g., the employer might schedule operations with highest exposure potential during periods when the fewest employees are present.

When effective work practices or engineering controls are not feasible or while such controls are being instituted, appropriate personal protective equipment must be used, e.g., gloves, safety goggles, helmets, safety shoes, protective clothing and respirators. To be effective, personal protective equipment must be individually selected, properly fitted and periodically refitted, conscientiously and properly worn, regularly maintained and replaced as necessary.

TABLE 1.1 POTENTIALLY HAZARDOUS OPERATIONS AND ASSOCIATED AIR CONTAMINANTS

Process types	Contaminant type	Contaminant examples
Hot operations		
Welding	Gases (g)	Chromates (p)
Chemical reactions	Particulates (p)	Zinc and compounds (p)
Soldering	(Dust, fumes, mists)	Manganese and compounds (p)
Melting		
Moulding		
Burning		
Liquid operations	Vapours (v)	Benzene (v)
Painting	Gases (g)	Trichlorethylene (v)
Degreasing	Mists (m)	Methylene chloride (v)
Dipping		1 ,1 , 1 - Trichloroethylene (v)
Spraying		Hydrochloric acid (m)
Brushing		Sulfuric acid (m)
Coating		Hydrogen chloride (g)
Etching		Cyanide salts (m)
Cleaning		Chromic acid (m)
Dry cleaning		Hydrogen cyanide (g)
Pickling		TDI, MOI (v)
Plating mixing		Hydrogen sulphide (g)
Galvanizing		Sulphur dioxide (g)
Chemical reactions		Carbon tetrachloride (v)
Solid operations		
Pouring	Dusts	Cement
Mixing		Quartz (free silica)

Separation		Fibrous glass
Extraction		
Crushing		
Conveying		
Loading		
Bagging		
Pressurized spraying	Vapours (v)	Organic solvents (v)
Cleaning parts	Dust (d)	Chlordane (m)
Applying pesticides	Mist (m)	Parathion (m)
Degreasing		Trichloroethylene (v)
Sand blasting		1,1,1-Trichloroethane (v)
Painting		Methylene chloride (v)
		Quartz (free silica, d)
Shaping operations		
Cutting	Dusts	Asbestos
Grinding		Beryllium
Filing		Uranium
Milling		Zinc
Moulding		Lead
Sawing		
Drilling		

TABLE 1.2 AN OCCUPATIONAL HYGIENE SURVEY CHECKLIST

1. Determine purpose and scope of study:
   a) Comprehensive occupational hygiene survey?
   b) Evaluation of exposures of limited group of workers to specific agents?
   c) Determination of compliance with specific recognized standards?
   d) Evaluation of compliance with specific recognized standards?
   e) Response to specific complaint?

2. Discuss purpose of study with appropriate representatives of management and labour.

3. Familiarise yourself with plant operations:
   a) Obtain and study process flow sheets and plant layout.
   b) Compile an inventory of raw materials, intermediates by-products and products.
   c) Review relevant toxicological information.
   d) Obtain a list of job classifications and the environmental stresses to which workers are potentially exposed.
   e) Observe the activities associated with job classification.
   f) Review reports of previous studies.
   g) Determine subjectively the potential health hazards associated with plant operations.

h) Review adequacy of labelling and warning.

4. Prepare for field study:
   a) Determine which chemical and physical agents are to be evaluated.
   b) Estimate, if possible, ranges of contaminant concentrations.
   c) Review, or develop if necessary, sampling and analytic methods, paying particular attention to the limitations of the methods.
   d) Calibrate field equipment as necessary.
   e) Assemble all field equipment.
   f) Obtain personal protective equipment as required (hard hat, safety glasses, hearing protection,
   g) Prepare a tentative sampling schedule.
   h) Review occupational health and safety regulations being applied by the health authorities.

5. Conduct field study:

   a) Confirm process operating schedule with supervisory personnel.
   b) Advise representatives of management and labour of your presence in the area.
   c) Deploy personal monitoring or general area sampling units.
   d) For each sample, record the following data:
      i. sample identification number
      ii. description of sample (as detailed as possible)
      iii. time sampling began
      iv. flow rate of sampled air (check frequently)
      v. time sampling ended
      vi. any other information or observation that might be significant (e.g., process upsets, ventilation system not operating, use of personal protection)

   e) Dismantle sampling units.
   f) Seal and label adequately all samples (filters, liquid solutions, charcoal or silica gel tubes, etc.) that require subsequent laboratory analyses.

6. Interpret results of sampling programme:
   a) Obtain results of all analyses.
   b) Determine time-weighted average exposures of job classification evaluated.
   c) Determine peak exposures of workers.

d) Determine statistical reliability of data, e.g., estimate probable error in determination of average exposures.

e) Compare sampling results with applicable industrial hygiene standards and regulations.

f) Discuss survey results with appropriate representatives of management and labour.

8. Implement corrective action comprised of, as appropriate:

a) Engineering controls (isolation, ventilation, etc.).

b) Administrative controls (job rotation, reduced work time, etc.).

c) Personal protection.

d) Biologic sampling programme.

e) Medical surveillance.

f) Education and training.

9. Determine whether other health and safety considerations warrant further evaluation:

a) Air pollution?

b) Water pollution?

c) Solid waste disposal?

d) Safety?

e) Health physics?

10. Schedule return visit(s) to evaluate effectiveness of controls:

a) Walk-through and observation.

b) Measurements.

3. Occupational and other work-related diseases

3.1 Occupational and work-related disease

"Occupational diseases ... stand at one end of the spectrum of work-relatedness where the relationship to specific causative factors at work has been fully established and the factors concerned can be identified, measured, and eventually controlled. At the other end [are] diseases [that] may have a weak, inconsistent, unclear relationship to working conditions; in the middle of the spectrum there is a possible causal relationship but the strength and magnitude of it may vary."

3.2 Degree of work-relatedness

The degree of work-relatedness of a work-connected disease condition varies in different situations and determines whether a disease is considered an occupational disease, a work-related disease or aggravation of a concurrent disease, e.g.,

A specific agent like lead or silica, which is present essentially in the workplace, causes a disease condition which cannot occur due to other causes; this is an occupational disease.

Where infection can occur at the workplace, an occupational disease can also be caused by a specific agent, such as tuberculosis among health care workers in a tuberculosis treatment centre. Of course infection can also occur in the general population under non-occupational conditions.

Work-related diseases occur much more frequently than occupational diseases.

Work-related are caused by the interaction of several extrinsic risk factors and a number of intrinsic factors each of which may or may not operate in any individual case. Occupational hazards are among the risk factors which can contribute to the occurrence of work-related diseases. Examples are many and include:

a) behavioural responses
b) psychosomatic illness
c) hypertension
d) coronary heart disease
e) chronic non-specific respiratory disease
f) loco motor disorders.

Work conditions can aggravate pre-existing disease: hepatic dysfunction can be aggravated by exposure to certain chlorinated hydrocarbons; bronchial asthma can be aggravated by dust exposure and renal disease can be aggravated by inorganic mercury, cadmium and certain solvents.

Exposure to combinations of occupational hazards may result in synergistic effects which are much more pronounced than effects of individual exposures simply added together.

Individual susceptibility to the effects of some occupational exposures varies. Genetic factors are important determinants of individual susceptibility.

4. Occupational diseases

4.1 Definition

Occupational diseases are adverse health conditions in the human being, the occurrence or severity of which is related to exposure to factors on the job or in the work environment. Such factors can be:

a) Physical: e.g., heat, noise, radiation
b) Chemical: e.g., solvents, pesticides, heavy metals, dust
c) Biological: e.g., tuberculosis, hepatitis B virus, HIV
d) Ergonomic: e.g., improperly designed tools or work areas, repetitive motions
e) Psychosocial stressors: e.g., lack of control over work, inadequate personal support
f) Mechanical: these mainly cause work accidents and injuries rather than occupational diseases.

4.2 Characteristics of occupational diseases

The occupational cause of occupational disease is often overlooked by health care providers. This is due to several special characteristics of occupational disease that may obscure its occupational origin.

The clinical and pathological presentation of most occupational diseases is identical to that of non-occupational diseases; e.g., Asthma (excessive airway narrowing in the lungs) due to airborne exposure to toluene diisocyanate is clinically indistinguishable from asthma due to other causes.

Occupational disease may occur after the termination of exposure. An extreme example would be asbestos-related mesothelioma (a cancer affecting the lung and abdomen) which can occur 30 or 40 years after the exposure.

The clinical manifestations of occupational disease are related to the dose and timing of exposure; e.g., at very high airborne concentrations, elemental mercury is acutely toxic to the lungs and can cause pulmonary failure, while at lower levels of exposure, elemental mercury has no pathologic effect on the lungs but can have chronic adverse effects on the central and peripheral nervous systems.

Occupational factors can act in combination with non-occupational factors to produce disease; e.g., Exposure to asbestos alone increases the risk of lung cancer five-fold; and the long-term smoking of cigarettes increases the risk of lung cancer between 50 and 70-fold.

4.3 Prevention of occupational diseases

4.3.1 Primary prevention

Primary prevention is accomplished by reducing the risk of disease. In the occupational setting, this is most commonly done by reducing the magnitude of exposure to hazardous substances. As the dose is reduced so is the risk of adverse health consequences. Such reductions are typically managed by industrial hygiene personnel and are best accomplished by changes in production process or associated infrastructure, e.g., the substitution of a hazardous substance with a safer one, or enclosure or special ventilation of equipment or processes that liberate airborne hazards. These are known as engineering controls.

