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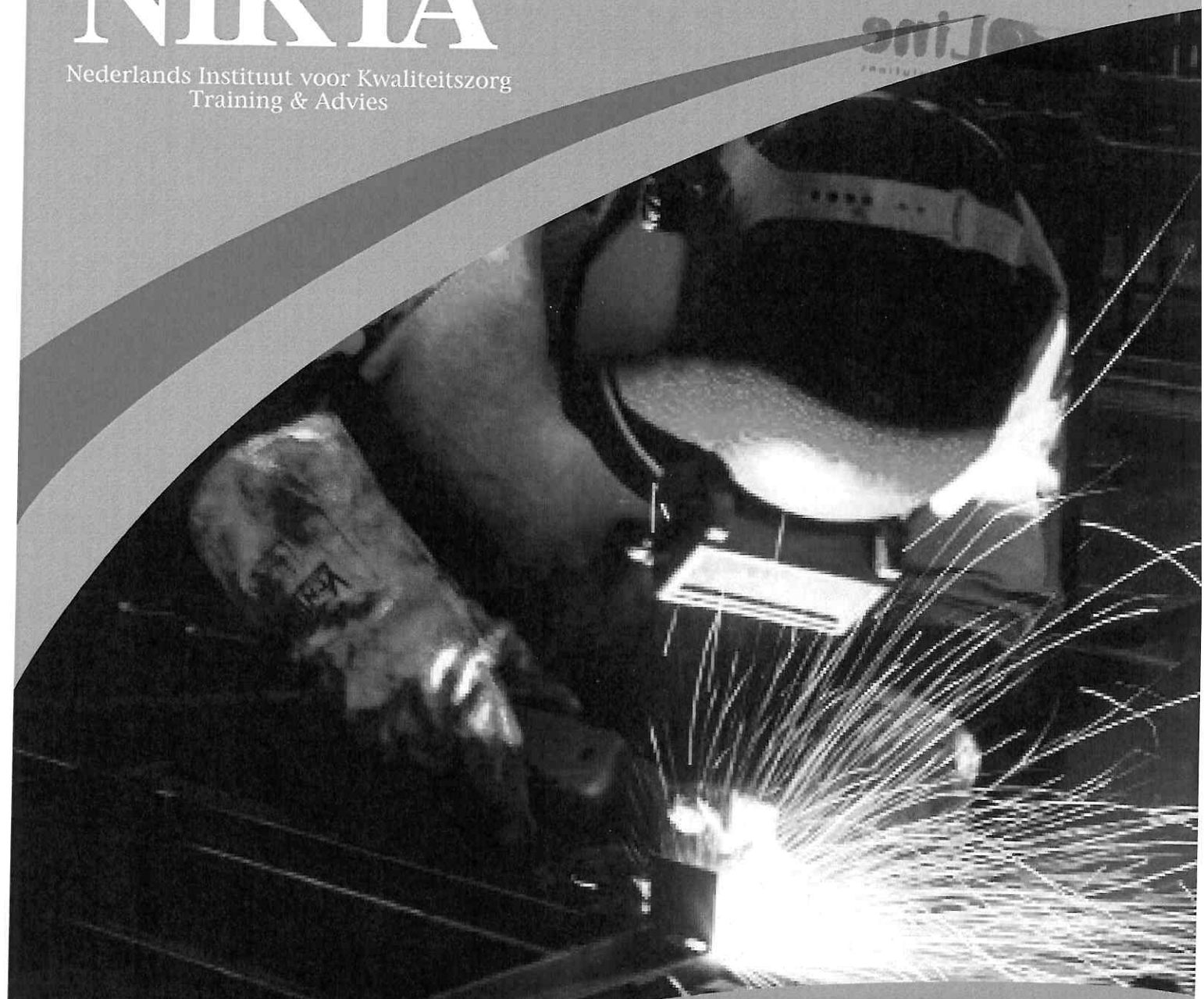

Basis Elements of Safety

versie 2015.01

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Inhoudsopgave

do NOT write in this book!

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Safety begins with you and is based on knowingly taking responsible risks. Will decisions taken always be well-considered?
Often, it goes well; unfortunately, it also often goes wrong, with potentially disastrous results!

Preface

The VCA system was developed by the Central College of VCA Experts (Centraal College van Deskundigen VCA; CCvD-VCA) and the Collaboration for Safety Foundation (Stichting Samenwerken voor Veiligheid; SSW) in order to assess contractors according to fixed criteria for the safety of their work. That offers the clients of contractors more confidence in the safe and reliable conducting of business.

Safety criteria

VCA originated in the (petro-)chemical industry, where for understandable reasons, high requirements are set for working in a *safe way*. It is logical that this industry requires contractors admitted to their premises and institutions for work to meet the safety criteria that apply to their own employees as well. Therefare, in the early nineties, a list of requirements was established for assessing contractors. One of the questions in the list is whether the contractor will also require a provider (read: sub-contractor) to obtain the VCA company certificate. That has led to a great expansion of the VCA, outside the (petro-)chemical industry as well.

VCA has no legal basis. It is a requirement that the client can set for contractors. It is also a way for a company to be able to implement a structured labour policy.

VCA diploma

Checklist for Contractors

The abbreviation VCA stands for 'VGM Checklist voor Aannemers' ('VGM Checklist for Contractors'). VGM = 'Veiligheid, Gezondheid en Milieu' ('Safety, Health and Environment'). The checklist consists of a *number of questions* that the contractor must be able to answer in the positive in order to be eligible for the VCA certificate.

Two of the questions, 3.2 and 3.3, concern safety courses for personnel: Basic safety (B-VCA) is intended for operational employees, and Safety for Operational Supervisors (Veiligheid voor Operationeel Leidinggevenden; VOL-VCA) is intended for supervisors starting from the level of foreman. Each supervisor who is (at times) present at projects must have taken the course.

The courses will end with an official exam that will be taken at an independent and recognised exam centre. Successful candidatas receive a diploma that is valid for 10 years. Thereafter, another exam must be taken. Starting 01-01-2004, all successful candidatas are included in the central VCA diploma registry. The registry is public and can be consultad via www.vca.ssvv.nl.

Central VCA diploma registry

VCA company certificate

There are *three certificate levels*: VCA * (one star), VCA ** (two stars) and starting 1 July 2008 VCA-Petrochemical. VCA-Petrochemical is equivalent to

VCA** with a number of additional requirements. For the three systems, the contractor must be able to demonstrate that the system has been functioning for at least three months and that the number of accidents has been demonstrably reduced.

Audit

The VCA company certificate will be awarded after an audit by an independent Certification Institution by the Council of Accreditation for three years. Each year, an interim audit takes place. After three years, there is another initial audit like the first one.
With an audit, it will be checked, among other things, whether each employee who has been employed for longer than three months has the right safety trainings. A request will be made for (copies of) the applicable, valid VCA diplomas. For companies/institutions that have projects done by VCA-certified contractors, there is the VGM Checklist for Clients (VGM Checklist Opdrachtgevers; VCO. Finally, there is a VCU: the VGM Checklist for Staffing Companies (VGM Checklist Uitzendorganisaties) for the use of temporary workers for VCA/VCO-certified companies.

Each chapter is built up in the same way. It begins with an introduction, then the lesson material follows. It will close with a summary and test questions. The answers are included in the back of the book. In order to be well prepared for the exam, you can take a practical exam after going through the lesson material. It consists, just like the real exam, of 40 multiple-choice questions, each with three answer options. If you make fewer than 13 mistakes, you pass.

Good luck with the course!

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For most Dutch laws, it applies that someone is innocent until proven guilty. For the Labour conditions law, commonly called the Arbowet, it works differently. The employer is assumed to be guilty and must provide evidence of innocence by demonstrating that he or she has done everything to prevent the accident and/or the damage to the health of employees. In such cases, we talk about the reversed burden of proof. That is not to say that the employee is assumed to be without fault. Because the Arbowet has selected this construction, that has consequences for safety policy in each company.

1.1 The origin of the Labour conditions law

Arbowet

The Van Houten children's law of 1874 was a first beginning of our current Arbowet. This was intended to protect the 'poor worker' against the 'rich industrialist'. Children first had to be *protected* from the damaging influences of the poor work climate in that time. Despite the good intentions, the execution of the law was a flop, because the monitoring was insufficient. In 1919, the first Labour law was implementad, and a year later, the Labour inspectorate was established. The three inspectors were to monitor the compliance with these laws. Aside from the banning of child labour for children under 12 years of age, work and rest times were established in the Labour law. Today, these rules are in the Labour hours law.

The Safety law of 1934 governed matters that had to do with *safety, health and hygiene*. Therein, rules were established for the circumstances under which work could be done. This law applied for factories, workplaces, construction and agricultura and domestic shipping.
The Labour conditions law today has replaced this Safety law. The law was designed for the benefit of the employee, and that can still be seen in the liability of the employer. The goal of that is the best possible execution of a labour policy (safety, health and well-being) and to offer protection in the carrying out of work.
Within the framework of directives from the European Union, rules are also given concerning safe and healthy work. Therefore, the Dutch health & safety law had to be modified. Together with these changes, some were established concerning the approach to sick leave. *The Gate-watcher law* (Wet Poortwachter) is an example of that.

Wet Poortwachter

1.2 Fundamentals of health & safety law

The Labour conditions law, commonly called the Arbowet, is *the most important law from our national Safety and Health (Veiligheids en Gezondsheids; V&G) laws*. The Arbowet includes instructions concerning the rights and obligations of both the employer and the employee. Both are responsible for an ongoing improvement of safety and health, i.e. the conditions under which labour is conducted.

That responsibility initially lies with the employer, but for a number of aspects, the employee is also responsible. Temporary workers and similar workers, such as interns and volunteers, will also be considered employees. That means that the employer will be obligated to organise the work in such a way that it must not only be safe, but that health may not be negatively influenced. The law is applicable at all places where labour is conducted.
Other goals of the law are the *prevention and limitation* of illness among employees through the implementation of a sick leave policy, usually in collaboration with an occupational health service, and to offer protection against sexual intimidation, aggression and violence.

✔ *In order to achieve these goals, the assumptions of the Arbowet are:*
- *Employer ensures safety and health.*
- *Improvement of safety and health of employees at work.*
- *Striving for the best possible labour conditions.*

1.3 Expert assistance

The employer must seek assistance in the area of protection and prevention. This can be done by appointing one more expert employees and by relying on additional external assistance, if the enterprise does not have the necessary expertise available internally. This external assistance is usually an occupational health service.

Checkup

In the context of health oversight, the employer is required to periodically provide employees with the opportunity to have a checkup in *order to prevent and limit health risks.*

1.4 Monitoring of health & safety compliance

The governmental inspectorate far safety and health (Veiligheid en Gezondheid, V&G), formerly the Labour inspection, is an investigative service and, on behalf of the government, monitors compliance with health & safety law and the Labour hours law. The governmental V&G inspectorate can also, in response to complaints, accidents or requests, carry out inspections on its own initiative. Employers and employees are obligated to cooperate with monitoring and accident investigations.
The governmental V&G inspectorate can enforce compliance with the law with various instruments. They can:
- Give a warning.
- Issue a demand for compliance with health & safety law.
- In response to a punishable offence, file an official report.
- Stop the work, if there is a serious danger to people.

Identity

A *combination* of the above actions is also possible. Employees must be able to prove identity, and comply with the stoppage, instructions and measures.

With collaborating contractors, it's more challenging to assign responsibility for

health and safety. Multiple employers at one location must collaborate in the execution of measures concerning safety and health of employees and must coordinate their performance in this area.

1.5 Fundamentals of environmental law

> ! *The goal of environmental law is the protection of people and the environment against damaging effects of activities, the limiting of waste streams and the targeted and correct removal of waste products.*

1.6 Fundamentals of labour hours law

Promote

The goal of the labour hours law is the fixation of work and rest times in order to prevent the endangering of the safety and health of employees. Another goal is to *promote* the combination of labour and health care/family.

1.7 European Guidelines for national law

The European Union set up the European Guidelines. These guidelines set requirements for the laws in the member states. They must at least meet the guidelines by including them in the national law. All laws that are in conflict with the European Guidelines must be modified or removed from the national laws.

Conformité Européenne

Conformité Européenne (CE) means: in agreement with the European regulations. For monitoring the mínimum safety requirements for personal protection equipment, work vehicles, hoisting cranes, safety clothing and toys, CE labelling was established.

1.8 Summary

The goal of the Arbowet is lasting improvement of labour conditions. The employer, together with the employees, is responsible for the health and safety of the employees, but also of third parties.
The rights and obligations of the employer and employee are listed in the health & safety laws. These must meet the European Guidelines. The employee must be supported in prevention and protection by internal and/or external experts. The governmental V&G inspectorate monitors the compliance with the Arbowet and the Labour hours law.

Environmental law must protect people and the environment, and the Labour hours law aims for a healthy and safe combination of work, rest and health care. *The CE symbol* is shown on products in order to indicate that they meet the minimum safety requirements.

1.9 Practice questions for Chapter 1

1. What is one of the goals of the health & safety (V&G) law?

A The protection of the employer against business risks.
B The improvement of safety and health of employees at work.
C. The improvement of the safety regulations in the European Guidelines.

2. At what places is the health & safety (V&G) law applicable?

A. At all places where labour is conducted.
B. At all places where there are machines and tools.
C. At all places in all companies and institutions.

3. Who maintains oversight of compliance with the health & safety (V&G) law?

A. The occupational health service.
B. The governmental health and safety (V&G) inspectorate.
C. Police and the Justice Department.

4. How can the employer be assisted in the area of prevention and protection?

A. The employer can ask the governmental health and safety (V&G) inspectorate for advice.
B. The employer can make use of the prevention service of a friendly colleague company.
C. The employer can appoint one or more expert employees.

5. What is the employer obligated to do when it comes to monitoring health?

A. The employer must maintain personal oversight over the health of employees.
B. The employer must periodically give employees the opportunity to have a health check-up.
C. The employer can require all employees to have an annual medical exam.

6. Who is responsible for the compliance with the health & safety law where there are multiple contractors working at a single premises?

A. The employer who gives the instructions, maintains supervision and provides the equipment.
B. The employer by which you are employed and that pays your wage.
C. The employer that has the most employees working at that location.

2. Dangers, risks and prevention

Employees sometimes deal with more dangers and risks at the workplace than they realise. Only by knowing and identifying the dangers and risks can the right measures be taken in a timely manner in order to work safely and healthily. In particular, the employee must try to avoid dangerous situations and actions and make a quick assessment before commencing work of whether safe completion of the work is possible.

2.1 Concepts

Danger

- Danger: A danger is a phenomenon that can threaten the health of people. An oncoming vehicle on a two-lane road is a danger. When using that road, you must seriously take that danger into account, as well as other potential dangers. You have to focus your attention and behaviour on that.

Risk

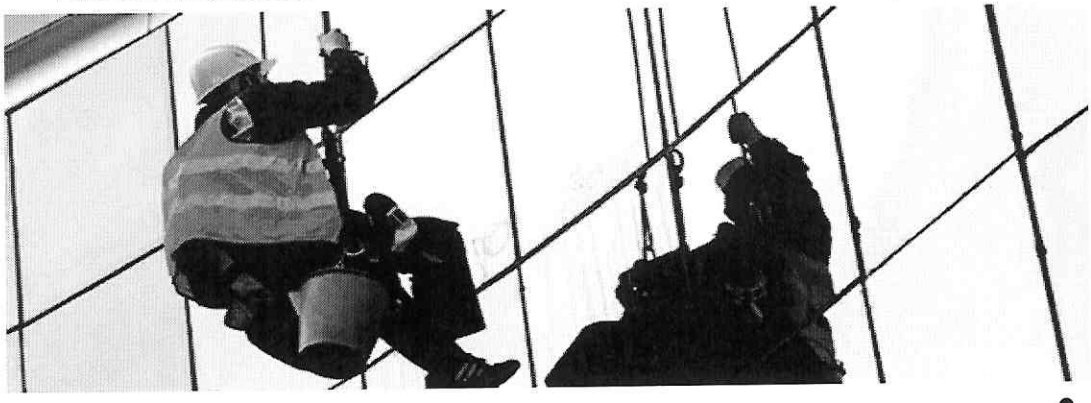
- Risk: A risk is the *chance* (the degree of probability) that an undesired effect occurs. In short: CHANCE x EFFECT. In determining risks, we look first at the possible negative effects and then at the chance of the effect occurring. The frequency (the number of times) and the time of exposure will be involved in the determination of the risk. The chance that you collide with an oncoming vehicle on a two-lane road is, among other things, dependent on how often you use the road, how many oncoming vehicles there are, the technical state of your own vehicle and your driving skills. The undesired effect of a frontal collision is typically not small - extensive injury and a lot of damage.

Degree of probability
=
Chance x Effect

2.2 Identifying dangers and risks

In order to be able to do something about your safety, you must first know what *dangers threaten you and what risks you run.* A few dangers at work are:

- Height (falls).
- Fire and explosion.
- Toxic substances.
- Noise.
- Radiation.
- Falling objects and moving parts.
- Vehicles and traffic.



Behaviour

Sources of danger at work are the kind of work, the workplace and/or the environment, the equipment that will be used for the work (tools and machines), the products/materials that are worked with and, last but not least, the competence and behaviour of the employee. Everything can be 100% regulated in order to let everyone work safely and healthily, but if the training and mentality of the employees does not connect with that, the risks will not be managed.

In order to get an idea of work activities or circumstances that include dangers and risks, a *summary* follows here that you can probably supplement yourself:

- Working with hazardous substances.
- Working with dangerous tools and machines.
- Working with high pressures.
- Working with radiation sources.
- Excavation work.
- Working with electricity.
- Working in cold and heat.
- Working in a noisy environment.
- Working at heights.

2.3 Prevention hierarchy

Prevention hierarchy means what the order is of the steps that must be taken in order to prevent accidents and damage to health.

Activities

When the dangers and risks are known, the following step is to take measures that remove or reduce the risks. A practical approach to realise prevention - *the preventing of accidents* - is to prevent unsafe activities and unsafe situations. An unsafe activity is an activity that is not carried out according to the instructions and that can lead to an accident. It is doing something or not doing something so that an accident can occur. Research shows that 80% of all accidents will be caused by unsafe activities. Examples are:

- Carrying out work for which permission has not been granted.
- Not using prescribed PPE.
- Bypassing or disabling security devices.
- Using tools for what it is not intended.
- Using broken tools.
- Incorrect hoisting or lifting.
- Handling a load incorrectly.
- Incorrect placing and using of ladders.

If you see someone executing an *unsafe activity*, then stopping the unsafe activity or having it stopped is the first thing that you do. Thereafter, you report this to the immediate supervisor.

Situations

Unsafe situations are situations in which work is done without meeting the conditions for safe work, and that can lead to an accident or to damage to health. This is about things that are observable; no activities are taking place.

Examples are:

- No or insufficient lighting.
- No or insufficient ventilation.
- Not or insufficiently secured equipment or machines.
- No or insufficient alarm systems.
- No or blocked escape routes.
- Open voltage source in the vicinity.
- Insufficient room to move around equipment.
- Work floors that have not been cleared.
- Fire and explosion danger.

If you discover an unsafe situation, the removal of (the cause of) that unsafe situation is the first thing you do. Thereafter, you are going to screen off and secure the dangerous situation and then warn and engage others.

2.4 (Task) Risk analysis and LMRA

- The (task) risk analysis: A (task) risk analysis is mapping the risks that certain (risky) work activities bring with them. The goal of such an analysis is to determine the risks and the level thereof, so that appropriate measures can be taken in order to secure the safety and health of the employees with a risky task and/or in a risky environment.
- The LMRA: This abbreviation stands for *Last Minute Risk Analysis*. It is a practical method for the employee to quickly determine immediately before commencing work at the workplace whether all the conditions for the safe and healthy execution of the assigned task are met. This means not blindly trusting that everything is properly arranged, but looking for yourself at whether everything is okay. With changes in the work activity, you do that again. The danger is particularly in routine work activities, because many people then assume that everything is fine. That's precisely when an LMRA is important! Think, before you begin.

Practical method

2.5 Summary

Dangers and risks threaten safety and health at work. In order to be able to do something about that, the causes must be known. The approach of prevention occurs by preventing unsafe activities and unsafe situations. Just before commencing work, you must quickly check for yourself whether everything is okay: the LMRA.

2.6 Practice questions for Chapter 2

1. What is the right description of the concept of risk?
A. Cause x result.
B. Chance x effect.
C. Damage x safety.

2. What are dangers at the workplace?
A. Falls, poisoning, noise and traffic.
B. Cuts, back injury, burns and broken bones.
C. Markings, warning signs, roof-edge security and fire extinguishers.

3. What are possible sources of danger?
A. Unsafe activities and situations.
B. Inadequate laws and oversight by the governmental health & safety (V&G) inspectorate.
C. The kind of work and the behaviour of the employee.

4. Which work activities or circumstances at work can include dangers or risks?
A. Working with high pressures, electricity and radiation sources.
B. Insufficient emergency response officers and an attractive colleague.
C. Threat of bankruptcy and personnel parties.

5. What is an unsafe activity?
A. An activity that is carried out according to the instructions and that can lead to a risk.
B. An activity that is not carried out according to the instructions and that can lead to an unsafe situation.
C. An activity that is not carried out according to the instructions and that can lead to an accident.

6. What should happen first when seeing an unsafe activity?
A. Having the activity stopped.
B. Warning supervisor.
C. Cutting the electricity.

3. Accidents: causes and prevention

All accidents are preventable. That is the only correct starting point when determining and executing the Labour policy. We also know that absoluta safety does not exist. Therefore, we devote attention to the prevention of accidents. In order to be able to do that successfully, we have to know what an accident is, precisely, and what the causes and results of an accident are. By investigating and recording accidents, we can get an grip on the causes and tendencies. When those are known, the policy can be aligned accordingly and accidents can be prevented.

3.1 Concepts

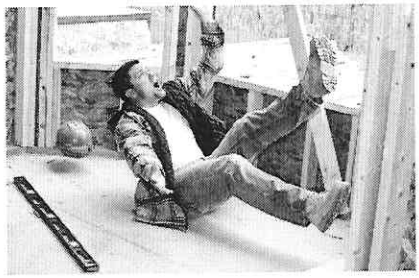
Accident: *An accident is an undesired occurrence with damage (material, environmental, time lost) and/or injury as a result.*
Near-accident: *A near-accident is an undesired occurrence without material damage and/or injury, that under slightly different circumstances could have led to damage and/or injury. It thus barely went well. This kind of incident causes a shock effect, but it can be learned from. Therefore, a near-accident, just like an accident, will always be reported to the supervisor.*

3.2 Accident theory

An accident is a *suddenly occurring event.* It is often the result of a sequence of small events that have taken place in the time leading up to the accident.
When it is known how accidents arise, they can be better prevented.

