Falck Safety Services
Location Rotterdam
Beerweg 101
Harbour No. 7033
3199 LM Maasvlakte Rotterdam
The Netherlands
Phone  +31(0)181 376666
Fax    +31(0)181 362981
E-mail booking@falck.nl
www.falcksafetyservices.nl

Falck Safety Services
Location Den Oever
Havenweg 11
1779 XT Den Oever
The Netherlands
Phone  +31(0)227 512660
Fax    +31(0)227 512663
E-mail bookingdo@falck.nl
Index

Merchant shipping introduction 5
1. Standards of Training Certification and Watchkeeping STCW. 5
3. Learning outcomes and objectives. 7
4. Merchant shipping national, international and European regulations. 9
5. Familiarization after arriving on board. 10

Personal safety and social responsibilities (PSSR) 12
1. Introduction PSSR 12
2. STCW 2010 & MLC 13
3. Safe working practice 16
4. Contribute to effective human relationships on board ship 26
5. Types of emergencies 28
6. Take precautions to prevent pollution of the marine environment 32
7. ISPS code 36
8. Alcohol and drugs abuse 38

Personal survival techniques 42
1. Lifeboats 43
2. Liferafts 49
3. Personal survival equipment 54
4. Radio communication 60
5. Pyrotechnical distress signals 64
6. Visual and audible distress signals 66
7. SAR organisation 68

Elementary first-aid 74
1. First aid with accidents 76
2. Hypothermia 90

Fire prevention and fire fighting 98
1. Fire fighting on merchant vessels 98
2. Fire prevention 110
3. Breathing protection 117
Merchant shipping introduction

1. Standards of Training Certification and Watchkeeping

This course handout will provide the necessary knowledge and background information for the Basic Safety Training according to STCW 78, as amended, the International Convention on Standards of Training Certification and Watchkeeping for Seafarers, 1978 as amended.

In chapter VI Emergency, occupational safety, security, medical care and survival functions, regulation VI/1 of the STCW Convention the following is written: “Mandatory minimum requirements for familiarization, basic safety training and instruction for all seafarers. Seafarers shall receive familiarization and basic safety training or instruction in accordance with section A-VI/1 of the STCW Code and shall meet the appropriate standard of competence specified therein.”

Basic training
Seafarers employed or engaged in any capacity on board ship on the business of that ship as part of the ship’s complement with designated safety or pollution prevention duties in the operation of the ship shall, before being assigned to any shipboard duties:

Receive appropriate approved basic training of instruction in:
• Personal survival techniques as set out in table A-VI/1-1,
2. Learning outcomes and objectives

**Personal survival techniques** as set out in table A-VI/1-1; Competence, Knowledge, Understanding and Proficiency in survival at sea in the event of ship abandonment.

- Types of emergency situations which may occur, such as collision, fire, foundering.
- Types of life-saving appliances normally carried on ships.
- Equipment in survival craft.
- Location of personal life-saving appliances.
- Principles concerning survival including:
  1. Value of training and drills.
  2. Personal protective clothing and equipment.
  3. Need to be ready for any emergency.
  4. Actions to be taken when called to survival craft stations.
  5. Actions to be taken when required to abandon ship.
  6. Actions to be taken when in the water.
  7. Actions to be taken when aboard a survival craft.
  8. Main dangers to survivors.

**Fire prevention and fire-fighting** as set out in table A-VI/1-2; Competence, Knowledge, Understanding and Proficiency in minimizing the risk of fire and maintain a state of readiness to respond to emergency situations involving fire.

- Shipboard fire-fighting organization.
- Location of fire-fighting appliances and emergency escape routes.
- The elements of fire and explosion (the fire triangle).
- Types and sources of ignition.
- Flammable materials, fire hazards and spread of fire.
- The need for constant vigilance.
- Actions to be taken on board ship.
- Fire and smoke detection and automatic alarm systems.
- Classification of fire and applicable extinguishing agents.
Fight and extinguish fires

- Fire-fighting equipment and its location on board
- Instruction in:
  1. fixed installations
  2. firefighter's outfits
  3. personal equipment
  4. fire-fighting appliances and equipment
  5. fire-fighting methods
  6. fire-fighting agents
  7. fire-fighting procedures
  8. use of breathing apparatus for fighting fires and effecting rescues

Elementary first-aid as set out in table A-VI/1-3, Competence, Knowledge, Understanding and Proficiency in taking immediate action upon encountering an accident or other medical emergency.

- Assessment of needs of casualties and threats to own safety
- Appreciation of body structure and functions
- Understanding of immediate measures to be taken in cases of emergency, including the ability to:
  1. position casualty
  2. apply resuscitation techniques
  3. control bleeding
  4. apply appropriate measures of basic shock management
  5. apply appropriate measures in event of burns and scalds, including accidents caused by electric current
  6. rescue and transport a casualty
  7. improvise bandages and use materials in emergency kit
Personal safety and social responsibilities (PSSR) as set out in table A-VI/1-4 Competence, Knowledge, Understanding and Proficiency: Complying with emergency procedures.

- Types of emergency which may occur, such as collision, fire, foundering.
- Knowledge of shipboard contingency plans for response to emergencies.
- Emergency signals and specific duties allocated to crew members in the muster list; muster stations; correct use of personal safety equipment.
- Action to take on discovering potential emergency, including fire, collision, foundering and ingress of water into the ship.
- Action to take on hearing emergency alarm signals.
- Value of training and drills.
- Knowledge of escape routes and internal communication and alarm systems.

Take precautions to prevent pollution of the marine environment:

- Basic knowledge of the impact of shipping on the marine environment and the effects of operational or accidental pollution on it
- Basic environmental protection procedures.
- Basic knowledge of complexity and diversity of the marine environment

Observe safe working practices:

- Importance of adhering to safe working practices at all times.
- Safety and protective devices available to protect against potential hazards aboard ship.
- Precautions to be taken prior to entering enclosed spaces.
- Familiarization with international measures concerning accident prevention and occupational health.

Contribute to effective communication

- Understand the principles of, and barriers to, effective communication between individuals and teams within the ship
- Ability to establish and maintain effective communication

Contribute to effective human relationships on board ships

- Importance of maintaining good human and working relationships aboard ship
- Basic teamworking principles and practice, including conflict resolution
- Social responsibilities; employment conditions; individual rights and obligations; danger of drug and alcohol abuse

Understand and take necessary actions to control fatigue

- Importance of obtaining the necessary rest
- Effects of sleep, schedules and the circadian rythm on fatigue
- Effects of physical stressors on seafarers
- Effects of environmental stressors in and outside the ship and their impact on seafarers
- Effects of schedule changes on seafarer fatigue
3. Merchant shipping national, international and European regulations

Merchant shipping

Merchant shipping is subject to national, as well as international and European regulations. The Schepenwet [Shipping Act] plays a central role in this respect. This legislation applies to all seagoing vessels flying the Dutch flag. It focuses on the safety of ships and their crews, their operations and their cargo. The Netherlands Shipping Inspectorate (NSI—Inspectie Leefomgeving en Transport, ILT) monitors vessels flying the Dutch flag, foreign vessels, crews, shipping companies and classification societies. Vessels flying a foreign flag are regulated in accordance with the Paris Memorandum of Understanding on Port State Control.

The Schepenwet plays a central role in relation to the merchant navy. This legislation applies to all ocean-going ships which fly the Dutch flag and are registered in the Netherlands, the special cities in Carabean region Saba, Sint Eustasius, Bonaire, the self regulating countries in Carabean region Aruba, Curacao and Sint Maarten (equal to the Kingdom of the Netherlands). It focuses on the safety of ships, their crews, operations and cargo. In addition to the Schepenwet there is a multiplicity of legislation which is applicable in the areas of the environment, safety and working conditions. The Zeevaartbemanningswet (Ocean Shipping Crews Act) plays an important role in this respect.

The Netherlands Shipping Inspectorate (Inspectie Leefomgeving en Transport) monitors Dutch and foreign ships, crews, shipping companies and classification offices. The regulations of the Netherlands always apply to Dutch vessels in addition to international conventions. The regulation of ships flying the Dutch flag chiefly involves admission and certification. Vessels flying a foreign flag are regulated on the basis of the Paris Memorandum of Understanding on Port State Control, which is abbreviated to the Paris MOU 36th amendment, adopted 23 May 2013 (effective date: 20th of August 2013). In this respect regulation often occurs in the form of announced and unannounced on board inspections. In addition, the NSI supervises the transport of hazardous substances by merchant navy vessels. Not only NSI will monitor this sector, also the port authorities, the coastguard, the KLPD (National Police Corps Services), the labour inspectorates and the inspectorate within the Department of Housing are also involved.

If Dutch vessels fail to satisfy the specified requirements, the relevant shipping companies are called to account. In exceptional circumstances a ship may be detained by withdrawing the required certificates or refusing to issue them. If the crew fails to satisfy the relevant requirements, their documents (sailing permits, seaman’s logs and crewing certificates) will be withdrawn.
4. Familiarization after arriving on board

Familiarization training according STCW 78, as amended

Before being assigned to shipboard duties, all persons employed or engaged on a seagoing ship other than passengers, shall receive approved familiarization training in personal survival techniques or receive sufficient information and instruction about how to:

Communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarm signals.

English language is the common language in the maritime sector. For safety and to be understood a “Standard Marine Navigational Vocabulary” is developed by the Maritime Safety Committee, MSC. The MSC is a subcommittee from the International Maritime Organization (IMO) based in London. This vocabulary has been compiled to assist:

- In the greater safety of navigation and of the conduct of ships.
- To standardize the language used in communication for navigation at sea, in port-approaches, in waterways and harbours.

IMO’s Standard Marine Communication Phrases (SMCO) were adopted by the 22nd Assembly in November 2001 as resolution A.918 (22) IMO Standard Marine Communication Phrases.

These phrases are not intended to supplant or contradict the International regulations for Preventing Collisions at Sea or special local rules or recommendations made by IMO concerning ships’ routeing. Neither are they intended to supersede the International Code of Signals and the Radio Regulations nor to supplant normal radiotelephone practice as set out in the International Telecommunication Union ITU regulations.

It is not intended that use of the vocabulary shall be mandatory, but rather through constant repetition in ships and in training establishments ashore, that the phrases and terms used will become those normally accepted and commonplace among seamen. Use of the contents of the vocabulary should be made as often as possible in preference to other wording of similar meaning.

In this way it is intended to become an acceptable “language” for the interchange of intelligence between individuals of all maritime nations on the many and varied occasions when precise meanings and translations are in doubt, increasingly evident under modern conditions at sea.
The ISM Code: International Management Code for the Safe Operation of Ships and for Pollution Prevention. The purpose of the International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code) is to establish a management system in shipping companies to ensure the safe operation of ships and the prevention of pollution. The Code was adopted by the International Maritime Organisation (IMO) and reproduced in Chapter IX of the International Convention for the Safety of Life at Sea (SOLAS). Implementation of the ISM Code is obligatory in all the Member States.

In chapter 6, resources and personnel. The company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions, which are essential to be provided to sailing should be identified, documented and given.

The familiarization consists of:

- Know what to do if:
  1. a person falls overboard,
  2. fire or smoke is detected, or
  3. the fire or abandon ship alarm is sounded;
- Identify muster and embarkation stations and emergency escape routes.
- Locate and don life-jackets.
- Raise the alarm and have basic knowledge of the use of portable fire extinguishers.
- Take immediate action upon encountering an accident or other medical emergency before seeking further medical assistance on board.
- Close and open the fire weather tight and watertight doors fitted in the particular ship other than those for hull openings.
1. Introduction PSSR

STCW 78, as amended

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 was adopted by the International Maritime Organisation in 1978. This Conference was put into force only in 1984 due to the slow process involved in the acceptance of member states. Until 1992, the Conference had been ratified by various governments. The Member States decided it was necessary to revise the terms of the Conference completely, which was done in April 1995. This revision is called STCW-95 (Standards of Training, Certification and Watchkeeping for Seafarers).

The revision of the STCW Convention terms was necessary due to the large number of accidents that could have happened due to human factors. There was a big gap related to teaching competence because of the crew changes and the different level of education systems and training systems. Although the principles were good, they were not sufficient and specific to be implemented appropriately. It mainly did not provide sufficient means for its implementation and control by the authorities.

The STCW 95 Code lists minimum requirements for all personnel involved in the maritime activity. The new requirements came into force on February 1st, 1997. The basic training requirements still apply, especially for the ones whose training sessions started after August 1st, 1998.

STCW Requirements

The basic training for seafarers is applied to all ship crew members involved in any job on board as a basic part of their operations and both specific and designated safety duties and pollution prevention actions. The main basic formation elements are four, namely:

- Personal Survival Techniques as set out in table A-VI/1-1
- Fire prevention and fire-fighting as set out in table A-VI/1-2,
- Elementary first-aid as set out in table A-VI/1-3, and
- Personal safety and social responsibilities as set out in table A-VI/1-4.
2. STCW 2010

The competence of seafarers is the most critical factor in the safe and efficient operation of ships, and has a direct impact on the safety of life at sea and the protection of the marine environment. The IMO Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) is a comprehensive set of international regulations intended to ensure that the highest standards of seafarer competence are maintained globally.

New wide-ranging amendments to the STCW rules, agreed by governments in Manila in 2010, are intended to ensure that STCW standards stay relevant, so that seafarers can continue to develop and maintain their professional skills.

In particular, numerous changes are now being introduced to take account of technical developments that require new shipboard competences.

The STCW amendments will begin to apply from January 1st 2012, when they enter into force. In particular, companies and crew will be required to comply with the new minimum STCW rest hour rules for seafarers. Between 2012 and January 2017, the other new requirements will be introduced by your maritime administration according to a transitional timetable. This short brochure, produced to coincide with the new IMO Day of the Seafarer (June 25th, the day on which the ‘Manila Amendments’ were adopted) summarises what seafarers can expect from the updated STCW Convention.

Changes to Competence Tables

Various changes to the STCW Competence Tables are included in the Manila Amendments. Important examples include the need for deck officers to be competent in the use of ECDIS and for engineer officers to be able to operate pollution prevention equipment. More generally, additional emphasis is given to environment management.

Leadership and Teamwork: For deck and engine officers, substantial new competence requirements related to leadership, teamwork and managerial skills have been added. Assertiveness training for all seafarers has also been included, given its importance not only for those who have to direct operations but also for those in lower grades who may have to communicate on safety matters with senior officers, the master and/or shore personnel.
Training Record Books: It will be mandatory for all deck and engine rating trainees to demonstrate competence through the use of on board training record books, with completion to be supervised by officers responsible for on board training (in addition to the existing requirements applicable to officer trainees).

Mandatory Security Training: As well as specific training and certification requirements for Ship Security Officers, new security familiarisation and training requirements have been introduced for all grades of shipboard personnel. Seafarers may already comply with these new security requirements through seagoing service or previous training.

Refresher Training: An important feature of the Manila amendments is the additional emphasis given to the need for seafarers’ standards of competence to be maintained throughout their careers. All seafarers are now required to provide evidence of appropriate levels of competence in basic safety training (including survival, fire-fighting, first aid, and personal safety and social responsibilities) every five years. Much of this refresher training can be conducted on board, but some will require training at shore based institutions. Seafarers who hold certificates of proficiency in survival craft, rescue boats (PSCRB) and fast rescue boats or advanced fire fighting will also have to show that they have maintained their levels of competence in these skills every five years.

Tanker Training: STCW now contains new, comprehensive Competence Tables for training in oil, chemical and gas tanker operations, at both basic and advanced levels. (New guidance has also been developed for crew on offshore support vessels and all ships in polar waters.)

New Seafarer Grades and Certification: STCW 2010 introduces extensive training and certification requirements for the new grades of ‘Able Seafarer Deck’ and ‘Able Seafarer Engine’. These are in addition to the current navigational and engine watch rating requirements which are otherwise unchanged. New competence standards and certification for the position of ‘Electro-Technical Officer’ and
‘Electro-Technical Rating’ have also been established, in recognition of a position already widely established, particularly in the passenger ship industry. It should be noted that there are many interchangeable competences between the Able Seafarer Engine and the Electro-Technical Rating. It is therefore possible to consider the Electro-Technical Rating aspects as a supplement to the Able Seafarer Engine training, which should contribute to career development for such seafarers and might enhance the flexibility of their role on board.