Other methods of exposure reduction include use of personal protective equipment and rotation of workers through areas in which hazards are present to reduce the dose to each worker (NB: this method does, however, increase the number of workers exposed to the hazard).

4.3.2 Secondary prevention

This is accomplished by identifying health problems before they become clinically apparent (i.e. before workers report feeling ill) and intervening to limit the adverse effects of the problem.

This is also known as occupational disease surveillance. The underlying assumption is that such early identification will result in a more favourable outcome.

An example of secondary prevention is the measurement of blood lead levels in workers exposed to lead. An elevated blood lead level indicates a failure of primary prevention but can allow for corrective action before clinically apparent lead poisoning occurs. Corrective action would be to improve the primary prevention activities listed above.

4.3.3 Tertiary prevention

This is accomplished by minimising the adverse clinical effects on health of a disease or exposure. Typically this is thought of as clinical occupational medicine. An example of tertiary prevention is the treatment of lead poisoning (headache, muscle and joint pain, abdominal pain, anaemia, kidney dysfunction) by administration of chelating medication. The goal is to limit symptoms or discomfort, minimize injury to the body and maximize functional capacity.

4.4 Physical hazards at the workplace

4.4.1 Thermal stress

a) Thermal environment

The temperature of the human body when healthy is at a constant of around 37 T through a dynamic balance between heat production and heat loss. The heat regulating centre in the hypothalamus controls this balance.

Heat is produced by the metabolic processes, by muscular activity and by food consumption. Heat is exchanged with the surrounding environment by conduction, convection, radiation and evaporation of sweat. Heat exchange is influenced by air temperature, air velocity, relative humidity and radiation.

Various combinations of these factors can cause different degrees of comfort and discomfort and several indices have been described to express the degree of thermal stress resulting from combinations of these factors, e.g., the effective temperature, the corrected effective temperature and wet-bulb-globe temperature indices.

b) Types of thermal stress

i. Cold stress:

This exists when the surrounding temperature falls, as occurs when entering cold storage rooms. A human tries to reduce the exposed skin surface (by bending the joints if possible or by wearing thick woollen clothes). Peripheral vasoconstriction of skin vessels occurs resulting in vascular injury, chilblains, frost bite (dry gangrene) or trench foot (wet gangrene). Heat production increases through increased muscle tone and shivering. Extreme cases result in hypothermia, lowering of the temperature of core organs and death.

ii. Heat stress: the stages

Vasomotor control: As the heat stress increases, more blood is pumped to the skin and less to the visceral organs and brain. There is cardiovascular stress and tachycardia. Muscular work is reduced since it produces more heat. Heat exhaustion is manifested by headaches, dizziness, sleepiness, lack of concentration and anorexia.

Evaporative cooling: The body starts to sweat with the amount related to the degree of stress and acclimatization. Loss of sodium chloride through sweating causes heat cramps (painful cramps starting in the working muscles and spreading to other muscles) and dehydration which aggravates cardiovascular problems. The volume of urine is reduced. High air velocity and low relative humidity help cooling through the evaporation of sweat.

Dry heat exposure is encountered in foundries, steel mills and in the glass industry and moist heat exposure in textile mills, mines, the food canning industry and laundries.

Heat stroke: If sweating is not sufficient to keep the body temperature within the physiological range, the heat regulating centre fails, sweating stops, the skin is flushed and the patient is said to suffer from heat stroke. Unconsciousness and death may follow. Heat stroke occurs in workers in hot humid environments especially when exposed to direct sunlight. It is an emergency situation where rapid cooling, rehydration and replacement of electrolytes are indicated.

c) Prevention of heat stress

A gradual exposure to a hot environment results in acclimatization and better tolerance. Heat stress is especially dangerous for children, the elderly and patients with cardiovascular, renal and skin diseases.

Engineering control measures should be used to prevent heat exposure including shielding, insulation and ventilation. Pre-placement and periodic medical examinations are important; lost fluids and sodium chloride should be replaced; personal protective clothes can help in some situations and workers should be given adequate rest periods to be spent in a more comfortable environment.

4.4.2 Noise

Noise is unwanted, unpleasant sound. Workers are exposed to noise in:

a) textile and glass industries
b) ship building
c) aeroplane manufacture
d) engineering industries
e) manufacture of boilers and pressure vessels
f) power plants.

Sound is propagated in the form of waves, each of which can be described in terms of frequency or number of cycles per second measured in hertz (Hz) and intensity as expressed in decibels (dB).

The human ear can hear sounds ranging in frequency from 20 Hz to 20 000 Hz. The intensity of very faint sounds is around 0 dB and a jet engine can produce sounds of 130 dB, which is painful to the ear. The sounds we normally hear are complex sounds formed from many waves of varying frequencies and intensities. Ordinary speech is heard at frequencies of 500 Hz to 2000 Hz.

In addition to interference with the hearing of normal speech, noise can cause annoyance and stress and can lead to increased accident rates and lower productivity. Extra-auditory effects are observed in different systems, including endocrine, gastrointestinal and cardiovascular systems, and interfere with sleep.

The most important effect of exposure to noise is noise-induced hearing loss (NIHL). Hearing impairment is at first temporary; as exposure to noise (about 85 dB) continues, hearing impairment becomes permanent. NIHL usually takes many years

(7-10 years) to develop. The most hazardous is high intensity, high frequency, continuous noise. Personal susceptibility has a definite effect.

Audiometry reveals early hearing impairment at frequencies of 3000-6000 Hz before hearing of normal speech is affected. Hence, the importance of measurement of hearing on pre-placement and periodic hearing examinations.

Measures to control noise in the workplace include:

a) design and maintenance of machinery
b) segregation and dispersion of noise sources
c) prevention of propagation and reflection of noise by the use of sound proofing materials for floors, walls and ceilings
d) rotation of workers
e) reduction of work exposure hours
f) use of personal protective devices, e.g., ear plugs, ear muffs and helmets.

4.4.3 Vibration

Workers exposed to whole vibrations include tractor drivers, transport workers, workers involved in drilling for petroleum and those in the textile industry. Whole body vibrations cause various ailments related to congestion of pelvic and abdominal organs.

Segmental vibrations affect workers using pneumatic or electrical vibrating tools in mining, road construction, shoe manufacture and sawing. Vascular changes in the upper limbs lead to "dead hands" and "white fingers" and prolonged exposure leads to rarefaction in the small bones and wrist.

4.4.4 Poor or defective illumination

Lighting standards depend on the type of work performed and degree of precision required. Adequate lighting should be provided either by natural or artificial means, avoiding shadows and glare and observing appropriate colours and contrast.

Defective illumination leads to eye strain, fatigue and increased accident rates. Defective illumination in miners leads to miner's nystagmus (rapid, involuntary movement of the eyes).

4.4.5 Radiation

a) Non-ionizing radiation

i. Ultraviolet radiation
Exposure occurs in welding, metal cutting and exposure to carbon arc and causes skin erythema, burns and hyperpigmentation. Exposure of the eyes causes "arc eye" with conjunctivitis and severe pain and may lead to corneal ulceration. Eye protection using special face shields is necessary. Prolonged exposure causes atrophy of the skin and epitheliomas.

ii. Infrared radiation
Exposure occurs in front of furnaces, in steel mills, in the glass industry, in blacksmiths and in chain manufacture. Exposure of the eyes can cause cataracts or corneal affection.

Skin burns can also occur. Complete protection of the eyes can be achieved by wearing special goggles.

b) Ionizing radiation
Sources of radiation include radioactive isotopes and X-ray machines. Ionizing radiation is used in medicine, industry, agriculture, research and atomic warfare. Radiations are either electromagnetic waves, like X-rays and gamma-rays, or minute particles, like alpha, beta and neutrons. Both types cause ionization or excitation of atoms which leads to tissue destruction.

The effect of ionizing irradiation depends on the dose, type of radiation, whether exposure was continuous or interrupted and whether it was total body or localized, as well as the type of tissue irradiated. The power of penetration of different types of radiation varies from very high, such as X-ray and gamma-ray radiation, to very low, such as alpha radiation.

Different tissues vary in their sensitivity to radiation, with the tissues of the haemopoietic system and the gastrointestinal mucosa being the most sensitive and those of the bones and muscles being the least sensitive.

Effects may vary:

a) Death occurs within hours if the whole body is exposed to a high dose.
b) Acute radiation syndrome occurs if the dose is less. Signs and symptoms appear within 24-48 hours and are due to affection of the gastrointestinal mucosa causing severe bloody diarrhoea and shock of the haemopoietic system and of the skin. If death occurs it is due to

haemorrhage (due to thrombocytopenia) or infection (due to damage of intestinal mucosa and leukopenia).

c) Beta-radiation affects the skin only, causing skin burns and alopecia.

d) Chronic radiation effects may follow long after an acute exposure or follow repeated exposure to doses not enough to cause acute effects.

e) Chronic effects include skin atrophy, loss of finger prints, alopecia, nail changes, telangiectasia, pigmentation, keratoses and epitheliomas. Other effects include sterility, abortion, mutagenic effects and birth defects.

Control of exposure to external radiation sources rests on three general principles:

a) Keeping sufficient distance between source and worker.

b) Reducing time of exposure.

c) Containment and shielding.

Control of exposure to internal irradiation (uptake of radioactive materials) follows more stringent regulations.