Investigate

After an accident, it will be investigated how it came about and what the results are. It is a cause-and-effect series.
The two immediate causes of an incident or accident are *unsafe activities* and *unsafe situations.*
By combatting unsafe activities and situations, a lot of misery can be prevented. And that is even better than healing!



3.3 Handling incidents

Action plan

You can learn from mistakes. In order to prevent the repetition of accidents, *a number of steps* must be taken. Immediately take action in order to prevent worsening of the situation and report the accident to the direct supervisor. Then the accident should be *recorded and investigated.* That results in an action plan or plan of approach.

This includes the measures that will be taken in order to prevent accidents in the future, the person who is responsible for that action, the time frame in which the actions must be taken and any costs thereof.
How should accidents be handled?

- Report the accident to the direct supervisor.
- Accompany the victim to medical services.

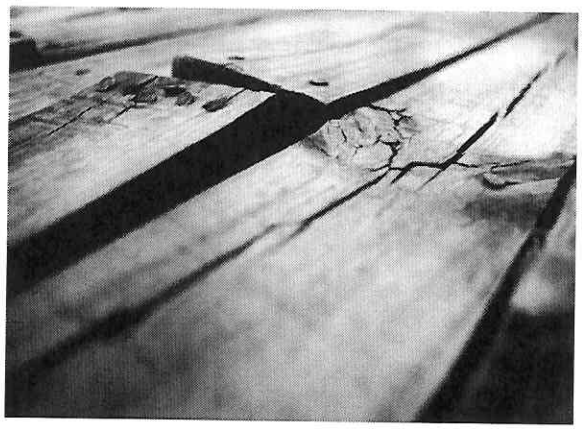
- Take immediate measures in order to prevent repetition.
- Follow the internal instructions.

How should near-accidents, unsafe activities and unsafe situations be handled?

- Take immediate measures such as marking the situation, stopping the activity or having it stopped.
- Report them to the direct supervisor.

3.4 Summary

In order to prevent accidents, the causes thereof must be known. The direct causes of accidents are unsafe activities and unsafe situations. These are things that you often control yourself and/or can evaluate. Even more important is doing something about it. If an accident still occurs, it must be quickly and correctly handled and can be learned from in order to prevent repetition. Reporting, recording, investigating and setting up a plan of approach follow that.



3.5 Practice questions for Chapter 3

1. What is an accident?
A. An undesired occurrence with damage and/or injury.
B. An undesired occurrence without damage or injury.
C. An undesired occurrence with or without damage or injury.

2. What is a near-accident?
A. An undesired occurrence with damage and/or injury.
B. An undesired occurrence without damage or injury.
C. An undesired occurrence with or without damage or injury.

3. What are the immediate causes of an accident?
A. Unsafe actions and situations.
B. Injury and damage.
C. Reporting, recording and investigating.

4. How can accidents be prevented?
A. With good medical facilities, fire extinguishers and evacuation plans.
B. By combatting unsafe activities and situations.
C. By working less for higher wages.

5. What is an example of an unsafe activity?
A. Working on a scaffold without railings.
B. A scaffold without railings.
C. Working with sharp knives.

6. What is an example of an unsafe situation?
A. Working on a scaffold without railings.
B. A scaffold without railings.
C. Working with sharp knives.

If you pass your VCA exam and receive the diploma, then that's worthy of congratulations! Even more important than the VCA diploma is that you learn to put it into practice. With the right mentality in combination with your knowledge and skills, you can work safely and healthily. Knowledge of safety is worthless without safety behaviour.

4.1 Behaviour and safety

Safety can be promoted by *certain behaviour.*

- In the first place, you ensure your own safety and that of other persons involved.
- You have a positive attitude with respect to safe work.
- You comply with the safety prescriptions, and youfollow directions and instructions.
- You address colleagues about unsafe actions and unsafe behaviour.
- You report unsafe situations to your direct supervisor, and you intervene appropriately.
- You pay attention to your personal hygiene and to order and neatness at the workplace.

Alcohol

Anyone who is under the influence of alcohol and/or drugs experiences reality in a different way. A clear view of safe work no longer exists then. With that, the user brings not only themselves, but often others into danger. Alcohol and/or drugs *reduce alertness, functioning and the ability to assess situations.* The barrier to demonstrating out-of-bounds behaviour is lowered, and it makes the user think that he or she is capable of more than is really the case. In addition, it places extra work pressure on saber colleagues and disrupts the work organisation. *So no drugs or alcohol at work*!

If you have signs of problematic alcohol and/or drug use, report this to your supervisor. Employees with problematic alcohol and/or drug use, an addiction, must be assisted in finding expert help.

4.2 Order and neatness

Clean work Environment

A cleaned work environment does not only make work nicer, but also safer than when materials, waste, cables and tools are all over the work floor.
Ensuring order and neatness *prevents incidents, contamination and damage to the environment.* Work can be done more quickly and efficiently with less loss of tools and materials. It's thus pleasant and motivating.
All reasons, then, to ensure that the workplace is cleaned in a timely manner. The English call that 'good housekeeping'.
Examples of that are: cleaning the surroundings, storing or removing leftover materials, systematically storing tools and materials, hanging cables on safety hooks or hiding them and a good layout of the workplace or yard.

You cannot do this alone. There must be good agreements about this made in order to collectively ensure a pleasant, clean and thus safe workplace and work environment.

4.3 Tripping, slipping and stumbling

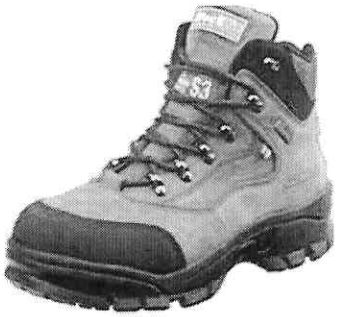
Walking on uneven, slick or loose ground is the *main cause* of tripping, slipping and stumbling, respectively.

A small height difference will sooner cause tripping than a larger one. Other causes are walking over hoses or pipes and walking on slanted ground. Not everyone is equally limber or athletically built. Physical capabilities and limitations also determine whether someone will more quickly trip, slip or stumble. Loose tiles and slick, polished floors are life-threatening. Running (behaviour!) and working in slippers is asking for trouble.

Behaviour

The dangers of walking can be removed at the source by:

- A good design so that unsafe situations are prevented, good housekeeping and ensuring a flat, anti-skid floor.
- Resolving unsafe situations as quickly as possible.
- Follow the walking routes that are indicated on the floor.
- Behaviour: not running, being alert and not allowing distractions. Never stop on an obstacle, but walk around it or step over it. Step straight across a long obstacle.
- Do not wear things that prevent you from seeing where you're walking.
- Wear appropriate footwear: safety shoes or boots.



Lighting

Measures for managing *the risks of walking* are: separating people and dangers with a physical barrier (fence, markings, chain) and with good lighting, so that you can see where you're walking.

4.4 Summary

Safety behaviour is a necessary supplement to professionalism. That includes no alcohol or drugs, but good housekeeping and personal hygiene.
In order to prevent tripping, slipping and stumbling, measures must first be taken at the source, but you can also contribute a lot with your behaviour.

4.5 Practice questions for Chapter 4

1. What behaviour promotes safety?
A. Reporting colleagues who do not work safely and never clean up to the supervisor.
B. I ensure my own safety. If everyone else does that as well, then nothing can happen.
C. A positive attitude about safety and attention to arder and neatness.

2. What happens with someone who is under the influence of alcohol and/or drugs at the workplace?
A. They think that they can do anything and does other things more easily than normal.
B. They are very alert and function better.
C. They can better assess situations, ensuring a relaxed atmosphere.

3. What influence do order and neatness have on safe working?
A. Order and neatness prevent the use of personal protection equipment.
B. Order and neatness prevent incidents.
C. Order and neatness limit the exposure to hazardous substances.

4. What is a cause of tripping?
A. An anti-skid floor.
B. A slick floor.
C. An uneven floor.

5. What is a cause of slipping?
A. An anti-skid floor.
B. A slick floor.
C. An uneven floor.

6. What is a source measure in order to prevent tripping, slipping and stumbling?
A. An anti-skid floor.
B. Wearing safety footwear.
C. Reporting unsafe situations at the weekly work discussion.

5. Tasks, rights, obligations and consultation

According to the health and safety laws, the employer is responsible for the safety and health of the employees. In the event of damage to the health of the employees, the employer is liable unless it can be proven otherwise. That is not to say that the employee is always without blame. The employee, too, has legal responsibilities. In mutual consultation, the employer and employee must maintain a healthy and safe work situation. The employee also has certain rights.

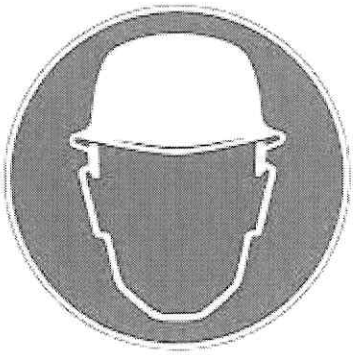
5.1 Tasks, rights and obligations of the employee

According to the Arbowet, the employee has the following *general obligations*:

- Ensure his or her own safety and health and that of other persons concerned.
- Making proper use of and taking care of the (personal) protection equipment, machines, devices, tools, hazardous substances, transport resources and other resources.

Reporting

- Reporting incidents to supervisor.
- Reporting serious and unavoidable dangers to safety and health.
- Cooperating with the employer and preventative services in the area of promoting safety and health in the workplace.
- Contributing in a positive way to the prevention policy.
- Refraining from violence, bullying or undesired sexual behaviour at work.
- Following instructions, directions and trainings.
- Refraining from changing or removing security measures and using them in the right way.
- Immediately reporting dangers to safety and health to supervisor.



General rights of the employee are:

- *The right to information and training.*
- *The right to cease work in the event of threats and serious dangers to people.*
- *The right to a safe and healthy work environment.*

In the case of *serious or immediate danger*, the employee should:

Stop

- Immediately report this to supervisor.
- Stop work and/or keep himself or herself safe.
- Taking into account his or her own technical knowledge and resources, take appropriate measures in order to prevent the consequences of such a danger.

5.2 Safety, health and environment consultation

The employee consults with the employer about safety and health.
That consultation can take place in various farms:

- Discussion between the employer and a representative of the employees. Present for this are: the chair (employer), a delegation from the employer(s), a delegation from the employees and experts, for example prevention specialists. A *report* must be made of this discussion. This consultation is usually in the form of the work council.

Work discussion

- Work discussion between employees and their supervisors.
- Health & safety meetings or toolbox meetíngs, where a safety theme is (briefly) discussed.

5.3 Summary

According to health & safety regulations, the employer and employees have tasks, obligations and rights. In mutually organised consultation, these must be given shape, with the goal of improving safety and health in the workplace. An important right of the employee is the right, under strict conditions, to interrupt the work in the event of immediate, serious danger to people.

5.4 Practice questions for Chapter 5

1. What are the general obligations for the employee according to the health & safety regulations?

A. Participating in the work council meeting, procuring safe tools and having machines inspected.
B. Following trainings, information and instructions and contributing positively to the prevention policy.
C. Being at work on time, producing good-quality work and cleaning up after the work.

2. What is NOT required of the employees according to the health & safety regulations?

A. Taking measures to combat risks at the source.
B. Ensuring their own safety and that of other concerned persons.
C. Reporting accidents, near-accidents and dangers to safety and health to the supervisor.

3. What is a right of the employee according to the health & safety regulations?

A. Right to wage continuation for illness.
B. Right to a clean workplace.
C. Right to interrupt work.

4. For whom is there a right to a safe and healthy workplace according to the health & safety regulations?

A. For the employee.
B. For the employer.
C. For the employee and the employer.

5. Who is involved in the work discussion?

A. Employer and employees.
B Employers and the trade unions.
C. Employees and their immediate supervisors.

6. What can the representative of the employees be consulted about in the work council?

A. About personal protection equipment, hazardous substances and work methods.
B. About policy measures, layoffs and development of new products.
C. About investments, choice of suppliers and reorganisations.

6. Procedures, instructions and alerts

For safe work and a safe work environment, clarity is required about what, where and under what conditions may, may not or must occur. That can be described in procedures and regulations or be made clear with markings or signs/alerts. Good instructions are also necessary.

6.1 Safeguarding the workplace and installation (also see 11.6)

Before commencing work, it must be ascertained that the workplace and the installation are safe.

One of the measures is the *placement of flanges* in pipes. Separation with flanges is necessary when separating pipe sections, vats/tanks and equipment. This can also be necessary when cleaning, repairing, inspecting, rinsing, removing gasses or steaming out pipes, vats/tanks and when replacing closures and equipment.

Flanges

Input and output piping is often located in a closed space. In order to be 100% sure that there is no liquid or gas running through the pipes, they must be closed off with *flanges*. Each flange has its *own place*. There are connection flanges, a round plate that will be placed between two parts of the pipe, and spectacle flanges. With the latter, the open or the closed part of the flange can be turned in the pipe. It is then always clear whether the pipe is open or closed, and that the right flange is used. *Flanges may only be placed or removed by trained flange installers.* In order to prevent the remains of materials from being able to stream into the closed space, the closing off of pipes with flanges must be located *as close as possible* to the closed space.

Prevention

The function of the security features of equipment and installations is the prevention of equipment and parts of installations from unintended movement and preventing equipment, machines and parts of installations are unintentionally exposed to electrical voltage.

Securing takes place by taking installations and equipment out of service, securing them from re-connection and marking (for example indicating with signs what is happening and what may or may not be done or must be done). The securing must be done by an *authorised person*. A measurement must demonstrate that the installation is actually free of voltage.

The elimination of pressure from installations and/or equipment must be checked.

6.2 Work permits

Standard procedure

Work that is risky and/or that must be done in a risky environment requires extra *attention in the preparation and organisation*. With help from a work permit, it is possible to arrange that in a standard procedure.

There are general and specific work permits. The goal of a general work permit is making sure that consultation takes place and formal permission is given to carry out work on the premises and in the installations. With a specific work permit, it is about work with *specific risks*, and the work requires specific training or information. The conditions for being allowed to carry out the work are that it be stated in writing, with information, and that the work permit is signed.

Specific work permits

Specific work permits can be needed for:

- Entering closed spaces.
- Working at heights.
- Work with fire danger: fire permit or hot-work permit, such as for welding, cutting/burning and grinding.
- Working on or with dangerous radiation sources.
- Excavation work in contaminated soil, subsoil with pipes, opening floors and streets.
- Hoisting work above or in the environment of important installations.
- Working with or demolishing asbestos-containing materials.
- Working with hazardous substances.

Function

The function of a *work permit* is:

- Coming to a clear agreement between all involved parties about the carrying out of work and risks involved.
- Establishing the conditions that MUST be worked under.
- Providing formal permission to carry out certain work activities.
- Making binding agreements with everyone who has to do with the work.

> ***In a work permit, at least the following is included:***
>
> - *The duration of validity: usually 1 day.*
> - *Applicant: what work activities will be required and who will do which work and how.*
> - *Measures to be taken by the approver of the work permit.*
> - *Measures to be taken by the operational employees who will carry out the work activities.*
> - *Measures in order to leave the work environment safe after the work is completed.*
> - *The endorsement and signatures.*
> - *Conditions for the extension of the work permit.*

Persons who are involved with a work permit have obligations. Obligations of the approver of the permit:

- Check on the dispensation of the installation before signing the work permit.
- Discuss the nature of the work, conditions and measures to be taken with the permit holder before signing the permit.
- Signing the work permit.
- Providing any necessary measurements and detections (EX-OX-TOX).
- Providing safety: connection flanges, electrical and/or mechanical locks.
- With collaborating parties, ensuring coordination and agreements between the parties.

Obligations of the permit holder:

- *The holder is usually the supervisor of the operational employees*
- *He or she gives explanations to the employees.*
- *He or she signs the work permit.*
- *He or she sees to it that the work is carried out according to the work permit.*
- *He or she ensures that the work permit is in place.*

Obligations of the operational employees:

- *They stay up to date on the content of the work permit.*
- *They comply with the conditions that are in the work permit.*
- *They comply with the measures that are in the work permit.*
- *They only work with a valid work permit and take the duration of its validity into account.*

6.3 Alerts and markers

Alert signs

Alerts with signs are *legally established.* The principles on which the law rests are the possible dangers, the measures imposed, the obligation to wear personal protection equipment, First aid supplies, fire-fighting equipment and evacuation routes, and finally, it is a part of the prevention approach. The latter means that the authorities are of the opinion that by posting alerts, undesired events can be prevented, or the consequences thereof can be limited.

There are *different groups* of alert signs:

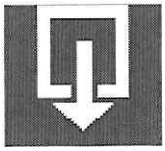
- Prohibition signs.
- Instruction signs.
- Caution signs.
- Safety provisions.
- Fire-fighting equipment.

- *Prohibition signs:* These are signs that forbid something, indicating what may not be done. This is a round white sign with a red border and a red diagonal stripe. In the white area, what is prohibited is indicated with a black symbol.

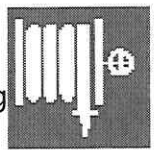
- *Instruction signs:* Instruction signs indicate what is required. It is an instruction. These are round blue signs with a white symbol that indicates what is required. Examples are the obligation to wear certain personal protection equipment.

- *Caution signs:* These signs warn persons present about a threat of danger. These are triangular yellow signs with a black edge and a black symbol that indicated the danger. It can mean: danger, warning or caution.

- *Safety provisions:* A safety provision will be indicated with a square ar rectangular green sign with a white symbol that indicates the provision. The symbols used point to the location of the (emergency) exit and where assistance and evacuation routes can be found.



- *Fire-fighting equipment*: The signs for fire-fighting are square or rectangular, have a red colour and a white symbol that indicates the equipment. They farm an indication of where the fire-fighting equipment can be found and the route to get there. A sign also hangs at the location itself.

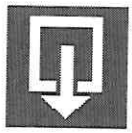
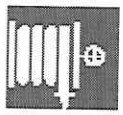


Markings

Indicates danger or risk

Markings are indications that are intended to show or to ask for attention to risks and dangers. These can be *tapes or stripes/markings* on the floor or the wall. The tape is not protection in the sense that it can hold someone back, like a barrier or fence, but it indicates a danger or risk. Tapes have a *red-white* or *yellow-black* colour. Yellow-black markings signal small/low passages, items that impact or against which someone can impact (crane blocks) and areas with hazardous substances.
With stairs, there are also often markings to be found: the top and bottom stair tread is often fitted with a stripe in a contrasting colour (usually yellow or white). The same applies when there is little difference between the floor and the stair tread, and it indicates tripping danger.

In passages and storage spaces, it is indicated with white and/or yellow stripes where walking is permitted, where forklifts may drive, where materials may be placed and which passages must be kept free. Markings must always be *clearly visible from all sides.*

Type	Shape	Colour		Pictogram	Example
Prohibition Signs	Round	White	Red	Black	
Caution Signs	Triangular	Black	Yellow	Black	
Instruction Signs	Round	Blue		White	
Safety Provisions	Square/ Rectangular	Green		White	
Fire-fighting Equipmet	Square/ Rectangular	Red		White	

6.4 Summary

In many companies, there are rules established to protect safety and health. Before work begins, the installation must be secured. Pipes can be sealed off with flanges so that hazardous substances do not present a threat. In order to come to good agreements for risky work, there are permits for safe work. This includes a differentiation between a general permit for normally occurring work and a supplementary permit for work with unusual risks. Dangers and risks can be marked with stripes and tapes and indicated with various kinds of signs.

6.5 Practice questions for Chapter 6

1. What is a good measure in order to prevent a machine accidentally begins to move during maintenance?
A. Place a warning sign.
B. Inform all involved employees.
C. Disconnecting the electrical supply.

2. What is the safest way to disconnect an electrical connection?
A. After flipping the switch, securing it with a lock.
B. After flipping the switch, placing a label on it that reads: 'Switched off'.
C. Just flipping the switch is sufficient.

3. What is the purpose of a work permit?
A. Making sure that operational employees receive and use the correct personal protection equipment.
B. Making sure that a consultation takes place and formal permission is given for work on the premises and on installations.
C. Making sure that the work is completed on time and that it meets the quality requirements.

4. For what is a supplemental work permit required?
A. For hoisting work on a cargo ship and work in the area of laser radiation.
B. For work that lasts longer than one day and that must be carried out by specially trained persons.
C. For the demolition of asbestos-containing materials at height and excavating in contaminated soil.

5. What is one of the obligations of a work permit holder?
A. To inform operational employees about the content of the work permit.
B. To give the work permit to one of the operational employees before the commencement of the work.
C. To check twice a day whether the work is being done according to the work permit.

6. What do signs with safety provisions point to?
A. To the safest place on the company premisas.
B. To the department of safety, health and environment.
C. To the place where the First aid supplies can be found.

7. Preparing for emergencies

In the event of emergency situations, it is important that everyone knows what they should, should not and may do. Ensuring personal safety comes first, and then limiting the consequences of the emergency situation as much as possible.

7.1 Concepts

Emergency situation: An emergency situation is caused by accidents, fire, explosion, uncontrolled raleases of liquids, biological agents or radioactivity. Threats of emergency situations can range from severe weather to natural disasters, social unrest, (threats of) terrorist attacks and loss of infrastructure.

7.2 Managing and handling emergency situations

In the process of managing and handling emergency situations, there are three phases to differentiate:

Information

- *The first report of an emergency situation:* The first report of an emergency situation is the description of the way in which an emergency situation can be reported, and what information must be included.
- *The actions and response measures:* This is a description of everything that must be done in response to a report of an emergency situation, depending on the severity of the emergency situation ranging from evacuation to intervention (extinguishing, security and evacuation), rescue operations and provision of help.
- *The ending:* In this phase, it is indicated who is/are empowered to declare the emergency situation over and how the ending wil be made known.

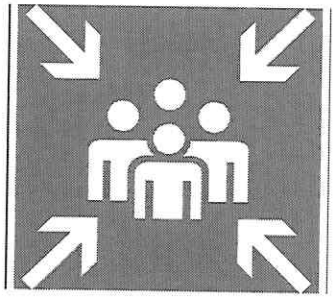
7.3 Evacuation

✔ *For an evacuation, it must be clear to everyone what the instructions are and how to react to an alarm.*

Instructions

When entering a location, everyone must be aware of:

- *The gathering places where roll call will be held*: check who might be left behind.
- *The evacuation options*, such as emergency exits, stairwells and evacuation routes.
- *Instructions from the client* that can be made known with help from an intercom, loud-speaker and/or light signals.



Evacuation exercise

It is legally required that at least once a year, an *evacuation exercise* be held. *Everyone* is required to participate in the exercise, including borrowed personnel and visitors. The goal of this is to prepare personnel for emergency situations, to test the emergency plan and to test whether the personnel are sufficiently prepared for emergency situations.