**Medical Standards:** Additional medical fitness standards and requirements for certification have been introduced.

**Prevention of Unsafe Alcohol Use:** These include a specific limit of 0.05% blood alcohol level or 0.25mg/l alcohol in the breath.

‘Manila Amendments’ Key new training requirements

**Changes to Minimum Rest Hours**

The STCW Convention also covers watchkeeping arrangements. This includes: Seafarers’ minimum rest periods to prevent fatigue and ensure that seafarers are fit for duty. The STCW minimum rest hours are now harmonized with the work hour requirements adopted by the International Labour Organization including the ILO Maritime Labour Convention (MLC).

The new IMO rest hour requirements will enter into force in January 2012 and introduce stricter minimum requirements than those currently in force. The main changes are as follows:

- Minimum amount of rest in any 7 day period is increased to 77 hours from 70 hours.
- Seafarers must always have 10 hours rest in any 24 hour period with no exceptions, except during an emergency.
- The rest hour limits now apply to most seafarers on board, including masters, not only watchkeepers as had previously been the case.

It is now mandatory to maintain records of each individual seafarers’ rest hours, which may be inspected during Port State Control inspections.

From January 2012, seafarers will need to review and sign a record of their work/rest hours periodically (typically at least once a month) to ensure they comply with the minimum rest hours stipulated.
3. Safe Working Practice

Safety is everyone’s job all the time. Every simple operation on board offers a risk. Working on a vessel involves working with powerful machinery, fast equipment, highly pressurised liquids and gases, volatile fuels, heavy cranes, high voltage and unpredictable natural phenomena. Everyone on board must observe all safety precautions, wear appropriate clothing and follow the safety procedures on board. Potential location of hazards on board a vessel:

- Gangway and (safety) net
- Main deck
- Holds and hatches
- Forecastle and poopdeck
- Windlass, anchors and winches
- Cranes and derricks
- Manifold and pipeline systems
- Accommodation
- Bridge/Engine room

One of the problems of working on board vessels is that external help takes longer to arrive than when working ashore. Organisations involved in emergency response operations on board are therefore instructed on any possible activity that can be performed at sea. The definitions below show how these location or condition warning signs can be interpreted and what preliminary safety actions must be taken before proceeding with any task.
Accident
An accident is an unexpected and unplanned event that can cause physical and/or material damage.

Incident
An incident is a sequence of events or actions that although have not caused physical or material damage, has the potential to do so.

Danger
Condition that can cause potential damage.

Risk
Possibility of being in danger.
The first less attentive moment can be the last opportunity to save one’s life. Some general safety precautions are:

• Reading and understanding the safety instructions for every piece of equipment.
• Developing planned maintenance in all equipment.
• Wearing personal protective equipment.
• Employer’s Duties & Responsibilities
• Your employer must inform you about:
  1. Dangers related to work
  2. How to work safely (job responsibility)
  3. What is done to protect your health and safety
  4. Where and how to get first aid
  5. What to do in an emergency (Muster list/Station bill).

Additionally, your employer should also provide;
• Training, so you can work safely (a personal mentor)
• Personal protective equipment
• Warning signs and posters
• Regular exercises and safety meetings

In order to provide good communication, within some companies their vessels are divided into safety areas. Each safety area has a person who is hold responsible for safety, who will represent the workforce and who discusses safety issues during safety meetings. Seafarers have rights and responsibilities so they must be able to express their opinions when decisions need to be taken. These safety representatives have special powers and therefore are given special training. They perform their normal tasks and dedicate some time to work as a safety representative.
Activities on merchant and fishing vessels and the workers’ responsibilities:

- Look after his/her health and safety to prevent the others on board from being affected by his/her actions or omissions.
- Immediately inform the designated person of any danger or identified deficiency.
- Operate and use installations and machines in a correct way to prevent incident and accidents to yourself and others.

Ship board hazards

Working on ships is a hazardous occupation to which one is exposed as soon as one steps on board. That is why it is important to understand the hazards on board and equipment and procedures provided to avoid the hazard.

Slips, trips and falls due to:
- Slippery surfaces
- Obstructions
- Open manholes
- Unfenced tween decks
- Loose or missing gratings
- Injuries due to ship movements in rough weather

Head injuries due to:
- Low doorway entrances
- Overhead loads
- Falling equipment or material

Getting caught in moving machinery such as:
- Grinding wheels
- Winch drums
- Gears
- Flywheels

Eye injuries due to:
- Chipping
- Welding
- Chemicals

Confined spaces:
- Lack of oxygen in confined spaces
- Presence of hydrocarbon gas and toxic gasses

Chemical injuries due to:
- In proper use of chemicals
- No MSDS sheets available
- No proper PPE
Risk Assessment

In a lot of shipboard operations risks are involved, it is the shipowner and the vessels crew responsibility to carry out a risk assessment. During the risk assessment the level of risk is determined and its consequences if something will go wrong. National and international guidelines will define unhealthy agents, tolerance limits and the technical and legal criteria to assess and perform dangerous activities and operations as well as their level of risk.

The elimination of risks through the use of PPE is difficult to check. The PPE’s, even being approved by the Labour Ministry and implemented as guidelines and instructions do not immediately ensure safety, so their efficiency has to be assessed.

The risk assessment involved in the job basically consists of:
• Identification of dangers and of people at risk.
• Risk determination.
• Decision on whether the risk is acceptable.
• Preparation of Action Plans (if necessary).

Personal Protective Equipment

The Personal Protective Equipment also known as PPE is designed to protect the person against the risks associated with dangerous tasks. You can get hurt during maintenance jobs such as cleaning, de-scaling and other routine jobs on board. PPE can be devided in:
• Head protection
• Hand protection
• Eye protection
• Ear protection
• Respiratory protection
• Safety footwear
• Safety harness
• Body protection

It is best to eliminate hazards at the source (where practicable). The last option is to protect people against hazards. This means we allow a risk/hazard to exist. The worker is protected against injuries by using Personal Protective Equipment (PPE). How efficient it is depends on the situation and whether it’s used properly. The best protective equipment however is that which you carry with you all the times,
**PPE - Head protection**

Helmet, PVC or Glassfiber hat. It consists of a hard shell and a support inside a helmet that is adjusted to the head. The helmet is used to protect the head against falling objects, bumping and knocking. Protective headgear must be worn outside the accommodation and control rooms. Safety helmets must fit and should be put straight on the head. Safety helmets must be kept in good condition, not be modified by painting, decorations or engravings. Special provisions should be made to issue welders combined safety helmets, safety face shield or screen units.

Chinstraps must be used:
- When walking or working in windy conditions.
- When working at elevated locations.

**Hand protection**

The use of gloves of the appropriate type protects the hand against:
- Injuries/abrasions/burns
- Corrosive/poisonous substances
- Skin diseases

Each job requires a particular type of protection. Regular heavy fabric gloves will minimise injuries. Leather or leather palmed gloves must be used when working with hot equipment. Rubber or neoprene gloves must be used when handling chemicals. Long gauntlet types are preferable, except when working with moving machinery.

**PPE - Eye protection**

Safety glasses offer protection to the eyes. Many of them are made of high impact plastic and should be worn to protect the person from flying particles. Such as:
- Safety glasses.
- Safety goggles.
- Face shield.
**Ear protection**

**PPE - Ear protection** can be done with ear muffs that cover the ears or internal ear plugs that are inserts introduced into the ear and can be disposable or reusable. Some available models can be used in areas where the level of noise is higher than 90 decibels. Hearing loss can occur if the person is exposed to high level of noise for long periods. Deafness develops when people are exposed to noise levels above 80 dB, for a longer period of time. The aim of ear protection is to protect the hearing against dangerous noise levels. In use are:

- Earplugs.
- Ear muffs or ear caps.

**PPE - Respiratory protection** with the aim is to protect the lungs and body from damage by:

- Poisonous/irritant gases
- Asphyxiate gases
- Dust (airborne particles)

**PPE - Protective equipment consists of:**

- Dust filters.
- Fresh air masks.
- Canister respirators (protection against organic vapours).
- Self-contained breathing apparatus. This equipment consists of a mask, breathing control valves and a compressed air cylinder.

**PPE - Safety footwear**, shoes or boots must have steel toecaps, steel sole plates, oil and chemical resistant soles and ankle padding. However, some shoes are made of other materials that offer the same protection but are lighter and offer thermal protection preventing the feet from freezing. These should be worn when the person is working next to heavy equipment. The aim is to protect the feet from an injury by:

- Sharp objects.
- Dropped objects.
- Corrosive splashing.
- Sparks and slipping.
Permit to Work System

Dangerous jobs are controlled by checklists or a Permit to Work system. All, even routine activities, are subject to this Permit to Work System. So, if you are in doubt, ask!

Obtaining the first permission (1st step)
The permit to work should be obtained before the activities start. It is compulsory for the following jobs:

- Hot work (welding, grinding, cutting etc.)
- Cold work (pump maintenance)
- Electrical jobs (installing and maintenance)
- Jobs involving scaffolding, overboard work
- Confined space entry
- Work with dangerous substances (chemical)
- Pressure tests
- Diving operations
- Safety on maintenance systems
- Jobs performed over more than 2.5 metres above deck level

Issuing authority
The permission should normally be granted 24 hours before the activities start. In some cases, as in confined space entries, the authorisation may have to be granted 48 hours before the job starts.

Authority in the area
The person responsible for a given area will visit the work location with the worker and help him/her assess the possible risks involved with the job.

Issuing authority:
After the authority for the area has identified the risks related to the job, he/she prepares instructions about the work described and its location, the precautions to be taken and the permission to perform the job by the relevant authority (normally the first officer or first engineer).

Starting the job (2nd step)
A competent and authorised employee (person responsible for the job) will visit the work location to take the necessary precautions described in the permit (for example, gas test and isolation). The permit will then be signed by the responsible authority who will distribute copies of the permit as necessary. The authority representative will guide the team and put a copy of the permit in the work location.
During the job (3rd step)
The work location should be visited by an official authority on board (normally a safety officer) and he/she will check if the Permit to Work is being used and was understood. He/she will also visit the work location with the person responsible for the area.

Validity of the permit and its extension
A permit is normally valid for one shift, i.e. 12 hours. The authority can extend it. The person will check the job and verify if it is conflicting with other jobs or another written Permit to Work issued. The authority will sign all permits and extensions. The maximum extension given to the next shift is 12 hours.

Early cancellation
When the alarm sounds or depending on operational reasons, a permit to work can be cancelled or suspended. After the alarm, the authority will make the place safe and will either gather information or respond to the alarm. What normally follows is an announcement through the PA system by the officer in charge. After the authority issues the permit to work, it can be resumed.

Work done (4th step)
The authorised person will perform the job properly and remove all tools, equipment and materials from the location to ensure the area is clean and tidy and safe again. The area authority will be informed that the job was completed and that all is back in place. The permit will be signed and returned to the person that issued it. This person will check and sign it off, after which the safety precautions and barriers will be removed and the permit cancelled.
Confined Spaces

This is one of the most dangerous jobs done on board a ship. This operation needs extra attention and no one should ever enter into a confined space such as a tank or pipeline if the necessary safety precautions have not been taken. Each person that has to enter into any of these spaces must be familiar with the risks, be trained on all entry aspects and follow all procedures provided for the job.

Confined space is any area which has not been designed for human use and that lacks ventilation to remove contaminants, as well as lack of oxygen. Dangerous spaces are linked to entry procedures. However, certain precautions should be followed in the following spaces:

- Ballast tanks.
- Boilers
- Interior of independent inert gas generators
- Engine rooms
- Fuel, lubricants, water sewage tanks
- Keel pipes
- Bow thrusters and unprotected engine rooms
- Any other remote space where the crew does not normally operate.

Risks involved
Before entering into a confined space with suspicious atmosphere, all possible risks must be revised and the entry must be planned. The risks can be:

- Lack of oxygen because of not enough ventilation.
- Risks of explosive and/or dangerous gasses or fumes.
- Risk of toxic gasses or fumes.

Communication
Communication is the art or way used to pass on a message from a person to another. In its simpler form, communication consists of verbal transmission of information between an emittent and a recipient, but this can be more complex if it involves more people and/or other communication methods.

**Communications methods**

There are various ways to communicate. The basic ones are:
- Verbal communication
- Written communication
- Visual signs (pictures, videos, filmes, slides, etc..)
- Body Language

Studies show that messages that we send are transmitted beyond words. The tone of our voices and body language are also involved in the transmission of information. The percentage of each type of information is the following:
- Body Language 55%
- Tone of voice 38%
- Words 7%
4. Contribute to effective human relationships on board ship

Interpersonal relationship on board (IPR)

Human relations exist since men started to live in groups. Human beings have a relationship with basic purposes such as protect themselves against animal attacks or food collection. We then started to form groups for other social reasons. The formation of certain groups develop in structural societies where their members live close to one another since they have something in common such as cultural activities, religious creed or political opinions.

Many groups evolve, grow and develop techniques, create richness, power and transform themselves into nations where every person has his/her own place in society, his/her own culture, history and concept on their
own county’s transformation. These result in an accumulation of events, knowledge and common effort and a continuous search for legislations that are adjusted to the majority’s thoughts in a democratic effort to allow for harmonic and balanced forms of life to exist and changes to occur trauma-free over long periods of time.

When we remove a person from his group, he/she is submitted to abrupt changes causing some trauma, a cultural shock that can result in emotional unbalance, reduction of physical or mental capacity and even unhappiness which can effect everybody else around him/her.

When we put together people from different cultures, from different climates and regions with different habits, customs and creeds and confined them in a small world on board, the emotionally unbalanced occurrences begin. The crew member tends to be isolated, does not communicate with others because of the language barrier, is not aware of the environment, the jargon and their functions on board. This depresses him, he loses self-confidence and is soon affected by stress which can lead to the consumption of alcohol and drugs, which is a serious problem.

Every time people who work or live together have different “rules” or “norms”, there is room for conflict. The possibility of working at sea makes people from different cultures to come in contact with each other and have a relationship confined in the same working environment. It is important that universal rules and tolerance be developed by these people and used in a multi-cultural working environment. The maritime activity is done in a hostile environment, many times under severe weather conditions. Crew members are subject to risks, many of them high, since they are confined in such limited space.
Discipline
It is a management action to ensure the standardisation of the company, operational practices, procedures and hierarchy on board. The objective of discipline is to determine and identify the cases in which the person has not been sufficiently responsible or motivated to meet the service standards provided in the job or has a behavioural problem. Disciplinary actions should deal with this and/or restore the order and integrity of the organisation and not make the situation worse. To keep a moderate control over the crew is essential to ensure that the situation is dealt with properly and the objectives reached. Some types of discipline are:

- Preventive: The consequences of certain actions are observed and known in time. This helps the crew members to follow the rules and avoid mistakes.
- Corrective: it is the action taken after the problem, which is used to avoid future mistakes based on proper rules and regulations.

Disciplinary rules and behavioural standards should be observed and followed and penalties can be applied when they are not followed. Depending on the fault, some advising can be given initially but new occurrences involving behaviour and/or functions can lead to severe punishment.

5. Types of emergency
Emergency procedures are necessary in case of accidents or any other type of unexpected event that can affect the lives of crew members, passengers or assets. In general, an accident or emergency can be solved quickly if the right procedure is adopted within the first few minutes. It is important that the crew members know the emergency procedures for each situation in particular and are disciplined and trained to react effectively.

Fire
A fire on board is a more horrifying experience than a fire onshore. In general, the crew fights the fire with no help from fire brigade members. Fire has to be extinguished in closed spaces which are usually built with steel. The water used to extinguish these fires worsen the ship’s stability and ships carry huge quantities of highly combustible and dangerous substances. The crew member does not have anywhere to go unless he/she abandons the ship using the life saving boats.