Laboratories or establishments in which radioactive materials are handled should be constructed in such a way as to offer maximum containment, enclosure and shielding of radioactive material, and to ensure easy and complete cleaning in case of spills. Handling by remote control is very useful.

Ventilation and waste disposal systems should be separate from those of other areas and radioactive waste should not reach public waste systems. Radioactive waste should be disposed of in such a way that environmental contamination is not likely.

Environmental monitoring should be practised and alarm systems should be provided.

Other measures include:

- pre-placement and periodic medical examinations with special emphasis on eyes, skin and blood
- personal protective clothing
- personal monitoring badges
- pocket dosimeters
- whole body counters

- monitoring of radioactivity in biological fluids.
- Changes in barometric pressure

a) Reduced barometric pressure

Passenger planes are normally pressurized but military pilots may be exposed to reduced atmospheric pressure. In this case expansion of intestinal gases may cause respiratory embarrassment but before decompression sickness occurs they will have landed.

Workers at high altitude suffer from effects of reduced partial pressure of oxygen. The body compensates by increasing the pulse rate, increasing the breathing rate and polycythaemia.

4.4.7 Chemical hazards (occupational poisoning)

Workers in different occupations are exposed to thousands of chemicals, some of which can cause occupational diseases. For the sake of discussion, these chemicals are classified according to their physical state, chemical composition or physiological action.

a) Gases and vapours

These can be classified according to their physiological action into: asphyxiates, irritant gases, organometallic compounds and anaesthetic vapours.

i. Asphyxiants

Can cause asphyxia either by replacing oxygen or by some other mechanism. They are classified into: simple asphyxiants and chemical asphyxiants.

Simple asphyxiants: replace oxygen, e.g., nitrogen, methane, hydrogen and carbon dioxide.

Nitrogen: a simple asphyxiant used in the fertilizer industry and present in mines when 0_2 is consumed. In mines it can be detected by the safety lamp which is extinguished at 0_2 concentration of 17%. At 12% 0_2 there is dyspnoea, cyanosis, unconsciousness, loss of motor power, convulsions and death.

Methane (marsh gas): results from decomposition of organic matter and is present in marshes, sewers and mines. It is a simple asphyxiant, inflammable and lighter than air.

Carbon dioxide (CO_2): results from combustion of fuels; it is a colourless gas, heavier than air. It can be found in mines, wells, caves and close to furnaces and brick kilns. It is also present in the manufacture of soft drinks, beer, in the sugar industry and is used as dry ice. In addition it can be used to extinguish fires. CO_2 is a simple asphyxiant but in low concentrations stimulates rapid respiration. Resuscitation calls for 0_2 inhalation, warmth, cardio-respiratory stimulants and if respiration stops, artificial respiration.

Chemical asphyxiants: interfere through some chemical action with the respiratory function of the blood, tissue cells or respiratory centre, e.g., carbon monoxide (CO), hydrogen sulphide and hydrocyanic acid.

Carbon monoxide (CO): a colourless, odourless gas which results from incomplete combustion of fuel. It is a product of coal distillation plants, steel furnaces, fuel boilers and furnaces and home heating appliances. It is also present in vehicle exhaust fumes.

CO has a great attraction to haemoglobin (HbCO) (210 times that of oxygen) and thus interferes with 0_2 transport. Exposure causes headaches, dizziness, chest oppression, loss of motor power, unconsciousness, convulsions, cardiovascular effects, coma and death (depending on the percentage of HbCO in the blood).

Prevention of CO poisoning depends on proper design, maintenance and regular inspection of home appliances and industrial sources and also on control measures in garages.

In a case of poisoning, 0_2 inhalation is indicated (with 5% CO_2), with warmth, stimulants and artificial respiration provided if needed; the worker should be removed from exposure first.

Hydrogen sulphide (H_2S): a colourless gas, heavier than air; it has the odour of rotten eggs. Exposure occurs in oil fields and refineries, tanneries, sewers and in the manufacture of rayon and artificial rubber. It can be detected by its smell and causes paralysis of the olfactory nerve after a short while.

In addition to being a chemical asphyxiant, it has an irritant effect on the eyes and upper respiratory centre; it also causes asphyxia by combining with cytochrome oxidase enzyme and preventing tissue respiration. If respiratory paralysis occurs artificial respiration is indicated. Nitrites (sublingual and intravenous) serve to break the combination between the gas and cytochrome oxidase enzyme by forming methaemoglobin.

Hydrocyanic acid (HCN): a colourless gas that has the odour of bitter almonds. HCN is used in fumigation of ships as a pesticide and its salts are used in photography, metal hardening, electroplating and in extraction of gold from ore.

The gas can be absorbed through the skin and its inorganic salts are among the most potent poisons. They produce their effects through inhibiting cytochrome oxidase enzyme thus interfering with tissue respiration. Signs and symptoms appear within minutes in the form of dizziness, oppression of the chest, cardio-respiratory manifestations, unconsciousness and death which, in severe cases, occurs within minutes. Organic salts are not as toxic.

First aid includes the inhalation of amyl nitrite and intravenous injection of sodium nitrite followed by sodium thiosulfate. Cobalt EDTA and hydroxocobalamin are also used in the treatment of cyanide poisoning. Cardio-respiratory stimulants, warmth and artificial respiration may also be indicated.

Since HCN is a very rapid poison, the first aid equipment should be very close to the work site and well-trained first aid attendants available at all work shifts.

ii. Irritant gases
These can cause irritation or inflammation of the mucous membranes with which they come into contact. This property depends on their degree of solubility in water.

Highly soluble gases, like ammonia, affect the upper respiratory passages. Less soluble gases like chlorine and sulphur dioxide affect both the upper respiratory passages and the lung tissues. Gases which are even less soluble, like nitrogen oxides and phosgene, act essentially on the lungs and in this case the irritant affect may be delayed for hours.

Sulphur dioxide (SO): one of the most common air pollutants. It results from the combustion of fuels containing sulphur and is present in vehicle exhaust fumes, in front of furnaces and is also produced in the extraction of metals from sulphide ores. It is used in the production of sulphuric acid, in the preservation of fruits, in sugar industry and in the bleaching of wool.

It is colourless, has a pungent odour and is oxidised in air into sulphur trioxide.

Exposure causes irritation of the eyes and upper respiratory passages. High concentrations may cause oedema of the larynx, pulmonary oedema, pneumonia and even death.

Ammonia (NH): a common upper airway tract irritant. It is a highly soluble alkaline gas that is widely used in industry as a refrigerant and in the manufacture of fertilisers, explosives and plastics. It attacks the skin, the conjunctiva and the mucous membranes of the upper respiratory tract. Oedema of the larynx and pulmonary oedema can occur with exposure to high concentrations and can cause death.

Management consists of removing the patient from exposure followed by supportive care with oxygen and attention to fluid and electrolyte homeostasis. Most patients gradually improve over time and make a full recovery without parenchymal lung damage except for bronchiectasis.

Formaldehyde (HCHO): a potent upper respiratory tract irritant that is used as a disinfectant and industrial cleaner and may release gas from particle board. It is an animal carcinogen and may cause acute bronchial irritation in humans.

Hydrogen fluoride (HF): a potent upper respiratory tract acid irritant that causes pulmonary oedema. It is used in the microelectronics industry for etching silicon chips and is also used to etch glass.

Ozone (0): an important irritant produced by photochemical oxidation of vehicle exhaust fumes and which is generated in arc welding. Ozone causes nose and eye irritation and is also a potent respiratory tract irritant causing coughing, tightness in the chest and shortness of breath.

Chlorine (Cl.): a greenish yellow gas with a pungent irritating odour. It affects the upper and lower respiratory tract. Exposure occurs in the production of sodium hydroxide. The gas is used in bleaching and water disinfection and exposure can occur during the transport of liquid chlorine. Exposure causes irritation of the eyes and upper respiratory tract and larger concentrations may result in pulmonary oedema and death.

Phosgene (COCl): results from decomposition of chlorinated hydrocarbons when they come into contact with a hot surface (CC14 is used in firefighting). Phosgene is sparingly soluble in water, therefore upper respiratory irritation is slight. However, delayed pulmonary oedema can occur and therefore the patient should be observed for 48 hours and given rest, warmth stimulants and O_2.

Nitrogen oxides (NO): nitrous oxide (NP) is an anaesthetic and in the absence of 0_2 is a simple asphyxiant. Nitrogen oxides are a mixture of NO_2 and N_20_4 and are brown in colour. Exposure occurs in chemical laboratories, in the explosive industry, in the manufacture of nitric or sulphuric acids, fertiliser industry and on slow combustion of nitrogen-containing materials. It is present in welding operations and in soils.

Due to their poor water solubility, nitrogen oxides can be inhaled in high concentration without sufficient warning irritation but it has a severe irritant effect on the lung tissue. Symptoms may be delayed 2-20 hours, after which fatal pulmonary oedema may occur.

Therefore, regardless of the condition of the patient when first seen, he/she should be put under close observation, preferably in hospital, for at least 24 hours.

iii. Organometallic compounds

Arsine (ASH): produced during chemical treatment of metals when arsenic is present as an impurity and nascent hydrogen is evolved. It is colourless and has a garlic odour. Exposure results in haemolysis, anaemia, jaundice and anuria in severe cases.

Nickel carbonyl [$Ni(CO)_4$]: a volatile liquid produced during the extraction of nickel. Inhalation causes severe pulmonary irritation.

iv. Anaesthetic vapours

Many of these have some other systemic effect as well and tend to accumulate in low, closed, poorly ventilated places.