What to do when there's an alarm:

> ***With an evacuation alarm, everyone must do the following, in this order:***
>
> - *Immediately stop work.*
> - *Stop external communication.*
> - *Follow the instructions of the client.*
> - *Report to the assembly point according to the evacuation plan.*
> - *Not use any lifts.*
> - *Evacuate perpendicular to the wind direction, away from the source.*
> - *Report upon arrival at the assembly point.*

7.4 Summary

In an emergency situation, it is expected of everyone that they know what to do and that everyone will do that in the prescribed way. After an initial report, a number of actions and measures follow in order to alleviate the emergency situation and in order to limit the consequences of it as much as possible. In an evacuation, use will be made of an evacuation plan. Everyone present must report at the assembly point. Only a person authorised to do so can end the emergency.

7.5 Practice questions for Chapter 7

1. What is an emergency situation?
A. An unsafe situation to which no attention is paid.
B. A safe situation that can easily turn into an unsafe situation.
C. A situation that is caused by, for example, an explosion ar a gas cloud.

2. What can cause emergency situations?
A. Fire, accident with injury and radioactivity.
B. Bankruptcy, reorganisation and layoffs.
C. A faulty scaffold ar a torn hoisting strap.

3. What is an explosion an example of?
A. Of an unsafe situation.
B. Of an emergency situation.
C. Of an unsafe action.

4. What are possible consequences of an emergency situation?
A. Earthquake, tsunami and a tornado.
B. Injury and damage.
C. Evacuation and stoppage of work.

5. What three phases does the management and handling of an emergency situation have?
A. First report, second report and third report.
B. Explosion, evacuation and measures.
C. First report, actions/measures and ending.

6. What should you do in event of an evacuation alarm?
A. Complete the work, call the supervisor and go upwind to the assembly point.
B. Stop work, do not make phone calls and go crosswind to the assembly point.
C. Report the emergency situation, rescue victims and run to the assembly point.

Hazardous substances form a danger for health and/or for the environment. Where work is done with hazardous substances, it is of great importance that employees know that hazardous substances are involved, what the properties of those substances are, what influence they can have on health and how they can protect themselves against the damaging effects. Producers of hazardous substances and employers have an important duty to inform users in the right way about the dangers of the substances and the associated management measures. Management at the source is always the first measure: investigate whether there is an innocuous substance that can replace the hazardous substance. Unfortunately, that's not always possible.

8.1 The dangers of too-high and too-low oxygen concentrations in the air for people and the environment

Oxygen

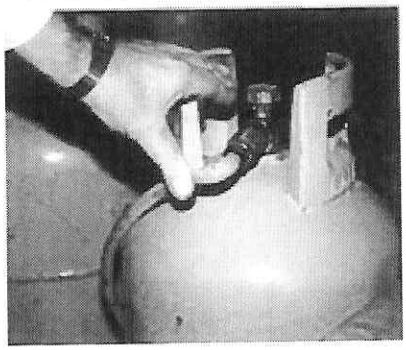
We take it for granted that the air we breathe has the right composition. The environmental air that is inhaled consists of *21 % oxygen*. The rest is nearly 79% nitrogen and a few tenths of a percent noble gases. The minimal percentage of oxygen in inhalad air wherein one is allowed to work is 19%. Below that, oxygen deficiency occurs that, depending on the percentage of deficiency, will result in unconsciousness or death. The causes of a too-low oxygen concentration in the air can be:

- Lack of ventilation.
- Corrosion (rust-formation).
- Other reactions in which oxygen is consumae, for example, bacterial and biological reactions or fire.
- Substances that are released in a space and that displace the oxygen, e.g. nitrogen or other inert gasses.

Ventilated

In order to prevent oxygen deficiency, work spaces with insufficient oxygen must be mechanically *ventilated/aerated* and independent breathing protection (breathing apparatus or fresh air hood) may have to be worn.

A higher oxygen level in the air is also dangerous. We do not notice it when breathing, but if there is more than 21 % oxygen in the air, *substances can burn more easily, and they burn more intensely*. The excess of oxygen can be caused by leaking oxygen lines and/or oxygen bottles. By applying hose protection between the hose and the oxygen bottles and by not placing oxygen bottles in a locked or closed space, the excess of oxygen can be prevented.



Vatbaar voor explosie

Vatbaar voor explosie (bijkomend gevaar)

Vatbaar voor explosie

Niet brandbaar, niet giftig gas

Brandgevaarlijke vloeistof of gas

Brandgevaarlijke vaste stoffen

Voor zelfontbranding vatbare stof

Ontwikkeling brandbare gassen bij watercontact

Oxiderende stof

Organische peroxide, brandgevaar

Gevaar van bevordering van de verbranding

Giftige stof

Infectueuze stof

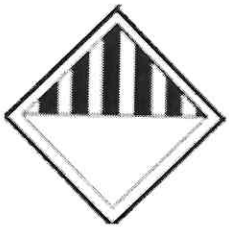
Radioactieve stof categorie I-wit

Radioactieve stof categorie II-geel

Radioactieve stof categorie III-geel

Radioactieve stof

Bijtende stof



Diverse gevaarlijke stoffen en voorwerpen

8.2 Classification and dangers of hazardous substances

Substances that pose a danger to health and/or the environment are called hazardous substances. There is a classification into categories of hazardous substances. Working with hazardous substances carries inherent dangers. Below, these will be named by category, with the specific dangers and examples of the substances.

Explode

- *Explosive:* Explosive substances can easily explode, even without a supply of oxygen at a certain temperature, in contact with other substances, with shocks or friction, for example, munitions, TNT and gunpowder.

- *Oxidising*: Oxidising or fire-promoting substances release oxygen and therefore react violently with other (flammable) substances. They present a danger to the skin and clothing, and a fire becomes more intense with these substances. Examples are hydrogen peroxide, ozone and oxygen.

- *Very highly flammable, highly flammable and flammable:* Very highly and highly flammable liquids quickly catch fire, even at normal environmental temperatures. Petral, acetone and white spirits (trade name for turpentine) are examples of these.

Through the skin

- *Toxic and highly toxic:* Toxic and highly toxic substances can have serious consequences when inhaled, swallowed or absorbed through the skin. Examples are carbon monoxide (in exhaust gasses), hydrogen sulphide (H2S), sometimes called sulphureted hydrogen (in natural gas and flatulence and very toxic in small concentrations), methanol (alcohol that causes blindness and is lethal with consumption of 25 grams) and benzene.

- *Damaging*: Damaging substances have less serious consequences than toxic substances when inhaled, swallowed or absorbed through the skin. Examples are lacquer, paint and wood-protecting products.

- *Caustic or corrosive:* Caustic or corrosive products have effects when contacting skin, lungs, eyes and mucous membranes. Acids and bases are examples. These acids and bases can affect materials. In some cases, this can cause the release of toxic or flammable gases.

Inflammations

- *Irritants:* Irritating substances can cause inflammations in contact with the skin, eyes, lungs and mucous membranes. They are often part of cleaning products (diluted or weak acids/bases, solvents and polyesters). These are less dangerous than caustic products.

- *Carcinogenic:* Carcinogenic substances belongs to substances. Asbestos, petral, vinyl chloride and diesel smoke are examples. This is the pictogram for asbestos. Contains asbestos; can in the long-term cause asbestosis and/or asbestos lung cancer. Types: white, brown, blue, white-ish and grey asbestos.

- *Environmentally dangerous:* These substances pose a threat to the environment and animals. Pesticides that are used for weeding and pest control and CFCs that are used in cooling installations are examples of these.

Allergic reactions

- *Sensitising*: Sensitising agents can cause allergic reactions. These are certain resins, colouring agents, certain types of paint, metal treatment agents and hair-colouring agents.

- *Compressed gases in gas bottles*: When heated, the chance of explosion exists.

8.3 Labelling, hazard pictograms and product information

In order to make hazardous substance recognisable and in order to be able to know what is in them, the manufacturer must place a label on packaging, which must say:

- *Name/names of the product:* It is important to know what is in a package. In the event of accidents with the substance, first-aid providers and doctors can quickly provide adequate help when they know what substance is concerned. Therefare, potentially hazardous substances may never be put into a package other than the original packaging.

- *Hazard pictogram(s):* The purpose of hazard pictograms is to be able to see at a glance what the most important hazardous property is of a substance. It is the indication far hazardous substances at the workplace. You will find the pictograms in 8.2.

- *Information for the supplier and/or importer*

- *R-phrases and S-phrases (old label) or GHS-hazard statement (new label):* The old labels show the so-called R- and S-phrases. R(isk)phrases indicate the general dangers of the substance concerned and the S(afety)-phrases give the safety measures against those dangers. On the new labels, there are H(azard)and P(revention}-phrases, as part of the unified GHS-hazard statement. All R- and S-phrases and H- and P-phrases have a *number.* Sometimes, only the numbers are listed on the label. In the chemical chart book and other handbooks, the associated phrases can be found.

Examples of R- and H-phrases are:
- *R7 / H270: May cause fire.*
- *R20 / H332: Harmful by inhalation.*
- *R24 / H311: Toxic in contact with skin.*
- *R36 / H319: Irritating to eyes.*
- *R47 / H340: Can cause birth defects.*

Examples of S- and P-phrases are:
- *S1 / P405: Keep locked up.*
- *S11 / P222: Avoid contact with air.*
- *S21 / P270: When using, do not smoke.*
- *S37 / P280: Wear suitable gloves.*
- *S50 / P221: Do not mix with... (to be specified by the manufacturer)*

8.4 Exposure to, absorption of and action of hazardous substances

Poisoning

A toxic substance is a substance that, absorbed in relatively small quantities, leads to poisoning. With poisoning, the normal working of the human body is disrupted. With the help of a personal monitor, the degree of exposure to hazardous substances of an employee during work can be measured. The personal monitor must be worn at chest height (not under the clothing) and must be tested before use.
Toxic and damaging substances can enter our bodies in various ways.

- *Intake via the mouth (digestive system):* Many toxic substances are swallowed. Sometimes, this happens consciously (alcohol or pills), sometimes unconsciously, for example by storing food in the area of chemicals or by handling food and/or drinks with dirty hands or with dirty cutlery. The washing of the hands before eating, drinking or smoking and eating in a special room can prevent poisoning.

- *Absorption through the skin:* Some products are quickly absorbed through the skin, for example, solvents and degreasers. Our skin is porous, breathes and can sweat. Our skin is not really water-tight or air-tight. The washing of the hands with solvents is an example of an unsafe activity. With good personal protective equipment, absorption through the skin can be prevented.

- *Intake through the nose (respiratory system):* With intake via the respiratory organs, the hazardous substances can enter the blood via the lungs. The upper airway serves as a *filter*. Large particles will be filtered. Small particles penetrate further and can eventually enter the bloodstream. Aside from particles, poisoning can also occur by inhaling dust, gas, smoke, vapour or mist, far example hydrochloric acid ar asbestos. In these cases, always wear breathing protection and ensure sufficient ventilation to prevent intake.

Breathing protection

- *Direct introduction to the bloodstream:* Hazardous substances can also enter the bloodstream directly through wounds. With scrapes in particular, the skin is damaged over a large area and hazardous substances can quickly and easily pass into the body. Stepping on a nail or the bite of a snake are also examples of direct intake of hazardous substances into the bloodstream.

- *The occupational health strategy:* With the establishment of measures to prevent or to limit exposure to hazardous substances or chemical processes, a fixed order is utilised:

1. It should first be reviewed whether the hazardous substance in the form in question is necessary. That is the source approach. Various scenarios are possible:
   a. Elimination by not making use of a hazardous substance.
   b. Replacement with a substance without or with less (serious) risks to health. Examples are water-based paint (no solvents) and the required asbestos-free brake pads on vehicles.
   c. Modification by, for example, not using the substance in powder form but in tablet form.
2. If the source approach is not possible, a collective protection against the hazardous substances should be applied. With good ventilation (contaminated air moved outside and clean air brought in), preferably as close as possible to the source, that can be achieved. An example is point-extraction when welding.

Good ventilation

3. If step two produces inadequate results, people and a source should be physically separated from each other. That can be done by using a wall, a reactor vat or a cabinet with extraction (fume hood/oxygen hood).
4. If none of the three measures above produce adequate results, a last measure can be taken: personal protection equipment.

8.5 Personal hygiene

In order to ensure that hazardous substances do not enter the body, it is important that attention be paid to personal hygiene. The *following measures* should therefore be taken:

- Eat and drink in a special area.
- Remove soiled work clothing, since dust and dirt collect in clothing.
- Clean the hands and face.
- With a wound, clean, care for and cover the wound as quickly as possible.
- Use good personal protection equipment.

8.6 The meaning of limit values and scent observations

Poisoning is, among other things, dependent on the toxicity and the amount of the toxic substance in the environmental air in the workplace. In order to know whether a situation is or is not damaging for health, a limit value is established for many substances. This list is revised annually with new insights. The limit value is the *maximum concentration* of a hazardous substance as a time-weighted average over a reference period, above which no employee may be exposed. When this value is not exceeded, there is no danger to the health of persons, insofar as is known.

Maximum concentration

With the establishment of the limit value, it is assumed that this concentration will also not have negative effects on the health óf the employee with repeated and long-term use. For some substances, the limit value is not known. That is not to say that these substances are not dangerous. *It only means that it is not known whether or how dangerous they are.*
The standard limit value is a time-weighted average. That is to say, this value is only valid under the following conditions:

- A normal workday (8 hours).
- A normal workweek (40 hours).
- Normal physical exertion.
- Normal healthy adult person in normal working conditions.

Masked

Our sense of smell is not a reliable way to establish the presence of hazardous substances. Many substances do not have any odour or smell pleasant, the scent limit can lie above the allowable limit value, the odour of hazardous substances can be masked by other, nontoxic substances. Smell is *very subjective* or person-dependent.

8.7 Monitoring and medical examination

Those who work with hazardous substance should be checked regularly for any negative effects of those substances on the health. That is *monitoring*. Therefore, a *periodic medical examination* is necessary. The blood level of hazardous substances and general health condition will be examined. Those will be compared with previous results for the same person. This way, it can be determinad whether the employee is fit and remains fit for his or her work. A medical

Previous results

examination should determine whether the candidate may continu working with the hazardous substances or not. How often such an examination should take place is dependent on the product, the kind of dangerous substances and the exposure-how often and how much. Usually, this means an annual medical check-up.

8.8 Specific hazardous substances

- Organic solvents are often petroleum products, such as turpentine in paints and lacquers. They are *very toxic* when inhalad. In the short term, they cause headaches, and in the long term, they affect the brain.
- Cyclic compounds such as petral (also carcinogenic) and phenol are *toxic*. Other examples are toluene and xylene.
- Heavy metals such as lead, mercury and zinc are very toxic with the inhalation of metal vapours.
- Carbon monoxide is *inhaled and is very toxic*. It displaces the oxygen in the blood and is explosive because it is a gas that arises from incomplete burning of fossil fuels (natural gas, coal, wood).

Irritating

- Cement is *irritating to airways* and the skin. In addition, there is a danger of eye damage, and in the wet state, it causes chemical burns with prolonged contact.
- Asbestos damages the inside of the lungs when asbestos fibres are inhaled. Results are asbestosis and in most cases lung cancer and mesothelioma as well. Swallowing asbestos is also dangerous.
- Hydrogen sulphide (H2S) is very toxic even in low concentrations, and exposure quickly progresses from headaches to death.
- Silica dust can lead to pneumoconiosis with prolonged inhalation.

Do not mix

Not only industrial substances can be dangerous; substances can be found in households that can threaten health. In the first place, the substance itself presents a danger, but also the manner in which it is handled is important in order to avoid any damaging effects from those substances. Therefore, it is important to read the label and the directions before using the substance, and *do not mix substances* with the idea that they will work better that way.

Take a look in the kitchen cabinet, often below the counter and thus easily accessible for children(!). There is often a strongly caustic drain-clearing agent. Dishwashing detergent for dishwashers are irritants that cause serious injury if they come into contact with the eyes. Organic solvents such as turpentine (white spirits) degrease the skin, are (highly) flammable and cause brain injury with prolonged use. Who doesn't have very highly flammable white spirits at home?

Paints and varnishes may contain organic solvents. Take this into account. Store these substances out of the reach of children, and *leave them in their original packaging*, so that it is clear, and remains clear what it is.

Working with suspected asbestos-containing materials

Inventory

There are legal provisions associated with the handling of asbestos and asbestos-containing materials. Each company must make an *inventory of the asbestos present* in the enterprise. If there is asbestos present, the employer sets up a management program to keep exposure to asbestos as low as possible. New processing of or working with asbestos is forbidden, and asbestos-containing waste must be collected and picked up separately. Where there is a risk of contact with asbestos, a label must be applied.

Sample

If the suspicion exists that there is asbestos, then the work must *be immediately stopped.* The operational supervisor and the client must be warned. The client must have a sample taken and investigated, so that it can be established whether there is asbestos. If it indeed is asbestos, it must be *removed in accordance with the legal conditions.*

8.9 Leaks and biological substances

Results of leaks

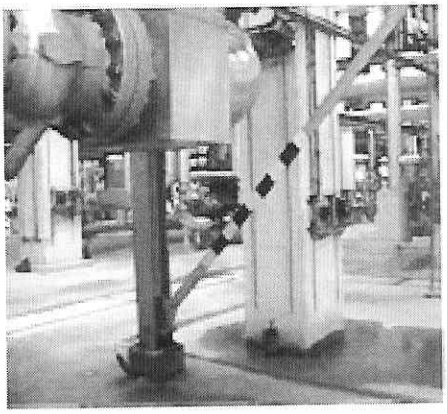
Through leaks in storage tanks, pipes and equipment, but also through spillage in the processing of hazardous solids, liquids and gases, dangers can arise: contamination of the air by the product, fire, environmental contamination and slippage.

Causes of leaks

The causes of leaks can often be found in *poor maintenance of installations or poorly installed flanges* (sealers in pipes). Taps and seals can leak, and things can go wrong when transfusing liquids. Damage can be caused by, for example, collision with a forklift.

If the cause is known, action can be undertaken. Preventative measures in order to prevent leaks occurring include regular checks of the installation as well as maintenance and repair of defects by trained personnel. Corrective measures that should be taken if a leak occurs or has occurred are:

- Report the start of every new leak.
- An adequate leak-catcher under tanks.
- (Have) the leak expertly repaired.
- (Have) the leaked product expertly removed.



Working with biological substances

Natural products are recommended because they are so healthy. That is true, but that is not to say that everything that is natural is also healthy. There are many biological substances that are bad for health. Think about the whole process of waste processing from collection through burning. In industries such as agricultura, health care and the food industry, work is done with biological substances. Working with animals, in contaminated soil, with sewage, water purification installations, the biotech industry and the pharmaceutical industry bring employees into contact with biological substances. This poses a threat to health in the form of infections/illnesses, poisoning, allergies, moulds and parasites. To protect against these dangers and risks, the hands must be washed frequently and people sometimes have to be regularly inoculated.

Protective clothing

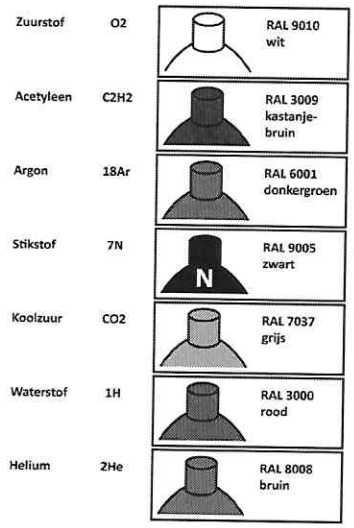
Personal protection can also take the form of *protective clothing*, the right hand, eye and breathing protection, and sometimes a protective cream is helpful.

8.10 Industrial gas cylinders

Industrial gas cylinders contain all kinds of gases and can be distinguished from each other with the use of colour coding, so that a colour makes it clear what is in the cylinder. There is an old coding system and a new one. Where the new coding system is used, the letter N is added. *Each gas has its own specific characteristics that entail certain risks.* Therefare, it's very important that it be clear what is inside a cylinder.

A few examples are:

- *Oxygen is in a cylinder with a white shoulder.*
- *Nitrogen: black shoulder.*
- *Carbon dioxide: grey shoulder.*
- *Air: light green shoulder.*
- *Acetylene: maroon shoulder.*



In choosing the right gas, you should first look at the *shoulder* of the cylinder and then at the *label* in order to be certain that you are dealing with the gas that is needed for the work.
In order to be able to use industrial gases, transport and storage is necessary.

ADR

The transport is regulated in the ADR. For storage, the following measures must be taken into account:

- Secure the bottles/cylinders well.
- Protect the bottles against negativa effects of weather.
- Protect the bottles against sun rays and other sources of heat.
- Do not stock gas bottles at the workplace.
- Ensure sufficient ventilation.
- No storage in cellars and pits (many gases are heavier than air and can accumulate).
- No oxygen bottles near bottles with a flammable gas.
- Appropriate fire-fighting equipment and cooling water must be located near the storage area.

8.11 Summary

When working with hazardous substances, it is important to know what the dangers and risks are and what measures should be taken in order to protect the health of employees. The air in which work is done must contain a minimum of 19% oxygen. Too much oxygen in the air promotes fire. There are many kinds of hazardous substances, each with their own specific characteristics. Labels on packages with, among other things, R- and S-phrases (GHS hazard statements) and hazard symbols give information about the products.

The occupational health strategy is an obligatory order for the taking of countermeasures. Personal hygiene contributes to the reduction of risks. Because people cannot always rely on their noses, the government has established limit values for many products, below which work may be done. With monitoring, employees who work with hazardous substances will be medically evaluated and, if needed, intervention can take place in a timely fashion. When there are incidents with hazardous substances, such as leaks, the procedures designad for dealing with this must be followed, but preventative measures must also be taken. Industrial gas cylinders have a colour code in order to make it clear what is inside the gas bottles. Transport, storage and use of gas bottles are subject to regulations.

8.12 Practice questions for Chapter 8

1. At what oxygen percentage in the environmental air may work no longer be done in that space?

A. At 21 % or more.
B. At 19%.
C. At 18% or less.

2. What is a possible result of a too-low oxygen percentage in the environmental air?

A. Suffocation, unconsciousness and death.
B. Increased fire danger.
C. Allergic reactions and anxiety.

3. What is an example of an oxidising substance?

A. A concentrated cleaning solution.
B. Hydrogen peroxide.
C. Methanol.

4. How can risks from hazardous substances best be managed at the source?

A. By separating people and the source from each other.
B. By modifying the hazardous substance.
C. By not using the hazardous substance.

5. What information is provided by S- and P-phrases on the label of a hazardous substance?

A. The research and selection of the substance.
B. The safety/prevention measures that should be taken in arder to work safely with the substance.
C. The norms that the product must meet.

6. Under what conditions do the limit values for hazardous substances apply?

A. At room temperatura, at the regular workplace and work hours.
B. For persons above 18 who are not pregnant and who do not do shift work.
C. For a normal workday and workweek and for normal, adult persons.

9. Fire and explosion

Fire is useful and is used daily for heating, cooking, warm water, washing or to look at (fire place). Fire can be a controlled and desired situation, but it can also be otherwise. Uncontrolled fires are undesirable. Therefore, there are different tools for extinguishing a fire, and it is important that everyone knows what to do when there is an uncontrolled fire.

9.1 Dangers of fire and explosion

Fire is a chemical reaction, whereby fuel and oxygen react with each other. The result is smoke, heat and often flamas. The creation of rust is also a chemical reaction with oxygen. A car that is rusting away is thus more or less on fire. The difference is that then the chemical process goes so slowly that it does not create flamas, (significant) heat or smoke. Because of that, we do not talk about 'fire' in that case. *Not every burning is a fire.* The difference is in the burning velocity.

Explosion

With an explosion, the chemical reaction goes much more quickly than with a fire. A great deal of heat is released in a very short period. Due to all this heat, the air suddenly presses outwards, and a pressure wave is generated. The pressure wave will be heard as a boom, and it blasts away whatever it encounters. In principle, an explosion is nothing more than a lot of air that is very quickly displaced.

Energy

There are (normally) two substances needed for a fire or explosion: a burnable or explosive substance and oxygen. But that is not sufficient. There is also energy needed in order to get the reaction started: *the ignition temperature or an ignition source.* Examples of ignition sources are flames (open fire) and hot gases, mechanical sparks and welding sparks, electrical installations and materials, hot surfaces, static electricity and lightning. From this description, it appears that the following factors are needed for a fire or explosion:

- A flammable or explosive substance.
- Oxygen.
- An ignition source or ignition temperature.

Fire triangle

These three factors together form the fire triangle. There are two more things that are important for the course of a fire:

- The mixture ratio.
- A catalyst.

There is a total of five factors that influence a fire: the fire pentagon.

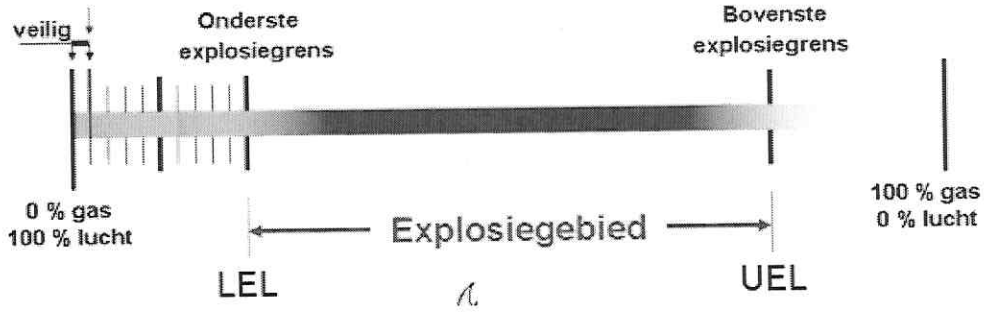
The mixture ratio

The ratio of flammable substance and oxygen is also important for the course of the fire. If there is too little oxygen, no fire will start. In order for the fire to progress quickly, the ratio between the amount of flammable substance and oxygen must be exactly right. This is the *mixture ratio.* The mixture ratio is essential in the starting of a fire or explosion. There is a minimum concentration of gas, vapour, mist or material needed in order for an explosion to occur. The minimum amount that is needed is the *Lower Explosion Limit (LEL).*

Lower Explosion Limit

In most cases, there is also a maximum amount of gas, vapour, mist or material in the surrounding air that can cause an explosion. If the maximum amount is exceeded, then there will be too little oxygen present for an explosion to be possible. We call this the *Upper Explosion Limit (UEL).* The UEL is the maximum concentration that can still lead to an explosion.

Upper Explosion Limit



The explosion limits for gasses differ enormously. If the difference between the lower and upper explosion limits is big, then we are dealing with a large explosive range, and there is a great deal of danger. If the lower and upper explosion limits are close together, the explosive range is smaller, and there is less danger of explosion.

Catalyst

A catalyst is a substance that has an influence on the speed at which a reaction takes place. A catalyst can both *speed up and slow down* the process. In the flames of a fire, substances are created that work as positive catalysts. If a substance accelerates a reaction, it is a positive catalyst. If a substance slows down a reaction, it is a *negative* catalyst. Fire-fighting powder is a negative catalyst. The bizarre thing about a catalyst is that it does have an effect on the speed of the reaction, but that it does not burn.

Negative

Factors that can promote the starting of a fire

- *Liquids with a low flashpoint will catch fire sooner than liquids with a high flashpoint.*
- *Gases and vapours with a small explosive range are less dangerous than gases with a large explosive range.*
- *The lower the auto-ignition temperature, the higher the fire danger of the substance.*
- *With oxygen percentages in the air higher than 21 %, the flammability of substances increases.*
- *With great heat, tanks and vats filled with flammable substances can explode.*

Flashpoint

The lowest temperature at which a liquid gives off sufficient vapour so that this vapour, under normal atmospheric conditions, in the presence of air, can be ignited is called the *flashpoint*. The lower the flashpoint, the more easily the combustion takes place, and the more danger of fire there is for the liquid.

Lowest temperature

Auto-ignition temperature

The auto-ignition temperature of a substance is the lowest temperature at which a substance will catch fire *without an external source* of ignition, measured under normal conditions. In contrast with the flashpoint, this applies to all substances - solids, liquids and gases - and there is no ignition source needed for the combustion. The energy will be provided by the *high temperature*.

Oxygen

One of the elements from the fire triangle and fire pentagon is oxygen. Without oxygen, no fire or explosion is possible.
When oxygen is contained under pressure (200 bars), as with welding and cutting, then hose protection must be utilised in order to prevent a break in the hose from allowing the oxygen to freely escape, which can increase the danger of fire. In closed spaces, oxygen and gas bottles may not be present, because the ventilation options are limited and an explosion or flammable mixture can quickly be created.

The effect of tire on the surroundings

Due to a fire, visibility will be limited, and toxic or damaging substances may be released. Because combustion *gases are hot, and lighter than air*, these gases initially rise. Later, when they have cooled and descend again, they can come to the ground in a different place. Due to the heat of a fire, other substances in the surroundings can reach their auto-ignition temperature and spontaneously begin to burn. Due to heat radiation, gas bottles and reservoirs can heat up, so that they split and explode. The heat makes it difficult to approach a fire, and to extinguish it.

9.2 Fire-fighting equipment

Three factors

If it is known how a fire can start, it is easy to think about how it can be extinguished. There are at least *three factors needed* for the creation of a fire: the fire triangle. If one of the three factors is removed, the fire is extinguished. The principies of fire fighting are derived from this:
The disconnection or removal of a flammable substance can be done, for example, by sealing a leak or *closing a gas tap.* Extinguishing agents can reduce the ignition energy and remove heat through cooling, displace the oxygen and exclude the oxygen. Finally, the ignition source can be removed.

Dangers and disadvantages of extinguishers

- *Water:* Water is the most familiar wet extinguishing agent. It cools, so that the temperature is lowered. With the creation of steam, oxygen will be displaced.

> ! ***Disadvantages of extinguishers with water are:***
> - *The water damage can be greater than the fire damage.*
> - *Water is an electrical conductor.*
> - *Water is prone to freeze.*
> - *Quite a few chemicals react strongly with water.*
> - *Environmental damage from contaminated water.*
> - *Many flammable liquids, such as oil and oíl products, float on top of water, so that the fire becomes larger. In addition, an explosive reaction takes place if water is sprayed in or on a burning liquid, oil or fat.*

- *Foam:* Foam farms a layer on the flammable substance, lowering the surface tension and thus ensuring that the oxygen supply is sealed off. Aqueous Film Forming Foam (AFFF), or 'Light Water' works the same way as foam, by *forming a watery foam layer.* Disadvantages are: foam causes limited damage, is prone to freezing and can be electrically conductive (except far spray faam).

Cooling effect

- *Sand*: Sand has a cooling effect and suffocates the fire: *it excludes oxygen.* A disadvantage of sand as an extinguishing agent is that it sticks and hardens at high temperaturas.

- *Powder:* Extinguishing powder is a negative catalyst. This is a *substance that slows the chemical reaction*, so that combustion is suppressed. The powder also works to a limited degree to exclude oxygen and lower temperaturas. Disadvantages are that the powder restricts visibility in small spaces and causes a great deal of contamination and damage. Powder must, in contrast with other extinguishing agents, not be aimed at the burning, but at the flames.

- *Carbon dioxide:* Carbon dioxide (C02) is also called *carbonic acid gas.* It is also found in soft drinks and beer. Carbonic acid gas displaces the oxygen, so that the fire goes out. Because it is a compressed gas that cools a great deal when released from the extinguisher, and forms a kind of snow, it is also called carbon dioxide snow. Due to the low temperature (around minus 80' C) at which the vapour escapes from the liquid, it has a limited cooling effect. *If it touches the skin, it results in burns.* The extinguishing of a fire in a small space with C02 can displace so much oxygen that an oxygen deficiency arises for the person extinguishing the fire and others present. Ensure when extinguishing a fire with C02 that there is independent breathing protection and ensure good ventilation after the fire is extinguished.

Kind of snow

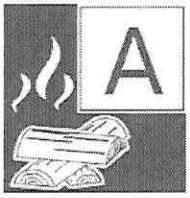
- *Fire blankets:* With a fire blanket, the supply of oxygen can be cut off from burning products and people and fires on a flat surface. The disadvantage is that the fire must be *approached closely.* If the fire is not well or completely covered with the fire blanket, that presents a danger for the person extinguishing the fire, and there is more chance of injury and damage.

9.3 Classification of fires and associated suppression equipment

Fires will be divided into classes:

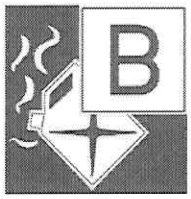
Solid substances

- *Class A tires:* are tires of solid substances (ordinary combustibles), such as wood, paper, cotton, plastic and coal, and these are easy to start. These tires will be extinguished with water, tire extinguishing powder (ABC) and foam. The tire blankets will be utilised for burning products and persons and tire on a flat surface. A dust explosion is a particular kind of class A tire.



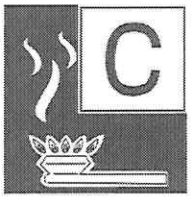
Liquids

- *Class B tires:* are tires of liquids or liquid-forming substances ('fat tires'), such as petral, oíl, asphalt, bitumen, (candle) fat, plastic, alcohols, paints, rubber, paraffin and solvents. These tires will be extinguished with foam, sand, class B extinguishing powder or carbon dioxide (C02).



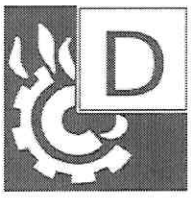
Gas tires

- *Class C tires:* are gas tires (natural gas, propane, butane, methane and acetylene) and will be extinguished by closing off the gas source or with class C extinguishing powder.



Metal tires

- *Class D tires:* are metal tires (magnesium, aluminium, potassium, sodium and metal alloys) and are not common. These tires are not easy to extinguish. There are special fire-fighting tools that are suitable for metal tires, for example class D extinguishing powder.



- *Non-classitied tires:* are tires such as electrical tires (meter boxes, switch tires, high-voltage housings, electrical shorts, computers and other electrotechnical devices). These tires will be extinguished with carbon dioxide (C02) or moditied foam.

9.4 Responding to a fire

In the event of a fire starting, the following measures should be taken in the order presented below:

- Tirst ensure your own safety.
- Report the fire.
- Warn people in the area about the tire.
- Close doors and windows.
- Bring people to safety.
- Extinguish the tire if possible.

> ***Extinguishing a fire:***
> - *Tirst ensure your own safety.*
> - *Choose the right tire extinguishing agent.*
> - *Put out the tire.*
> - *Note: the tire can re-ignite!*
> - *If the tire appears to be or becomes too large, then stop and evacuate.*

As quickly as possible

With extensive burns, you should cool them for at least 15 minutes with clean water. If this is not available, then ditch water or rinse water can also be used. *The skin must be cooled as quickly as possible.* Be careful of over-cooling! Never use salve or the like, because this does not cool the skin. Often, the salve must be removed later by the doctor in order to assess the wound.

9.5 Explosive environment

EX

In an explosive environment, it is possible that an explosive mixture will be created. Therefore, special measures must be taken in such an environment in order to prevent the possible presence of such explosive mixtures. An explosive environment will be indicated with a caution sign bearing the symbol: *EX*

There are several branches or sectors in which the risk of explosions can be present: chemical industry, landfills, energy installations, waste processing companies, gas companies, wood processing industry, agriculture companies (biogas), metal processing companies, food and livestock feed industry, pharmaceutical industry, refineries and recycling companies.
Both gas and solids can create an explosive environment. This is the case when there are flammable gases and vapours, liquids with a

flashpoint lower than the environmental temperature and dust clouds.
In explosive environments, a personal explosion meter can be used. With the use of this personal explosion meter, it is important that:

Chest-high

- The explosion meter be worn *chest-high*, but not under the clothing.
- The explosion meter be tested or is tested before use.
- It is known what actions should be taken in the event of an alarm.

9.6 Summary

Fire and explosion are great dangers. Far fire, at least fuel, oxygen and an ignition temperature are needed. By taking away one of these three, the fire can be extinguished. Therefore, there are extinguishing agents that are or are not appropriate per fire class. The person extinguishing the fire should always consider his or her own safety first when fighting a fire. In an explosive environment, special measures must be taken.

9.7 Practice questions for Chapter 9

1. What three factors at minimum are needed far a fire to start?
A. Hydrogen, axygen and nitrogen.
B. Oxygen, fuel and ignition temperatura.
C. Water, powder and foam.

2. What is the auto-ignitian temperature?
A. The temperature at which a liquid raleases so much gas that a flammable mixture is created.
B. The temperature at which a flammable substance spontaneously begins to burn.
C. The temperature at which an ignition source provides sufficient energy in order to cause a fire.

3. What is the characteristic of a class 2 flammable liquid?
A. This liquid is very highly flammable.
B. This liquid is highly flammable.
C. This liquid is flammable.

4. What does the abbreviation UEL mean?
A. The explosiva range: the range between the lower and upper explosion limits.
B. The lawer explosian limit: the limit below which the mixture of air and flammable gas cannot result in an explosian.
C. The upper explosian limit: the limit above which the mixture of air and flammable gas cannot result in an explosion.

5. How can a class B fire best be extinguished?
A. With a fire blanket.
B. With sand.
C. With extinguishing pawder.

6. What are the first two actions when discovering a fire?
A. Ensure your own safety and extinguish the fire.
B. Report the fire and extinguish it.
C. Ensure your own safety and report the fire.

10. Work equipment

Tools and machines make work easier and allow more to be produced in a short time. That means an improvement of the labour conditions and of the revenues. Another aspect is the risks associated with working with tools and machines. Only with the right management measures can the full benefit of this be enjoyed.
The Arbowet requires the employer to provide good and safe tools. With the proper maintenance of these, many accidents can be prevented. When acquiring new machines, the employer must also consider the safety aspect in the selection and must provide the employees with instruction about the dangers and management measures. Moving loads can be done with or without mechanical assistance. The weight and the shape of the load determine the method of moving. For heavy items that cannot be lifted by hand, we need mechanical assistance such as pallet jacks, forklifts, hoisting cranes and hoisting tools.

10.1 Machines, powered hand tools and hand tools

General dangers, risks and possible injury:

- Being caught by moving parts.
- Being struck by flying material/parts.
- Being pinched in clamping equipment.
- High or low temperature of the work item.
- Physical overburdening due to incorrect posture.

Distraction

- Disruption of the controls or energy source.
- Distraction of the operator.
- Poor maintenance.
- Dislocation of the hand and wrist and bruises from incorrect use.
- Injury due to 'walking' of tools.
- Long stopping times of machines.
- Inhaling damaging substances.
- Shooting off of staples/nails from a stapler/nail gun.
- Kickback and deflection from hard materials of a staple/nail gun.
- Penetrating through the work piece by a staple/nail gun.
- Physical complaints from vibrations.
- Injury from flailing air hose.

Electrocution

- Electrocution.
- Fire or explosion from spark jumping.
- Wounds from parts shooting ouUaway, cuttings, shavings or splinters.
- Hearing damage from noise.

This summary, which is certainly not complete, indicates that working with machines and tools is *dangerous and risky*. Therefore, requirements are established for machines, and there are general safety rules established for them. Of course, there are also requirements established for the operator.

> ***Requirements for machines and powered tools:***
> - *Periodic inspection, according to the VCA system, annually.*
> - *Marking of the approval period with a sticker or colour code.*
> - *Use and maintenance instructions in the language of the country where the machine/tool will be used.*
> - *After 1995 provided with the CE marking.*
> - *Moving parts are screened off.*
> - *The machine/tool is in good working order and is suitable for the work to be done.*

Personal protection

General safety measures for working with machines and powered too is:

- They must be switched off during maintenance.
- They may never run with an opened drive housing.
- The floor around the machines must be cleared, clean, flat, dry and anti-skid.
- There must be sufficient walking and movement space for the operation of the machine.
- Personal protection equipment must be available and used.
- They must be operated in the correct manner.
- There must be an instruction card for the operation of the machine available.
- Dangerous zones must be screened off.
- A brake must counteract long stopping times.
- There must be an emergency stop/dead man's switch present (if applicable).
- There must be good dust extraction (if applicable).

There is a number of measures that can prevent accidents or limit the consequences of them as much as possible. Those are the *dead man's switch* on powered hand tools and the *emergency stop* as well as the null-load or null-voltage switch on fixed machines.

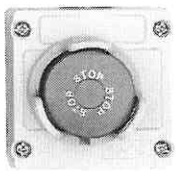
Dead man's switch

This button must remain pressed in while operating in order to keep the machine or tool running. *If the switch is released, the machine/tool stops.* Think about a set of electric hedge shears. These must be operated with two hands. As soon as one hand lets go of the machine, the hedge shears stop. This way, a hand can never get caught in the cutting shears. None of the switches can or may be blocked.

Emergency stop

Recognisable

This is intended to let connected machines stop immediately in case of emergency. The emergency stop must be *recognisable, clearly visible and easily reachable.* After use of the emergency stop, the machine can only be re-engaged according to the usual start-up procedure.



Null voltage/null load switch
This switch ensures that when the voltage to a machine is lost, it will not automatically start running again when the voltage is restored. The machine must deliberately be turned back on.

Safety measures for operating and requirements for the operator of machines and powered tools:

- *The operator of dangerous machines must be at least 18 years old.*
- *Do not wear gloves near turning parts and where there is a danger of getting caught.*
- *Security measures must remain intact.*
- *The operator must have sufficient training and experience.*
- *Loose-fitting clothing and loose-hanging hair and jewellery are forbidden.*
- *A running machine must not be left unattended.*
- *The operator must know the location and function of the emergency stop.*

10.2 Fixed machines

Permanently set up machines are often *big, heavy machines* that are affixed to the floor. Examples are: industrial saws, surface planers, drill presses, grinders and the like. Good training and professional knowledge are necessary in order to be able to work safely with these machines.

Permanently set-up circular saw
Specific dangers and risks for this machine are being caught or struck by the saw or other moving parts, being struck by sawn-off or flying parts of the product or health complaints from inhaling damaging substances. Safety requirements for this machine:

Protective cap

- Protective cap (preferably transparent) on a sturdy mount above the saw.
- The right blade guard and blade guard support.
- An adjustable guide.
- One or more connections for dust extraction.

Preventative measures for working with the machine:

- A *push block* with an interchangeable hand grip in order to push through small work pieces must be available.
- Large work pieces must be pushed through by two people or via a roller track.
- The saw blade must be set as high as possible in order to prevent kickback of the work piece.

Permanently set-up drill (press)
Specific dangers and risks for this machine are:

- Injury from the drill bit breaking.

- The work piece flying off.
- Injury from chips.
- Infection from splashed cooling and cutting oils.

One safety requirement for this machine is the placing of a *transparent screen* between the operator and the machine.
Prevention measures for working with this machine: Secure the work piece well and remove the shavings with a turnings brush or hook.

Permanently set-up grinders
Specific dangers and risks for this machine are:
- Grindstone coming apart.
- Eye injury from flying bits.
- Injury from touching the turning grindstone.
- The work piece getting stuck against the grindstone.
- Inhaling dust from grinding.

Safety requirements for the machine

Screened off

A protective pane must be placed. The maximum allowable distance between the tool rest and the grindstone is 3 mm. The sides of the machine must be *screened off.* The grinding side of the stone must be smooth. Two grindstones on one machine may not differ too much in size. Grindstones must be sufficiently round and undamaged.

Preventative measures for working with this machine
The tool rest must be regularly adjusted, only when the machine is switched off. Because the grindstone wears down, the tool rest may not be U-shaped. Only *expert personnel* may mount or change the grindstone. The protective pane must always be used.

10.3 Powered hand tools

Safe voltage

Electric powered hand tools make the work lighter, but the dangers of electricity must not be ignored. Most devices work on 230 volts. The risks can be reduced by working with a safe voltage: a maximum of 50-volt AC or 120-volt DC. This voltage will be applied in clammy, small spaces, such as cellars and crawlspaces. In places where the risk is less great, work can be done with normal 230 volts. The use of double-insulated tools is then required. These tools have the advantage of *extra insulation*, so that the chance of electrocution is reduced. With two nested squares, it will be indicated on the tool that it is double insulated. Double-insulated tools may never be used in damp spaces, and the plastic housing must be fully intact. Double-insulated devices have a cast plug without grounding. With defects or damage to the cord or the plug, a new cable must be installed.

The angle grinder/hand grinder/grinder tool

Abrasion

On a grinder tool, two kinds of discs will be applied: cutting discs and abrading discs. With the thin cutting disc, stone and metal items can be cut through. That is faster than sawing. The work of the disc will primarily be done by the outer edge. The side may not be used. The thicker abrading disc is intended for the removal of burrs. *With abrasion, the side of the disc is used.* That is also the reason why the disc must be thicker.

Depending on the type, abrading discs will be used for:

- Cutting and abrading up to a maximum of 3 - 4 mm.
- Welded seam grinding or abrading to a maximum of 4 - 4.5 mm.
- All kinds of abrading work greater than 4.5 mm.

The following must legally be specified on grinder discs:

- *The name of the manufacturer;.*
- *Maximum allowable torque.*
- *Date.*
- *Indication of what material the disc is intended for.*
- *Dimensions of the disc.*
- *Application.*

Risks with the use of the angular grinder are: injury from flying bits of the disc and the work piece, a grinding disc that flies apart or touching the turning disc. Fires or explosions can be created (ignited by heat and sparks). Furthermore, hearing damage can result, and health complaints can arise from vapours and dust that are created when grinding.

Grinder tool

The grinder tool must be fitted with a *protective cap*, depending on the power: a side grip and a dead man's switch. The maximum allowable torque of the grinder disc may never be lower than the torque of the grinder tool. Use of grinding goggles and hearing protection are required, and the work piece must be secured. The grinder tool may only be put down when the disc has stopped turning.

Pneumatic hand tools

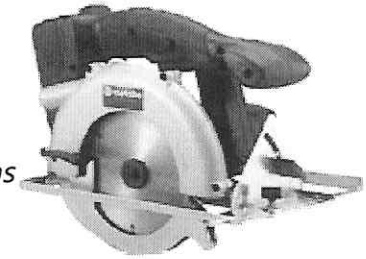
Vibrations

In order to avoid the risks of electricity with certain work activities, use will be made of pneumatic tools. These tools are powered by compressed air. That causes *vibrations.* Vibrations can lead to serious joint complaints, muscle pain and disruption of the blood circulation. '*White fingers*' is an example of this. Vibrations cause disruptions of the nerves as well, which can lead to a tingling feeling in the fingers and hands. Soft leather gloves can capture the vibrations. Body vibrations cause tiredness. This is why many people sleep very well in cars or trains. Due to tiredness, performance, reactions and concentration are impaired. With strongly vibrating work activities, such as riveting and demolition work, regular breaks must be taken. When doing machining work, the use of safety glasses, goggles or a face screen is required. After use of the tool, shut down

the air supply.

The handheld circular saw

With a handheld circular saw, a protective cap must *fully screen off the part of the saw that is not cutting*. The protective cap automatically remains above the sawing part of the saw when cutting. The blade guard must fit the diameter and thickness of the saw blade. In order to be able to work safely with a handheld circular saw, the saw blade and the guide must be set so that the saw blade *extends as little as possible below the work piece to be cut.* If needed, a second person must assist in the cutting. The saw may not be clamped, and the electrical cord/cable must remain behind the saw at all times.



Assist

Nailing and stapling machine/nail gun

These machines will be *pneumatically* powered and have security against accidental firing. The connected air pressure may not be higher than indicated on the machine.

With the use of these machines, *the working pressure on the air hose must be monitored.* When placing a feeder, the fence must be empty.

Working pressure

The choice of nails/staples depends on the device, the material and the shape of the work piece. The free hand must always be held as far away from the machine as possible. The head of the machine *must be pressed firmly* against the work piece when nailing/stapling. If that does not happen, the machine will not work. That is a *built-in security* measure.

The chainsaw

The chainsaw is a dangerous tool. It therefore has to meet a whole series of safety requirements:

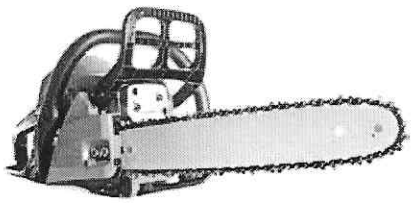
- The handgrips must be free of vibration and have an antislip surface.
- Vibrations must also be dampened internally.
- The rear handgrip must be protected against the consequences of any break in the chain.
- Above the front handgrip, there must be a *protective bracket.*
- With the release of the operating switch/gas handle, the chain's motion must be braked with kickback protection.
- There must be a *chain-capture mechanism* installed.
- There must always be double hand operation used. If one hand or both hands let go, the machine stops: dead man's switch.
- A protective cap must protect the chain when the chainsaw is not being used.
- The machine must be balanced in order to prevent vibrations and 'strikes' from the machine.
- Locking of the controls with automatic uncoupling of the control button.

Protective bracket

Prevention measures when working with a chainsaw are:

Special training

- The operator has had special training and is tested for knowledge and skills.
- The operator must wear special trousers and gloves with anti-cut and blocking fibres.
- The operator stands in such a way that in the event of kickback, the chain cannot touch the body.
- The operator must use the *right combination* of saw blade/chain and hold the machine steady with two hands.



10.4 Hand tools

Hand tools are *tools without power* that do not have a permanent set-up and will be operated by hand. Lack of maintenance and incorrect use are the most important causes of accidents with tools.

Safety requirements for tools are:

Intact and clean

Tools must be *intact and clean*. Wooden handgrips may not show any splits or breaks and may not be painted. The head of a hammer must be intact and well secured; the steel must be smooth and intact.
Impact tools such as chisels (with hand protection!) and impact spanners may not show any burrs. Because they become harder with every strike, they must be regularly replaced. Chisel heads made of excessively hard metal can throw off metal splinters. In order to be able to apply more power, spanners may be extended, but only with the proper accessories. The spanner must be intact, and the jaws must fit precisely (without filler plates!) around the bolt. A ring spanner endoses the whole bolt head and is better than an open-end spanner.

A number of extra requirements are established for impact spanners:

- There must be a line attached in order to prevent the spanner from shooting off or falling when coming loase from a strike.
- The impact spanner may not be held with a hand when struck.
- Only one person may operate the impact spanner.
- The operator must be a trained person, for example a flange installer.
- The strike direction must be free of limbs and obstacles.
- The workplace must be cleared.
- The impact spanner is not a standard tool and must be reported in the safe work permit.

Secured

It is often tempting to use, for example, a screwdriver as a crowbar or a chisel. This causes a lot of accidents. Use tools only for their intended purpose. A screwdriver *must fit precisely* into the screw slot and may not be sharpened. Small work pieces must be secured/clamped.

Files must be fitted with an *undamaged and sturdy handle* that must fits without

help.
For pliers, the jaws and the hinge must be intact and clean.
Knives must be *sharp and suited* to the nature of the work. Always cut away from the body. Do not slide a sliding blade too far, and break off the worn part with a blade breaker or pliers.
Use the right saw with a well sharpened saw blade for the work to be carried out. The saw must be *well set* (position of the teeth with respect to each other), properly secured in the bracket or handle and the teeth must be pointed forward when sawing.

10.5 Hoisting in general

Horizontal
Vertical

Hoisting equipment is equipment that is set up and outfitted for the horizontal and vertical movement of free-hanging loads. There are different kinds of hoisting equipment.

- Mobile cranes.
- Gantry cranes, bridge cranes and overhead cranes.
- Auto loading cranes.
- Construction cranes.
- Hand hoists.

It is forbidden to hoist with something that is not especially made for it. Within the European Community, the Machine Guidelines apply. The purpose of these is to bring safely operating machines to the market.

For hoisting equipment with an inspection requirement, the following documents are necessary:

- A *crane book* in which all inspections and repairs are signed off. The inspection details must be recognisably applicable to the hoisting equipment;
- *Hoisting tables and graphs* from which it can be worked out what weight across what distance (force x arm) may be moved. For hoist installations, those are the hoist tables.
- *Evidence of inspection* for winches, hoists, hoisting masts, (extra) chains, eye bolts, shackles, slings, chains, cables and lifting beams.

Evidence of inspection

The expertise of the operator of hoisting equipment will be demonstrated with testing, *the hoisting licence.* A hoisting licence is required on all large cranes and hoisting installations with a capacity of more than 10 tonmeters (force x arm). In the registration book of the machinist, the trainings that he or she has are listed, as well as the kinds of hoisting equipment with which he or she has experience and how long. In order to be able to work safely with hoisting equipment, not only the hoisting crane but all hoists, winches, slings and other hoisting accessories and hoisting tools must be inspected annually.

General dangers when working with hoisting equipment are the falling of the hoisting equipment and the falling of the load. The general safety measures are

then that the maximum work load {force x arm) may not be exceeded, that the load must be held in the proper way, that there are regular visual checks of the hoist material and that the angle of spread for two- or three-leg attachment must be kept as small as possible (max. 120 degrees). Information about the maximum load of hoisting accessories can be found on the *hoisting accessories in the form of a plate or ring or stamped into the material.* In arder to know whether hoisting may or may not be done on the basis of wind force, the user instructions from the manufacturer of the crane must be consulted.

Stamped into the material

10.6 Hoisting machines

Hoisting equipment must be checked regularly for wear and damage. With the utilisation of multiple hoisting machines at one location, good coordination must take place. The crane operator and whomever connects and guides the load (rigger) must understand each other properly. They must be able to see each other and preferably be able to hear each other. For good understanding, there are certain gestures agreed upan for hoisting work.

User instructions

In order to know whether hoisting may or may not be done on the basis of wind force, the user instructions from the manufacturer of the crane must be consulted. In order to spread the weight across a greater surface and to increase stability, a mobile crane must be stabilised on firm ground with wooden plates/ planks under the feet.

The load must be secured in the correct manner, whereby the machinist and the rigger regularly check the attachment. For hoisting equipment that is used, proof of inspection must be available.

The risks and dangers with hoisting work are:

- The falling of (parts of) the load.
- The falling of the hoisting equipment.
- Contact with objects in the environment when manoeuvring the load.
- Making contact within the turning radius of the hoisting equipment.
- Poor weather.

10.7 Hoisting accessories

Under hoisting accessories or hoisting tools, all the interchangeable materials that are not mounted to the hoisting machine as a standard are included, for example chains, cables, shackles, hooks, rings, swivels, eye bolts, straps, slings, lifting slings and lifting beams. Which hoisting tool should be used is dependent on:

- The dimensions and shape of the load.
- The distance of the move.

Chains

Parts of the chain work are:

- *Chains;*
- *Hooks;*
- *Swivels;*
- *Rings;*
- *Shackles;*
- *Eye bolts*

Indicated on the chain

They can be used *individually, but also together.* Chain work exists in various kinds of steel. The strongest (and most expensive) are the ennobled steel types. The maximum load is *indicated on the chain work.* That can be stamped into the chain, on a metal plate on the chain or in a free link. For each chain, there must be a certificate indicating the following:

- The safe work load.
- The test load.
- (Any) tempering load.
- The registration number.
- The test date and the name of the inspecting institution.

Tested every 4 years

All the chain work must be inspected *at least once a year* by a special inspection company. Chains will become brittle from use over time. The only way to combat this is to temper the chain, making it soft and tough again. After the tempering, the chain must always be tested. If the chain work is rejected after testing (and tempering), it must be destroyed. Chain work must be tested at least every four years.

The work load that is indicated on a chain only applies when the chain is loaded straight (in the long direction of the links). If you wrap the chain around something, it becomes loaded sideways and the forces on the chain increase significantly, and the chain can become deformed. Therefore, it is dangerous to make a loop in a chain with a hook. The knotting of chains is also forbidden.
For hoisting chains, the following rules apply:

- Fully tighten bolt closures.
- Never load the point of the hook.
- Check whether the work load of the chain is sufficient for the load.
- Check chains and accessories for damage (serious rust or damaged links and closures).
- Load chain work only in the longitudinal direction.
- Do not force chain work into place by hitting it with a hammer.
- Protect the chain with planks or a piece of car tire against a load with sharp angles.
- An excessively heavily loaded chain with stretched out ar tightly drawn links must be rejected.

- Use an extension for a chain only with a special coupling link that is as strong as or stronger than the chain itself.

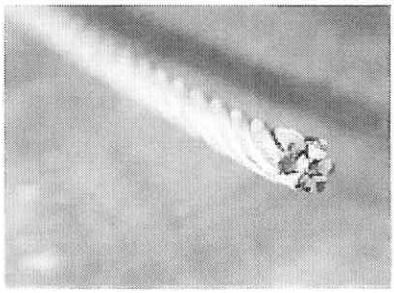
Steel cables

Steel cables are cables with a tough core, with braided steel around it.
Steel cables also require inspection certificates. Good maintenance is important for steel cables. Therefore, the following rules apply:

- Store cables in dry, well ventilated spaces in connection with rust formation.
- Avoid contact with moisture and corrosive substances.

Protect the steel

- Protect the steel cable with a stop block or car tire against damage from sharp angles of the load.
- Grease must be *regularly removed*, so that the cable can be checked for rust and wear. Thereafter, re-grease with acidfree grease.
- Do not make any knots in steel cables.



Steel cables must be rejected in the following cases:

- With frayed splits.
- Broken threads, the so-called 'meat hooks' across a greater length.
- Multiple thread breakages at one place (break nest).
- A seriously bowed or kinked cable.
- A lot of rust or wear.
- Broken or split cable connections.
- Reduction of the diameter.

With the choice of chain or cable, *the cable is usually the best choice*. For very heavy loads or if there are hoisting eyes applied to the load, the chain is better.

Straps and slings

Straps are pieces of cable, rape or chain whereby there are loops on both ends that are large enough to pass the other end thraugh. With slings, the eye is too small to strap or to rig.

Hoisting straps

Hoisting straps resemble straps, but they are flat. They are at least 5 cm wide, the loops are at least 20 cm long, and they are made of woven steel thread or plastic. The inside of the loop is *sometimes protected with leather.* On the required label sewn to the hoisting strap, the maximum allowable safe work load, the material from which the hoisting strap is made, the inspection date and inspection institution are listed.

Label sewn

Safety rules far the use of hoisting straps:

- Watch for sharp angles, protect the strap with special angle protectors or with an car tire.
- Look on the label to see whether the hoisting strap is strong enough for the load.
- The hoisting strap is made of plastic. The ultraviolet radiation in sunlight ages the strap.
- Check the hoisting strap regularly for damage from overload or contact with acid, also under the covering.

Evidence of inspection

Hoisting straps will be rejected if they are worn or split, if there is oil or chemicals on them, if there is something wrong with the metal parts or if the label has become unreadable.
All rejected hoisting tools must be destroyed befare disposal.

Rope

For hoisting, natural-fibra rape and synthetic fibre rope will be applied.
With the use of rope, it must be ensured that it is not affected by aggressive substances and chemicals, oil and grease, rust, moisture, hot items and direct sunlight.
Rope will only be used for *special jobs* and when cables or chains cannot be used, for example when lifting aggressive substances. The rape must be destrayed after use. With rape, a maximum of 1000 kg may be hoisted.

Assembled hoisting tools

An assembly is a combination of a number of hoisting tools that will be used in order to hoist one load, for example a lifting beam with a number of chains or an eye with two, three or four chains (two-, three- or four-legged). A lifting beam is a construction of multiple steel beams in order to spread the load across different chains. A *lifting beam* will be used for a load with complicated dimensions, precisely above the centre of mass, if there is little space above the load and for the multiple placement of similar loads. Because the cables, chains or hoisting straps hang straight down, they cannot shift toward each other.

Lifting beam

When moving a load of 1000 kg, you spread the weight with an equator across two cables. Each of the two cables then experiences a force equivalent to the weight of 500 kg. If the same load is moved with an eye and two cables (two-legged), then the cables are spread at an angle and due to the sideways load, the force per cable is higher. The further the cables are spread, the greater the force becomes. *The legal maximum is 120 degrees.*
The forces in the cables under the influence of the angle when hoisting a load of 1000 kg in a two-legged attachment are:

30 degrees	=	*52% of the load*	=	*520 kg per cable*
45 degrees	=	*55% of the load*	=	*550 kg per cable*
60 degrees	=	*58% of the load*	=	*580 kg per cable*
90 degrees	=	*70% of the load*	=	*700 kg per cable*
120 degrees	=	*100% of the load*	=	*1000 kg per cable*
150 degrees	=	*194% of the load*	=	*1940 kg per cable*

As the angle of the cables in a two-legged attachment becomes largar, the forces on the load also become largar, so that this can break and fall.

10.8 Hand Hoist

A hand hoist is a hoisting device without its own power that is operated by hand. Hand hoists will be used when the use of a crane is not efficient. Also when positioning a load in horizontal and vertical directions, a hand hoist will be used. The greatest danger of the hand hoist is *mechanical failure.* This usually happens from *overloading* the hand hoist. The maximum allowable load is indicated on the hand hoist.

Mechanical failure

Another danger is the failure of the *attachment point.* Ensure that a sufficiently sturdy construction is used. Hand hoists may only be secured to sturdy attachment points, so never to railings, pipes or scaffolding.

Rules for use:

- Inspect the hand hoist before use for damage. In case of defects, return and report.
- Do not load hooks on the point, in order to prevent them from bending open.
- Avoid overloading.
- Lengthening the handle of a hand hoist with a piece of pipe is not permitted because this leads to overloading.
- Return a defective hand hoist for repairs and report that to the supervisor.
- Sideways forces on the cable of a hand hoist are, in connection with overloading, forbidden.

Avoid overloading

10.9 Forklifts

For shifting loads on forks or with special equipment, the forklift (or lift truck) will be used, especially in warehouses but at a number of other places as well. It is tempting to use the forklift for things for which it is not intended. This leads annually to many serious accidents. Dangers when working with forklifts include:

- Falling of the load.
- Tilting of the load and/or forklift.
- Collisions with people, stacks of goods and/or a structure.
- Damaging of goods and equipment through incorrect use.
- Inhaling exhaust gases/dust when using a diesel forklift in an enclosed space.

Forklift operators must have tested *theoretical and practical expertise* in order to be able to drive a forklift. The safety belt must always be used. Some rules for

use are:

- The forklift must be stably loaded with the load spread across the two forks.
- Ride along on the forklift is not permitted without a special second seat.
- Only in a special work basket, under strict conditions, may persons be moved vertically.
- The counterweight may not be increased.
- The view of the driver must be optimal.
- The driving routes must be separated from walking routes.
- Hoisting may only be done with a forklift if it is fitted with a special hoisting set-up.

10.1 Pallet jack

A pallet jack is a *tool with a lift height of 20 cm*, suitable far the manual or electric horizontal shifting of pallets. *Dangers and risks* when working with pallet jacks are:

- Back complaints from incorrect posture.
- Painful shoulders and arms from pulling on the pallet jack with heavy loads.
- Pinching of fingers, ankles, feet and toes.
- Falling of the load.
- Collisions with people, stacks of goods and/or a structure.
- Damaging of goods and equipment through incorrect use.

Good posture

Preventative measures when using a pallet jack are: load it stably, spread over the two forks, move over even ground and ensure that there is sufficient space to manoeuvre. The operator of a pallet jack must attend to good posture and pull the pallet jack in the correct fashion (not pushing!).

10.11 Summary

When working with tools and machines, much can go wrong. In order to prevent this, it is important to use tools and machines properly and to maintain them well. Knowledge and skills in the area of tools and machines is an important condition for working with them safely. Time must always be allowed for clear instructions. Alerting colleagues to incorrect and dangerous use should become a habit, without the atmosphere in the workplace being negatively influenced. Bypassing security devices will be seen in the Arbowet as a serious violation.

Hoisting is a high-risk activity. Therefore, there are high requirements set for the people, equipment and materials. The rules must be strictly followed in order to prevent accidents because hoisting accidents are usually serious.
That unfortunately also applies to the forklift. Only operators with tested expertise may drive the forklift. They know exactly what may and may not and can and cannot be done. A pallet jack is handy for the vertical shifting of a pallet, but there are physical risks associated with it.

10.12 Practice questions for Chapter 10

1. What is the maximum allowable distance on a permanently set-up grinder between the tool rest and the grindstone?

A. 3 mm.
B. 5 mm.
C. 7 mm.

2. What are the most important dangers when working with a drill press?

A. The breaking of the drill bit and the dislodging of the work piece.
B. Strangling from getting your tie caught in the turning drill but.
C. Getting the tips of your work gloves caught by the turning drill bit.

3. Which security devices ought to be installed on a circular saw?

A. A blade guard with blade guard support.
B. Hearing protection.
C. A protective pane.

4. Whích PPE may you not wear near the turning parts of machines?

A. A safety visor.
B. Hearing protection.
C. Safety gloves.

5. What is a safety measure when using pneumatic tools?

A. Take regular breaks.
B. Mount a dead man's switch on the compressor.
C. Check the air hoses before each use for hairline cracks.

6. What applies for hoisting chains?

A. The maximum load far a chain will be determined by the weather conditi ons.
B. You may not use a hammer in order to get chain work into place.
C. Put the hook around the chain in arder to secure the load well.

7. Three loaded pallets that are stacked on top of each other must be moved one by one. What work equipment is the most appropriate far this?

A. A pallet jack.
B. A forklift.
C. A hand hoist.

For special work, there are special management measures in order to counteract and/or reduce the associated dangers and risks. There must be special requirements set for the materials, tools and equipment.
The executing personnel must be trained for the tasks, and the safety provisions strictly followed. The latter must of course always be done, but in particular for the work discussed in this chapter.

11.1 Welding and cutting

Welding and cutting are hot-work activities, for which in many cases, particularly in a risky environment, a safe work permit is required. That is not without reason because welding and cutting are associated with fairly significant dangers and risks.

- *Electrocution.*
- *Fire and explosion from heating and flying splatters.*
- *Burning of the skin and the retinas in the eyes (are eye) by ultraviolet (UV) radiation.*
- *Blinding of the eyes and heat from infrared (IR) radiation.*
- *Poisoning and lung diseases caused by welding smoke.*
- *Incorrect work postura.*
- *Very bright light.*

In order to manage and limit the dangers and risks, a number of safety measures are taken for welding and cutting.
That starts with a work permit. In that, the conditions will be established under which these hot-work activities should be carried out. Extraction of the welding smoke and good ventilation must provide healthy air. *Welding curtains* protect the environment against UV and IR radiation. Appropriate fire-fighting equipment must be within reach, and of course the right personal protection equipment may not be lacking: (ventilated) welding hood or welding goggles (depending on the method of welding, welding apron, welding clothing, gloves and safety footwear (shoes, boots).

Welding curtains

Welding is a process whereby, with the help of heat, two metal parts, with or without the addition of another substance, are attached to each other. When cutting, the metal is 'cut' into pieces with heat.

There are various kinds of welding techniques.
The most common are *electrical welding* (arc welding), whereby use is made of an arc, MIG/MAG welding, TIG welding, laser welding, plasma welding, submerged arc welding, point welding, etc. and oxy-fuel welding. For oxy-fuel welding and cutting, use is made of intense fire, from a combination of pure oxygen and *acetylene*.

Electrical welding

Acetylene

Acetylene is an unstable and very highly flammable, colourless gas. It smells of garlic, is lighter than air, has a large explosive range and is primarily used for

welding.

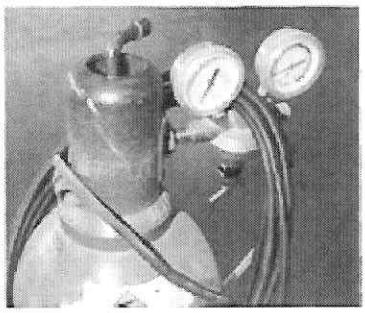
Propane

Propane is a very highly flammable, colourless and odourless gas. For safety, an odour is added to it. Propane has a small explosive range, but in contrast is heavier than air. That means that the gas remains *close to the ground* in the event of a leak, in the area near people, and can gather in pits, cellars and excavations. The *dangers and risks of oxy-fuel welding* are:

- Fire and explosion.
- Fire-promoting and oxidising circumstances due to the presence of oxygen.
- Flash-back of the flame into the cylinder.

Therefore, a number of safety measures must be taken:

- Acetylene bottles must stand upright or lie at an angle of at least 30 degrees. With the use of propane, there must be good ventilation and/or continuous gas measurements.
- There must be *hose-break protection* on the gas cylinders.
- There must be a *flame damper* in the hose between the acetylene bottle and the burner.



11.2 Demolition

Good preparation

Demolition work often entails more risk than construction because unforeseen circumstances can more easily occur. A demolition job *requires good preparation*, and it is not without reason that there are ever-more companies specialised in demolition work. The're a lot of dangers with demolition, and very diverse: stumbling and tripping, collapse, danger of falls, release of hazardous substances, instability of the demolition boundary, protruding construction parts, working at heights, noise and falling demolition equipment.

Safety measures that can be taken to counteract this, are:

- Fall protection.
- Set-up of a demolition plan.
- Do not work above or below each other.
- Use demolition chutes.
- Take into account the carrying capacity of the remaining structure.
- Inventory the concentration of hazardous substances (asbestos inventory).
- Use personal protection equipment: helmet, safety footwear, overalls, breathing protection and hearing protection.

KOMO-certified

If ceramic fibres are discovered during demolition, then there are *a few simple things to do to prevent* dust or fibres from being released and with which they can be removed. This may exclusively be done by employees of KOMO-certified companies. Many specialised demolition companies are *KOMO-certified.* The actions in question are:

- Application of a fixative, with which fibres remain in place.
- The asbestos-containing materials must remain intact as much as possible.
- Do not use demolition chutes.
- Disposable overalls and P3 dust masks must be worn.

11.3 Working around wall and floor openings

Cut-outs

The dangers with wall and floor openings, also called cut-outs, are the d*anger of falls and falling items*. Therefore, cut-outs must be covered with load-bearing materials, affixed to the floor or wall, or a sturdy railing or barrier must be applied. If such security is not possible, then the danger must be marked, and the approach must be hindered.

11.4 Digging and working near and in excavations

For the laying of utilities (electricity, water, gas, communications and sewage), laying of traffic routes (auto, train, metro), canals, the building of construction works and landscaping, there must often be excavation done in the top layer of soil.
In the Netherlands this is, in comparison with many other countries that have rocky soil, relatively easy. That is an advantage, but every advantage has its flip-side. Clays, sandy and especially peaty soils are also unstable.

Excavation damage

In addition, in the densely populated Netherlands, we have already placed many cables and pipes into the ground. Therefore, digging must be done carefully in order *to prevent excavation damage*. The delivery security of the utility companies is at stake, and there are many safety risks and environmental risks, as well as the chance of economic damage. Think about the laying of a metro tunnel in Amsterdam in peaty soil. Despite all the preparations, calculations and measures, things still go wrong, with all the associated consequences thereof.

Dangers and risks with excavation work are:

- *Electrocution due to damage to electrical cables.*
- *Tire and explosion due to damage to gas and oil pipes.*
- *Becoming buried by collapsing walls of the excavation.*
- *Water problems from in-streaming (ground) water.*
- *Soil contamination with hazardous and/or biological substances.*
- *Suffocation due to damage to gas lines.*

Therefore, there are rules established for careful excavation:

- It begins with *requesting information* about the placement of cables and pipes in the ground, the so-called Klic (Kabels en Leidingen Informatie Centrum/Cables and Pipes Information Centre)-report.
- Then test trenches must be dug.
- Only dig after the placement of cables and pipes is established by test trenches within 1 .5 m of the reported location.

Supervisor

- There may only be excavation be done at the direction of the supervisor or contractor.
- Instructions from the utility operator must be followed.
- With use of digging machines, a non-toothed digging bucket must be used.
- Any cables and pipes lying where they are not expected, and any damage, must be immediately reported to the supervisor.

In order to safeguard the safety and health of all persons present, a number of safety measures when working near or in excavations must be taken:

- Walls of excavations must be well braced.
- The slope of the excavation walls must be matched to the depth of the excavation and the nature of the soil.
- The excavated soil must be stored at a safe distance.

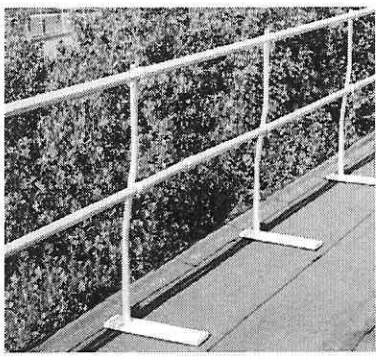
Safe distance

- Vehicles, materials and equipment must remain at a *safe distance.*
- The shoring (protection against calving and collapse) must connect well with the edge of the excavation.
- *A fence* must be placed around the excavation.
- No gas cylinders may stand in the excavation.
- Excavations of 1m or more in depth will be considered as closed spaces.
- Provide two means of access.

11.5 Working at heights

According to the Arbowet, a standing height of 2.5 m above the ground and with falling danger above a dangerous point such as moving parts or a water surface is defined as '*working at heights.*' Dangers and risks with working at heights are: falling from a roof edge or floor, falling through a floor opening or being struck by a falling item. In that case, the health & safety laws (V&G) laws require that preventative measures be taken, such as:

- A safe scaffolding, platform or work floor be used.
- Use effective fences, railings and sidewalls.
- Close off floor openings.
- Use protective equipment such as: safety helmet, safety shoes, fall prevention and nets.



Working on flat and sloped roofs

A flat roof or upper floor usually forms a sturdy surface. That often gives an unjustly secure feeling. For work on flat roofs, there is primarily the danger of falling off. Edge security or a net is required with a danger of falling 2.5 meters or more. *Roof-edge security* can be omitted when the work activities and the route to the work are located more than 4 meters from the edge of the roof and both the work area and the route to get there is marked off with tape or supports. All openings in the roof must be closed off.

Roof-edge security

When the danger of falls despite these measures cannot be entirely excluded, then other measures must be taken in order to limit the consequences of falling,

Safety harness

for example, the placing of nets or the *wearing of a safety harness.* These measures must also be taken if the edge security can only be partially placed or when the use of the edge security creates more danger than is inherent in the work that must be carried out.

In order to have sufficient grip on a slanted roof and when a roof does not have sufficient carrying capacity, walking plans must be used. This allows the weight of the body to be better distributed across the roof. The walking planks must be long enough and must be supported by the beams in the roof. The 60-cm wide walking planks must be fitted every 40 cm with cross-slats in order to prevent slippage. Furthermore, the same rules apply for slanted roofs for fall security as for flat roofs.

Sturdy materials

Wall and floor openings must be covered over with *sturdy materials and provided with proper barriers.* If securing is impossible, the risk must be marked with a colour or written warning. If there are large openings in the roof (cut-outs), then there must be nets hung underneath.

Ladders

The use of the ladder is limited to reaching a certain height and to minor and short-lasting work activities or if a safer alternative such as a scaffold or aerial platform is not possible at a certain location.

According to the law, there must be an indication on the ladder of what kind of ladder it is, the name of the manufacturer and usage instructions in Dutch. Short-term work, for a maximum of 4 hours per day, may be carried out on ladders, as long as the user remains standing with both feet on one rung, with one hand holding the ladder, and it is low-risk work. The reach is limited to one arm's length. When long-term ar regular work at heights must be done, other equipment is more suitable, such as a scaffolding or aerial platform. Before a ladder is used, it must be checked for breakage. *A broken or damaged ladder may not be used.* Only experts may repair ladders. Keep the ladder and the ladder feet clean, since dirt makes breakages invisible. Oil and snow make a ladder slick. Have ladders *inspected* by an expert *at least once per year.* Wooden ladders may not be covered with paint. This makes inspection more difficult.

Inspected

In order to make safe access to a flat roof or elevated floor possible, a ladder must extend at least one meter above the place to which it gives access, or there must be adequate stability provided in another manner for stepping on and off the ladder. The guideline for the maximum height that may be covered by a ladder is 7.5 meters (measured from the foot of the ladder to the feet of the user), and because the user must be able to hold on to the ladder at that height, it must be at least 10 meters long. The force exercised is a maximum of 100 N (10 kg).

Flat,sturdy ground

The ladder must be set on flat, sturdy ground at an *angle of 75 degrees*. In order to determine the correct angle, you should stand with your feet against the bottom of the side rails. If you can grasp the side rails by stretching your arms straight out, then the ladder is set properly. The bottom of the ladder must be fitted with a stability beam. The top must be secured with a rope in order to prevent it from slipping away.
Do not set up the ladder upside down or backwards. With an extension ladder, the minimum overlap length will be determined by the design and the characteristics of the ladder. The different parts may not be able to move with respect to each other. Extension ladders must be set up and moved by two people. Shiftable ladders must be secured before anyone steps on them. *When moving a ladder, no one may be standing on it.*
A metal ladder must stand at least 2 meters away from any non-insulated electrical wires or other elements under voltage. Place a ladder against a window only with a bridging ladder support in place. The access to the ladder must be free or marked. A ladder may never be left (set up) unattended.

Prevent overloading

Do not climb a ladder further than what still allows for a good grip (41h rung from the top). In order to prevent overloading, a ladder in principie *may not be used by multiple people at the same time*. Always use a ladder by facing the rungs, and ensure that you have three contact points with the ladder: two feet, one hand or two hands, one foot. Raise tools and/or materials with a rope to the top. With a wind force of 6 or more, work may no longer be done on a ladder.

Standing steel scaffolds

Steel scaffolds will be used for work activities in construction and for cleaning and remodelling. A scaffold to which a hoist or lifting machine may be attached is a special scaffold. A scaffold that is well built and maintained is a safe workplace. The building and maintaining of the scaffold is work for specialists. There must be an authorised monitor present during the building, and a stability calculation for the scaffolding (platform) as well as instructions for the construction must be available.

Scaffold cards

Scaffold builders *guarantee* that a scaffold is well built. They indicate with the use of scaffold cards ('scafftag') whether a scaffold can be used or not. The scaffold card hangs on the scaffold. A card with the text *'Stelling niet gereed' ('Do not use scaffold')*, meaning that the scaffold should not be climbed. A card that shows *'Stelling gereed' ('Scaffold ready')* means that the scaffold is safe. If the scaffold for any reason is no longer safe, then the scaffold card must be removed from the cover and given to the scaffold builder or site supervisor. Everyone must leave the scaffold until it is again ready for use.

Never change anything on a scaffold yourself. Do not allow materials or tools to swing from the scaffold. A smooth scaffold floor is dangerous. Free the scaffold

of frost or spread sand on the scaffold floor. Remove snow. Use absorptive material for oil and grease. Work may not be done on steps or ladders that stand on a scaffold. If work must be done at a higher elevation, then use an auxiliary scaffold a maximum of 50 cm high and add an additional rail. When adding materials, consider the maximum load of the scaffold. For a normal (light) scaffold, the floor load is a maximum of 150 kg/m2. For a special (heavy) scaffold, that is 300 kg/m2. The load capacity is reported on the scaffold card. Scaffolds must be inspected *once every three months* after building as well as after a storm (wind force 9 or higher). The scaffold card indicates how long the current inspection approval is valid.

Hanging scaffold

Everyone has seen a hanging scaffold before on the facade of a large building. They will be used for maintenance and cleaning work activities. The placement of a hanging scaffold is work for specialists. They must *test the hanging scaffold with at least 1.25x the maximum operating load* before it is put into use. During use, the maximum load may not be exceeded. People who work with the hanging scaffold must have had good instruction from the site supervisor before use, and its operation must be tested. The following must be clearly indicated on a hanging scaffold:

Specialist

- The name of the manufacturer.
- The date on which the hanging scaffold was made.
- The type number.
- The maximum load (which of course may not be exceeded).
- A CE certification mark (for hanging scaffolds after 1996).

Safety harness

There is always a risk that the hanging scaffold begins to hang at an angle. Therefore, the users are required to wear a *safety harness* that must be secured to a special attachment point. In order to prevent someone from being injured by falling items, the area below the hanging scaffold must be marked off with a tape or barriers. If there is a power disruption, the hanging scaffold must be evacuated. As long as there is work taking place on the hanging scaffold, the operations panel must remain manned. A hanging scaffold may never be left unattended when ready for use. The minimum age for the user is 18 years old. If there is no or reduced eye contact with the operator, a communications device must be used.

Communications device

Rolling scaffolds

Rolling scaffolds have some advantages with respect to regular steel standing scaffolds: they are a bit lighter and easier to move. They also have, however, disadvantages: because they are lighter and smaller, they are less stable than a regular scaffold.

Rules for working on a rolling scaffold:

- Block the wheels before anyone climbs on the rolling scaffold.

- Climb the rolling scaffold on the inside. The sides act as ladders.
- Bring all the materials and tools to the top in a safe manner.
- Keep the work floor clean and cover it with sand when slick.
- The stabilisers are intended for steadiness, not for climbing onto the scaffold.
- A rolling scaffold may *never be left unattended.*

There are also rules for moving a rolling scaffold:

- The scaffold may never be moved if there is still something or someone on it
- Ensure that during the move, no tools and material are still on the scaffold.
- Stabilisers must remain as close to the ground as possible, and if there are wheels on them, they must touch the ground.
- Stabilisers cannot be shifted while the scaffold is moving.
- The floor over which the scaffold is moved must be flat and have sufficient carrying capacity. If this is not the case, then use rails or u-channels.
- In order to prevent tipping, a tall rolling scaffold must be dismantled to a maximum height of 8 meters before moving.

Aerial platforms

Moveable piece

The aerial platform is a *moveable piece of work equipment* that is set up for moving people in order to work at heights.
Examples are:

- Self-propelled aerial platform.
- Aerial platform on a boom trailer, truck or van.
- Scissor lift.

The dangers of working with aerial platforms are:

- Electrocution.
- Collision.
- Falling items from the platform.
- Pinching between object and platform.
- Tipping of the aerial platform.
- Falling off the platform.

The operator of an aerial platform must have tested expertise. There must be clear instructions near the controls. The aerial platform must have a valid inspection sticker, clear usage instructions and a plate with the maximum load. In the associated logbook, the inspections, maintenance and repairs are listed.

Attached to the basket

During the work with the aerial platform, it must be set up horizontally on a flat surface and the surroundings must be blocked off. For self-propelled aerial platforms, they may only be driven with the stabilisers retractad, the arm lowered and the basket in the neutral position. An aerial platform is not made for hoisting and it is not a lift. *Stepping off at height is forbidden.* The minimum age for working on an aerial platform is 18. Users *must always wear a safety harness* that is *attached to the basket.* At a height of over 25 meters, a two-way radio

must be used. If an aerial platform is used in a risky environment, then there must be an assistant on the ground.

Work baskets hanging from a crane

Hang work baskets with a four-legged attachment of high-quality steel cable from a crane. They may only be used if scaffolds, aerial platforms and ladders cannot be used. They must be inspected and there must be written proof of this available. On the outside of the basket, information must be presented about the allowable work load, its own mass and the permissible number of persons. The rules for use are strict:

- The minimum age for users is *18*.
- The crane operator and the basket personnel must, where possible, have eye contact, and *they must be able to communicate with each other.*
- One person gives instructions to the crane operator. If multiple people give instructions, confusion arises.
- The required safety harness must be strapped to the basket.
- Stepping in and out may only be done on firm ground. Use as a lift is an improper use of work equipment and forbidden.

Eye contact

11.6 Working in closes spaces

Characteristics

A closed space is a (work)space with the following characteristics:

- *Narrow, often small, wet, slick space with little room for movement.*
- *The space is not intended for regular use by people.*
- *Often cables and pipes in unexpected places.*
- *Very little natural ventilation.*
- *Difficult access: escape and assistance are difficult and contact with the outside is poor.*
- *Poorly lit, often no daylight.*

Even if not all the characteristics are present, there can still be a closed space. Examples of closed spaces are: storage reservoirs or tanks, sewers and pipes, lift shafts, crawlspaces and cellars, and tents used for excavations, contaminated soil and laying pipes.

Dangers in closed spaces

Fire and explosion

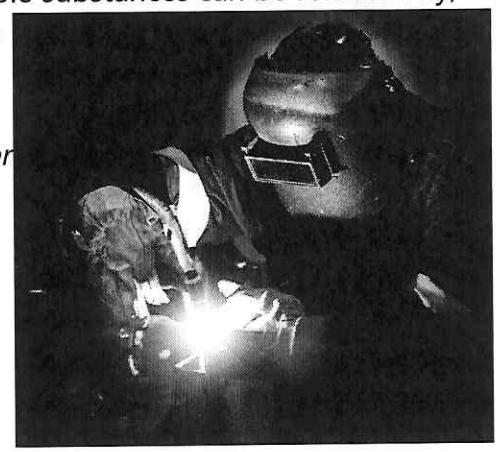
In a closed space, a flammable mixture of gases or vapours can easily be created, because there is little or no natural ventilation. Therefore, the lower explosion limit, the LEL, can quickly be reached, for example when spraying paint or painting in a tank. There can also still be residues of flammable substances present. In order to have a safety margin, *10% of the LEL is used as the limit* for being able to enter a closed space. Above that, the space must be evacuated,

Safety Margin

and measures must be taken in order to lower the percentage.

With movement and increasing temperatures, liquids can vaporise more quickly. When working in a closed space, flammable substances can be released by, for example, leaks from gas bottles or hoses when welding. Extra oxygen from leaks in hoses of oxygen bottles or burners that are not properly closed lead to *increased danger of fire and explosion.* In addition, (soiled) cleaning rags and waste from, for example, wood and paper are flammable substances. With open fire, welding flames and glowing hot metal parts created by a cutter, an uncontrolled fire can easily occur.

Increased danger



Suffocation

Oxygen deficiency

If oxygen is used up or replaced by an inert gas, an *oxygen deficiency* can quickly be created in a closed space. Oxygen will be used by burning, welding, rust formation, respiration and the curing of paint of adhesivas.
With a too-low oxygen percentage, the lungs cannot take up *sufficient oxygen.* You become groggy and sleepy and become unconscious before death. With an oxygen percentage of <19%, the oxygen deficiency can be corrected with mechanical aeration, or independent breathing protection can be used.

Poisoning

The chance of poisoning in a closed space is bigger than outside. With the limited size in combination with a lack of ventilation, the *concentration* of released or present dust, gases and vapours can quickly become dangerously high. Through swallowing, inhaling or contact with the skin, poisoning can occur. Toxic substances can be created in a closed space by work activities such as painting, spraying (solvents) or welding (vapours), or they come from outside the closed space. In sewers, methane and the very toxic hydrogen sulphide (H 2S) are created by *decomposition processes.*

Decomposition processes

Sometimes it appears that tanks are clean, but toxic and flammable substances often still come out of pares and rust in the walls. Filter masks may NEVER be used in closed spaces. They do protect against dangerous substances but not against a possible oxygen deficiency.

Electrocution

The chance of electrocution in a closed space is increased because the temperature in a narrow space is high, among others as a *result of too little ventilation.* With perspiration, the resistance of the skin decreases. Closed spaces are often damp and built from metal that conducts electricity well.
In a closed space, work may therefore only be done with a safe voltage: a maximum of 50 volts AC or 120 volts OC. Electrical devices must be properly cleared

of voltage and secured against engagement with locks.

Falls and slips, moving parts and filling items

Good lighting

Closed spaces are often small and there are often cables and pipes running through them. There is a big chance of falls, trips and getting pinched. Good lighting, caution and keeping things tidy are preventative measures. In large storage tanks, there are often stirring mechanisms. When working in the tank, these must be taken out of service and locked by an expert, but if they unintentionally begin to move, they can create a lot of problems. If work is done in layers above each other, extra attention must be paid to falling items. First, make sure that nothing can fall, and if that still happens, that no one can be struck. The safety helmet is a last (required) defence.

Safety measures for working in closed spaces

Access conditions

Monitor the ventilation

The length of stay in the closed space must be kept to a minimum. Entering a closed space in the petrochemical industry is only allowed with a valid work permit or written permission, and you must have at least two people of 18 years or older. One person carries out the work, and the other acts as an external watcher or manhole watcher who must remain at the entrance. The watcher may not enter the closed space under any conditions. He or she *triggers an alarm* in the case of incidents and dangers and must *monitor the ventilation*. He or she must have *demonstrable tested expertise*. The space must be clean and dry. Exits must be kept free, and barriers and warning signs must be in place. Deep pits or trenches must be provided with at least two ladders. Exits must always be kept free, so that personnel in the closed space and emergency services can easily get in and out. Pipes must be disconnected or sealed off and moveable parts must be taken out of service and locked by an expert.

Isolation (also see 6.1)

Connection flanges

Spectacle flanges

Isolation with flanges is necessary for separating sections of pipes, vats/tanks and equipment. It can be necessary when cleaning, repairing, inspecting, rinsing, removing gas or steaming out pipes, vats/tanks and equipment.
In a closed space, there are often supply and exhaust pipes. In order to be 100% certain that there is no liquid or gas running through a line, they must be isolated with flanges. Each flange has its own place. There are *connection flanges*, a round plate that is placed between two parts of the pipe, and *spectacle flanges*. For the latter, part of the flange in the pipe can be turned open or closed. It is then always clear whether the pipe is open or closed, and that the right flange is being used.
Flanges may only be installed and removed by trained *flange installers*. In order to prevent the remains of materials being able to flow into the closed space, the isolation of pipes with flanges must take place as close to the closed space as possible.

Ventilation

After the opening of a closed space, it must first be ventilated. With overall ventilation, substances can be evacuated from the closed space and the oxygen level can be raised to normal. If substances such as welding vapours are released by the work activities, then they will be locally extracted.
With the release of substance from the space and from the work activities, overall ventilation and local extraction will be combined.

Measuring

Oxygen deficiency

If there is a chance of an oxygen deficiency or a too-high concentration of hazardous substances, then measurements must be taken at various places and sometimes also continuously for EX-OX-TOX (EXplosive-Oxide-TOXic substances):

- The oxygen percentage must be at least 19%.
- The concentration of flammable gases must be lower than 10% of the LEL. Then there is time to evacuate the space and engage countermeasures.
- The concentration of toxic substances must be lower than the limit value.

All measurements must be carried out by *specially trained personnel.* Errors in measurements and incorrect interpretation of the measurement data can endanger lives.

Gas bottles forbidden

Gas bottles are forbidden in a closed space. In a closed space, gas can be used via hoses. The gas bottles remain outside the closed space. The hoses must be checked for leaks in advance. During breaks, the burners and hoses must be brought outside, and the gas bottles closed. The hoses must be secured with *hose-breakage security*, which ensures that in the event of a hose breakage, the gas flow will be stopped.

Hose-breakage security

Special tools

There are special tools for working in closed spaces, when the risk of fire cannot be entirely avoided, for example pneumatic tools, gas-tight lamps and spark-free tools. Welding and cutting is then not possible.

Alarm procedures

Before the work in a closed space takes place, the measures must be discussed thoroughly. It is important that everyone knows the (alarm) procedures, that everyone knows what risks there are and how the work must be done. This can all be included in the *safe work permit.*

Safe work permit

Welding and cutting in closed spaces

Measures for working with fire in a closed space are:

- Flammable substances should be removed or sealed.

- Fire extinguishers should be kept within reach.
- Be extra attentive to oxygen leaks.
- Local extraction of welding vapours.
- Use a safe voltage for arc welding: maximum 50 volts AC and 120 volts DC.

Paint spraying

Large surfaces will often be handled with a paint spray. Extra measures apply for this:

- *Independent breathing protection (breathing mask or fresh air cap) is required.*
- *In order to remain below 10% LEL, ventilation of the whole space is required.*
- *All equipment must be grounded in connection with static electricity.*
- *Ventilation must continue until several days after the painting, because the paint continues to cure for a couple of days.*

Personal protective equipment (PPE)

For work in closed spaces, at least the following PPE apply:

- Protective overall.
- Safety glasses.
- Gloves.
- Safety shoes/boots.
- Safety helmet.

11.7 Summary

Specific work activities require specific attention.
For the different kinds of welding and cutting, appropriate measures must be taken, and the right equipment must be used.
Demolition is often more dangerous than construction. Specialists know all about it! Cut-outs in floors and walls require full attention. Falling accidents are often deadly ...

Digging and working in excavations entail specific dangers and risks that with caution can be counteracted.
Working at heights requires great caution and good preparation, in particular in order to counteract risks at the source. Finally, a safety harness offers the last protection.
Working in closed spaces entails a number of serious dangers. Only with strict procedures can incidents be prevented.

11.8 Practice questions for Chapter 11

1. What are dangers with electrical welding?
A. Formation of static electricity and high physical burdens.
B. Burns, electrocution and poisoning.
C. Suffocation and power disruptions.

2. What are dangers with oxy-fuel welding?
A. Fire, explosion and flash-back.
B. Flame extinguishment, UV radiation and warping of the work piece.
C. Poor visibility through the welding cap and electrocution.

3. What work activities entail the following dangers: tripping, noise, collapse, working at heights and hazardous substances?
A. Working in closed spaces.
B. Working in or near excavations.
C. Demolition work.

4. What are rules for careful excavation?
A. Only dig after the locations of cables and pipes are known, dig test tren ches and do not dig with a toothed digging bucket.
B. Only dig with hand tools and do not dig deeper than 50 cm.
C. Only dig at places that are marked by the supervisor with red-white tape and only in daylight.

5. What are specific dangers when working in a closed space?
A. Falling danger, cutting danger and stress.
B. Electrocution, are eyes and sin burns.
C. Fire, explosion, suffocation and poisoning.

6. The LEL will be quickly reached in a closed space. Why is that?
a. There is very little natural ventilation.
b. Toxic substances are released easily.
c. There are always open connections with the rest of the installation.

7. What is the task of a manhole watcher?
A. Maintaining supervision of the progress of the work and offering first aid with incidents in closed spaces.
B. Maintaining supervision of the people in the closed space and the sur roundings and raising the alarm in case of incidents.
C. To check every fifteen minutes whether everything is going well in the closed space and to check and test tire extinguishers.

Electricity is as old as the Earth, but methods for practical use were only discovered in the nineteenth century. In our modern society, a life without electricity is barely imaginable. Electricity is not only very useful and easy, it is also a risk source that contributes to many accidents.

12.1 Dangers of electricity

Electrocution

The immediate dangers that are associated with the use of electricity are: current passing through the body (electrocution), wounds from fire phenomena (sparks and ares), fire and explosion. An indirect danger or secondary accident is for example *a fall as a result of a shock reaction* in the event of a (non-)damaging electrical shock. With an electrical short, people can be hit by flying materials, or can be thrown back by the pressure wave.
Accidents with electricity will be caused by:

- Defects and improper machines, devices and lines.
- Poor or missing grounding.
- Faulty connections or installation.
- Direct or indirect contact with parts under voltage.
- Inadvisable use of electrical installations and/or materials.
- Carelessness, inattention and ignorance.

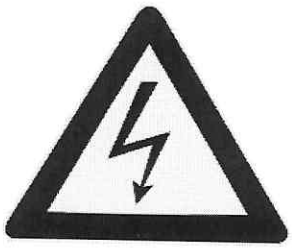
Electrocution

The injury from current passing through the body is dependent on:

- *The current strength.*
- *The voltage (kind and level).*
- *The path of the current through the body.*
- *The duration of the flow of current.*
- *The condition of the victim.*

Amperes

Influence of the resistance and the current strength. Current strength will be expressed in *amperes* (A). A low-voltage installation, as in residences, is fused at 16A. One thousandth of one A is a milliamp (mA).



Starting at 30 mA, there is a chance of increased blood pressure, irregular heart rhythm, cramps, unconsciousness or heart fibrillation-uncontrolled contraction of the heart muscle, also called a heart attack.
The consequences above are also dependent on:

- They type of voltage: alternating current or direct current.
- The resistance of the soil (and footwear): a rubber mat and a linoleum floor conduct electricity poorly and have a higher resistance than a concrete or tiled floor. *Fluids are good conductors*, so a wet floor has lower resistance than a dry one.

Conductors

First aid

If someone is affected by electrical current, then the supply of current must first

be broken. Breaking the current will usually be done by flipping a switch or the mains or by pulling the plug out of the socket. When that is not possible, then try to get the victim loose from the current line. Be careful in doing this and *first ensure your own safety*! If the current cannot be broken in a normal way, then do the following:

- Stand on a dry, insulated item (for example, a rubber mat).
- Wrap your hands with a dry, insulating material (plastic, rubber or leather).
- Use a dry stick to remove the current line or the device from the victim.

Never, however, take the actions above with a broken high-voltage line or tram or train lines. The danger to yourself is too big. In such a case, call the fire department or the police (112).

Alternating and direct voltage

Direct current

In residences and other buildings, alternating current will be used. Direct current is found in *batteries and battery packs*. Direct current is in general less dangerous than alternating current. Direct current in the case of electrical shorts does cause larger ares than alternating current.
A safe voltage, that is, a voltage that is not deadly, is a maximum of 50 volts for AC current and a maximum of 120 volts for direct current (under dry conditions).

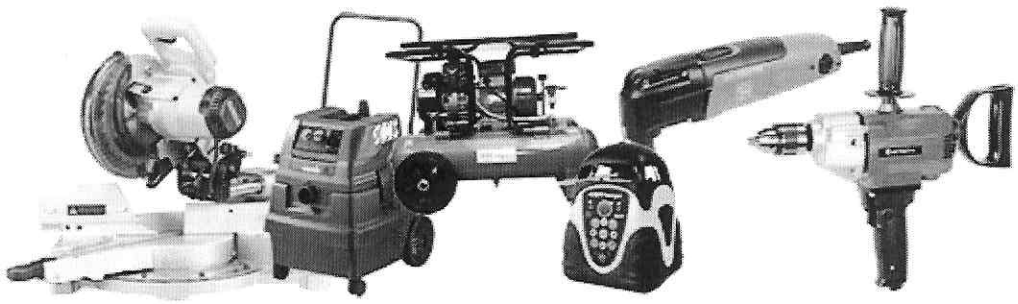
12.2 Safety measures for working with electricity

Safety grounding

A safety ground is a connection of the protruding metal parts of electrical devices with the earth. The goal of this is to prevent the protruding parts from developing voltage in the event of a defect in an electrical device.

Double insulated

Electric hand tools are not grounded, but *double insulated*. That can be seen from the symbol with the two nested squares on the device. Double-insulated electrical devices have a moulded plug without grounding and are not grounded via the power so urce.



Preventative measures

On scaffolds, this kind of equipment is often used. Therefore, *scaffolds must be grounded* in order to prevent them from acquiring a voltage in the event of damaged cables. Workplace and storage containers must also be connected according to the instructions far this reason. Preventative measures in order to protect people against dangers of electricity are:

- Physical isolation, such as the shell of a washing machine or a door for a switch or meter box.
- Insulation of wires, cables and equipment with *non-conductive material.* Non-conductiva materials are rubber, plastic and ceramics. It can only be removed by breaking it.
- Double insulation, so that the voltage-bearing parts are insulated and the outside of the device consists of insulating material.
- Ground-fault security with a grounded switch that reacts to current leakage (the difference between the outgoing and incoming current) and, at values above, for example, 30 mA, cuts the voltage. For extra safety, a *building power connection box* is fitted with a ground-fault switch of 30 mA per outgoing lead. The ground-fault switch increases safety because it protects against electrocution, but it does not offer absolute safety. It offers no protection against surges, overheating or short-circuits. The ground-fault switch must be tested regularly.
- Use of a safe (low) voltage of less than 50 volts AC and 120 volts DC.

12.3 Temporary electrical equipment

Exterior damage

At construction sites, use will often be made of *temporary electrical equipment.* With that, thought must be given to cable winders, extension cords, electrical tools and construction power boxes. Before use, these must be checked for *exterior damage.* Damaged equipment must not be used and must be reported to the supervisor. The ground-fault switch in the construction power box has a general security value of 30 mA per outgoing line.

Cable winders must be *completely unwound.* Rolled cables through which a lot of power is drawn work as a coil. The heat that is generated can melt the insulation with short-circuiting as a result. Pay attention to the *maximum allowable power of the winder* in the wound or unwound condition in order not to overload the cable and to ensure that the cable is suitable for powering the connected devices. One of the VCA requirements is that electrical work equipment be inspected at least once per year for proper operation, the state of the maintenance and the electrical safety. Various security measures can be applied to housings:

- Double insulation, secured against penetration of dust and moisture.
- Secured against penetration of moisture, for example rain.
- Secured against penetration of dust.
- Secured against impacts and falling items.

Degree of protection

The degree of protection is indicated with the *letters IP, followed by three numbers.* The first number stands for the protection against dust, the second against moisture, and the third against impacts/falling items. The higher the number (max. 6 for dust and 8 for moisture), the better the security. The third number is still in development.

12.4 Static electricity

Charge differences

Static electricity arises when two substances, electrically separated from each other, have *charge differences.*
With friction, substances can slowly become charged. Lightning is a known example of the discharge of static electricity. Due to friction between a large amount of warm, rising air and colder environmental air, a charge difference is created between the two air types. The charge becomes so high that, just like with a short circuit, a discharge takes place. Sensitive electronic devices can become defective. Walking across synthetic carpeting and friction from clothing on the skin can generate static electricity. If this is discharged by, for example, grasping the tap, you feel a jolt and there is a spark.
In industry, static electricity is *primarily* created by:

- Rising gas or vapour bubbles that create turbulence in pipelines and tanks and vats with stirring mechanisms.
- Paint spraying or similar activities.
- Pneumatic transport of powders and grains in mixers, rotary valves of weighing vats and tanker trucks.
- Turning drive belts over guide rollers.
- Some fluids from streaming through a plastic line or from stirring.

Static electricity can be limited by:

- The grounding of equipment, tanks and pipelines, preferably on the existing ground line net.
- The limiting of flow speed.
- The grounding and limiting of the flow speed when spraying and sandblasting.
- The addition of anti-static additives to liquids.
- The limiting of the fall height of liquids or dust through application of an internal pipe that reaches to near the ground.
- The wearing of anti-static footwear and clothing.

12.5 Summary

Electricity is very handy, but it is dangerous. Therefore, it is good to know the risks and causes of accidents with electricity. On the basis of that, appropriate measures can be taken. Direct risks: current passing through the body, burns from ares, explosion. Indirect risks: falling as a result of shock reactions.
Safety measures include good installation done only by expert personnel, a safety ground, double insulation, annual inspection of electronic equipment, physical isolation, safe voltage and the ground fault switch. Static electricity is a unique form that requires special measures.

12.6 Practice questions for Chapter 12

1. What makes the electrical resistance of the skin lower?
A. Aging.
B. Perspiration.
C. Sunlight.

2. Starting at what voltage is alternating current dangerous?
A. From 50 volts.
B. From 220 volts.
C. From 380 volts.

3. How can overloading of a cable winder arise?
A. By allowing employees to work too much overtime while using electrical hand tools.
B. By allowing the connected equipment to run far a long time at full power.
C. By connecting too much power and not completely unwinding the win der.

4. How does a ground fault switch work?
A. It disconnects the current immediately when the current leakage is too high.
B. It disconnects the current immediately when the current leakage is too low.
C. It connects the current immediately when the current leakage is too high.

5. Which is a short circuit?
A. A situation in which heat is generated in a cable winder.
B. A situation in which the insulation of a power cable is removed.
C. A situation in which two parts with different voltages come into contact with each other.

6. How can static electricity be created?
A. Friction over plastic, walking across a syntheticcarpet and running drive belts.
B. By grounded pipelines for transport of powders, grains and fluids.
C. By electrical currents with high voltages in installations without ground fault switches.

13. Ergonomic workplace

Ergonomics is the science concerned with the design and set-up of the workplace. Such designs or modifications are intended to produce machines, environments and equipment that people can work with without health risks. Ergonomics plays an important role in that. The starting point of health & safety laws is that the labour situation and task must be adjusted to the individual characteristics of the employee and not the other way around. In this chapter, two cases are examined: noise and physical strain.

13.1 Workplace and noise

A lot of noise at the workplace can create a number of dangers:

- It leads to loss of concentration.
- It causes temporary or lasting hearing loss.
- It reduces the ability to communicate.

Results of too much noise are:

- It disrupts the communication that is needed for the work.
- Warnings or calls for help cannot be heard.
- It causes lasting hearing damage.
- It reduces the concentration and causes tiredness, headaches and nervousness.
- It accelerates breathing, increases blood pressure and causes stomach and digestive complaints.

Lasting hearing loss

People with lasting hearing loss have difficulty hearing *high tones* and *soft sounds*. They have difficulty on the telephone and following a conversation in a noisy space, and they often hear whistles, peeps and buzzing tones that do not come from the environment. The noise level will be expressed in decibels (A) or dB(A). The A stands for the filter that is equal to the range of the human ear. Sound pressure will be measured with a noise meter.

Sound is damaging from 80 dB(A). A rule of thumb for the estimation of damaging sound is the level of noise at which you must raise your voice in order to make yourself understandable at a normal conversational distance.

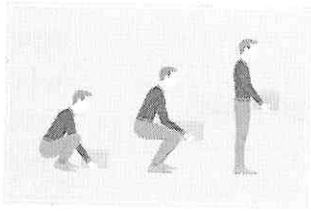
13.2 Physical strain during work

Lifting

The most common physical strain is *lifting*. Lifting is a separate skill. If the proper lifting posture is used, lifting causes less strain for the body, and there is less chance of back complaints. Lifting with a bent back strains the back muscles and/or ligaments too much. Therefore, nerves can become pinched and a hernia can be caused. The best method is to lift with a straight back and bent knees, so that the load is kept as close as possible to the body.

With insufficient grip, the load can slip from the hands and fall on the feet, and when putting the load down, the fingers can be pinched. Therefore, there are rules for *safe and healthy lifting*:

- The employer must provide training and instruction about safe lifting and moving of loads.
- The advised maximum weight to be lifted is 25 kg.
- Heavier and large loads should be lifted with multiple people and/or with equipment.
- Use the right lifting posture: *straight or arched back* and bent knees and hold the load close against the body.
- Avoid lifting while sitting.
- Do not lift too high.
- Do not move the load too far.
- Lift gently.
- Determine the tempo for yourself and take breaks.
- Be extra careful on slick, uneven floors, holes and stairs.



Appropriate protection

People who must lift must wear safety clothing and use *appropriate personal protection equipment* for the lifting, such as gloves and safety footwear. In order to prevent sprains and in order to allow sprains to heal, it is important to regularly change posture.

The employer is required to provide and allow the use of appropriate equipment. If that is not sufficient in order to carry out the work safely, then it must be organised in a different way. Equipment for lifting are, for example, tongs for bricks, magnets for steel plates, suction grips for glass and hand trucks, pallet jacks or shopping carts for heavy loads.

13.3 Workplace and vibrations

Many employees will be exposed during their work to *vibrations* through the use of certain tools and/or vibrations in transportation. Whether vibrations have an influence on health depends on the size, speed and frequency of the displacement (expressed in Hertz: number of vibrations per second) and the duration of exposure.

Physical vibrations

There are two kinds of physical vibrations: *hand/arm vibrations* and *body vibrations*. Hand/arm vibrations usually occur with the use of mechanical (hand) tools. This causes strain to the arms. With body vibrations, the entire body is subjected to vibrations. These vibrations will often be transferred to the body via a large installation, a moving floor or by a vehicle.

Hand/arm vibrations

Regular use of certain mechanical tools (chainsaws, grinders, pneumatic hammers) can lead to pain in the hands and arms, damage to blood vessels and joints in the fingers and hands. With regular rest breaks, tingling sensations in the fingers or numbness can be prevented.

White fingers

Damaged blood vessels and nerves in the hands cause the lasting phenomenon of '*white fingers*'.

Body vibrations

Body vibrations cause tiredness, head and muscle pain and reduced concentration. Body vibrations can also have an effect on the working of the stomach and digestive system or back complaints and can cause disturbance to the balance organ.

13.4 Workplace and lighting

Brightness

Workplaces must be sufficiently well lit. The eyes become tired from too little light, causing mistakes to be made. The nature of the work determines the necessary brightness. For precision work, *higher brightness is needed* than for rough work. There must be sufficient lighting in arder to be able to observe details.

13.5 Summary

Ergonomics is the science concerned with the design and set-up of the workplace. In addition, physical strain and environmental factors such as sound are also considered.

Too much noise can cause lasting hearing loss. Physical or bodily strain will primarily be caused by lifting. By taking the correct measures, lifting properly and using the right equipment, a lot of pain and work disability will be prevented.

13.6 Practice questions for Chapter 13

1. What are the possible results from too much noise?
A. Deafness in offspring.
B. Disruption of communication and stomach and digestive complaints.
C. Dizziness and ear pain.

2. How can hearing loss be recognised?
A. The hearing of a peep tone that does not come from the environment.
B. The hearing of whistling and buzzing tones from the environment.
C. Not understanding a partner in conversation at a distance of less than 1 m.

3. In what units will the noise level be expressed?
A. In joules.
B. In parts per million (ppm).
C. In dB(A).

4. What is the rule of thumb in order to know without using a sound meter whether a sound is damaging?
A. If you hear whistling, peeping and buzzing tones.
B. If the machines make more noise than the radio.
C. If you need to raise your voice in order to be understood at a normal conversational distance.

5. Which safety measures can be taken when fitting and moving a load?
A. Lift gently, not too high and not too far.
B. Lift at least 25 kg at one time, preferably while sitting.
C. Lift as quickly as possible with straight knees.

6. What must someone do for a task that requires a lot of lifting?
A. Refuse the work, because a lot of lifting is legally forbidden.
B. Regularly change positions.
C. Use equipment as much as possible with light loads.

14. Personal protective equipment

When we want to protect ourselves from dangers at work, personal protection equipment (PPE) is often too quickly used. That is easier than the realisation of source resolution or collective protection. The use of PPE must be a last resort for safety, when other management measures are not possible. Therefore, PPE are discussed in this last chapter. Producer, employer and employee each have their own obligations in the area of PPE.

14.1 Tasks, responsibilities and obligations for the use of personal protection equipment (PPE)

Protect

PPE cannot prevent accidents. They only prevent or reduce injury from accidents and incidents. They protect against the consequences of a lack of safety and may only be used when the dangers cannot be removed at the source, isolated or screened off, and cannot be solved by collective measures.
PPE means any equipment that is intended to be worn by the employee or to be attached to the employee in order to protect against one or more dangers that can threaten his or her safety or health at work. All accessories are also included.
There are three parties involved with the PPE.

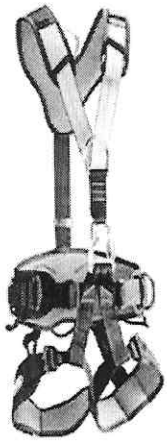
Legal CE requirements

- *The producer*: The producer must ensure that the PPE actually offers the promised protection, that they are *reliable and tested*, and that they meet the *legal CE requirements*: effective (ensure sufficient protection with possible accidents), ergonomically responsible (as comfortable as possible to use) and supplied with clear usage instructions.

- *The employer:* The employer or the user company is responsible for the free provision of the correct PPE, the (having given) giving of the associated instructions and the maintenance of supervision of the proper use thereof.

- *The employee*: Finally, the employee is obligated to use the PPE in the correct manner, and to clean them according to the instructions. The maintenance consists of regular checks, careful storage and good care and management.

There are *several kinds of PPE* for the protection of eyes, ears, breathing, head, hands, feet and body.



14.2 Eye and facial protection

Dangers that threaten the eyes and the face are:

- Flying hard, sharp bits.
- Flying hot bits from grinding, welding and cutting.
- Flying particles from chopping and drilling.
- Flying splatter of corrosive, irritating or damaging liquids.
- Heat, light and radiation (UV and IR).

Safety glasses

The lenses of safety glasses are made from *temperad glass or plastic*. They can be fitted with side guards that also protect the eyes from the side. The frame of safety glasses is often made from *non-flammable material*. Contact lenses offer no protection and can create problems and present a danger in dusty spaces. The safety glasses offer protection against flying hard, sharp bits.

Safety goggles

Dusty environment

Safety goggles wrap completely around the face and can best be compared with ski goggles. On the sides, there are open or dustprotected ventilation hales. Goggles are suitable for working in a *dusty environment*, when chopping, drilling and grinding, and against splatter of hazardous liquids.

Face shield

A face shield has a *plastic or metal mesh screen* and protects not only the eyes, but the entire face. Sometimes, it is fitted with a chin strap. The face shield is suitable for *working above the head*, working with high-pressure cleaners and chemicals and protects against flying dust and hot particles from short circuits. Because the face shield is not fully attached to the face, it will fog up less quickly than goggles, but it offers no protection against dust, gases, vapours or particles that get underneath it.

Welding goggles and welding helmet

Welding goggles will be used for welding with gas (oxy-fuel welding) and protect against *IR radiation* (light, heat) and metal splatter. It also offers protection when de-burring the welding seam and when grinding. A welding helmet (or welding shield, welding mask) will be used for electrical welding (arc welding) and protects the whole face against UV and IR radiation (blinding light and heat) and metal splatter.

Two windows

The welding goggles and the welding helmet both have *two windows*. Below the clear window of tempered glass for protection against hot metal splinters and splatters, there is a darker window. The darker glass protects against the radiation of light and heat. Ultraviolet radiation burns the skin and can lead to skin cancer. With electrical welding, use may not be made of welding goggles.

14.3 Hearing protection

People who must work in an environment with *damaging noise* (from 80 dB(A)) can protect themselves with hearing protection. Because these only help if they are always, without interruption, worn, comfort of wear is of great importance, and they must sufficiently dampen the noise. An excess of noise during work leads to noise deafness; the noise can mask other sounds (which you no longer hear through the noise) and it disrupts comprehension.

Deafness

Kinds of hearing protection

Comfort of hearing protection is very individual, so the involvement of the users

in the choice of the equipment is important. Personal hearing protection comes in many kinds and sizes. The operation differs greatly between types.

Plugs

Wadding or pellets provide a maximum sound dampening of about 10 dB(A). They are made from *plastic-coated glass plugs* and are meant for one-time use. Plugs give a maximum sound dampening of 10-15 dB(A). They are specially *shaped plastic* rods or memory foam rolls that are inserted into the ear.
Universal banded ear plugs give, depending on the tone level, a sound dampening of 10-15 dB(A). Banded ear plugs are attached to a bracket that is worn around the neck.
Custom-moulded earplugs provide sound dampening of about 25 dB(A). Custom-moulded earplugs are individually measured on the basis of a wax mould of the ear. They are made of plastic and fit into the entrance to the ear canal without putting pressure on the walls of the ear canal. They are comfortable, very durable, but expensive. The replaceable and adjustable filter in the custommoulded earplugs will be adjusted to the situation, allowing the human voice to continue to be clearly heard.

Ear muffs: look like large headphones, they shut off the ears from the surroundings, the protection factor depends on the type of protector and the pitch of the noise, maximum protection approximately 25 dB(A).

Legal rules for hearing protection
The main points from the health & safety (V&G) law are:

- *(damaging) sound must regularly, in any case if circumstances change, be measured and tracked.*
- *At sound levels of 80 dB(A) or more, the employer must inform employees about the dangers of sound. In addition, the employer must provide employees with the opportunity to have their hearing checked regularly and must make hearing protection available.*
- *At sound levels of 85 dB(A) or more, the employer must also take measures in order to reduce the noise level to below this limit, and the employee is legally required to wear the provided hearing protection.*

14.4 Breathing protection

Breathing can be threatened during work by a too-low concentration of oxygen, a too-high concentration of hazardous vapours, gases or particles or of nuisance vapours, gases and particles.
There are two kinds of breathing protection: *dependent breathing protection and independent breathing protection.*

Dependent
Independent

With dependent breathing protection, the environmental air is inhaled through a filter mask with a dust and/or gas filter, and people are dependent on the environmental air. With independent breathing protection, no use is made of the

environmental air. Air will be carried in a respiration cylinder or clean air will be supplied through a hose via a respiration line or a rebreather unit connected to a fresh air hood.

Dependent breathing protection

There are two kinds of filter masks: *dust-filter masks and gas-filter masks.* A dust-filter mask protects only against dust or mist. A gasfilter mask can protect against contamination by gas, vapour, smoke, mist and dust above the limit values when working or evacuating in emergency situations. When choosing the right mask, the risks of the place where the work will be carried out must be taken into account. There are great differences in the quality and the effect of different dust- and gas-filter masks.

Choose the right mask

A gas filter must be matched to the gas, dust or mist to which people could be exposed. For organic solvents, a different filter canister is needed than for acids. Gas filter canisters have the limitation that they can only *filter small amounts of hazardous substances* from the environmental air. They cannot compensate for an oxygen deficiency. Therefore, they may never be used in a closed space. Filter canisters have a limited durability, varying from 5 minutes to 8 hours. The duration of use is dependent on the kind of filter, the concentration of hazardous substances and the amount of air inhaled. The maximum duration of use is listed on the package. Working with a mask requires *practice and instruction.* Breathe deeply and slowly.

Practice

✖ ***Dust filters are classified into three classes:***
- *P1 for nuisance substances.*
- *P2 for damaging substances.*
- *P3 for toxic substances.*

✔ ***Gas and vapour filters are classified by intake capacity:***
- *Class 1 = small*
- *Class 2 = medium*
- *Class 3 = large*

Filter breathing protection equipment will be made in various versions:
- The mask will only be used for dust and not for gasses and is made from cloth or paper. It is sufficiently secured if no 'draft' is felt with deep inhalation.
- *Half-face masks* enclose the nose and the mouth and are made from rubber. If they are fitted with an inlay mechanism, they are only appropriate for filtering dust. With a screw-mount, gas- and vapour-filter canisters can be attached. Combination with dust filters is then also possible. For those who wear beards, the rubber seal insufficiently seals with the face, so there is insufficient protection.

Full-face

- *Full-face mask* enclose the whole face and further work the same as half-face masks.

Independent breathing protection

Independent breathing protection must be used in an environment with *less than 19% oxygen in the air*, with large and unknown concentrations of hazardous substances in the air and when working in a closed space when the limit values are exceeded.

Compressed air

With breathing-air masks, use will be made of *compressed air from a compressor* via a breathing apparatus supplied through (respiration) lines or lines on a ventilator. Only people who are medically approved and have had special training with an exam at a recognised centre may work with respiration equipment. Use can be made here as well of half- or full-face masks with known limitations for people who wear beards. With (fresh) air hoods, use will be made of air that is supplied from outside by a pump through a hose and a filter. Air hoods will be placed over the head and attach at the chest.

The pump provides *positive pressure of fresh air* in the hood, so that no contaminated air can be inhaled. The air will vented out at the bottom of the hood on the front. Communication with the wearer is difficult, so measures must be taken in order to improve that.

Check

Before the use of breathing protection, instruction and practice in a space without hazardous substances is required.
The air from a (fresh) air hood must always be pumped via a filter to the hood. Always check whether the mask fits well and provide good maintenance and regular cleaning. Also check whether the correct filter is placed in the correct way.

14.5 Head protection

The safety helmet *is the only protection device* for good protection of the head against impacts and falling items. The interior of the helm distributes the force from a blow or from a falling object across the entire head.
The interior of a safety helmet *must be set properly on the head*. The exterior must be sufficiently sturdy to ensure that, for example, a falling object cannot reach the head.
If a helmet is damaged or a has taken a blow, it must be replaced. Stickers and paint can compromise the helmet and can make damage invisible. The helmet ages more quickly from sunlight, so do not leave it in a sunny place.

Maximum duration

Helmets have, depending on the kind of material from which the helmet is made, a *maximum duration of use*. In the helmet, the production date is indicated. Metal impact helmets may not be used in industry because they are electrically conductive.

14.6 Hand and arm protection

There are different gloves with or without wrist shields that protect against all kinds of situations: cold, heat, radiation, skinning by sharp objects, liquids and chemical substances. The wearing of gloves is very important because for many work activities, the hands will be used. *Gloves are made for every kind of work.* It is important to know which kind of gloves should be worn for a task. Gloves can be classified by what they are made from - for example, rubber, leather, PVC, neoprene, vinyl or even lead - and by the shape -regular gloves and gloves with an extended wrist and/or arm protection.

Classified

Do not wear leather or fabric gloves when using chemicals, for example with solvents, acids and bases. *Never wear gloves in the area of turning parts, because gloves can get caught in them.* When cutting, cut-resistant gloves are worn by butchers, poultry dealers and fish sellers. Insulated gloves are suitable for working with heat and cold. Rubber or plastic gloves protect against hazardous substances.

14.7 Foot and leg protection

Safety shoes and safety boots are known as safety footwear. Good safety footwear have the following characteristics:

- A reinfarced toe, in order to protect the toes against heavy objects.
- A reinforced sole, in order to protect the feet against stepping on sharp objects.
- An oil- and chemical-resistant and anti-static sale, in order to protect against slipping and the accumulation of static electricity.

In construction, safety shoes with reinforced toes and soles are required. In order to use safety footwear safely, the shoes or boots must be *cleaned and lubricated regularly.* This keeps them water-tight. In order to prevent them from splitting, wet shoes should never be dried out near the heater. Split footwear and footwear that has come into contact with toxic substances must be replaced.

14.8 Body protection

Dangers that threaten the body during work are: hazardous substances, contamination, heat, cold, rain and poor visibility. There are different kinds of body protection: the overall, protective clothing, disposable clothing, outer wear, insulating undergarments, rain clothing, reflective clothing and anti-static clothing. The *overall* is the most commonly used as body protection against contamination.

Overall

For welding and grinding, the overall must be made of n*onflammable or fire-retardant* (not fire-sustaining) material. The overall must fit well, and there must not be any loose-hanging parts such as fringe and wide sleeves on it.
For certain work, plastic disposable clothing will be used. Due to the limited

Disposable clothing

ventilation, wearing the disposable overall quickly becomes stuffy. After wearing once, *disposable clothing must be thrown away.* Reflective clothing improves visibility of employees, for example when doing road work.
Anti-static clothing will be used in an environment with explosive danger. This will prevent sparks from being created by a static charge, which could cause fire or explosions.

For the winter, there are special outerwear suits and insulating undergarments. Protective clothing must offer specific protection against special dangers, such as toxic substances, cold, heat and radiation.

Soiled clothing

Soiled clothing must remain with the company for cleaning. Never blow soiled clothing clean with compressed air, since then the contamination is released into the air. Neither should oxygen from an oxygen canister be used, since this increases the danger of fire. *Torn clothing* must be repaired or replaced. Use only tightly-closing clothing in order to prevent getting caught by moving or turning parts.

14.9 Fall protection

In the first place, everything possible must be done when working at heights (above 2.5 meters) in order to prevent the danger of falls. Only if collective protection such as roof edge security, railings on scaffolds and nets is insufficiently possible, do we use *individual fall protection equipment.*

Individual

A positioning system must be used in such a way that falling is impossible by keeping sufficient distance from the edge of the work area (drop). A fall capture system must be used in such a way that the fall height is limited as much as possible and that the shock in the event of a fall is dampened as much as possible.

The *safety harness or harness belt* is the only allowed fall protection equipment. It is an assembly of belts that sit on the upper legs, stomach, chest and shoulders. On the back is a ring to which a clean catch line with a fall absorber must be connected, linking the harness belt with an anchor point.

The safety harness must be well matched to the body measurements of the user. The length of the fall line must be shorter than the fall that can be made. *From 2.5 m,* fall security must be used. A capture line is 1.5 m long, including any absorbing section.
The hip belt may not be used as fall security, but it may be used as distance security. The hip belt must prevent a fall.

Safety harness

A safety harness breaks a fall. If a safety harness has broken a fall, then the entire capture system, including the safety harness, must be *thoroughly checked* by an expert before re-use. Safety harnesses must be inspected annually by a certified company. They must, just like the capture line and the absorber, be stored

in a clean, dry place. Capture lines may not be soiled.
After a fall with a safety harness, the blood circulation in the lower body will be restricted. If help does not arrive within 10-20 minutes, unconsciousness occurs, with death as a possible result. Keep the legs moving as much as possible and pull on the capture line in order to lower the pressure on the legs. For help, there must be at least two people present.

14.10 Summary

PPE is a last resort for protection against possible consequences of incidents. First, measures must be taken at the source or collective measures taken in order to protect employees against dangers and risks. Depending on the kind of work in different situations with different substances, materials and equipment, the choice of the correct PPE will be made. It must be clear who may and must use which PPE when and where.
Correct use and maintenance are what make PPE useful.

14.11 Practice questions for Chapter 14

1. When do we use PPE?
A. If that is easier and faster than collective protection.
B. If source prevention is not possible or insufficient.
C. If the safety inspector is in the area.

2. What do you do after use of PPE?
A. Destroy the PPE.
B. Clean and safely store the PPE.
C. Inspect the PPE.

3. When must independent breathing protection be used?
A. In an environment where there is little oxygen.
B. In an environment where hazardous substances are stored.
C. In a damp environment.

4. Who may use breathing masks?
A. Anyone who understands them.
B. The head of the company.
C. Specially trained and medically approved personnel.

5. What is true for personal fall protection equipment?
A. It may be used up to a height of 20 meters.
B. The safety harness is the only correct PPE.
C. The safety harness and the hip belt offer the same protection.

6. Why must someone who is hanging in a safety harness after a fall be freed quickly from the situation?
A. Because otherwise the blood circulation in the lower body of the victim is in danger.
B. Because the safety harness will fail after 15 minutes.
C. Because the victim cannot move in that situation.

Answers to practice questions

Chapter 1 Laws
1. B 2. A 3. B 4. C 5. B 6. A

Chapter 2 Dangers, risks and prevention
1. B 2. A 3. C 4. A 5. C 6. A

Chapter 3 Accidents: causes and prevention
1. A 2. B 3. A 4. B 5. A 6. B

Chapter 4 Safety behaviour
1.C 2. A 3. B 4. C 5. B 6. B

Chapter 5 Tasks, rights, obligations and consultation
1. B 2. A 3. C 4. A 5. C 6. A

Chapter 6 Procedures, instructions and alerts
1. C 2. A 3. B 4. C 5. A 6. C

Chapter 7 Preparing for emergencies
1. C 2. A 3. B 4. B 5. C 6. B

Chapter 8 Hazardous substances
1. C 2. A 3. B 4. C 5. B 6. C

Chapter 9 Fire and explosion
1. B 2. B 3. C 4. C 5. C 6. C

Chapter 10 Work equipment
1. A 2. A 3. A 4. C 5. B 6. B

Chapter 11 Specific work and circumstances
1. B 2. A 3. C 4. A 5. C 6. A 7. B

Chapter 12 Electricity
1. B 2. A 3. C 4. A 5. C 6. A

Chapter 13 Ergonomic workplace
1. B 2. A 3. C 4. C 5. A 6. B

Chapter 14 Personal protection equipment
1. B 2. B 3. A 4. C 5. B 6. A

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Name candicate: _____

Examination questions:

Event code : Test exam Basic Elements of Safety

Please read the following instructions carefully!

This examination is comprised of **40** multiple-choice questions.
Each question is followed by three possible answers, of which only one is correct.
A maximum of **40** marks can be scored in this examination. Every correct answer scores 1 mark.
You will have passed when you score at least **28** marks.

The maximum time for this examination is **60** minutes.

Requirements:

- these examination questions
- the answer sheet (used to note your answers)
- a pencil and eraser

Directions:

- make sure that you have all the pages in these examination questions
- only use a pencil to enter your answers on the answer sheet
- indicate your answer by using your pencil to blacken the appropriate square
- always thoroughly erase any incorrectly entered answer

A multiple-choice question will be regarded as incorrectly answered when:

- the wrong answer has been chosen
- more than one square has been blackened
- no square has been blackened
- a square has not been blackened, but has been marked in some other way

At the end of the examination:

- write or check your name on the answer sheet
- give the supervisor these examination questions and the answer sheet

1 What is the purpose of environmental legislation?

A To specify the methods that must be used for storing hazardous substances.
B To protect humans and the environment against hazardous substances.
C To regulate the production of hazardous substances.

2 What can the government's Health and Safety Inspection Service do when they see an offence?

A Give the management a reprimand, suspend the work and withdraw the VCA (SCC) certificate.
B Appoint an official to coordinate the work, give a warning and impose a requirement.
C Impose a requirement and/or make a report of the offence.

3 Which factor has a direct impact on the risks associated with work?

A The workplace.
B The supervision exercised by the client.
C The Health and Safety Plan (H&S Plan).

4 What is the purpose of a TRA (Task Risk Analysis)?

A To reduce the risks of the work.
B To eliminate all risks.
C To prepare for the proper execution of the work.

5 Who should you notify right away about an accident?

A The immediate supervisor.
B The medical department.
C The government's Health and Safety Inspection Service.

6 What is an example of safe behaviour at the workplace?

A Always wear hearing protection.
B Call others to account when they perform an unsafe action.
C Never use hazardous substances.

7 What is the best way to avoid tripping at the workplace?

A Make sure the workplace is tidy.
B Make sure the floor is non-skid.
C Have cleaning done more often.

8 What is one of the employee's obligations?

A Do not change protective devices, and use them in the correct way.
B Maintain an accident register.
C Supervise high-risk activities.

9 What colours are used on signs for fire fighting equipment?

A White pictogram on a red background.
B White pictogram on a green background.
C Black pictogram on a yellow background.

10 What are blanking flanges used for?

A To shut off supply lines to storage tanks.
B For moving pipework when working on storage tanks.
C For shutting valves or pressure valves on storage tanks.

11 What is one purpose of a werkvergunning (work permit)?

A All those involved in the work must consult about the safe execution of the work.
B The government's Health and Safety Inspection Service can check which activities are performed.
C It allows the arbodienst (Occupational Health and Safety Service) to determine whether the employees involved need to undergo an examination.

12 What does this sign mean?

(white symbol on a blue background)

A Watch out for falling objects.
B Keep fall protection equipment ready for use.
C The use of fall protection equipment is mandatory.

13 What must be included in a company emergency plan?

A The phases of dealing with emergency situations.
B When evacuation drills are to be held.
C Which substances and processes on the site may cause emergency situations.

14 Hazardous substances are classified by category. What are some of these categories?

A Flammable - corrosive - harmless.
B Explosive - highly/extremely flammable - harmful.
C Harmful - carcinogenic - suffocating.

15 What is the best way of limiting exposure to toxic substances?

A By always having the same person work with the toxic substance.
B By training employees in working with toxic substances.
C By using another, non-toxic substance.

16 The following pictogram is displayed on the packaging of a substance. What is a characteristic of this substance?

(black symbol on white background with red border)

A Corrosive.
B Highly flammable.
C Oxidising.

17 Which substance is an organic solvent?

A White spirit.
B Water.
C Mercury.

18 What is the LEL (Lower Explosion Limit) of a gas?

A The highest concentration of the gas at which an explosion can occur.
B The lowest measurable concentration of the gas.
C The lowest concentration of the gas at which an explosion can occur.

19 What is the first thing you should do if you discover a fire?

A Alert the fire department.
B Alert the police.
C Ensure one's own safety.

20 What is an explosion-hazardous environment?

A An environment in which an explosive mixture can arise.
B An environment where many explosions happen.
C An environment with too much gas and too little air.

21 Which of the following is a risk associated with permanently installed grinders?

A The grinding stone can bite into the material.
B The grinding stone can disintegrate.
C Due to the low rpm, the grinding stone can come off its shaft.

22 Is the earthing of double insulated electric hand tools permitted?

A This is only permitted with the employer's approval.
B Yes, this is permitted.
C No, this is not permitted.

23 When must a lifting sling be rejected?

A When it is more than two years old.
B If the lifting sling has been exposed to sunlight.
C If the label is unreadable.

24 What is one of the rules that applies to the use of chains?

A Completely screw in the shackle pins.
B Grease the chain before hoisting.
C Always work in pairs.

25 Which rule applies to the use of a manual hoist?

A You must always load the hook on its point.
B A manual hoist may only be loaded in a vertical position.
C A manual hoist must never be overloaded.

26 Are you allowed to increase the counterweight on a forklift?

A Yes, this is permitted by at most 10% of its weight.
B Yes, this is permitted at any time.
C No, this is not permitted.

27 How should an acetylene cylinder be positioned during welding?

A The cylinder may be laid down on the floor.
B The cylinder must always be in an upright position.
C The cylinder must be positioned at an angle of at least 30° to the floor.

28 How can you prevent falling hazards at the edge of a work floor?

A By putting proper barriers at the edge of the work floor.
B By giving the workers proper instruction at the start of the work.
C By placing warning signs at the edge of the work floor.

29 What is the best safety provision for a floor opening?

A The floor opening must be covered with materials capable of carrying heavy loads.
B The floor opening must be properly lit.
C Sufficient warning signs must be placed around the floor opening.

30 Hazards can arise during excavations due to the fact that there are many cables and pipelines buried in the ground. This is why 'rules for careful excavation' have been established. What is one of these rules?

A First manually dig trial trenches close to the specified location of the cables or pipelines.
B When using an excavator always use a toothed excavator bucket.
C Never dig in areas where cables or pipelines are known to be buried in the ground.

31 Which of the following is mandatory when working from a safety cage at height?

A The safety cage must be suspended from a chain or a steel cable.
B Everyone in the safety cage must wear a safety harness attached to the safety cage.
C Everyone in the safety cage must have a walkie-talkie.

32 You are spray painting in a confined space. Why do you have to ventilate this space?

A In order to remain below 10% of the Lower Explosion Limit (LEL).
B In order to remain below 50% of the Lower Explosion Limit (LEL).
C In order to remain below the Lower Explosion Limit (LEL).

33 What affects the size of an electric current passing through the human body?

A The length of the exposure.
B The body temperature.
C The resistance of the ground or floor.

34 Why is insulation used for electrical conductors?

A To prevent contact with live parts.
B To prevent damage.
C To limit the consequences of a short circuit.

35 What is a risk associated with static electricity?

A Static electricity can cause non-conductive materials to catch fire.
B Static electricity poses virtually no risk.
C Static electricity can result in a spark that could cause an explosion.

36 What is important for manually lifting an object that is on the ground?

A That after you have lifted the object you can turn it sideways.
B That you lift with a straight back and bent knees.
C That your feet are spread apart as far as possible.

37 What must you do with your personal protective equipment (PPE – Dutch abbreviation: PBM's)?

A Take proper care of it.
B Have your name put on it.
C Have an expert inspect it after every use.

38 What hazard do safety goggles protect against?

A Dust.
B Bright light.
C Heat.

39 What is it impossible for gloves to protect against?

A Moving parts.
B Hazardous substances.
C Cold or heat.

40 What rule applies to the use of protective clothing?

A Immediately replace torn/worn clothing at your own cost.
B Immediately have torn/worn clothing repaired or replaced.
C Replace clothing once a year.

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Examenevenementcode

Proefexamen_Basis	VCA	

Nummer Examencentrum

Examencentrum

Lokatie

Datum examen

Examenvorm
○ Schriftelijk ○ Voorleesexamen (alleen voor VCA Basis)

Nummer kandidaat

Achternaam

Voornaam of voorletters

Geboortedatum

Geboorteplaats

Fouten

Score

Let op! Alleen invullen met een zwart potlood, verbeter door het foute antwoord goed uit te gummen. Slechts 1 antwoord is juist!

	A	B	C		A	B	C
1	○	○	○	21	○	○	○
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5	○	○	○	25	○	○	○
6	○	○	○	26	○	○	○
7	○	○	○	27	○	○	○
8	○	○	○	28	○	○	○
9	○	○	○	29	○	○	○
10	○	○	○	30	○	○	○
11	○	○	○	31	○	○	○
12	○	○	○	32	○	○	○
13	○	○	○	33	○	○	○
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15	○	○	○	35	○	○	○
16	○	○	○	36	○	○	○
17	○	○	○	37	○	○	○
18	○	○	○	38	○	○	○
19	○	○	○	39	○	○	○
20	○	○	○	40	○	○	○

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11	●	○	○
12	○	○	●
13	●	○	○
14	○	●	○
15	○	○	●
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19	○	○	●
20	●	○	○

	A	B	C
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28	●	○	○
29	●	○	○
30	●	○	○
31	○	●	○
32	●	○	○
33	○	○	●
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37	●	○	○
38	●	○	○
39	●	○	○
40	○	●	○

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