Grounding
After grounding water can enter the vessel. This flooding of compartments will have an effect on the vessels satbility. The vessel will be listing and even worse can sink.
Collision
It is when a ship hits a fixed obstacle. It can be against a mooring anchor, a pier or another moored vessel. It is an emergency when a ship collides with another ship. The collisions generally cause fire or floods. Many ships sink due to collision. Collisions can also cause a fuel or contaminant substance tank to break.

Muster List
The muster List or Emergency Response Plan is a plan to respond to the following emergencies: fire, flooding, collision, grounding, man overboard and ship abandonment. The crew member must know his/her duties and personal obligations and responsibilities and know how to proceed to avoid problems in an emergency situation. Individual tasks are designated in the Master List Table (Emergency Bills – Station Bills). These tasks are posted on the crew cabin and public spaces on the ship. The Table includes details on the alarm systems and how they sound. The special tasks are designated to each crew member and the table will also include activities and jobs each member has to do. Each crew member must go to his/her muster station, protect the equipment, follow the supervisor’s instructions in his/her station or respond to which he/she has been trained to do when the alarm sounds.

Emergency signals
The emergency alarms signs are given on board to indicate some kind of emergency. These signs can be given by using a bell that is heard on the ship or ship’s siren that can be heard inside and outside the closed areas. The following signals can be used on board the ships:
- General emergency: interrupting bell sounds followed a announcement by vessels Public Adress (PA) system.
- Ship abandonment: the instructions to abandon the ship are given verbally by the captain through the PA system and a continious sound is activated.
Initial action

When you hear the emergency alarm, an accident or an emergency can be quickly solved if the right actions are taken within the first few minutes. However, if a minor emergency is not dealt with immediately, it can lead to a situation which is out of control. Once the emergency is detected, the initial right action can mean the difference between life and death.

Drills and Training

The importance of knowing what to do and how to react in an emergency must not be overlooked. The only way to become efficient when responding to an emergency is through drills and training. It is very important to know the location of the ship’s compartments and stations.
Knowing the ship and escape routes

It is also important to know the route to the corresponding station. Know the main escape route and the alternative escape route to the life boat (the main route may be blocked). You should know the ship’s layout by studying its blueprints, numbering systems, direction, deck levels, internal communication systems and alarm systems. The escape routes offer safety aids that allows you to get to your muster station in the dark. Get to know the nautical terminology because you will not have any difficulty in understanding the instructions on board.

Some definitions are as follows:

- Portside; left side of the ship looking towards the front. The numbering of cabins and equipment on this side are all even numbered.
- Starboard; right side of the ship looking towards the front. The equipment and cabins on this side are all odd numbered.
- Forward/bow; front part of the ship.
- The Stern; rear part of the ship.
- Bridge; area for navigational watches and control of the vessel.
- Midships; halfway between bow and stern.
- Leeward; sheltered side of the ship.
- Windward; side of the ship where the wind blows in.

Ship’s numbering System

The ship’s numbering system is based on the cabins, as well as the side of the ship where it is located. The general numbering system consists in having the smaller numbers located to the bow, and the numbers increase as the person moves towards the stern. The odd numbers are on the starboard side whereas the even numbers are on the portside.
6. Take precautions to prevent pollution of the marine environment

Precautions to prevent marine pollution

Over the last 25 years, ocean pollution became increasingly important worldwide. Pollution comes mostly from the land caused by industrial by-products, pesticides and agricultural chemicals and sewage systems from urban areas. However, a significant amount of pollution is caused by vessels and other maritime activities. The biggest contamination resulting from maritime operations, in terms of tonnes, is petroleum. Part of the petroleum spilled at sea is the result of accidents.

Causes of pollution

Pollution can be caused intentionally or by accident. In March 1967 the tanker Torrey Canyon ran aground off the south-west coast of England, spilling 120,000 tons of oil into the sea. It was, at that time, the worst oil pollution disaster ever, and the impact on public opinion was enormous. Sometimes they refer to intentional pollution as operational pollution.

Causes (from 1975-1994):
1. 50% operational
2. 25% accidents
3. Other nature and not reported

This includes events such as:
- Discharging into the sea of residues from ballast or fuel tanks.
- Water discharge from oil loading tanks.
- Launching residues from tank washing operations.
- Discharge contaminated water at sea with oil from the engine room.
- Launching of garbage.
- Discharge of sanitary sewage.

Examples of environmental pollution
- Overflowing of tanks.
- Incorrect valve handling.
- Equipment failure or malfunction.
- Waste disposal.
- Loss of stability or floating ability due to grounding, hull breaking, etc.
MARPOL 73, as amended

In 1973 the International Maritime Organisation, a United Nations agency responsible for international maritime transport created an agreement on marine pollution known as “MARPOL”. This Agreement consists of two annexes that rule the discharge of oil and dangerous chemicals at sea. MARPOL was amended in 1978 and three more annexes were included relating to dangerous materials, sewage and garbage. This agreement is more commonly referred to as MARPOL 73/78 (International Convention for the Prevention of Pollution From Ships). Many countries have ratified this agreement in which there are 20 articles, six annexes and two guidelines.

March 2012 amendments
Entry into force: 1 August 2013

Amendments to MARPOL Annexes I, II, IV, V and VI which are aimed at enabling small island developing States to comply with requirements for port States to provide reception facilities for ship waste through regional arrangements. Parties participating in a regional arrangement must develop a Regional Reception Facilities Plan and provide particulars of the identified Regional Ships Waste Reception Centres; and particulars of those ports with only limited facilities.

MARPOL annexes

The MARPOL annexes cover various types of marine contamination and restricted discharges. The following table shows the content of each annex and when it came into force:

<table>
<thead>
<tr>
<th>ANNEX</th>
<th>SUBJECT</th>
<th>ENFORCEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Regulations for the Prevention of Pollution by Oil</td>
<td>1973/1978</td>
</tr>
<tr>
<td>II</td>
<td>Regulations for the control of pollution by Noxious Liquid Substances in Bulk</td>
<td>1973/1978</td>
</tr>
<tr>
<td>III</td>
<td>Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form</td>
<td>1973/2014</td>
</tr>
<tr>
<td>IV</td>
<td>Regulation for the prevention of pollution by Sewage from Ships</td>
<td>2007</td>
</tr>
<tr>
<td>V</td>
<td>Regulations for the Prevention of Pollution by Garbage from ships</td>
<td>1973/2000</td>
</tr>
<tr>
<td>VI</td>
<td>Regulations for the Prevention of Air Pollution from ships</td>
<td>1997/2005</td>
</tr>
<tr>
<td></td>
<td>Guidelines for ballast water management and development of ballast water management plans</td>
<td>2011</td>
</tr>
</tbody>
</table>
Pollution prevention

Prevention is the most effective way to stop marine pollution. The basic protection procedures of the environment can prevent operational pollution. Following the discharge restrictions by contamination we will reach sea pollution prevention objectives. Simple precautions such as using oil trays under oil valves and other connections that can leak accidentally are effective. Accidental pollution can be prevented through the use of the right procedure. In order to prevent contamination:

- Use procedure checklists
- Use contention devices
- Recycle
- Observe discharge restrictions.

ANNEX V: Regulations for the prevention of pollution by garbage from ships

- No plastic
- Outside 25 nautical miles floating material dunnage, lining, packing materials
- Outside 12 nautical miles food waste, metal, glass, rags
- Not in special area’s such as enclosed seas for instance North Sea, Mediterranean, e.q.
- Record of garbage discharges
SOPEP/SMPEP
Shipboard Oil Pollution Emergency Plan/Shipboard Marine Pollution Emergency Plan

Regulation 26 of Annex I of MARPOL 73/78 requires that oil tankers of 150 tons gross tonnage or more and all ships of 400 tons gross tonnage or more carry an approved shipboard oil pollution plan (SOPEP). The International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, also requires such a plan for certain ships.

Regulation 16 of Annex II of MARPOL 73/78 makes similar stipulations for all ships of 150 gross tonnage and above carrying noxious liquid substances in bulk: they are required to carry on board an approved marine pollution emergency plan for noxious liquid substances. The latter should be combined with a SOPEP, since most of their contents are the same and the combined plan is more practical than two separate ones in case of an emergency. To make it clear that the plan is a combined one, it should be referred to as a shipboard marine pollution emergency plan (SMPEP).

The Guidelines for the Development of Shipboard Marine Pollution Emergency Plans have been developed by IMO to help Administrations and shipowners meet these requirements. (see www.imo.org)

- (Resolution MEPC.54(32), as amended by resolution MEPC.86(44)
- Guidelines for the development of Shipboard Marine Pollution Emergency Plans for Oil and/or Noxious Liquid Substances (Resolution MEPC.85(44)).
- MEPC.6/CIRC.8 (ANNEX 2 for SOPEP) List on national and operational contact points responsible for the receipt, transmission and processing of urgent reports from incidents involving harmful substances, including oil from ships to coastal states.

This information enables compliance with Regulation 26 of Annex 1 of MARPOL 73/78 which, requires that shipboard oil pollution emergency plans (SOPEP) shall contain a list of authorities or persons to be contacted in the event of an oil pollution incident.
7. ISPS Code

A new, comprehensive security regime for international shipping is set to enter into force in July 2004 following the adoption by a week-long Diplomatic Conference of a series of measures to strengthen maritime security and prevent and suppress acts of terrorism against shipping. The Conference, held at the London headquarters of the International Maritime Organization (IMO) from 9 to 13 December, was of crucial significance not only to the international maritime community but the world community as a whole, given the pivotal role shipping plays in the conduct of world trade. The measures represent the culmination of just over a year’s intense work by IMO’s Maritime Safety Committee and its Intercessional Working Group on Maritime Security since the terrorist atrocities in the United States in September 2001. The Conference adopted a number of amendments to the 1974 Safety of Life at Sea Convention (SOLAS), the most far-reaching of which enshrines the new International Ship and Port Facility Security Code (ISPS Code). The Code contains detailed security-related requirements for Governments, port authorities and shipping companies in a mandatory section (Part A), together with a series of guidelines about how to meet these requirements in a second, non-mandatory section (Part B). NB: In July 2004 the EU Act Nr. 725/2004 came into force, in which Part B is stated as a mandatory section and the Netherlands signed this treaty.

In the wake of the tragic events of 11 September 2001 in the United States of America, IMO Secretary-General Mr. William A. O Neil consulted on the need to review the measures already adopted by IMO to combat acts of violence and crime at sea. The International Maritime Organization’s (IMO) Diplomatic Conference of December 2002 adopted new Regulations to enhance maritime security through amendments to SOLAS Chapters V and XI. Chapter XI, previously covering ship safety has been split into two new chapters, XI-1 and XI-2.

Chapter XI-1, Special Measures to Enhance Maritime Safety, has been enhanced to include additional requirements covering ship identification numbers and carriage of a Continuous Synopsis Record.
Security Levels

The different security levels referred to in the ISPS Code are:

- Level 1
- Level 2
- Level 3

Security level 1: normal, the level at which the ship or port facility normally operates. Security level 1 means the level for which minimum appropriate protective security measures shall be maintained at all times.

Security level 2: heightened, the level applying for as long as there is a heightened risk of a security incident. Security level 2 means the level for which appropriate additional protective security measures shall be maintained for a period of time as a result of heightened risk of a security incident.

Security level 3: exceptional, the level applying for the period of time when there is the probable or imminent risk of a security incident. Security level 3 means the level for which further specific protective security measures shall be maintained for a limited period of time when a security incident is probable or imminent, although it may not be possible to identify the specific target. Setting security level 3 should be an exceptional measure applying only when there is credible information that a security incident is probable or imminent. Security level 3 should only be set for the duration of the identified security threat or actual security incident. While the security levels may change from security level 1, through security level 2 to security level 3, it is also possible that the security levels will change directly from security level 1 to security level 3.

Chapter XI-2, Special Measures to Enhance Maritime Security, has been created and includes a requirement for ships and companies to comply with the International Ship and Port Facility Security (ISPS) Code.
8. Alcohol and drugs abuse

Addiction

Alcohol abuse affects all of us – you, your work colleagues and your future. By recognising, understanding and reacting positively to the problem you can avoid certain tragedies in your family, with friends and your career. The use of alcohol and drugs can be found in life in many different ways, in any age group and in any social class. The addicted person can be considered any person who uses natural or synthetic substances in excessive amount. Substance abuse means that the drug has taken control over the addicted person and is the most important thing in the person’s life. Substance abuse includes alcohol, smoking and other items that can be obtained anywhere and can change people's behaviour. Alcohol and nicotine are drugs as lethal as cocaine or heroine.

The danger of addiction

The main consequence of addiction for offshore personnel is the danger it represents for the ship’s operation and the safety of all work colleagues. Alcohol and drug abuse can be disastrous in the working environment.

Alcohol

According STCW78, as amended, Section B- VIII/2 parts 4, 5 / PART 5 -GUIDANCE ON PREVENTION OF DRUG AND ALCOHOL ABUSE.

Drug and alcohol abuse directly affect the fitness and ability of a seafarer to perform watch keeping duties. Seafarers found to be under the influence of drugs or alcohol should not be permitted to perform watchkeeping duties until they are no longer impaired in their ability to perform those duties. Administrations should consider developing national legislation:

• Prescribing a maximum of 0.05% blood alcohol level (BAC) during watchkeeping duty as a minimum safety standard on their ships.
• Prohibiting the consumption of alcohol within 4 hours prior to serving as a member of a watch.
• Drug and alcohol abuse screening programme guidelines.
• The Administration should ensure that adequate measures are taken to prevent alcohol and drugs from impairing the ability of watchkeeping personnel, and should establish screening programmes as necessary which:

1. Identify drug and alcohol abuse.
2. Respect the dignity, privacy, confidentiality and fundamental legal rights of the individuals concerned.
3. Take into account relevant international guidelines.

Alcohol is a natural chemical product produced based on the fermentation of grain or fruit. Alcohol is depressive and intensifies one’s character. The character of one person is intensified when intoxicated by the effects of alcohol. If it is combined with depressive pills, marijuana and stimulant pills, the effects can be unpredictable and can even cause
death. Alcohol is a lethal drug which is part of our culture but its most frequent danger is its abuse in consumption. An alcoholic is a person that has lost control over the drinking habit. When alcohol becomes part of a person's every day life or if he needs alcohol to be sociable, then the person has become an alcoholic. Many alcoholic people are members of associations which desperately try to fight the disease.

People that use alcoholic drinks give the following reasons:
• To forget about their problems
• To be more sociable.
• To relax.
• To improve their humour.

Factors that can contribute to alcohol abuse:
• Working environment.
• Personal habits.
• Personal problems.

Effects of alcohol:
• Reduces the reflexes.
• Reduces the nervous system capacity.
• Dizziness.
• Vomiting.

Some warning signs of alcoholism are:
• Violence.
• Memory loss
• Depression.
• Disorientation.
• Trembling.
• Swelling.

The dangers of alcohol abuse are:
• Unconsciousness
• Increased weight.
• Undernourishment.
• Liver and kidney diseases.
• Ulcers.
• Embryo malformation.
• Changes in behaviour and reason.
• Accidents.
• Cancer.
• Brain damage.
• Heart diseases.
• Death.
Abandonment and survival techniques

Group survival equipment and personal survival equipment.

Personal survival techniques

1. Lifeboats
2. Liferafst
3. Personal survival equipment
4. Radio communication
5. Pyrotechnical distress signals
6. Visual and audible distress signals
7. SAR organisation

Abandonment by helicopter.
When a vessel must be abandoned it is important to make priorities. If abandonment is the only option different group or personal survival equipment can be used. A few group survival equipment are:

- Lifeboats (conventional and free fall)
- Liferafts (Trowing over board TOB and Davit Launchable Liferaft DLL)

Personal equipment:
- Survival suits
- Lifejackets
- Lifebuoys

Other options are to wait for external help such as a search and rescue SAR organization or other vessels in the neighbourhood. Remember the safest place is still your own vessels.