The following precautions should be observed when there is potential exposure to noxious gases.

- Workplaces should be ventilated or steamed repeatedly.
- If there is likelihood of the presence of noxious gases or insufficient oxygen, gas masks should be provided.

- Workers should be properly trained and should always work in teams with one team member nominated to observe from a distance, away from possible contamination.
- First aid equipment, including oxygen, should be readily available with a trained team of rescuers.
- An affected worker should be removed from the exposure and kept warm and rested. If breathing stops, artificial respiration should be continued until recovery or death is ascertained.

b) Metals

In industry, poisoning with metals usually takes the chronic form and results from the absorption of small amounts over long periods of time. Acute poisoning may result from accidental (or suicidal) intake of large doses of some of the more toxic compounds (like arsenicals).

Metals and their compounds gain access into the body by inhalation, ingestion and, in a few cases, through the skin. A large number of metallic compounds are used in industry with the following being some of the more important.

i. Lead

Inorganic lead: Exposure to inorganic lead compounds occurs in mining, extraction, smelting, metal cutting, manufacture of lead pipes, lead paints, manufacture of lead batteries, crystal glass and hot metal typesetting.

It is absorbed as dust via the respiratory tract, and via the gastrointestinal tract with food and drinks. Inorganic lead is not absorbed through the skin. The signs and symptoms of exposure include a blue line on the gums, intestinal colic and constipation, anaemia, general weakness and, in severe cases, foot drop and wrist drop. Encephalopathy due to lead is now very rare.

Engineering control methods to prevent exposure are ventilation, mechanisation and housekeeping. Personal cleanliness, change of clothes, washing facilities and provision of clean areas for eating and storing food will reduce uptake of lead by mouth. Periodic medical examination helps detect early affection.

Organic lead (tetraethyllead): Organic lead was used as a fuel additive in petrol but has been discontinued in recent times. It is a volatile liquid and can be absorbed by inhalation and through the skin. Exposure causes excitation of the central nervous system then depression and may end in death.

ii. Mercury

Mercury is a volatile liquid metal. Exposure occurs in mining, extraction, chemical laboratories, the chemical industry in general, the pharmaceutical industry, the manufacture of thermometers and barometers, the explosive industry, the manufacture of mercury vapour lamps, the manufacture of pesticides, mirrors and in dentistry.

Inorganic mercury compounds: cause stomatitis, a brown line on the gums, loose teeth, metallic taste, tremors and personality changes. There is kidney affection and gastrointestinal disturbances.

Organic mercury (pesticides): exert their effect on the central nervous system. Mercury fulminate (an explosive) causes skin ulcers and perforation of the nasal septum.

iii. Manganese

Exposure occurs in mining, extraction, the steel industry, the dry battery industry, the glass and ceramics industry, the manufacture of welding rods and in the chemical industry. Manganese exposure can cause pneumonia and can affect the central nervous system causing Parkinson disease, tremors, mask face, rigidity and personality change.

iv. Arsenic

Exposure occurs in mining and extraction. Arsenic compounds are used in pesticides, wood preservatives, medicines, paints and the chemical industry. Acute exposure causes severe gastroenteritis, shock and even death. Chronic exposure to arsenic causes affection of the peripheral nerves, skin lesions, skin cancer, anaemia, perforation of the nasal septum and lung cancer.

c) Organic solvents

Organic solvents are organic liquids in which other substances can be dissolved without changing their chemical composition. They are used in the extraction of oils and fats in the food industry, the chemical industry, paint, varnishes, enamel, the degreasing process, dry cleaning, printing and dying in the textile and rayon industries.

Organic solvents are volatile: many of them are inflammable and they are considered fire hazards.

Chemical groups include:

- hydrocarbon solvents
- alcohols and ethers
- ketones
- esters
- glycols and their compounds.

Solvents are absorbed mainly through the lungs, via the gastrointestinal tract if taken by mouth, and many of them can be absorbed via intact skin. As a group, solvents affect several of the body's systems and can cause the following effects:

- nervous system: dizziness, unconsciousness and death, peripheral neuritis, affection of vision, insomnia, headache and easy fatigue
- gastrointestinal system: dyspepsia, anorexia and nausea and may be secondary to liver affection
- respiratory tract: may show upper respiratory irritation in some cases
- kidney: affection may cause nephritis or renal failure
- blood forming organs: may be affected causing anaemia or even leukaemia
- skin: may show contact dermatitis or acne.

Specific examples of poisoning by organic solvents:

Petroleum products: may cause unconsciousness and when swallowed by accident cause gastritis or pneumonia due to aspiration into lungs.

Benzol (benzene, C6H6): is a product of coal distillation and is used in the paint industry, artificial rubber manufacturing, the pharmaceutical and chemical industries, rubber products manufacturing and degreasing. The central nervous system toxicity is the most important aspect of acute high dose exposure to benzol. Aplastic anaemia is the classic cause of death in chronic benzol poisoning.

Benzol-induced leukaemia may develop in some cases in persons who previously have had aplastic anaemia. The toxic effects of benzol are best prevented by replacing it with less toxic compounds. There are many solvents safer than benzol.

Chlorinated hydrocarbons: the addition of chlorine to carbon and hydrogen increases the stability and decreases the flammability of the resulting compounds. They have slightly pungent odours. Six chlorinated aliphatic hydrocarbons are commonly used as solvents:

- trichlorethylene
- perchloroethylene (tetrachloroethylene)
- 1-1-1-trichloroethane (methyl chloroform)
- methylene chloride (dichloromethane)
- carbon tetrachloride
- chloroform.

Acute effects include:

- ***anaesthesia:*** dizziness, headache, nausea, vomiting, fatigue, "drunkenness", slurred speech, disequilibrium, disorientation, depression, loss of consciousness
- r***espiratory*** tract irritation: sore nose, sore throat, cough.

Chronic effects include: dermatitis, neurobehavioral dysfunction, hepatocellular injury and renal tubular dysfunction.

4.5 Pulmonary dust diseases

If the work atmosphere is dusty, dust will inevitably be inhaled. Dust particles below five microns in diameter are called respirable since they have the chance to penetrate to the alveoli. The respiratory tract has certain defence mechanisms against dust but when the environment is very dusty a significant amount of dust can be retained in the lungs.

Different kinds of dust have different effects:

- Soluble particles of toxic compounds reach the blood and cause poisoning, e.g., lead.

- Irritant dusts cause irritation of the upper respiratory tract and the lungs and certain metal fumes cause chemical pneumonia, e.g., cadmium, beryllium and manganese.
- Some others cause sensitization resulting in asthma or extrinsic allergic alveolitis, e.g., some organic dusts.
- Metal fume fever is caused by inhalation of fumes of zinc and copper causing fever, body aches and chills for 1-2 days.
- Pneumonic anthrax is caused by inhalation of wool dust containing the spores.
- Benign pneumoconiosis which causes X-ray opacities (nodulation) without symptoms or disability is caused by inhalation of iron, barium and tin dust.
- Byssinosis is caused by prolonged exposure (7-10 years) to cotton dust in the textile industry especially in the ginning, bale opening and carding. It is manifested by chest tightness on the first day following a weekend. Initially, the patient is free of symptoms for the rest of the week. Chronic bronchitis, emphysema and disability are common complications.
- Pneumoconiosis is disabling pulmonary fibrosis that results from the inhalation of various types of inorganic dust, such as silica, asbestos, coal, talc and China clay, e.g., silicosis and asbestosis:

Silicosis: silicosis results from the inhalation of respirable particles of free crystalline silica (SiO). Exposure occurs in mining and quarrying operations, stone cutting and shaping, foundry operations, glass and ceramics manufacture, sandblasting and manufacture of abrasive soaps. It takes many years to develop the disease (7-10 years, sometimes less) and this depends on the concentration of the dust at the workplace, its silica content, the particle size and on individual susceptibility. The dust particles settle in the lungs and cause small nodules of fibrosis that progressively become more numerous, enlarge and coalesce causing fibrosis and progressive loss of lung function and disability. There may be coughing and expectoration. In the early stages there may be signs detectable by X-ray but later on the worker complains of increasing dyspnoea on exertion. Complications include pulmonary tuberculosis and cardiac or respiratory failure.

The disease can be detected even before the symptoms appear by X-ray examination which shows numerous bilateral nodular shadows of different sizes or large masses of fibrosis.

Asbestosis: asbestosis is caused by inhalation of asbestos fibres. It is a hydrated magnesium silicate which is resistant to heat and many chemicals. In addition to mining and extraction, exposure to asbestos occurs in its use for insulation, in the making of asbestos cloth, in the manufacture of asbestos cement pipes and other products, vinyl floor tiles and in brake and cloth lining. Asbestos fibres, when inhaled, will cause diffuse interstitial fibrosis of the lungs, pleural thickening and calcification. Bronchogenic carcinoma or pleural and peritoneal mesothelioma are known effects. The early symptoms include progressive dyspnoea on exertion, cough, expectoration, chest pain, cyanosis and clubbing of the fingers. The disease takes about seven years to develop and depends upon the dust concentration at the workplace. Early detection depends on symptoms and signs and the X-ray picture. Smoking increases the risk of developing lung cancer several fold.

Dust control measures include:

- substitution of harmful dust with a harmless one
- automation and mechanisation of dusty processes
- segregation of dusty jobs
- enclosure of dusty operations
- ventilation of general and local exhaust fumes
- housekeeping and general cleanliness
- the use of water in dust suppression for toxic dust: personal cleanliness, washing facilities, changing work clothes before going home, washing of work clothes, provision of separate areas for eating, drinking and smoking
- health education
- pre-placement medical examination
- personal protective equipment.

4.6 Pesticides

Pesticides are a group of chemicals used to destroy various kinds of pests including insects, rodents, weeds, snails, fungi, etc. The degree of toxicity of different pesticides varies greatly from deadly poisons to slightly harmful pesticides.

Exposure to pesticides occurs in industries where the pesticides are manufactured and formulated, and during their application in agriculture or in public health. Pesticides are also used at home.

They are classified into several groups, according to their chemical composition. The most frequently used nowadays are organophosphates, carbamates and thiocarbamates, pyrethroids and organochlorine pesticides. Other groups include lead arsenate, organic mercury, thallium compounds, coumarin, bromomethane, cresols, phenols, nicotine, zinc phosphide, etc.

Pesticides are absorbed through the lungs, the gastrointestinal tract and sometimes through the intact skin and eyes (organophosphates).

4.6.1 Organochlorine

Examples are DDT, aldrin, dieldrin, toxaphene and gammaxene. They are slightly too moderately toxic, and are not biodegradable in the environment or in the human body. They accumulate in the environment and for this reason have been banned in many countries.

Acute exposure causes irritability of the central nervous system. Symptoms appear after 30 minutes to several hours (usually not more than 12 hours). They include headache, dizziness, nausea, abdominal pain, irritability, convulsions, coma, pyrexia, tachycardia, shallow respiration and death.

If the patient survives, convulsions stop within 24 hours but weakness, headaches and anorexia may continue for two weeks or more. Chronic exposure may cause gastrointestinal, liver, kidney or nervous affection.

First aid treatment:

a) Remove contaminated clothing.
b) Wash skin with soap and water but do not rub the skin.
c) Induce vomiting, stomach wash and saline cathartic.
d) Administer sedative for convulsions.
e) Administer cardio-respiratory stimulants.

4.6.2 Organophosphates

These include parathion, methyl parathion, malathion and tetraethyl pyrophosphate. Organophosphates include some extremely toxic and some slightly toxic compounds. They do not accumulate in the environment or in the human body. They are biodegradable within a few weeks.

Organophosphates cause the inhibition of the choline-esterase enzyme resulting in accumulation of acetyl choline in the body. Symptoms and signs include dyspnoea, sweating, nausea, abdominal colic, diarrhoea, constriction of the pupils, muscle twitches, irritability, anxiety, headaches, ataxia, convulsions, respiratory and circulatory failure, coma and death. In severe cases symptoms appear within minutes and in slight cases after hours but never exceeding 24 hours. Death may occur within hours in severe cases. If recovery occurs it takes a few weeks for the patient to return to normal. Blood examination reveals reduction of choline-esterase activity; the test is used in periodic medical examinations.

First aid treatment:

a) Take patient to hospital.
b) Remove contaminated clothing.
c) Wash skin with water without rubbing (if available, a solution of 5% ammonia or 2% chloramine is more effective than water). However, if eyes are contaminated they must be washed with water.
d) If the pesticide has been swallowed, first give the patient water to drink and then induce vomiting by putting your finger down the patient's throat.
e) Administer atropine (the antidote) intravenously.
f) Administer artificial respiration if required.
g) Administer cardio-respiratory stimulants.
h) Later, treat the patient with oximes.

4.6.3 Carbamates and thiocarbamates

These are moderately toxic (carbaryl) and cause toxicity through the same mechanism as organophosphates except that inhibition of choline-esterase enzyme is temporary and recovers spontaneously within 48 hours if death does not occur.

4.6.4 Pyrethroids

These are synthetic pesticides of low toxicity used in homes. Toxic symptoms take the form of sensitivity reactions.

4.7 Safe handling of pesticides

a) Pesticides are licensed for use by the government following careful consideration of their toxicity to humans.
b) Extremely toxic substances should not be handled freely by the public.

c) Extra care should be taken during transportation of chemicals to ensure that containers are not crushed nor their contents spilt. If any spillage occurs, it should be reported and decontamination procedures carried out.
d) All pesticide containers should be properly labelled in the local language.
e) Storage sites should be properly cleaned and ventilated and should not be used by unauthorized personnel.
f) Before using such chemicals application, workers should be well trained and have received health education.
g) Public health measures should be taken to avoid contamination of water bodies and residential areas by chemicals.
h) Crops should not be harvested before the time necessary for pesticides to biodegrade.
i) Empty containers and pesticide waste should be properly disposed of.
j) Workers should practise good personal hygiene.
k) First aid treatment and antidotes should be available.
l) Pre-placement and periodic medical examinations should be undertaken.
m) All concerned, including the public, should receive health education regarding pesticides.
n) Personal protective equipment should be supplied to workers.
o) Engineering control measures should be in place within the chemical industry.

5. Biological hazards

5.1 Occupational infections

Human diseases caused by work-associated exposure to microbial agents, e.g., bacteria, viruses, rickettsia, fungi and parasites (helminths, protozoa), are called occupational infections. An infection is described as occupational when some aspect of the work involves contact with a biologically active organism.

Exposure occurs among health care workers in fever hospitals, laboratories and general hospitals; among veterinarians and agricultural workers in animal husbandry and dairy farms and pet shops; and among sewerage workers, wool sorters and workers in the leather industry.

5.1.1 (Occupational) pulmonary tuberculosis

Health care workers in tuberculosis treatment centres, in laboratories and in veterinary clinics are particularly affected. The disease is caused by Mycobacterium tuberculosis (Koch's bacillus) and is transmitted occupationally by droplet infection, contact with infected material from humans (sputum) or animals. The organism can survive in dust and away from direct sunlight for many days and enters the body through the respiratory tract or abraded skin where it causes a skin ulcer.

The disease usually affects the lungs but can also affect the gastrointestinal tract, bones, kidneys, meninges, pleura and peritoneum. Pulmonary tuberculosis is manifested by coughing, expectoration, haernoptysis, loss of weight, loss of appetite, night sweats and night fever. It can be diagnosed by chest X-ray and bacteriological examination of the sputum.

Workers should undergo a pre-placement examination and be tested with tuberculin and vaccinated with BCG if the tuberculin test is negative. Pre-placement and periodic X-rays should be taken. Health education is important and proper disposal of infected material should be observed.

5.1.2 Brucellosis

Brucellosis is caused by an organism which can infect cattle, sheep and pigs. The disease causes recurrent abortion in animals and is present in the placenta, in animal secretions, in milk and in urine.

Exposed workers are veterinarians, workers in agriculture and animal husbandry, shepherds and laboratory and slaughterhouse workers. Most occupational cases occur through contact with infected animals or their secretions and products. The incubation period is 2-4 weeks.

The acute stage (undulant fever) extends for 2-4 weeks with fever, enlarged spleen and lymph nodes. In the subacute phase the organism localizes in joints, intestines, reproductive organs, pleura or meninges.

In the chronic phase the localized disease continues with occasional fever or the only symptom may be general weakness. During this stage the disease is difficult to diagnose. Therefore, periodic medical examination of all exposed workers should be carried out using serological tests.

Control of the disease in humans depends on control in animals. Workers should wear protective clothing and observe proper cooking of animal products and boiling of milk since the disease can also be transmitted through food.

5.1.3 Anthrax

Anthrax is essentially an animal disease. Exposed workers are those in agriculture and animal husbandry, slaughter houses, tanneries and those working in the manufacture of goods from wool, hair, bones and leather. The disease affects cattle, sheep, horses and pigs and when the animal dies the anthrax bacillus forms spores which are extremely resistant and can survive for years.

Infection can occur through the skin, the lungs or the intestine. Infection through the skin causes a "malignant pustule". It starts with erythema 1-8 days after infection which leads to a papule then pustule with surrounding swelling and local lymph node enlargement. Infection through the lung occurs in wool stores causing severe fatal pneumonia. Infection through the intestines causes septicaemia.

Animal products intended for use in industry should be carefully examined and disinfected.

5.1.4 Viral hepatitis Band C

Health care workers who are likely to come into contact with the blood and body fluids of infected persons are at great risk of infection. An acute onset of hepatitis is the exception; more often there are vague general symptoms or none at all and the infection is discovered on routine serological examination.

The disease may pass into chronic active hepatitis: liver cirrhosis, hepatic failure and liver carcinoma.

Because of the exposure to patients' body fluids via contaminated glassware and other contaminated equipment, such as needles, which may provide an opportunity for contact with mucous membranes or parenteral inoculation, strict "infection control" procedures should be developed for situations where there is potential risk, such as phlebotomy, dentistry and haemodialysis.

Workers at increased risk of hepatitis B infection should receive hepatitis B immunisation.

5.1.5 Acquired immunodeficiency syndrome (AIDS)

Transmission of the acquired immunodeficiency syndrome (AIDS) agent, the human immunodeficiency virus (HIV), occurs only through sexual contact, perinatally from an infected mother and through contaminated blood or blood products. Seroconversion after a needle-stick injury is estimated to be less than 1%, which is much lower than the risk (6%-30%) of acquiring hepatitis B after a needle-stick injury.

The virus is not transmitted through casual, non-intimate workplace contact or social encounters, such as eating in restaurants or using public transportation or bathroom facilities.