1. Lifeboats

Different type of life boats can be used for a group evacuation. The SOLAS 1974, as amended definitions of the different systems are:

- Conventional lifeboats or Survival craft is a craft capable of sustaining the lives of persons in distress from the time of abandoning the ship.
- Free fall lifeboats or Free-fall launching is that method of launching a survival craft whereby the craft with its complement of persons and equipment on board is released and allowed to fall into the sea without any restraining apparatus.

Manning of survival craft and supervision (SOLAS 1974, as amended):

- There shall be a sufficient number of trained persons on board for mustering and assisting untrained persons.
- There shall be a sufficient number of crew members, who may be deck officers or certificated persons, on board for operating the survival craft and launching arrangements required for abandonment by the total number of persons on board.
• A deck officer or certificated person shall be placed in charge of each survival craft to be used. A second incommand shall also be nominated in the case of lifeboats.
• The person in charge of the survival craft shall have a list of the survival craft crew and shall see that the crew under his command are acquainted with their duties. In lifeboats the second-in-command shall also have a list of the lifeboat crew.
• Every motorized survival craft shall have a person assigned who is capable of operating the engine and carrying out minor adjustments.
• The master shall ensure the equitable distribution of persons among the ship's survival craft.

When boarding a lifeboat you move away from the entrance as quickly as possible to limit the boarding time. The appointed coxswain is in charge of the abandonment.

Once on the boat, think about the 3 S’s:
• SIT DOWN (sit down)
• STRAP IN (strap in)
• SHUT UP (silence)

NB: Survival crafts on board passenger ships have no seatbelts. Conventional boats (not free-fall) are equipped with a gravity lowering system. That means that the boat will be lowered into the water when the brake, via remote control, is released. The following step is to detach the boat from the cables by means of a ‘on load’ system. This system makes it possible to open the hooks, even when the cables are under tension. This system is also protected with a hydraulic valve so that the boat cannot fall. Once in the water the release handle can be used.

This can be done manually in an emergency! Watch out! Deaths have been cause by incorrect use!

The coxswain will move away on an evacuation course when the boat is free of the vessel and put out the sea anchor at a safe distance. Another name for lifeboat is TEMPSC (totally enclosed motor propelled survival craft). An air supply system is installed in the boat. This system is necessary for 3 reasons:
1. Persons on the boat need air.
2. When all the hatches and ventilation ducts are closed and the air supply system is open, there will be over-pressure on the boat which will keep poisonous gases out.
3. The engine uses air from in the boat.

The air supply system works for 8 minutes.
Check whether the tanks of compressed air are open and open the reducing tap.

The lifeboat’s hull must be made from a water-proof, fire-resistant material.

Material used could be:
- Polyester.
- Steel.
- Aluminium.

The lifeboat must be strong enough to be able to fall from a height of 3 metres. The boat is not heat-resistant enough when the water surface is burning. So a spray or sprinkler system is mounted on the boat. A pump is connected to the engine on the boat. Water will flow over the boat when the engine turns and the suction valve is opened. The pipelines and sprinklers are to found on the outside of the boat.

A diesel engine has been used in the lifeboats because it is very reliable and the flashpoint is higher than a petrol motor. It should be possible to start the engine in 2 ways. A main system and a back-up system.

The minimum speed of the boat amounts to 6 knots per hour and there must be enough fuel for 24 hours of travel.
The lifeboat has a double hull and a low centre of gravity and is therefore self-righting and unsinkable. The hull is filled with hard polystyrene. It is important that everyone remains seated with their safety belts on because of the low centre of gravity. This is the first thing you do when you take your place in a lifeboat. The SOLAS convention (Safety of Life At Sea) and the LSA (life Saving Appliances) code will provide general regulations for lifeboats and rafts. The regulations provide information about: construction, stability, propulsion, equipment and signalling.

Such as:
The lifeboat must be orange so that the boat is visible on the open sea also a minimum inventory can be found on the boat in accordance to the SOLAS standard.
Launching systems

Generally used launching systems are:

- Fixed davit system. (e.g. A-frame on board MODU)
- Gravity davit system.
- Free-fall launching system.

The davit system with double or single cable is provided with a winch and brake, so that a controlled drop is possible. Once in the water the hooks must be opened to release the cables.

The free-fall boat normally is launched without cables. The boat is launched by activating the disconnection system. It slides from the launching scaffold and drops into the water. The boat will bounce a lot in the water because of gravity and the dropping speed. Hydraulic launching system can be used in shallow water or when there is ice or debris.

Lifeboat hooks

Every lifeboat is equipped with a releasing system it can be a hook system to release the falls when the boat waterborne or it is a release system when the boat is position. Think of the free fall lifeboat. We will not go in details because every lifeboat has different launching systems and release hooks. But the trained coxswain is familiar with the system on board the relevant lifeboat on board the vessel.

Normally the maintenance and safety wires will not be attached. These cables prevent the boat dropping down during maintenance work.

Assembly or muster

It is important to know how many persons have been divided between the various lifeboats in an emergency situation. The names of those present are handed to the control room after being checked. Each coxswain has a lifeboat and life raft assigned to him. The assembly station is in or outside the accommodation but close to the boats or rafts.

The coxswain makes sure that:

- The name list is checked.
- The persons are clothed properly.
- There is radio contact with the bridge.

The lifeboat should be ready for use but should be checked again by the boat’s crew before launching. The coxswain will check the boat while the muster checker calls out the list of names.
Check points at the boat

- The lattice work should be open.
- The maintenance service wires must be loose.
- Painterline must be checked.
- The entrance hatches must be open.
- The plug in the bottom must be in place.
- The escapeladder must be deployed.
- Carry out an engine check.
- Check the VHF radio.
- Check the rudder stand.

Boarding

You will receive permission to board after being checked. This is because you could be assigned to another boat if there are problems with the first. Permission to board and launch can be given by the bridge and is done on the initiative of the boat commander. The commander is responsible for the boarding procedure, most passengers are requested to take their places at the back so that the propeller and rudder touch the water.

THE PASSENGERS AND CREW MUST:

- Board in a disciplined fashion.
- Use all entrance hatches.
- Keep the entrance hatches clear.
- Share the weight around and sit down.
- Fasten the safety belt.
- Remain calm.
- Be as quiet as possible.
- The coxswain closes the hatch.

Extra actions when the boat is launched into a burning sea surface:

- Shut all hatches and ventilation ducts.
- Switch on the sprinkler system.
- The air system is turned on.
Launching and moving away from the vessel

When the coxswain has been being granted permission he will launch the boat by pulling on the cable of the remote control. This removes the brake and the boat will drop by gravity. Once in the water the hooks will be opened and the boat commander will then move away from the vessel. The commander moves at an angle into the wind and waves because of fire, smoke, poisonous vapours and wreckage.

At a safe distance
The crew and passengers must concentrate on their survival situation once they are at a safe distance from the ship. It is important that all boats and rafts come together and are fixed depending on the circumstances. The boats throw out their sea anchors or turn on their engines to stay together, a large orange patch is easier to find.

IMPORTANT
• The sea anchor has 2 ropes, a towing line and a (thinner) recovery rope.
• There should be no tension on the recovery rope because the anchor will then not work.
• Everybody must take an anti-seasickness tablet, they are quite strong and could make you sleepy but they work well.
• All passengers must keep their safety belts fastened, so that the boat will return to its normal position if it should capsize.
• Indicate a lookout, to search for survivors or look for the rescue services.
• Offer first aid to the wounded, a first aid box can be found in the boat.
• With good weather you can open the hatches and ventilation ducts.
• Read the instructions about the use of Emergency signals.
• Watch out for good discipline and morals, firm organisation and positive thinking.
• Seek contact with the rescue services. (see Emergency signals).
2. Life rafts

There are two types of liferafts, the TOB Throw OverBoard and the DLL Davit Launchable Liferaft.

Throw Over Board

Are relatively easy to use and always ready to use. Can be launched quickly. Provide relatively good protection. Require minimum stowage space. Do not necessarily require launching facilities. Are relatively cheap and easy to maintain.

The liferaft shall be packed in a container that is:

- Constructed as to withstand hard wear under conditions encountered at sea.
- Sufficient inherent buoyancy, when packed with the life raft and its equipment, to pull the painter from within and to operate the inflation mechanism should the installation sink or capsize.
- As far as practicable watertight, except for drain holes in the container bottom.

Construction of life rafts

Every life raft shall be so constructed as to be capable of withstanding exposure for 30 days afloat in all sea conditions. The life raft shall be so constructed that when it is dropped into the water from a height of 18 m. If it is to be stowed at a height greater than 18 m, it should be dropped from the height at which it is to be stowed. The height the liferaft to be stowed should be indicated on the liferaft. The life raft and its equipment will operate satisfactorily. If the life raft is to be stowed at a height of more than 18 m above the waterline in the lightest seagoing condition, it shall be of a type which has been satisfactorily drop-tested from at least that height. The life raft and its fittings shall be so constructed as to enable it to be towed at a speed of 3 knots in calm water when loaded with its full complement of persons and equipment and with one of its sea-anchors streamed. Unless the life raft is to be launched by an approved launching appliance the total mass of the life raft, its container and its equipment shall not be more than 185 kg. No life raft shall be approved which has a carrying capacity of less than six persons. Inflatable life rafts are designed for 4 persons till more than 200 (depending on vessel requirements). The life rafts are packed in containers including the special designed emergency equipment.
Position of the life rafts

The raft including the emergency equipment is packed in a polyester container or rubber back.

Design

Rafts are made from plastic with rubber on both sides. The topside is usually bright orange and the underneath is black. All parts of the raft are glued. The quality demands are controlled by international and national authorities such as described in SOLAS convention and Life saving Appliances LSA code.

Components of the raft:

- Separate inflatable compartments.
- Inflatable roof supports.
- Inflatable roof.
- Inflatable floor.
- Sea water batteries.
- Stability bags.
- One or two entrances.
- Over pressure valves.
- Extra inflation valves.

Throw Over Board raft

A painter runs from the raft container which is fixed to a Hydraulic Release Unit. The painter is stored in the container and is joined by a steel cable with a steel cylinder of compressed gas. (CO2 and N2)

When the raft is thrown overboard the painter will activate the cylinder, and then prevent the raft drifting away. The steel cable acts as a break line, if the installation should sink the break line will snap through the upwards force and the raft will float to the surface. After launching the raft you should pull the painter out of the container, if there is any resistance you should tug sharply so that the pressure cylinder is activated, the raft will then inflate and come out of the container.
Where should the raft be launched?

**IMPORTANT POINTS:**
- Is there a fire on board?
- Is the surface of the water burning?
- Can you reach the leeside?
- Is there debris where you wish to go overboard?

It could be necessary to launch the raft elsewhere in these situations. Untie the painter and carry the raft to another position, fasten the line and throw the raft overboard. Check the painter. It is of course of great importance that the painter remains in place until everyone is in the raft because the raft would otherwise drift too far away in a strong wind or current.

**TOWING A RAFT** It is possible to tow the raft with a specially attached towing piece. The strengthened towing piece should be used to connect several rafts together. The speed of towing a raft should if possible be restricted to 3 knots.
**ENTRANCE TO THE RAFT:**
Before entering the raft you should remove sharp objects such as tools. Enter the raft by means of a (rope) ladder, scramble net, rope or from the water, try to ensure that you stay dry. You could jump into the raft from a not too great a height but it is not recommended, the shell of the container could cause injury. Never jump into the raft if other persons are already in the raft.

**Launch procedure for a throwable raft**
- Ensure that the painter is attached properly.
- Check whether it is clear overboard,
- remove the band around the container and take the raft to the railing.
- Remove the railing if necessary.
- Throw the raft out.
- Pull the rest of the painter sharply out of the container to activate the CO2 cylinder.
- The raft will inflate in ± 60 sec

**Davit Launchable Liferaft DLL**
These rafts have a special method of launching but can also be thrown overboard.

**Advantages:**
- You enter the raft on deck.
- You descend to the water in a controlled fashion.
- You do not come into contact with (cold) water.
- So designed to meet the requirements for evacuation.

**DISADVANTAGES:**
- A complicated method of launching.
Hook system
Davits with a single wire for launching a raft should have a hook that opens automatically when the raft makes contact with the water, as long as the safety pole is removed! The operator should lock the hook if it is fixed to the raft. When the raft nears the water (± 0.5 m.) the lock should be set to ‘acute’. The hook will only open when the weight of the raft no longer hangs on the hook. Make sure the safety pole only opens at 0.5 m. from the water.

Turning a raft.
If the raft is inflated upside-down or turns over, you must turn it back again.

• Climb the ladder on the side onto the raft
• where the CO2 cylinder can be found.
• Stand on the float and while
• holding the turning line gently lean backwards.
• If you are lying on your back with the (soft) raft on
• you, pull yourself from under the raft with
• the turning line.
• Then climb into the raft.

Some manufacturers are investigating the possibility to develop a liferaft which will be self-righting.
3. Personal life saving equipment

There are three different ways to enter the water:
• Without survival suit or lifejacket.
• With lifejacket.
• With survival suit and lifejacket.

Entering the water without survival suit and lifejacket, then the risks of drowning and hypothermia are high. Swimming demands energy to initiate muscle action. The heat loss incurred due to submergence in water will be far greater than that which the body can produce, resulting in the rapid development of hypothermic symptoms. Blood flow to the muscles will be impaired. Therefore swimming is not the most ideal method. Is it still necessary to swim, think of a life raft floating by then swim as a group.

The best method to swim

The best method to swim is a compromise, where on the one hand energy is used and on the other hand won, because the victim turns on his back and by paddling with his hands he can choose the best position against sea and wind. In this situation clothing should never be removed (with the exception of heavy boots), as clothing provides a little insulation. Spare your energy in as much as possible; do not waste it by calling for help for example.

The H.E.L.P. position. H.E.L.P. stands for Heat Escape Lessening Position. If you're wearing a life jacket you have an important safety appliance at hand. The life jacket provides you with buoyancy so that the risk of drowning is reduced; it allows you to concentrate on preserving your body heat. A good method to keep the body temperature as high as possible is to reduce muscle activity by using the H.E.L.P. position. If you're with more people the HUDDLE position can be used. Because you lessen your body surface, your loss of heat is also reduced.
Lifejackets (conventional)

- Also lifejackets must comply with the life-saving appliances LSA code this will mean:
- A lifejacket shall not sustain burning or continue melting after being totally enveloped in a fire for a period of two seconds.
- At least 75% of persons, who are completely unfamiliar with the lifejacket, can correctly don it within a period of 1 min without assistance, guidance or prior demonstration.
- After demonstration, all persons can correctly don it within a period of 1 min without assistance.
- It is clearly capable of being worn in only one way or, as far as is practicable, cannot be donned incorrectly.
- It is comfortable to wear.
- It allows the wearer to jump from a height of at least 4.5 m into the water without injury and without dislodging or damaging the lifejacket.

An adult lifejacket shall allow the person wearing it to swim a short distance and to board a survival craft. Nowadays lifejackets are also equipped with a buddy line and a spray hood, however this is not a requirement. A requirement for Ro-Ro passenger vessels’ lifejackets is to have attached a light according paragraph 2.2.3 of the LSA Code. Attention: In the chapter safety we will come back on work jackets, it is pointed out those working vest are not qualified as SOLAS approved lifejackets.

**An adult lifejacket shall have sufficient buoyancy and stability in calm fresh water to:**
- Lift the mouth of an exhausted or unconscious person not less than 120 mm clear of the water with the body inclined backwards at an angle of not less than 20° from the vertical position.
- Turn an unconscious person clear of the water in not more than 5 seconds.

A requirement for having lifejackets for children on board is a minimum of 10% of the total amount of passengers on board the vessel.
Lifejackets (inflatable)

Additional inflatable lifejacket must have:

- They must at least have two separate compartments.
- Inflate automatically on immersion.
- Be fitted with a device to inflate it manual.
- Be equipped with tubes for oral inflation.

The jacket is automatically inflated when the user falls into the sea, or manually by pulling a toggle hanging from the side. The inflation usually works as follows: a tablet dissolves in contact with water and activates a CO2 cylinder. There are also systems with a hydrostatic release device.