The following groups are at potential risk of contact with HIV-infected body fluids:

a) blood bank technologists
b) dialysis technicians
c) emergency room personnel
d) morticians
e) dentists
f) medical technicians
g) surgeons
h) laboratory workers
i) prostitutes
j) First aiders.

For occupational health professionals, employees trained in first aid and public safety personnel who may provide medical services to HIV-infected individuals, reasonable steps should be taken to avoid skin, parenteral or mucous membrane contact with potentially infected blood, plasma or secretions.

- Hands or skin should be washed immediately and carefully if blood contact occurs.
- Mucous membranes (including the eyes and mouth) should be protected by eye glasses or masks during procedures that could generate splashes or aerosols of infected blood or secretions (suctioning, endoscopy).
- Contaminated surfaces should be disinfected using 5% sodium hypochlorite.

Workers in the personal service sector, who work with needles or other instruments that can penetrate intact skin, such as tattooists and hairdressers, should follow precautions indicated for health care workers and practise aseptic techniques and sterilization of instruments. All personal service workers should be educated concerning transmission of blood-borne infections, including AIDS and hepatitis B.

5.2 Other exposures and their health effects

5.2.1 Occupational dermatoses

Occupational dermatoses are the most common occupational diseases and are almost always preventable by a combination of environmental, personal and medical measures.

The skin can be affected by many factors:

a) repeated mechanical irritation may cause callosities and thickening of the skin
b) various kinds of radiation
c) tuberculosis and anthrax
d) chemicals can cause irritation or sensitization.

Types of occupational dermatosis:

a) acute contact eczema due to irritation or sensitization
b) chronic contact eczema due to irritation or sensitization
c) chloracne (lubricating and cutting oils, tar and chlorinated naphthylenes)
d) photosensitization (chemicals, drugs and plants)
e) hypopigmentation and hyperpigmentation (dyes, heavy metals and chlorinated hydrocarbons)
f) keratoses (ionizing radiation, ultraviolet radiation)
g) benign tumours and epitheliomas (UV, ionizing radiation, tar, soot, arsenic)
h) ulcers (trauma, burns).

5.2.2 Occupational cancer

The cause of cancer is still not completely understood. It has been observed however, through epidemiological studies and statistical data that cancer of certain organs has been associated with certain exposures.

Occupational cancer is no different from ordinary cancer as far as signs and symptoms or histopathology is concerned. A positive history of exposure to a carcinogenic agent can be obtained in occupational cancer. Examples of some carcinogenic agents and the organs affected are given below.

Carcinogenic agent	**Organ affected**
Arsenic	Skin and lung
Chromium compounds, hexavalents	Lung
Nickel	Lung and nasal sinus
Polycyclic aromatic hydrocarbons	Skin
Coal tars	Skin, scrotum, lung, bladder
Benzol	Blood (leukaemia)
B-naphthylamine	Bladder
Ionizing radiation	Skin, bone, lung, blood (leukaemia)

Asbestos	Lung, pleura, peritoneum

5.2.3 Reproductive effects

Occupational exposure to certain chemicals or physical factors (like ionising radiation) has been found to have certain effects on reproductive functions:

a) dysfunction in males (sterility or defective spermatozoa) and females (anovulation, implantation defects in the uterus)
b) increased incidence of miscarriage, stillbirth and neonatal death
c) induction of structural and functional defects in new-born babies
d) induction of defects during the early postnatal development stage.

Exposure of either parent may lead to reproductive defects.

Chemicals which have been suspected of reproductive effects include:

a) alcohols
b) anaesthetic gases
c) cadmium
d) carbon disulphide
e) lead
f) manganese
g) polyvinyl chloride.

5.2.4 Occupational asthma

Asthmatic patients suffer from attacks of shortness of breath. Although bronchial asthma can be caused by a large number of substances or combinations of substances outside the workplace, many occupational exposures can be associated with the occurrence of asthma. Although in many cases it is difficult to evaluate how much of the problem is caused by workplace exposure, in certain instances it is obvious that asthmatic attacks are caused by work exposure only and not by factors outside work.

Examples of substances that may cause occupational asthma:

a) Plant origin:
   - wood dust
   - flour and grain dust
   - fungal spores
   - formaldehyde

- gum arabic

b) Animal origin:

- Wool
- Hair
- feathers

c) Other substances:

- antibiotics (penicillin)
- toluene diisocyanate
- platinum salts.

6. Work related diseases

6.1 Characteristics of work-related diseases

This category has certain characteristics which were identified and stated by a WHO Expert Committee as follows:

"Multifactorial diseases", which may frequently be work-related, also occur among the general population, and working conditions and exposures need not be risk factors in each case of anyone disease. However, when such diseases affect the worker, they may be work-related in a number of ways: they may be partially caused by adverse working conditions; they may be aggravated, accelerated or exacerbated by workplace exposures; and they may impair working capacity. It is important to remember that personal characteristics, other environmental and sociocultural factors usually play a role as risk factors for these diseases.

Multifactorial "work-related" diseases are often more common than occupational diseases and therefore deserve adequate attention by the health service infrastructure, which incorporates the occupational health services."

The work-related diseases which deserve particular attention are:

a) behavioural and psychosomatic disorders
b) hypertension
c) coronary heart disease
d) peptic ulcers
e) chronic nonspecific respiratory disease
f) locomotor disorders.

6.2 Behavioural and psychosomatic disorders

Both home and work environments can be a major source of adverse psychosocial factors. Individuals differ widely in their responses.

6.2.1 Risk factors for behavioural and psychosomatic disorders

a) Environmental psychosocial risk factors

- work overload and underload
- boredom and lack of control over work situation
- shift work
- migration (migrant workers)
- organizational structure at the work establishment and the role of the individual in the organization; role ambiguity and role conflict
- opportunity for career development and promotion
- physical insecurity (fires, explosions) and responsibility for other people's safety
- job design and degree of interest
- low wages
- job turnover
- early or involuntary retirement
- unemployment.

b) Physical stressors

- thermal environment
- noise
- vibration
- radiation
- poor lighting.

c) Environmental chemical stressors

These can increase the risk of psychosomatic illness. Some chemical hazards however, have specific effects on the central nervous system, e.g., carbon monoxide, carbon disulphide, alcohols and some other solvents.

d) Social support system

This improves the ability of an individual to adapt to environmental psychosocial stress. Support can be from the family, the work community or the community outside of work.

e) Individual psychosocial factors

- inter-individual relationship at work
- personality type
- individual susceptibility
- age
- sex.

6.2.2 Behavioural and psychosocial reactions to stress

- overeating leading to obesity
- smoking
- alcohol and drug abuse and drug addiction, any of which can be a risk factor for psychosomatic illness
- fatigue
- anxiety
- depression
- hostility and aggression
- neurosis causing a range of mental and emotional disorders
- mental disorders and psychiatric disorders
- mass psychogenic illness (mass hysteria)
- psychosomatic disease: headache, backache, muscle cramps, disturbed sleep, peptic ulcer, diabetes mellitus, cardiovascular disorders etc.

6.3 Hypertension

In over 90% of patients with hypertension, the disease is called "essential hypertension" and no cause can be identified. Genetic predisposition is an important risk factor. Exposure to lead, cadmium and noise is a risk factor in developing hypertension and it has also been suggested that psychosocial stress is a factor in the development of hypertension. Other risk factors in the development of hypertension include dietary habits (excess salt and fats), obesity and physical inactivity.

6.4 Coronary heart disease (CHD)

Narrowing of the coronary arteries causes inadequate blood supply to the heart muscle causing "angina pectoris" or recurrent brief attacks of chest pain often associated with exercise.

Occlusion of any artery causes myocardial infarction or necrosis of part of the heart muscle which may cause death within a short time or later on due to complications.

The incidence of the disease is increasing and more and more young people are being affected. It is more common in men than women below 45 years of age, but in older age the two sexes may be equal.

The risk of coronary heart disease is associated with hypertension, high dietary fat intake, high serum cholesterol and being overweight. In addition there is a significant familial tendency. A coronary-prone personality has been described as the aggressive, competitive person who takes on too many jobs, fights deadlines and is obsessed by lack of adequate time to finish his work. Overload at work has also been associated with coronary heart disease.

Psychosocial stress increases serum cholesterol, causes hypertension and enhances clot formation. Cigarette smoking is another risk factor for CHD. Other occupational factors related to CHD are sedentary work, exposure to carbon disulphide, carbon monoxide and nitrates and chronic exposure to noise, heat and cold. Solvents such as benzene, trichlorethylene, chloroform, ethyl chloride and fluorocarbon compounds directly affect the myocardial tissue. Lead and mercury cause CHD, secondary to hypertension, and cobalt, arsenic and antimony produce myocardial damage.

6.5 Peptic ulcer

Several risk factors have been associated with the development of gastric and duodenal ulcers. These include heredity, certain medicines (analgesics and non-steroidal anti-inflammatory drugs), cigarette smoking, medical illness, surgical procedures, type of personality, local infection (Helicobacter pylon) and occupation.

Occupational factors associated with the risk of developing peptic ulcers include jobs with a high degree of responsibility and irregular shift work; the higher the work stress the higher the ulcer rate. Also peptic ulcers are related to inhaled irritant gases which dissolve in sputum and are ingested.

6.6 Chronic nonspecific respiratory diseases (CNRD)

CNRD is a general term used to describe a group of diseases in which there is chronic cough and sputum production and/or shortness of breath at rest and/or during exercise.

These conditions include chronic bronchitis, emphysema, bronchial asthma and asthmatic bronchitis. All these diseases may be acutely or chronically exacerbated by infection. CNRD are diseases of multiple ethology and represent a classic example of disorders that may be occupational in origin, work-related or related to the social phenomena of urbanization and industrialization.

When the risk of these disorders is strongly related to specific occupational exposure such as non-fibro genic dusts (e.g., cotton, rice and flax) or irritants, they may easily be thought of as occupational diseases. It is well known, however, that other factors, such as smoking, climatic conditions, community air pollution, atopy, familial genetic factors, individual susceptibility, bronchial hyper-reactivity, childhood respiratory infections, repeated respiratory infections in adult life and socioeconomic status, can play a major role. In any individual case, it is difficult to ascertain how much synergism has occurred between any combination of two or more. It is generally believed however, that in smokers who are exposed to community or workplace air pollution, smoking plays a more important role in the causation of CNRD than does air pollution.

In dusty occupations where dust is known to cause specific pulmonary diseases (silicosis, asbestosis, coal workers' pneumoconiosis, byssinosis, etc.), dust concentrations lower and durations shorter than those which cause the specific disease may be sufficient to contribute to the causation of CNRD.

Examples of occupations where work-related CNRD may occur are those where dust (organic or inorganic), irritant gases or aerosols are present. These pollutants may contribute to the causation of CNRD by causing irritation of the respiratory mucous membrane or through allergic mechanisms. These occupations include the chemical industry, mining, foundries, textile mills, silos, cement factories, the glass industry, the fertilizer industry, steel mills, smelters and a multitude of other occupations.

6.7 Locomotor disorders

Two examples of locomotor disorder will be given for which evidence of work relatedness is available: low back pain syndrome and shoulder-neck pain syndrome.

6.7.1 Low back pain

Low back pain is a symptom of common occurrence in the general population, affects males and females at all ages, but is more common between the ages of 25 and 64 years. It is said to affect over half the working population at some time during their active working life and it is estimated that 2%-5% of industrial workers experience low back pain each year.

Pain in the lumbosacral area can result from inflammatory, degenerative, traumatic, neoplastic or other disorders. In some instances it is claimed to be psychogenic in origin. The most common type of occupational low back pain is nonspecific, of indeterminate pathology and often associated with posture, lifting of heavy objects and injurious (twisting) movements of occupational or non-occupational origin.

The risk factors for low back pain include congenital back defects, weak musculature, rheumatic affection and degenerative conditions of the spine and intervertebral discs. Certain occupations carry a higher risk of developing low back pain. These include heavy manual work, mining, docking, material handling, jobs requiring awkward postures and postures that have to be maintained for prolonged periods or involve frequent bending, twisting or whole body vibration, nursing and policing. These occupations require proper selection, physical training, proper placement and adoption of safe criteria for load lifting.

6.7.2 Shoulder-neck pain

A variety of diseases may result in shoulder and neck pain: examples are inflammatory reactions in the synovial membrane and bursa system and degenerative disorders in the cartilage, ligaments and tendons. In addition, muscular, vascular and neuromuscular disorder may result in shoulder pain and pain may be referred from the chest.

Disorders associated with general muscle weakness and general malaise, such as infections, may also result in an increased susceptibility to shoulder and neck complaints from loads on the shoulder which a worker can normally tolerate. From the occupational health standpoint, individual predisposing factors such as age, difficulties in organizing the work task and inflammatory rheumatic predisposition play a role.

It has been found that working with the hands above shoulder height is more frequent in workers with both acute and chronic shoulder and neck pain. However, increased work-loads on shoulder and neck muscles can also be produced without lifting the arms above the shoulders.

Further proof of the work-relatedness of shoulder and neck pain is presented by the fact that application of ergonomic principles to improve methods of work reduces the pain.

Notes:

Module 10 - Occupational Ergonomics

1. Introduction and basic concepts

Ergonomics is the study of the complex relationships between people, physical and psychological aspects of the work environment (e.g., facilities, equipment and tools), job demands and work methods. It is a field which integrates knowledge derived from the human sciences (in particular anatomy, physiology and psychology) to match jobs, systems, products and environments to the physical and mental abilities and limitations of workers. Ergonomics stresses fitting the job to the worker as compared to the more usual practice of obliging the worker to fit the job.

The aim of ergonomics is primarily to optimize, first and foremost, the comfort, as well as the health, safety and efficiency, of the worker. Applying ergonomic principles however, is not only beneficial to workers. The benefits to employers are equally significant and are both visible and measurable in terms of increased efficiency, higher productivity, reduction in work time lost due to illness or injury and decreased insurance costs.

A fundamental principle of ergonomics is that all work activities cause the worker to experience some level of physical and mental stress. As long as this stress is kept within reasonable limits, work performance should be satisfactory and the worker's health and well-being should be maintained.

If stress is excessive, however, undesirable outcomes may occur in the form of errors, accidents, injuries or decreases in physical or mental health. Ergonomically related injuries and illnesses range from eye strain and headaches to musculoskeletal ailments such as chronic back, neck and shoulder pain, cumulative trauma disorders (CTDs), repetitive strain injuries (RSIs) and repetitive motion injuries (RMIs)-three terms which are used interchangeably.

Preventing eyestrain, headaches and musculoskeletal disorders and obtaining optimal performance can be achieved when equipment, workstations, products and working methods are designed according to human capabilities and limitations, i.e. by applying principles of ergonomics.

The costs of ignoring these basic principles include:

a) injuries and occupational diseases (including RSI, CTD and RMI)
b) increased absenteeism
c) higher medical and insurance costs
d) increased probability of accidents and errors
e) higher turnover of workers

f) less production output
g) lawsuits
h) low-quality work
i) less spare capacity to deal with emergencies.

The goal of an occupational ergonomics programme is to establish a safe work environment by designing facilities, furniture, machines, tools and job demands to be compatible with workers' attributes (such as size, strength, aerobic capacity and information processing capacity) and expectations. A successful ergonomics programme should simultaneously improve health and enhance productivity.

1.1 Prevention of accidents

Through design of a machine guard will allow a worker to operate a piece of equipment with smooth, non-awkward, time-efficient motions. This minimises any inconvenience introduced by the guard and decreases the likelihood that it will be bypassed or removed.

Through study of the biomechanics of the human walk to determine forces and torques acting at the interface between the floor and the sole of the shoe. This information can be used to improve the friction characteristics of floor surfaces and shoe soles to reduce the risk of a slip or fall.

1.2 Prevention of fatigue

Designing a computer work station (equipment and furniture) so that an operator can use a video display unit (VDU) for an extended period of time without experiencing visual or postural fatigue.

Evaluating the metabolic demands of a job performed in a hot, humid environment to recommend a work-rest regimen that will prevent heat stress.

1.3 Prevention of musculoskeletal disorders

Evaluating lifting tasks to determine biomechanical stresses acting on the lower back and designing lifting tasks to ensure that these stresses will not cause back injuries.

Evaluating highly repetitive manual assembly operations and developing alternative hand tools and work methods to reduce the risk of cumulative trauma disorders such as tendonitis, epicondylitis, tenosynovitis and carpal tunnel syndrome.

2. Ergonomics – a multi-disciplinary science

Ergonomics is a multidisciplinary science with four major areas:

a) human factors engineering
b) work physiology
c) occupational biomechanics
d) anthropometry.

2.1 Human factors engineering

Human factors engineering, sometimes called engineering psychology, is concerned with the information processing aspects of work.

2.1.1 Objectives of human factors engineering

Broadly, the objectives are to design procedures, equipment and the work environment to minimize the likelihood of an accident caused by human error.

a) Basic operational objectives:
- reduce errors
- increase safety
- improve system performance

b) Objectives bearing on reliability, maintainability and availability and integrated logistic support:
- increase reliability
- improve maintainability
- reduce personnel requirements
- reduce training requirements

c) Objectives affecting users and operators:
- improve the working environment
- reduce fatigue and physical stress
- increase human comfort
- reduce boredom and monotony
- increase ease of use
- increase user acceptance

d) Other objectives:
- reduce loss of time and equipment
- increase economy of production.

2.1.2 Common causes of work accidents caused by human error

a) Failure to perceive or recognise a hazardous condition or situation

To react to a dangerous situation it is necessary to perceive that the danger exists. Many workplace hazards are not perceived through human sensory channels, e.g.,

- excessive pressure inside a boiler that could cause an explosion
- a fork-lift truck approaching from behind in a noisy factory
- unguarded machinery in a poorly lit room
- the sudden release of an odourless toxic gas.

In these situations, it is necessary to supplement the sensory functions with special informational displays, e.g.,

- a pressure gauge with redline marks to indicate a dangerous condition inside the boiler
- a horn or beeper on the fork-lift truck that sounds automatically while it is in motion
- a well-lit warning sign at the entrance to a poorly lit equipment room
- an emergency alarm system that indicates the release of toxic gases.

b) Failure in the information processing or decision-making processes

Decision-making involves combining new information with existing knowledge to provide a basis for action.

Errors can occur at this stage if the information processing load is excessive, e.g., in the accident at the Three Mile Island nuclear power plant in the USA in the 1970s, operators were required to react to multiple simultaneous alarms.