LIFEJACKETS ARE FURTHER EQUIPPED WITH:

- Reflective material.
- Obvious colour.
- Whistle.
- Emergency light.
- Indication of approved body.
- Floating capability in Kilo Newton.
- Inspection date inflatable lifejackets.
**Immersion suits**

An immersion suit will give isolation and buoyancy a helicopter transportation suit doesn’t, see chapter helicopter safety. In the life saving appliances LSA code we find information about survivalsuits. The immersion suit shall be constructed with waterproof materials such that:

- It can be unpacked and donned without assistance within 2 min, taking into account any additional clothing.
- So constructed that, can be worn in conjunction with warm clothing and a lifejacket.
- It will not sustain damage or continue melting after being totally enveloped in a fire for a period of 2 seconds.
- It will cover the whole body with the exception of the face. Hands shall also be covered unless permanently attached gloves are provided.
- It is provided with arrangements to minimize or reduce free air in the legs of the suit.
- The immersion suit is to be worn with a lifejacket (if not different requirements).
- Immersion suit continues to provide sufficient thermal protection, following one jump by the wearer into the water from a height of 4.5 meter.
- To ensure that when it is worn for a period of 1h in calm circulating water at a temperature of 5°C, the wearer’s body core temperature does not fall more than 2°C.

**A SURVIVAL SUIT IS FURTHER EQUIPPED WITH:**

- Buddy line
- Reflective material
- Whistle
- Safety light
**Life buoys**

There should be a certain number of life buoys onboard. A lifeline should be fixed around the buoy to make it easier for the person in distress to hold on to it. All approved buoys should be either white/red or orange coloured, carry a reflecting band and the identification of the ship. Should the ship be abandoned, life buoys may prove valuable in helping to save persons who are in the water and unable to reach a lifeboat or life raft. Therefore throw as many life buoys in the water as possible when abandoning.

**Buoy light/smoke signal**

Some of the buoys carry a self-igniting buoy-light that will burn for at least 2 hours. The buoys may also be equipped with buoyant lines and/or smoke signals. The smoke signal gives orange smoke for at least fifteen minutes. You can enter the lifebouy by putting the lifebuoy over your hat and lean with your arms on the lifebuoy. Try not to move to reduce heat loss. When you throw the lifebuoy overboard make sure that the victim can reach for the floating line.
4. RADIO COMMUNICATION

Vessels have requirements depending on the area where they operate equipment on board according the Global Maritime Distress Safety System GMDSS. Hereby is the world devided in area’s A1, A2, A3 and A4. Depending on the operations and area of a mobile installation requirements are set for the emergency radio equipment.

On the picture on the left you will see a general GMDSS setup with the nessecary transmitters and receivers. Beside those equipment most offshore platforms are equipped with commercial satelite communucation also called INMARSAT.

On board of survival crafts there are several means of communication. Probably the most effective and reliable is radio communication because it is possible to contact rescuers on a long distance. Not all the systems are permanently installed and should be brought to the lifeboats (and rafts) in case of an emergency abandonment.
The different systems presently in use are:

- VHF radio (Very High Frequency)
- EPIRB (Emergency Position Indicating Radio Beacon)
- SART (Search And Rescue Transponder)

**Very high frequency radios**

VHF installations come in two types, fixed and portable. Portable sets are used for communication on board the vessel. The range and capacity of the batteries of these handsets are limited. In case of an emergency the handsets are used for communication between muster points and control room/bridge, the handsets can be taken inside life boats- and rafts for communication.

The law requires the following channels to be installed:

<table>
<thead>
<tr>
<th>Channel</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 6</td>
<td>Intership</td>
</tr>
<tr>
<td>Channel 15</td>
<td>Intership</td>
</tr>
<tr>
<td>Channel 16</td>
<td>Ship to ship</td>
</tr>
<tr>
<td>Channel 17</td>
<td>Intership</td>
</tr>
<tr>
<td>Channel 67</td>
<td>Search and rescue working</td>
</tr>
<tr>
<td>Channel 70</td>
<td>Digital Selective Calling DSC</td>
</tr>
</tbody>
</table>

The fixed installations are built into lifeboats and will generally have more channels to choose from, but will at least have the above mentioned. The range of a maritime VHF installation working on full power (25watt) will have maximum 30 –60 nautical miles, depending on weather conditions and antenna height. In case of an emergency, channel 16 can be used to transmit a Mayday call; however this not anymore guarded for 24 hours. So use the digital selective calling frequencies instead. By a spoken message is case of an emergency we always use the Standard English Marine vocabulary. An emergency call will be send as:

**MAYDAY MAYDAY MAYDAY!**  
This is: (name and call sign 3x)

**MAYDAY!**  
This is: (name and call sign 1x)  
Our position is: (degrees/minutes or distance/bearing, name of installation or vessel)

Give necessary info:  
- Nature of distress.  
- What assistance is required.  
- Amount of people involved.  
- Other useful information.
DSC

With the implementation of the GMDSS convention we also changed from spoken emergency calls in digital messages called DSC Digital Selective Calling. Sending in digital language is more clear and will be less disturbed by bad radio signals. For DSC special frequencies are appointed.

EPIRB

Emergency Position Indication Radio Beacons are required on ships. The beacons are self powered by means of batteries and transmit signals to satellites. These satellites are from the Cospass/Sarsat system, an international co-operative search and rescue effort. The system ensures a global coverage, 24 hours a day and contributes to help saving lives of seaman in distress. The E.P.I.R.B., once operated, automatically transmits a signal that is recognised by the satellite as an emergency call. The satellite will determine the position of the beacon and will then pass the information through to an earth station. From here the information is transferred to the Rescue Co-ordination Centre, nearest to the emergency position of the beacon. From this centre the SAR operation starts or the information is relayed to another SAR centre. Additionally the EPIRB’s will send a signal out that can be picked up by SAR helicopters and vessels equipped with the necessary homing devices. The homing devices will send the searching party straight to the person or persons in distress.
SART

The Search and Rescue Transmitter SART is a transmitter which can be used to take with you in the lifeboat or life raft. It is possible that the lifeboat is equipped with a SART. This is by the way not a requirement. The Search and Rescue Transmitter SART is a passive beacon until interrogated by radar frequency. It will then automatically transmit series of pulses, which are displayed on the radar screen of passing aircraft or vessels. The pulses are very obvious and therefore easy to recognise by the radar operator. Once recognised the navigator can plot the emergency position, the system is only for short range.
5. Pyrotechnic distress signals

Pyrotechnics are part of the signalling equipment found in the inventory of lifeboats, life rafts, ships, aeroplanes and helicopters. They may play a vital part in locating persons in distress. **WARNING:** All pyrotechnics should be handled with care. They can be dangerous when safety is disregarded. Since there are many different types of pyrotechnics and various manufactures, always make sure to read the operating instructions first. In order to ensure a safe way of activating the signal, even by people who do not know how to read the instructions are also depicted in so-called pictograms.

**Never activate pyrotechnics facing the wind!**

Rocket/parachute flare

A flare is a good pyrotechnics to attract attention over great distance. To be used during day or night, not with fog and low clouds. The visibility in clear weather is ranging from 30 to 40 sea miles. When a parachute flare is activated, a rocket is fired to a height of approximately 300 meters. When the flare is ignited a bright light burns for about 1 minute, the parachute keeps the flare in the air as long as possible. During the ascent of the rocket, the wind influences the tail in such a manner that the rocket turns into the wind. The flare will drift over your position when hanging on the parachute, giving an indication of your location. Never use flares when helicopters are nearby! They may damage the aircraft and interfere with your own rescue!

Hand Flares

Hand flares are used to pinpoint your position. Effective both day and night, not with foggy weather. The visibility is around 6 sea miles in clear weather. Never look into the flare. The light may damage your eyes. These flares provide their own oxygen when burning which means that splashing waves will not extinguish the flare. They will continue burning even when held under water. These hand-held flares burn for about 1 minute.
Smoke signals

The use of the smokesignal is to pinpoint your position and to indicate the wind direction. Effective only in daytime, not with foggy weather. The visibility depends on the wind force. After the smoke signal is activated it must be thrown in the water. The signal will get very hot so don’t hold it. The signal produces an orange coloured smoke for approximately 3 to 5 minutes. Make sure that the wind blows the smoke away from you, since the chemicals may suffocate you.

The use of the smokesignal is to pinpoint your position and to indicate the wind direction. Effective only in daytime, not with foggy weather. The visibility depends on the wind force. After the smoke signal is activated it must be thrown in the water. The signal will get very hot so don’t hold it. The signal produces an orange coloured smoke for approximately 3 to 5 minutes. Make sure that the wind blows the smoke away from you, since the chemicals may suffocate you.
6. Visual and audible distress signals

Signal mirror or heliograph
It is possible to attract attention over long distances, up to 20 miles by reflecting the sun rays to a ship, aeroplane or coastline. The limitations are that the sun must be shining and it doesn’t work 360 degrees around.

Signalling torch. (Flash light)
Very valuable source of light inside your liferaft/lifeboat. It can also be used to attract attention at close range for instance to contact other liferafts or lifeboats. Morse code can also be sent. The torch is waterproof and spare batteries are provided as well.

Whistle
In the inventory we also find a whistle, just like the ones we have on our life jackets or survival suits. Not very effective, since the sound of waves and wind will in most cases overrule the whistle.

Radar reflector
This will provide in a better reflection on the radar screen of a searching vessel, airplane or helicopter. It is important that the radar reflector is installed in a correct way. (Not to be used together with SART)
7. SAR organization

Search and rescue (SAR) comprises the search for, and provision of aid to, persons who are feared to be, in need of assistance. The two operations search and rescue may take many forms, depending on whether they are both required, on the size or complexity of the operation and on the available staff and facilities. It is necessary that the available resources are so organised and co-ordinated that effective and extensive search and rescue operations can be assured. This requires the establishment of a search and rescue organisation provided with a SAR plan and the means for carrying it into effect.

International Search and Rescue organisations.

Search and rescue is organised on national and international levels. The most important thing in rescue organisations is that people in distress have confidence in them. It is therefore necessary that people have insight in the basic principles of the rescue organisation. As an important date in SAR organisation the sinking of the Titanic in April 1912 must be mentioned, although it took till 1960 before most seafaring countries signed an international treaty. On December 7th 1944 Search and Rescue for people involved in aircraft accidents was already settled on a small scale international basis, by means of the so-called ICAO-doctrine (International Civil Authority Organization) which was taken over by all NATO partners. As from that date it was compulsory for all NATO members to have a national SAR organisation. The ICAO-doctrine was unchanged so it could also stay in use for non-NATO partners.
The most remarkable and important date in Search and Rescue organisation is the formation of the United Nations in 1945. Under auspices of UN we find several organisations, such as:

- ILO, International Labour Organisation
- WHO, World Health Organisation
- WMO, World Meteorological Organisation
- IMO, International Maritime Organisation

In the field of SAR, IMO is the most important organisation in UN. As mentioned before 1960 was a remarkable year in SAR. In 1960 all IMO members signed the SOLAS convention. SOLAS stands for Safety of Life At Sea.

In the SOLAS convention all members agreed on the following:
- Each member is responsible for a so-called Search and Rescue Region (SRR).
- International emergency frequencies are laid down.
- All participants are obligated to render assistance in case of an accident.

Nowadays SAR can be translated as:
- SAR units are on voluntary base.
- Specially trained SAR units.

In order to get SAR operations started it was agreed that in case of an accident the country in whose SRR the accident took place is responsible for the co-ordination of SAR actions, irrespective of the nationality of the person or object in distress. If the position of the accident is not exactly known the most probable SRR country is appointed as the co-ordinating country and remains responsible until the exact position of the calamity is known.

**HOW DOES THE INTERNATIONAL SEARCH AND RESCUE OPERATE?**
The cooperation between the IMO International Maritime Organization and ICAO International Civil Aviation Organization is described in the IAMSAR International Aeronautical and Maritime Search and Rescue manual. In the Volume I, II and III. SAR actions can be divided into two main sections:

- On the shore.
- On the spot.
Actions ashore are co-ordinated by a so-called Rescue Co-ordination Centre. Actions on the spot are co-ordinated by either an OSC On scene commander or a CSS (stands for Co-ordinator Surface Search).

**In the event of an emergency**

If a situation occurs where a Search and Rescue mission is to be initiated the normal course of events would be to alert the Coastguard who would take overall control of the incident. If the nature of the emergency requires the assistance of the Coastguard, they will assume total control until the rescue is complete or the search abandoned.

Due to their geographical location, the Coastguard will delegate specific tasks to a person close enough to the scene of the emergency to be able to monitor the situation in detail and who can co-ordinate developments as required. Depending on the situation this may be the OIM of the nearby installation, the master of a safety or supply vessel or the captain of a suitably equipped aircraft. The OSC will modify any plans if the local weather conditions change affecting flying conditions or the safety of any surface craft. He will also establish direct communication links with the shore base co-ordination centre and report directly to them at regular intervals giving details of the situation as it develops. Any unit arriving on the scene should report to the OSC and work through him unless told otherwise.

In any large-scale emergency the OSC may also designate tasks. If the number of surface vessels is sufficient, a C.S.S. may be appointed to control the surface search and report to the OSC. For the air search a helicopter co-ordinator can be appointed to liaison with receptor platforms, organise routing of helicopters and refuelling arrangements. In some instances he may also assist with air traffic control.
Reception of evacuees and survivors

If personnel is evacuated or picked up by helicopter, they will be taken to a receptor platform or, if the location is close to land, onshore. Any installation, which is to be used as a reception point, will be chosen for its medical facilities, helicopter refuelling capabilities and accommodation levels. If evacuation is by life raft or life boat, the reception point could be a rescue ship which will then transfer personnel by helicopter, or if weather conditions are adverse, evacuees will remain onboard until conditions improve or the ship reaches port or land. In addition to these dedicated services, the Coastguard can call up and ask assistance from any vessel in the vicinity, military or civilian. Under the SOLAS agreement these crafts must respond to the call unless circumstances make this impossible.

In any of these situations, the rescue team will be trained to deal with such circumstances. Survivors must do as requested by these teams. The more co-operative you are, the easier their tasks become, thereby ensuring the chances of a safe rescue and recovery.

Resources available

The Royal Airforce operates Nimrod aircraft for Search and Rescue purposes. As the aircraft is fitted with sophisticated communications and search equipment, in any incident the commander of the Nimrod is likely to take the role of O.S.C. if required by the Coastguard. The Norwegians operate a similar service with Orion Aircraft.

Helicopters

Rescue by helicopter can be effected from a shore base or offshore location. In the North Sea a field shuttle aircraft may be used for SAR by fitting a rescue winch and crewing aircraft with trained crews. SAR helicopters are available in the Brent, Forties, Ekofisk, Frigg and Statfjord fields. Norway, U.K. and Belgium use Sea King helicopters. It is a longer-range helicopter with a rescue winch and an all-weather capability. The endurance is 6 hours giving a range of some 600 nautical miles at a normal cruising speed of 100 knots. The helicopter can carry 19 survivors in a sitting position or 9 stretcher cases, and they have excellent communication-, navigation- and search and rescue equipment. Another helicopter in use by SAR is the Bell 412. Sometimes they are equipped with infra red radar, night vision, searchlight etc. At each station one helicopter is available at 15 minutes readiness, plus another within 1 hour during daylight. The final stage of the rescue itself can prove hazardous if the person to be rescued is unfamiliar with techniques and procedures. In attempting to help he/she may actually hinder operations.
SAR Nautical wall chart North Sea.
First aid in case of accidents and immersion in cold water

First aid definition: First Aid is the help given to a person who has been the victim of an accident or a sudden oncoming illness.

Aim of First Aid:

• Save life.
• Relieve pain.
• Prevent further worsening.
• Promote recovery.
• Bridge the time between the accident and the arrival of professional help.
Action in emergency:
- Safety.
- Yourself.
- Buddy and/or bystanders.
- Casualty.
- Take away the cause of the accident or remove the casualty from the danger.

What has happened/which injuries:
- Observe.
- Use senses.
- Make a diagnose.
- Use as much information as possible.
- Give immediate, appropriate and adequate first aid.

Reassure casualty:
- Keep talking.
- Help facing away from the injury.
- Explain what you are doing.

Alert medical attention:
- Your name and telephone number.
- The exact location of the incident.
- An indication of the type and seriousness of the accident and injuries.
- The number of casualties.
- What first aid has been given?

Help on the spot:
- If there's no danger for the casualty do not remove the casualty.
- If there's any chance that the casualty's condition might worsen because of danger, remove the casualty.
- To move the casualty to a safe area for a short distance, you can use the Emergency grip of Rautek.
1. First aid

Consciousness is an awareness of our surrounding. Unconsciousness is a damage of this awareness that can vary from being confused to being in deep coma. Unconsciousness is the result of an interruption of the normal activity of the brain. The level of consciousness can be determined by testing the casualty's response to stimuli such as sound or gently shaking. The most important function of a First Aider is to ensure that the casualty's breathing is sufficient.

Unconsciousness can be a life-threatening situation!

Respiration problems:
To check a person breathing, you can:
- Feel for movement with your hand on chest/abdomen (if conscious),
- Listen for sound.
- Feel for air flow.
- Look for movement of the chest.

Reasons for respiratory problems:
- Illness of the airway system.
- Accidents.
- Inhalation trauma.

Threatened breathing due to facial injuries, lung disease, burned airways.

Symptoms:
- Difficult breathing.
- Conscious.

Conclusion:
- Threatened breathing.

Action:
- Half-sitting position.
- Constant observation of breathing.
- Alert medical attention.
Obstructed breathing:

Symptoms:

Conscious:
- Blueness of lips, ears or face.
- Gripping the throat.
- Gasping for air.

Unconscious:
- Breathing is audible, snoring.

Conclusion:
- Obstructed breathing, choking.

Action:
- If choking: Clear airway.
- Firm hits between the shoulder blades.
- Heimlich’s manoeuvre (abdominal thrust).

If unconscious and if breathing is adequate:
- Recovery position
- Alert medical attention.

If unconscious and if not breathing (choking):
- Start CPR
- Alert Medical attention

Better do something then nothing and certain don’t walk away!
Insufficient or no respiration

Symptoms:
- Unconsciousness.
- Possible blueness of the face.
- No respiration or insufficient respiration.

First Aid:
- Open tight clothing.
- Open airway, with chinlift.
- Alert medical attention.
- Start CPR

**CPR.** (Cardio Pulmonary Resuscitation)
With CPR we mean to give compression and mouth to mouth ventilation. We try to bring oxigene to the brains.

Symptoms:
- Pale / gray skincolour.
- Unconscious.
- No breathing.

Action:
- Alert medical attention and start CPR.

**WE GIVE CPR BY ONE FIRST AIDER:**
- Start with chest compression. (30x)
- Followed by mouth–to-mouth. (2x)
- Continue with the above in the following sequence: 30-2-30-2-30-2-30-2-30-2-30-2 cq.

The rhythm that you should use is 100 compressions per minute. The depth of the compression of an adult is 5 cm.

You can stop CPR when:
- Breathing is returned or coughing.
- Professional first aider takes over.
- Exhausted and nobody to take over
- Danger for yourself and the casultay.
With more first aiders change on a regular base, for example every 2 minutes (5 times 30-2). Always give the CPR by one person unless not possible due to position of the casualty.

Though it is not mandatory to have an “Automatic External Defibrilators AED” on board, the moment there is one available, get it as quick as possible on the spot and connect. An AED is designed on such a way that you cannot make mistakes.
Wounds and bleedings

Wounds can be internal or external. Internal wounds are complicated because treatment is not possible for a first aider.

External wounds can give complications due to the fact that germs and bacteria can freely enter the body and can start an infection. As a first aider you have to be constantly aware of the danger of contamination and infection when dealing with external wounds. This means you have to work as sterile as possible.

The seriousness of a bleeding depends on:

- Type of bloodvessel involved
- Quantity of bloodloss (shock)
- Speed of bloodloss
- Location of the bleeding

Symptoms wound
- Blood
- Damaged skin
- Pain

Actions
- Cover the wound to protect it against further contamination
- Remove jewelry on the body parts below the injury
- Search for medical attention

Symptoms bleeding:
- Wound
- Severe bloodloss

Actions:
- Stop the bleeding by direct pressure on top of the wound
- If possible after 10 minutes of pressure wound pressure bandage
- Make sure of something between your hand and the wound preferably as clean as possible
- Alert medical attention
Burns and scalds

Burns can be caused by:
• Heat
• Cold
• Friction
• Radiation
• Chemicals
• Electricity

Scalds can be caused by:
• Hot liquids
• Steam

Classification of burns and scalds
1st degree
• Red skin
• Swelling
• Pain

2nd degree
• Blisters
• Pain

3rd degree
• Black skin (burns)
• White/grey skin (scalds)
• No pain

Actions
• Immediate cooling for at least 10 minutes with slowly running not to cold water.
• Chemical burns at least 30 minutes after removing contaminated clothes
• 2nd and 3rd degree burns should be covered sterile
• Alert medical attention

Do not
• Puncture blisters or remove loose skin
• Remove anything sticking to a burn (clothes)
• Apply ointments, lotions or fat to a burn
Fractures and dislocation

Fractures are injuries of the skeleton and can occur on any bone of the body. Dislocations are problems of the joints because they have gone out of the surrounding. The treatment of these injuries is the same. The best treatment of these injuries is to do as little as possible, because everything you do will give more damage. Normally these injuries are not urgent so we have time to wait for medical assistance.

Possible symptoms (not all have to be present):
- Pain
- Loss of function
- Swelling
- Bruising of the tissue (black spot)
- Deformity
- Open wound
- Abnormal uncontrolled movements
- Pieces of bone sticking out

Actions
- Cover open wound
- Immobilise the fracture
- Reassure the casualty
- Position the casualty as comfortable as possible without changing the position of the fractured bodypart.
- Arrange for medical attention
- Support the fractured bodypart
- For the hand, wrist and lower arm use a sling
- For the elbow, upper arm and shoulder use a broad fold
- For the lower limbs use a rolled up blanket
Bruises, sprains and strains
A bruise is an injury of the soft tissue that will result in a black spot. A sprain is an injury cause by the overstretching of a ligament of a joint. A strain is a (partial) rupture of muscle tissue.

**Symptoms**
- Pain
- Limited function
- After some time swelling
- After some time change of color

**Actions**
- Let the casualty sit or position him on the floor
- Cool for a minimum of 10 minutes with
- Slowly running water
- Ice pack (put something between the pack and the skin)
- Cold pack (put something between the pack and the skin)
- Wet dressing (regularly refresh the dressing)
- Immobilize and compress injured bodypart
- Elevate the injured bodypart
- Remove any jewelary below the injured bodypart

Eye injuries
The mental impact of an eye-injury should never be underestimated. So the reassurence of a casualty plays an important role. Do only the strictly nescessary treatment to save an eye.

Dust in the eye, symptoms
- Irritation of the eye
- Casualty wants to close the eye
- Severe watering of the eye
- Casualty wants to rub the eye

**Actions**
- Prevent the casualty to rub in the eye
- Take the casualty to a spot where there is sufficient light available
- Open the eye and inspect the whole surface of the eye
- If the particle is on the coloured part of the eye or is stuck leave it and arrange professional help
- If it is on the white of the eye try to remove it to the closest corner of the eye.
- If in doubt arrange profesional help
Penetration of the eye
Never remove a penetrating object from an eye

Symptoms
• Felt something against the eye
• Pain

Actions
• Do not remove the object
• Cover the eye and make sure not to push the object deeper
• Cover also the non-injured eyes, because the movement of the eyes is connected
• Do not leave the casualty alone and even better keep bodily contact with him.
• Arrange for professional treatment

Chemical burns of the eye

Symptoms
• Irritation of the eye
• Blurred vision

Actions
• Wash out the eye for at least 30 minutes
• Make sure the chemicals do not get in the non-injured eye
• Cover the eye
• Arrange professional help
Welders flash and Snowblindness

Snowblindness on board can occur in summer due to reflections on the sea and on white surfaces of the ship.

**Symptoms**
- Pain
- Sensation like ‘grit in the eye’
- Eyes are very sensitive for light

**Action**
- Bring the casualty in a room with dimmed light
- Arrange for professional help

Intoxications

Intoxication means that a dangerous amount of a hazardous substance has come into the body and presents a problem to the health.

**Ways to get a poison into the body**
- Injection
- Inhalation
- Digestion
- Absorption through the skin

**Poisoning by injection**
Here we can think of stings or bites of certain insects or other poisonous animals. An other reason can be an accident involving liquids under high pressure.

**Symptoms**
- Puncture wound
- Pain spreading in the whole body
- Loss of consciousness
- Loss of breathing
- Loss of circulation
- Extensive damage inside the body

**Actions**
- Immediately arrange professional help
- Stabilize the vital functions
- Do not let the casualty move
Poisoning by inhalation

Here we make a division in irritant and non-irritant gasses and vapors. Of these gasses the non-irritant gasses are the most dangerous because they don’t give you any warning. The most important thing to do is take care of your own safety, because those gasses can also become a problem for you.

Irritating gasses (chloride, ammonia)

**Symptoms**
- Pain in the throat
- Persistent coughing
- Pain when breathing

**Actions**
- Take care of your own safety
- Bring or let bring the casualty into the fresh air
- Bring the casualty in a half-sitting position or when unconscious recovery position
- Advise the casualty not to move, slower spreading through the body
- Arrange medical attention
- If not breathing start CPR

Non Irritant gasses (CO, CO2, N2)

**Symptoms**
- Headache
- Red (CO) or blue lips
- Quick breathing
- Cramp
- Unconscious
- No breathing

**Actions**
- Take care of your own safety
- Bring or let bring the casualty into the fresh air
- Bring the casualty in a half-sitting position or when unconscious recovery position
- Advise the casualty not to move, slower spreading through the body
- Arrange medical attention
- If not breathing start CPR
Poisoning by digestion

This category can be divided in 3 different products

- Biting (acids, chloride)
- Non-biting (medicins, food)
- Petroleum

**Biting**

**Symptoms**
- Pain of lips, mouth, throat, oesaphagus and stomache

**Actions**
- Identify chemical and find MSDS sheet
- If conscious rinse the mouth and throat
- Let the casualty dring 2 glasses of water
- Do not induce vomiting
- Arrange professional help
- If unconscious stabilise the vital functions

**Non-biting**

**Symptoms**
- Desorientation
- Sleepy
- Slow and shallow breathing

**Actions**
- Identify chemical and find MSDS
- If conscious induce vomiting
- Do not give anything to drink, the poison will spread quicker through the body
- If unconscious stabilise the vital functions
- Arrange professional help

**Petroleum**

**Symptoms**
- Nasty taste in the mouth

**Actions**
- Identify chemical and find MSDS
- Do not give anything to drink
- Do not induce vomiting
- Arrange professional help
- If unconscious stabilise vital functions
Poisoning by absorption through the skin. These poisons are absorbed by the skin and come into the system. Examples are benzene, toluene, insecticides etc.

**Symptoms**
- Muscle cramp
- Breathing problems
- Paralisation

**Actions**
- Take care of your own safety
- Remove or let the casualty remover infected clothing
- Wash the skin for at least 30 minutes
- If unconscious recovery position
- If not breathing give CPR. Make sure for protection of your mouth.

---

**Medical assistance on a vessel**

Vessels are equipped with a medical hospital and one of the officers is appointed and trained to carry out medical care and medical first aid. Most shipping companies have onshore a medical support team by means of a doctor on call 24 hours.

**Radio Medical Service (RMS).**

When there is a severe casualty or sickness on a vessel the appointed officer can ask advice from an onshore organization called RMS. This radio medical service is operated by the Dutch Lifeboat association called the KNRM. The RMS will have doctors available to give medical assistance.

The Radio Medical Service is manned by five doctors (doctors with a nautical background) those doctors work in different shifts during the week and in the weekend. They will be informed and within 10 minutes they can make contact with the vessel by means of the coast guard in the Netherlands. The doctor is familiar with the situation of the vessel and the possibilities on board. The doctor can determine by radio, satellite or telephone what the symptoms are.

Depending on the situation the doctor can describe medicines or give the advice for a medevac. Yearly the doctors deal with 800 advices.
Medical Evacuation (MEDEVAC)
If a casualty or sick person is in such a condition that medical assistance from the shore is needed, the coastguard in good cooperation with the RMS doctor will decide to carry out a MEDEVAC. Within the Dutch SAR region, the Navy or the KNRM will carry out the MEDEVAC. In most cases, a doctor will escort the MEDEVAC to treat the person on the spot and prepare for transportation.
2. Hypothermia

“Hypo” means low and “thermia” for heat, so hypothermia is standing for low (core) temperature. The body temperature usually varies between 36.9° and 37.4° C. Below 35°C we call it hypothermia.

Three forms of hypothermia:
- Cronic
- Sub-acute
- Acute

Chronic:
This form especially effects elderly people and/or alcoholics. As chronic hypothermia especially effects elderly and/or alcoholics it is not within the scope of this syllabus to discuss this form of hypothermia.

Sub-acute:
Hypothermia caused by exposure for example to cold air. The most simple form of hypothermia in terms of protection and treatment. Heat loss because of exposure should not be overlooked. Hypothermia sets in, slowly but steadily. The casualty itself is not aware of the fact that he is affected by hypothermia. A dangerous situation can develop, since hypothermia can lead to loss of co-ordination between thinking and doing. Putting on enough clothing can easily prevent exposure. An important precaution in order to prevent this form of hypothermia is to make sure not to get exposed to the cold or limit this exposure.

Acute:
Hypothermia caused by immersion in cold water. Acute hypothermia can be the result of immersion in cold water. In the North Sea the surface temperatures varies between 2°C to 6°C in wintertime and 15° to 17°C during summer. The temperature of coastal waters strongly depends on the air temperature, but the North Sea is always cold to very cold.

What happens after immersion in cold water?

The reaction of the human body to sudden exposure to cold water is:
- Quick breathing that can lead to hyperventilation
- Gasping for air
- Increasing blood pressure
- Increasing heart rate
- Disorientation
- Panic

Cold Shock.
This can result in a so-called ‘Cold shock’. Cold shock can lead to:

- Inhalation of seawater
- Reduce swimming capability
- Drowning, within first 2-3 minutes

![Windchill factor diagram](image)

### What to do to prevent cold shock?

- Wear protective clothing. Clothing serves a dual purpose. In clothing a considerable amount of air is trapped. This air helps you to stay afloat for a while. It also gives our body time to adjust to the cold water temperature.
- Whenever possible, do not jump in the water. Try to get into the water gradually.
- Use a life raft or lifeboat, or a personal escape system.
- Mental preparation. As soon as you enter the water your only concern is to control your breathing. This control can only be achieved by a positive mental attitude. BE PREPARED!
Hypothermia:
After the initial cold shock hypothermia will slowly but steadily set in. A number of factors will determine how quick someone will become hypothermic:

- Water temperature
- Air temperature
- State of the sea
- Age, size, body, sex and gender
- Layers of insulation
- Physical condition
- Mental condition

Prevention: If working on places where falling overboard is possible, make sure that you have a lifeline and life jacket.

Body heat loss.
When a person is immersed in cold water the body cools down very fast. However it may take 10 to 15 minutes before the core temperature starts to drop. The greatest areas of heat loss are head and neck, chest, armpits and groin region.

What can you do to prevent hypothermia?
Without a life raft or other floatation device a person in the water must swim to keep her/his head above water, especially with waves. In this situation there are two problems:

- Drowning
- Cooling down.

Swimming produces heat, but because the body is completely exposed to the cold water, heat loss will be larger than the heat production. Another important factor is that it is not possible to swim for a long time. Conclusion: Do not swim!
Wearing a PFD
If an immersed person wears a PFD, his only concern is to stay warm because his PFD will keep him/her afloat. To stay warm the best thing you can do is:
• Minimise your activities.

HELP position
Reduce exposure by assuming the Heat Escaping Lessening Position. Bring your arms close to the side of your body.
• Cross your ankles.
• Keep your legs close and pull up your knees.
• Search for the most comfortable position
• Protect your face for spray water

HUDDLE position.
If you are with more persons in the water the Huddle position might help in some cases. (moral, injured persons, etc.)
• Wrap your arms around each other.
• Form a circle facing the others.
• Keep bodies as close as possible together.
• Fill up the inner circle.

Do not change anymore. The HUDDLE position reduces heat loss by limiting the body surface exposed to the water and helps SAR-units in locating you.

Wearing a survival suit
A survival suit keeps you afloat and warm. However in case of an unconscious person a survival suit does not turn the victim into the right position. Therefore a life jacket has to be worn.
Windchill factor

When somebody is working outside also the windchill factor can be an important factor to deal with. Because of the moving air around your body, you will experience this air as colder. This is called the windchill factor, see the next table.

<table>
<thead>
<tr>
<th>Beaufort Scale</th>
<th>Wind Strength</th>
<th>The Risk of Frostbite on Bare Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Wind</td>
</tr>
<tr>
<td>0</td>
<td>Calm</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Light Breeze</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>Gentle</td>
<td>8.8</td>
</tr>
<tr>
<td>4</td>
<td>Moderate</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Moderate Gale</td>
<td>17.3</td>
</tr>
<tr>
<td>5</td>
<td>Fresh</td>
<td>22.3</td>
</tr>
<tr>
<td>6</td>
<td>Moderate Gale</td>
<td>30.3</td>
</tr>
<tr>
<td>7</td>
<td>Moderate Gale</td>
<td>34.7</td>
</tr>
</tbody>
</table>

Important to know what NOT TO DO!

- Do not rub the patient.
- Do not warm up the patient with warm/hot water.
- Do not lift the patient vertically.
- Do not administer drugs.
- Do not allow patients to drink alcohol.

Shelter, beware of wind chill. Basic first aid in case of hypothermia.
Basic first aid in case of severe HYpothermia

First aid:
1. Lift the casualty horizontal
2. Don’t move the casualty
3. Do not remove wet clothing
4. Put the casualty in a horizontal position with the feet raised
5. Put the casualty in warm blankets
6. Protect victim against the wind
7. Get professional help.

First aid for a hypothermic casualty in a life raft or lifeboat.
In all lifeboats and liferafts we find an amount of Thermal Protective Aids TPA’s depending on the capacity. This is 10% of the capacity. The TPA’s will prevent more heat loss by the wind and the casualty warm up again due to his/her own bodyheat. The TPA’s are not designed to use in the water.

Preventive equipment.
Prevention and preparation is an important issue. If you have to work above or close to the water, use a lifejacket or workvest. If you have a MOB drill or real MOB situation use the correct protection.
1. Fire Fighting

The combustion process
Oxidation is a chemical process between a reactive material and oxygen. During this process energy is generated in the form of heat. Fire is a fast oxidation process between an inflammable material and oxygen. During this process spontaneous energy is generated, mostly in the form of heat and light in the form of flames.

All materials occur in one or more forms (physical condition):
- Solid matter
- Liquid
- Gas or vapour

All materials consist of molecules. Each molecule must be encircled by enough oxygen molecules for good oxidation. Only the molecules of a gas are not joined together, and can therefore move freely around to mix with oxygen molecules. This mixture can burn. These molecules mixed with oxygen molecules can make an inflammable mixture. This mixture can ignite at a certain temperature, the ignition temperature. If the energy that is released is sufficient to set up a chain reaction, it is called fire.

The Fire Triangle
So it seems there are three components needed to get a combustion.

- Fuel.
- Oxygen.
- Heat (energy).

The three components for fire are illustrated in a fire triangle.
Fire fighting
The fire triangle also illustrates two important factors in preventing and extinguishing fire:

- When one side of the fire triangle is missing there can be no fire.
- When one side of the fire triangle is removed the fire will go out.

Leaving the fire to burn out
The removal of fuel.

**Example:**

- Burning oil flows out a leaking flange.
- Turn the valve off.
- The fire will go out due to lack of fuel.

One side of the fire triangle indicates the oxygen concentration. A concentration of 14% is needed for a flaming fire. A smouldering fire actually only needs 3% oxygen to remain ‘alive’. Stop the oxygen supply.

**Example:**

- Stop the supply of oxygen by adding foam to a burning liquid
- Or suppress the oxygen by steam or CO2.
- The fire will be smothered.

Lower the temperature
By lowering the temperature the vaporisation of an inflammable material will be decreased or stopped.

**Example:**

- Cooling/ extinguishing with water.

The fire will go out because the chain reaction is stopped.
Chain reaction
Part of the heat releases more gas and another part raises the temperature of the gas to ignition temperature. At the same time air is sucked into the area where the flames and gas meet up. The result is a chain reaction. The burning gas produces heat which releases and burns more gas. The released gas burns, produces more heat causing more gas to be released. And so on. After a while the gas is released at maximum tempo causing the combustion process to work evenly. This continues goes on until most of the fuel has been used. Then the burning process will fall apart.

Catalyst
Sometimes fuel, oxygen and energy are present in the correct ration but there is no fire. There is then a catalyst needed to start off the combustion reaction. A sugar cube will not burn, but can burn when it is sprinkled with the ash of a cigarette. A catalyst is a material that “interferes” in some way with the combustion reaction, without being used during this process.

The fire triangle is a simple form to illustrate the conditions necessary to create fire. An extended explanation is shown in the fire pentagon. The fire pentagon is a better representation of the combustion process. This is important, because it gives us the 5 direction to use in extinguishing a fire. The principle of extinguishing is attack one of the five sides of the pentagon and that way disturb the chain reaction of the fire.

The five techniques are:
- Cooling
- Smothering
- Removal of fuel
- Change of mixture
- Add a catalyst

Cooling
This takes the energy and out of the process. The goal is to get the temperature below the ignition temperature or even better below the flashpoint so the production of vapours stop.
Smothering
By smothering we try to lower the amount of oxygen around the fire. This can either be done by blocking the oxygen supply or by replacing the oxygen by an other gas or vapour.

Removal of fuel
This technique is used on fires that are to dangerous to extinguish. An example is a gas fire. If we extinguish this fire the gas starts spreading and can give explosive concentrations. A safer way is to shut down the gas supply and let the gas burn with a controlled flame till the gas supply stops.

Change of mixture
This technique can be used to disturb the mixture of fuel and oxygen. If this is disturbed the reaction cannot take place anymore.

Add a catalyst
By adding a catalyst the chain reaction of the fire will be negatively influenced. Simply explained we make the energy level needed for ignition so high that the chain reaction stops.

Progress of fire and risk of explosion
What happens during combustion of material?
Combustion is a chemical reaction in which the fuel begins a connection with the oxygen in the surrounding air. When an inflammable liquid is heated by an energy source flammable vapours are released. The inflammable vapours can react with oxygen if sufficient energy is added.

Heat (energy) is released by this combustion reaction. If sufficient energy is released the rest of the fuel is further heated so that the combustion reaction is maintained. The type of fuel determines how much energy must be added in the first instance to start up the combustion. Inflammable gasses usually only need a small ignition source (spark) to start a reaction. Solid matter such as wood must first be heated for a time before they stay burning.

A solid matter fire is slow to develop. We recognise a number of phases:
• The smoulder stage
• The flame stage
• The glow stage

The smoulder stage is the first phase of combustion. When heated all the inflammable gasses are released but not yet enough to get the combustion really started. A cigarette in a waste paper bin can smoulder for 1 to 2 hours. Smouldering can put itself out (when lacking in oxygen, fuel or energy) or move over to the flame stage. The fire can support itself when the flame stage has started. The flame stage is usually accompanied by a rapid rise in temperature within 5 to 15 minutes. All the fuel present is heated and many inflammable gasses start to combust quickly.
A temperature of about 900°C is reached when the fire is completely developed. All the inflammable matter burns. A glowing layer remains when all the inflammable gasses from the fuel have been burnt: the glow stage has started. Extinguishing will now take longer because the glowing parts of the fuel are less accessible to the extinguishing agent. Liquid and gas fires develop faster and reach a higher temperature than fires of solid matter. These fires only have a flame stage. Constant vaporisation takes place on the surface of liquids. The higher the temperature, the more vaporisation. When there are sufficient vapours above the surface and they are well mixed with oxygen from the air they can be ignited. The flashpoint is the temperature (at atmospheric pressure) where the liquid starts to giving vapours. It is given in degrees centigrade.

Inflammable gas or inflammable vapour could, in the correct proportions, form an explosive mix. When too little inflammable vapour / gas is present in a mix it is too ‘poor’ and is under the lower explosion limit. A mix with too much inflammable vapour / gas is above the upper explosion limit and is too ‘rich’. An explosive gas / air mixture can come about quickly when there is leakage of gasses and liquids.

<table>
<thead>
<tr>
<th></th>
<th>LEL (Lower Explosion Limit)</th>
<th>UEL (Upper Explosion Limit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To lean</td>
<td>Explosive</td>
<td>To rich</td>
</tr>
<tr>
<td>100% air</td>
<td>8.5 vapour</td>
<td>0% air</td>
</tr>
<tr>
<td>0% vapours</td>
<td>100% air</td>
<td>100% vapours</td>
</tr>
</tbody>
</table>

Spread of fire

The fire can spread if there is sufficient inflammable matter and oxygen available. A fire mostly spreads with the wind outdoors. Heat and inflammable gasses are ‘transported’ along with the flames and smoke. A fire can spread because inflammable matter in the direct vicinity is heated up.

The transport of heat occurs by means of:
- Conduction
- Radiation
- Convection

Conduction is heat transport via a solid matter. The heat will spread quickly by a conducting matter such as metal.
Radiation is transport by means of energy waves. The enormous radiation heat of a fire can often travel a distance. Heat transport takes place for 80% by radiation. Convection is heat transport resulting from the movement of gasses (air) or liquid. Central heating in homes is based on this principle.
The spread of fire
An enormous heat can develop when a fire continues without control. The fire can spread in two ways:

- Fire penetration
- Fire transport

Fire penetration is the movement or spread of a fire through bulkheads. This is possible by the energy transferred by pipe transits and cable work. Fire transport is the movement or spread of fire between two objects not connected. This could be by heat radiation or the flow of heated combustion gasses.

Division of fire classes.
Fuels react in their own way to fire and should therefore be extinguished in different ways. Fuels are divided into a number of classes with specific characteristics during fires so that the fire fighter knows which extinguishing agent should be used. We recognise:

Class A fire
Solid matter fires (e.g. wood, rubber, paper).
Solid matter must first change into a gas before it can burn. This process is known as pyrolysis which is generally defined as a chemical decomposition through the influence of heat. When the gas has mixed with enough with air and is heated to a high enough temperature combustion begins.

Class B fire
Class B fires are liquid fires (e.g. gas oil, oil and paint). Inflammable gasses are released by the liquid vaporising. Highly inflammable liquids vaporise at room temperature and could then combust, think of terpentine and gasoline. One spark (energy) can be sufficient to set fire to these liquids. Heavier liquids such as oil and fats must first be heated to above the flash point before an inflammable mixture can be formed.

Class C fire
Class C is formed by gas fires such as propane and natural gas. No heating is necessary because the fuel is present as inflammable gas. Some gasses are lighter, others heavier than air. An inflammable/explosive mixture can be formed quickly through mixing with air when there is a gas leak.
Class D fire
Class D concerns fires of (light) metals, magnesium and aluminium for example. Metals burn from the formation of glow, at extremely high temperatures (approx. 2500 °C). These fires can often not be extinguished in the normal way. Extinguishing is only possible by complete and longlasting smothering or with the help of special extinguishing agents.

Class F fire
Class F indicates that the extinguishing agent is suitable for extinguishing very hot oils and fats, the quantity being as 5 litres, large deepfryers for example.

Electrical fires
Fires involving electricity deserve special attention. Extinguishing is possible but depends on current and voltage. The label on the extinguisher shows whether it is suitable for extinguishing live parts. An expert must always be warned in the case of high voltage. The current must always be switched off. If there is no residual current left, extinguishing can start in the normal fashion.
Characteristics of extinguishing materials.

- Water.
- Foam.
- Carbon dioxide (CO2)
- Dry chemicals. (powder)

**Water**

Water can be found (almost) everywhere in large quantities and is a good and cheap extinguishing material. The greatest extinguishing effect of water is cooling. Water absorbs much heat from the vicinity. 1 litre of water can produce 1700 litres of steam. The steam has a smothering effect in a closed room. An other effect is mixing a liquid up so it can not ignite (e.g. alcohol)

Extinguishing characteristics

When water is added to a wood fire (or a similar fuel) the effect, in principle, is the cooling of the fuel still to be burnt which stops the vaporisation and so kills the flames which feed on the vapour. This happens almost the same way with certain oils, such as heavy fuel oil, lubricating oil or asphalt. They will not vaporise to any great degree under normal pressure and at normal temperatures until they are heated to a higher temperature. This indicates a high flash point. When a fire in these materials with a high flash point (>65ºC) has started, the supply of vapour is kept going because the flames continue to heat the surface causing the vaporisation to continue. The fire will continue until all the fuel is finished if no action is taken.

However when water in the form of a fine spray is spread over the surface it will cool down, the vaporisation will stop and the fire will stop. So water can be used as an good extinguishing agent for certain types of oils and extinguishing is handled in nearly the same way as for a wood fire or other ordinary fuels.

Cooling is a way of closing off the gasses that feed a fire of non-volatile or ‘heavy’ oils. Use water in the form of a spray or fine mist; never use a fixed jet on the surface of oil. Water jets are only effective at distance, because the water will spread itself into droplets over the distance. Water sprays are also effective for cooling off steel tanks, pipes, constructions, etc., especially when they are high up. However other rules are valid when inflammable liquids are involved which are volatile. (liquids with a flash point < 65ºC.)

These products produce sufficient vapours to be able to burn at ‘normal’ temperatures and pressure. The water which reaches the surface will not boil. It will probably sink without being heated too much; which eliminates the cooling parties. The actual cooling effect only occurs in the flames where small droplets of water will vaporise and lessen the heat. Generally speaking water is not suitable as an extinguishing agent for gasses or volatile oil.
Cooling

Water is used to cool and to keep cool. To protect buildings, constructions, tanks, etc. against heating up or the influence of flames. Water, added in the correct way, (in the form of a mist or spray and in sufficient quantities, generally estimated at 10 l. per minute) can absorb heat and prevent damage. Water cools the best when it changes into steam.

Parts of the installation that are not visible through the smoke or flames are often forgotten but do also need protection. The available water should be used to cool the most critical parts. These could include parts of the installation that will come into contact with the flames and parts that will be radiated.

NOTE:
• Non-insulated smoke gathers in a ‘cloud’. The ‘cloud’ could topple over when only one side is cooled.
• Hot pumps, compressors. Cracks can be formed by the shock effect of cold water on only one side.

The use of water

Water can be used in two ways for an oil fire: Mist or spray jets and fixed jets. Each has advantages and disadvantages and its own area of application.

In general; a fixed jet has the greatest reach and power, the wide jet (spray jet) has a short reach and offers the most protection to the fire fighter. A combination between fixed jet and spray jet, an in-between position, is in most cases preferred. The intention is to get the water in the correct form to the correct place so that the maximum effect of cooling and extinguishing is achieved.

ANOTHER WAY OF USING WATER

Most of what has already been explained is about the cooling effect of water. However water can also be used as a propulsion force. The position of the oil fire is very important. Oil floats on water and overflow from a burning area can cause the burning oil to float to another area which could cause even more damage.
It could be directed to an area where it could burn without causing as much damage. This can be achieved by the combined effect of flotation power and the force of water jets. Another way to use water is on liquids that will mix with water (e.g., alcohol). There need to be a minimum concentration of the fuel in the mixture. If you add enough water to mix it up below this minimum the fire will also stop.

**FOAM**

Foam is also a frequently used as an extinguishing agent. Foam consists of 3 elements:

- Water
- Foam forming agent (AFFF)
- Air

A certain percentage of a foam forming agent is added to water with an inline conductor. Air is sucked into and mixed with the foam forming agent (premix) at the foam jet pipe. Extinguishing foam is formed.

Foam is usually the best extinguishing agent for liquid fires (slick fires). Foam has several characteristics which allow it to be used as an effective extinguishing agent:

- Foam prevents heating by radiation, because the flames can be separated from the liquid.
- Foam represses the formation of vapour because a film layer and/or layer of foam is formed. The foam lies like a blanket on the liquid, so that vapours cannot form just above the liquid.
- Foam cools. The foam mixture consists of 94 - 99% water. This cools the upper layer of the liquid. The chance of reignition is very small after proper extinguishing with foam.

A disadvantage of foam is that it is broken down very quickly, depending on conditions such as heat, wind and rain, this is way foam must be added constantly for a long time. The liquid can start to burn again spontaneously if the layer of foam breaks down. Several ‘foam blankets’ can be created depending on the quantity of added air. The foaming capacity number is a measurement of the quantity of added air per litre of foam mixture. 3 classes are recognised:

- Low foam
- Medium foam
- High foam

High foam is used especially for fires in large enclosed areas. Low and medium foam are mostly used for extinguishing liquid fires. The biggest difference between the foams is the jet range. Foam can be used for many products depending on the type of foam forming agent. One of the most well-known
types of foam is AFFF (Aqueous Film Forming Foam). The addition of AFFF provides a layer of film between the liquid and the air. Types of foam are also suitable for glow fires in solid matter. By adding foam forming agents the surface tension of the extinguishing water is decreased and the water can penetrate deeper, for example, in cotton and paper.

Modern foam concentrates work with hard or soft, fresh or salt water. The mixing concentration of the foam forming agent and water can differ from approx. 1% to 6%. This depends on the supplier and quality of the FFA. So always follow the supplier’s instructions and those on the equipment producing the foam.

Carbon dioxide gas (CO₂)

The extinguishing agent CO₂ is a non-flammable and non-toxic gas that represses oxygen. CO₂ is always stored at a pressure of approx. 65 bar. 1 kg CO₂ expands to 500 litres of gas during extinguishing. Because of the great cooling that occurs, carbon dioxide snow at a temperature of -80 °C is released as well as CO₂ gas. The carbon dioxide snow vaporises quickly into CO₂. Carbon dioxide is suitable for various fires in the flame stage. The chance of re-ignition is high because it does not cool. CO₂ has the clear advantage of not being electrically conductive and causes almost no additional damage. Therefore it is very suitable for fires in electrical and sensitive equipment. A disadvantage is that not only the fire will be smothered but also persons still in the room will die due to lack of oxygen. This will only cause problems when used in large quantities in small areas. When used in the outside air the carbon dioxide will blow away quickly, the extinguishing effect is then small. Carbon dioxide is not suitable for metal fires. Due to the high temperature of metal fires the CO₂ will split into Carbon and Oxygen. This will make the fire only bigger. CO₂ is used in fixed installations or in portable extinguishers.
Powder

The extinguishing effect of powder is the interruption of the reaction between fuel and oxygen. That is why we call powder a negative catalyser. That is way we speak of the rapid flame knock down. Powder has a long-life, is non-toxic in low concentrations and does not conduct electricity. ABC Powder will also form a crust around solid fuel. If this crust is totally covering on all sides Oxygen O2 can not get in and the vapours can not come out. Extinguishing powders consists mainly of salts. Extinguishing powders can be used for various types of fuel depending on the composition. The most important components are:

- Natrium/potassium bicarbonate, for class B and C.
- Mono-ammonium phosphate, for class A, B and C.

A and D powders form a (melted) layer on the burning matter and disrupt further combustion. B and C powders work as negative catalysts and knock the flames down. In enclosed spaces and especially when sensitive equipment is set out, the powder will cause much additional damage because the fine powder gets everywhere and is corrosive on the long term. The damage caused by the powder can sometimes be more than the fire damage. It is then better to use another extinguishing agent.
2. Fire Prevention

On a vessel there is a (large) concentration of persons, equipment and cargo combined together on a ship. Such as; accommodations, galley, HVAC’s, engine rooms, deck/food stores and cargo holds. Specific risks are the nature of the work and the presence of dangerous materials, depending on the cargo.

- Containers with flammable and or dangerous goods.
- Dangerous Cargo in tanks.
- Dangerous Cargo in bulk

Construction requirements

Safety guidelines have been set out to ensure that the spread of fire remains limited during an incident. And further that the safety of those present is guaranteed as much as possible, that they can escape if necessary and that the fire can be fought. The necessary provisions can be included when the platform is designed and built. The guidelines are stated in the ISO and EN standards and in the IMO FSC (Fire Safety Code) code for ships.

A vessel is divided into a number of fire compartments. Partitions of different strengths can be placed depending on the degree of compartmentalisation. In class A, B, and H the number after the letter shows it is resistant to the extreme heat of a liquid fire for 2 hours.

Material with different characteristics will react to fire differently. During fires material can be exposed to high temperatures, smoke gasses, possible explosions and sudden cooling (with extinguishing). This can lead to:

- Loss of capacity
- Heat tension / expansion
- Change of shape
A vessel consists largely of steel which has the ability of absorbing and conducting heat quickly. In a short space of time a large of build-up of heat will be created when there is a fire. Through this the chance of it spreading is greater than in a 'normal' house fire. Steel is extremely strong but will soften quickly at temperatures above 300 °C. At 500 °C steel has lost half its strength and will collapse. The time necessary to reach the point of collapse is called the collapse time. The collapse time depends on the thickness of the steel and the intensity (energy) of the fire. During a pressure fire (fire where the fuel under pressure is freed) softening will occur quicker than during a slick fire / open fire. The greatest enemy during an incident is the time factor because of the enormous quantities of steel used in the construction of a vessel. It is important to assess the situation quickly so that the correct (cooling) actions can be started. Wood behaves completely different during a fire. Change of shape and loss of capacity occur much slower causing the spread of the fire to also be much slower. Wood burns at a speed of 4 cm per hour in a fire developed normally.

**Prevention**

The start or the spread of a fire on ship should be prevented in the earliest stage possible. That is why all the crew on board should know the emergency procedures in the case of fire. The fire procedure must be reported in the Contingency Plan and must be explained to the personnel. Written procedures are required on the installation to provide the personnel with a guideline in the case of fire or an explosion. It should also be mentioned here that no two fires are ever the same. There are so many variable factors that it is not possible to put together guidelines on how a fire should be extinguished. It is however possible to provide general rules for each type of fire. The first thing required in fire prevention is well-trained personnel preventive maintenance of material and the maintenance and use of fire fighting equipment.
Training

Training and practice in fire safety is most important. Correct training can prevent fire starting or spreading. When a fire starts it means that something has gone wrong at a certain stage. Sometimes the fire can be blamed on a fault or an omission in the design but it is usually related to human failure. Consider work, maintenance, messy work places, smoking in bed, etc. Correct training can limit the development of fires.

The following parts should be practised or attended at least every seven days:

- Alarm procedures.
- Communication.
- Work procedures.
- Instruction about the various types of fire.
- Training with various sorts of extinguishing agents.
- Special courses.
- Use of fire equipment.

Also important:

- Periodical medical training.
- Reporting all dangerous situations:
  - To prevent emergency situations.
  - The return to a safe situation.
  - Learning moments. How and when can it happen?

Prevention also involves a good household policy and adequate execution of work, for example attention to welding and other ‘hot’ work. Think when you are doing something like smoking in bed or in other places, throwing away matches or burning cigarettes. Manpower is restricted on vessels and that is why it is essential that everyone is alert to the risk of fire and has knowledge of the necessary preventive measures, extinguishing equipment and First Aid materials. Specially trained teams of fire fighters are necessary to fight large fires. Every person on board must familiarise himself with the extinguishing equipment available and how to use it and its location. Report missing, damaged or used extinguishing equipment to the Safety Officer. In this case they must be replaced immediately. All extinguishing equipment and breathing protection must be in good condition and ready for direct use.
Fire fighting plan

These plans show a map of the installation or the ship in relation to the fire safety rules and fire fighting equipment. Moreover they include important information about fire fighting on board.

Information on the fire fighting plan and musterlist:

- Position of the water-tight doors.
- Exits and Emergency exits.
- Emergency stop knobs for the ventilation. (machine room, accommodation, pump rooms, etc.)
- Fire extinguishing pumps.
- Fire hose connections.
- Type and position of the fire extinguishing agents.
- Position of the international dock connection.
- Position of the alarm equipment.
- Position for operating the fixed extinguishing installations.
- Position of personal fire equipment.
- Assembly places
- Alarms.
- Role in case of fire.

This information is generally given by symbols on pictograms. The meaning of the symbols is explained in the key. Everyone on board should get to know the plan and should orient themselves as soon as they come aboard. So that they become familiar with the escape routes, locations of the extinguishing agents, etc. because quick and efficient work is essential in the case of emergency.
Watertight doors and exits
All the doors must be shut in case of fire or a fire drill. This is extremely important because combustion always needs oxygen which could flow through open doors.

Turning off the ventilation
The ventilation must also be switched off for the same reason. The shutters must also be closed after the ventilation is turned off. The ventilators must be turned off:
  a) Nearby the ventilator.
  b) As indicated on the fire fighting plan.

Fire extinguishing pumps and emergency pumps.
Fire extinguishing pumps are usually to be found in the main machine room. The number and capacity of pumps must comply with the prescribed requirements. The emergency pumps must be situated far away from the normal fire extinguishing pumps.

Fire hoses
The number, the size and the length of the hoses is prescribed in the regulations. Fire hoses on an open deck must have a diameter of at least 52 mm and are the so-called "two inch hoses". Smaller diameter fire hoses are only permitted in the accommodation.

Fire hose cabinets
These are equipped with:
  • A fire valve.
  • A hose and branchpipe.
  • A connection for the hose.

These cabinets must be positioned so that all parts of the ship or installation can be reached with at least two hoses.
Jet pipes

The branchpipe are usually adjustable. They must be able to alter a fixed jet of water into a spray mist when adjusted. The spray can be adapted into a fine mist.

Detection

One of the most important issues for fire safety is the detection a fire or a risk of fire situation as soon as possible. This offers the opportunity of taking fast action to prevent the fire or to extinguish it in an early stage. Detection consists in an area where there is a risk of gas escape or the detection of smoke, heat or flames in case of a fire. An alarm system should warn in both cases. In case of a gas leak if the mixture reaches 10% of the lower explosion level LEL, so the emergency valves close and the ventilation stopped. A second “high” gas alarm is given in case of a mixture of 40% LEL. Note that there is still no change on an explosion. In case of smoke, heat or flame detection raise the alarm to start the emergency procedures applicable to this situation.

Fire alarm and fire detection

1. Depends on:
   • The construction of the vessel.
   • Type of cargo.
   • Possible source of the fire.
   • Number of persons in an area.

2. Why:
   • To be able to localise the fire as quick as possible
   • To fight a fire.
   • To evacuate persons.
   • To restrict damage.

3. Where:
   • All areas where persons work.
   • Unmanned areas.

4. Alarms:
   • Which type for what purpose.
   • What actions to take.
There are various alarm systems in use.

The sort of fire alarm and fire detection system chosen depends on the:
• Control rooms and power provisions.
• The fire extinguishing control system.
• Detection.
• Alarms:
  • The automatic fire extinguishing system.

ALARMS:
There are different alarm statuses, namely:

1. Alarm announced over the public address system.
2. General gas alarm (low and high gas alarm).
3. General fire alarm.
4. Abandon platform alarm.
3. Breathing protection

The breathing process
The unrestricted inhalation of air (of the correct composition) is vitally important. The breathing organs consist of the airways and lungs and alveoli. The airways are for transporting air to and from the alveoli. The lungs are surrounded by the diaphragm (a flat muscle) underneath the ribs forming the separation between the chest cavity and abdomen. Ribs and diaphragm have a function in breathing.

The carbon dioxide content (CO2)
A group of nerve cells in the brain (the breathing centre) controls breathing. These cells react to the concentration CO2 in the blood. The exhaled air contains more CO2 and less oxygen than inhaled air. Carbon dioxide gas is formed in the body by (slowly) burning certain proteins. Oxygen is used during burning which is extracted from the blood. The body takes its energy from the burning. The composition of air during inhalation and exhalation.

Dangerous substances in the surrounding air during combustion
During a fire dangerous substances such as dust particles, vapour and gasses come free into the air. Dust particles interfere with the lung function. (they damage the alveoli)

Vapours and gasses can be dangerous because:
- They can drive away the air. (lack of oxygen)
- They can damage the alveolus and the blood. (interfere with the gas exchange in the lungs)
- They can damage the nervous system. (paralysing the breathing muscles)
Gasses and vapours which could have a damaging effect

With a smothering effect:
- Carbon dioxide. (CO2)
- Methane.
- Butane.
- Propane.
- Nitrogen

With a damaging effect to the nervous system and the blood:
- Carbon monoxide. (CO)
- Hydrogen sulphide.
- Benzene.
- Hydrogen cyanide.
- Toluene.

Substances with a corrosive effect:
- Smoke.
- Ammonia.
- Sulphur dioxide.
- Bromine and Chlorine.
- Hydrogen chloride.

Lack of oxygen

Our breathing frequency in rest is 12-15 times a minute. The volume of the inhaled air can be divided into three amounts.
1. Amount for normal use. (at rest ± 0.5 l.)
2. Extra inhalation volume. (± 3 l.)
3. Residual volume after exhalation (dependant on age, condition, smoker, etc.)

Breathing protection

The following breathing protection equipment is in use:
- Dust masks.
- Filter tube masks. (escape mask)
- Overpressure masks. (constant supply of air)
- Breathing masks.

Our lungs can breathe at an atmospheric pressure of ± 1 bar. Any increase or decrease of the pressure can have a disadvantageous effect on the breathing function. The pressure is decreased by the constant pressure regulator when an overpressure mask is worn.
Breathing mask (escape set)

Inhaling compressed air is dangerous. The risk of decompression sickness exists with a limited over-pressure. The risk of inflation and then tearing of the alveolus exists with a higher over-pressure. That is why a reducing valve and respirator decrease the overpressure of the air to a few millibars when breathing air is used. The pressure is automatically reduced in escape sets with independent breathing protection after activation or opening the air cylinder. The air supply is limited to a maximum 10 or 15 minutes. Follow the supplier’s instructions when using.

Escape mask

An escape mask offers protection from smoke and dangerous gasses. Even though the mask contains a filter the amount of oxygen in the air must be above 17%. Another risk is the lack of an indicator on the mask that shows how long it offers protection for. Depending on the amount of gas and/or smoke the filter will become saturated with toxic vapours at some time and will offer no more protection. Follow the supplier’s instructions when using.

Therefore the escape mask is only suitable for a quick escape attempt, for example to a lifeboat. If you use an escape mask through smoke you need to consider the following:

Escape without an escape mask:

- Move into the wind
- At a fast pace
- Use a safe route
- Stay low
- Follow instructions
Escape wearing an escape mask in a smoke filled environment:

Walk:
• Feel the floor with your foot before putting your weight down. (prevents falling and collisions)
• Keep in contact with the walls. (recognise the route)
• Hold one hand at eye level. (head protection)

Climbing stairs:
• If possible walk alongside the walls.
• Feel for the steps.

Going downstairs:
• If possible walk alongside the walls.
• Walk backwards.
• Feel for the steps.

Opening doors:
• Stay low to the floor.
• Take cover behind the door or wall, depending how the door opens.
Falck Safety Services
Location Maasvlakte Rotterdam
Beerweg 101
3199 LM Maasvlakte-Rotterdam
Harbour number 7033
The Netherlands
Phone +31 (0) 181 376666
Fax +31 (0) 181 362981
booking@falck.nl
www.falcksafetyservices.nl

Falck Safety Services
Location Den Oever
Havenweg 11
1779 ZG Den Oever
The Netherlands
Phone +31 (0) 181 376666
Fax +31 (0) 181 362981
bookingdo@falck.nl