Errors can also occur if previous training was incorrect or inappropriate for handling a specific situation.

c) Failure in motor actions following correct decisions

Following a decision, it is frequently necessary for a worker to perform some motor action by using a control to implement the desired change, e.g., flipping a switch or adjusting a knob. Failures can occur if controls are not designed to be consistent with human motor abilities, e.g., the force required to adjust a control valve in a chemical plant should not exceed human strength ability, or if manipulation of the control causes an unexpected response.

Controls that start potentially dangerous machinery or equipment should be guarded to prevent accidental activation, usually by covering the control or placing it in a location where it cannot be accidentally touched.

2.2 Work physiology

Work physiology is the subdiscipline of ergonomics concerned with stress that occurs during the metabolic conversion of biochemical energy sources, such as glucose, to mechanical work. If this stress is excessive, the worker will experience fatigue. Fatigue may be localized to a relatively small number of muscles or may affect the entire body.

2.2.1 Static work and local muscle fatigue

Static work occurs when a muscle or muscle group remains in a contracted state for an extended period of time without relaxation. High levels of static work can be caused by:

- sustained awkward posture, e.g., a mechanic who must continuously twist his body to perform repairs to an automobile engine
- high strength demands associated with a specific task, e.g., using a wrench to undo a badly rusted wheel-nut when changing a tyre.

When a muscle contracts, the blood vessels that supply nutrients and remove metabolic wastes are compressed by the adjacent contractile tissue. As a result, vascular resistance increases with the level of muscle tension, and the blood supply to the working muscle decreases. If the muscle is not allowed to relax periodically, the demand for metabolic nutrients may exceed the supply. Metabolic wastes can also accumulate. The short-term effects of this condition include ischaemic pain, tremor or a reduced capacity to produce tension. Any of these effects can severely inhibit work performance.

Static work also causes a temporary increase in the peripheral resistance of the cardiovascular system. Significant increases in heart rate and mean arterial blood pressure have been observed in conjunction with short duration static contractions. Caution should be exercised to avoid placing a person with a history of cardiovascular disease on a job that requires moderate to heavy static exertions.

In most situations, dynamic activities involving cyclical contraction and relaxation of working muscle are preferable to static work. If, however, the job requires highly repetitive or forceful exertions, a variety of localized cumulative trauma injuries may occur to musculoskeletal tissue or peripheral nerves.

2.2.2 Dynamic work and whole-body fatigue

Dynamic, whole-body work occurs when multiple groups of large skeletal muscles repeatedly contract and relax in conjunction with the performance of a task, e.g., walking on a level surface, pedalling a bicycle, climbing stairs and moving a load (by carrying, pushing, pulling, or shovelling) from one location to another.

The intensity of whole-body, dynamic work is primarily limited by the capacity of the pulmonary and cardiovascular systems to deliver sufficient oxygen and glucose to working muscles and to remove products of metabolism.

Whole-body fatigue occurs when the collective metabolic demands of working muscles throughout the body exceed this capacity. Common symptoms of whole-body fatigue include shortness of breath, weakness in working muscles and a general feeling of tiredness. These symptoms will continue and may increase until the work activity is stopped or decreased in intensity.

For extremely short durations of whole-body dynamic activity (typically 4 minutes or less), a person can work at intensity equal to his or her aerobic capacity. As the duration of the work period increases, the work intensity must be adjusted downward. If a task is to be performed continuously for 1 hour, the average energy expenditure for this period should not exceed 50% of the worker's aerobic capacity. For a job that is performed for an 8 hour shift, the average energy expenditure should not exceed 33% of the worker's aerobic capacity.

Aerobic capacity varies considerably within the population. Individual factors that determine aerobic capacity include age, sex, weight, heredity and current level of physical fitness.

The prevention of whole-body fatigue is best accomplished through good job design. The energy expenditure requirements of a job should be sufficiently low to accommodate the adult working population, including those individuals with limited aerobic capacity. These requirements can be met by designing the workplace to minimize unnecessary body movements (excessive walking or climbing) and providing mechanical assists (such as hoists or conveyors) for handling heavy materials. If these approaches are not feasible, it may be necessary to provide additional rest allowances to prevent excessive fatigue, particularly in hot, humid work environments because of the metabolic contribution to heat stress.

To assess the potential for whole-body fatigue, it is necessary to measure or estimate the energy expenditure rate for a specific job, which is usually done in one of three ways:

a) **Table reference**: extensive tables of the energy costs of various work activities have been developed.
b) **Indirect calorimetry**: energy expenditure can be estimated by measuring a worker's oxygen uptake while performing the job.
c) **Modelling**: the job is analysed and broken down into fundamental tasks such as walking, carrying and lifting. Parameters describing each task are measured and substituted into equations to predict energy expenditure.

2.3 Occupational biomechanics

Biomechanics is the sub-discipline of ergonomics concerned with the mechanical properties of human tissue, particularly the resistance of tissue to mechanical stress. A major focus of occupational biomechanics is the prevention of the lower back and upper extremities.

2.3.1 Mechanical stress

Overt accidents: some of mechanical stresses that cause injury in the work environment is associated with overt accidents, e.g., crushed bones in the feet resulting from the impact of a dropped object. The hazards that cause these injuries can usually be controlled through safety engineering techniques.

Cumulative trauma injuries: other injurious mechanical stresses are more subtle and can cause cumulative trauma injuries. Such stress can be external, such as a vibrating chain saw that causes Raynaud syndrome, or internal, such as compression of spinal discs during strenuous lifting.

Such stress is most effectively controlled through ergonomics, i.e. designing job demands so that resulting mechanical stress can be tolerated without injury.

2.3.2 Biomechanics of lifting, pushing and pulling

a) Principles of lifting
- Test your personal strength limits and make sure the load to be lifted is below 50% of that limit.
- Avoid lifting loads that exceed the general strength limits calculated for various types of lifting.

- Minimize twisting with a load, and, when it is necessary to twist, rotate the pelvis.
- Keep the load close to the body when lifting it.
- Exercise caution when working in slippery or cluttered areas.

b) Principles of pushing and pulling

- Make certain that the area ahead of the load is level and clear of obstacles; if it is not level, some system of braking should be available.
- Push the load rather than pull it; this will reduce spinal stress, and in most cases will improve the visibility ahead.
- Wear shoes that provide good foot traction; the coefficient of friction between the floor and the sole of the shoes should be at least 0.8 wherever heavy loads are moved.
- When starting to push a load, brace one foot and use the back, rather than the hands and arms, to apply force; if the load does not start to move when a reasonable amount of force is applied, get help from a co-worker or use a powered vehicle.
- Pushing or pulling is easier when the handles of the loaded cart are at about hip height (91-114 cm for men) than they are at shoulder height or above. Handles lower than the hips are awkward and unsafe to use.

2.4 Use of anthropometric data

One of the primary reasons for physical stress on the job is the mismatch in size between the worker and the workplace, equipment or machinery. This mismatch may result in having to work bent over, having to work with one or both arms and shoulders held high for long periods or having to sit on a stool or bench that is too low or too high.

Anthropometry is concerned with fitting tools and workspaces to the dimensions of the human body. Since humans come in a tremendous range of shapes and sizes, this is often a difficult task. Knowing the distribution of shapes and sizes is the first step in anthropometric design. There are thousands of different measurements on the human body that are relevant to the design of tools, workplaces and even clothing.

2.4.1 Anthropometric tables

Anthropometric tables list summaries of these measurements across different population groups. Numerous anthropometric data sources are available, each representative of the different populations measured, e.g., there are anthropometric databases available on military personnel, American industrial populations and different countries and regions of the world.

2.4.2 Reach and fit

The concepts of reach and fit are essential to anthropometry and they apply in many different situations including design of almost any product or technology people use:

- chairs and seating
- baths, showers, kitchens
- workplaces in general
- computer workstations
- cars and other vehicles
- corridors, stairways and building interiors in general
- tools.

A general rule of anthropometric design is that tall people establish fit requirements, short people establish reach requirements.

2.4.3 Steps in design

Step 1 Defining who to design for (define the population)
Many companies and factories have a diverse population, both within and across workplaces. Therefore the population being designed for must be defined to ensure that the design fits the physical characteristics of the actual workplace population.

Step 2 Determining which important parts and dimensions to use
For design or redesign of equipment, tools, workstations or jobs, body dimensions that specifically relate to the tasks being performed should be used, e.g.,

a) designing for short-reach distances to obtain parts from bins at a workstation allows smaller employees to reach without forming awkward postures;
b) for a seated workstation, using clearance dimensions for the largest male allows most employees to place their legs under the workstation without forming awkward postures, such as leaning or twisting the back.

For the design of new jobs, employers must also determine:

a) how the job is going to be performed (identification of the tasks);
b) how any new equipment or tools will be used (e.g., location of controls, reach requirements); and
c) what body dimensions are important to use for the design.

As a minimum, the dimensions related to work height (the actual height at which the hands perform the work), reach and fit (clearance) should be addressed.

3. Designing for adjustability

This strategy accommodates nearly all the workforce, e.g., an existing work surface that allows a shorter individual to stand and work without bending over might require that a taller individual bend forward to work on the same work surface. A work surface that is adjustable in height allows the taller individual to stand and work without bending. At a computer workstation, adjustability may be considered for the chair, work surface and monitor.

4. Designing for extremes

An alternative approach to designing for adjustability is to design for the extreme (95th percentile male or 5th percentile female) and accommodate the rest of the population, e.g., design the work surface height for the 95th percentile male and accommodate shorter individuals through work stands.

Notes: