FOREWORD

To assist education and training entities in the Danube region in building their institutional and organizational capacity so as to match the Standards for competence for inland navigation personnel – Operational level – OL 7 - Health and safety and environmental protection required by EU Directive 2017/2397 on the recognition of professional qualifications in inland navigation, the transnational model course on Safety practices for emergency situations during ship operation was developed.

The train the trainer course will increase knowledge and abilities needed for intervention in case of emergency situations during ship operation according to applicable instructions and procedures.

This didactical manual is designed as guidelines for conducting the Train the trainer course and is intended to assist training providers and their teaching staff in organizing and introducing new training courses, or in enhancing, updating or supplementing existing training materials with the ultimate end result of raising quality and effectiveness of the training courses.

Since education and training systems as well as the cultural background of inland navigation topics differ considerably from one country to another, the model course material has been designed so as to identify the basic entry requirements and trainee target group for each module of this course in standard applicable terms and clearly specify the technical content and levels of knowledge and abilities required to meet the provisions of applicable EU regulations and related recommendations.

The following consortium conducted the development of this Train the trainer manual during Danube SKILLS project financed by the Danube Transnational Programme:

Project co-funded by European Union funds (ERDF, IPA)

SAFETY PRACTICES FOR EMERGENCY SITUATIONS DURING SHIP OPERATION

Interreg
EUROPEAN UNION
Danube Transnational Programme
Danube SKILLS

MODULE I

Interreg
Danube Transnational Programme
Danube SKILLS

Project co-funded by European Union funds (ERDF, IPA)

TRAIN THE TRAINER

- SAFETY OF WORK -

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1. GENERAL DEFINITIONS

For the purposes of this compendium the following terms have been defined as follows:

- ***competent authority****:* a ministry, government department or other authority having power to issue regulations, orders or other instructions having the force of law in respect of safety and health aboard any vessel registered in their territory or any ship within their territorial waters and ports;
- ***competent person****:* a crew member possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skills, and including, where appropriate, any certificates required by the competent authority, to fill a particular position, carry out a specific task, or assume supervisory responsibility. The competent authority may define appropriate criteria for the designation of such persons and may determine the duties assigned to them.
- ***crew*****:** inland navigation personnel, other than the Boatmaster, working on the vessel;
- ***officer***: one who is ranked as an officer by national laws or regulations;
- ***personal protective equipment***: includes but is not limited to protective clothing, safety helmets, eye and face protection, hearing protection, gloves, safety footwear, lifelines, safety harnesses, breathing apparatus and respirators, as appropriate;
- ***responsible persons***: persons having authority delegated to them either directly or indirectly by the vessel owner or the Boatmaster to carry out or supervise the duties or operations under consideration;
- ***vessel:*** any inland navigation registered craft, whether publicly or privately owned, engaged in commercial navigation;
- ***vessel owner***: any person(s) or organization that owns the vessel or acts on behalf of the owner and is responsible for the vessel and its equipment or for the crew members employed thereon.

2. INTRODUCTION

This course compendium was designed both for trainers who will be involved in training of such course module, and the trainees as learning aids in order to facilitate the learning process.

This course compendium aims to assist in the implementation of the EU Directive on the recognition of professional qualifications in inland navigation personnel and in meeting the requirements of the Standards of competences for inland navigation personnel- Operational level, that will be part of this legislative act.

The main objective of this course compendium is to provide practical guidance on safety and health on board the vessels with a view to preventing accidents, diseases and other harmful effects on the health of inland navigation personnel arising from employment on board inland navigation vessels.

"Safety first" is the key factor to ensure that all operations on board of inland vessels are carried out in an efficient and smooth manner. Personal safety or safety of life during ship operations comes at the top of priority list as there is no loss which is considered greater than the loss of human life.

3. LEARNING OUTCOMES

By the end of this course, trainees will be able to:

- complies with established emergency response plans and procedures;
- identifies emergency alarm signals;
- takes correct action in given emergencies drills;
- identifies safety hazards in a given situation;
- select the correct personal protective equipment for shipboard tasks;
- adheres to procedures for entry into enclosed spaces.

4.

INSTRUCTIONS AND RULES FOR THE SAFETY OF WORK AND PREVENTION OF ACCIDENTS

COMPETENCE

Work according to instructions and rules for safety at work and prevention of accidents

4.1 Safe working practices

4.1.1 General duties and responsibilities of vessel owners

The vessel owner is primarily responsible for the safety and health of all crew members on board vessel.
However, the **day-to-day responsibility generally lies with the Boatmaster,** who should observe the vessel owners' reporting procedures.
Vessel owners should:

- provide adequate means and organization and should establish a suitable policy on the safety and health of crew members consistent with international and national laws and regulations;
- ensure that design of their vessels takes account of ergonomic principles and conforms to relevant international and national laws, regulations, standards or codes of practice;
- provide and maintain vessels, equipment, tools, operating manuals and other documentation, and organize all planning and operations in such a manner that, as far as it is reasonably practicable there is no risk of accident or injury to crew members. In particular, activities should be planned, prepared and undertaken so that:
    - dangers likely to arise on board vessel are prevented;
    - excessively or unnecessarily strenuous work positions and movements are avoided;
    - organization of all work takes into account the safety and health of crew members;
    - materials and products are used safely and pose no danger to crew members' health; and
    - working methods are employed which protect crew members against the harmful effects of chemical, physical and biological agents.
- ensure that crew members perform their work with due regard to their safety and health;
- instruct the Boatmaster and the Boatmaster should instruct the crew members that the work of all on board will be organized in such a way as to avoid unnecessary risks to safety and health;
- make Boatmasters and all the crew members fully aware of all activities on board that could affect their safety and health;
- ensure that, before taking on their responsibilities, all crew members are suitably instructed in the hazards connected with their work and the on board environment and trained in the precautions which must be taken to avoid accidents and injury to health. The training should address day-to-day on board operations as well as contingency planning and emergency preparedness;
- take all practicable steps to ensure that, before taking on their responsibilities, crew members are made aware of the relevant national and international laws, regulations, standards, codes of practice, instructions and advice relating to the prevention of accidents and injuries to health;
- provide appropriate medical equipment and trained personnel in accordance with national laws and regulations;
- report occupational accidents, diseases and dangerous occurrences to the competent authority in accordance with national laws and regulations; All accidents to crew members resulting in loss of life or serious injury should be reported forthwith to the competent authority and an investigation of these accidents should be carried out. Other injuries resulting in incapacity from work for periods of time as may be specified in national laws or regulations, as well as prescribed occupational diseases, should be reported to the competent authority within such time and in such form as may be specified;

- investigate all accidents and near accidents, analyse their underlying causes and convey what is learned throughout the company as appropriate;
- consider establishing a near-accident reporting system;
- encourage crew members to report all unsafe and unhealthy conditions or operations;
- provide each vessel with the necessary equipment, manuals and other information to ensure that all operations are carried out in such a manner as to reduce to a minimum any adverse effects on crew members' safety and health.

4.1.2 General duties and responsibilities of the Boatmaster

The Boatmaster should implement the vessel owner's safety and health policy and programme on board the vessel. The policy and programme, including safety rules and instructions, should be clearly communicated to all members of the crew.

The Boatmaster should issue appropriate notices and instructions in a clear and easily understood manner, in a language or languages understood by the entire crew and verify, as appropriate, that such instructions have been understood.

The Boatmaster should ensure that:

- work carried out on or from the vessel is carried out in such a way as to avoid the possibility of accidents and the exposure of crew members to conditions which may lead to injury or damage to their health;
- the availability of operating manuals, vessel plans, national laws and regulations, safety procedures and other such information to those crew members who need such information to conduct their work safely;
- any necessary instructions and notices concerning the safety and health of the crew are posted in prominent and suitable places or brought to the crew's attention by other effective means;
- safety equipment, including all emergency and protective equipment, is maintained in good order and stowed properly;
- all statutory drills are carried out realistically, effectively and conscientiously at the required intervals and in compliance with any applicable rules and regulations;
- practice and training are given in emergency procedures; the use of any special emergency equipment should be demonstrated to the crew members at regular intervals.

4.1.3 General duties and responsibilities of crew members

Crew members should participate in ensuring safe working conditions and should be encouraged to express views on working procedures adopted as they may affect safety and health, without fear of dismissal or other prejudicial measures.

Crew members should:

- cooperate as closely as possible with the vessel owner in the application of the prescribed safety and health measures;
- take care of their own safety and health and of other persons who may be affected by their acts or omissions at work;
- use and take care of personal protective equipment and clothing at their disposal and not misuse any means provided for their own protection or the protection of others;
- report forthwith to their immediate supervisor any situation which they believe could pose a hazard and which they cannot properly deal with themselves;
- comply with the prescribed safety and health measures; and
- participate in safety and health meetings.

Except in an emergency, crew members, unless duly authorized, should not interfere with, remove, or displace any safety device or other equipment and appliances furnished for their protection or the protection of others, or interfere with any method or process adopted with a view to preventing accidents and injury to health.
Crew members should not operate or interfere with equipment which they have not been duly authorized to operate, maintain or use.
A crew member who gives an order or otherwise instructs another crew member should be certain that the order or instructions are understood.
The crew should implement the crew member's safety and health policy and programme as delegated to them by the Boatmaster in a diligent and professional manner and demonstrate their full support for shipboard safety. They should do everything in their power to maintain their own health and safety as well as the health and safety of other crew members and other persons on board.

4.2 Health and safety working instructions during on board activities

4.2.1 Nature of on board hazards

The **various on board hazards** are:

- slips, trips and falls due to slippery surfaces (oil, grease, garbage, water, ice, etc.) or obstructions (pipelines, welding cables, lashing eyes, wires, ropes, etc.);
- head injuries due to low doorway entrances, overhead loads, falling equipment or material;
- falls through open manholes, unfenced 'tween decks, loose or missing gratings;
- clothing, fingers getting caught in moving machinery such as grinding wheels, winch drums, gears, flywheels, etc.
- burns from steam pipes, hot machinery, welding sparks;
- eye injuries through chipping, welding, chemicals;
- hazards of extreme weather e.g. cold temperatures can cause frost bite.

4.3 Safety instructions and rules for safety of work and prevention of accidents

4.3.1 Advantages of safe working practices

A well designed and executed occupational health and safety programme is often said to be good for business as well as being a key legal and social obligation (making sure that employees in any size or type of business go home in the same condition that they came to work). Furthermore, so-called “best-practice” organizations not only recognize the basic value of good occupational health and safety, but see that extra efforts to ensure that its people are not harmed or made ill in any way at work (even at a minor level) are also an essential part of a truly excellent enterprise.
These best practice organizations therefore believe that occupational health and safety:

- helps demonstrate to all stakeholders that a business is socially responsible;
- protects and enhances an organization’s reputation and credibility;
- helps maximize the performance and/or productivity of employees;
- enhances employees’ commitment to the team/organization as a whole;
- builds a more competent, happier and healthier workforce;
- reduces business costs and disruption;

- enables organizations to meet customers' occupational health and safety expectations, and
- encourages the workforce in general to stay longer in active life.

Many organizations, and especially the larger ones, are expected by law in many countries, to demonstrate ever-higher standards of corporate governance around Risk and Safety and greater transparency in reporting practices. The combination of operating in a market driven economy, alongside a society that is more aware of risks, means that many enterprises now therefore realize the significant gains that can be made from integrating well-designed occupational health and safety performance into their wider business model and strategies.
Simple improvements to workplace safety practices can quickly increase competitiveness, profitability and the motivation of employees. In addition, the implementation of a new occupational health and safety management system can rapidly provide an effective framework to prevent or minimize accidents and workplace related ill-health and thereby show an immediate return on investment.

4.3.2 Dangers related to on board hazards

The various dangers related to on board hazards to personnel and vessels are:

- movement of the vessel;
- provision for safe embarkation and disembarkation of the vessel(e.g. gangplank, ship's boat);
- stowing movable objects;
- working with machinery;
- working with electricity and electrical equipment/devices;
- fire precaution and fire-fighting;
- use of hand tools;
- use of portable power tools;
- slips, falls and tripping.

4.3.3 Safe movements about the vessel

General provisions

Crew members should move about the vessel bearing in mind the possibility of an unusual lurch or heavy roll by the vessel while in inland waterways.
Permanent fittings which cause obstruction and which may be dangerous to vehicles, lifting appliances or persons should be made conspicuous by means of colouring, marking or lighting.
Any deck obstructions and head-height obstructions that are a hazard should be painted in a bright, conspicuous colour.
Where necessary, warning notices should be posted. Graphic symbols should be utilized where possible.
Head-height obstructions should be padded.
The stowage of deck cargoes should take account of the requirements for safe access to crew quarters, for crew working on board the vessel and access to safety equipment.

Passageways and walkways

All passageways, walkways, stairs and all deck surfaces used for transit should be properly maintained and kept free from materials or substances liable to cause slips or falls.
Transit areas should, where practicable, be provided with a surface which is slip resistant in dry as well as in wet conditions.

Walkways on deck should be delineated by painted lines or otherwise and indicated by signs. Any gear or equipment stowed to the side of a passageway or walkway should be securely fixed or lashed against the movement of the ship during voyage.
When rough weather is expected, lifelines should be rigged securely across open decks.

Watertight doors

All crew members who may have to use watertight doors should be instructed in their safe use.
Power-operated watertight doors can be closed from the bridge and particular care should be taken when using such doors. If opened locally under these circumstances a door will reclose automatically and crush anyone in its path as soon as local control has been released. Both hands are usually required to operate the local controls, and for this reason no person should alone attempt to carry any load through such doors. The bridge should be notified whenever such doors are opened and immediately after they are closed.
Notices clearly stating the method of operating the local controls of watertight doors should be prominently displayed on both sides of the doors.
No attempt should be made to pass through a watertight door when it is closing or when the warning alarm is sounding.
Whenever a watertight door is energized, and under remote control, transit is not allowed. If necessary to leave the area confined by such doors, emergency exits shall be used. A warning to that effect shall be displayed at the local operating point.

Lighting

Areas of the vessel used for loading or unloading, other work processes or transit should be adequately and appropriately illuminated.
Lighting should be reasonably constant and arranged to minimize glare, dazzle and the formation of deep shadows and sharp contrasts between one area and another.
Broken or defective lights should be reported immediately and repaired as soon as practicable.
It should be prohibited to enter unlighted or inadequately lighted places on the ship without safe portable lights.
Lights, both fixed and portable, should be checked to ensure proper operation and safe rigging prior to use. No operation should be permitted to commence or continue if lighting is insufficient.

Deck opening

Protection around cargo hatches and other deck openings

Every cargo hatchway should be protected by means of a coaming or fencing to a height of at least 1 m above the deck. Hatch covers, pontoons and beams that have been removed should be placed so as to leave a safe walkway from rail to hatch coaming and fore and aft. Access within cargo spaces and holds should be kept clear.
Mechanically, hydraulically and electrically powered hatch covers should be opened and closed only by designated members of the ship's crew or other authorized persons. The hatches should only be operated after ensuring it is clear to do so.
Any openings through which a person might fall should be fitted with secure guards or fencing of adequate design and construction.

4.3.4 Safe access to vessel

Means of access to vessel
There should be a safe means of access between any ship and any quay, pontoon or similar structure or another ship alongside which the vessel is secured to.
Crew members should be provided with adequate information on how to make their way safely to and from the ship through the terminal or shore side cargo handling area.
In some modern ports access equipment and information on safe means of access are provided by the port authorities. However, the Boatmaster should ensure, as far as possible, that the equipment meets the required safety standards.

Crew personnel should not use a means of access which is unsafe.
They should also use means of access with care, e.g. they should make several trips or use a stores crane when carrying personal gear, stores or ship's equipment rather than attempting to carry too much at once.
All access arrangements should be supervised at all times, either by crew personnel or by shore personnel, particularly in ports.
Access should generally be by an **accommodation ladder or gangway** which is appropriate to the deck layout, size, shape and maximum freeboard of the craft.
Any access equipment should be of good construction, sound material, adequate strength, free from obvious defect, properly maintained and inspected at frequent intervals. It should not be painted or treated to conceal cracks or defects.
Access equipment should be placed in position promptly after the craft has been secured and remain in position while the ship is secured.
A lifebuoy with a self-activating light and a separate safety line or some similar device should be provided at the point of access aboard the craft.
All access equipment and the approaches to such equipment should be properly illuminated.

Crew members should use only the appropriate equipment for craft access.
As far as it is practicable, access equipment should be kept free of any snow, ice, grease or other substance likely to cause a slip or fall.
Any gap between the dockside and the ship, whereby a person on the ship's means of access might fall into the water, should be protected by a safety net, of suitable size, mesh and construction, secured to the ship and dockside, as appropriate.
The means of access and its immediate approaches should be kept free from obstruction and, as far as practicable, kept clear of any substance likely to cause a slip or fall.
The means of access should be sited so that no suspended load passes over it.
Any accommodation ladder or gangways should be:

- at least 55 cm in width; and
- provided with stanchions and taut rails, chains or fencing on both sides.

Stanchions should not be more than 3 m apart, and properly secured to avoid inadvertent displacement.
Fencing should be at least 1 m high, with an intermediate rail or chain at a height of about 50 cm.
The accommodation ladder or gangway should be so constructed that ordinary changes in the ship's draught or height above the quay can be easily accommodated.
Where practicable, accommodation ladders should have a swivel top platform, slip-resistant treads and wheels or rollers at the bottom.
Any necessary adjustment should not tilt the treads or steps to such an extent that they cease to offer a firm foothold.
Duckboards should be fitted to provide a secure foothold at small angles of inclination.
The gap between the top of the gangway or ladder and the ship should be protected on each side by handrails, taut chains or other suitable means, with intermediate chains at a height to match the handrails and intermediate protection of the gangway.
Gangways and accommodation ladders should be clearly marked with the maximum permitted angle of use and maximum safe loading in both number of persons and total weight. Under no circumstances should this limit be exceeded.

If the upper end rests on or is flush with the top of a rail or bulwark, substantial and properly secured steps fitted with an adequate handrail should be provided to ensure safe passage to and from the gangway.
Where practicable, accommodation ladders should not be used at a greater angle to the horizontal than 55 degrees.
If the gangway rests on rollers or wheels, it should be fitted or protected in such a way as to prevent the user's feet from being caught and it should be placed in a position which does not restrict the free movement of the rollers or wheels.

Accommodation ladder

A gangway should never be permitted to drop between the shore and the vessel in such a way that it may be crushed or damaged.
Special care should be taken during maintenance to detect any cracking, rusting or corrosion in gangways, ladders and metal fittings.

Any defects posing a hazard should be made good before further use.

Transport of persons by water
When persons have to be transported to or from a ship by water, suitable and proper measures should be taken to provide for their safe passage. The boats used should be of suitable construction, properly equipped and maintained and suitably.

4.3.5 Stowage of cargo

All cargoes should be stowed and secured in a manner that will avoid exposing the vessel and persons on board to unnecessary risk. The safe stowage and securing of cargo depends upon proper planning, execution and supervision by properly qualified and experienced personnel.
Loading, stowage and securing of cargo other than bulk cargo is to be carried out in accordance with the ship's approved cargo-securing manual.
All cargo should be stowed having due regard to the order of discharge at a port or number of ports. When planning the position of cargo and the order of loading and unloading, the effects that these operations will have upon access and the safety of personnel should be considered. The following points should be taken into account:

- Cargo information, including gross mass of the cargo or cargo units and any special properties detailed on board or in the shipping documents, should be recorded and used in planning;
- Wherever practicable, where more than one port is involved for loading or unloading, cargo should be loaded in layers rather than in tiers, so as to avoid the development of high vertical walls of cargo;
- Care should be taken not to over stow lighter cargoes with heavier cargoes, which may lead to a collapse of the stow;
- Wherever practicable, cargo should be stowed so as to leave safe clearance behind the rungs of hold ladders and to allow safe access as may be necessary at inland waterway;
- The need to walk across or climb onto the deck cargo, where this may involve an approach to an unprotected edge with risk of falling, should be minimized;
- Care should be taken to avoid large gaps next to cargo where it is stacked against corrugated bulkheads.

Deck cargo should be stowed in accordance with the statutory requirements, and kept clear of hatch coamings to allow safe access. Access to safety equipment, firefighting equipment (particularly fire hydrants) and sounding pipes should also be kept clear. Any obstructions in the access way, such as lashings or securing points, should be painted white or other contrasting colour to make them more easily visible. Where this is impracticable and cargo is stowed against ship's rails or hatch coamings to such a height that the rails or coamings do not give effective protection to personnel from falling overboard or into the open hold, temporary fencing should be provided.
Suitable safety nets or temporary fencing should be rigged where personnel have to walk or climb across built-up cargo, and are therefore at risk of falling.
When deck cargo is stowed against and above ship's rails or bulwarks, a wire rope pendant or a chain, extending from the ring bolts or other anchorage on the decks to the full height of the deck cargo, should be provided and used to save personnel having to go over side to attach derrick guys and preventers directly to the anchorages on the deck.

Where beams and hatch covers have to be removed at intermediate ports before surrounding deck cargo is unloaded, an access space at least 1 m wide should be left adjacent to any part of the hatch or hatchway that is to be opened. If on deck this is impracticable, fencing or lifelines should be used to enable crew members to remove and replace beams and hatch coverings in safety.

4.3.6 Working with machinery (fixed installations)

General provisions

All operations in machinery spaces should be performed by a competent person under the supervision of a responsible officer.

No person should operate a machine unless authorized and trained to do so. Machine operators should be competent in the use of the machine and familiar with its controls.

No work other than routine duties should be undertaken except on the orders of a responsible officer. Maintenance work should be carried out in compliance with manufacturer's instruction manuals. When necessary, specific work should be carried out within the "permit-to-work" system.

Moving parts of machinery should be provided with permanent guards or other safety devices such as railings or fencing.

If the use of any piece of machinery or equipment is considered to be temporarily unsafe, it should be immobilized or put in a safe place or condition immediately and, if necessary, a warning notice should be posted adjacent to or at the control position.

No guard, fencing or shielding should be removed for repair or maintenance except when the machinery to which it relates has been stopped. The machinery should not be restarted until the fencing or shielding has been replaced and secured.

All valves, pipes and fittings should be adequately supported and fixed or clamped to avoid vibration and possible fracture.

All items such as, steam pipes, exhaust pipes and fittings which, because of their location and operating temperature present a hazard, should be adequately lagged or shielded.

The source of any oil leak should be located as soon as possible and the leak stopped.

All areas should be suitably illuminated. Areas under floor plates where oil pipes are located should be painted a light colour.

Care should be taken to keep the noise level as low as practicable, and to maintain or where necessary improved sound-absorbing arrangements.

Crew members should be informed of the danger of removing hearing protection in areas where the noise level is high, even for short periods. When work has to be carried out in such areas, a suitable system of communication should be agreed upon before the work begins.

Ventilation should be maintained to ensure a comfortable atmosphere so far as it is reasonably practicable in all areas, with special attention being given to working areas and control rooms.

Propulsion machinery

The propulsion machinery should be provided and maintained in accordance with the requirements of the competent authority and good practice.

The machinery should be stopped before any work is done by crew members on, or using, machinery items which would constitute a hazard:

- throttle or starting system should be closed;
- turning gear or a suitable brake should be engaged; and
- a warning notice should be posted.

Internal combustion engines

Internal combustion machinery should be maintained in safe condition and be regularly inspected as required by the manufacturer.

A source of ignition, e.g. a portable electric light or naked flame, should not be brought near an open engine crank case until it has been cooled and well ventilated and until all explosive gases have been expelled.

Control-room operation and unattended machinery spaces

Only authorized persons should enter a control room or an unattended machinery space.

Crew members should never enter, or remain in, an unattended machinery space unless permission has been received from, or instructions given by, the engineer officer in charge at the time.

The instrumentation and alarms on which the safety of an unattended installation depends should be maintained in good operational order in accordance with the manufacturer's instructions.

Any alarms that have operated should be made re-operative before the machinery space is left.

Notices of safety precautions to be observed by crew members working in control-rooms and unattended machinery spaces should be clearly displayed at entrances.

4.3.7 Working with electricity and electrical equipment/devices

General provisions

Crew members should receive adequate training before being permitted to work on electrical installations.

The installation should be maintained and protected to minimize the possibility of fire, external explosion, electrical shocks and danger to crew members.

All live parts should be effectively insulated and enclosed in conduits or otherwise protected and should be maintained in that condition.

All electrical equipment should be regularly inspected to ensure that it is suitable for its intended use. Any electrical faults or other defects should be immediately reported to the appropriate person and repaired by a competent person.

Attention should be paid to the maintenance of the emergency source of electrical power.

All electrical appliances should be clearly marked to indicate their safe operating voltage.

Flickering lights should be investigated and repaired by a competent person.

Circuits and appliances carrying different voltages in the same installation should be clearly distinguishable by notices, markings on distribution boxes and other conspicuous means.

Repairs to electrical installations should be carried out only by a competent person or when a "permit-to-work" has been issued.

Every circuit should be protected against overload currents, so as to reduce damage to the system and keep the danger of fire to a minimum.

Personal protective equipment, such as rubber gloves and rubber boots, should be used whenever there is a risk of electric shock, but should not be regarded as providing full protection against such a risk.

Protection against contact with live equipment should be afforded by:

- placing live parts out of reach;
- effective enclosure of live parts; and
- adequate insulation.

The following notices should be exhibited at suitable places:

- a warning notice prohibiting unauthorized persons from entering electrical equipment rooms, interfering with switchboards, and handling or interfering with electrical apparatus;
- a warning notice specifying the person to be notified in the event of an electrical accident or some other dangerous occurrence, and indicating how to communicate with that person;
- a notice specifying the voltage present in equipment or conductors; and
- a notice prohibiting the use of naked flames in the vicinity of the battery room.

Only authorized persons should have access to and enter equipment rooms containing live electrical equipment or have access to the rear of live switchboards.
No work should be done in dangerous proximity to a conductor or installation until it has been made dead and signs have been suitably posted.
If a conductor or an installation is in the immediate vicinity of a work location and cannot be made dead, special precautions should be taken. Any such operation should be supervised by a competent person.
All conductors and equipment should be considered to be live unless there is definite proof to the contrary.
Before the current is restored, a competent person should ensure that no crew members remain in a dangerous position.
After work has been done on electrical equipment, the current should be switched on again only by, or on the orders of, a competent person.
If temporary connections have to be made while repairs are being carried out, the connections should be made with cables having an adequate margin of current and voltage rating and by a competent person. They should be disconnected and removed as soon as they are no longer required. Crew members not authorized to carry out electrical work should never install new equipment or alter existing equipment.

Rectifiers and electronic equipment

No maintenance or repair work should be attempted until the equipment has been effectively isolated and any stored energy dissipated.
Special attention should be paid to the hazard of working near charged capacitors associated with rectification circuits.
Only competent persons should be authorized to repair electronic equipment.

Radio communication equipment

Aerials and open wire feeders should be placed and guarded in a way to make them inaccessible to unauthorized persons.
Conductors that pass through areas of high electromagnetic flux should be insulated or otherwise protected in areas to which, crew members have access.
Any work in the vicinity of transmitting aerials should be carried out only within the "permit-to-work" system. Warning notices should be posted at appropriate places until the work has been completed.
No crew members should be allowed to work in the vicinity of transmitting aerials whilst there is a possibility that such aerials may be energized.
Suitable means should be provided and maintained to exclude any persons from the vicinity of equipment where there is a danger from shock, radio frequency burns and injury from X-rays or other radiation.

Work with visual display units (VDUs) including microcomputers

Crew members should be given adequate individual training in the use and capabilities of VDUs and microcomputers.
Work with VDUs can be mentally tiring and measures should be taken to minimize the risk of eyestrain. Lighting should be adequate for the task, with glare and reflection cut to a minimum, and the display screen should be clear and easy to read. Rest periods should be provided.
Symptoms such as neck and arm pains may arise as the result of bad posture. VDU operators should avoid sitting in a slumped or cramped position and should be provided with an adjustable chair. Screens and keyboards should be adjustable to the correct height and the correct distance from the operator.

4.3.8 Fire precaution and fire fighting

Fire prevention

Smoking

Smoking should be permitted only in authorized areas, and instructions and prohibition notices should be prominently displayed.

Careless disposal of burning matches and cigarette ends is dangerous: ashtrays, or other suitable containers, should be provided and used in locations where smoking is permitted.

Crew members should be made aware of the dangers of smoking in bed.

Laundry and wet clothing

Care should be taken when drying items of clothing. Clothing should not be hung directly on or close to heaters and should never be dried in the engine-room.

Spontaneous combustion

Waste, rags, and other rubbish as well as clothes soaked with paint, oil, thinners, etc., are dangerous if left lying around as they may spontaneously combust.

All waste should be stored in proper dustbins until it can be safely disposed of.

Galleys

Galleys present particular fire hazards and the means to smother fat or cooking oil fires, such as a fire blanket and appropriate fire extinguisher, should be readily available. Water shall never be used in attempts to fight fires involving hot oil in cooking areas.

Action in the event of fire

The risk of fire breaking out on board a craft cannot be eliminated but its effects will be much reduced if the advice given from the competent person is conscientiously followed.

A fire can usually be extinguished most easily in its first few minutes. Prompt and correct action is essential.

The alarm should be raised and the bridge informed immediately. If the craft is in port, the local fire authority should be called. If possible, an attempt should be made if safe and practicable to extinguish or limit the fire, by any appropriate means readily available, either using suitable portable extinguishers or by smothering the fire as in the case of a fat or oil fire in the galley.

The craft's personnel should be aware of the use of different types of fire extinguisher and their suitability for different types of fire. Water extinguishers should not be used on oil or electric fires and foam extinguishers should not be used on electrical fires.

Openings to the space should be shut to reduce the supply of air to the fire and to prevent it spreading. Any fuel lines feeding the fire or threatened by it should be isolated.

If practicable, combustible materials adjacent to the fire should be removed, boundary cooling of adjacent compartments should be considered and temperatures monitored if spaces are not otherwise accessible.

If a space is filling with smoke and fumes, any crew members not properly equipped with breathing apparatus should leave the space without delay; if necessary, escape should be effected by crawling on hands and knees because the air close to deck level is likely to be relatively clear. Where available, emergency escape breathing devices (EEBDs) should be used.

After a fire has been extinguished, precautions should be taken against its spontaneous re-ignition.

Crew members should not re-enter a space in which a fire has occurred without wearing breathing apparatus until it has been fully ventilated.

4.3.9 Use of hand tools

Hand tools

Vessel owners should ensure that all machines, tools and other equipment are suitable for the work in hand and the conditions in which they are to be used.
Personal protective equipment, e.g. eye, face, hearing protectors and hair nets for long hair, should be worn when appropriate.

Hand tools

Tools should be treated with due care and should be used only for the purpose for which each tool is designed.
Damaged or unsafe tools should not be used.
Tools that are not being used should be placed in a carrier, box or tool rack
All tools should be stowed in lockers or other appropriate places at the end of a work period or operation.

4.3.10 Use of portable electric, pneumatic and hydraulic tools

Power- operated toll

Power-operated tools are dangerous if they are not maintained and operated correctly.
Special care should be taken when crew members' work in damp conditions since the risk of electric shock is greatly increased in the presence of moisture or high humidity.
Since ships are largely made of metal, which conducts electricity, great care should be taken in the use of electrical tools.

Electrical tools designed to be earthed should be properly connected.

Electrical tools should be inspected before use and particular attention should be paid to power supply leads.
Electrical leads and hydraulic/pneumatic tool hoses should be kept clear of anything that might damage them.
Tool pieces, such as drills or bits, must be secure in the tool and must not be fixed or replaced while the tool is connected to a power source.
Power tools should be switched off and disconnected from the power source when not in use.

Compressed air

Compressed air should never be directed at any part of a person's body as air puncturing a person's skin could have serious consequences.
Compressed air should not be used to clean a working area.
Crew members should be particularly aware of the dangers of using high pressure pneumatic equipment, such as cleaning and scaling devices, as their misuse can lead to fatal consequences.

Workshop and bench machines (fixed installations)

No person should operate a machine unless authorized and trained to do so.

Machine operators should be competent in the use of the machine and familiar with its controls.
All dangerous parts of machines must be securely guarded. Examples of "dangerous parts" are reciprocating components, revolving shafts, gearing, belt drives, etc.
A machine should be checked each time before use and the guards and safety devices should be inspected before the machine is started.
No control or light switch should be in such a position that an operator is required to lean over a machine to reach it.
Loose fitting and unsuitable clothing should not be worn when operating machines.
If a machine is found to be defective it should be isolated from its source until repaired by a competent person.
Working areas should be kept clean and uncluttered and debris such as metal turnings and swarf should not be allowed to build up around a machine.
A machine in use should never be left unattended, even for a few minutes, and should always be stopped when it is not being used.
Before a drill or lathe is started, the chuck key should be removed and the operator should ensure that other people are clear of the machine.
Work -pieces for drilling and milling should be securely held at all times by a machine vice or clamp.

Abrasive wheels

Abrasive wheels should be selected, mounted and used only by competent persons and in accordance with the manufacturer's instructions.
A wheel should be closely inspected for damage and brushed clean before it is mounted.
The clamping nut should be tightened only enough to hold the wheel firmly.
A strong guard should be provided and kept in position at every abrasive wheel (unless the nature of the work absolutely precludes its use) both to contain the wheel parts in the event of a burst and to prevent an operator from coming into contact with the wheel.
The speed of the spindle should not exceed the stated maximum speed of the wheel and should be periodically checked.
When dry grind operations are being carried out or an abrasive wheel is being trued or dressed, suitable transparent screens should be fitted in front of the exposed part of the wheel or operators should wear properly fitting eye protectors.

4.3.11 Safety, health and hygiene on board

On board housekeeping and personal health and hygiene

The importance of good housekeeping in the prevention of accidents and conditions likely to be injurious to health should be given proper priority in the training of every member of the crew until its acceptance becomes second nature.
Minor deficiencies in the structure, equipment or furnishings (for example, protruding nails and screws, loose fittings and handles, uneven and damaged flooring, rough and splintered edges to woodwork and jamming doors) may cause cuts, bruises, trips and falls. They should be repaired as soon as they are noticed.
Any spillage of oil or other substance likely to cause a hazard should be removed immediately.
Accumulations of ice, snow or slush should be removed from working areas and passages on deck.
If asbestos-containing panels, cladding or insulation work loose or are damaged in the course of a voyage, the exposed edges or surfaces should be protected pending proper repair by a suitable coating or covering to prevent asbestos fibres from being released and dispersed into the air. Known asbestos-containing materials should only be disturbed for the purpose of essential maintenance and then only in strict compliance with national or international requirements, as appropriate. In general, the use of asbestos insulating material should be prohibited.

Flickering lights may indicate faults in wiring or fittings which may lead to electric shocks or fires. They should be investigated and repaired by a competent person. Failed light bulbs should be replaced as soon as possible.
Instruction plates, notices and operating indicators should be kept clean and legible.
Heavy objects, particularly if placed at a height above deck level, should be stowed securely against the movement of the ship. Similarly, furniture and other objects likely to fall or shift during heavy weather should be properly stowed or secured.
Doors, whether open or closed, should be properly secured.
Coils of rope and wires on deck should be located so as not to pose a tripping hazard.
Under no circumstances whatsoever should crew members stand in a bight of a rope or wire which is lying on deck. Crew members should never stand or move across a rope or wire that is under strain.
Ropes and wires are frequently under strain during mooring operations and crew members should, as much as possible, always stand in a place of safety from whiplash should ropes or wires break.
The stowage and dispersal of deck or machinery equipment should be well planned and organized so that each item has its proper place.
Crew members should always stand clear of any load being lifted and should not walk close to or underneath any load being lifted or while it is suspended.
Litter presents a fire risk and may cause slips, falls or conceal other hazards. It should be disposed of in compliance with the appropriate legislation.
Tasks should be carried out with account being taken of possible risks to other persons; for example, water from hosing down the deck may enter other spaces and result in slips and falls.
Aerosols having volatile and inflammable content should never be used or placed near naked flames or other heat sources even when empty.
High standards of personal cleanliness and hygiene should be maintained at all times. Washing facilities should be provided in toilets. Hands should always be well washed after using paints or after possible exposure to toxic substances.
Working in conditions of high humidity and heat may cause heat exhaustion or heat stroke. Sensible precautions should be taken, including the drinking of sufficient water and the taking of additional salt, if appropriate.
Crew members should be made aware of the health hazards related to smoking.
Use of chemicals
Toxic and other hazardous substances and products should be used and stored in such a way that the users and others are safeguarded against accidents, injuries or particular discomfort.
A record (product data sheet) should, when obtainable, be kept on board, available to all users, containing sufficient information to determine the degree of the danger posed by the substances.
If possible, the substance should be stored in the original packaging or in another correspondingly labelled packaging that cannot give rise to confusion. Such substances must be stored in a locked, well-ventilated room.
Chemicals should always be handled with extreme care, protection should be worn and the manufacturer's instructions closely followed. Particular attention should be paid to protecting eyes.
Some cleaning agents, such as caustic soda and bleach, are chemicals and may burn the skin. A chemical from an unlabelled container should never be used.
Exposure to certain substances such as mineral oils, natural solvents and chemicals, including domestic cleaning agents and detergents, may cause dermatitis. Suitable gloves should be worn when using such substances and the owner should provide suitable barrier creams which may help to protect the skin.

4.3.12 Remove slips, trips and falls

Slips, trips and falls are among the most common accidents leading to injuries on board vessel. All crew members know that a vessel moving in waterways is drastically different from a shore-based work environment, with an unstable working platform inevitably making accidents more likely.

There are many causes but they generally fall into the following areas: poor onboard housekeeping, not complying with safety procedures, not applying hard-won training and experience.

A vessel's decks and internal spaces are prime locations for trip, fall and slip hazards. Raising crew awareness of trip and head-height hazards can be assisted by conspicuously marking obstructions, changes of deck height, steps and inclines with high visibility paint or "tiger-stripes".

Use may also be made of "watch your steps" type labels and strategically placed warning and instructions notices.

Furthermore, where openings are created in decks during operations or repairs, it is vital that these are properly fenced off and marked.

Familiarizing yourself with these areas and always staying alert is vital.

First and foremost, crew should keep their eyes and ears open to potential hazards and report and rectify them as soon as possible. Those on a short voyage and junior crew can be particularly vulnerable, so proper familiarization training and mentoring should be provided.

It is also important to ensure that safety management system procedures for safe operations and working practices are strictly adhered to, including the completion of appropriate risk assessment and permits to work.

Having the discipline to keep decks free of obstructions, stores and equipment well stowed and secured, and working areas clean will make a big difference.

Regularly used walkways, ladders, and working areas, including mooring decks, should have non-slip coatings to provide a good foothold. Internal and external areas should be well lit for safe access and any defective light fittings rectified promptly.

Safety labels

4.4 Health and safety working instructions during activities that take place on board in order to prevent accidents

4.4.1 Loading and unloading cargoes

Transporting loads is a very dangerous operation. It might seem like a simple task of getting stuff from one place and bringing it to another. But loading, unloading and transporting cargo can cause serious injury and even fatality. Workers loading and unloading cargo are exposed to

serious danger in that heavy objects may hit or fall on them if they don't follow the right loading and unloading safety procedures.
Loading, stowage and securing of cargo other than bulk cargo is to be carried out in accordance with the ship's approved cargo-securing manual.
Suitable safety nets or temporary fencing should be rigged where personnel have to walk or climb across built-up cargo, and are therefore at risk of falling.
When deck cargo is stowed against and above ship's rails or bulwarks, a wire rope pendant or a chain, extending from the ring bolts or other anchorage on the decks to the full height of the deck cargo, should be provided and used to save personnel having to go over side to attach derrick guys and preventers directly to the anchorages on the deck.

Working with cargo

Safety arrangements made prior to working with cargo should ensure that adequate and suitable lifting plant is available, in accordance with the register of lifting appliances and cargo gear, and that all plant and equipment and any special gear necessary is available and used. Cargo gear should be checked regularly throughout the cargo operation for damage or malfunction.
Repair or maintenance work, such as chipping, spray painting, shot blasting or welding, should not be undertaken in a space where cargo operations are in progress.
Loads being lowered or hoisted should not pass or remain over any person engaged in any work in the cargo space area, or over means of access. Personnel should take care when using access ladders in hatch squares whilst cargo operations are in progress.
Cargo information for goods should always provide the gross mass of the cargo or of the cargo units. Where loads of significant gross mass are not marked with their weight, the loads should be check-weighed unless accurate information is available, as provided by the shipper or packer of the goods.
A signaller should always be employed at a hatchway when cargo is being worked, unless the crane driver or winchman has a complete, unrestricted view of the load or total working area. The signaller should be in a position where they have a total view of the operation; where this is not possible, then, additional signallers should be used to assist.
Before giving a signal to hoist, the signaller should receive clearance from the person making up the load that it is secure, and should ascertain that no one else would be endangered by the hoist. Before giving the signal to lower, the signaller should warn personnel in the way and ensure all are clear.
Loads should be raised and lowered smoothly, avoiding sudden jerks or 'snatching'. When a load does not ride properly after being hoisted, the signaller should immediately give warning of danger and the load should be lowered and adjusted as necessary.
Hooks, slings and other lifting gear should not be loaded beyond their safe working loads. Straps and slings should be of sufficient size and length to enable them to be used safely and be so applied and pulled sufficiently tight to prevent the load or any part of the load from slipping and falling. Loads (sets) should be properly put together and properly slung before they are hoisted or lowered.
Before any heavy load is swung, it should be given a trial lift in order to test the effectiveness of the slinging.
Except for the purpose of breaking out or making up slings, lifting hooks should not be attached to:

- the bands, strops or other fastenings of packages of cargo, unless these fastenings have been specifically provided for lifting purposes; or
- the rims (chines) of barrels or drums for lifting purposes, unless the construction or condition of the barrels or drums is such as to permit lifting to be done safely with properly designed and constructed can hooks.

Suitable precautions, such as the use of packing or chafing pieces, should be taken to prevent chains, wire and fibre ropes from being damaged by the sharp edges of loads.
When slings are used with barrel hooks or other similar holding devices where the weight of the load holds the hooks in place, the sling should be led down through the egg or eye link and through the eye of each hook in turn so that the horizontal part of the sling draws the hooks together.
The angle between the legs of the slings should not normally exceed 90°, because this reduces the safe working load of the sling. Where this is not reasonably practicable, the angle may be increased up to 120° provided that the slings have been designed to work at the greater angles. However, it should be noted that at 120° each sling leg is taking stress equivalent to the whole mass of the load.
Trays and pallets (unit loads) should be loaded using a pallet loader where available. If slings are used, the trays and pallets should be hoisted with four-legged slings and, where necessary, nets and other means should be used to prevent any part of the load falling.
Bundles of long metal goods, such as tubes, pipes and rails, should be slung with two slings or straps and, where necessary, a spreader. Slings or strops should be double wrapped and secured to prevent the sling coming loose. A suitable lanyard should also be attached, where necessary.
Logs should be loaded or discharged using wire-rope slings of adequate size; tongs should not be used except to break out loads.
Cargo buckets, tubs and similar appliances should be carefully fitted so that there is no risk of the contents falling out and they should be securely attached to the hoist (e.g. by a shackle) to prevent tipping and displacement during hoisting and lowering.
Shackles should be used for slinging thick sheet metal if there are suitable holes in the material; otherwise, suitable clamps on an endless sling should be used.
Loose goods such as small parcels, carboys and small drums should be loaded or discharged in suitable boxes or pallets with sufficiently high sides, and lifted using four legged slings.
Slings or chains being returned to the loading position should be securely hooked on the cargo hook before the signaller gives the signal to hoist. Hooks or claws should be attached to the egg link or shackle of the cargo hook, not allowed to hang loose. The cargo hook should be kept high enough to keep slings or chains clear of personnel and obstructions.
'One-trip slings' (i.e. slings that have not been used previously for lifting and are fitted to the load prior to loading) should not be taken back on board ship after the load is discharged at the end of the voyage but should be left on shore for disposal.
When work is interrupted or has ceased for the time being, the hatch should be left in a safe condition, with either guardrails or the hatch covers in position.

Lighting in cargo spaces

During cargo operations, cargo spaces should be adequately lit, avoiding strong contrasts of light and shadow or dazzle. Open or naked lights should not be used. Portable lights should be adequately guarded, suitable for the task, and firmly secured in such a manner that they cannot be accidentally damaged. Portable lights should never be lowered or suspended by their electrical leads, and leads should be run so that they are clear of loads, running gear and moving equipment.

General precautions for personnel

Personnel undertaking duties in cargo spaces should move with caution over uneven surfaces or loose dunnage, and be alert to protrusions such as nails.
Where work is being undertaken on or near the cargo 'face', the face should be secured against collapse, especially where bagged cargo may be bleeding from damage.
Where it is necessary to mount a face, a portable ladder should be used, properly secured against slipping or shifting sideways, or held in position by other personnel. When work is

undertaken in areas where there is a risk of falling, safety net(s) should be erected. Such nets should not be secured to hatch covers.
Personnel should be aware that cargoes may have been fumigated at other points in the transport chain, and there is a risk that toxic fumes may build up in enclosed spaces.

4.4.2 Mooring and unmooring

Mooring

All crew members involved in mooring and unmooring operations of any kind should be informed of the hazards of engaging in such operations.
A competent person should be in charge of mooring operations and ascertain that there are no persons in a dangerous position before any heaving or letting go operation is commenced.

On each occasion that a vessel berths, all relevant circumstances such as weather, passing vessels, etc., should be considered in determining a safe securing pattern of ropes and wires.
Mixed moorings of wires and ropes in the same direction should not be used because wires and ropes stretch differently.
There should be sufficient crew members available to ensure the safe conduct of operations.
Only competent persons should operate windlasses and winches.
Under no circumstances whatsoever should crew members stand in a bight of a rope or wire which is lying on deck. Crew members should never stand or move across a rope or wire that is under strain.

Ropes and wires are frequently under strain during mooring operations and crew members should, as much as possible, always stand in a place of safety from whiplash should ropes or wires break.
Due to the types of man-made ropes that may be on board ship, crew members should be trained in the techniques of "stopping off' wires and ropes. Chain-securing devices should be used for stopping off wire mooring ropes but never for fibre ropes.
A designated crew member should regularly inspect the moorings when a vessel is alongside and the moorings should be kept tight at all times to prevent the ship's movement.

Mooring to buoys

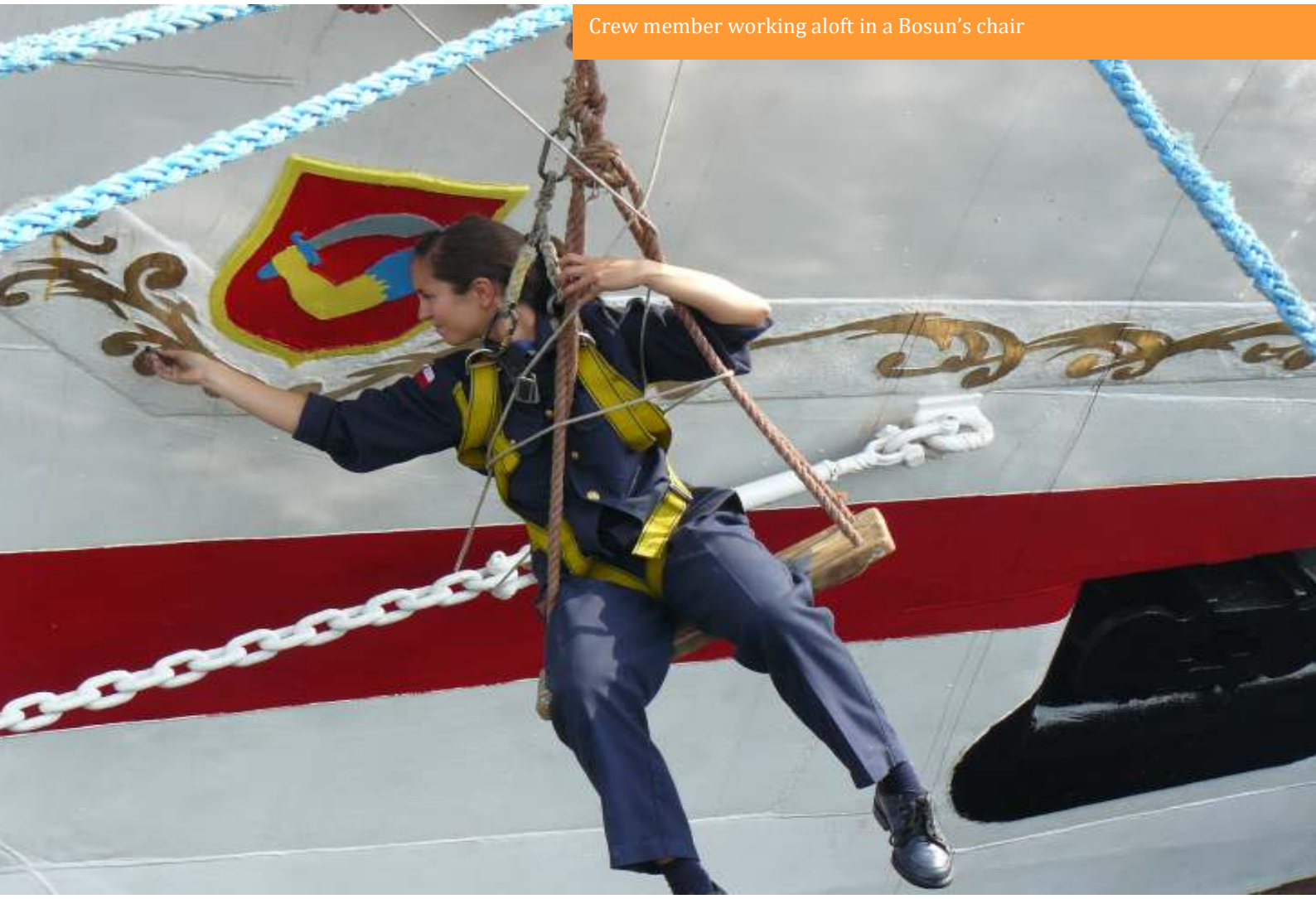
Where mooring to buoys by the ship's crew is permitted by the local authority, the following additional precautions should be followed:

- lifebuoys, with and without attached lines, should be readily available;
- crew members engaged in mooring to buoys from a ship's boat should wear personal protective equipment and a life-jacket;
- equipment should be provided to enable anyone who falls into the water to climb on board the boat;
- the eye of a slip wire used for mooring to buoys should never be put over the buts;
- mooring strong points, such as chain-securing devices and quick-release mechanisms, should be maintained in a serviceable condition.

4.4.3 Working aloft and over the side

General provisions

Consideration should be given to a permit-to-work system for work aloft or over the side depending on the nature of the work. A form for working aloft should take account of the particular nature of the operation.
Particular attention should be paid to water and weather conditions and the possibility of squalls before working aloft or over the side is commenced. In general, working aloft or over the side should not be permitted if the movement of a ship in an inland waterway makes such work hazardous.
Special consideration should be given to the problems of working near the ship's whistle, funnel, radio aerials and radar scanners. All relevant officers should be informed before work commences and all relevant equipment should be isolated, shut down or appropriate procedures adopted. Warning notices should be posted as appropriate. The Boatmaster should be informed when the work is completed.
Young or inexperienced persons should not be required to work aloft or over the side unless accompanied by an experienced crew member or under adequate supervision.
All crew members should wear safety harnesses and safety nets should be rigged where appropriate. Persons working over the side should wear life jackets or other suitable flotation devices. Someone should be in attendance on deck and a lifebuoy with a line attached should be readily available.
Warning notices that crew members are working aloft should be posted on deck and elsewhere as appropriate. Tools should not be carried in pockets but secured in belt tool carriers and they should be kept secured to the belt with a lanyard or string during the work. Tools and stores should be sent up and lowered by line in suitable containers.



Crew member working aloft in a Bosun's chair

All equipment, such as lizards, blocks and gantlines, should be carefully examined before use and if there is any doubt as to the standard, quality and condition of any item it should not be used.
Where possible, only permanent fixtures to the ship's structure, such as welded eye pads, should be used as securing points for lizards, blocks and gantlines.
Lizards and gantlines should be away from, or protected from, sharp edges.
Cargo handling operations should not take place in the vicinity where crew members are working aloft.
Crew members working aloft or over the side should be continuously supervised by a competent person.

Cradles and stages

Cradles should be at least 40 cm wide and fitted with guard-rails to a height of 1 m.
Plank stages should be made from sound wood and materials and should be free from defect.
As far as possible, stages should be secured against movement.
Gantlines should be long enough to allow stages to be lowered to a level which enables crew members to step off the stage easily.
When crew members working on a stage are required to lower the stage themselves, all movements of the stage should be small and carefully controlled.

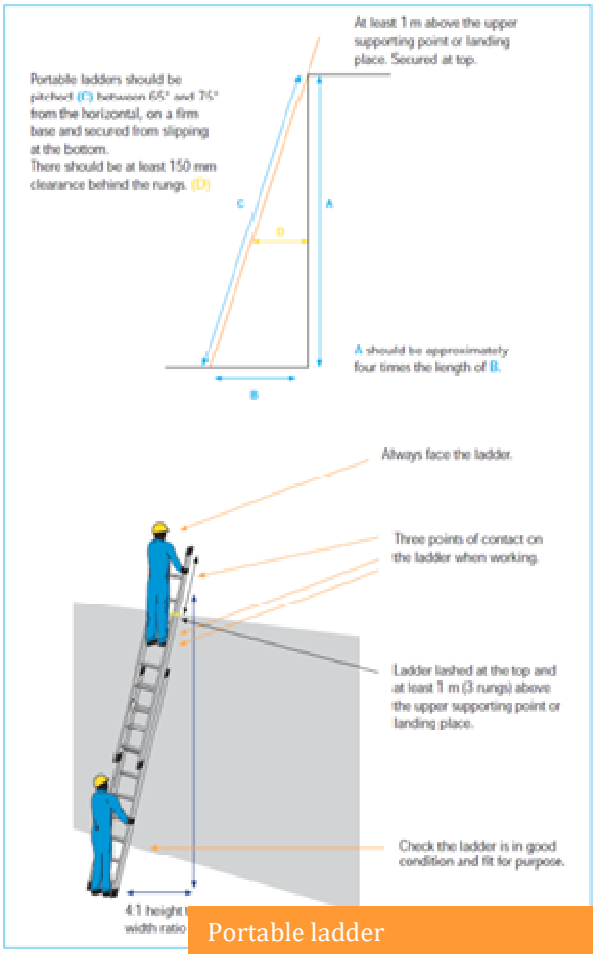
Bosun's chairs

A hook should not be used to secure a bosun's chair unless it is a type which cannot be accidentally dislodged.

A chair used with a gantline should be secured with a double sheet bend and the loose end should be tucked into the rope lay of the standing part.

A chair, and all associated equipment such as gantlines, should be carefully inspected before use and a load test applied before hoisting takes place. If it is necessary to hoist a person aloft, it should be done only by hand and never by mechanical means, such as a winch.

Crew members should be reminded that when securing the hitch in a chair the practice of holding both parts of the gantline with one hand and making the lowering hitch with the other is dangerous.



Portable ladder

Ropes

The safety of crew members working aloft depends to a large extent on the condition of the ropes used in the operations. Such ropes must be given considerable care and attention.

Ropes should be stowed in a special locker and used for no other purpose other than working aloft. Nothing else should be stowed in the locker; stores such as detergents and paints may damage ropes. The locker should be dry and not subject to excessive heat.

All ropes should be thoroughly inspected each time before use and daily when in use. It should be remembered that although the surface of a rope may indicate that it is in good condition, it may have deteriorated inside.

All ropes (e.g. gantlines, lifelines and lizards) should be load tested before use to four or five times the weight that they will be expected to carry.

Portable ladders

Working from ladders, where there is a risk of overstretching and falling, should be discouraged.

A safety harness secured above the person should be used when working aloft.

The ladder should extend to a height of at least 1 m above the top landing place.

A ladder should be effectively secured so that it cannot move.

Crew members using a ladder should:

- have both hands free for climbing up and down;
- face a rigid ladder when climbing up and down;
- not carry tools or equipment.

Rigid portable ladders should be placed at an angle between 65 and 70 degrees to the horizontal and there should be a clearance of at least 15 cm behind all the rungs.

Rope ladders

Rope ladders should be of good construction, adequate strength and properly maintained.

The rope ladder should be properly secured but never secured to railings, or to any other means of support, unless the railings or support will safely take the weight of a person and the ladder.

Rope ladders

The rope ladder should either hang fully extended or be pulled up completely: it should never be left so that slack may suddenly pay out when the ladder is used.

The ladder should be rigged and used under the supervision of a responsible person.

Working over the side from punts

Punts should be stable and have suitable fencing.

The person in charge should consider the potential hazards of working at the stern and near side discharges and the hazards of strong tides and wash from passing vessels, etc. All relevant persons should be informed that the work is taking place.

A person painting over the side should wear a lifeline and a buoyancy garment. Someone should be in attendance on deck and a lifebuoy with a line attached should be readily available.

4.4.4 Working with dangerous and irritating substances and radiations

General provisions

Dangerous and irritating substances should be handled only under the supervision of a responsible officer.

Crew members should wear appropriate personal protective equipment.

Crew members should be aware that materials such as residual fuel oil and used or spent engine oil contain substances known to be carcinogenic. In addition to any carcinogenic effects, contact between oil and human skin may lead to a range of skin complaints ranging from mild irritation to severe oil acne. Contact must be avoided by taking suitable precautions, e.g. the owner should provide barrier creams and personal protective equipment.

Boatmasters should ensure that the data sheet information provided by the manufacturers with their products is made available to all crew members who may come into contact with these products.

Work with unsaturated polyesters

Composite bonding material can contain unsaturated polyesters which may cause skin irritation which can be difficult to control. Appropriate personal protective clothing should be worn when using substances which contain unsaturated polyesters.

Work with adhesives

Many adhesives emit fumes which are detrimental to health. Appropriate respiratory equipment should be worn and work spaces should be well ventilated.

Fire precautions should be observed when working with adhesives.

Some adhesives, such as "super-glues", can bond skin upon contact. Such adhesives should be used with great caution and the manufacturer's instructions should be closely followed if skin

becomes bonded to objects or to other parts of the body. Force should never be used to separate skin or to detach skin from objects.
Under no circumstances should "super-glues" be used for the purposes of practical jokes.

Removing insulation, paint and other coatings

When possible, information on the nature of the material should be obtained and any particular hazards identified and suitable precautions taken.
Even seemingly innocuous material may contain harmful substances of which crew members are unaware. Appropriate personal protective equipment should always be worn when insulation, paint and other coating are removed.

Work with asbestos

All types of asbestos have a fibrous structure which can produce dust harmful to health if the surface integrity is damaged or disturbed. The danger is from minute fibres which can become lodged in the lungs and may cause cancer at a later period.
Crew members should be supplied with information if asbestos is on board ship. Such information should indicate the specific location.
Asbestos which is sealed is unlikely to release dust; old asbestos may be in poor condition and consideration should be given to its removal.
In general, asbestos should be removed only by a specialist removal contractor.
If it is necessary to carry out emergency repairs involving the removal of asbestos, full personal protective equipment, including respirators, should be worn and asbestos-handling safety procedures should be followed. If necessary, expert advice should be sought.

Personal protective equipment for painting

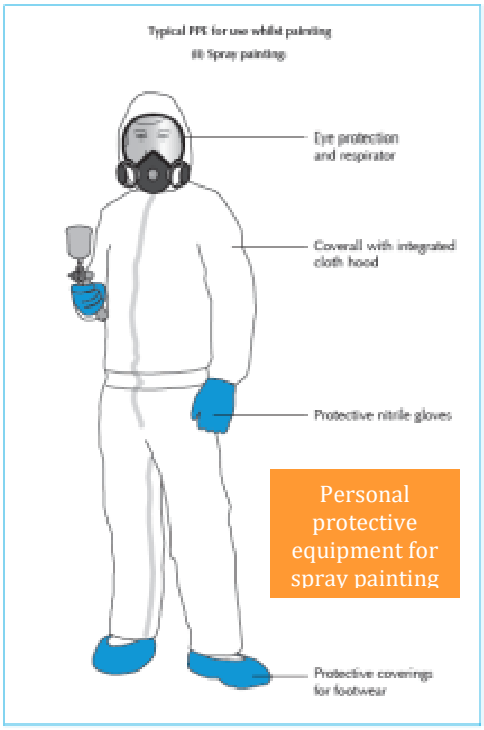
Work with man-made mineral fibres

Man-made mineral fibres, such as those found within insulation material, can cause skin, nose and eye irritation. Appropriate personal protective equipment, such as goggles, masks and coveralls should be worn when handling such material.

Painting

Paints may contain toxic or irritant substances and a paint for which no manufacturer's information is available should not be used.
Some paints dry by evaporation of the paint's solvent and the process may cause flammable or toxic vapours. All interior and enclosed spaces should be well ventilated while painting is in progress and until the paint has dried
Smoking should not be permitted during painting. Naked lights, such as matches, should not be used in spaces until paint has fully dried.
Great care should be taken when mixing two-pack (two components) paint as a chemical reaction takes place during the mixing which might create heat and fumes.
Chemical rust removers are corrosive and precautions should be taken to protect eyes and skin.
Spaces where paint and painting equipment are stored should be well ventilated.

Spraying



Personal protective equipment for spray painting

Personnel should closely follow the manufacturer's instructions on the operation of spray equipment.
A "paint mist" may form during spraying operations and personnel should wear suitable personal protective equipment such as a combination suit, hood, gloves and eye protectors. A respirator may also be necessary.
Paints containing mercury, lead or any toxic compounds should not be sprayed in interior spaces.
Airless spray equipment ejects paint at a very high pressure. The operation is hazardous as the paint can penetrate the skin or cause eye injuries. Great care should be taken in the use of such equipment.
Crew members should be trained in the correct methods of unblocking nozzles according to the manufacturer's instructions.

Radio and radar installations

Warning notices of the danger of high voltages should be located near radio transmitter aerials and lead-through insulators.
When crew members are working near aerials and scanners, equipment should be isolated from the mains supply and radio transmitters earthed. Warning notices should be displayed on the relevant equipment.
Fuses should be removed from any equipment upon which work is to be carried out before that work commences.

Ionizing radiations

Crew members should not be exposed to dangerous levels of microwave radiation. Instructions contained in manufacturers' manuals should be strictly followed.
Eyes are particularly sensitive to microwave and ultrawave radiation. Care should be taken not to look into a radar scanner or waveguide when a radar is operating.
No work should be carried out within the marked safety radius of a satellite terminal antenna unless its transmitter has been switched off.

4.4.5 Working with batteries

Battery rooms should be adequately ventilated to avoid accumulation of explosive gases.
Light fittings and any electrical equipment in the battery room should be of a type certified as being suitable for a hydrogen atmosphere.
Particular hazards when charging batteries are hydrogen explosion and short circuits.
During charging, a battery gives off hydrogen and oxygen and the subsequent mixture can be easily ignited. Short circuits may cause arcing which could lead to an explosion or burn crew members.
Only authorized persons should enter battery rooms and, when doing so, they should ensure that they do not introduce any source of ignition. Smoking is prohibited in battery rooms.
Care should be taken when using metal tools or implements to avoid making contact with the metal battery case or terminals.
Battery rooms should be kept clear of any equipment, including any other electrical equipment, likely to act as a source of ignition, and should not be used as storerooms.
Lead-acid batteries and alkaline batteries should not be stored in the same room because of the possible interaction of the electrolytes.

Storage batteries

When a battery is being charged it 'gases', giving off both hydrogen and oxygen. As hydrogen is easily ignited in concentrations ranging from 4% to 75% in air, battery containers and compartments should be kept adequately ventilated to prevent an accumulation of dangerous gas.

Smoking and any type of open flame should be prohibited in a battery compartment. A conspicuous notice to this effect should be displayed at the entrance to the compartment.

Safe and effective means of inspecting and servicing the batteries should be provided by adequate lighting and access to each cell, and personal protective clothing, gloves and goggles should be supplied and worn by crew members engaged in topping up the batteries. Warning: Open flames and naked lights should not be used to inspect battery cells.

Lighting fittings in battery compartments should be properly maintained at all times, with protective glasses in position and properly tightened. If cracked or broken glasses cannot be replaced immediately, the electric circuit should be isolated until replacements are obtained.

No unauthorised modifications or additions should be made to electrical equipment (including lighting fittings) in battery compartments.

Portable electric lamps and tools, and other portable power tools that might give rise to sparks, should not be used in battery compartments.

The battery compartment should not be used as a store for any materials or gear not associated.

A short circuit of even one cell may produce an arc or sparks that may cause an explosion of any hydrogen present. Additionally, the very heavy current that can flow in the short-circuiting wire or tool may cause burns due to rapid overheating of the metal.

Insulation and/or guarding of cables in battery compartments should be maintained in good condition.

All battery connections should be kept clean and tight to avoid sparking and overheating. Temporary clip-on connections should never be used because they may work loose due to vibration and cause a spark or short circuit.

Metal tools, such as wrenches or spanners, should never be placed on top of batteries because they may cause sparks or short circuits. The use of insulated tools is recommended.

Jewellery, watches and rings, etc. should be removed when working on batteries.

A short circuit through any of these items will heat it rapidly and may cause a severe skin burn. If rings cannot be removed, they should be heavily taped in insulating material.

The battery chargers and all circuits fed by the battery should be switched off when leads are being connected or disconnected. If a battery is in sections, it may be possible to reduce the voltage between cells in the work area, and hence the severity of an accidental short circuit or electric shock, by removing the jumper leads between sections before work is begun. It should be appreciated that whilst individual cell voltages may not prevent a shock risk, dangerous voltages can exist when numbers of cells are connected together in series. A lethal shock needs a current of only tens of milliamps and particular care should be exercised when the voltage exceeds 50V.

The battery-charging systems should be checked to ensure that it is only possible to charge within the specified rate. Battery boxes should be checked for fixing and integrity as part of the planned maintenance.

Battery cell vent plugs should be screwed tight while connections are being made or broken.

The ventilation tubes of battery boxes should be examined regularly to ensure that they are free from obstruction.

Lids of battery boxes should be fastened while open for servicing and properly secured again when the work is finished.

Batteries should be kept battened into position to prevent shifting in rough weather.

Alkaline and lead-acid batteries should be kept in separate compartments or separated by screens. Where both lead-acid and alkaline batteries are in use, great care should be exercised

to keep apart the materials and tools used in servicing each type, because contamination of the electrolyte may cause deterioration of battery performance and mixing of the two electrolytes produces a vigorous chemical reaction, which could be very dangerous.
Both acid and alkaline electrolytes are highly corrosive. Immediate remedial action should be taken to wash off any accidental splashes on the person or the equipment. Hands should always be washed as soon as the work is finished.
Batteries should always be transported in the upright position to avoid spillage of electrolyte. A sufficient number of people should be employed because the batteries are heavy and painful strains or injury can otherwise easily result

4.4.6 Presence in engine-room

Crew members should never enter or remain in an unmanned machinery space alone, unless they have received permission from or been instructed by the engineer officer in charge at the time. They may only be sent to carry out a specific task that they may be expected to complete in a comparatively short time. Before entering the space, at regular intervals whilst in the space and on leaving the space, they must report by telephone, or other means provided, to the duty deck officer.
Before they enter the space, the method of reporting should be clearly explained. Consideration should be given in appropriate instances to using a permit to work.
If it is the engineer officer in charge who enters the machinery space alone, they too should report to the deck officer before entry, at regular intervals whilst in the space and on leaving the space.
Notice of safety precautions to be observed by crew members working in unmanned machinery spaces should be clearly displayed at all entrances to the space. Warning should be given that in unmanned machinery spaces there is a likelihood of machinery suddenly starting up.
Unmanned machinery spaces should be adequately illuminated at all times.
When machinery is under bridge control, the bridge should always be advised when a change in machinery setting is contemplated by the engine room staff, and before a reversion to engine room control of the machinery.

Maintenance of machinery

Before machinery is serviced or repaired, measures should be taken to prevent it being turned on or started automatically or from a remote-control system.
Electrically operated machinery should be isolated from the power supply.
Steam-operated machinery should have both steam and exhaust valves securely closed, the valves locked or tied shut or some other means employed to indicate that the valves should not be opened. The same care is required when dealing with heated water under pressure as is required when working on steam-operated machinery or pipework.
In all cases, warning notices should be posted at or near the controls giving warning that the machinery concerned is not to be used.
Hydraulic-operated machinery should have its own oil supply valve isolated and the oil return valve if fitted.
The cleaning or replacement of fuel or lubricating filter elements on engines or turbines should, so far as practicable, only be undertaken with the engine or turbine in the stopped condition. Where valves or filter covers have to be removed or similar operations have to be performed on pressurised systems, that part of the system should be isolated by closing the appropriate valves. The position of a duplex filter change over cock does not guarantee that the 'out of service' filter chamber has been isolated. The drain and/or vent cocks should be opened gradually to ensure that pressure is off the system before any other fastenings of bolts are slackened off.

When joints of pipes, fittings, etc. are being broken, the fastenings should not be completely removed until the joint has been broken and it has been established that no pressure remains within.
Before a section of a steam pipe system is opened to the steam supply, all drains should be opened. Steam should be admitted very slowly and the drains kept open until all the water has been expelled.
Maintenance or repairs to, or immediately adjacent to, moving machinery should be permitted only in circumstances where no danger exists or where it is impracticable for the machinery to be stopped. Close-fitting clothing should be worn and long hair should be covered. The officer in charge should consider whether it is necessary in the interests of safety for a second person to be in close attendance whilst the work is being carried out.
Heavy parts of dismantled machinery temporarily put aside should be firmly secured against movement in an inland waterway and, as far as practicable, be clear of walkways. Sharp projections on them should be covered when reasonably practicable.
Spare gear, tools and other equipment or material should never be left lying around, especially near to stabiliser or steering gear rams, switchboards and batteries.
A marlin spike, steel rod or other suitable device should be used to align holes in machinery being reassembled or mounted; fingers should never be used.
When guards or other safety devices have been removed from machinery, they should be replaced immediately once the work is completed and before the machinery or equipment is tested.
An approved safety lamp should always be used for illuminating spaces where oil or oil vapour is present. Vapour should be dispersed by ventilation before work is done.

4.4.7 Lifting loads

Manual handling

It is important to identify some areas that may require attention in respect of manual handling. In all cases, a risk assessment should be used as the basis for appropriate control measures, which should be put in place to protect those who may be affected.
The assessment should take full account not only the characteristics of the load and the physical effort required but also of the working environment (e.g. ship movement, confined space, high or low temperature, physical obstacles such as steps or gangways) and any other relevant factors (e.g. the age and health of the person, the frequency and duration of the work).
The term “manual handling” is used to describe any operation that includes any transporting or supporting of a load, lifting, putting down, pushing, pulling, carrying or moving by hand or bodily force. This guidance is generally concerned with preventing musculoskeletal injury.
Musculoskeletal injuries can occur as a result of accident, poor organisation or an unsatisfactory working method.
The vessel owners companies are required to take appropriate measures or provide the means to:
Assess the risk of injury from any hazardous manual-handling activity.
Avoid the need for any hazardous manual-handling operations, which may cause injury to crew members, e.g. by re-organisation of the work, or automating or mechanising the operation.
Reduce the risk of injury from hazardous manual handling.
Provide information on the weight of each load and, if appropriate, which side is heaviest.
Train crew members in appropriate manual-handling techniques. Before instructing personnel to lift or carry by hand, where there is a risk of injury, companies should consider whether alternative means of doing the same job would reduce this risk.
Means of reducing the risk of injury may include:

- re-organisation of the workplace (to enable crew members to maintain good posture while lifting or carrying); and

- taking account of an individual's capabilities when allocating tasks.

There are often limitations in a ship on the improvements that can be made but the vessels owners companies should ensure that, as far as reasonably practicable, risks have been minimised.

Instruction for personnel should involve experienced and properly trained crew members demonstrating best practice, especially to entry level personnel.

Instructions for crew members include:

- full and proper use of any system of work provided by the company;
- use any mechanical aids provided;
- follow appropriate systems of work laid down in respect of health and safety;
- take sensible precautions to ensure that you are aware of any risk of injury from a load before picking it up;
- cooperate on all health and safety matters;
- inform your line responsible of identified hazardous handling activities;

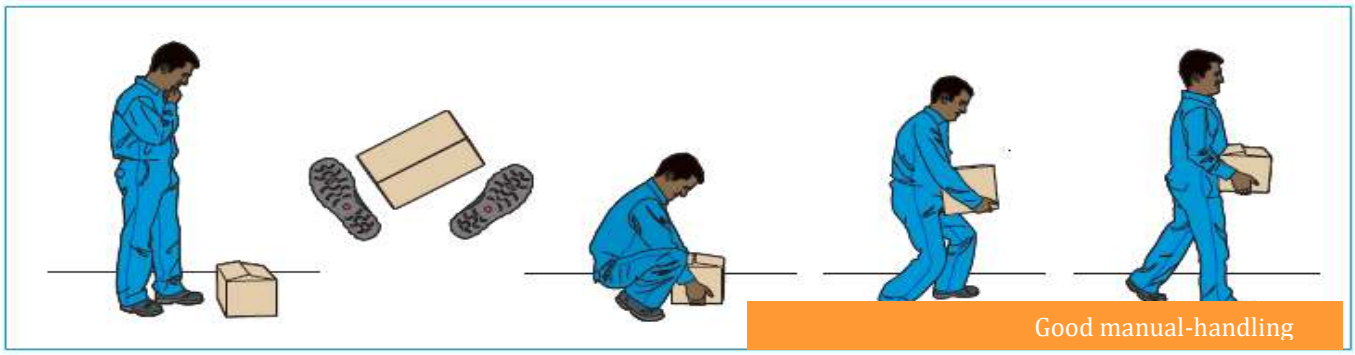
For a long lift, such as deck to shoulder height, consider resting the load midway in order to change grip.

Long lifting a load

Guidance:

- assess the load to be lifted, taking account of any information provided;
- look for sharp edges, protruding nails or splinters, surfaces that are greasy or otherwise difficult to grip and for any other features that may prove awkward or dangerous;
- ensure that the deck or area over which the load is to be moved is free from obstructions, especially in narrow accesses, and is not slippery; and
- check the final stowage location to ensure that it is clear and suitable for the load.

Good manual-handling techniques:



Good manual-handling

The image illustrates some important points in lifting techniques:

- the load and the lift should be assessed before lifting;
- a firm, stable and balanced stance should be taken, close to the load with the feet apart but not too wide, with one leg slightly forward to maintain balance, so that the lift is as straight as possible;
- at the start of the lift and when lifting from a low level or deck, a crouching position should be adopted, with knees and hips bent, whilst maintaining the natural curve of the back to ensure that the legs do the work. It helps to tuck in the chin while gripping the load and then raise the chin as the lift begins.
- the load should be gripped with the whole of the hand, not fingers only. If there is insufficient room under a heavy load to do this, a piece of wood should be put underneath first. A hook grip is less tiring than keeping the fingers straight. If the grip needs to be varied as the lift proceeds, this should be done as smoothly as possible;

Two people handling a load

- the load should be lifted by straightening the legs, keeping it close to the body. The heaviest side should be kept closest to the trunk. The shoulders should be kept level and facing the same direction as the hips. Turning by moving the feet is better than twisting and lifting at the same time. Look ahead, not down at the load, once it is held securely.

When **two or more people are handling a load**, it is preferable that they should be of similar stature. The actions of lifting, lowering and carrying should, as far as possible, be carried out in unison to prevent strain and any tendency for either person to overbalance.

The procedure for putting a load down is the reverse of that for lifting: the legs should do the work of lowering with knees bent, back straight and the load close to the body. Care should be taken not to trap fingers. The load should not be put down in a position where it is unstable. If precise positioning is necessary, the load should be put down first and then slid into the desired position.

A load should always be carried in such a way that it does not obscure vision, so allowing any obstruction to be seen.

The risk of injury may be reduced if lifting can be replaced by controlled pushing or pulling. For example, it may be possible to slide the load or roll it along. However, uncontrolled sliding or rolling, particularly of large or heavy loads, may introduce fresh risks of injury. Particular care must be taken if:

- stooping, stretching or twisting is likely;
- hands on the load are not between waist and shoulder height;
- the deck area is insecure or slippery;
- force is applied at an angle to the body;
- the load makes sudden or unexpected movements; and
- if the vessel is rolling or pitching.

For pulling and pushing, a secure footing should be ensured, and hands applied to the load at a height between waist and shoulder wherever possible. Wheels on barrows and trolleys should run smoothly, and the supervisor or safety officer should be informed if the equipment provided is not suitable, or is in poor condition.

Pulling and pushing a load

A further option, where other safety considerations allow, is to push with the worker's back against the load, using the strong leg muscles to exert the force.

Push with the worker's back against

Even a gentle uphill slope dramatically increases the force needed to push an object, so help may be necessary when moving a load up a slope or ramp. Care should be taken with un-braked trolleys and sack trucks on a moving/rolling deck, because sudden changes in the angle of deck and direction of the slope may result in loss of control and injury. If a trolley becomes loose, do not try to stop it by standing in its way, but get behind it and try to act as a brake.

Care must be taken with the laying out of heavy mooring ropes and wire ropes/hawsers. This duty requires a good technique initially in lifting the heavy eye of the rope, followed by a good pulling technique. Crews should make sure that there are enough people available to do the task safely.
When moving a load, such as a barrel or drum, rolling the load may be a safer operation than lifting it. Care must still be taken, and the use of a trolley should be considered for heavy or large barrels or drums.

Suitable shoes or boots should be worn for the job. Protective toecaps help to guard toes from crushing if the load slips.

Moving a barrel

Clothing that does not catch in the load and gives some body protection should be worn.
Where the work is very strenuous (e.g. due to load weight, repetitive effort over a period or environmental factors, such as a confined space or an extreme of temperature), rest should be taken at suitable intervals to allow muscles, heart and lungs to recover. Fatigue makes accidents more likely on work of this type. Whenever possible, manual lifting and carrying should be organised in such a way that each person has some control over their own rate of work.

Mechanical handling

Cargo handling equipment should be operated only by trained and experienced persons. Manufacturer's instructions regarding operation and maintenance as contained in the ship's cargo handling manual should be followed at all times.
Equipment should be inspected by a responsible person prior to and after use. No equipment should be used or operated unless the prescribed certificates of tests and examinations are on the ship and are current and valid.
The crew member with primary responsibility for cargo operations should check that all safety features are in place and that any possible hazards are clearly marked and otherwise dealt with to prevent injury to any persons who may be working on board the vessel.
The Boatmaster should ensure that the crew is aware of any hazardous cargoes or operations. Appropriate protective equipment should be provided to crew members before commencement of cargo operations.
Prior to commencement of cargo operations, clear means and lines of communication should be established between the ship's crew and terminal personnel or dockworkers. This is particularly important in case of hazardous cargoes or hazardous operations. If hand signals are to be used, their meaning must be clear to all those concerned in the operation.
All crew members must take particular care to not exceed the safe working load of any equipment. The Boatmaster should take particular care, especially in older vessels, not to overstress any part of the ship's structure.
When work is interrupted or has temporarily ceased, hatches should be left in a safe condition, with either guard-rails or the hatch covers in position.
No other work should be carried out in a space in which cargo is being worked.
Crew members should immediately report the damage of cargo handling equipment to a responsible ship's officer. Damaged equipment should be immediately taken out of service.
When dangerous goods are carried, the special regulations should be strictly followed.
Cargo gear should be properly stowed to prevent it from breaking loose and posing a hazard when the vessel is on movement.

Cargo should be stowed and secured assuming the worst weather conditions which may be expected.
When deck cargoes are carried, particularly timber, attention should be paid to ensuring the ship's stability throughout the voyage, especially in consideration of the possibility of added weight due to absorption of water or accumulation of ice or snow.

Lifting gear

All lifting equipment used on board ship should be of good design, sound construction and material, adequate strength for the purpose for which it is used, free from defect, properly installed or assembled and properly maintained.
Lifting gear should be tested and examined in accordance with national requirements.
Lifting gear should be clearly and legibly marked with its safe working load, including the safe working load at various operating positions.
A register of a ship's lifting appliances and items of loose gear should be kept on the vessel. All lifting gear and loose gear should be included in the register.
All equipment should be thoroughly examined by a responsible crew member before use and regularly examined during use. The frequency of examination should depend on the operation, e.g. derrick wires subjected to hard usage should be inspected several times a day.
Crew members using cranes, derricks or special lifting gear should preferably be trained and certified for the particular equipment; if this is not possible, they should be thoroughly instructed by a competent person from the vessel crew prior to any cargo operations.
Loads being lowered or hoisted should not pass or remain over any person engaged in loading or unloading or performing any other work in the vicinity.
Cargo handling equipment should always be manned when controls are in the "on" position. When not in operation it should be turned "off' and safety locks or devices should be put in place.
Persons operating equipment should have a clear view. If this is not possible, a signaller should be placed at a point clearly visible to the equipment operator and from the area of work.

Use of slings

Straps and slings should be of sufficient size and length to enable them to be used safely and be applied and pulled sufficiently tight to prevent the load or any part of the load from slipping and falling.
Before heavy loads such as lengths of steel sections, tubes and lumber are swung, the load should be given a trial lift to test the effectiveness of the slinging.
Except for the purpose of breaking out or making up slings, lifting hooks should not be attached to:

- the bands, straps or other fastenings of packages of cargo;
- the rims of barrels or drums.

Slings or chains being returned to the loading position should be securely hooked on the cargo hook before the signaller gives the signal to hoist. Hooks or claws should be attached to the egg link or shackle of the cargo hook and not allowed to hang loose. The cargo hook should be kept high enough to keep slings or chains clear of persons and obstructions.
Loads (setts) should be properly put together and properly slung before they are hoisted or lowered.
Loads should be raised and lowered smoothly, avoiding sudden jerks or "snatching" loads.
Suitable precautions, such as the use of packing or chafing pieces, should be taken to prevent chains, wire and fibre ropes from being damaged by the sharp edges of loads.

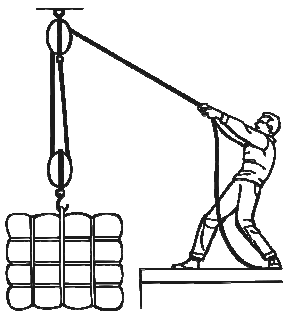
When slings are used with barrel hooks or similar holding devices where the weight of the load holds the hooks in place, the sling should be led down through the egg or eye link and through the eye of each hook in turn so that the horizontal part of the sling draws the hooks together.
The angle between the legs of slings should not normally exceed 90 degrees. Where this is not reasonably practicable, the angle may be exceeded up to 120 degrees provided that the slings have been designed to work at the greater angles.
Trays and pallets should be hoisted with four-legged slings and, where necessary, nets or other means should be used to prevent any part of the load falling.
When bundles of long metal goods, such as tubes, pipes and rails are being hoisted, two slings should be used and, where necessary, a spreader. A suitable lanyard should also be attached, where necessary.
Cargo buckets, tubs and similar appliances should be carefully filled so that there is no risk of the contents falling out. They should be securely attached to hoist (for example, by a shackle) to prevent tipping and displacement during hoisting and lowering.
Shackles should be used for slinging thick sheet metal if there are suitable holes in the material; otherwise, suitable clamps on an endless sling should be used.
Bricks and other loose goods of similar shape, carboys, small drums, canisters, etc., should be loaded or discharged in suitable boxes or pallets with sufficiently high sides and lifted by four-legged slings.

Pulley blocks

Pulley blocks

All blocks should be inspected before use and no block should be used unless it has identification marks and its safe working load marked on it in tonnes.
When a block is inspected it should be ascertained that no sheave is cracked, that it turns freely and the groove is not excessively worn, that the swivel head fitting is securely fastened and the block shank freely turns, that the side straps are sound and that all sheave clearances are satisfactory.

Line drawing of a man lifting a large load using a block and tackle pulley system



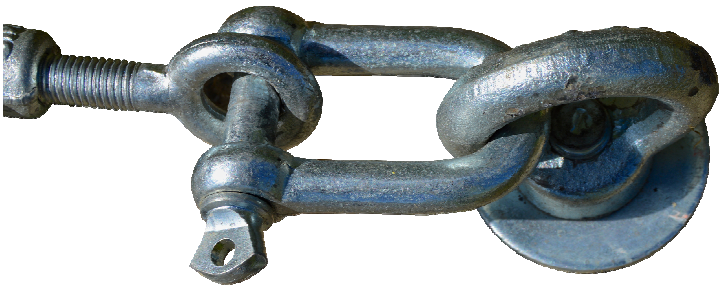
All grease nipples and/or lubrication holes should be kept clear and each block should be regularly greased.

Hooks

Every hook should be provided with an efficient device to prevent displacement of the sling or load or be of such construction as to prevent displacement. Hooks should be marked with their safe working load.

Shackles

No shackle should be used unless its safe working load is clearly marked. A shackle should be of the correct type, size and safe working load for its intended use.
All shackles should have their pins effectively secured or seized with wire.



The running part of any rigging should not come into contact with the pin of a shackle.
All shackle pins should be kept lubricated.

Working on deck while the vessel is moving on the water

The responsible person should ensure that crew members working on deck are properly instructed in the tasks which they are required to perform.
Crew members should be prohibited at all times from sitting upon the vessel's bulwark or rail.
Deck crew officers should be informed of all work being performed on deck or in deck spaces.

Heavy weather

Lifelines should be rigged in appropriate locations on deck if heavy weather is expected.
Attention should be given to the dangers of allowing any person out on deck during heavy weather. No crew members should be on deck during heavy weather unless it is absolutely necessary for the safety of the ship or crew.
The lashings of all deck cargo should be inspected and tightened as necessary when heavy weather is expected. Work on deck during heavy weather should be authorized by the master and the bridge watch should be informed.
Any person required to go on deck during heavy weather should wear a life jacket and be equipped with a portable transceiver. If possible, the person should remain in communication with a backup person and be visible at all times.
Crew members on deck should wear reflective clothing.

Crew members should work in pairs or in teams. All crew members should be under the command of an experienced senior officer.

Working in hatches and holds

Before any work in any hatches or holds where the atmosphere may contain toxic or flammable gases or be deficient in oxygen, the enclosed-space procedures should be observed.
If work is to be performed on or near a tall stack of cargo, an officer should ensure that it is safe to do so. Safety nets should be rigged where appropriate.
When possible, loosely stowed dunnage should not be walked upon. If this is unavoidable, care should be taken not to walk on any protruding nails.
Work should not be carried out in holds where cargo operations are taking place.

4.4.8 Entering and working in enclosed or confined spaces

General provisions

All enclosed or confined spaces should be considered unsafe for entry until proven otherwise.
If there is an unexpected reduction in or loss of ventilation, in spaces which are usually ventilated by whatever means, then those spaces should also be considered as dangerous.
Any enclosed or confined space may have an atmosphere deficient in oxygen, and/or contain flammable or toxic fumes, gases or vapours, thus presenting a major risk to health or life for anyone entering it. Areas in which an unsafe atmosphere is present or can arise include cargo holds, double bottoms, cargo tanks, pump rooms, compressor rooms, fuel tanks, ballast tanks, cofferdams, void spaces, duct keels, inter-barrier spaces, sewage tanks, cable trunks, pipe trunks, pressure vessels, battery lockers, chain lockers, inert gas plant scrubber and blower spaces and the storage rooms for CO_2, halons and other media used for fire extinguishing or inerting.
Such enclosed or confined spaces should not be entered except upon the explicit instruction of the master or the responsible officer. If a deficiency of oxygen or the presence of toxic gases, vapours or fumes is suspected in any space, then that space should be considered dangerous.
The crew should be drilled periodically in confined spaces rescue and medical first aid.

Precautions on entering in enclosed spaces

Before a space is entered, the following precautions should be taken, as appropriate, to make it safe for entry without the need for breathing apparatus, and to ensure that it remains safe whilst crew members are inside:

- a competent person should make an assessment of the space and a responsible officer should be appointed to take charge of the operation;
- the potential hazards should be identified;
- the space should be prepared and secured for entry;
- the atmosphere should be tested;
- a "permit-to-work" system should be used;
- entry procedures should be established and followed;
- continuous ventilation should be maintained throughout.

Additional precautions, including the use of breathing apparatus, should be taken where the aforementioned precautions have been followed and an unsafe atmosphere has been established.
A crew member should not enter a dangerous space to attempt a rescue without first having called for assistance and then having donned a breathing apparatus. Even then entry should not be made until assistance arrives.

Duties and responsibilities of a competent person and of a responsible officer

The designated competent person should be capable of making an informed assessment of the likelihood of a dangerous atmosphere being present or arising subsequently in a space. The competent person should have sufficient theoretical knowledge and practical experience of the hazards that might be met in order to be able to assess whether precautions are necessary. The assessment should include any potential hazards which might be met, and should take into account any dangers from neighbouring or unconnected spaces, as well as the work needing to be done in the space itself.
A responsible officer should be designated to take charge of every operation where entry into a potentially dangerous space is necessary. This officer may be the same person as the competent person.
The responsible officer must decide on the basis of the competent person's assessment the procedures which must be followed for entry into the space.
These will depend on whether the assessment shows:

- no risk is envisaged to the life or health of a person entering the space;
- no immediate risk to life or health but that a risk could arise during the course of work in the space;
- an immediate risk to life or health.

Danger label

If no risk to life or health is envisaged, and it is considered that conditions in the space will not change, then entry may be made. The space should be monitored as long as anyone is inside.

Preparing and securing the space for entry

Care should be taken to avoid the effects of a possible release of pressure or vapour when opening the entrance to the space.
The space should be isolated and secured against the escape of dangerous substances by blanking off pipelines or other openings or by closing valves. Valves should then be tied, or some other method employed to show that they must not be opened.
The space should be cleaned or washed if necessary, to remove as much as possible of the sludge or other deposit liable to give off dangerous fumes. Special precautions may be necessary.

The space should be thoroughly ventilated by natural or mechanical means, to ensure that all harmful gases are removed and no pockets of oxygen-deficient atmosphere remain. Compressed oxygen should not be used to ventilate any space.
The persons in charge, on the bridge, on the deck, in the engine-room, or the cargo control room should be informed as necessary of any space to be entered so that, for example, fans are not stopped, equipment not started or valves not opened by remote control.
Appropriate warning notices should be placed on the relevant controls or equipment.
Where necessary, pumping operations or cargo movements, should be suspended when entry is being made into a dangerous space.

Testing the atmosphere of confined and enclosed spaces

Only persons trained in the use of the equipment should test the atmosphere of a space.
Equipment should be properly calibrated before use.
Testing of the atmosphere should be carried out before entry and at regular intervals thereafter.
Testing of the atmosphere before entry should be made by remote means. If not possible, the competent person should ensure that all attempts have been made to reduce the danger posed by the atmosphere and only then should entry be made with the additional precautions.
Testing of the atmosphere should be carried out on different levels, where appropriate.
Personal monitoring equipment designed purely to provide a warning against oxygen deficiency and hydrocarbon concentrations should not be used as a means of determining whether a dangerous space is safe to enter.

Use of a permit-to-work system

A "permit-to-work" system should be used. Entry into a space should be planned in advance and if unforeseen problems or hazards arise during the operation, then work should be stopped and the space evacuated immediately. Permits to work should be withdrawn, and the situation reassessed. Permits to work should be revised as appropriate after the reassessment.
Everyone should leave the space on expiry of a "permit to work", and the entrance should be closed or otherwise secured to prevent re-entry, or declared safe for normal entry when it is no longer dangerous.

Procedures and arrangements before entry

Access to and lighting within the space should be adequate.
No sources of ignition should be taken or put into the space unless the master or responsible officer is satisfied that it is safe to do so. A rescue team and resuscitation equipment should be available for immediate action. The resuscitation equipment should be positioned ready for use at the entrance.
Only trained personnel should be assigned duties at entry, functioning as attendants or as members of rescue teams.
The number entering should be limited to those persons who actually need to work in the space and could be rescued in the event of an emergency.
At least one person, trained in entry procedures and the action to be taken in the event of an emergency, should be detailed to stay by the entrance whilst it is occupied.
A communication system should be agreed and tested by all involved, to ensure that persons entering the space can keep in touch with the person stationed at the entrance.
A communication system should be set up between the responsible officer and the person stationed at the entrance.

It should be checked that entry with breathing apparatus is possible before entry is allowed. The extent by which movement could be restricted, or the removal of a casualty could be hampered, by the use of breathing apparatus, lifelines or harnesses should be ascertained.
Rescue harness lifelines should be long enough for the purpose and easily detachable by the wearer, but should not otherwise come away from the harness.

Procedures and arrangements during entry

The space should be continuously ventilated whilst occupied and during temporary breaks. All persons in the space should leave it immediately should the ventilation system fail.
Whilst the space is occupied the atmosphere should be tested periodically. Should there be any deterioration in the conditions all persons should leave immediately.
Work should stop and all persons should leave the space if unforeseen difficulties or hazards occur. The situation should then be reassessed.
If any person working in a space feels in any way adversely affected he should give a pre-arranged signal to the person standing by the entrance and immediately leave the space.
A rescue harness should be worn to facilitate recovery in the event of an accident.
The general (or crew) alarm should be sounded in the event of an emergency, so that immediate back-up can be given to the rescue team.

Additional requirements for entry into a space where the atmosphere is suspect or known to be unsafe

Where the atmosphere is considered suspect or unsafe to enter without breathing apparatus and provided all reasonable attempts at gas-freeing have been carried out, entry may be made if this is essential for testing purposes, the working of the ship, the safety of life or the safety of the ship. The number of persons entering should be the minimum necessary to undertake the work.
Breathing apparatus should always be worn. Respirators must not be used because they do not provide a supply of clean air from a source independent of the atmosphere in the space.
Two air supplies should be available to the wearer of breathing apparatus, except in the case of emergency, or where this is impractical because movement in the space would be seriously impeded. A continuous supply provided from outside the space should normally be used. Should it prove necessary to change over to the self-contained supply, the person should immediately vacate the space.
Precautions should be taken to safeguard the continuity of the outside source of air during occupation of the space by the wearer of breathing apparatus.
Special attention should be given to supplies originating from the engine-room.
A single air supply may be acceptable, where remote testing of the space is not reasonably practicable provided prolonged presence in the space is not required and the person is situated so that he can be hauled out immediately in case of emergency.
A rescue harness should be worn. Lifelines should be used where practicable, and should be attended by a person stationed at the entrance who has received training in how to pull an unconscious person from a dangerous space. If hoisting equipment would be needed to effect a rescue, the availability of persons to operate the equipment in the event of an emergency should be ensured.
Portable lights and other electrical equipment should be of a type approved for use in a flammable atmosphere.
Personal protective equipment should be worn where there is a hazard due to chemicals, in liquid, gaseous or vapour form.
A pre-arranged plan should be drawn up to deal with the rescue of collapsed persons within a dangerous space, which should take into account the design of the individual ship and of the

equipment and manpower on board. The need to allocate personnel to relieve or back-up those first into the space should be considered.

Breathing apparatus

If a person working in the space indicates that he is being affected by the atmosphere, using the agreed communication system, the person stationed by the entrance should immediately raise the alarm. On no account should the person stationed at the entrance to the space attempt to enter it before additional help has arrived. No one should attempt a rescue without wearing breathing apparatus and a rescue harness and, whenever possible, the use of a lifeline.
If air is being supplied through an air-line to the person who has become unwell, an immediate check should be made that his air supply is being maintained at the correct pressure.
An incapacitated person should be removed from the space as quickly as possible, unless he is gravely injured, e.g. a broken back, when essential first-aid treatment should be administered first. The restoration of the casualty's air supply at the earliest possible moment must be the first priority.

Breathing apparatus and resuscitation equipment

Every crew member likely to use breathing apparatus should be instructed in its use by a competent person.
The full, pre-wearing check and donning procedures recommended by the manufacturer should be undertaken by the master, or the responsible officer, and the person about to enter the space. In particular the following should be checked:

- that there will be sufficient clean air at the correct pressure;
- that low pressure alarms are working properly;
- that the face mask fits correctly against the user's face, so that, combined with pressure of the air coming into the mask, there will not be an ingress of oxygen deficient
- air or toxic vapours when the user inhales. It should be noted that facial hair or spectacles may prevent the formation of an airtight seal between a person's face and the face mask;
- that the wearer of the breathing apparatus understands whether or not his air supply may be shared with another person and if so is also aware that such procedures should only be used in an extreme emergency;
- that when work is being undertaken in the space the wearer should keep the self-contained supply for use when there is a failure of the continuous supply from outside the space.

When in a dangerous space:

- no one should remove his own breathing apparatus;
- breathing apparatus should not be removed from a person unless it is necessary to do so to save his life.

Where any person may be required to enter a dangerous space **appropriate resuscitators** should be provided, and if entry is expected to occur at water the vessel should be provided

with the appropriate equipment. If the appropriate equipment has not been provided entry should not take place.

Maintenance of equipment and training

A competent person should maintain and periodically inspect and check for correct operation all breathing apparatus, rescue harnesses, lifelines, resuscitation equipment and any other equipment provided for use in, or in connection with, entry into dangerous spaces or during emergencies. A record should be kept of the inspections and checks. All items of breathing apparatus should be inspected and checked for correct operation before and after use.
Equipment for testing the atmosphere of dangerous spaces should be kept in good working order and, where applicable, regularly serviced and calibrated. The manufacturer's recommendations should be kept with the equipment and should be followed.
Vessel owners should provide crew members with the necessary training, instructions and information on entry into dangerous spaces, which should include:

- recognition of the circumstances and activities likely to lead to the presence of a dangerous atmosphere;
- recognition of the hazards associated with entry into dangerous spaces, and the precautions to be taken;
- the use and proper care of equipment and clothing required for entry into dangerous spaces;
- instructions and drill in rescue from dangerous spaces.

5.

UNDERSTAND ORDERS AND BE UNDERSTOOD IN RELATION TO ON-BOARD DUTIES

COMPETENCES

Follow instructions and communicate with others in term of shipboard duties

Contribute to good social relation and Cooperate with others on board

Dangers of alcohol and drug abuse on board vessel

5.1 Communication with management and others in performing duties

Competence: Follow instructions and communicate with others in term of shipboard duties

Communication is an essential part of human interaction. The benefits of effective communication are many and obvious as they enhance all aspects of our personal and professional lives. Ineffective or misunderstood communications in our personal lives may give rise to problems or embarrassment but in our professional lives the results of misunderstandings may have much more serious results. In the world of international shipping, with crew members from many countries sailing on vessels trading to all parts of the world, effective communication between those on board and between ship and shore is vitally important.

As in all workplaces, the ability of the crew members to contribute to effective communications and teamwork is pivotal to smooth running and safe operations.

Communication is an act of imparting, giving, transmitting and receiving information. Teamwork means working together in an organized and cooperative effort. Effective communications and teamwork therefore requires giving clear and concise information, listening, questioning and receiving feedback that confirms understanding by others to achieve a commonly held purpose or goal.

Communication with the team

Many accidents are found to be due mainly to operational issues of proper procedure, maintenance and design, rather than to proper implementation of regulations but effectiveness of bridge resource management and particularly ineffective relationship between Boatmaster and the crew members are recurrent themes. Communications difficulties often occur in these areas due in part to cultural differences by also to the language barriers.

Communication inside the bridge team

Before the vessel leaves for a voyage the Boatmaster must inform the bridge team about the specific elements of the journey like:

- route plan;
- requirements that must be fulfilled by the bridge team during the voyage;
- discussions about the particularities of the route and identifying the sensible points;
- defining the way of work on the bridge in order to assure the necessary level of safety.

Communication inside the bridge team must be clear. Communication between crew members who talk different languages, especially with inexperienced crew members must be done in a common language.

The advantage of pre-established and generally understood navigation command can be appreciated in this context. The full list of EDINNA Standards inland navigation communications phrases –Riverspeak- is comprehensive.

Participate in group discussions to achieve appropriate work outcomes

The ability of the personnel on board to coordinate their activities and to effectively communicate between them is vital in emergency situations.

Especially for the Boatmaster it is important to be able to communicate efficiently with the crew members whenever it is necessary but in most of the situations it is important for the Boatmaster to be able to transmit his intentions and orders to his crew members, especially in case of emergency. No matter if the vessel is underway or if it is doing an entrance in the port manoeuvre, the crew members must function as an upright team.
A crew team member with a well explained plan by the Boatmaster and in the same time well understood plan, will possess a good response in case of emergency. Where the members of the bridge team are able to anticipate dangerous situations and to recognise the development of an error chain, they will have the capacity of taking the necessary actions for avoiding that certain situation and correcting the committed errors.

If the Boatmaster is making a good schedule of the vessel's voyage, the bridge team will have a better control of the vessel's evolution and will avoid the appearance of unpredicted events due to the configuration of the navigation area. The way that the configuration of the initial plan and applying the emergency one is being done, is related to the experience of the bridge team and of the Boatmaster and the appearance of unpredicted problems. Whenever it is possible, when the voyage is completed successfully, the Boatmaster must discuss with the bridge team about the way the voyage was planned and executed, especially about the observed weak points. This kind of discussions lead to correction of lead to correction of the initial plan and obtaining a better voyage plan that can be used next time for the same route.

5.2 Importance of respect for team work

Competence: Contribute to good social relation and cooperate with others on board

Working in a team
A valuable quality of an organization such as one representing a commercial vessel is given by the team work and this quality is enhanced by the people forming a team recognizing their values, limitations and competencies. At the same time, organisation of work of the bridge must lighten the workload of each member of the team.

Working in a team and free circulation of information professionally encourages development of relations between the bridge team.
Communication on the bridge must be open, with no restrictions caused by the differences of position occupied in the chain of command by the people involved in particular activities. The open communication that must be mainly ensured by the Boatmaster on the bridge but also in other

compartments of the vessel also includes new member's training and familiarization with the elements and particularities of the vessel.
Procedural rules drawn by the Boatmaster must be written and reflect the Boatmster's specific requirements and particular circumstances in which the vessel might find itself, its commercial scope and the bridge team's professional experience. These orders and instructions drawn by the Boatmaster must no enter in conflict with the general rules related to vessel's safety management system. Besides the general procedural order, specific instructions must exist for special circumstances cases.
The Boatmaster's duties regarding taking decisions about vessel's safety and their responsibilities, but also regarding the possibility of taking over crew members' duties when necessary must be clearly stated in the company's safety management system. The Boatmaster must not be forced by the company in any way in taking decisions regarding vessel's safety and safety of navigation, especially in rough weather and rough water conditions.
The bridge team must know very well what they have to report to the Boatmaster in normal conditions of navigation, the requirements regarding complete information of the Boatmaster, but also the circumstances in which the Boatmaster must be called on the bridge. The Boatmaster must clearly state the tasks, and these must be limited to those that can be effectively accomplished and also their priority must be clearly established.
The members of the team must be asked and they have to confirm that they have understood the tasks and responsibilities they have been assigned. Periodical reports of events that occurred during fulfilment of tasks represent one of the best means to monitor performance of members of a bridge team and to detect any degradation in executing the activities on board.

Leadership

Leaders (Boatmasters) can create their own leadership style, according their own personality, but there are several common elements to all the leadership styles that help imposing authority:

- confidence in own taken decisions and actions;
- mistakes acceptance when this is obvious;
- demonstrating respect for others;
- gaining respect through accomplished actions;

An efficient management of the navigation bridge coming from the leader (Boatmaster) means correct use of available human resources and promoting a good communication inside the bridge team. Inexperienced crew members are often concerned that they might be inconveniencing the Boatmaster as Leader by calling him on the bridge. However Boatmasters need to be called as soon as possible if a difficult situation is developing.
Cultural differences represent the fundament of communication and imply development of understanding abilities between different nationalities. Cultural differences become visible when we get in contact with people of different nationalities. This is a situation frequently met on board vessels with multinational crew.

A good leader (Boatmaster) knows how to overcome the difficulties that arise from different cultures of crew members working together. He should first try to understand each culture of crew members on board and then try to work together and create a bond. What it is considered appropriate in one culture could be, most of the times, inappropriate in another culture. Misunderstandings caused by cultural differences appear when a person of a certain culture wants to force his own point of view to another person who belongs to a different culture, with different principles. Wrong interpretation is the main element that appears

whenever we want to force to another person our own concepts. In the absence of good knowledge of the cultural characteristics of another person, it is preferable to have a diplomatic approach of certain aspects that are related to one own's culture.
Every person develops a certain personality in the spirit of the culture he/she comes from. That's why, every time there is an interaction with another culture on board vessel, it is indicated for the Boatmaster, in the first phase, to discover cultural similarities and to obtain the answer for the existent differences.
The growth of cultural awareness means to observe positive aspects but also the negative ones that appear inside the cultural differences. Cultural diversity could represent a source of problems for the leader (Boatmaster) especially in a field like navigation where there is a constant need for collaboration.
Also, cultural diversity could be an advantage if the leader manages to find ways of cultural approach and understanding especially in the scope of development.

5.3 Dangers to safe vessel operation related to alcohol and drugs

Competence: Dangers of alcohol and drug abuse on board vessel

Drug and alcohol abuse and its adverse effects on safety is one of the most significant social problems of our time. It is, appropriately, receiving attention both in the public eye and in government legislation.
The use of alcohol and/or other drugs in general is increasing globally, and the impact of substance abuse can has influence on the workplace.
The management of risk factors including use of alcohol and drugs - illicit, prescriptive and over-the-counter - is a serious issue that extends beyond physical safety to include decision making.

Poor judgement in a high-stakes situation could result in substantial damage to property and the environment, loss of vessels, injury to personnel and even death. When proper judgement is impaired by substance use and key decisions must be made, the risks increase dramatically.

The progression of drug and alcohol use may go unnoticed until a health or safety crisis occurs. However, even the moderate use of drugs or alcohol may cause substantial harm and hazard irrespective of the workplace and regardless of the type of work being performed.
Long-term carelessness and neglect, to which substance abuse may contribute, can result in a steady drop in performance that, over time, may cause greater financial loss than events of a more dramatic and easily identified nature.
Vessel owners/operators and managers cannot therefore afford to ignore any issues that affect productivity.
In any alcohol and drug prevention programme, responsibility for the various tasks and duties needs to be identified. Administrations, international organisations (IGO's), nongovernmental organisations (NGO's), training institutes, shipping communities and organisations, vessel owners/operators, trade unions, managers, manning agencies, masters and crew members all have a role to play and a responsibility to fulfil. All inland naval transport companies and organisations are to be encouraged to develop and institute drug and alcohol abuse prevention programmes as failure to so do could adversely affect the interdependency and relationship that binds such companies and organisations.
The degree of responsibility and involvement of every company and organisation should be determined according to the potential effects of failing to act. From the perspective of an

administration, there is a responsibility to provide guidance and support and enabling legislation. At the other end of the spectrum, vessel's officers and crew have a responsibility to actively participate in any prevention programme that affects the safety of the vessel, their fellow crew members and, of course, themselves.

Responsibilities of government commence with formulation, adoption and promulgation of policies, laws and regulations to protect the health and safety of its citizens and workers, including crew members even though they may be employed outside the country by foreign concerns. Laws and regulations should not only address restrictions and the imposition of penalties but also provisions for assisting persons deemed to be dependent on drugs and alcohol through prevention and rehabilitation programmes

Promoting Prevention through:

- **Health checks and medical examinations**: ensuring checks for drug and alcohol abuse are included in the crew members' medical examination both on initial screening and during crew members' periodic medical checks;
- **Training & education**: provide the support, guidance and expertise to assist the development of schemes to prepare trainers, the application of training and the education of crew members and shore workers in the effects, symptoms and results of drug and alcohol abuse;
- **Promoting and raising the profile of prevention**: coordinate accident reports and provide risk assessment data and other information that may be used by the country's naval transport industry to raise the profile of the subject and to promote the dangers posed by drug and alcohol abuse;
- **Setting safety limits**: prescription of a maximum blood alcohol level for crew members as a minimum safety standard and any other prohibitions on the consumption of drugs, including prescribed medications, or alcohol that can impair the ability of crew members or those on board engaged in safety sensitive operations;
- **Provision of rehabilitation services**: provide rehabilitation services for those crew members diagnosed as having or who have acknowledged a drug or alcohol abuse problem;
- **Non-discrimination**: develop and introduce legislation that ensures rehabilitated crew members, following an individual's successful completion of an approved treatment programme, are not discriminated against by employers;
- **Declaring drug and alcohol abuse to be a medical condition**: encourage those with drug and alcohol abuse problems to seek assistance thereby reducing health and safety risks to fellow seafarers on board ships;
- Focal point: to act as a focal point for industry and to express and share the national views/experiences gained from prevention programmes at international level.

A comprehensive, company-wide alcohol and drug abuse programme should cover all employees including management and address all actions and activities related to drugs and alcohol. Creating a comprehensive programme for any company engaged in ship operations is a great challenge that needs to take into account vessel ownership, flag state registration requirements, management issues, working environment, personnel issues, cultural variations and cost. The long-term sustainability of a programme will be enhanced by, and its success may depend on, integration into other health or medical programmes or on-going safety systems such as a company's safety and environmental management system.

Support for a new alcohol and drug abuse prevention programme has to come from top management irrespective where in the organisation the need is identified. An alcohol and drug abuse prevention programme designed to promote the health and safety of employees will not succeed without management and senior shore and Boatmaster' commitment to the programme. Employees must also accept the need to change as they learn new ways of thinking and doing.

6.

PERSONAL PROTECTIVE EQUIPMENT

COMPETENCE

Use personal protective equipment

to prevent accidents

6.1 Personal protective equipment

6.1.1 General requirements

Risks to the health and safety of crew members must be identified and assessed. It will often not be possible to remove all risks, but attention should be given to control measures that will make the working environment and working methods as safe as reasonably practicable.
Personal protective equipment must be used only when risks cannot be avoided or reduced to an acceptable level by safe working practices. This is because personal protective equipment does nothing to reduce the hazard and can only protect the person wearing it, leaving others vulnerable.
Controls should be chosen taking into account various factors. In order of effectiveness these are:

- elimination;
- substitution by something less hazardous and risky;
- enclosure (enclose the hazard in a way that eliminates or controls the risk);
- guarding/segregation of people;
- safe system of work that reduces the risk to an acceptable level;
- written procedures that are known and understood by those affected;
- reviewing the blend of technical and procedural control;
- adequate supervision;
- identification of training needs;
- information/instruction (signs, hand-outs); and
- PPE (last resort) – cannot be controlled by any other means.

It should be noted that the use of personal protective equipment may in itself cause a hazard, e.g. through reduced field of vision, loss of dexterity or agility.
The Company must ensure that crew members are provided with suitable personal protective equipment where it is needed.
The Company should assess the equipment required to ensure that it is suitable and effective for the task in question, and meets the appropriate standards of design and manufacture.

6.1.2 Suitable equipment

Suitable equipment should:

- be appropriate for the risks involved, and the task being performed, without itself leading to any significant increased risk;
- fit the crew member correctly after any necessary adjustment;
- take account of ergonomic requirements and the seafarer's state of health; and
- be compatible with any other equipment that the seafarer has to use at the same time, so that it continues to be effective against the risk.

The Company must also ensure that PPE is regularly checked and maintained or serviced. Records should be maintained of servicing and any repair required and carried out.
All crew members required to use protective equipment must be properly instructed and trained in its use. This should include being advised of its limitations and why it is needed. A record should be kept of who has received training.
Defective or ineffective protective equipment provides no defence. It is therefore essential that the correct items of equipment are selected and that they are properly maintained at all times. The manufacturer's instructions should be kept safe with the relevant apparatus and, if necessary, referred to before use and when maintenance is carried out. Personal protective equipment should be kept clean and should be disinfected as and when necessary for health reasons.

A competent person should inspect each item of protective equipment at regular intervals and in all cases before and after use. All inspections should be recorded. Equipment should always be properly stowed in a safe place after use.

6.1.3 Crew members' duties

Crew members must wear the protective equipment or clothing supplied when they are carrying out a task for which it is provided, and follow appropriate instructions for use.
Personal protective equipment should always be checked by the wearer each time before use.
Crew members should comply with the training they have received in the use of protective items, and follow the manufacturer's instructions for use.

6.1.4 Types of equipment

Overalls, gloves and suitable footwear are the proper working dress for most work about vessel but these may not give adequate protection against particular hazards in particular jobs.
Personal protective equipment must always be selected according to the hazard being faced and the kind of work being undertaken, in accordance with the findings of the risk assessment.
Personal protective equipment can be classified as follows:

Type	Examples
Head protection	Safety helmets, bump caps, hair protection
Hearing protection	Earmuffs, earplugs
Face and eye protection	Goggles and spectacles, facial shields
Respiratory protective equipment	Dust masks, respirators, breathing apparatus
Hand and foot protection	Gloves, safety boots and shoes
Body protection	Safety suits, safety belts, harnesses, aprons, high visibility clothing
Protection against drowning	Lifejackets, buoyancy aids and lifebuoys
Protection against hypothermia	Immersion suits and anti-exposure suits

6.2 Use personal protective equipment

6.2.1 Head protection

Helmet

Helmets may be designed for different purposes. A helmet designed to provide protection from objects falling from above may not be suitable for protecting crew members from chemical splashes. Thus, it may be necessary to carry different types of helmets on particular ships.

In general, the shell of a helmet should be of one-piece construction, with an adjustable cradle inside to support the helmet on the wearer's head and,

where appropriate, a chin-strap to prevent the helmet from falling off.
The cradle and chin-strap should be properly adjusted as soon as the helmet is put on to ensure a snug fit.

6.2.2 Hearing protection

Crew members who, by the nature of their duties, are exposed to high levels of noise such as those working in machinery spaces, should be provided with and should wear ear protectors.
Various types of hearing protectors are available for shipboard use, including ear plugs and ear muffs, each of which may be of different design standards. Protectors should be of a type recommended as suitable for the particular circumstances and climatic conditions.
In general, ear muffs give the most effective protection.
Hearing protectors should be made available at the entrance to the machinery space.


Hearing protectors

6.2.3 Face and eye protection


Face protection


Eye protection

Face and eye protectors are available in a wide variety of designs. Careful consideration should be given to the characteristics of the respective hazard to ensure the selection of the appropriate protector.
Ordinary prescription (corrective) spectacles, unless manufactured to a safety standard, do not afford protection. Certain box-type goggles are designed so that they can be worn over ordinary spectacles.

6.2.4 Respiratory protective equipment

Appropriate respiratory protective equipment should be provided for work in conditions where there is a risk of oxygen deficiency or exposure to poisonous, dangerous or irritating fumes, dust, or gases.

The selection of correct equipment is essential. Since there is a wide variety of equipment available for shipboard use, advice should be sought on the appropriate equipment for use on particular ships and for particular purposes.
Crew members should be trained in the use and care of equipment.
The face-piece incorporated in respirators and breathing apparatus must be fitted correctly to prevent leakage. The wearing of spectacles, unless adequately designed for the purpose, or beards and whiskers are likely to interfere with the face seal.

Respiratory equipment

6.2.5 Hand and foot protection

Gloves

Gloves should give protection from the particular hazard of the work being carried out and must be appropriate to that type of work. For example, leather gloves are generally better for handling rough or sharp objects, heat-resistant gloves for handling hot objects, and rubber, synthetic or PVC gloves for handling acids, alkalis, various types of oils, solvents and chemicals.
All crew members at work should wear appropriate safety footwear. Shoes and boots should have firm, slip-resistant soles and reinforced toecaps. Sandals and similar footwear should not be worn when working.

Safety footwear

6.2.6 Protection from falls

Crew members working aloft, over the side, or where there is a risk of falling, should wear a safety harness attached to a lifeline.

6.2.7 Body protection

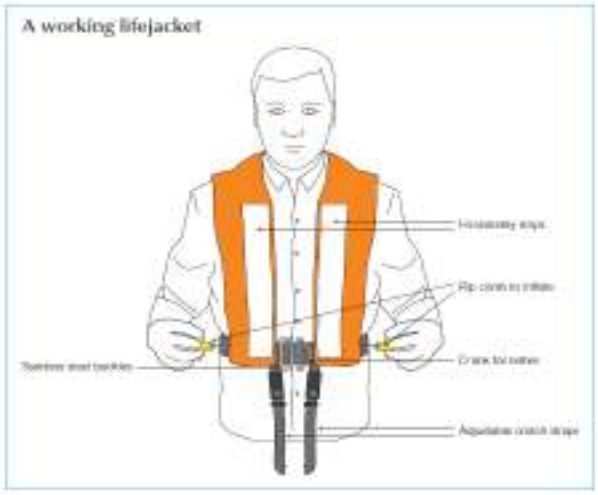
Body protection

Special outer clothing may be needed for protection when personnel are exposed to particular contaminating or corrosive substances. This clothing should be kept for the particular purpose and dealt with as directed in the relevant sections of this Code.

Employees who face possible body injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs.
There are many varieties of protective clothing available for specific hazards. Employers are required to ensure that their employees wear personal protective equipment only for the parts of the body exposed to possible injury.
High-visibility clothing should be worn when it is important to be seen to be safe, e.g. during loading and unloading operations.

6.2.8 Protection against drowning

Where work is being carried out over side or in an exposed position where there is a reasonably foreseeable risk of falling or being washed overboard, or where work is being carried out in or from a ship's boat, a lifebuoy with sufficient line should be provided. In addition and, as appropriate, a working lifejacket, a personal flotation device or a buoyancy aid should be worn. Where necessary, personnel should be provided with thermal protective clothing to reduce the risks of cold shock.



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MODULE II

Interreg
Danube Transnational Programme
Danube SKILLS

Project co-funded by European Union funds (ERDF, IPA)

TRAIN THE TRAINER

- MEDICAL FIRST AID -

Table of Contents

1. INTRODUCTION

This course compendium was designed both for trainers who will be involved in training of such training module and the trainees as learning aids in order to facilitate the learning process.
This course compendium aims to assist in the implementation of the new European Directive on the recognition of professional qualifications in inland navigation and in meeting the requirements of the Standards of competences for inland navigation personnel- Operational level that will be part of this legislative act.
The main objective of this course compendium is to provide practical guidance for trainers and trainees to administer medical first aid and to be able to apply true emergency measures on board the vessels and decide when treatment can be safely delayed until more skilled personnel arrive.

2. LEARNING OUTCOMES

By the end of this course, trainees will be able to assess if:

- manner and timing of raising the alarm is appropriate to the circumstances of the accident or medical emergency;
- identification of probable cause, nature and extent of injuries, prompt and complete and the priority and sequence of actions is proportional to any potential threat to life;
- it minimizes the risk of further harm to self and casualty at all times.

3.

SAFETY INTERVENTIONS IN EMERGENCIES SITUATIONS ACCORDING TO APPLICABLE INSTRUCTIONS AND PROCEDURES

COMPETENCE

Act in the case of emergencies according to applicable instructions and procedures

3.1 General provisions

Crew members should be informed of the location to which they must go on hearing the emergency signal and of their duties when they arrive at that station. The location should be well marked.
The Boatmaster should ensure that a muster list is compiled and kept up to date and that copies are displayed in conspicuous places throughout the vessel. The muster list should contain details of the general alarm signal and other emergency signals and the action to be taken when such signals are activated. The means by which the order to abandon ship is given should also be included. The muster list should indicate the individual duties of all personnel on board and all crew members should be given written details of their own duties.
All crew members concerned should muster at a drill wearing the appropriate clothing.
The purpose of drills is to familiarize personnel with their respective duties and to ensure that they can carry out those duties in an appropriate manner. Each crew member should participate in drills in accordance with national and international requirements.
The timing of drills should be varied to ensure that crew members who because of their duties have not taken part in a particular drill may participate in the next drill.
Crew members should receive training as soon as possible, if possible before joining the vessel, to ensure that there is no period of time when the crew member is incapable of carrying out safety-related responsibilities.
Drills often involve the whole crew but it might be preferable to confine certain drills to crew members with specific tasks.
Although drills are an essential part of emergency training, a training scheme should consist of more than just drills. Information should be given to the entire crew on saving life and instructions provided to certain crew members on the use of particular items of equipment.

3.2 Types of emergencies

- Fire-fighting
- Abandon ship
- Man overboard

3.3 Applicable procedures in case of an accident

The investigation of accidents and incidents plays a very important role in safety.
The Boatmaster is responsible for the statutory reporting of accidents and dangerous occurrences covered by the regulations.
The points to look out for will depend on the circumstances. For example, after an incident/accident one of the most important things is to administer medical first aid to the injured persons.
When a vessel is on voyage, it is often difficult to get a doctor on board or to transport the ill or injured person ashore. The success of the treatment depends on the medical know-how and treatment facilities on board.
The Boatmaster is officially responsible for the treatment given on board. In practice, the person in charge is the Boatmaster himself or a person appointed by him. International regulations and instructions determine the crews' level of medical training. In addition, the vessel has a medical chest and the necessary medical equipment.
It is crucial that the person in charge of treatment on board is capable of recognizing the patients' symptoms and of following the patients' condition.

First aid is the treatment aimed at preventing the death or further damage to health of an ill or injured person perceived to be in a life-threatening condition.

Certain conditions, such as severe bleeding or asphyxiation, require immediate treatment if the patient is to survive. In such cases, even a few seconds delay might mean the difference between life and death. However, the treatment of most injuries or other medical emergencies may be safely postponed for the few minutes required to locate a crew-member skilled in first aid, or to locate suitable medical supplies and equipment.

All crew members should be prepared to administer first aid. They should have sufficient knowledge of first aid to be able to apply true emergency measures and decide when the treatment can be safely delayed until more skilled personnel arrive. Those not properly trained must recognize their limitations. Procedures and techniques beyond the rescuers' ability should not be attempted. More harm than good might result.

Emergency first aid must be started immediately at the scene. The first aid procedures are the same in the case of an accident and an attack of illness.

4.

MEDICAL FIRST AID ON BOARD OF THE VESSEL

COMPETENCE

Perform medical first aid

4.1 Emergency first aid procedures

Emergency first aid procedures consist of the following:

- assessment of the situation and rescuing the victim from danger;
- securing breathing;
- securing circulation;
- stopping bleeding and treatment of shock.

When the situation has been stabilized, the actual treatment and the possible transportation of the patient to shore for further treatment can be started. On arrival at the scene, a rapid evaluation of what has happened must be made. If the dangerous situation continues, the patient must be rescued from it. The helper must at all times make sure that he/she is not in danger to himself/herself (electric shock, gas, fire, etc.).

First aid administration must be started immediately when it is safe to do so. The patients' own breathing is assessed and mouth-to-mouth respiration started, if necessary. If the patients' heart is not beating, cardiac massage is started.

A breathing patient is placed on his/her back, and an unconscious patient on his/her side. It must be ensured that the lungs are getting oxygen, the respiratory tract is open and the pulse can be felt. External bleeding must be stopped.

When the patient is no longer in imminent danger, he/she is examined more carefully, his/her wounds are bound more carefully, and fractures are supported. The patient is protected and settled as comfortable as possible. Any necessary further medical treatment is initiated, and the patients' condition is monitored constantly, and, if necessary, his/her transportation to shore is arranged.

Priorities

On finding a casualty:

- look to your own safety, do not become the next casualty;
- if necessary, remove the casualty from danger or remove danger from casualty

(but see observation below on a casualty in an enclosed space). If there is only one unconscious or bleeding casualty (irrespective of the total number of casualties), give immediate treatment to that casualty only, and then send for help.

If there is more than one unconscious or bleeding casualty:

- send for help;
- then start giving appropriate treatment to the worst casualty in the following order of priority: severe bleeding; stopped breathing/heart; unconsciousness.

If the casualty is in a space, do not enter the enclosed space unless you are a trained member or a rescue team acting under instructions. Send for help and inform the Boatmaster.

It must be assumed that the atmosphere in the space is hostile. The rescue team must not enter unless wearing breathing apparatus which must also be fitted to the casualty as soon as possible. The casualty must be removed quickly to the nearest safe adjacent area outside the enclosed space unless his injuries and the likely time of evacuation make some treatment essential before he can be moved.

4.2 Structure and functions of the human body

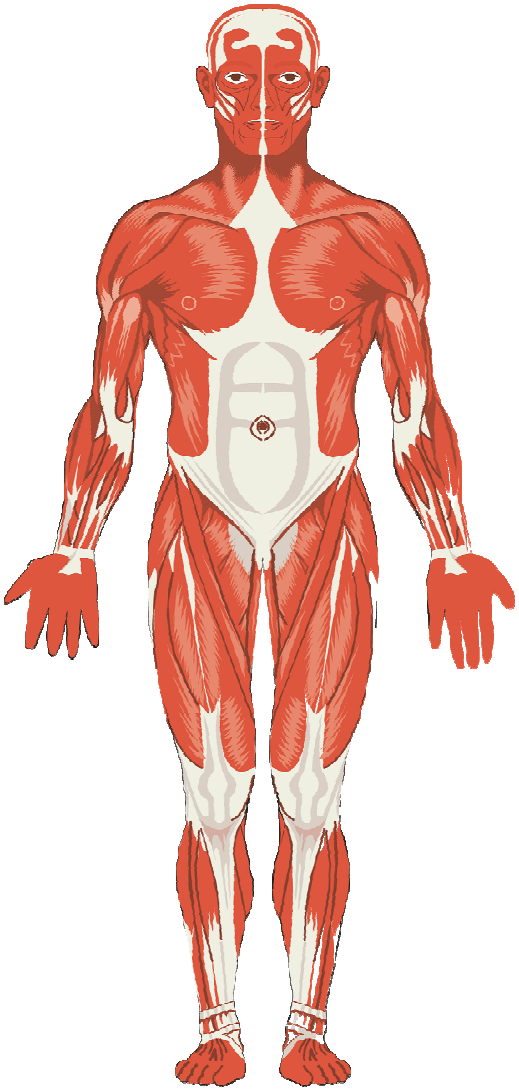
Giving proper medical treatment and examining sick or injured persons appropriately requires basic knowledge of the location and functioning of the human body.

Musculoskeletal system

The musculoskeletal system consists of the bones and the joints that connect them, as well as the

muscles. The bones of the extremities are so-called long bones; the skull and the bones of the chest and pelvis are so-called flat bones. Bones are surrounded by a tight bone membrane, under which lies the actual hard bone surface. The bone is living tissue, which self-repairs after an injury by forming new bone under the bone membrane. The bone marrow is softer and more porous than the surface bone. New blood cells are formed in the marrow.

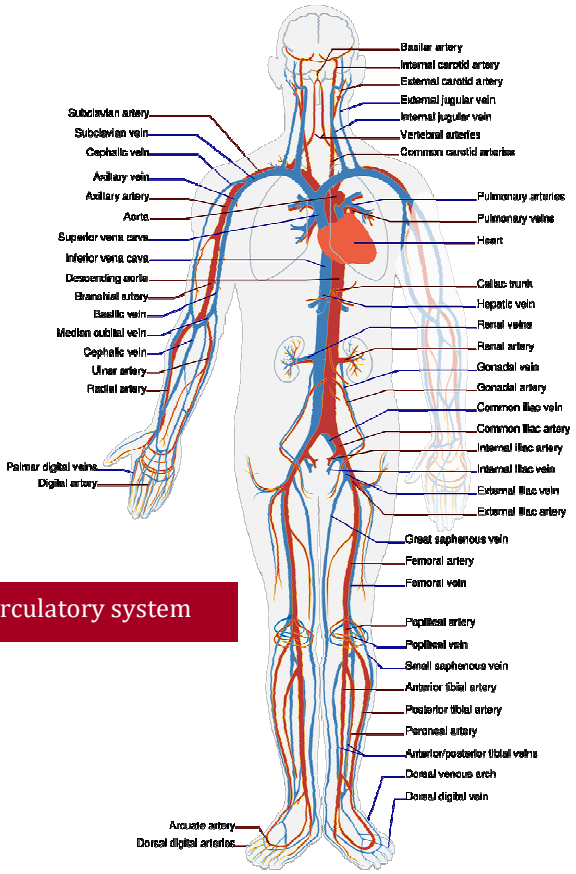
Skeletal system



Muscular system

Circulatory system

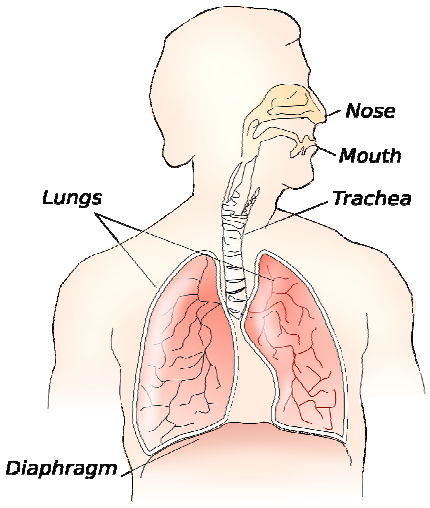
The heart, arteries and veins form the circulatory system. The heart pumps blood to all organs through the arteries, and the blood returns to the heart through the veins.



Circulatory system

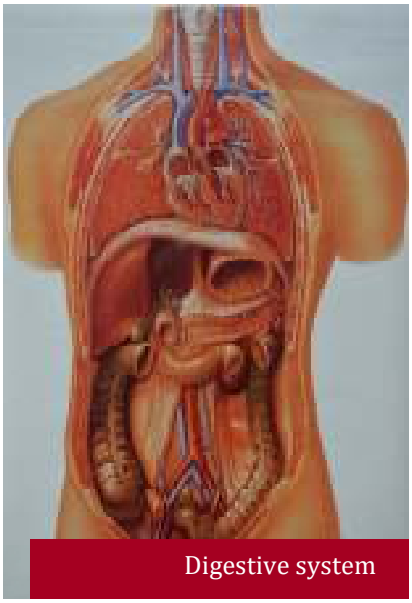
Respiratory system

The respiratory system consists of the nose, mouth, pharynx, larynx, trachea, the bronchi, two lungs and diaphragm.



Respiratory system

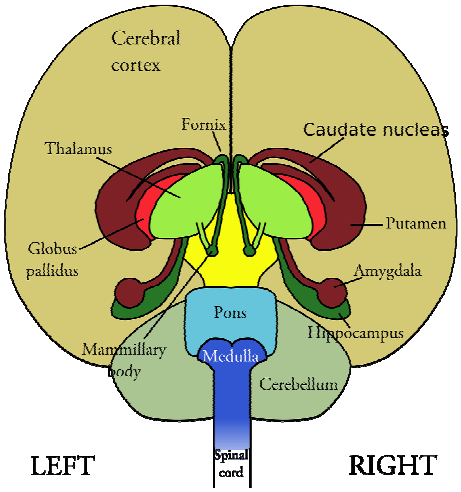
Digestive system



Digestive system

The digestive system consists of the gastrointestinal tract, the esophagus, stomach, small intestine, large intestine, rectum and anus, as well as the teeth, tongue, salivary glands, liver and pancreas.

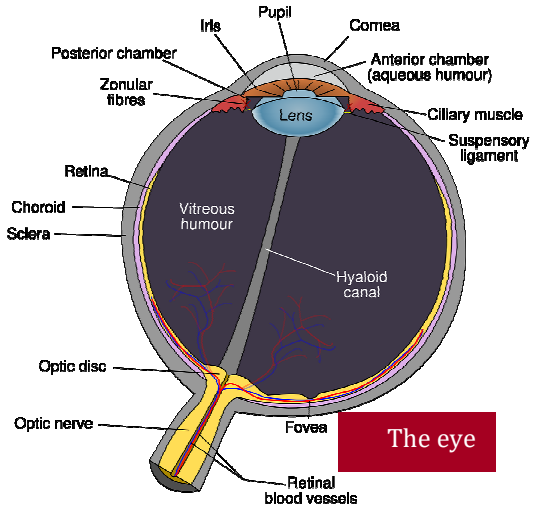
Nervous system



Nervous system

The nervous system consists of the central nervous system (CNS), i.e., the brain and the spinal cord, and the peripheral nerves that radiate from it.

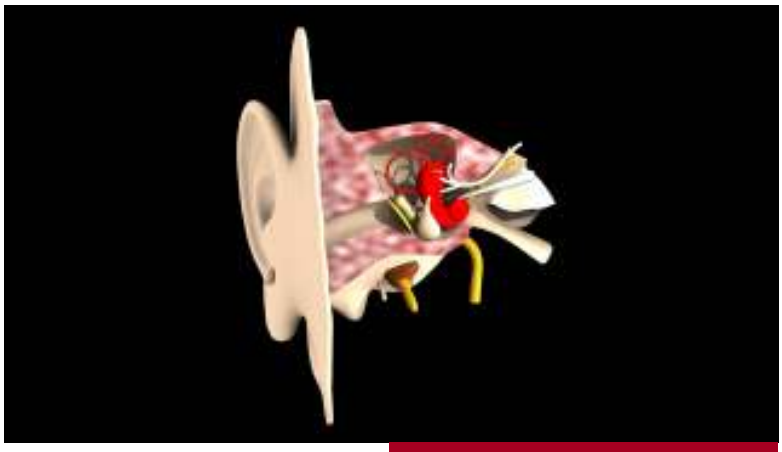
The eye



The eye

The eye is a ball about 2.5 cm in diameter, surrounded by the white sclera. The transparent cornea is situated in the anterior part of the eye.

The ear

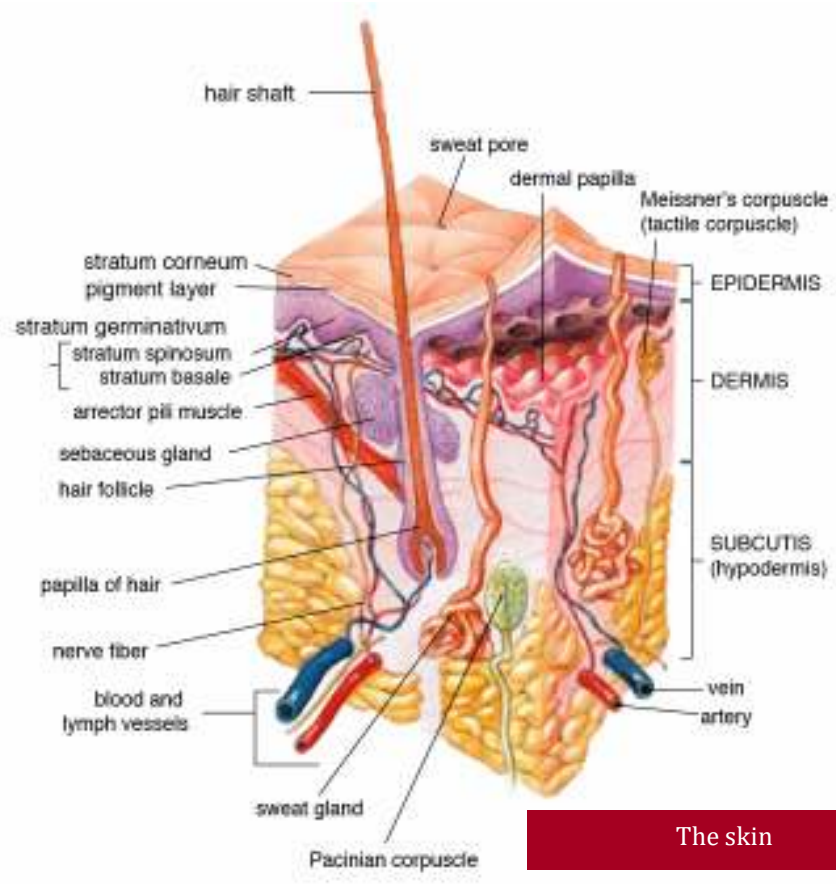


The ear

The outer ear consists of the external ear (auricle) and the external auditory canal.

The skin

The skin is composed of two layers: the epidermis, or outer layer, which is covered by the "horny layer" (stratum corneum), and dermis, or lower layer.



The skin

4.3 General principles of first aid aboard vessel

First aid must be administered immediately to:

- restore breathing and heart-beat;
- control bleeding;
- remove poisons;
- prevent further injury to the patient (for instance, his removal from a room containing carbon monoxide or smoke).

A rapid, emergency evaluation of the patient should be made immediately at the scene of the injury to determine the type and extent of the trauma. Because every second may count, only the essential pieces of the patients clothing should be removed.
In case of injured limb, get the sound limb out of clothing first, and then peel the clothes of the injured limb. If necessary, cut clothes to expose the injured part.
Keep workers from crowding round.
The patients' pulse should be taken. If it cannot be felt at the wrist, it should be felt at the carotid artery at the side of the neck.
If there is no pulse, heart compression and artificial respiration must be started.
The patient should be treated for shock, if the pulse is weak and rapid, or the skin pale, cold, and possibly moist, with an increased rate of shallow, irregular breathing.
Remember that shock can be a great danger to life, and its prevention is one of the main objectives of first aid.
The patient should be kept in the position that best provides relief from his injuries. Usually this is a lying-down position, which increases circulation of the blood to the head.
The patient should be observed for type breathing and possible bleeding. If he is not breathing, artificial respiration must be given.
Severe bleeding must be controlled.
During this time, the patient, if conscious, should be reassured and told that all possible help is being given. The rescuer should ask about the location of any painful areas.
The patient should be kept in a lying-down position and moved only when absolutely necessary.
The general appearance of the patient should be observed, including any signs and symptoms that may indicate a specific injury or illness.
The patient should not be moved if injuries of the neck or spin are suspected. Fractures should be splinted before moving a patient. No attempt should be made to set a fracture.
Wounds and most burns should be covered to prevent infection.
Once life-saving measures have been started or deemed not necessary, the patient should be examined more thoroughly for other injuries.
The patient should be covered to prevent loss of body heat.
If necessary, protect him also from heat.
The patient should not be given alcohol in any form.
Never underestimate and do not treat as being minor injuries such as:

- unconsciousness;
- suspected internal bleeding;
- stab or puncture wounds;
- wounds near joints;
- possible fractures;
- eye injuries.

Never consider anyone to be dead, until you and others agree that:

- no pulse can be felt, and no sounds are heard when the examiner's ear is put to the chest;
- breathing has stopped;
- the eyes are glazed and sunken;

- there is progressive cooling of the body (this may not apply if the surrounding air temperature is close to normal body temperature).

4.4 Measures to be taken in case of emergency

4.4.1 Unconscious casualties

The sequences of steps for the initial assessment and treatment of the unresponsive victim are:

- Unresponsive and not breathing normally;
- Call Emergency Services- EMS;
- Give 30 chest compressions;
- Continue CPR 30:2;
- As soon as AED (Automated External Defibrillator) arrives, switch it on and follow instructions.

The sequence of steps takes the reader through recognition of cardiac arrest, calling EMS, starting CPR and using AED.

SEQUENCE / Action		Technical description
SAFETY **Make sure you, the victim and any bystanders are safe**		
RESPONSE **Check the victim for a response**		Gently shake his shoulders and ask loudly: "Are you all right?" If he responds leave him in the position in which you find him, provided there is no further danger; try to find out what is wrong with him and get help if needed; reassess him regularly
AIRWAY **Open the airway**		Turn the patient onto his back if necessary Place your hand on his forehead and gently tilt his head back; with your fingertips under the point of the victim's chin, lift the chin to open the airway
BREATHING **Look, listen and feel for normal breathing**		In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent, slow and noisy gasps. Do not confuse this with normal breathing. Look, listen and feel for **no more** than 10 seconds to determine whether the victim is breathing normally. If you have any doubt whether breathing is normal, act as if it is they are not breathing normally and prepare to start CPR
UNRESPONSIVE AND NOT BREATHING NORMALLY **Alert emergency services**		Ask a helper to call the emergency services (112) if possible otherwise call them yourself Stay with the victim when making the call if possible Activate speaker function on phone to aid communication with dispatcher
SEND FOR AED **Send someone to get AED**		Send someone to find and bring an AED if available. If you are on your own, do not leave the victim, start CPR

CIRCULATION

Start chest compressions

Kneel by the side of the victim

Place the heel of one hand in the centre of the victim's chest; (which is the lower half of the victim's breastbone (sternum))

Place the heel of your other hand on top of the first hand

Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs

Keep your arms straight

Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone)

Position yourself vertically above the victim's chest and press down on the sternum approximately 5 cm (but not more than 6 cm)

After each compression, release all the pressure on the chest without losing contact between your hands and the sternum

Repeat at a rate of 100-120 min^{-1}

IF TRAINED AND ABLE

Combine chest compressions with rescue breaths

After 30 compressions open the airway again using head tilt and chin lift

Pinch the soft part of the nose closed, using the index finger and thumb of your hand on the forehead

Allow the mouth to open, but maintain chin lift

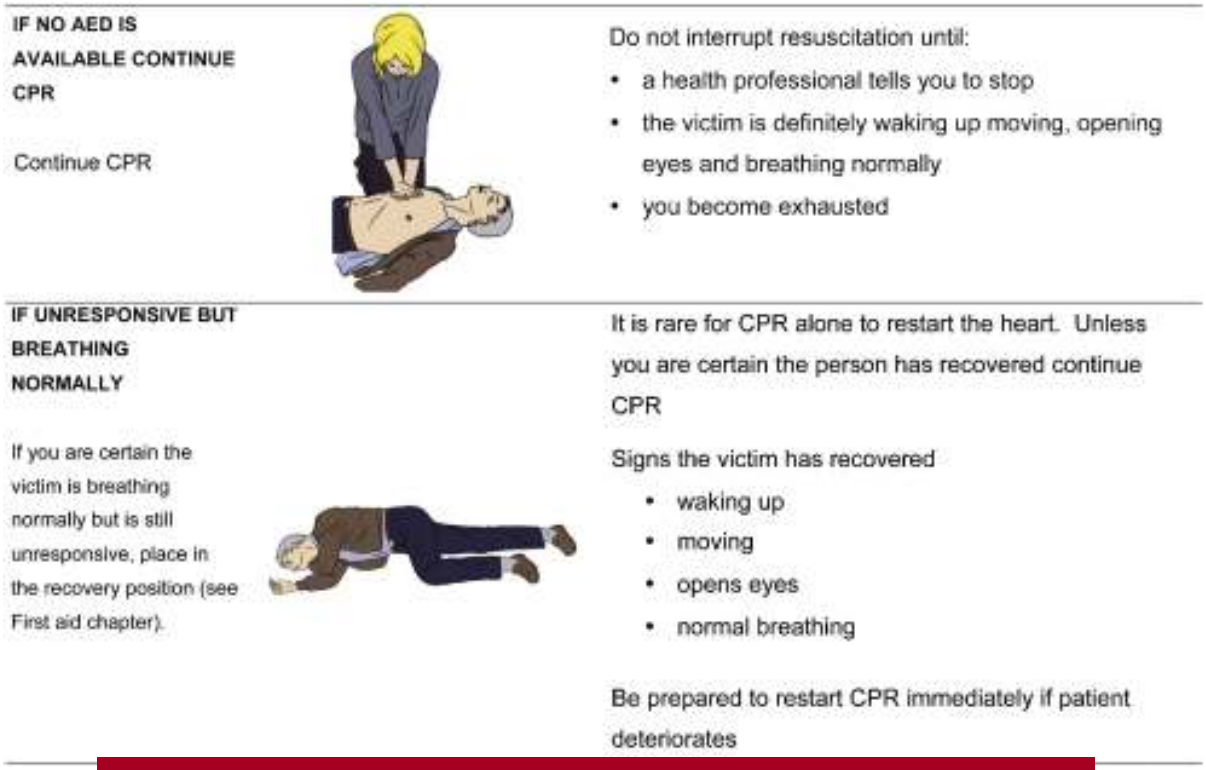
Take a normal breath and place your lips around his mouth, making sure that you have a good seal

Blow steadily into the mouth while watching for the chest to rise, taking about 1 second as in normal breathing; this is an effective rescue breath

Maintaining head tilt and chin lift, take your mouth away from the victim and watch for the chest to fall as air comes out

Take another normal breath and blow into the victim's mouth once more to achieve a total of two effective rescue breaths. Do not interrupt compressions by more than 10 seconds to deliver two breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions

		Continue with chest compressions and rescue breaths in a ratio of 30:2
IF UNTRAINED OR UNABLE TO DO RESCUE BREATHS **Continue compression only CPR**		Give chest compressions only CPR (continuous compressions at a rate of 100-120 min^{-1})
WHEN AED ARRIVES **Switch on the AED and attach the electrode pads**		As soon as the AED arrives: Switch on the AED and attach the electrode pads on the victim's bare chest If more than one rescuer is present, CPR should be continued while electrode pads are being attached to the chest
Follow the spoken/visual directions		Ensure that nobody is touching the victim while the AED is analysing the rhythm
If a shock is indicated, **deliver shock**		Ensure that nobody is touching the victim Push shock button as directed (fully automatic AEDs will deliver the shock automatically) Immediately restart CPR 30:2 Continue as directed by the voice / visual prompts
If no shock is indicated, continue CPR		Immediately resume CPR. Continue as directed by the voice/visual prompts



Step-by-step sequence of actions for use by the Basic Life Support

In the above figure is presents the detailed step-by-step sequence for the trained provider. It continues to highlight the importance of ensuring rescuer, victim and bystander safety. Calling for additional help (if required) is incorporated in the alerting emergency services step. For clarity the algorithm is presented as a linear sequence of steps. It is recognized that he early steps of checking response, opening the airway, checking for breathing and calling the emergency medical dispatcher may be accomplished simultaneously or in rapid succession.

4.4.2 Supplemental information for the key steps

Opening the airway and checking for breathing

The trained provider should assess the collapsed victim rapidly to determine if they are responsive and breathing normally.

Open the airway using the head tilt and chin lift technique whilst assessing whether the person is breathing normally. Do not delay assessment by checking for obstructions in the airway. The jaw thrust and finger sweep are no longer recommended for the lay provider. Check for breathing using the technique described in the above figure noting the critical importance of recognizing agonal breathing.

Agonal breathing is the medical term for the gasping that people do when they're struggling to breathe because of cardiac arrest or other serious medical emergency. The desperate gasping for air is usually a symptom of the heart no longer circulating oxygenated blood, or there is an interruption of lung activity that is reducing oxygen intake. It can often signal that death is imminent.

If you see someone struggling to breath, call your local emergency medical services immediately.

Agonal breathing may occur with cardiac arrest or a stroke. So it's possible the person may lose consciousness while gasping. Stroke symptoms include:

- weakness on one side of the body;

- lack of coordination;
- poor speech or an inability to understand speech;
- a sudden headache.

Alerting emergency services

112 is the European emergency phone number, available everywhere in the EU, free of charge. It is possible to call 112 from fixed and mobile phones to contact any emergency service: an ambulance, the fire brigade or the police. Some European countries provide an alternative direct access number to emergency medical services, which may save time. Bystanders should therefore follow national guidelines on the optimal phone number to use.

Early contact with the emergency services will facilitate dispatcher in the recognition of cardiac arrest, telephone instruction on how to perform CPR, emergency medical service/first responder dispatch, and on locating and dispatching of an AED.

If possible, stay with the victim while calling the emergency services. If the phone has a speaker facility switch it to speaker as this will facilitate continuous dialogue with the dispatcher including (if required) CPR instructions. It seems reasonable that CPR training should include how to activate speaker phone. Additionally bystanders may be used to help call the emergency services.

Starting chest compression

In adult needing CPR, there is a high probability of a primary cardiac cause. When blood flow stops after cardiac arrest, the blood in the lungs and arterial system remains oxygenated for some minutes. To emphasize the priority of chest compression, it is recommended that CPR should start with chest compression rather than initial ventilations. Manikin studies indicate that this is associated with a shorter time to commencement of CPR.

When providing manual chest compression:

1. Deliver compressions' in the centre of the chest;
2. Compress to a depth of at least 5 cm but not more than 6 cm;
3. Compress the chest at a rate of 100-120 compressions/min with as few interruptions as possible;
4. Allow the chest to recoil completely after each compression; do not lean on the chest.

Hand position

Experimental studies show better hemodynamic responses when chest compressions are performed on the lower half of the sternum. It is recommended that this location be taught in a simplified way, such as "place the heel of your hand in the centre of the chest with the other hand on top". This instruction should be accompanied by a demonstration of placing the hands on the lower half of the sternum.

Chest compressions are most easily delivered by a single CPR provider kneeling by the side of the victim, as this facilitates movement between compressions and ventilations with minimal interruptions. Over-the-head CPR for single CPR providers and straddle-CPR for two CPR providers may be considered when it is not possible to perform compressions from the side, for example when the victim is in a confined space.

Compression depth

Fear of doing harm, fatigue and limited muscle strength frequently result in CPR providers compressing the chest less deeply than recommended. Four observational studies, published after 2010 Guidelines, suggest that a compression depth range of 4.5-5.5 cm in adults leads to better outcomes than all other compression depths during manual CPR.

The ERC (European Resuscitation Council) endorses the ILCOR (International Liaison Committee on Resuscitation) recommendations that it is reasonable to aim for a chest compression of approximately 5 cm but not more than 6 cm in the average sized adult. In making this recommendation the ERC recognizes that it can be difficult to estimate chest compression depth and, compressions that are too shallow are more harmful than compressions that are too deep. The ERC therefore decided to retain the 2010 guidance that chest compressions should be at least 5 cm but not more than 6 cm. Training should continue to prioritise achieving adequate

compression depth.

Compression rate

Chest compression rate is defined as the actual rate of compressions being given at any one time. It differs from the number of chest compressions in a specific time period, which takes account of any interruptions in chest compressions.

The ERC recommends, therefore, that chest compressions should be performed at a rate of 100-120 compressions/min.

Minimizing pause in chest compressions

Delivery of rescue breath, shocks, ventilations and rhythm analysis lead to pauses in chest compressions. Pre-and post-shock pauses of less than 10 s, and chest compression fraction >60% are associated with improved outcomes. Pauses in chest compressions should be minimized, by ensuring CPR providers work effectively together.

Firm surface

CPR should be performed on a firm surface whenever possible. Air-filled mattresses should be routinely deflated during CPR. The evidence of use the back-boards is equivocal. If the back-board is used, take care to avoid interrupting CPR and dislodging intravenous lines or other tubes during board placement.

Chest wall recoil

Leaning on the chest preventing full chest wall recoil is common during CPR. Allowing complete recoil of the chest after each compression results in better venous return to the chest and may improve the effectiveness of CPR. CPR providers should, therefore, take care to avoid leaning after each chest compression.

Duty cycle

Optimal duty cycle (ratio of the time chest is compressed to the total time from one compression to the next) has been studied in animal models and simulation studies with inconsistent results. A recent human observational study has challenged the previously recommended duty cycle of 50:50 by suggesting compression phases >40% might not be feasible, and may be associated with decreased compression depth. For CPR providers, the duty cycle is difficult to adjust, and is largely influenced by other chest compression parameters. In reviewing the evidence, the ERC acknowledges there is very little evidence to recommend any specific duty cycle and, therefore, insufficient new evidence to prompt a change from the currently recommended ratio of 50%.

Feedback on compression technique

The use of CPR feedback and prompt devices during CPR in clinical practice is intended to improve CPR quality as a means of increasing the chances of ROSC (Return of Spontaneous Circulation) and survival. The forms of feedback include voice prompts, metronomes, visual dials, numerical displays, waveforms, verbal prompts and visual alarms.

The use of CPR feedback or prompt devices during CPR should only be considered as part of a broader system of care that should include comprehensive CPR quality improvement initiatives, rather than as an isolated intervention.

Rescue breaths

In non-paralysed, gasping pigs with unprotected, unobstructed airways, continuous-chest-compression CPR without artificial ventilation resulted in improved outcome. Gasping may be present early after the onset of cardiac arrest in about one third of humans, thus facilitating gas exchange.

During CPR, systemic blood flow, and thus blood flow to the lungs, is substantially reduced, so lower tidal volumes and respiratory rates than normal can maintain effective oxygenation and ventilation.

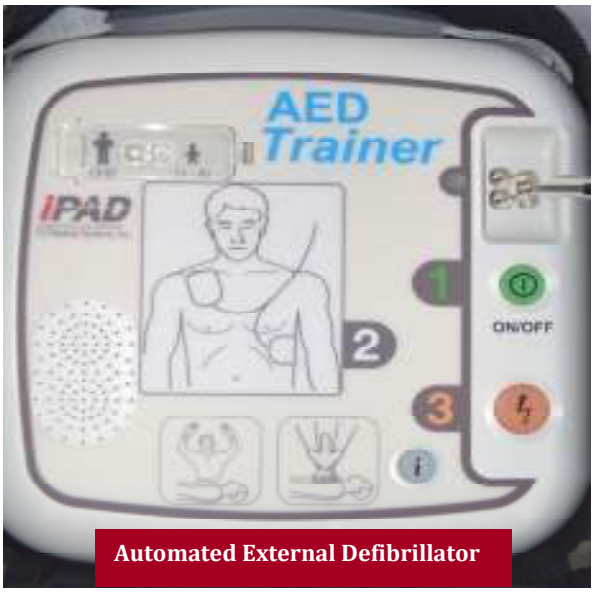
Mouth-to-nose ventilation

Mouth-to-nose ventilation is an acceptable alternative to mouth-to-mouth ventilation. It may be considered if the victim's mouth is seriously injured or cannot be opened, the CPR provider is assisting a victim in the water, or a mouth-to-mouth seal is difficult to achieve.

Compression-ventilation ratio

A ratio of 30:2 was recommended in Guideline 2010 for the single CPR provider attempting resuscitation of an adult. ERC recommends a compression ventilation ratio of 30:2. The ERC, therefore, endorses the ILCOR recommendations that all CPR providers should perform chest compression for all patients in cardiac arrest.

4.4.3 Use of an automated external defibrillator- AED



Automated External Defibrillator

AEDs are safe and effective when used by lay people with minimal or no training. AEDs make it possible to defibrillate many minutes before professional help arrives. CPR providers should continue CPR with minimal interruption of chest compression while attaching an AED and during its use. CPR providers should concentrate on following the voice prompts immediately when they are spoken, in particular resuming CPR as soon as instructed, and minimizing interruptions in chest compression. The importance of immediate defibrillation has always been emphasized in guidelines and during teaching, and is considered to have a major impact on survival from ventricular fibrillation.

Interval between rhythm checks

In accordance with the ILCOR recommendation, and for consistency with previous guidelines, the ERC recommends that chest compressions should be paused every two minutes to assess the cardiac rhythm.

Voice prompts

It is critically important that CPR providers pay attention to AED voice prompts and follow them without any delay. Voice prompts are usually programmable, and it is recommended that they are set in accordance with the sequence of shocks and timings for CPR given above. These should include at least:

1. minimize pauses in chest compressions for rhythm analysis and charging;
2. a single shock only, when a shockable rhythm is detected;
3. a voice prompt for immediate resumption of chest compression after the shock delivery;
4. a period of 2 min of CPR before the next voice prompt to re-analyse the rhythm.

Devices measuring CPR quality may in addition provide real time CPR feedback and supplemental voice/visual prompts.

4.4.4 Foreign body airway obstruction (choking)

Foreign body airway obstruction (FBAO) is an uncommon but potentially treatable cause of accidental death. As most choking events are associated with eating, they are commonly witnessed. As victims initially are conscious and responsive, there are often opportunities for early interventions which can be life -saving.

Because recognition of airway obstruction is the key to successful outcome, it is important not to confuse this emergency with fainting, myocardial infraction, seizure or other conditions that may cause sudden respiratory distress, cyanosis or loss consciousness. FBAO usually occurs while the

victim is eating or drinking. In the figure below is presented the treatment algorithm for the adult with FBAO.

Recognition

Foreign bodies may cause either mild or severe airway obstruction. It is important to ask the conscious victim "Are you choking?" The victim that is able to speak, cough and breathe has mild obstruction. The victim that is unable to speak, has a weakening cough, is struggling or unable to breathe, has severe airway obstruction.

Treatment for mild airway obstruction

Coughing generates high and sustained airway pressures and may expel the foreign body. Aggressive treatment with back blows, abdominal thrusts and chest compression, may cause harm and can worsen the airway obstruction. These treatments should be reserved for victims who have signs of severe airway obstruction and who should remain under continuous observation until they improve, as severe airway obstruction may subsequently develop.

Treatment for severe airway obstruction

The clinical data on choking are largely retrospective and anecdotal. For conscious adults with complete FBAO, case reports have demonstrated the effectiveness of black blows or 'slaps', abdominal thrusts and chest thrust. Approximately 50% of episodes of airway obstruction are not relieved by a single technique. The likelihood of success is increased when combinations of back blows or slaps, and abdominal and chest thrusts are used.

Action		Technical description
SUSPECT CHOKING **Be alert to choking particularly if victim is eating**		
ENCOURAGE TO COUGH **Instruct victim to cough**		
GIVE BACK BLOWS **If cough becomes ineffective give up to 5 back blows**		If the victim shows signs of severe airway obstruction and is conscious apply five back blows Stand to the side and slightly behind the victim Support the chest with one hand and lean the victim well forwards so that when the obstructing object is dislodged it comes out of the mouth rather than goes further down the airway Give five sharp blows between the shoulder blades with the heel of your other hand
GIVE ABDOMINAL THRUSTS **If back blows are ineffective give up to 5 abdominal thrutsts**		If five back blows fail to relieve the airway obstruction, give up to five abdominal thrusts as follows: Stand behind the victim and put both arms round the upper part of the abdomen Lean the victim forwards Clench your fist and place it between the umbilicus (navel) and the ribcage Grasp this hand with your other hand and pull sharply inwards and upwards Repeat up to five times If the obstruction is still not relieved, continue alternating five back blows with five abdominal thrusts
START CPR **Start CPR If the victim becomes unresponsive**		If the victim at any time becomes unresponsive: • support the victim carefully to the ground • immediately activate the ambulance service • begin CPR with chest compressions

Treatment algorithm for the adults with FBAO

4.5 Control bleeding

The human body contains approximately 5 litres of blood. A healthy adult can lose up to half a litre of blood without harmful effects, but the loss of more than this can be threatening to life.
Haemorrhage from major blood vessels of the arms, neck, and tights may occur so rapidly and extensively that death occurs in a few minutes. Haemorrhage must be controlled immediately to prevent excessive loss of blood.
Bleeding may occur externally following an injury to the outside of the body, or internally from an injury in which blood escapes into tissue spaces or the body cavity.

The signs and symptoms of excessive loss of blood are:

- weakness or fainting;
- dizziness;
- pale, moist and clammy skin;
- nausea;
- thirst;
- fast weak and irregular pulse;
- shortness of breath;
- dilated pupils;
- ringing in the ears;
- restlessness; and
- apprehension.

The patient may lose consciousness and stop breathing. The number of symptoms and their severity are generally related to how fast the blood is lost and in what amount.
Once the bleeding has been controlled, the patient should be placed in a reclining position, encouraged to lie quietly and treated for shock.
Fluid should not be given by mouth when internal injury is suspected.

Control

Bleeding may be controlled by direct pressure, elevation, and pressure at pressure points. A tourniquet should be applied only when every other method fails to control the excessive bleeding.

Direct pressure

The simplest and preferred method for controlling severe bleeding is to place a dressing over the wound and apply pressure directly to the bleeding site with the palm of the hand.
Ideally a sterile dressing should be applied. Otherwise, the cleanest cloth available should be used. In the absence of a dressing or cloth, the bare hand may be used until a dressing is available. If the dressing becomes soaked with blood, another dressing should be applied over the first one with firmer hand pressure. The initial dressing should not be removed because this will disturb the clotting process.

Applying direct pressure to a wound

The bandage should be tied over the dressing to provide additional pressure.

Do not cut off the circulation. A pulse should be felt on the side of the injured part away from the heart. If the bandage has been applied properly, it should be allowed to remain in place undisturbed for at least 24 hours. If the dressing is not soaked with blood and the circulation beyond the pressure dressing is adequate, it need not be changed for several days.

Elevation

When there is a several bleeding wound of an extremity or the head, direct pressure should be applied on a dressing over the wound with the affected part elevated. This elevation lowers the blood pressure in the affected part and the flow of blood pressure in the affected part and the flow of blood are lessened.

Tourniquet

A tourniquet should be applied to control bleeding only when all other means have failed. Unlike direct and hand pressure, a tourniquet shuts off all normal blood circulation beyond the site of application.

Modern tourniquet

Lack of oxygen and blood may lead to the destruction of tissue, possibly requiring amputation of a limb. Releasing the tourniquet periodically will result in loss of blood and danger of shock. If the tourniquet is too tight or too narrow, it will damage the muscles, nerves and blood vessels; if to loose, it may increase blood loss. Also, there have been cases where tourniquets have been applied and forgotten. If a tourniquet is applied to save a life, immediate Radio Medical Advice must be obtained.

A tourniquet must be improvised from a wide band of cloth. An improvised tourniquet may be made from folded triangular bandages, clothing or similar material.

Record the time the tourniquet was applied. If you are sending the casualty to hospital, attach a sheet of paper to this clothing or an extremity, indicating the time.

Note:

- Never cover the tourniquet with clothing or bandages, or hide it in any way;
- Never loosen the tourniquet, unless a physician advices it.

4.6 Shock

Shock following an injury is the result of a decrease in the vital functions of the various organs of the body. These functions are depressed because of inadequate circulation of blood or an oxygen deficiency.

Shock usually follows severe injuries such as extensive burns, major crushing injuries (particularly of the chest and abdomen), fractures of large bones, and other extensive or extremely painful injuries.

Shock follows:

- the loss of large quantities of blood;
- allergic reactions;
- poisoning from drugs, gases, and other chemicals;
- alcohol intoxication; and

- rupture of a stomach ulcer.

It also may be associated with many severe illnesses such as infections, strokes and heart attacks.
In some individuals the emotional response to trivial injuries or even to the mere sight of blood is so great that they feel weak and nauseated and may faint. This reaction may be considered to be an extremely mild form of shock which is not serious and will disappear quickly if the patient lies down.
Severe shock seriously threatens the life of the patient.
Signs and symptoms of shock are:

- **Paleness:** The skin is pale, cold, and often moist. Later it may develop a bluish, ashen colour. If the patient has dark skin, the colour of mucous membranes and nail beds should be examined.
- **Rapid and shallow respirations**: Alternatively breathing could be irregular and deep.
- **Thirst, nausea and vomiting**: These frequently occur in a haemorrhaging patient in shock.
- **Weak and rapid pulse**: Usually the pulse rate is over 100.
- **Restlessness, excitement and anxiety**: These occur early, later giving way to mental dullness and still later to unconsciousness. In this late stage the pupils are dilated, giving the patient a vacant, glassy stare.

Although these symptoms may not be evident, all seriously injured persons should be treated for shock to prevent its possible development.
Treatment:

- **Eliminate the causes for shock**: This includes controlling bleeding, restoring breathing and relieving severe pain.
- **Have the injured person lie down**: The patient should be placed in a horizontal position. The patient's legs may be elevated approximately 30 cm to assist the flow of blood to the heart and head. The legs should not be elevated if there is injury to the head, pelvis, spine, or chest, or difficulty in breathing.
- **Keep the patient warm, but not hot**: Too much heat raises the surface temperature of the body and diverts the blood supply away from vital organs to the skin.
- **Relieve pain as quickly as possible**: If pain is severe, 10 mg of morphine sulphate may be given by intramuscular injection. If the blood pressure is low, morphine sulphate should not be given because it may cause an additional drop in the pressure. Also, it should not be given to injured patients unless pain is severe. The dosage should be repeated only after obtaining Radio medical advice.
- **Administer fluids**: Liquids should not be given by mouth if the patient is unconscious, drowsy, convulsing, or about to have surgery. Also, fluids should not be given if there is a puncture or crush wound to the abdomen, or a brain injury. If none of the above conditions is present, give the patient a solution of oral rehydration salts (half a glass every 15 minutes). Alcohol should never be given.

4.7 Burns and scalds, electrical burns and electrocution

Clothing on fire

If someone's clothing is on fire, by far the best way to put the fire out is to use a dry-powder extinguisher at once. If a dry-powder extinguisher is not available, then lay the person down and smother the flames by wrapping him in any available material, or throw bucketfuls of water over him, or use a hose, if available. Make sure that all smouldering clothing is extinguished.
The powder from a fire extinguisher will not cause much, if any, eye damage. Most people shut their eyes tightly if sprayed with powder. Any powder in the eye should be washed out immediately after the fire has been extinguished and while burns are being cooled.

Heat burns and scalds

All heat burns should be cooled as quickly as possible with running cold water, applied for at least 10 minutes, or by immersion in basins of cold water. If it is not possible to cool a burn on the spot, the casualty should be taken to a place where cooling can be carried out. Try to remove clothing gently but do not tear off any that adhered to the skin. Then cover the burned areas with a dry, non-fluffy dressing larger than the burns, and bandage in place.

Electrical burns and electrocution

Make sure you do not become the next casualty when approaching any person who is in contact with electricity. If possible, switch off the current. Otherwise insulate yourself before approaching and touching the casualty, by using rubber gloves, wearing rubber boots, or standing on an insulating rubber mat.

Electrical lines may be removed from the casualty with a wooden pole, a chair, an insulated cord, or other non-metal object.

Then check casualty immediately for breathing and heartbeat.

If casualty is not breathing give artificial respiration.

If heart is stopped, apply heart compression.

Send for help.

When the casualty is breathing, cool any burnt areas with cold water and apply a clean, dry, non-fluffy covering to these areas.

The treatment for electrical burns is the same as for thermal burns. It includes relief of pain, prevention and treatment of shock and control of infection.

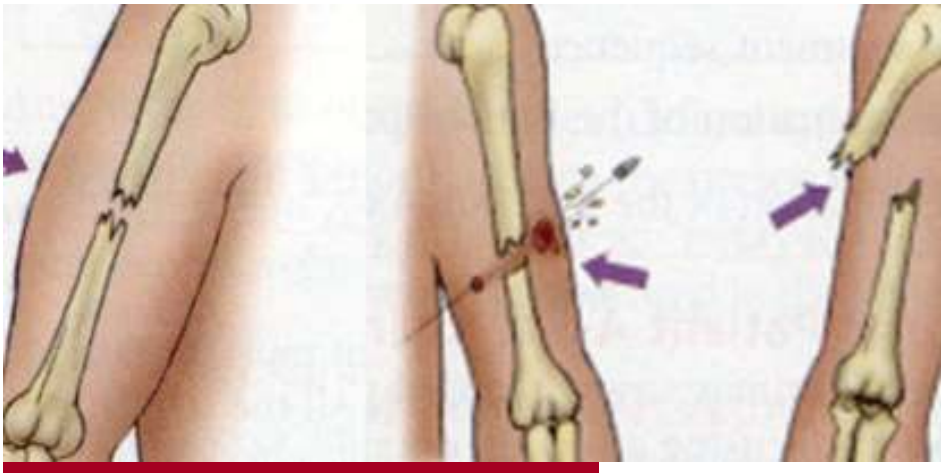
Electrical burns may be followed by paralysis of the respiratory centre, unconsciousness and instant death.

4.8 Chemical splashes

Remove contaminated clothing. Drench casualty with water to wash the chemicals from the eyes and skin. Give priority to washing the eyes which are particularly vulnerable to chemical splashes. If only eye is affected, incline the head to the side of the affected eye to prevent the chemical from running across into the other eye.

4.9 Fractures

A fracture is a broken bone. The bone may be broken into two or more pieces or it may have linear cracks. Fractures are described as closed if the skin remains unbroken. If there is a wound at or near the break, it is said to be an open fracture.



Closed and open fractures

Careless handling of a patient may change a simple fracture into a compound one, by forcing jagged bone-ends through intact overlying skin. Compound fractures accompanied by serious bleeding are likely to give rise to shock, especially if a large bone is involved.
The following are indications that a bone is very probably broken:

- The fact that a heavy blow or other force has been applied to the body or limbs;
- The casualty himself, or other people, may have heard the bone break;
- Intense pain, especially on pressure or movement at the site;
- Distortion: Compare good limb with injured one or side of the body to see if the affected part is swollen, bent, twisted or shortened;
- Irregularity: The irregular edges of a broken bone can sometimes be seen in an open fracture. They may be seen or felt under the skin in a closed fracture;
- Loss of use: The casualty may be unable or unwilling to use the injured part because of the pain. He may also experience severe pain if an attempt, even a very gentle one, is made to help him move it. Watch his face for signs of pain. Occasionally, if the broken ends of a bone are impacted together, the patient may be able to use the affected part but usually only with a fair amount pain;
- Unnatural movement and granting of bone-ends: Neither of these symptoms should be sought deliberately. A limb may feel limp and wobbly, and granting may be felt when an attempt is made to apply support to the limb. Either of these indicates that the bone is certainly broken;
- Swelling: The site may be swollen and/or bruised. This may be due to internal bleeding. Swelling occurs almost immediately and discoloration of the skin may follow.
-

General treatment

Radio medical advice should be sought early in the case of a compound fracture or a severe type of fracture (skull, femur, pelvis, spine) because it might be necessary to evacuate the patient from the vessel.
Unless there is an immediate danger of further injury, the patient should not be moved until bleeding is controlled and all fractures are immobilized by splinting.

Bleeding

Bleeding from open fractures should be stopped in the normal way by pressing the area the blood comes from and applying a dressing. Blood will not come from the broken bone-end but from around the break. Care must be exercised in lifting up the affected part if it is broken, but it should always be elevated if bleeding is severe. People can die from loss of blood. They will not die from a broken bone, although moving it may be painful. Rest is very important to prevent further bleeding, to prevent further damage and to relieve pain.
If bleeding is well controlled, the wound can be treated. The area around it should be cleansed thoroughly with soap and water and then disinfected with 1% (10 g /litre) cetrimide solution. Surface washing should not be allowed to spill into the wound. The wound itself should not be washed. It should be covered with a sterile dressing. Particles of dirt and pieces of clothing, wood, etc., should be gently removed from the wound with sterilized forceps. Blood clots should not be disturbed, as this may cause fresh bleeding. The wound should not be sutured. Dressing on it should be allowed to remain in place 4-5 days, if there is no wound infection.

Immobilization

Inflatable splints are a useful method for temporarily immobilizing limb fractures but are unsuitable for fractures that are more than a short distance above the knee or elbow, as they cannot provide sufficient immobilization in these places. The splints are applied to the limb and inflated by mouth. Other methods of inflation can make the splint too tight and thus slow down or stop the circulation. Inflatable splints can be applied over wound dressing.

Various types of splints

The splints are made of clear plastic through which any bleeding from the wound can easily be seen. All sharp objects and sharp edges must be kept well clear of inflatable splints to avoid puncture.
To provide adequate stability, the splint should be long enough to extend beyond the joints at the end of the fractured bone.
Inflatable splints may be used when a patient is being transported about the vessel or during removal to hospital. They should not be left in place more than a few hours. Other means of immobilizing the fracture should be used after that period.
Immobilize a limb in the position in which it is found, if it is comfortable. If it does become necessary to move an injured limb because of poor circulation or for any other reason, first apply traction by pulling the limb gently and firmly away from the body before attempting to move it.
If a long bone in the arm or leg has been fractured, it should be straightened carefully. Traction should be applied on the hand or the foot, and the limb moved back into position. Compound fractures of joints, such as the elbow or knee, should not be manipulated. They should be placed gently into a proper position for splinting. The knee should be splinted straight. The elbow should be splinted at a right angle.

Circulation of the blood

Check and re-check the circulation of blood in a fractured limb by pressing a nail. When circulation is normal, the nail becomes white when pressed and pink when released. Continue until you are satisfied that all is well. Danger signs are:

- Blueness or whiteness of fingers and toes;
- Coldness of the parts below the fracture;
- Loss of feeling below the injury;
- Absence of pulse.

If there is any doubt at all about the circulation, loosen all tight and limb-encircling dressing at once and straighten out the limb, remembering to use traction when doing so. Check the circulation again. If the limb does not become pink and warm and you cannot detect a pulse, then medical help is to be avoided. Get Radio medical advice.
Remember that fractures may cause serious blood loss internally. Check and take appropriate action.

4.10 Fractures of specific body areas

Skull fracture

A fracture of the skull may be caused by a fall, a direct blow, a crushing injury, oral penetrating injury such as a bullet wound. The patient may be conscious, unconscious, or dizzy, and have a

headache or nausea. Bleeding from the nose, ears, or mouth may be present and there may be paralysis and signs of shock.

Treatment

The patient with a head injury should receive immediate attention to prevent additional damage to the brain. The patient should be kept lying down. If the face is flushed, the head and shoulders should be elevated slightly. If the face is pale, the head should be kept level with the body or slightly lower. Bleeding can be controlled by direct pressure on the temporal or carotid arteries. The patient should be moved carefully with the head supported on each side with a sandbag.

Upper jaw fracture

In all injuries of the face, ensuring an adequate airway must be the first consideration.

Treatment

If there are wounds, bleeding should be controlled. Loose teeth should not be removed without Radio medical advice, unless it is feared that they will be swallowed or block the airway.

Lower jaw fracture

A fracture may cause a deformity of the jaw, missing or uneven teeth, bleeding from the gums, swelling and difficulty in swallowing.

Treatment

The injured jaw may interfere with breathing. If this occurs, the jaw and tongue should be pulled forward and maintained in that position. A problem arises when both sides of the jaw are broken. In this case the jaw and tongue may move backwards and obstruct the air passage. Hook a finger-yours or the casualty's- over and behind the lower front teeth and pull the jaw, and with it the tongue, forward. Then, if possible, arrange for the casualty to sit up with his head forward; clenching the teeth may also stop further slippage. If the casualty cannot be put in a sitting position on account of other injuries, he must be placed in the unconscious position and another person must stay with him, watching carefully for any sign of obstructed breathing. Normally, jaw fractures give little trouble because the casualty sits with the teeth clenched, often refusing to speak much on account of pain. The spasm in the jaw muscles which is caused by pain keeps the teeth clenched and jaw immobilized.

Application of cold compresses may reduce the swelling and pain. The patient's jaw must be immobilized not only by closing his mouth as much as possible but also by applying a bandage.

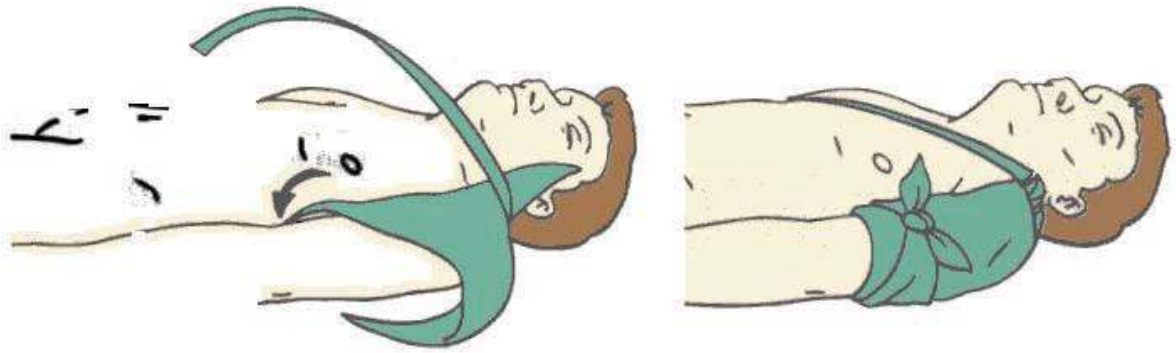
If the patient is unconscious or bleeding from the mouth, or if there is danger of vomiting, an attendant must be present at all times to loosen the bandage if necessary.

Upper arm (humerus) and the elbow fractures

Complications may occur in fractures of the humerus because of the closeness of the nerves and blood vessels to the bone. There is pain and tenderness at the fracture site, and an obvious deformity may be present. The patient may be unable to lift his arm or to bend his elbow.

Treatment

A full-arm, inflatable air splint should be applied to the fracture. If inflatable splints are not available, the arm should be placed in a sling, with the sling and arm secured to the body by a wide cravat bandage. A short padded splint, applied to the outer surface of the arm, may also be used. The elbow should not be bent, if it does not bend easily. Long, padded splints should be applied, one to the outer surface and another to the inner surface of the arm. If there is any possibility that the elbow is involved in the fracture, the joint should be immobilized with a splint. Treat for pain.



Splinting a fractured humerus

Lower arm (radius and ulna) or forearm fractures

There are two large bones in the forearm, and either one or both of these may be broken. When only one bone is broken the other acts as a splint and there may be little or no deformity. However, a marked deformity may be present in a fracture near the wrist. When both bones are broken, the arm usually appears deformed.

Treatment

The fracture should be straightened carefully by applying traction on the hand.

A half-arm, inflatable air splint should be applied to the fracture. If inflatable splints are not available, two well-padded splints should be applied to the forearm, one at the top and one at the bottom. The splints should be long enough to extend from beyond the elbow to the middle of the fingers. The hand should be raised about 10 cm higher than the elbow, and the arm supported in a sling. If necessary, a splint may be improvised. Treat for pain.

Splinting dislocated or fractured forearm

Wrist and hand fractures

A broken wrist is usually the result of a fall with the hand outstretched. Usually there is a lump-like deformity on the back of the wrist, along with pain, tenderness and swelling.

A fracture of the wrist should not be manipulated or straightened. In general, it should be managed like a fracture of the forearm.

Splint for crushed or fractured hand

The hand may be fractured by a direct blow or may receive a crushing injury. There may be pain, swelling, loss of motion, open wounds, and broken bones. The hand should be placed on a padded splint which extends from the tips of the fingers. A firm ball of gauze should be placed under the fingers to hold the hand in a cupped position. Roller gauze or elastic bandage may be used to secure the hand to the splint. The arm and hand should be supported in a sling. Often, further treatment is urgent, regardless of the severity of the injury, to preserve as much of the function of the hand as possible.

Finger fracture

Splinted a finger fracture

Only the fractured finger should be immobilized, and the mobility of the other fingers should be maintained. The finger should be straightened by grasping the wrist with one hand and applying traction to the fingertip with the other. The finger should be immobilized with a splint. The patient should be examined by a physician as soon as possible.

Spine fractures

A fractured spine is potentially a very serious injury. If you suspect a fractured spine tell the casualty to lie still and do not allow anyone to move him until he is supported on a hard flat surface. Any careless movement of a casualty with a fractured spine could damage or severe the spinal cord, resulting in permanent paralysis and loss of feeling in the legs and double incontinence for life.

Falls from a height are the likeliest cause of spinal injury during ship operations. Always suspect a fracture of the spine if a person has fallen a distance of over 2 meters. Ask if there is any pain in

the back. Most people with fractures of the spine have pain, but a very few do not. So, check carefully how the injury happened and, if in doubt, treat as a fractured spine. First ask the casualty to move his toes to check whether or not he has paralysis and check also that he can feel you touching his toes.

A casualty who has a fractured spine must be kept still and straight. He must never be bent or jack knifed by being picked up under the knees and armpits. He can, however, be safely rolled over on the one side or the other, because, if this is done gently, there is very little movement of the spine. The aim in first aid will be to place the casualty on a hard flat surface where his spine will be fully supported and usually proceed to fix cervical collar.

Lower leg (tibia and fibula) fracture

Fractures of the lower leg are common and occur as a result of various accidents. There is a marked deformity of the leg when both bones are broken. When only one bone is broken, the other acts as a splint and little deformity may be present. When tibia is broken, a compound fracture is likely to occur. Swelling may be present, and the pain is usually severe.

Treatment

The leg should be straightened carefully, using slight traction. A full leg inflatable air splint may be applied, if available. The air splint will assist in controlling the bleeding, if there is a compound fracture. If other types of splints are used, a well-padded splint should be applied to each side of the leg, and another should be placed under the leg. The splints should extend from the middle of the thigh to beyond the heel.

Splinting fractures of tibia and fibula

4.11 Transporting a casualty

The removal of a sick or injured person either from the site of an accident or ashore is a matter of importance, since his life may depend on the arrangements made, particularly if he has spinal injuries, a heart condition , or a severe fracture, with any of which he is likely to be suffering from shock. So use the utmost gentleness, reassure your patient, try to have a clear picture in your

mind of the nature of the disability you are dealing with, and exercise common sense.
Unless there is danger from fire, explosion or toxic substances, do not move a casualty until:

- suspected fractures have been immobilized; and
- severe bleeding has been stopped.

Then check out the best route for transport, lift the casualty gently and carry him smoothly - remember that every jolt causes unnecessary pain.
The method of transport will depend on the situation of the casualty and the nature of the injury.
If the vessel is in port, it is usually best to await the arrival of an ambulance because the attendants will be expert in handling casualties. You can assist them and give them the benefit of your knowledge. For instance, if a patient has fallen to the bottom of a hold, the best procedure is to take down a stretcher, give first aid treatment, then place the stretcher on a hatch cover or similar flat platform and have patient lifted by vessel's crane over the side. This lift can be a frightening experience for a helpless and shocked person and he will be reassured if the person in charge stands on the hatch cover with legs astride the stretcher, maintaining balance by holding on to the guy wires. Similarly, if the patient is on deck and the gangway is narrow or unsteady, it may be far less unnerving for him if he is lowered over the side on a hatch cover or something similar.

Manhandling

Ordinary manhandling may be possible, in which case two helpers carry a casualty, with each one using an arm to support the casualty's back and shoulders and his spare hand to hold the casualty's thighs. If conscious, the casualty may help to support himself with his hands on the shoulders of the helpers.

Three-handed seat carry

The simple pick-a-back method is useful only where the casualty is conscious and able to hold on by putting his arms round the carrier's neck.
In a narrow space, the simple for-and-aft carry may be best. One helper supports the patient under his arms and the other under his knees.
One advantage of the three-handed seat, is that one of the helpers has a free arm and hand that can be used either to support an injured limb or as a back support for the casualty. Which of the two helpers has the free arm will depend on the nature of the injury.
As a last resort, the drag-carry method may have to be used in narrow spaces, particularly where there is wreckage following an explosion and where it may be possible for only one man to reach a trapped patient and rescue him. After the initial rescue, two men may be able to undertake further movement through a narrow space.

Transport made by two people

Mobilization by firefighter method

Mobilization by gripping arms

Mobilization with blankets

Stretcher

A good general purpose stretcher for use on board of the vessels: it is easily carried, gives firm support to the patient and in particularly useful in narrow spaces, when difficult corners have to be hoisted.

Transport a casualty on a stretcher

5.

GENERALIZED HYPOTHERMIA DUE TO COLD WATER IMMERSION

COMPETENCE

Required first aid measures in case of emergency

5.1 Generalized hypothermia

Generalized hypothermia is the leading cause of death among shipwreck survivors. In a cold environment, the body will automatically increase its heat production efforts in order to compensate for heat loss. However, if the rate of heat loss exceeds the rate of heat production, body temperature falls and hypothermia will result.

Note:

- Forced immersion is the main threat to life after hitting the water;
- Anyone immersed in cold water anywhere will lose heat and the heat loss will lower Internal body (core) temperature;
- The loss of body heat is one of the greatest dangers for survival in cold water;
- Some degree of hypothermia occurs in most survivors extracted from cold water;
- The degree of hypothermia depends on the duration of immersion and the water temperature (and so on latitude and season), the person's activity in the water, and body insulation (the amount of fat and clothing on the individual);
- Most ordinary clinical thermometers do not measure temperatures below 34 °C: a special low-reading thermometer must be used if hypothermia is suspected;

The severity of hypothermia is defined as follows:

- mild hypothermia – core temperature above 32 °C;
- moderate hypothermia – core temperature between 32 °C and 28 °C;
- severe hypothermia – core temperature below 28 °C.

Mild hypothermia symptoms:

- an increase in pulse and breathing rates;
- poor muscular co-ordination;
- slurred speech;
- impaired judgement;
- shivering.

Moderate hypothermia symptoms:

- a slowing of pulse and breathing rates;
- drowsiness;
- confusion;
- in many cases, "paradoxical undressing", or a false sense of warmth, and cessation of shivering;
- death – in many cases, even with hospital care.

Severe hypothermia symptoms:

- coma;
- shock;
- lung failure;
- kidney failure;
- death – in most cases, even with hospital care.

5.2 First Aid for hypothermia

For survivors who, although shivering dramatically, are rational and capable of recounting their experiences:

- have their wet clothes replaced with dry clothes or blankets;
- check quickly for injuries;
- forbid the use of alcohol.

In more serious cases, in which the survivor is not shivering but is semi-conscious, unconscious, or apparently dead, apply immediate first aid.

If the survivor is not breathing:

- ensure that the airway is clear and start, mouth-to-mouth or mouth-to-nose artificial respiration, immediately;
- continue basic- life support for at least 30 minutes.

If the survivor is breathing but unconscious:

- place him in the recovery position to ensure that breathing is not obstructed by the tongue or by vomit;
- check for other causes of unconsciousness, such as head injury;
- avoid all unnecessary manhandling, such as removing wet clothes or massaging the limbs.

To prevent further loss of heat from evaporation or exposure to the wind, immediately wrap the survivor in blankets, keeping the body horizontal with the head slightly lower than the rest of the body.

A patient with mild hypothermia who is shivering will recover if further heat loss is prevented.

A patient with moderate or severe hypothermia, especially if he is not shivering, requires external rewarming:

- place a waterproof sheet on a bunk, and lay the patient on the sheet;
- cover him with two or three blankets;
- put four towels (or other large pieces of cloth) into a bowl of hot water (about 40 °C), then put the dripping wet towels into four plastic bags;
- put the plastic bags on the patient's armpits and each groin;
- after 10 minutes replace with fresh wet hot towels;
- continue until the patient's temperature is over 32 °C.

What not to do

Do not try to warm a survivor in hypothermia by using an external source of radiant heat, such as a fire or electric radiator: this will divert blood from the core of the body to the skin, causing the body temperature to fall further.

Cold exposure injuries

Cold injuries to parts of the body – most commonly the face and extremities – are caused by exposure of tissues and small surface blood vessels to abnormally low temperatures.
Cold exposure injuries are common in patients in hypothermia.

The extent of a cold injury depends on:

- temperature;
- duration of exposure;
- wind velocity;
- humidity;
- presence or absence of protective clothing;
- wether or not skin comes into direct contact with cold metal or frozen cloth.

5.3 Frostnip and frosbite

Frostnip, the mildest form of cold injury, is caused by exposure to temperatures above freezing (0-16 °C) in conditions of relatively high humidity.

Signs and symptoms:

- tingling;
- itching;
- burning sensation, possibly aggravated by warmth;
- no blistering or skin discoloration.

Frostbite, involving the death of skin, is a more severe injury than frostnip.

Signs and symptoms:

In cases of superficial frostbite:

- only skin involved;
- skin pale and swollen;
- blisters filled with clear fluid.

In cases of deep frostbite:

- involvement of skin and deeper tissues, such as muscle;
- ulcers, in some cases: especially when skin is separated from metal or frozen fabric with which it has been in direct contact;
- blisters filled with blood;
- in severe cases, presence of gangrene.

First aid treatment

Test for skin sensation:

- normal ability to feel a light touch indicates that the small nerve fibres immediately under the skin surface are alive;
- loss of sensation suggests that injury has extended through the full thickness of the skin.

Warm the injured part in water at 40 °C (not warmer) for 15 to 30 minutes, using a basin for hands and feet and warm compresses for face and ears.
To relieve pain, which may be severe, give tramadol, 100 mg orally, every 8 hours or, if needed, morphine, 10–15 mg intramuscularly, every three to four hours.
If the skin has blisters, leave them alone as long as possible:
If the blisters burst:

- cut the dead skin away with sterile scissors;
- swab the area with povidone-iodine solution;
- cover with a sterile dressing.

What not to do

Never rewarm frostbitten tissue with direct heat from a fire.

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MODULE III

Interreg
Danube Transnational Programme
Danube SKILLS

Project co-funded by European Union funds (ERDF, IPA)

TRAIN THE TRAINER

- PERSONAL SURVIVAL TECHNIQUES -

Table of content

1. GENERAL DEFINITIONS

For the purposes of this compendium the following terms have been defined as follows:

- ***anti-exposure suit***: a protective suit designed for use by crew members in rescue situations;
- ***competent authority****:* a ministry, government department or other authority having power to issue regulations, orders or other instructions having the force of law in respect of safety and health aboard any vessel registered in their territory or any ship within their territorial waters and ports;
- ***competent person****:* a crew member possessing adequate qualifications, such as suitable training and sufficient knowledge, experience and skills, and including, where appropriate, any certificates required by the competent authority, to fill a particular position, carry out a specific task, or assume supervisory responsibility. The competent authority may define appropriate criteria for the designation of such persons and may determine the duties assigned to them.
- ***crew*****:** inland navigation personnel, other than the Boatmaster, working on the vessel;
- ***detection:*** the determination of the location of survivors or survival craft;
- ***immersion suit:*** a protective suit which reduces the body heat loss of a person wearing it in cold water;
- ***inflatable appliances:*** an appliance which depends upon non-rigid, gas-filled chambers for buoyancy and which is normally kept inflated until ready for use;
- ***officer***: one who is ranked as an officer by national laws or regulations;
- ***personal protective equipment***: includes but is not limited to protective clothing, safety helmets, eye and face protection, hearing protection, gloves, safety footwear, lifelines, safety harnesses, breathing apparatus and respirators, as appropriate;
- ***responsible persons***: persons having authority delegated to them either directly or indirectly by the vessel owner or the Boatmaster to carry out or supervise the duties or operations under consideration;
- ***vessel:*** any inland navigation registered craft, whether publicly or privately owned, engaged in commercial navigation;
- ***vessel owner***: any person(s) or organization that owns the vessel or acts on behalf of the owner and is responsible for the vessel and its equipment or for the crew members employed thereon.

2. INTRODUCTION

This course compendium was designed both for trainers who will be involved in training of such training module and the trainees as learning aids in order to facilitate the learning process.

This course compendium aims to assist in the implementation of the new European Directive on the recognition of professional qualifications in inland navigation personnel and in meeting the requirements of the Standards of competences for inland navigation personnel- Operational level that will be part of this legislative act.

The main objective of this course compendium is to provide practical guidance on safety and health on board the vessels for crew members which have to meet the minimum standard of competence in personal survival techniques, preventing accidents, diseases and other harmful effects on the health of inland navigation personnel arising from employment on board inland navigation vessels.

3. LEARNING OUTCOMES

By the end of this course, trainees will be able to:

- Identify and use a lifejacket;
- Identify and use an immersion suit;
- Safely jump from a height into the water;
- Right an inverted liferaft while wearing a lifejacket;
- Keep afloat without a lifejacket;
- Operate location devices, including radio equipment;
- Operate survival craft equipment.

4.

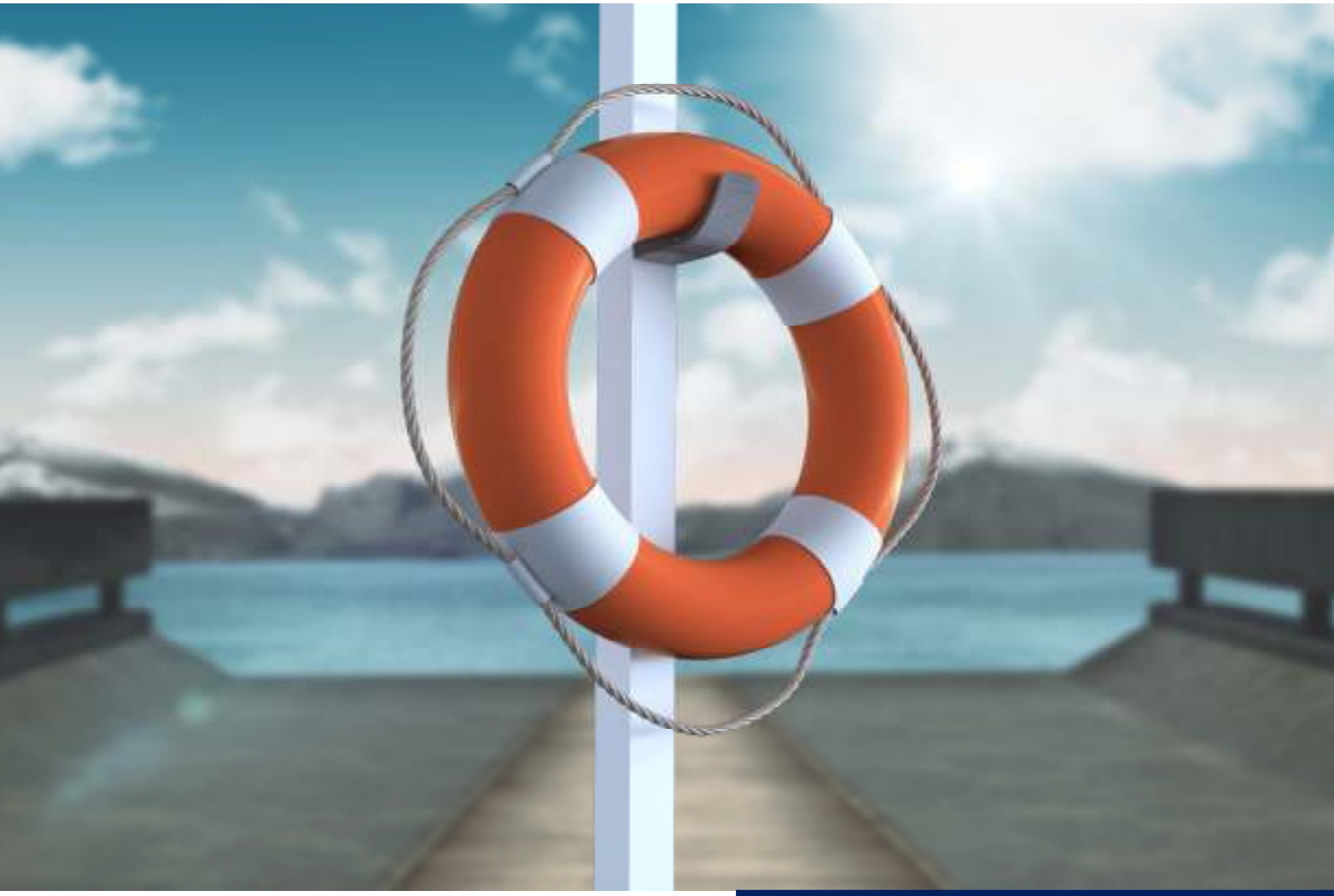
PERSONAL PROTECTIVE EQUIPMENT AND SHIP BOARD LIFE SAVING EQUIPMENT

COMPETENCE

Use and maintain personal life-saving appliances and shipboard life- saving equipment

4.1 Personal life-saving appliances

4.1.1 Lifebuoys



Lifebuoy

Lifebuoy specification

Every life buoy shall:

- have an outer diameter of not more than 800 mm and inner diameter of not less than 400 mm;
- be constructed of inherently buoyant material; it shall not depend upon rushes, cork shavings or granulated cork, any other loose granulated material or any air compartment which depends on inflation for buoyancy;
- be capable of supporting not less than 14.5 kg of iron in fresh water for a period of 24 hours;
- have a mass of not less than 2.5 kg;
- not sustaining burning or continue melting after being totally enveloped in a fire for a period of 2 s;

- be constructed to withstand a drop into the water from the height at which it is stowed above the waterline in the lightest condition, without impairing either its operating capability or that of its attached components;
- it is intended to operate the quick- release arrangement provided for the self-activated signals and self-igniting lights, have a mass of not less than 4 kg; and
- be fitted with a grabline not less 9.5 mm in diameter and not less than four times the outsider diameter of the body of the buoy in length. The grabline shall be secured at four equidistant points around the circumference of the buoy to form four equal loops.

Lifebuoy self-igniting lights

Self-igniting lights shall:

- be such that they cannot be extinguish by water;
- be of white colour and capable of either burning continuously with a luminous intensity of not less than 2 cd in all directions of the upper hemisphere or flashing at a rate of not less than 50 flashes and not more than 70 flashes per minute with at least the corresponding effective luminous intensity;
- be provided with a source of energy;

4.1.2 Lifejackets

General requirements for lifejackets

Lifejackets

A lifejacket shall not sustain burning or continue melting after being totally enveloped in a fire for a period of 2s.

Lifejackets shall be provided in three sizes in accordance with the table below.

Lifejackets sizing criteria

Lifejacket marking	Infant	Child	Adult
User's size: Weight (kg)	Less than 15	15 or more but less than 43	43 or more
Height (cm)	Less than 100	100 or more but less than 155	155 or more

If a lifejacket fully complies with the requirements of two adjacent size range, it may be marked with both size ranges, but the specified ranges shall not be divided. Lifejackets shall be marked by either weight or height, or by both weight.
If an adult lifejacket is not designed to fit persons weighing up to 140 kg and with a chest of up to 1 750 mm, suitable accessories shall be available to allow it to be secured to such persons.

An adult lifejacket shall be constructed that:

- 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 time of 1 min, without assistance;
- it is clearly capable of being worn in only one way or inside-out and, if donned incorrectly, it is not injurious to the wearer;
- the method of securing the lifejacket to the wearer has quick and positive means of closure that do not require tying of knots;
- it is comfortable to wear;
- it allows the wearer to jump into the water from a height of at least 4.5 m while holding on to the lifejacket, and from a height of at least 1 m with arms held overhead, without injury and without dislodging the lifejacket or its attachments.

Adult lifejackets shall have sufficient buoyancy and stability in calm fresh water to:

- lift the mouth of exhausted or unconscious persons;
- turn the body of unconscious, face-down persons in the water;
- incline the body backwards from the vertical position;
- lift the head above horizontal;
- return the wearer to a stable face–up position after being destabilized when floating in the flexed position.

An adult lifejacket shall allow the person wearing it to swim a short distance and to board a survival craft.
An infant or child lifejacket shall perform the same as an adult lifejacket except as follows:

- donning assistance is permitted for small children and infants;

The requirements for infant lifejackets:

- facilitate the rescue of the infant by a caretaker;
- allow the infant to be fastened to a caretaker and contribute to keeping the infant close to the caretaker;
- keep the infant dry, with free respiratory passages;
- protect the infant against bumps and jolts during evacuation; and
- allow a caretaker to monitor and control heat loss by the infant.

A lifejacket shall have buoyancy which is not reduced by more than 5% after 24 hours submersion in fresh water.
The buoyancy of a lifejacket shall not depend on the use of loose granulated materials.
Each lifejacket shall be fitted with a whistle firmly secured by a lanyard.

Lifejacket lights and whistles shall be selected and secured to the lifejacket in such a way that their performance in combination in not degraded.
A lifejacket shall be provided with a releasable buoyant line or other means to secure it to a lifejacket worn by another person in the water.
A lifejacket shall be provided with a suitable means to allow a rescuer to lift the wearer from the water into a survival craft or rescue boat.

Inflatable lifejacket

A lifejacket which depends on inflation for buoyancy shall have not less than two separate compartments and shall:

- inflate automatically upon immersion, be provided with a device to permit inflation by a single manual motion and be capable of having each chamber inflated by mouth.
-

Lifejacket lights

Each lifejacket light shall:

- have a luminous intensity of not less than 0.75 cd in all directions of the upper hemisphere;
- have a source of energy capable of providing a luminous intensity of 0.75 cd for a period of at least 8 hours;
- be visible as great a segment of the upper hemisphere as is practicable when attached to a lifejacket; and
- be of white colour.

Immersion suit

4.1.3 Immersion suits

General requirements

An immersion suit shall be constructed with waterproof materials so that:

- it can be unpacked and donned without assistance within 2 minutes, taking into account donning of any associated clothing , donning a lifejacket if the immersion suit is to be worn in conjunction with a lifejacket and inflation of orally inflatable chambers if fitted;
- it will not sustain burning 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, except that covering for the hands may be provided by separate gloves which shall be permanently attached to the suit;
- it is provided with arrangements to minimize or reduce free air in the legs of the suit; and
- following a jump from a height of not less than 4.5 m into the water there is no undue ingress of water into the suit.

An immersion suit on its own, or worn in conjunction with a lifejacket if necessary, shall have sufficient buoyancy and stability in calm fresh water to:

- lift the mouth of an exhausted or unconscious person clear of the water by not less than 120 mm; and

- allow the wearer to turn from a face-down to a face-up position in not more than 5 seconds.

An immersion suit shall permit the person wearing it, and also wearing a lifejacket if the immersion suit is to be worn in conjunction with a lifejacket, to:

- climb up and down a vertical ladder at least 5 m in length;
- perform normal duties associated with abandonment;
- jump from a height of not less than 4.5 m into the water without damaging or dislodging the immersion suit or its attachments, or being injured; and
- swim a short distance through the water and board a survival craft.

4.2 Shipboard life-saving appliances

4.2.1 Liferafts

General requirements

Every liferaft shall be so constructed as to be capable of withstanding exposure for 30 days afloat in all water conditions.
The liferaft shall be so constructed that when it is dropped into the water from a height of 18 m, the liferaft and its equipment will operate satisfactorily.
The floating liferaft shall be capable of withstanding repeated jumps onto it from a height of at least 4.5 m above its floor both with and without the canopy erected.
The liferaft and its fittings shall be so constructed as to enable it be towed at a speed of 3 knots (aprox. 5 km/k) in calm water when loaded with its full complement of persons and equipment and with one of its anchors streamed.
The liferaft shall have a canopy to protect the occupants from exposure which is automatically set in place when the liferat is launched and waterborne.
Lifelines shall be securely bucketed around the inside and outside of the liferaft.
The liferaft shall be fitted with an efficient painter of length equal to not less than 10m plus the distance from the sowed position to the waterline in the lightest water condition or 15m, whichever is the greater.
A manually controlled exterior light shall be fitted to the uppermost portion of the liferaft canopy or structure. The light shall be white and be capable of operating continuously for at least 12 h with a luminous intensity of not less than 4.3 cd in all directions of the upper hemisphere. However, if the light is a flashing light it shall flash at a rate of not less than 50 flashes and not more than 70 flashes per minute for the 12 h operating period with an equivalent effective luminous intensity.
A manually controlled interior light shall be fitted inside the liferaft capable of continuous operation for a period of at least 12 h.

Inflatable liferafts

Inflatable liferaft

Inflatable liferafts shall comply with the general requirements of 4.2.1 and, in addition with the requirements of this point.

Construction

The main buoyancy chamber shall be divided into not less than two separate compartments, each inflated through a non-return inflation valve on each compartment.

The buoyancy chambers shall be so arranged that, in the event of any one of the compartments being damaged of failing to inflate, the intact compartments shall be able to support, with positive freeboard over the liferaft's entire periphery, the number of persons which the liferafts is permitted to accommodate, each having a mass of 75 kg and seated in their normal position.

The floor of liferaft shall be waterproof and shall be capable of being sufficiently insulated against cold either:

- by means of one or more compartments that the occupants can inflate, or which inflate automatically and can be deflated and re-inflated by the occupants; or
- by other equally efficient means not dependent on inflation.

The liferaft shall be capable of being inflated by one person. The liferaft shall be inflated with a non-toxic gas.

Each inflatable compartment shall be capable of withstanding a pressure equal to at least three times the working pressure and shall be prevented from reaching a pressure exceeding twice the working pressure either by means of relief valves or by a limited gas supply.

Access into inflatable liferafts

At least one entrance shall be fitted with a boarding ramp, capable of supporting a person weighing 100 kg sitting or kneeling and not holding onto any other part of the liferaft, to enable persons to board the liferaft from the water. The boarding ramp shall be so arranged as to prevent significant deflation of the liferaft if the ramp is damaged.
Entrances not provided with a boarding ramp shall have a boarding ladder, the lowest step of which shall be situated not less than 0.4m below the liferaft's light waterline.
There shall be means inside the liferaft to assist persons to pull themselves into the liferaft from the ladder.

Containers for inflatable liferafts

The inflatable liferaft shall be packed in a container that is:

- so constructed as to withstand hard wear under conditions encountered;
- of sufficient inherent buoyancy, when packed with the liferaft and its equipment, to pull the painter from within and to operate the inflation mechanism should the vessel sink; and
- as far as practicable watertight, except for drain holes in the container bottom.

Marking on inflatable liferafts

The liferaft shall be marked with:

- marker's name of trademark;
- serial number;
- date of manufacture;
- name of approving authority;
- name and place of servicing station where it was last serviced; and
- number of persons it is permitted to accommodate over each entrance in characters not less than 100 mm in height of a colour contrasting with that of the liferaft.

Equipment

The equipment of inflatable liferaft, consist of:

- one buoyant rescue quoit, attached to not less than 30 m of buoyant line;
- one knife of the non-folding type having a buoyant handle and lanyard attached and stowed in a pocket on the exterior of the canopy near the point at which the painter is attached to the liferaft;
- two sponges;
- two anchors, each with a shock-resistant hawser and tripping line if fitted, one being spare and the other permanently attached to the liferaft in such a way that when the liferaft inflates or it is waterborne it will cause the liferaft to lie oriented to the wind in the most stable manner;
- two buoyant paddles;
- three tin-operators and a pair of scissors;
- one first-aid outfit in a waterproof case capable of being closed tightly after use;
- one whistle or equivalent sound signal;
- four rocket parachute flares;
- six hand flares;
- two buoyant smoke signals;
- an efficient radar reflector;
- one daylight signal mirror with instructions;
- one repair outfit for repairing punctures in buoyancy compartments;
- one topping-up pumps or bellows.

Rigid liferafts

Rigid liferaft

Rigid liferafts shall comply with the the general requirements of 4.2.1 and, in addition with the requirements of this point.

Construction

The buoyancy of the liferaft shall be provided by approved inherently buoyant material placed as near as possible to the periphery of the liferaft. The buoyant material shall be fire-retardant or be protected by a fire-retardant covering.

The floor of the liferaft shall prevent the ingress of water and shall effectively support the occupants out of the water and insulate them from cold.

Access into rigid liferafts

At least one entrance shall be fitted with a boarding ramp, capable of supporting a person weighing 100 kg sitting or kneeling and not holding onto ant other part of liferaft, to enable persons to board the liferaft from the water.

Entrances not provided with a boarding ramp shall have a boarding ladder, the lowest step of which shall be situated not less than 0.4m below the liferaft's light waterline.

There shall be means inside the liferaft to assist persons to pull themselves into the liferaft from the ladder.

Marking on rigid liferafts

The liferaft shall be marked with:

- name and port of registry of the vessel to which it belongs;
- serial number;
- name of approving authority;
- number of persons it is permitted to accommodate over each entrance in characters not less than 100 mm in height of a colour contrasting with that of the liferaft.
- type of emergency pack enclosed;
- length of painter;
- launching instructions.

4.2.2 Lifeboats

Lifeboat

General requirements for lifeboats
Construction of lifeboats

All lifeboats shall be properly constructed and shall be of such form and proportions that they have ample stability on the water and sufficient freeboard when loaded with their full complement of persons and equipment, and are capable of being safely launched under all conditions of trim. All lifeboats shall have rigid hulls and shall be capable of maintaining positive stability when is an upright position in calm water and loaded with their full complement of persons and equipment and holed in any one location below the waterline, assuming no loss of buoyancy material and no other damage.

Each lifeboat shall be fitted with a permanently affixed approval plate, containing at least following items:

- manufacturer's name and address;
- lifeboat model and serial number;
- month and year of manufacture;
- number of persons the lifeboat is approved to carry.

All lifeboats shall be of sufficient strength to:

- enable them to be safely launched into the water when loaded with their full complement of persons and equipment; and
- be capable of being launched and towed when the vessel is making headway at a speed of 5 knots (approx. 7 km/h) in calm water.

Hull and rigid covers shall be fire-retardant or non-combustible.

Seating shall be provided on thwarts, benches or fixed chairs which are constructed so as to be capable of supporting a static load equivalent to the number of persons, each weighing 100 kg. Each lifeboat to be launched by falls shall have sufficient strength to withstand a load, without residual deflection on removal of that load.

Lifeboat buoyancy

All lifeboats shall have inherent buoyancy or shall be fitted with inherently buoyant material which shall not be adversely affected by water, oil or oil products, sufficient to float the lifeboat with all its equipment on board when flooded and open to the waterway.

Lifeboat propulsion

Every lifeboat shall be powered by a compression-ignition engine. No engine shall be used for any lifeboat if its fuel has a flashpoint of 43^0 C or less..

The engine shall be provided with either a manual starting system, or a power starting system, or a power starting system. Any necessary starting aids shall also be provided.

Lifeboat fittings

All lifeboats shall be provided with at least one drain valve fitted near the lowest point in the hull which shall automatically open to drain water from the hull when the lifeboat is not waterborne and shall automatically close to prevent entry of water when the lifeboat is waterborne. Each drain valve shall be provided with a cap or plug to close the valve, which shall be attached to the lifeboat by a lanyard, a chain or other suitable means. Drain valves shall be readily accessible from inside the lifeboat and their position shall be clearly indicated.

All lifeboats shall be provided with a rudder and tiller.

Lifeboat markings

The number of persons for which the lifeboat is approved.

The name and port of registry of the vessel to which the lifeboat belongs shall be marked on each side of the lifeboat's bow.

4.3 Requirements for endowment of inland waterway vessels with life-saving appliances

4.3.1 Vessels intended for the carriage of goods

Lifebuoys

On board vessel there shall be at least **three lifebuoys**:

- in accordance with European Standard EN 14144:2003; or
- in accordance with the 1974 International Convention for the Safety of Life at Sea (SOLAS 1974), Chapter III, Regulation 7.1, and the International Life-Saving Appliances (LSA) Code, sub-section 2.1.

They shall be ready for use and attached to the deck at appropriate points without being attached to their mounting. At least one lifebuoy shall be in the immediate vicinity of the wheelhouse and shall be equipped with a self-igniting, battery-powered light that will not be extinguished in water.

Lifejacket

A personalized, automatically inflatable life jacket shall be provided within reach of every person who is regularly on board of the vessel. Such life jackets shall conform to:

- European Standards EN ISO 12 4022:2006, EN ISO 124023:2006, EN ISO 124024:2006; or
- the 1974 International Convention for the Safety of Life at Sea (SOLAS 1974), Chapter III, Regulation 7.2, and the International Life-Saving Appliances (LSA) Code, sub-section 2.2.

Non-inflatable lifejackets in accordance with these Standards shall also be admissible for children.
Lifejackets shall be inspected in accordance with the manufacturer's instructions.
Ship's boat
The following vessels shall carry a ship's boat according to European Standard EN 1914:2016:

- motor vessels and barges exceeding 150 tdw;
- tugs and pushers with a water displacement of more than 150 m^3;
- floating equipment;
- passenger vessels.

It shall be possible for one person to launch such ship's boat safely within 5 minutes from the first manual action. If a powered launching device is used this shall be such that safe, quick launching shall not be impaired if its power supply fails.
Inflatable ship's boats shall be inspected according to manufacturer's instructions.

4.3.2. Passenger vessels

Life-saving equipment

In addition to the lifebuoy specified for cargo vessels, all parts of the deck intended to passengers and not enclosed shall be equipped with suitable lifebuoys, which shall be positioned on both sides of the vessel not more than 20 m apart. Lifebuoys shall be considered as suitable if they comply with:

- the European Standard EN 14144:2003; or
- the 1974 International Convention for the Safety of Life at Sea (SOLAS 1974), Chapter III, Regulation 7.1, and the International Life-Saving Appliances (LSA) Code, sub-section 2.1.

Half of the prescribed lifebuoys shall be fitted with a buoyant cord at least 30 m long with a diameter of 8 to 11 m. The other half of the prescribed lifebuoys shall be fitted with a self-igniting, battery-powered light which will not be extinguished in water.
In addition to the lifebuoys mentioned above, individual life-saving equipment shall be provided within reach for all shipboard personnel. For shipboard personnel not responsible for undertaking duties according to the safety rota non-inflatable or semi-automatically inflatable lifejackets are allowed.
Passenger vessels shall have appropriate equipment to enable persons to be transferred safely to shallow water, to the bank or another craft.
In addition to the life-saving equipment referred above, individual life-saving equipment shall be available for 100% of the maximum permitted number of passengers. Non-inflatable or semi-automatically inflatable lifejackets are also allowed.
The term "collective life-saving appliances" covers ship's boats and life rafts.
Life rafts shall:

- bear a notice indicating their purpose and the number of persons for whom they are approved;
- offer adequate seating space for the permitted number of persons;
- provide a buoyancy of at least 750 N per person in fresh water;
- be provided with a rope linked to the passenger vessel to prevent them drifting away;
- be made of suitable materials and be resistant to oil, oil products and temperatures up to 50^0;
- assume and maintain a stable trim and, in this respect, be fitted with appropriate devices enabling them to be grabbed by the indicated persons;
- be fluorescent orange in colour or have fluorescent surfaces, visible from all sides, of at least 100 cm^2;
- be such that they can be released from their stowed position and put overboard quickly and safely by one person, or can float free from their stowed position;

- be provided with appropriate means of evacuation from the evacuation areas, onto the life rafts if the vertical distance between the deck of the evacuation area and the plane of maximum draught is greater than 1 m.

5.

ASSISTANCE IN RESCUE OPERATIONS

COMPETENCE

Provide assistance in the case of rescue operations

5.1 Search and rescue operation

With the purpose of understanding correctly the term of search and rescue it is important to establish the time and circumstances of its formation, its history and normative-legislative interpretation accepted by the majority of countries across the world through their signing and accepting international conventions.

5.1.1 Search on Inland Waterways

The search on inland waterways should be adapted to the configuration of inland waterways and temporary safety conditions on the waterway. Safety conditions on the inland waterway include:

- waterway confinement;
- influence of water currents;
- water level;
- weather conditions;
- other factors.

The theory of the search on inland waterways is considered to be insufficiently developed in comparison to the theory of the search at sea. A partial reason of underdevelopment can be accepted to be insufficient usage of inland waterways compared to those of the sea.
River Information Services contribute to safe and more efficient transport processes and enable the full usage of watercourse capacities, faster integration of water traffic with other means of traffic.

Water Course Traffic Services

The Water Course Traffic Services which are currently applied in most of European countries are the main central units of the search and on water service. The manager of this centre is responsible for its work, and the centre needs to have:

- a detailed plan of search and rescue on water;
- proper facilities in order to be functional;
- means and equipment for search and rescue, especially for communications; and
- trained personnel.

The work of the centre is based on the plan and contains regulations and data on:

- procedures;
- the work of certain departments within the search and rescue on water service;
- means of communications and the way they are used;
- staff that take part in the search and rescue tasks; and
- the information gathered.

The centre must possess reliable equipment for receiving aid calls, equipment for maintaining communication via land or radio equipment with the rescue units, rescue centres within sectors, main stations for RIS, centres for supervising air transport, meteorological devices, centres for coordination with the surrounding areas, vessels, medical institutions, hydro-meteorological institution etc.

5.1.2 The engagement of search and rescue units

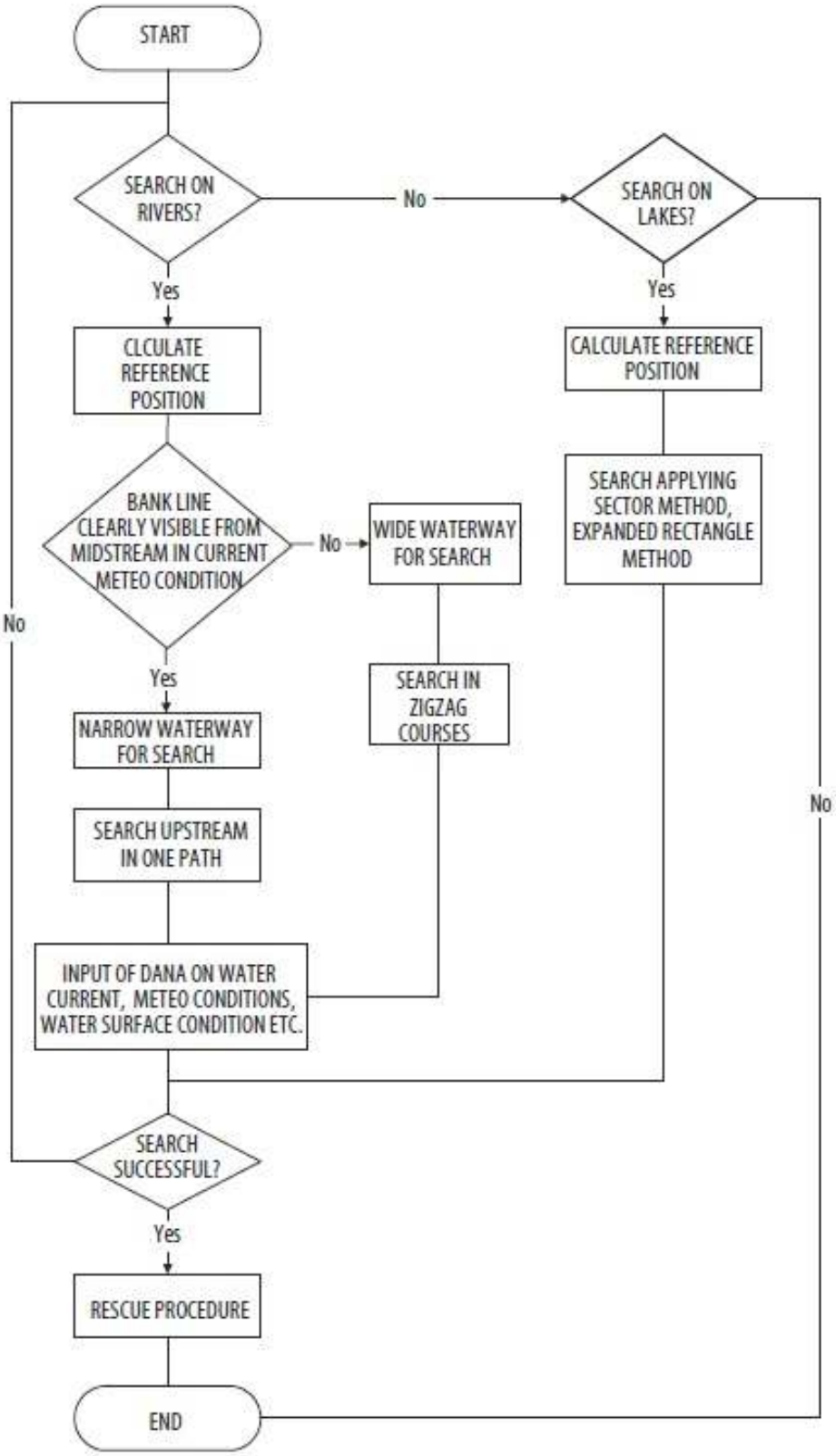
Search and rescue on inland waters missions for the engaged units involves planned and organized activities on locating and rescuing people or crafts as well as eliminating the consequences of the accidents on and near the inland waterways.
The most important factors which are taken into consideration and analysed when assessing the possibility of engaging units in carrying out search and rescue on inland waters tasks are the type, scale and characteristics of the accidents, the conditions of planning, organising and completing the search and rescue tasks, and the feasibility of fulfilling search and rescue tasks.

Depending on their consequences, inland water accidents can be:

- accidents with human casualties;
- accidents with material damage;
- accidents involving consequences on the environment.

The units engaged in search and rescue operations shall perform the following tasks:

- searching for, locating and salvaging crafts and other objects;
- rescuing the crew of the sunken and damaged crafts and other objects;
- searching for, locating and rescuing the distressed ones in the accidents;
- hauling the stranded and less damaged crafts, providing aid, mending minor damages on a craft, making the craft fit for sail to the maintenance companies and aid providing stations;
- keeping the sinking craft fit for sail, especially if its crew cannot do that relying on their own resources;
- providing assistance to the crafts caught on fire;
- eliminating environmentally hazardous consequences of an accidents; and
- diving and other underwater tasks with the aim of ensuring the craft's ability to sail and navigate safely.



General search algorithm for the rescue of a drowning person on inland waterways

Computer programs should be developed in order to improve search and rescue services on inland waterways. A better organization of search and rescue operations would contribute to greater success in the protection of human lives and assets and would greatly increase the safety of navigation on inland waterways.

5.2 Rescue and transport a casualty

Man overboard recovery

Man overboard recovery presents some difficult issues. The first problem is that of locating the casualty and the second that of recovering him.

If the casualty is seen to fall overboard or is subsequently located, it is vital that as many persons as is practically possible are detailed to continuously visually observe his position. Once the casualty has been found or if seen to fall overboard the location can be marked with a lifebuoy.

Practice has shown that different man overboard manoeuvres may be required depending upon the situation prevailing and the type of vessel involved.

Actually recovering a person from the water is usually achieved by use of a lifeboat.

In some conditions practiced and skilled crew members may use the lifeboat to recover the casualty.

The condition of a man overboard casualty will depend on a number of factors including how they have responded to the “cold shock”, what they are wearing and how long they have been in the water. They must be rescued with great care or their condition may considerable worsen.

Getting the person on board can be difficult, particularly if the casualty is unconscious or otherwise unable to help himself. If there is no specific recovery equipment a short strap can be quickly made from a length of rope and a parbuckle can be improvised using ropes or nets.

If possible the casualty should be recovered horizontally rather than vertically, particularly if they have been in the water for some time.

5.3 Swimming for rescue operations

Rescue Swimming refers to skills that enable an individual to attempt a rescue when a swimmer is in difficulty. These include a combination of communication skills, specific "rescue" swimming strokes, and release and evade techniques for self-preservation should the rescue go wrong.

From the outset once a swimmer in difficulty is spotted, eye contact must be maintained at all times.

Assess the situation: environment, available physical equipment, others who can help, etc.

Attempt to establish voice contact, which if successful can often result in a "voice-rescue."

A rescuer should enter the water only as a last resort.

Rescues should be attempted in the following order: talk, throw, reach, wade, row, swim, tow and carry.

6.

EMERGENCY ESCAPE ROUTES

COMPETENCE

Use emergency escape routes

6.1 Safety organization

According to the provisions of the European Standard laying down Technical Requirements for Inland Navigation vessels (ES-TRIN), Edition 2017/1 adopted by CESNI, safety organization on board of the inland vessels consists of:
A safety rota shall be provided on board passenger vessels. The safety rota describes the duties of the crew and the shipboard personnel in the following eventualities:

- breakdown;
- fire on board;
- evacuation of passengers;
- person overboard.

Specific safety measures for persons with reduced mobility shall be taken into consideration.
The crew members and shipboard personnel designated in the safety rota should be assigned their various duties, depending on the posts they occupy. Special instructions to the crew shall ensure that, in the event of danger, all doors and openings in the watertight bulkheads will be hermetically closed immediately.
The safety rota includes a safety plan, in which at least the following are clearly and precisely designated:

- areas intended for use by persons with reduced mobility;
- escape routes, emergency exits and muster and evacuation areas;
- life-saving equipment and ship's boat;
- fire extinguishers and fire extinguishing and pressurised sprinkler systems;
- other safety equipment;
- the alarm system;
- the bulkhead doors and the position of their controls, as well as the other openings;
- doors;
- fire dampers;
- fire alarm system;
- emergency power plant;
- ventilation system control units;
- shore connections;
- fuel line shut-offs;
- liquefied gas installations;
- public address systems;
- radiotelephone equipment;
- first-aid kits.

The safety rota shall:

- be dully stamped by the inspection body, and
- be prominently displayed at an appropriate point of each deck.

6.2 Safe escape routes

Safe escape routes should be provided on board of passenger vessels, which must meet the following requirements:

- escape routes should be maintained in a safe condition, clear of obstacles;
- additional aids for escape should be provided as necessary to ensure accessibility, clear marking, and adequate design for emergency situations;
- stairways, ladders and corridors serving crew spaces and other spaces to which the crew normally have access should be arranged so as to provide ready means of escape to a deck from which embarkation into survival craft may be effected.

There should be at least two means of escape, as widely separated as possible, from each section of accommodation and service spaces and control stations.
The normal means of access to the accommodation and service spaces below the open deck should be arranged so that it is possible to reach the open deck without passing through spaces containing a possible source of fire (e.g. machinery spaces, storage spaces of flammable liquids).
The second means of escape may be through portholes or hatches of adequate size and preferably leading directly to the open deck.
At least two means of escape should be provided from machinery spaces, except where the small size of a machinery space makes it impracticable. Escape should be by steel ladders that should be as widely separated as possible.

7.

INTERNAL EMERGENCY COMMUNICATION AND ALARM SYSTEM

COMPETENCE

Use internal emergency communication and alarm system

7.1 Emergency communication system

7.1.1 Internal communication facilities on board

There shall be internal communication facilities on board vessels with a wheelhouse designed for radar navigation by one person. It shall be possible to establish communication links from the steering position:

- with the bow of the vessel or convoy;
- with the stern of the vessel or convoy if no direct communication is possible from the steering position;
- with the crew accommodation;
- with the boatmaster's cabin.

Reception at all positions of these internal communication links shall be via loudspeaker, and transmission shall be via fixed microphone. The link with the bow and the stern of the vessel or convoy may be of the radio-telephone type.

7.1.2 Special provisions applicable to passenger vessels

Electrical equipment

Only electrical equipment shall be permitted for lighting.

For the following rooms and locations, adequate lighting and emergency lighting shall be provided:

- location where life-saving equipment is stored and where such equipment is normally prepared for use;
- escape routes, access for passengers, including gangways, entrances and exits, connecting corridors, lifts and accommodation area companionways, cabin areas and accommodation areas;
- markings on the escape routes and emergency exits;
- in other areas intended for use by persons with reduce mobility;
- operation rooms, engine rooms, steering equipment rooms and their exits;
- wheelhouse;
- emergency electrical power source room;
- points at which extinguishers and fire extinguishing equipment controls are located;
- areas in which passengers, shipboard personnel and crew, muster in the event of danger.

There shall be an emergency power plant, consisting of an emergency electrical power source and emergency switchboard, which, in the event of a failure of the supply to the following electrical equipment, can immediately take over as their replacement supply, where the equipment does not have its own electrical power source:

- navigation lights;
- audible warning devices;
- emergency lighting;
- radiotelephone installations;
- alarm, loudspeaker and on-board message communications systems;
- searchlights;
- fire alarm system;
- other safety equipment such as automatic pressurised sprinkler systems or fire extinguishing pumps;
- lifts and lifting equipment.

The light fittings for the emergency lighting shall be marked as such.
The emergency power plant shall be installed outside the main engine room, outside the rooms housing the power sources and outside the room where the main switchboard is located.
Cables feeding the electrical installations in the event of an emergency shall be installed and routed in such a way as to maintain the continuity of supply of these installations in the event of fire and flooding. These cables shall never be routed through the main engine room, galleys or rooms where the main power source and its connected equipment is installed, except insofar as it is necessary to provide emergency equipment in such areas.
The emergency power plant shall be installed either above the margin line or as far away as possible from the power sources, so as to ensure that, in the event of flooding it is not flooded at the same time as these power sources.

7.2 Alarm system

There shall be an independent alarm system enabling the accommodation, engine rooms and, where appropriate, the separate pump rooms to be reached.
The helmsman shall have within reach an on/off switch controlling the alarm signal; switches which automatically return to the position when released are not acceptable.
The sound pressure level for the alarm signal shall be at least 75 dB (A) within the accommodation area.
In engine rooms and pump rooms the alarm signal shall take the form of a flashing light that is visible on all sides and clearly perceptible at all points.

8. REFERENCE DOCUMENTS

- Consolidated text of SOLAS- The International Convention for Safety of Life at Sea, 1974, incorporating all amendments in effect from 1 July 2014, IMO 2014;
- International Life- Saving Appliances Code, LSA Code, IMO 2010;
- European Standard laying down Technical Requirements for Inland Navigation vessels- ES-TRIN, CESNI 2017
- Model of the Search and Rescue operations in Republic of Serbia, University of Defence, Military Academy of the Republic of Serbia, June 2015;
- A proposal for the models and measures of search and rescue on inland waterways, University of Split, Maritime Science Academy, Croatian Hydrographic Institute, Faculty of Traffic Science, Croatia, May 2010;
- Guidelines on the Service of Radiocommunication in Inland Waterways- General Part, Edition 2017, approved by Danube Commission, Moselle Commission and Central Commission for the Navigation on the Rhine;
- www.freepik.com;
- www.pixabay.com.

MODULE IV

Interreg
Danube Transnational Programme
Danube SKILLS

Project co-funded by European Union funds (ERDF, IPA)

TRAIN THE TRAINER

- FIRE FIGHTING -

Table of content

1. INTRODUCTION

This course compendium was designed both for trainers who will be involved in training of such training module and the trainees as learning aids in order to facilitate the learning process.
This course compendium aims to assist in the implementation of the new European Directive on the recognition of professional qualifications in inland navigation personnel and in meeting the requirements of the Standards of competences for inland navigation personnel- Operational level that will be part of this legislative act.
The **main objective** of this course compendium is to provide practical guidance on fire prevention and fire fighting with a view to preventing accidents during operation of inland vessels and to ensure safety of the crew and of the vessels by means of fire prevention and fire fighting measures.

2. LEARNING OUTCOMES

By the end of this course, trainees will be able to:

- Initiate actions on becoming aware of an emergency in accordance with accepted practices and procedures;
- Take action on identifying appropriate muster signals corresponding to subject emergency and comply with established procedures;
- Use various types of extinguishers;
- Use self-contained breathing apparatus;
- Extinguish smaller fires;
- Extinguish extensive fires with water, using jet and spray nozzles;
- Extinguish fires with foam, powder or any other suitable chemical agent;
- Enter and pass through, with lifeline but without breathing apparatus, a compartment into which high-expansion foam has been injected;
- Fight fire in smoke-filled enclosed spaces wearing self-contained breathing apparatus;
- Effect a rescue in a smoke-filled space wearing breathing apparatus.

3.

FIRE THEORY AND FIRE CLASSIFICATION

COMPETENCE

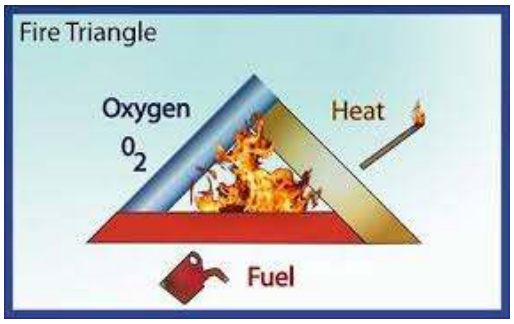
Distinguish the elements of fire and types and sources of ignition

3.1 Fire

3.1.1 Introduction

Every fire on the ship poses a great risk to the ship, crew and the environment, which is why a great attention is paid to this problem. According to Lloyd's statistics, most of the total number of fires appearing on the ship end with a complete loss of the ship. After collision, ship fires take second place in terms of damage in water traffic. The fires are very dangerous and often lead to extensive human casualties, as the crew and passengers cannot easily and quickly skip this hazard. If the fire is promptly detected, the crew can prevent larger damages by taking immediate measures – such as fighting the fire by use of a fire hose under breathing protection.
The most common causes of shipboard fire are the most obvious: maintenance burning and welding are responsible for nearly 40% of all outbreaks. Smoking leads to countless fires that break out when no one expects. Lack of attention, spontaneous combustion and electrical faults are the major causes. The engine room is at special risk from flashbacks in oil fired boilers, leaky piping carrying oil, overheated bearings and even the accumulation of rubbish (oil rags, dirty oil, tins of oil, etc.). The causes of engine room fires can usually be traced back to a lack of maintenance or bad watch keeping practices. They are usually caused by fuel spills, overheating components or careless use of electric welding or gas brazing gear.

3.1.2 What is fire?



Fire is the rapid oxidation of any combustible material. It is a chemical reaction involving fuel, heat, and oxygen. These three elements, commonly referred to as the fire triangle, in the right proportions, will always produce a fire. Remove any one side of the triangle and the fire will be extinguished.

Further fire research determined that a fourth element, a chemical chain reaction, was a necessary component of fire. The fire triangle was changed to a fire tetrahedron to reflect this fourth element. A tetrahedron can be described as a pyramid which is a solid having four plane faces. Essentially all four elements must be present for fire to occur, fuel, heat, oxygen, and a chemical chain reaction.

Once ignited, a chain reaction must take place whereby fires can sustain their own heat by the further release of heat energy in the process of combustion and may propagate, provided there is a continuous supply of an oxidizer and fuel. Removal of any one of these essential elements will result in the fire being extinguished.

Combustion process

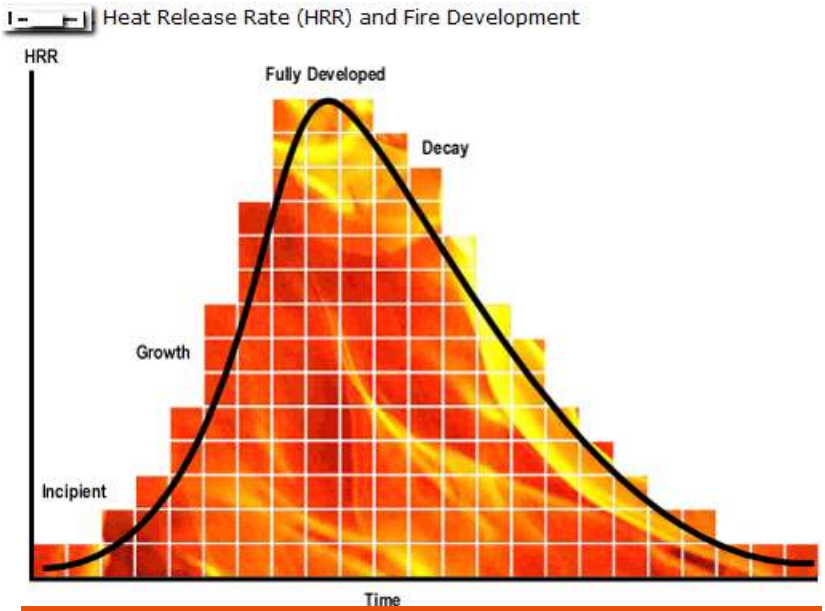
The combustion process occurs in two modes:

- the flaming;
- the non - flaming, smoldering or glowing embers.

For the flaming mode it is necessary for solid and liquid fuels to be vaporized. The solid fuel vapours are thermally driven off, or distilled and the liquid fuel vapours evaporated. It is this volatile vapour from the solid or liquid fuels that we see actually burning in the flaming mode. This gas or vapour production, emitted from the fuel is referred to as pyrolysis. Once a flame has been established, heat transfer from the flame to the fuel surface continues to drive off more volatile gases and perpetuates the combustion process. Continued burning in the flaming mode requires a high burning rate, and the heat loss associated with transfer of heat from the flame area by conduction, convection and radiation must be less than the energy output of the fire. If the heat loss is greater than the energy output of the fire the fire will extinguish.
Both modes, flaming and non-flaming surface modes, can occur singly, or in combination. Flammable liquids and gases only burn in the flaming mode. Wood, straw, and coal are examples where both modes may exist simultaneously.

Stages of a fire

Incipient – This first stage begins when heat, oxygen and a fuel source combine and have a chemical reaction resulting in fire. This is also known as "ignition" and is usually represented by a very small fire which often (hopefully) goes out on its own, before the following stages are reached. Recognizing a fire in this stage provides your best chance at suppression or escape.
Growth – The growth stage is where the structures fire load and oxygen are used as fuel for the fire. There are numerous factors affecting the growth stage including place where the fire started, what combustibles are near it, ceiling height and the potential for "thermal layering". It is during this shortest of the 4 stages when a deadly "flashover" can occur; potentially trapping, injuring or killing the firefighters.
Fully Developed – When the growth stage has reached its max and all combustible materials have been ignited, a fire is considered fully developed. This is the hottest phase of a fire and the most dangerous for anybody trapped within.
Decay – Usually the longest stage of a fire, the decay stage is characterized by a significant decrease in oxygen or fuel, putting an end to the fire. Two common dangers during this stage are first – the existence of non-flaming combustibles, which can potentially start a new fire if not fully extinguished. Second, there is the danger of a backdraft when oxygen is reintroduced to a volatile, confined space.



Heat Release Rate and Fire Development

Summary

A fire begins by an external ignition source in the form of a flame, spark, or hot ember. This external ignition source heats the fuel in the presence of oxygen. As the fuel and oxygen are heated, molecular activity increases. If sufficiently heated, a self-sustaining chemical chain reaction or molecular activity occurs between fuel and oxygen. This will continue the heating process and the resulting chain reaction will escalate without the need for an external ignition source. Once ignition has occurred, it will continue until

- all the available fuel or oxidant has been consumed; or
- the fuel and/or oxygen is removed; or
- by reducing the temperature by cooling; or
- by reducing the number of excited molecules and breaking the chain reaction.
-

Removal of oxygen

Except in those substances that contain their own oxygen, the removal of sufficient oxygen will extinguish a fire.

Small fires can be smothered with sand from a fire bucket, and a rug or blanket can be used to smother flames from a person's clothes. It is imperative to ensure the door is properly closed when leaving a fire to burn in a compartment or room.

Fires in cargo holds can be starved of oxygen by closing hatches and blanking off ventilators. In all spaces affected by fire, ventilation fans should be shut down and doors and other openings closed.

In fire extinguishing operations, oxygen is extinguished by smothering the fire with a layer of foam. Oxygen is also cut off during the operation of portable and semi portable carbon dioxide extinguishers and to some extent, during the operation of dry powder extinguishers. But for CO_2 and dry powder, the smothering action is temporary and there is a possibility for re - ignition.

In total flooding by fixed fire extinguishing systems on board ships, carbon dioxide displaces the air inside the compartment and fire is extinguished due to insufficient oxygen.

Removal of heat

A reduction in temperature is achieved by the use of a suitable cooling medium, normally water, at a sufficient rate. The rate at which heat is removed by the cooling medium must be greater than that produced by the fire. Cooling of boundary bulkheads will reduce the possibility of igniting material outside the affected compartment.

For a given quantity of water, about six times more heat will be removed if the water droplet size is small enough for it to be vaporised into steam. Coincidently, a degree of smothering can also be achieved from the steam generated. Heat can also be absorbed by decomposition of dry powder. The source of power should be cut off in electrical insulation and galley fires.

Removal of fuel

The removal of fuel is not always possible. However, in the case of liquid fuel fires caused by leaking pipes or fittings, the fuel supply should be closed. It may also be possible to drain the fuel from a burning tank.

It is particularly important to shut off the supply in a gas fire. However, gas could also be left burning in a controlled manner to exhaust itself.

In accommodation spaces, combustible materials should be removed from the vicinity of fire, including any adjacent compartment affected by the heat. On some occasions, it may be prudent to dump burning or potentially dangerous materials overboard.

Breaking the chain reaction

A fire may be extinguished by breaking the chain reaction between transient chemical elements produced on ignition (these elements are described as 'transient' since they are not present prior to ignition or in the final products of combustion). For instance, Halogenated hydrocarbons (Halons) and dry powders attack the structure of the elements and prevent their reaction by killing the flame, sometimes in less than one hundredth of a second.

The extinction takes place without any appreciable removal of heat, fuel or oxygen. However, the remaining three sides of the tetrahedron will still be present and, unless the heat is removed, there is a danger of re-ignition if the concentration of extinguishing agent is not maintained.

Explosions

Explosions

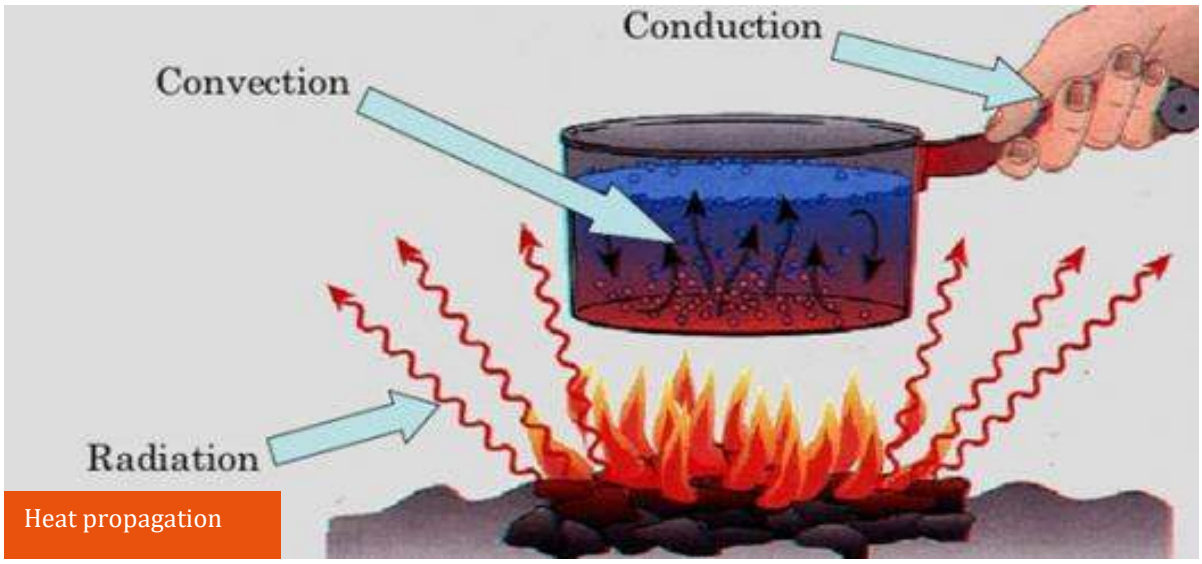
Generally, an explosion is defined as a very rapid release of high-pressure gas into the environment. The energy from this very rapid release of the high-pressure gas is dissipated in the form of a shock wave. Explosions can be classified as physical, a balloon bursting, as physical and/or chemical, a boiler explosion, or a chemical reaction of a gas/particle mixture.

The process of a chemical reaction explosion is similar to the combustion process whereby a fuel and oxidant have premixed prior to ignition such as petroleum vapour or fine particles of grain dust mixed with air. However, in an explosion the oxidation process proceeds at a greatly accelerated rate. The oxidation process is usually, but not always, confined within an enclosure such as a tank, grain silo, so that a rapid high-pressure rise occurs with an associated flame front. Generally, it is this high-pressure shock wave that causes the damaging effects of an explosion.

Resultant shock waves that propagate from the point of ignition at a velocity less than the speed of sound are termed deflagration. Shock wave velocities in excess of the speed of sound are termed detonations.

A rise in pressure creating a shock wave of 6894.76 Pascal's is sufficient to knock a person down. If the rise in pressure creates a shock wave of 13789.52 Pascal's to 20684.28 Pascal's this is sufficient to shatter an 8 to 12-inch thick concrete wall. A Pascal (pa) is equivalent to 1 N/m^2.

Heat propagation



Heat propagation

Conduction

Heat conduction (or **thermal conduction**) is the movement of heat from one solid to another one that has different **temperature** when they are touching each other.

Convection

Convection is the transfer of heat in liquids or by air currents.

Convection can happen naturally ("**natural convection**") or because of a moving device ("**forced convection**").
The fan is a device that produces the movement of the air artificially. The air in this case is moving because of the rotation of the fan. This is an example of "forced convection".

Radiation

Radiation is the emission or transmission of heat through space.
By limiting the heat transfer during a fire, the outcome will be a greatly minimized fire with lower damages or loses.

3.2 Classes of fire

Not all fires are the same. Different fuels create different fires and require different types of fire extinguishing agents.

Class A

Class A fires are fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics. These solid substances are mainly of organic origin and contain carbon and its compounds.
Regardless of the causes of ignition, a class A fire burns solid fuel. It can be extinguished either by water, foam or multi-purpose dry chemical powder. However, for complete extinguishment, class A fires should be entirely cooled down below the ignition temperature of the burning substance.

Embers produced in such kind of fire are reignited if they are left above the ignition temperature and come in contact with oxygen. Smothering (or choking) a class A fire does not completely extinguish the fire because it cannot reduce the temperature of the embers. Therefore, CO2 (Carbon dioxide) and ordinary dry chemical powders are not effective against a class A fire.

Class B

Class B fire refers to a fire involving flammable liquids such as petroleum (gasoline, kerosene, petrol, diesel, octane etc.), paint, alcohol, solvent, oil and tar etc., that normally do not leave any embers or residues (or very low amounts of residues). Most of these liquids have high carbon content and the compounds in them are highly combustible.

A class B fire does not leave embers or ashes and can be best extinguished by providing a wall between the fuel and the oxygen, a technique known as smothering. The most effective extinguishing agent against a class B fire is foam. However, the type of foam to be used depends on whether it is water soluble or hydrocarbon.
A small class B fire can also be extinguished by multipurpose dry chemical powder or by water mist that can effectively cool the fire. Re-ignition may also occur if the sources of heating the substance (above the ignition temperature) are not removed. One should never use water stream on a class B fire as it helps to spread the fire since these liquids are lighter than the water.

Class C

Class C fires include flammable gases such as propane and butane. Class B fires do not include fires involving cooking oils and grease. These gases are highly combustible and may cause large scale fires and explosions if mixed with enough oxygen.
A class C fire does not leave embers or ashes and can be best extinguished by dry chemical powder and CO_2.

Before trying to extinguish a class C fire, the source of the gaseous substance must be found and cut off. This can be done by closing the valve of the gas containing cylinder. A spark in the presence of any of these gasses, with the required amount of oxygen, may also cause an explosion.

Electrical fire – not classified (formerly Class E)

This type of fire involves energized electrical equipment such as motors, transformers, and appliances.
Electrical fires are fires involving potentially energized electrical equipment.
The US system designates these as "Class C"; the Australian system designates them "Class E". This sort of fire may be caused by short-circuiting machinery or overloaded electrical cables.

These fires can be a severe hazard to firefighters using water or other conductive agents, as electricity may be conducted from the fire, through water, to the firefighter's body, and then earth. Electrical shocks have caused many firefighters' deaths.
Electrical fire may be fought in the same way as an ordinary combustible fire, but water, foam, and other conductive agents are not to be used. While the fire is or possibly could be electrically energized, it can be fought with any extinguishing agent rated for electrical fire. Carbon dioxide CO_2, NOVEC 1230, FM-200 and dry chemical powder extinguishers such as PKP (Purple-K) and even baking soda are especially suited to extinguishing this sort of fire. PKP should be a last resort solution to extinguishing the fire due to its corrosive tendencies. Once electricity is shut off to the equipment involved, it will generally become an ordinary combustible fire.
In Europe, "electrical fires" are no longer recognized as a separate class of fire as electricity itself cannot burn. The items around the electrical sources may burn. By turning the electrical source off, the fire can be fought by one of the other class of fire extinguishers.

Class D

Class D fires are fires in combustible metals such as potassium, sodium, aluminium and magnesium.
Metal fires represent a unique hazard because people are often not aware of the characteristics of these fires and are not properly prepared to fight them. Therefore, even a small metal fire can spread and become a larger fire in the surrounding ordinary combustible materials. Certain metals burn in contact with air or water (i.e. sodium), which exaggerate this risk.

Generally speaking, masses of combustible metals do not represent great fire risks because heat is conducted away from hot spots so efficiently that the heat of combustion cannot be maintained. In consequence, significant heat energy is required to ignite a contiguous mass of combustible metal.

Generally, metal fires are a hazard when the metal is in the form of sawdust, machine shavings or other metal "fines", which combust more rapidly than larger blocks. Metal fires can be ignited by the same ignition sources that would start other common fires.
Care must be taken when extinguishing metal fires. Water and other common firefighting agents can excite metal fires and make them worse.
The most common agents are sodium chloride granules and graphite powder. In recent years, powdered copper has also come into use. These dry powder extinguishers should not be confused with those that contain dry chemical agents. The two are not the same, and only dry powder should be used to extinguish a metal fire. Using a dry chemical extinguisher in error, in place of dry powder, can be ineffective or actually increase the intensity of a metal fire.

Class F

Class F fires are fires in cooking oils and greases such as animal fats and vegetable fats.
Class F fires involve unsaturated cooking oils in well-insulated cooking appliances located in commercial kitchens.
Fires that involve cooking oils or fats are designated "Class K" under the American system, and "Class F" under the European/Australian systems.
Though such fires are technically a subclass of the flammable liquid/gas class, the special characteristics of these types of fires, namely the higher flash point, are considered important enough to be separately classified. Water mist can be used to extinguish such fires. Appropriate fire extinguishers may also have hoods over them that help extinguish the fire. Sometimes fire blankets are used to stop a fire in a galley or on a stove.

3.3 Sources of ignition

Fires start as a result of the combination of three agents: fuel, oxygen and an ignition source. Ignition sources include hot surfaces, electricity, static electricity, flames, sparks or smoke. In workplace risk assessments and safety precautions, every attempt should be made to identify and avoid the accidental combination of fuel, oxygen and an ignition source in order to prevent fires.
Fire risk assessments are an essential component of workplace hazard identification. Ignition sources must be identified and steps must be designed to minimize the chance of fire and the risks incurred by workers should a fire break out. Since oxygen is present in almost all processes, primary precautions are based on the handling and use of flammable materials (the fuel) and the prevention of accidental ignition through an ignition source. The use of static electricity free safety footwear is an example of a precaution aimed at eliminating an ignition source, in this case, static electricity.

4.

COMMON SHIPBOARD FIRE HAZARDS AND FIRE PREVENTION

COMPETENCE

Act according to shipboard fire-fighting procedures and organization

4.1 Smoking and naked lights

Careless smoking tops the list of causes of fire.
Smoking is a strong habit and poses a great risk as people not only tend to smoke without any regard to circumstances or location but also they hardly pay any heed to the safe disposal of lit cigarettes, cigars, pipe tobacco and matchsticks.
Temperature of a burning cigarette is about 500 ^{0} C. Thus glowing ashes and tobacco contain enough heat to start a fire in such materials as dunnage, paper, cardboard, cordage, linen and beddings.
If a person is tired after a busy day and smoking in bed, a smouldering fire can result if the glowing tobacco touches the bedding; resulting smoke will most certainly cause drowsiness and possible suffocation or asphyxiation of this person before the fire is discovered.
A person who has been drinking alcohol and smoking too, tends to be careless and has to be observed carefully by other crew members so that his careless actions do not jeopardize safety of crew and vessel.

Safety labels

Thus open flames, glowing embers and smoke can prove dangerous as well as unhygienic.
Smoking is therefore permitted on board a ship, only in designated smoking areas. These areas must be identified and clearly marked accordingly.

In port, shore personnel boarding the vessel for various works should be appraised of shipboard smoking regulations as well as locations of designated smoking areas on board.
Safety matches and / or cigarette lighters must never be carried on person outside ship's accommodation.
Many terminals expressly forbid smoking or even carrying on person of matchboxes and / or cigarette lighters, around their premises.

4.2 Spontaneous combustion and auto ignition

Some materials when damp or soaked with paints, oils of vegetable origin in particular can ignite without external application of heat.
Auto ignition temperature of a material is the temperature at which a flammable material will ignite without initiation of a spark or flame.
Spontaneous combustion is the process of gradual increase in temperature of a material as a result of oxidation, without drawing any heat from its surrounding. This process finally results in ignition of the material concerned.
Lagging on steam pipes or cotton rags if soaked with oils and or paints and stocked in a warm area without ventilation is prone to spontaneous combustion. This oil begins to oxidise and produces heat in the process. This heat causes the remaining oil to oxidise faster and produce still more heat that will start building up around the rag. This in turn will ignite any other flammable substance resulting in a major fire.
Petroleum liquids when heated sufficiently will ignite without the application of a naked flame. When fuel or lube oil under pressure sprays onto a hot surface, it will get hotter and will auto ignite as a result.
Attention!
a. Any oil saturated lagging must be removed at once and safely disposed of;

b. Oily rags, rags used for cleaning paint drums or soaked in paint thinners, saw dust impregnated with oil should be stored in a safe location in covered containers and disposed of in a proper way as early as possible.
c. Oil feeder piping need attention to avoid oil being sprayed from leaks.
d. Good house-keeping is the only effective answer to prevent fire due to spontaneous combustion and auto ignition.
e. Cotton rags used for mopping cargo tanks, which have carried any vegetable oil as last cargo, are extremely prone to spontaneous combustion.

4.3 Electrical circuits and electrical equipment

Electricity is a safe and convenient source of power if the equipment concerned is properly insulated and wired. If worn-out, misused or poorly wired electrical energy is converted into heat and the equipment concerned becomes a source of ignition and thus a fire hazard.
Only approved electrical equipment for shipboard use that will stand the strenuous conditions are installed and/or used on board a vessel. Any electrical equipment on board must be installed, maintained, tested and repaired in accordance with existing regulations and only by qualified personnel.


Safety label

a. Electrical wires that have bad insulation should be renewed;
b. Fuses and circuit breakers installed will be of proper size for their respective circuits;
c. Jury-rigging of an electrical outlet (to connect more than one appliance on one outlet) should be avoided;
d. Prior leaving cabin for work, crewmember must switch off every light bulb in the cabin. Overloading is dangerous. Only one appliance must be connected to each outlet in an electric circuit;
e. Vapour tight electrical fixtures cause the insulation to dry out and crack more rapidly than standard fixtures and should be examined carefully;
f. Electrical motors should be regularly inspected, tested, lubricated and cleaned;
g. While storage batteries are being charged, they emit hydrogen, which is lighter than air and a highly flammable gas, a battery room thus should have ventilation at the highest point. Smoking and any other source of ignition is strictly prohibited in a battery room;
i. When air driven lamps are to be used in non-gas free atmosphere, to avoid static electricity accumulation, following precautions must be observed:

- air supply should have a water trap incorporated;
- the supply hose must be of a low electrical resistance.

h. Torches and Portable battery powered equipment:

- Flashlights approved by a competent authority for use in flammable atmospheres must be used on board a tanker;
- Only intrinsically safe type UHF/VHF portable walkie-talkie must be used;
- Battery powered personal items like wristwatch, hearing aid and heart pacemakers are not considered as significant ignition sources;

- Ship staff must be warned against replacement / renewal of torch cells / batteries outside ship's accommodation.

Unless approved for use in flammable atmosphere, portable radios, walk-mans, portable CD players, calculators, cameras, cell phones and radio pagers must not be used on a tanker deck or areas where flammable gases may be present.

4.4 Radio transmitting antenna

During medium and high frequency radio transmission, significant energy is radiated which can induce an electrical potential capable of producing an incentive spark, in unearthed receivers within 500mtr range from transmitting antennae. In case antenna insulators have a surface coating of salt, dirt or water, high or medium frequency transmission can cause arcing. Low energy transmissions such as satellite communication or use of UHF/VHF communication is not considered dangerous.

All stays, cranes, derricks and fittings must be earthed.

During cargo loading/transfer/discharge, cargo tank washing, cargo tank purging operations, MF-HF transceiver to be switched off.

Properly sited radars do not present any ignition hazard on board a vessel but use of ship's 10 cm radar is capable of including an electrical potential into nearby conductors ashore.

Ship's Galley

Smoking is strictly forbidden in ship's galley!!

Once vessel leaves port, the cooking range battens are to be use at all times. Electrical power to any hot plate not in use must be switched off. No cloth or paper should be stowed above a cooking range as it can be ignited easily through carelessness.

Good housekeeping is of utmost importance. Used boxes, bags, paper, food leftovers should be placed in covered non-combustible refuse bins.

Hoods, filters and ductwork for cooking rangers shall be thoroughly cleaned every week and no oil/grease accumulation is allowed in and around hot plates.

A deep fryer can be a source of both heat and fuel for a galley fire.

Safety label

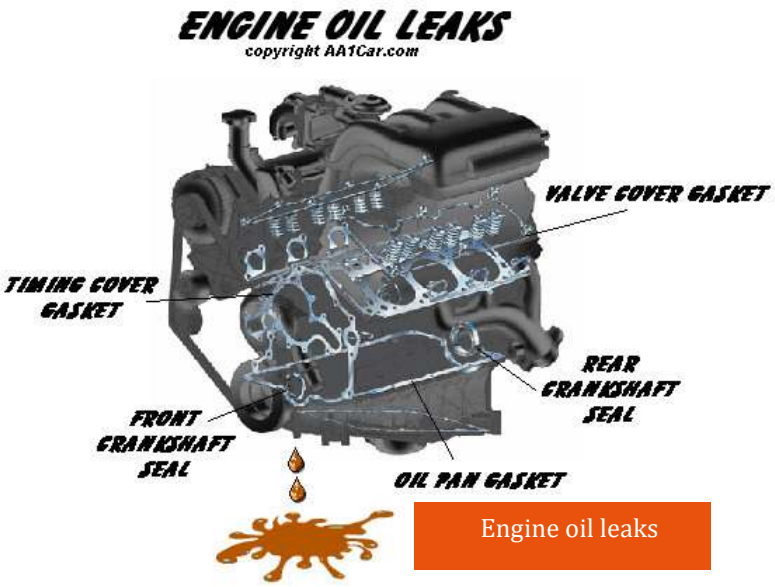
The fryer should be fixed in a location and must never be left unattended while it is operating. Fryer basket should never be filled so full that grease splatters and overflows.

4.5 Flammable liquids used on board vessels

Most commonly found on board are bunker fuels, lube oils of various grades, diesel oils, kerosene, paints and thinners.

For some flammable liquids, rate of vapour release is over a wide temperature range e.g. gasoline gives off vapour even at minus 43c thus proving itself a continuous fire hazard. Heating increases the rate of vapour release. This vapour is heavier than air, will seek low places, can spread to a distant source of ignition and dissipate slowly.

Bunker fuels and lube oils must be heated to release sufficient vapour for combustion. But once a light or heavy flammable liquid is burning, radiation feedback and the chain reaction quickly increase flame production.



Engine oil leaks

Attention:

- Watch out for oil leaks even if minor and rectify them immediately;
- Good housekeeping goes a long way in preventing fires caused by flammable liquid splits. Any spilled liquid should be wiped off surface using rags of sawdust.

4.6 Shipboard locations of fire hazard

4.6.1 Machinery space

Causes include:

- combustible liquids leaking through faulty or damaged joints / piping;
- oil soaked insulations and lagging;
- hot surfaces e.g. exhaust piping or overheated engine parts in close proximity of oil
- lines;
- hot work (e.g. welding and cutting with oxy acetylene torch);
- auto ignition e.g. oil dripping on hot surfaces.

Methods of detection include:

- smoke, heat and flame detectors;
- high temperature probes;
- rate of rise temperature probes;
- fire patrol.

Methods of containment include:

- watertight doors;
- fire doors and fire dampers;
- water sprinkles.

Fire Extinguishing System and Appliances include:

- fixed fire-extinguishing systems: e.g. using water, foam, and carbon dioxide;
- portable and mobile fire extinguishers using water, foam, carbon dioxide and dry chemical powders.

4.6.2 Accommodation

Causes include:

- combustible material;
- smoking and careless disposal of burning matchsticks, cigarettes and ash;
- textiles adjacent to hot objects such as radiators and lamps;
- defective or overloaded electrical systems;

- in laundry room: incorrect installation of tumbler dryer or failure to keep it clean.

Methods of detection include:

- smoke, heat and flame detectors;
- sprinkler systems;
- fire patrol.

Methods of containment include:

- construction of main horizontal and vertical zones using approved non-combustible materials;
- fire doors and fire dampers;
- sprinkler systems;
- fire retardant deck covering and furnishing.

Fire Extinguishing Systems and Appliances Include:

- water hydrants and hoses;
- portable extinguishers using water, foam, dry chemical powders and carbon dioxide.

4.6.3 Ship's galley

Causes include:

- overheating of cooking oils and fats;
- overheating of deep fat fryers;
- hot surface;
- defective electrical connections;
- grease / oil accumulation near hot plates or in the exhaust ducting.

Methods of detection include:

- fire patrol;
- temperature probes.

Methods of containment include:

- fire doors, ventilation and fire dampers;
- fire blanket.

Fire Extinguishing Systems and Appliances include:

- fixed carbon dioxide system;
- portable fire extinguishers using carbon or dry chemical powder.

4.6.4 Galley duct protection by CO_2 System

Operation:

- stop power to galley;
- ensure all personnel have left the space;
- close all vents, doors and dampers;
- open the CO_2 cylinder valve;
- allow time for cooling before venting the duct.

4.6.5 Radio room/Battery room

Causes include:

- overloads and short circuits;
- defective insulation;
- fractured and loose connections;
- build-up of hydrogen and its ignition in the battery room.

Methods of Detection include:

- fire patrol;
- smoke detectors.

Methods of Containment include:

- Fire doors.

Fire Extinguishing Systems and Appliances include:

- Portable fire extinguishers using carbon or dry chemical powder.

4.6.6 Paint lockers

Causes include:

- spontaneous combustion;
- spillage of varnishes / paints.

Methods of Detection include:

- smoke detectors;
- fire patrols.

Methods of Containment include:

- fire tight doors;
- vents, fire dampers.

Fire Extinguishing Systems and Appliances include:

- water sprinkler;
- portable fire extinguisher.

5.

TYPES OF FIRE EXTINGUISHERS

COMPETENCE

Use different types of fire extinguishers and fire-fighting systems

5.1 Requirements for fire- fighting equipment- EU Directive 2006/87/EC

5.1.1 Portable fire extinguishers

There shall be at least one portable fire extinguisher in accordance with European standard EN 3:1996 at each of the following places:

- in the wheelhouse;
- close to each entrance from the deck to accommodation spaces;
- close to each entrance to service spaces which are not accessible from the accommodation spaces and which contain heating, cooking or refrigeration equipment using solid or liquid fuels or liquefied gas;
- at each entrance to engine rooms and boiler rooms;
- at suitable points below deck in engine rooms and boiler rooms such that no position in the space is more than 10 metres walking distance away from an extinguisher.

For the portable fire extinguishers only powder-type extinguishers with a content of at least 6 kg or other portable fire extinguishers with the same extinguishing capacity may be used. They shall be suitable for Class A, B and C fires and for fires in electrical systems of up to 1000 V. In addition powder, water or foam fire extinguishers may be used which are suitable at least for the class of fire most likely to occur in the room for which they are intended.

Portable fire extinguisher

Portable fire extinguishers with CO_2 as the extinguishing agent may be used only for extinguishing fires in galleys and electrical installations. The content of these fire extinguishers shall be no more than 1 kg per 15 m^3 of the room in which they are made available for use.

Portable fire extinguishers shall be checked at least every two years. An inspection certificate shall be issued, signed by the inspector and showing the date of inspection.

If portable fire extinguishers are installed in such a way that they are out of sight the panel covering them shall be identified by a symbol for fire extinguishers.

5.1.2 Permanently installed fire-fighting systems in accommodation spaces, wheelhouses and passenger spaces

Water sprinklers

Fire protection in accommodation spaces, wheelhouses and passenger spaces is to be provided only by suitable automatic pressurised water sprinklers as permanently installed fire-fighting systems. The systems shall be able to spray water at a rate of at least 5 l/m^2 per minute

over the area of the largest room to be protected.

5.1.3 Permanently installed fire-fighting systems in engine rooms, boiler rooms and pump rooms

Extinguishing agents

For protecting engine rooms, boiler rooms and pump rooms, the following extinguishing agents may be used in permanently installed fire-fighting systems:

- CO_2 (carbon dioxide);
- HFC 227ea (heptafluoropropane);
- Inert Gas-541 (52 % nitrogen, 40 % argon, 8 % carbon dioxide).

Ventilation, air intake

Combustion air for the propulsion engines shall not be extracted from rooms that are to be protected by permanently installed fire-fighting systems. This shall not apply where there are two mutually independent and hermetically separated main engine rooms or if next to the main engine room there is a separate engine room with a bow thruster, ensuring that the vessel is able to make way under its own power in the event of fire in the main engine room.

Any forced ventilation present in the room to be protected shall switch off automatically if the fire-fighting system is triggered.

There shall be devices available with which all apertures which can allow air to enter or gas to escape from the room to be protected can be quickly closed. It shall be clearly recognisable whether they are open or closed.

The air escaping from relief valves in the compressed-air tanks installed in engine rooms shall be conveyed to the open air.

Over- or under pressure resulting from the inflow of extinguishing agent shall not destroy the components of the surrounding partitions of the room to be protected. It shall be possible for the pressure to equalise without danger.

Protected rooms shall have a facility for extracting the extinguishing agent and the combustion gases. Such facilities shall be capable of being operated from positions located outside the protected rooms and which would not be made inaccessible by a fire within such spaces. If there are permanently installed extractors, it shall not be possible for these to be switched on while the fire is being extinguished.

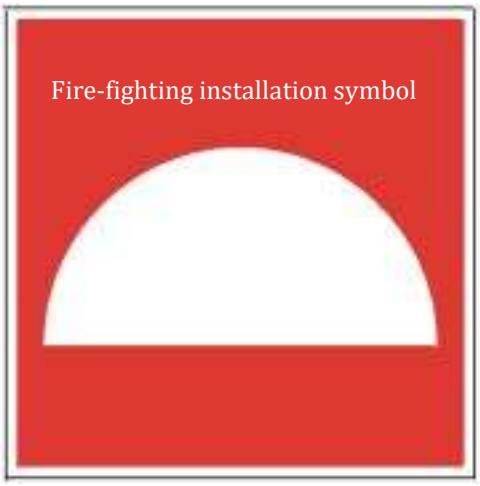
Fire alarm system

Fire alarm system

The room to be protected shall be monitored by means of an appropriate fire alarm system. The alarm shall be noticeable in the wheelhouse, the accommodation spaces and the room to be protected.

Triggering device

Fire-fighting systems with automatic triggering shall not be permissible. It shall be possible to trigger the fire-fighting system from a suitable place outside the room to be protected.



Triggering devices shall be installed in such a way that they can be operated even in case of a fire and in the event of damage by fire or explosion in the room to be protected the necessary quantity of extinguishing agent can still be conveyed. Non-mechanical triggering devices shall be powered from two different mutually independent energy sources. These energy sources shall be located outside the room to be protected. Control lines in the room to be protected shall be designed so as to remain functional for at least 30 minutes in the event of fire.

If triggering devices are installed in such a way that they are out of sight the panel covering them shall be identified by the **'fire-fighting installation' symbol.**

Fire-fighting installation' symbol

If the fire-fighting system is intended for the protection of several rooms, the triggering devices for each room have to be separate and clearly identified.

Next to each triggering device operating instructions in one of the languages of the Member States shall be posted up visibly and indelibly. They shall contain, in particular, instructions regarding:

- triggering of the fire-fighting system;
- the need for checking to ensure that all persons have left the room to be protected;
- action to be taken by the crew when the fire-fighting system is triggered;
- action to be taken by the crew in the case of failure of the fire-fighting system.

The operating instructions shall point out that before the fire-fighting system is triggered combustion engines drawing air from the room to be protected are to be shut down.

Warning system

Permanently installed fire-fighting systems shall be provided with acoustic and optical warning systems. The warning system shall be set off automatically as soon as the fire-fighting system is first triggered. The warning signal shall sound for an appropriate time before the extinguishing agent is released and it shall not be possible to switch it off.

Warning label

Warning signals shall be clearly visible in the rooms to be protected and outside the accesses to them and clearly audible even under operating conditions producing the loudest inherent noise. They shall be clearly distinct from all other acoustic and optical signals in the room to be protected.

The acoustic warning signals shall be clearly audible in the adjacent rooms even when connecting doors are closed and under operating conditions producing the loudest inherent noise.

If the warning system is not self-monitoring as regards short-circuits, wire breaks and voltage drops, it shall be possible to check that it is working properly.

At every entrance to a room that can be supplied with extinguishing agent, a clearly visible notice shall be put up bearing the following text in red lettering on a white background: ***'Warning, fire-fighting installation! Leave the room as soon as the warning signal sounds (description of signal)'.***

CO2 fire-fighting systems – additional requirements

Fire-fighting systems using CO_2 as the extinguishing agent shall comply with the following provisions:

- CO_2 containers shall be housed outside the room to be protected in a space or cabinet hermetically separated from other rooms. The doors to these installation spaces and cabinets shall open outwards, be lockable and bear on the outside a symbol for ***'General danger warning'*** together with the marking ***'CO_2'*** in the same colour and with the same height;
- installation spaces below decks for CO_2 containers shall be accessible only from the open air. These spaces shall have their own adequate artificial ventilation system with extraction ducts, completely separate from other ventilation systems on board;
- the CO_2 containers shall not be filled to more than 0,75 kg/l. The specific volume of unpressurised CO_2 gas is to be taken as 0,56 m^3/kg;
- the volume of CO_2 for the room to be protected shall be at least 40 % of its gross volume. It shall be possible to supply this volume within 120 seconds, and to check whether supply has been completed;
- opening the container valves and operating the flood valve shall be separate control operations;
- the warning signal shall sound for an appropriate time before the extinguishing agent is released and it shall not be possible to switch it off. The appropriate time shall be at least 20 seconds. There shall be a reliable device to ensure the delay before delivery of the CO2 gas.

HFC-227ea — fire-fighting systems – additional requirements

Fire-fighting systems using HFC-227ea as the extinguishing agent shall comply with the following provisions:

- if there are several rooms to be protected, each with a different gross volume, each room shall be provided with its own fire-fighting system;
- each container of HFC-227ea that is installed in the room to be protected shall be equipped with an overpressure relief valve. This shall harmlessly release the contents of the container into the room to be protected if the container is exposed to the effects of fire and the fire-fighting system has not been triggered;
- each container shall be fitted with a device for checking the gas pressure;
- the containers shall not be filled to more than 1,15 kg/l. The specific volume of the unpressurised HFC-227ea is to be taken as 0,1374 m^3/kg;
- the volume of HFC-227ea for the room to be protected shall be at least 8 % of the room's gross volume. This volume shall be supplied within 10 seconds;
- the HFC-227ea containers shall be provided with a pressure monitor which triggers an acoustic and optical alarm signal in the wheelhouse in the event of an unauthorised loss of propellant. If there is no wheelhouse, this alarm signal shall be given outside the room to be protected;
- after flooding, the concentration in the room to be protected shall not exceed 10,5 %;
- the fire-fighting system shall not contain any parts made of aluminium.

Inert Gas-541 — fire-fighting systems – additional requirements

Fire-fighting systems using IG-541 as the extinguishing agent shall comply with the following provisions:

- if there are several rooms to be protected, each with a different gross volume, each room shall be provided with its own fire-fighting system;

- each container of IG-541 that is installed in the room to be protected shall be equipped with an overpressure relief valve. This shall harmlessly release the contents of the container into the room to be protected if the container is exposed to the effects of fire and the fire-fighting system has not been triggered;
- each container shall be fitted with a device for checking the contents;
- the filling pressure of the container shall not exceed 200 bar at + 15 °C;
- the volume of IG-541 for the room to be protected shall be at least 44 % and no more than 50 % of the room's gross volume. This volume shall be supplied within 120 seconds.

5.2 Types of extinguishing agents and fire extinguishers

5.2.1 Water as extinguishing agent and types of water extinguishers

Water is usually present in large quantities. Water is relatively easy to use. Due to its high capacity as a thermal conductor, water has a high cooling effect.
Another positive side effect is the formation steam during extinguishing that has a suffocating effect on the fire.
Water is a very good extinguishing agent on so called solid fires. (Class A).

Fire hydrants

The cooling down limits or stops the discharge of gasses from the fuel so the fire process will eventually stop all together.
The amount of water necessary to put out a fire is approx. 4 l/min/m2.
To extinguish a Class A fire a spray type nozzle will usually have a large enough effect to get the highest cooling effect.
On liquids with a flashpoint > 29° C water can be used as extinguishing agent because the cooling effect stops the discharge of gasses from the product.
On liquids with a flashpoint < 23° C water cannot put out the fire.
The radiation of the flames can be limited however by using a spray nozzle.

Spray nozzle

When extinguishing a fire one has to take into account the difference between soluble and non-soluble liquids. With soluble liquids the water will mix with the liquid and therefore cooling down is possible. In the case of non-soluble liquids the product will float on the water possibly creating a larger fire with an unwanted spread of the liquid and as a result an uncontrolled spreading of the fire.

Water extinguishers

In case of products with a storage temperature of > 100° C we should be careful with the use of water because it will directly turn into steam.

Under normal conditions, class A material, such as wood, paper and clothes, do not give off vapour that can be ignited, but if wood and paper are heated by a few hundred degrees, ignition can take place. Fortunately, class A material is fairly easily cooled below its ignition point when it will cease to give off flammable vapour and combustion will end. Fortunately, class A material is fairly easily cooled below its ignition point when it will cease to give off flammable vapour and combustion will end.

Types of water portable fire extinguishers

Water extinguisher

Signal Red
Best For
Fires involving organic solid materials such as wood, cloth, paper, plastics, coal etc.
Danger
Do not use on burning fat or oil or on electrical appliances.
How to Use
Point the jet at the base of the flames and keep it moving across the area of the fire. Ensure that all areas of the fire are out.
How it Works
Water has a great cooling effect on the fuel's surface and thereby reduces the pyrolysis rate of the fuel.

Water extinguisher

Water spray extinguisher (water with additive)

Signal Red
Best For
Fires involving organic solid materials such as wood, cloth, paper, plastics, coal etc. These offer significantly improved fire - fighting capability compared to traditional jet type water fire extinguishers.
Danger
Do not use on burning fat or oil or on electrical appliances.
How to Use
Point the jet at the base of the flames from a safe distance of approx. 3 meters and keep it moving across the area of the fire. Ensure that all areas of the fire are out.
How it Works
 Water has a great cooling effect on the fuel's surface and thereby reduces the pyrolysis rate of the fuel. Instead of a jet nozzle a spray nozzle is used, with a higher pressure, which creates a fine spray. This allows for a given quantity of water to have a considerable increase in the surface area presented to the fire. This makes extinguishing more efficient by more rapid extraction of heat, formation of steam etc. They can also contain surfactants which help the water penetrate deep into the burning material which increases the effectiveness of the extinguisher.

Water mist extinguisher ("dry" water mist)

Signal Red on a White Background
Best For
The first broad spectrum extinguisher to tackle A, B, C rated risks as well as fats and deep fat fryers (Class F). Models with dielectric test to 35k Volts can be safely used on electrical fires (up to 1000 Volt) if a safety distance of 1m is adhered to, as their mist (de-ionized water) does not conduct electricity and the extinguisher does not normally form puddles, which could conduct electricity.
Point the jet at the base of the flames from a safe distance of approx. 3meters and keep it moving across the area of the fire. Ensure that all areas of the fire are out. The fire draws the microscopic water particles into the fire.
How it Works
Water is turned into microscopic particles in the supersonic nozzle. The water mist is drawn to the fire where it cools and suffocates the fire. The mist also forms a safety barrier between user and fire, which keeps some of the heat back.

5.2.2 Carbon dioxide as extinguishing agent and types of carbon dioxide extinguishers

Carbon dioxide extinguishes fires mainly by smothering. It dilutes the air surrounding the fire until the oxygen content is too low to support combustion. For this reason, it is effective on Class B fires, where the main consideration is to keep the flammable vapours separated from oxygen in the air. CO_2 has a very limited cooling effect. It can be used on Class A fires in confined spaces, where the atmosphere may be diluted sufficiently to stop combustion.
However, CO_2 extinguishing takes time. The concentration of carbon dioxide must be maintained until all the fire is out. Constraint and patience are needed.
Carbon dioxide is used primarily for Class B and Class C fires. It may also be used to knock down a Class A fire. It is particularly effective on fires involving:

- flammable oils and greases;
- electrical and electronic equipment, such as motors, generators, and navigational devices;
- hazardous and semi hazardous solid materials (such as some plastics, except those that contain their own oxygen);
- machinery spaces, engine rooms, paint, and tool lockers;
- cargo spaces which can be flooded with carbon dioxide;
- galleys and other cooking areas, such as diet kitchens;
- compartments containing high value cargo, delicate machinery, and other material that would be ruined or damaged by water or water-based extinguishing agents;
- spaces where after fire clean up would be a problem.

Limitations on the Use of Carbon Dioxide

CO_2 portable extinguishers are used primarily for small electrical fires (Class C) and have limited effectiveness on Class B fires. Their use will be confined to Class B pool fires no greater than four square feet. Successful operation requires close approach due to the extinguisher's characteristics short range.

Effectiveness

CO_2 is not effective on substances that contain their own oxygen (oxidizing agents).
Outside use
To be fully effective, the gas must be confined. For this reason, CO2 is not as effective outside as it is in a confined space. This does not mean that it cannot be used outside.

Possibility of re-ignition

Compared with water, carbon dioxide has a very limited cooling capacity. It may not cool the fuel below its ignition temperature and it is more likely than other extinguishing agents to allow re flash.

Hazards

Although carbon dioxide is not poisonous to the human system, it is suffocating in the concentration necessary for extinguishment. A person exposed to this concentration would suffer dizziness and unconsciousness. Unless removed quickly to fresh air, the victim could die.

Types of CO_2 portable fire extinguishers

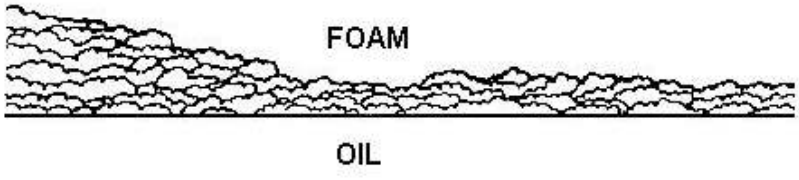
Black
Best For
 Live electrical equipment, although it allows re-ignition of hot plastics. Now mainly used on large computer servers, although care has to be taken not to asphyxiate people when using the extinguisher in small server rooms.
Danger
Do not use on chip or fat pan fires, as it can carry burning fat out of the container. This type of extinguisher does not cool the fire very well and you need to ensure that the fire does not start up again. Fumes from CO_2 extinguishers can asphyxiate if used in confined spaces: ventilate the area as soon as the fire has been controlled. Only use CO_2 extinguishers with frost-free horns, as the hand holding the horn can otherwise be frozen to the horn, as the gas gets very cold during the discharge.
How to Use
The discharge horn should be directed at the base of the flames and the jet kept moving across the area of the fire. Recommended distance of use 2 meters.
How it Works
Carbon dioxide extinguishers work by suffocating the fire. Carbon dioxide displaces oxygen in the air. However, once discharged, the CO2 will dissipate quickly and allow access for oxygen again, which can re-ignite the fire.

5.2.3 Foam as extinguishing agent and types of foam extinguishers

Foam is produced by the combination of three materials:

- water;
- air;
- foam making agent.

Foam is a blanket of bubbles that extinguishes fire, mainly by smothering. Mixing water and a foam-making agent (foam concentrate) produces bubbles. The result is called a foam solution. The various foam solutions are lighter than the lightest of flammable oils. Consequently, when applied to burning oils, they float on the surface of the oil.



Foam floating on the oil surface

Firefighting foam is used to form a blanket on the surface of flaming liquids. The blanket prevents flammable vapours from leaving the surface and prevents oxygen from reaching the fuel. A fire cannot exist when the fuel and oxygen are separated and therefore a properly placed foam blanket will smother the fire. In addition, the water in the foam also has a cooling effect, which gives foam the ability to cool surrounding structure to help prevent flash back. The ideal foam should flow freely enough to cover a surface rapidly, yet have adequate cohesive properties to stick together sufficiently to establish and maintain a vapour tight blanket.
In addition, the solution must retain enough water to provide a long-lasting seal. Rapid loss of water would cause the foam to dry out and break down (wither) from the high temperatures associated with fire. The foam should also be light enough to float on flammable liquids, yet heavy enough to resist winds.
In spite of its limitations, foam is quite effective in combating Class A and Class B fires. **Many advantages of foam** include the following:

- very effective smothering agent. Also provides cooling as a secondary effect;
- sets up a vapour barrier that prevents flammable vapours from rising. The surface of an exposed tank can be covered with foam to protect it from a fire in a neighbouring tank;
- some use it on Class A fires because of its water content. AFFF is especially effective, as are certain types of wet-water foam. Wet-water foam is made from detergents; its water content quickly runs out and seeps into the burning material;
- effective in blanketing oil spills. However, if the oil is running, an attempt should be made to shut down a valve if such action would stop the flow. If that is impossible, the flow should be dammed. Foam should be applied on the upstream side of the dam (to extinguish the fire) and on the downstream side (to place a protective cover over any oil that has seeped through);
- most effective extinguishing agent for fires involving large tanks of flammable liquids.

Foams are effective extinguishing agents when used properly. However, some limitations on foam include the following:

- because they are aqueous (water) solutions, they are electrically conductive and should not be used on live electrical equipment;
- like water, foams should not be used on combustible-metal fires;
- many of them must not be used with dry chemical extinguishing agents;
- sufficient foam must be on hand to make sure that the entire surface of the burning material can be covered. In addition, there must be enough foam to replace foam that is burned off and to seal breaks in the foam surface.

Foam portable extinguishers

Cream

Best For
Fires involving solids and burning liquids, such as paint and petrol but not suitable for chip or fat pan fires.
Danger
Do not use on chip or fat pan fires, electrical fires.
How to Use
For fires involving solids, point the jet at the base of the flames and keep it moving across the area of the fire. Ensure that all areas of the fire are out. For fires involving liquids, do NOT aim the jet straight into the liquid. Where the liquid on fire is in a container, point the jet at the inside edge of the container or on a nearby surface above the burning liquid. Allow the foam to build up and flow across the liquid. Use from a safe distance of approx. 3 meters.
How it Works They are mainly water based, with a foaming agent so that the foam can float on top of the burning liquid and break the interaction between the flames and the fuel surface.

5.2.4 Powder as extinguishing agent and types of powder extinguishers

Powder systems are used on-board Gas-carriers for protection of the deck area.
The dry powder system extinguishes or prevents a fire by covering an area with powder which reacts chemically with the fire.

Use of powder extinguisher

The powder is released from the storage tank through powder guns. The system is activated from designated release areas. Class C fires occur quickly and must be put out with equal speed. Knowing the proper way to fight this
type of fire is important – it can save lives

Monoammonium phosphate (ABC, multipurpose) dry chemical may, as its name implies, be used on Class A, Class B, and Class C fires and combinations of these. However, as noted above, ABC dry chemical may only control, but not extinguish, some deep-seated Class A fires and an auxiliary extinguishment method, such as a water hose line, is required. All dry chemical agents may be used to extinguish fires involving the following:

- flammable oils and greases;
- electrical equipment;
- hoods, ducts, and cooking ranges in galleys and diet kitchens;
- the surfaces of baled textiles;
- certain combustible solids such as pitch, naphthalene, and plastics (except those that contain their own oxygen);
- machinery spaces, engine rooms, paint lockers, and tool lockers.

The limitations on the use of dry chemicals are as follows:

- the discharge of large amounts of dry chemicals could affect people in the vicinity;

- like other extinguishing agents that contain no water, dry chemicals are not effective on materials that contain their own oxygen;
- dry chemicals may deposit an insulating coating on electronic or telephonic equipment, affecting the operation of the equipment;
- dry chemicals are not effective on combustible metals such as magnesium, potassium, sodium, and their alloys, and in some cases may cause a violent reaction;
- where moisture is present, a dry chemical agent may corrode or stain surfaces on which it settles.

Warning!

Dry chemical extinguishing agents are considered nontoxic, but they may have irritating effects when breathed. For this reason, a warning signal, similar to the one used in carbon dioxide systems, should be installed in any space that might be totally flooded with dry chemicals. Breathing apparatuses and lifelines must also be available in case crewmen must enter the space before it is entirely ventilated.

Types of powder portable extinguishers

Powder extinguisher multi-purpose

Powder extinguisher (multi - purpose)

Blue

Best For

Can be used on fires involving organic solids, liquids such as grease, fats, oil, paint, petrol, etc. but not on chip or fat pan fires. Can also be used on gas fires.

Danger
Safe on live electrical equipment, although it does not penetrate the spaces in equipment easily and the fire may re-ignite. This type of extinguisher does not cool the fire very well and care should be taken that the fire does not flare up again. Smoldering material in deep seated fires such as upholstery or bedding can cause the fire to start up again. Do not use on domestic chip or fat pan fires. There is danger of inhalation if powder extinguishers are used within buildings. Due to this, and the potential for powder to impair vision, powder extinguishers are no longer recommended for use within enclosed spaces.
How to Use
Point the jet or discharge horn at the base of the flames and, with a rapid sweeping motion, drive the fire towards the far edge until all the flames are out. If the extinguisher has a hand control, wait until the air clears and if you can still see the flames, attack the fire again. Recommended safe distance 3-5 meters.
How it Works
Similarly to almost all extinguishing agents the powder acts as a thermal ballast making the flames too cool for the chemical reactions to continue. Some powders also provide a minor chemical inhibition, although this effect is relatively weak. These powders thus provide rapid

knockdown of flame fronts, but may not keep the fire suppressed.

Dry powder extinguisher (special powder)

Dry powder extinguisher

Class D fires are comparatively rare and usually require special extinguishing methods.
Class D fires are fires in combustible metals such as potassium, sodium, aluminium, and magnesium.
Class D fires involve combustible metals - especially alkali metals like lithium and potassium, alkaline earth metals such as magnesium and group 4 elements such as titanium and zirconium.
Metal fires represent a unique hazard because people are often not aware of the characteristics of these fires and are not properly prepared to fight them.

Therefore, even a small metal fire can spread and become a larger fire in the surrounding ordinary combustible materials.
Certain metals burn in contact with air or water (for example, sodium), which exaggerate this risk. Generally speaking, masses of combustible metals do not represent great fire risks because heat is conducted away from hot spots so efficiently that the heat of combustion cannot be maintained. In consequence, significant heat energy is required to ignite a contiguous mass of combustible metal. Generally, metal fires are a hazard when the metal is in the form of sawdust, machine shavings or other metal "fines", which combust more rapidly than larger blocks. Metal fires can be ignited by the same ignition sources that would start other common fires.
Care must be taken when extinguishing metal fires. Water and other common firefighting agents can excite metal fires and make them worse. The most common agents are sodium chloride granules and graphite powder. In recent years, powdered copper has also come into use. These dry powder extinguishers should not be confused with those that contain dry chemical agents. The two are not the same, and only dry powder should be used to extinguish a metal fire. Using a dry chemical extinguisher in error, in place of dry powder, can be ineffective or actually increase the intensity of a metal fire.

5.2.5 Wet chemical extinguishers

Chemical extinguisher

Canary Yellow
Best For
Wet chemical fire extinguishers are ideal for Class F fires, involving cooking oils and fats, such as lard, olive oil, sunflower oil, maize oil and butter.
Danger
Check manufacturer's instructions for suitability of use. These extinguishers are usually not recommended for class B fires such as petrol.
How to Use
Apply the wet chemical using the extended applicator in slow circular movements, which gives a gentle, yet highly effective application. Apply the fine spray onto the burning fat until the surface of the burning cooking oil changes into a soapy like substance which prevents re-ignition. The gentle application helps to prevent burning oil splashing out of the container. Make sure that you empty the entire content of the wet chemical extinguisher onto the oil/fat, as the fire can re-ignite otherwise.
How it Works
Most class F extinguishers contain a solution of potassium acetate, sometimes with some potassium citrate or potassium bicarbonate. The extinguishers spray the agent out as a fine mist. The mist acts to cool the flame front, while the potassium salts saponify the surface of the burning cooking oil, producing a layer of foam over the surface. This solution thus provides a similar blanketing effect to a foam extinguisher, but with a greater cooling effect. The saponification only works on animal fats and vegetable oils, so most class F extinguishers cannot be used for class B fires. The misting also helps to prevent splashing the blazing oil.

5.2.6 Fire extinguishers for electrical fire

The essential action in the event of an electrical fire is to cut off the source of electrical supply. To avoid the spread of fire it will frequently be necessary to fight an electrical fire before the electric supply has been cut off. The fire-fighting medium must therefore be a non-conductor of electricity. CO_2 gas does not conduct electricity and is the most suitable medium for extinguishing electrical fires.

Powder extinguishers can also be used and are equally efficient, if it is possible to reach the source of the fire.

Different Types of Fire Extinguishers

Key Difference: There are different types of fire extinguishers such as water based, powder based, CO_2, Foam, Wet Chemical, etc. Extinguishers should be used depending on the type of fire.

Not all fires are the same and similarly not all fire extinguishers are the same. Before one can grab a fire extinguisher and put out a fire, they must understand first what kind of fire it is and what kind of extinguisher is required for that fire. If the wrong extinguisher is used, instead of killing the fire, it can serve as fodder and increase the intensity of the fire.

	Water	Water Mist, dielectrically tested	Foam	ABC Dry Powder	Specialist Powder	CO2 Gas	Wet Chemical
 Fires involving freely burning materials. For example wood, paper, textiles and other carbonaceous materials.	✓	✓	✓	✓			
 Fires involving flammable liquids. For example petrol and spirits. NOT ALCOHOL OR COOKING OIL.		✓	✓	✓		✓	✓
 Fires involving flammable gasses. For example propane and butane.		✓		✓			
 Fires involving flammable metals. For example magnesium and lithium.					✓		
 Fires involving electrical equipment. For example photocopiers, fax machines and computers.		✓		✓		✓	
 Fires involving cooking oil and fat. For example olive oil, maize oil, lard and butter.		✓					✓

6.

EMERGENCY PROCEDURE

COMPETENCE

Follow instructions concerning: personal equipment, methods, extinguishing agents and procedures during fire- fighting and rescue operations

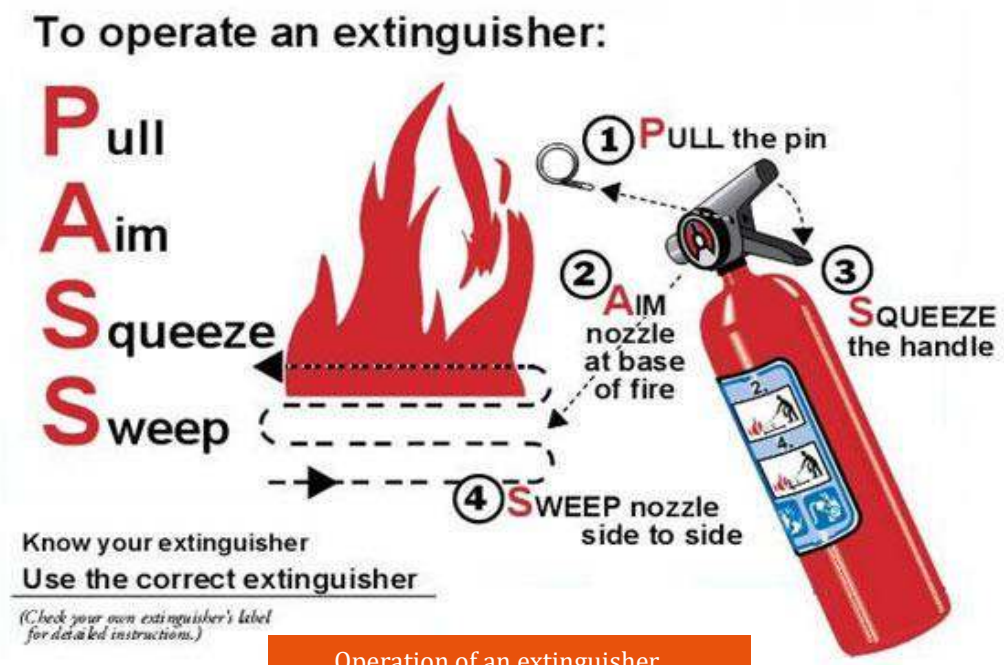
6.1 Use of fire extinguisher

Even though extinguishers come in a number of shapes and sizes, they all operate in a similar manner. Here's an easy acronym for fire extinguisher use:
PASS : Pull, Aim, Squeeze, and Sweep

General instructions for use:

1. Before using the fire extinguisher, ensure you have selected the correct extinguisher for the class of fire that you intend to fight;
2. Ensure that you are positioned between the fire and a safe exit or escape route.
3. Pull out safety pin firmly (this will be held in by an anti-tamper seal device);
4. Apply the powder rapid sweeping in bursts across the flame front and/or sweeping up the flames - keeping out of the smoke & powder;
5. If the fire is not out on completion of the extinguisher's contents, then leave immediately by a safe route from the building, closing all doors behind you.

Understanding the different types of fire is usually a good way to understand which type of fire extinguisher one should use. It is essential to understand which extinguisher works, because 'one size fits all' approach may endanger lives. The extinguishers are often colour coded to ensure people to identify which ones should be used where. The colours are Signal Red, Signal Red on a White Background, Blue, Cream, Black, and Canary Yellow.



Operation of an extinguisher

6.2 Operating instructions

Operating instructions
For portable CO_2 extinguishers

1. Pull out safety pin

2. Squeeze the handle

3. Direct nozzle at the base of the fire

Before you tackle a fire

Many people put out small fires quite safely. However, some people die or are injured by tackling a fire which is beyond their capabilities. Here is a simple fire code to help you decide whether to put out or get out:

- only tackle a fire in its very early stages;
- always put your own and other peoples safety first;
- on discovering the fire, immediately raise an alarm;
- make sure you can escape if you need to and never let a fire block your exit;
- if you cannot put out the fire or if the extinguisher becomes empty, get out and get everyone else out of the space immediately, closing all doors behind you as you go.

6.3 Personal equipment

The personal equipment consists of:

- protective clothing;
- boots;
- rigid helmet;
- electric safety lamp;
- axe;
- safety harness;
- safety lines.

The **protective clothing** is to be used to protect from heat radiated from a fire and should be used in close proximity to a fire.
Do not use the protective clothing in a fire – they are **not** fire entry suits.
The boots shall be of electrical non-conducting materials.
The helmet shall provide effective protection against impact.
The helmet shall be supplied with a full-face visor and a neck curtain.

The safety lamp is operated by batteries, which shall have a duration of at least three hours. The safety lamps shall be of an approved type and shall be electrically safe (on tankers) or explosion proof (if intended to be used in a hazardous atmosphere or area).

Personal equipment

Fire blanket

Fire blankets are made of fire resistant materials. They are useful for smothering small pan fires or for wrapping round a person whose clothing is on fire. Fire blankets should generally be disposed of after use.
Best For
Small pan fires where oil or fat has caught fire and clothing fires.
Danger
If the blanket does not completely cover the fire, it will not be able to extinguish the fire. While kite marked fire blankets have been successfully tested on deep fat fryers, modern frying fats are difficult to extinguish with a fire blanket. We therefore recommend wet chemicals for deep fat fryers.
How to Use
Place carefully over the fire. Keep your hands shielded from the fire. Do not waft the fire towards you. Make sure that you removed the heat source.
How it Works
Smothers the fire and prevents oxygen getting to the fire.

6.4 Breathing apparatus

Safety instructions when using breathing apparatus

Breathing apparatus

A breathing apparatus wearer brings him or herself in potentially dangerous situations.
Smoke and heat can make tasks difficult and they may also have to deal with stressful situations such as searching for casualties, which increase the problems.
A BA-wearer must act decisively but be able to recognise dangerous situations and act accordingly.
Your own safety and the safety of your body are of the utmost importance.
In order to increase the safety it is important, when working with BA, to act and work according to

predefined and well trained procedures. Procedures are developed for:

- donning of the face mask;
- the use and control of the face mask;
- replacing the cylinder.

Preparing breathing apparatus sets (BA-sets) for storage

By preparing the BA-sets in the fire station the first step for a swift intervention is made.
By preparing in advance we can prevent loss of time for a BA-team to be ready.
The BA-team can assume that all the equipment is prepared and checked and cylinders are full.
When preparing the BA-sets it is important that a number of actions are made.
First the cylinder, backpack and mask must be checked for visual flaws.
After this visual inspection the cylinder is mounted on the backpack. By opening the valve on the cylinder the pressure in the cylinder can be checked (pressure gauge) and the system can be checked for leakages. When there are no problems the valve can be closed.
The system is still under pressure and the next test that can be executed is the testing of the alarm signal (whistle). To do this the air in the system should be released very slowly.

As soon as the pressure in the system is lower than 55 bars the alarm signal will be activated.
The next procedure is adjusting the carrying straps on the backpack to the maximum.
The facemask must be packed in a plastic bag and when dealing with a strap mask the straps must be loosened to the maximum. The BA-sets are now ready to use and can be stored in the fire station.
Preparing BA-sets for use. In case of an incident the fire team must wear BA as soon as possible in order to be ready for duty. Preparation always takes place in a safe environment.

Use of breathing apparatus

Upon donning the BA-set it is possible that the fireman's outfit becomes disarranged. The collar on the helmet may cause problems so in order to protect the fire team members it is important that clothing is checked and where necessary adjusted. Now the plastic protection bag can be removed from the mask and the straps of the mask should be adjusted to the maximum. The mask is hanging around the neck with the carrying strap until the wearer goes into action. Previous to an action the mask is placed on the face and the regulator is clicked onto the mask.
Breathing apparatus & working in a hot, humid environment.
The connection of the regulator onto the mask needs to be checked. Finally the helmet is placed on the head, the collar is closed and the gloves are put on. When necessary, supplementary clothing can be donned. Due to the fact that it is essential that the fire team is fast but properly dressed operationally, it is wise to use a so-called dress man (with enough personnel available).
A dress man is a person who can help members of a fire team when dressing up and preparing for an action.

6.5 Emergency Escape Breathing Devices (EEBD)

In addition to the escape route, the vessels shall be provided with EEBD. Within the accommodation spaces at least two EEBD shall be stored with the rescue party equipment. In machinery spaces the EEBD shall be positioned at the foot of

Emergency Escape Breathing Device

the ladders in the engine room and in control rooms, workshops etc., in sufficient numbers for the personnel normally present in that area. At least one spare EEBD shall
be carried.
The EEBD must not be used for fire fighting, entering oxygen deficient enclosed spaces but only for escape from a compartment in the event of an emergency.
All vessels shall be provided with a training unit which crewmembers must be made familiar with during drills. The training unit shall be clearly marked to this effect.
The EEBD will have autonomy for at least 10 minutes.

6.6 Fire-fighting organisation

Preparation prior to a fire or incident is vital. The responsible officer and crew members must learn the basic procedures indicated on the Station Bill and any special procedures to cover special loads or hazards. Intimate knowledge of the ships facilities shown on the ship's fire safety plan is essential to control the fire in the early stages.
The crew must be fully aware of their tasks and use of their equipment and it must be tested during a fire drill.
All the equipment used in controlling a fire must be in a perpetual state of readiness, from the ventilation controls through to the batteries fully charged in the lamps everything is important.
The crew members of the vessel are required to have basic skills and competence for efficient intervention in case of fire.
These requirements are as follows:

1. Use of various portable fire extinguishers;
2. Use of BA (breathing apparatus);
3. Extinguishing smaller fires, electrical, oil etc.;
4. Extinguishing fires using jet and spray nozzles with water;
5. Extinguishing fires using foam, powder and chemical agents;
6. Entering and passing through a compartment with high expansion foam using no Breathing Apparatus;
7. Fighting fires in enclosed spaces using Breathing Apparatus;
8. Using fog or steam for fire suppression;
9. The above standards can be tested during the compulsory fire drill.

6.6.1 Fire drill

The purpose of the fire drill is to test the efficiency of the organization. The crew must be challenged in order to make it interesting and more importantly to learn from mistakes.
The danger is to make the drill a routine that does not test the organization.
One focused drill is more beneficial than repeating a routine drill many times.
Change the drill each time to stimulate and challenge thought.
The drill can also be used to check and test equipment in the drill environment required in accordance with the certificate - fire pumps, breathing apparatus, fire suits and communications.

Fire-fighting intervention

A successful meaningful drill requires thought before the drill begins, firstly defining the learning objectives, setting the timing and allocating time to debrief afterwards.
The objectives must reflex key tasks to be performed and must be measurable against a
standard i.e. one objective could be to dress effectively in fire outfits and breathing apparatus within a fixed time frame, effectively means skin is fully protected and the start - up tests are performed on the breathing apparatus.
Once the objectives are set, a scenario can be written, which incorporates specific events and consequences of certain actions; the script should test the entire crew.
The drill begins with a report of fire and subsequent sounding of the alarm, indicating that it is a drill, but trying to bring an element of surprise and realism. Occasionally begin the drill by a report of fire from sources other than the bridge. The speed of reaction, mustering, and specific duties performed, setting up of the command and communications should be analysed.
The attack on the fire will depend upon the scenario, however the leadership, assessment of the situation and subsequent decisions should be evaluated. Create chaos to see if the team can control and react to the ever changing situations a fire can create.
Evaluate the drill; by assessing if the objectives were reached, being critical about actions so that the lessons learned can be incorporated in the procedures. The crew should be encouraged to participate uninhibited, without fear of making mistakes. The drill will go wrong, but then lessons are learned. A drill that is perfectly conducted is not challenging the crew.
The level of competence can be improved through drilling. Specific skills can be identified, taught, demonstrated and practised. Slow down the task and repeat until the person or team demonstrates a set level of competence. Endeavour to share information and experience gained by all members of the crew.
Document the fire drill for future reference, to assess improvements in the organisation.
The speed of reaction, mustering, and specific duties performed, setting up of the command and communications should be analysed.

6.6.2 Leadership

This section deals with leadership, how to manage an incident effectively involving fire or spillage of a dangerous product.
The approach to leadership in emergency situations is based on a system used by fire and emergency services; it is called functional leadership which analyses the functions involved in dealing with an emergency. Previous approaches made assumptions that leaders were born with the qualities to lead. Certain qualities, courage, integrity, common sense etc., may help to lead but a good leader may not have to display these characteristics.

Leadership

Another approach suggests that the leader having skill or knowledge to deal with a situation makes the best leader. There is a little truth in this approach; however this is not the whole picture in dealing with an emergency.

A better approach is to analyse the functions involved. Leadership can only be applied to groups who are confronted with a need to take action or make decisions.

Within a group, 3 areas of need exist:

1. task needs;
2. team maintenance needs;
3. individual needs.

Task needs

Groups formed to undertake a task too complex or too impractical for one person to accomplish.

Team maintenance needs

The group to achieve the task must be held together as a cohesive team.

Individual needs

The group has individuals, who have their own demands, which contribute to the functioning of the group.

The functions of a good leader are to recognize the 3 areas of need, thus be aware of the needs of the group and perform the thought processes, communications and actions to satisfy the needs of the group.

Task functions:

- defining the task;
- making a plan;
- allocating work and resources;
- controlling quality and resources;
- checking performance against plan;
- adjusting plan.

Team maintenance functions:

- setting standards;
- maintaining discipline;
- building team spirit;
- praising, motivating and giving a sense of purpose;
- ensuring communications within the group;
- training the group.

Individual functions:

- attending to personal problems;
- praising individuals;
- giving status;
- recognising and using individual abilities;
- training the individual.

In an emergency the task needs are going to take priority and less attention is given to the other two, unless the team or an individual is not performing, in which case attention must be given to these in order to control the situation. In the training periods the team and individual needs can be built up in preparation for the high task priorities.

To simplify the thought processes the following 6 functions must be addressed by the leader to meet the needs of the group:

- planning;
- briefing;
- control;
- support;
- informing;
- evaluating.

Failure to perform anyone of these functions will result in partial or total failure of the group to achieve its aim.

Planning

This process concerns obtaining all available information, determining the extent of the task, deciding on a plan of action and an order of priorities. The initial alarm will initiate the fire organization which has already allocated key roles and duties to help contain the fire, however follow up works on fire location, size and possibilities of escalation will dictate further actions; the control of compartments, fuel cut and ventilation are important initials actions, which should be performed as early as possible.

Limitations on manpower and equipment can give serious restrictions, thus a quick response to control the incident is essential; to prevent escalation use of passive protection (fire resisting bulkheads) and active measures (fixed fire fighting systems, fire teams) must be placed effectively. The main priority in formulating an attack plan comes with safety of the crew. Assessment of the risk involved must be performed before committing teams, particularly in the engine room where temperatures can increase rapidly in a short time. Next priority considered is rescue, if a missing person has a chance of survival then a quick response has to be made, but again assess the risk to the rescuers. The incident may be dealt with in one of two ways, direct attack on the fire or indirect attack, meaning controlling the growth of the incident i.e. surround the fire with boundary cooling until the fire suffocates itself. The choice depends on the extent of the fire, the time required to begin the attack and possible casualties.

Before an attack first consider dangers such as BLEVE (Boiling Liquid Expanding Vapour Explosion) if closed containers are involved. The following list will help establish the priorities:

- safety of the crew and fire teams;
- rescue of endangered personnel;
- exposure of containers to fire, which could result in additional fires;
- confinement of the fire, preventing fire spread to surrounding area i.e. fire can spread in 6 directions, thus the fire needs to be blocked and confined;
- extinguish the fire when it is safe to do so and when the correct means are available;
- over haul, returning the scene back to safe condition.

Control

Once the team is set to work, the role of the leader or a delegated officer is to control the effectiveness of the crew and the working environment continuously. Ensure that all actions are contributing to the aim, maintain crew standards and if necessary influence the tempo of the actions which will affect the outcome. The working environment will need to be monitored,

particularly the stability of the vessel and growth of the fire which effect the safety of the working teams.

Supporting

In order to maintain the team and individual needs, it will be necessary to help the group emotionally with encouragement or physically with backup and support.

Less time can be spent on this function, if it is formerly addressed in the training sessions with team building. However, long protracted incidents may still require emotional supporting actions to be taken.

Informing

The communications links should be set up to assist in the flow of information two ways.

The command must inform crews of all matters affecting their activities, particularly matters concerning their own safety and the command must have reports back from the crews, in order to carry out evaluation of the progress.

Evaluating

The achievements need to be compared with the original plan. The performance needs to be checked with the plan.

In each situation the plan needs to be modified or remedy action taken. The situation on the ship may change rapidly; therefore the command must monitor conditions regularly. Debriefing after an incident can also be very effective at highlighting good work, problems and weaknesses in the performance.

Decision making

The style of leadership in an emergency will be autocratic, due to the urgency of the situation. However leaders will vary their style to be democratic if the situation and time pressures allow. Decision sharing will produce sounder decisions when skills and knowledge are coming from within the group. The styles of leadership vary from autocratic to democratic, as follows:

- autocratic;
- bureaucratic;
- laissez – faire;
- democratic.

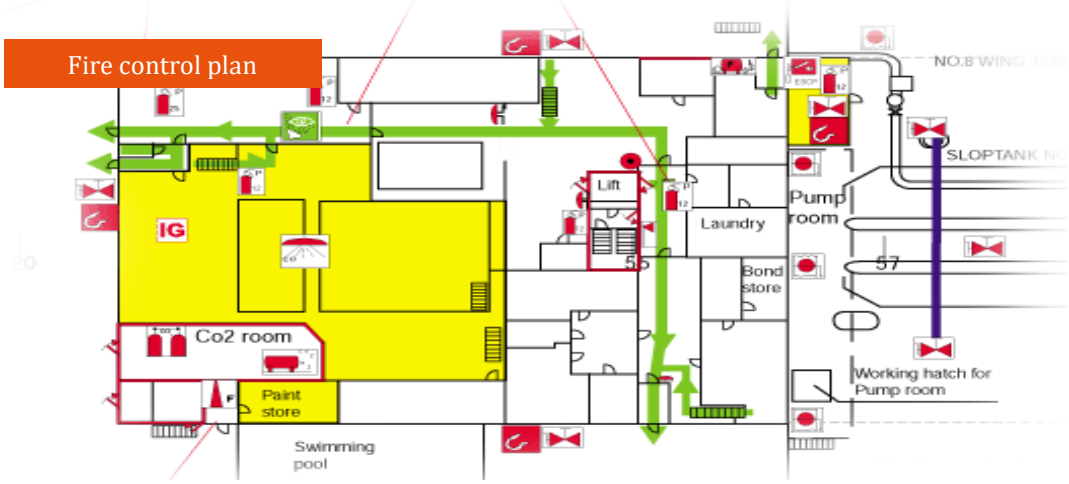
6.7 Location of fire-fighting appliances and detection systems

The fire control plan

The fire control plan illustrates the location of fire-fighting appliances and equipment on-board. The plan shows the vessels profile and an overview of each deck.

It indicate zones with isolated bulkheads and fire doors, manual call point plants with detectors, alarm buttons and alarm bells, the fixed main extinguishing plant and where on board these can be remote controlled. It also indicates where all portable extinguishing equipment, protection and utility equipment are kept.

Fire control plan



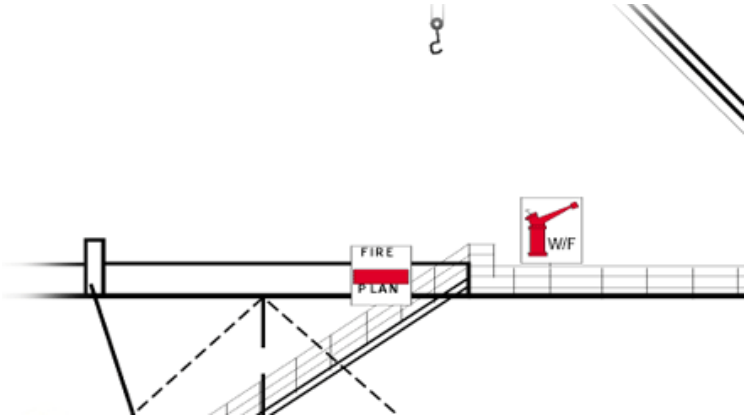
Symbols

Symbols for marking equipment are utilised to make the plan well arranged. Also, on the plan you can find a list with an explanation of the different symbols. Colouring is often utilised to keep the symbol apart. To effectively utilise the different fire technical installations, thorough knowledge of the individual plants is required, plus how to use them.

Fire control plan location

The fire control plan is placed on one of the decks in the accommodation area.

When the vessel is in port, a copy of the fire control plan shall be available at the gangway. If anything occurs during the stay and local help is required, the local fire department can quickly approach the plan, and from an early stage, have knowledge of the preparedness plan.



Fire control plan location

Emergency exits

It is important that all personnel on board become familiar with the escape ways or emergency exits immediately after embarkation. The emergency exit should be properly marked in such a way that everybody on board, regardless of nationality, understands the marking and symbols.

Emergency exits labels

Alarm system

Always activate the alarm before attempting to extinguish a fire!
The detection system will react when there is development of heat, smoke or flames on board and alarm the crew.
The release-point is used to manually alarm the crew in case of emergency or fire.

Automatic alarm system

An automatic alarm system is by definition an arrangement of devices that automatically detects fires and sounds alarms. The system consists of a detector, alarm-transmitter, control centre, and orientation panel. The system checks for smoke, gas, flame or any other indications that fire is present, or under development. It will also indicate where the fire is taking place so that escape, rescues, fire-fighting measures, and recovery of valuables may be organized.

7. REFERENCE DOCUMENTS

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- types of extinguishing agents and fire extinguisher/images/;
- how to operate a fire extinguisher- /images/.

MODULE V

Interreg
Danube Transnational Programme
Danube SKILLS

Project co-funded by European Union funds (ERDF, IPA)

TRAIN
THE
TRAINER

- ENVIRONMENT PROTECTION -

Table of content

1. GENERAL DEFINITIONS

For the purposes of this compendium the following terms have been defined as follows:
Biodegradation: Chemical dissolution of materials by bacteria, fungi, or other biological means;
Bilge water: oily water from the engine room bilges, peak, cofferdams or side compartments;
Cargo remnants: liquid cargo remaining in the cargo tanks or in the pipes after unloading when a stripping system in accordance with ADN has not been used, and dry cargo remaining in the holds after unloading before manual or mechanical sweepers or suction facilities are used;
Ecosystem: Community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.
Oil and greasy waste occurring during the operation of the vessel: waste oil, bilge water and other oily and greasy waste such as waste grease, used filters, used rags, containers and packaging for such waste;
Oil Spill: Release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity, and as a form of pollution.
Oil Pollution Emergency Plan- OPEP: in this plan, you get an overview of possible procedures in case of an oil spill. The plan also mentions whom you should contact (list of authorities, oil clean up teams and port state control) and how to report this event.
Petroleum: from Medieval Latin petroleum, from Latin: petra: "rock" + oleum: "oil", is a naturally occurring, yellow-to-black liquid found in geological formations beneath the Earth's surface, which is commonly refined into various types of fuels;
Reception facility: a vessel or a facility on land approved by the competent authorities for the collection of waste occurring on board;
Waste grease: used grease collected from run off from greasers, bearings and greasing facilities and other non-reusable grease;
Waste occurring on board: substances or articles the person in charge disposes of or which he intends or is required to dispose of;
Waste oil: used oil or other non-reusable grease from engines, gears and hydraulic equipment.

2. INTRODUCTION

This course compendium was designed both for trainers who will be involved in training of such training module and the trainees as learning aids in order to facilitate the learning process.
This course compendium aims to assist in the implementation of the new European Directive on the recognition of professional qualifications in inland navigation and in meeting the requirements of the Standards of competences for inland navigation personnel- Operational level that will be part of this legislative act.
The **main objective** of this course compendium is to provide practical guidance for trainers and trainees to protect the environment and to be able to apply emergency measures during pollution accidents or incidents during navigation on inland waterways.

3. LEARNING OUTCOMES

By the end of this course, trainees will be able to:

- State that it is a legal requirement to protect the marine environment from pollution by vessels;
- Describe the effects of operational or accidental water pollution;
- Describe procedures adopted on board to minimize water pollution.

4.

PROTECTION OF THE ENVIRONMENT

COMPETENCE

Protect the environment in accordance with relevant regulations

4.1 International regulations concerning the protection of the environment

4.1.1 CEVNI – European Code for Inland Waterways

General obligation to exercise vigilance

The Boatmaster, other crew members and other persons on board shall exercise every care required by the circumstances in order to avoid polluting the waterway and to restrict to the maximum the amount of waste occurring on board and to avoid as far as possible any mixing of the various categories of waste.

Prohibition on discharging and dumping

Vessels shall be prohibited from throwing, discharging or allowing to run into the waterway oily or greasy waste occurring during the operation of the vessel or household refuse, sludge, slops and other special waste.

Vessels shall be prohibited from throwing, discharging or allowing to spill into the waterway any parts of the cargo or cargo related waste. Packaging and means of stowage shall be also included.

Domestic waste water shall not be discharged or allowed to flow into the waterway except in accordance with the respective national regulations.

Discharge into the waterway of water separated by approved oil separator vessels shall be exempted from the prohibition for discharging into the water if the maximum content of residual oil after separation is consistently and without prior dilution in accordance with national requirements.

In the event of the accidental discharge of waste or the threat of such discharge, the Boatmaster shall notify the nearest competent authority without delay, indicating as precisely as possible the nature, quantity and position of the discharge.

On board collection and processing of waste

The Boatmster shall ensure the separate collection on board of oily and greasy waste occurring during the operation of the vessel in receptacles provided for the purpose and the collection of bilge water in the engine room bilges. The receptacles shall be stored on board in such a way that any leakage of the contents may be noticed in time and easily prevented.

The Boatmaster shall ensure the separate collection on board and delivery to a reception facility of the waste such as household refuse, sludge, slops and other special waste. If possible, household refuse shall be deposited separately according to the following categories: paper, glass, other recyclable materials and other refuse.

Pollution prevention register (used oil log), requirements for delivery to reception facilities

All vessels equipped with an engine, excluding small crafts, shall carry on board a valid pollution prevention register.

The pollution prevention register shall be issued and identified by the competent authorities.

The oil and greasy waste occurring during the operation of the vessel shall be delivered, against a receipt, to the reception facilities at regular intervals, depending on the condition and operation of the vessel. The receipt shall consist of an entry in the pollution prevention register by the reception facility.

Painting and external cleaning of vessels

It shall be prohibited to oil or clean the outside of vessels using products which may not be discharged into water.

Nor shall it be permitted to use anti-fouling systems containing the following substances or preparation thereof:

- Mercury compounds;

- Arsenic compounds;
- Organotin compounds which act as biocides;
- Hexachlorocyclorexane;

As an interim measure, pending complete removal and replacement of an anti-fouling system containing substances indicated above, it shall be permitted to apply to a vessel's hull a coating to inhibit the introduction into the water of the aforementioned substances from the anti-fouling systems under the coating.

4.1.2 CCNR initiatives on environmental protection of inland waterways

Environmental protection is of particular importance for a form of transport that - in part - uses natural infrastructure. Major rivers represent the backbone of a network of waterways that also encompasses estuaries, lakes and canals. Sustainable use of this infrastructure, which is mostly natural, places major demands on its users.

A number of recent studies have shown how environmentally friendly inland navigation is. Targeted measures help strengthen this profile. There is thus a close link between safety-related measures and those relating to environmental protection. In fact, safety and environmental protection go hand in hand in many fields.

General considerations with respect to inland navigation also apply to navigation on the Rhine.

These efforts to protect the environment are reflected in practice by an on-going fight against all forms of pollution.

Among the various activities are to be mentioned the protection against pollution resulting from accidents ("accidental pollution") and the protection at the level of working procedures on board vessels as well as the techniques used for the treatment of waste produced ("operational pollution").

Protection against accidental pollution

In inland navigation, accidents may take place as a result of technical faults or human error, just like in any human activity. The risks in question are a major consideration when drafting safety guidelines. An in-depth analysis of the various potential scenarios, as well as of actual accidents, provides a basis for a coherent set of measures designed to ensure a high level of passive safety in the field of water transportation (technical guidelines and measures regarding the transportation of dangerous goods).

Protection in the context of working practices and every-day operations

- **Reducing emissions of harmful exhaust fumes:**

Inland navigation almost exclusively uses diesel engines for propulsion, which are obviously fuelled by diesel. The emission of exhaust fumes containing harmful substances is thus inevitable. The Central Commission has introduced rules designed to control these constituent compounds. A type approval is required for new engines installed on board inland vessels (CCNR 1 since 2003 and CCNR 2 since 2007). In this respect, reference is also made to community directives on non-road mobile machinery (Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 and Directive 2004/26/EG)

- **Reducing carbon gas emissions:**

The reduction of CO_2 emissions is a primary focus of the Central Commission as part of its major climate change project. Accordingly, serious consideration is given to means of achieving major savings in fuel consumption, the use of alternative forms of energy such as natural gas and indeed the use of other combustion technologies, such as fuel cells.

- **Handling of waste generated on board vessels:**

Water transportation, by its very nature, whether involving passengers or cargo, generates waste. This waste must be handled in line with applicable regulations governing temporary storage on board vessels and transfer to recycling and disposal networks. Measures designed to prevent the generation of waste as well as the financing of the collecting, storage and disposal of this material are specific aspects. Given the very nature of inland navigation, including the

mobile and international nature inherent in this mode of transport, the States most closely affected have drawn up, with the support of the Central Commission, an international convention known as the **CDNI (Convention on Collection, Deposit and Reception of Waste Produced during Navigation on the Rhine and Inland Waterways).** This Convention came into force in November 2009. It covers waterways in Belgium, Germany, the Netherlands, part of the waterways in France (Rhine and Moselle), Luxembourg and Switzerland (Rhine). Introducing a ban on surface water discharges, the Convention and its implementing regulation set out detailed rules on waste prevention, how to handle waste generated on board vessels and the procedures governing transfer to land installations. The Convention also details the responsibilities with respect to the disposal of this waste. As the rules vary depending on the type of waste, they have been compiled together into separate annexes of the implementing regulation in accordance with the source of the waste on board vessels.

4.1.3 Convention on Cooperation for the Protection and Sustainable use of the Danube River (Danube River Protection Convention)

This convention, which has been signed in 1994 in Sofia by 11 of the Danube Countries (Austria, Bulgaria, Croatia, the Czech Republic, Germany, Hungary, Moldova, Romania, Slovakia, Slovenia and Ukraine) and the EU, forms the overall legal instrument for co-operation and transboundary water management in the Danube River Basin.
One of the main objectives of this Convention is in line with the water management cooperation which shall be oriented on sustainable water management that means on the criteria of a stable, environmentally sound development, which are at the same time directed to:

- maintain the overall quality of life;
- maintain continuing access to natural resources;
- avoid lasting environmental damage and protect ecosystems;
- exercise preventing approach.

4.1.4 Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy

The purpose of this Directive is to establish a framework for the protection of inland waters which:

- prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- promotes sustainable water use based on a long-term protection of available water resources;
- aims an enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation of phasing-out of discharges, emissions and losses of the priority hazardous substances; and
- ensures the progressive reduction of water pollution.

4.1.5 European Agreement concerning the international carriage of dangerous goods by inland waterways – ADN

The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) was signed at Geneva on 26 May 2000 on the occasion of a Diplomatic

Conference held under the joint auspices of the United Nations Economic Commission for Europe (UNECE) and the Central Commission for the Navigation of the Rhine (CCNR). It entered in force on 29 February 2008.
ADN consists of a main legal text (the Agreement itself) and annexed Regulations and aims at:

- ensuring a high level of safety of international carriage of dangerous goods by inland waterways;
- contributing effectively to the protection of the environment by preventing any pollution resulting from accidents or incidents during such carriage; and
- facilitating transport operations and promoting international trade in dangerous goods.

The Regulations annexed to the ADN contain provisions concerning dangerous substances and articles, provisions concerning their carriage in packages and in bulk on board inland navigation vessels or tank vessels, as well as provisions concerning the construction and operation of such vessels. They also address requirements and procedures for inspections, the issue of certificates of approval, recognition of classification societies, monitoring, and training and examination of experts.
The last updated version of this European Agreement is that of 2017.

4.2 Water pollution

4.2.1 What is water pollution?

Water pollution has become a growing concern over the last century as more and more waste is being disposed of in the waterways.
This increase in pollution is harming our food supplies, drinking water and environment. It is also creating issues in the ecosystem and hurting the animals and plant life that rely on the waters for their survival.
Water pollution is caused by the intentional or unintentional release of toxic chemicals/materials, contaminants and harmful compounds into various bodies of water such as rivers, lakes and the ocean.
Without proper disposal or filtration of these pollutants they can spread throughout the water and affect all living animals and organisms that come into contact with it by contaminating any living thing that requires water for survival.

In addition to harming animals water pollution can also affect plants, trees, the soil and other natural materials and resources of the earth.

4.2.2 Water pollution causes, effects and consequences

Water pollution may be caused by any hazardous substance or material that makes contact with the earth's water supply.
This may include oil from oil tankers and oil refineries, garbage from construction sites, city streets and residential lawns, improper disposal of hazardous materials from garbage disposal companies, chemical spills and improper chemical disposal, sewage leaks and agricultural runoffs etc.
Water pollution is generally caused by human activities but may also be caused by natural resources.
When water is polluted it is usually defined as either being polluted from point sources or non-point sources.
Point source pollution occurs from a specific location by a single source such as a large factory, oil refinery or hauling ship that contributed a massive amount of pollution within a single area.
This large scale pollution can then be spread across large bodies of water affecting many miles of water, agricultural land, animal habitats and maritime and inland ecosystems.

Non- point source pollution can occur from many different areas that all contribute to a body of water.
This can occur from large neighbourhoods with poor residential lawn quality, from sewage leaks and other types of contaminants, city streets where garbage and chemicals are not disposed of properly and large agricultural areas that use harmful chemicals which runoff into a body of water and contribute to other sources of water pollution.
When people rely on a specific body of water for drinking, cleaning and other purposes and that water becomes polluted it can become a major issue.
Once water becomes polluted it becomes unsafe for consumption due to the dangerous or toxic materials that are contained within the water.
If contaminated water is consumed it could lead to sickness, infections, exposure to diseases and even death.
While pollution is a growing concern determining what water is polluted isn't always easy when observed by the naked eye or our taste buds.
Water may appear to be clean for consumption however it may have hidden pollutants that can affect our bodies as well as animals, plants and various other organisms.
In order to determine the health of water (especially clear, clean looking water) researchers and scientists often need to perform special tests.
If the water is considered contaminated it will need to go through a filtration and removal process before it can become drinkable or even sustainable for numerous animal species that inhibit that body of water.
Finding a way to develop cheap filtration systems and better waste disposal management systems is going to be a vital step towards improving the health of our drinking water and the bodies of water that surround us.

4.2.3 Effects of water pollution:

- toxic rainfall can occur in areas where water and/or air is polluted with toxic chemicals and materials;
- polluted water can lead to sickness, disease, infections, deformities and even death among animals and plant life;
- once water becomes polluted it can affect people and animals either directly through consumption or indirectly through food sources, land degradation and the overabundance of plants and algae which can cover the surface of various bodies of water making it undrinkable and affecting the animals that live in that body of water.

4.3 Environmental effects of oil spills

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially the marine and inland ecosystem, due to human activity, and is a form of pollution. The term is usually given to marine oil spills, where oil is released into the maritime and inland waters, but spills may also occur on land. Oil spills may be due to releases of crude oil from tankers, offshore platforms, drilling rigs and wells, as well as spills of refined petroleum products (such as gasoline, diesel) and their by-products, heavier fuels used by large ships such as bunker fuel, or the spill of any oily refuse or waste oil.

Oil spills accident

When an oil spill occurs, many elements of the environment may be affected. Depending on the magnitude of the spill and its location, the effects can vary, ranging from minimal to serious ones. For instance, oil spills can have a major impact on the temporary animal and fish loss of habitat. Heavy oils may affect several organism functions like respiration, feeding, and thermo-regulation. At the same time, the entire ecosystem can change temporarily because of the chemical components and elements of the spilled oil that are toxic to the environment.
The general characteristics and transport of spilled oil dictate its environmental effects and mainly involve:

- the ability of oil to accumulate on top of water bodies forming oil slicks or

non-aqueous phase liquids which are generally more resistant to degradation and natural attenuation than the dissolved compounds. From such oil slicks evaporation of many volatile components of oil spill is the dominant process when the oil slick is in contact with air, such as in marine spills;

- the dissolution of certain more soluble oil compounds happens in time along

with some dispersion, diffusion, and advection;

- the persistence of many individual oil components makes them accumulate in

the environment and living organisms.
The effects of oil spills are not limited to the environment. There are immediate effects on humans, fish, animals, birds and wildlife in general, mainly due to:

- direct contact with the spilled oil including breathing of volatilized oil

components (hydrocarbons) from the spill;

- direct contact with the environment polluted with spilled oil components (some

of which may persist a long time), such as drinking polluted water or breathing polluted dust particles;

- consumption of polluted food - at any level within the food chain, with a higher

risk for food pollution at the higher levels of the food chain, i.e. humans and animals.

Steps to Take in Case of an Oil Spill
Oil Spill on Ship during transfer

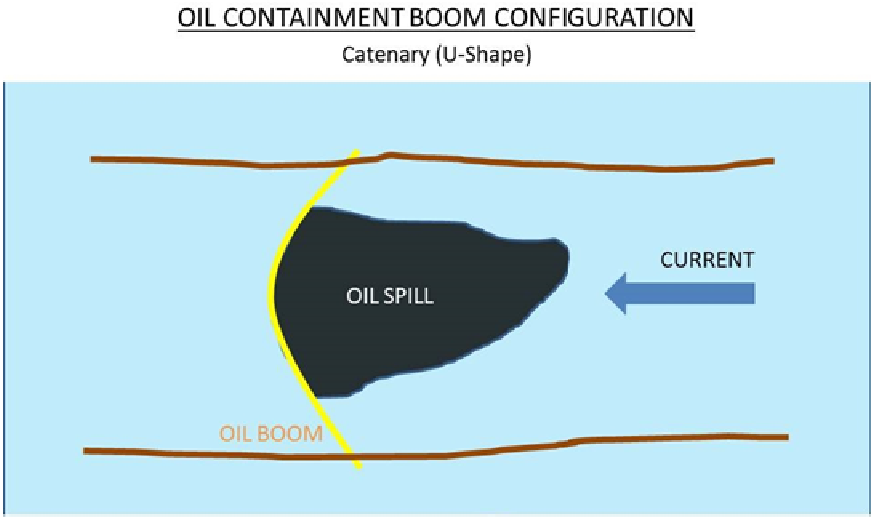
Anyone who sees oil on deck must:

- immediately close the ship side scuppers and alarm the ship staff by shouting and contacting duty officer on bridge and engine room;
- Stop all the transfer immediately, locate the effected tank and its sounding pipe, and vent position;
- The Boatmaster shall call the emergency muster and everybody must carry out their duty as listed in the muster list for oil spill.
- Use the equipment and other means to contain the spill within the ship.
- Lower the quantity of spilled tank to a safer level in any other permissible tank.
- Put sawdust over the scupper plug will give an additional barrier for oil to go overboard;
- Collect the spread oil in a 200-litre drum and clear the affected area.
- The Boatmaster must enter the whole scenario in the ship's incident report form and call up for a meeting to discuss the accident so such accidents can be avoided in near future.

Oil Spill during Bunkering Operation or Sludge Discharge Operation

The following points are to be noted in case of oil spill during bunkering:
One stand by officer is always present in the bunkering manifold. If he sees any oil or leakage near that area he must immediately, shout "stop" to the bunker-supplying vessel loudly or in the VHF and immediately press the remote switch (if same exists).
For sludge disposal operation, if any spill occurs immediately stop the ship's sludge transfer pump from remote panel, normally situated near the bunker manifold.

Inform the Chief engineer, duty officer about the emergency situation.
Scupper must be plugged before starting any of these operations. If oil spill occurs on the deck recheck the plug and put sawdust over it.
The Boatmaster will call for emergency muster and crew will carry out their duties as per the muster list for oil spill emergency.
Drip tray in bunker manifold must be checked for over filling and should be emptied in 200-litre drum if required.
A foam type portable fire extinguisher must be readily available to avoid the worsening of the situation by fire.
Actions to be taken in Case Oil Goes Overboard
If the oil spill goes overboard, the Boatmaster will immediately inform the competent authority like port state control and owner or office management.
Measures shall be taken to limit the area of spill in the water with use of oil booms and other oil spill equipment, and all efforts shall be made not to allow further oil to go overboard.
Use of Oil spill dispersant chemical can be done to contain the spill but with prior permission from port state authorities.
The Boatmaster shall contact the 24 hours Oil Spill Response Organization for further cleaning up operation by shore team.
Entry shall be made in: Bridge log book, Engine room log book and Oil Record Book about the spill.



Oil containment boom configuration

Collection of the Oil

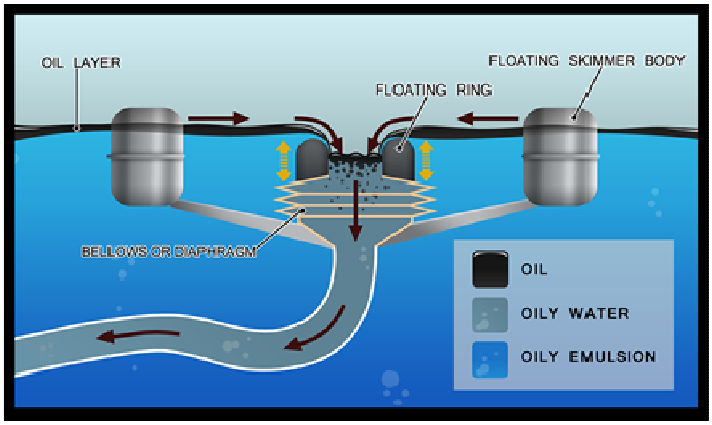
After the oil spill is contained, it has to be collected. There are several techniques for the collection of the oil spill, which shall be explained below

Oil skimmers

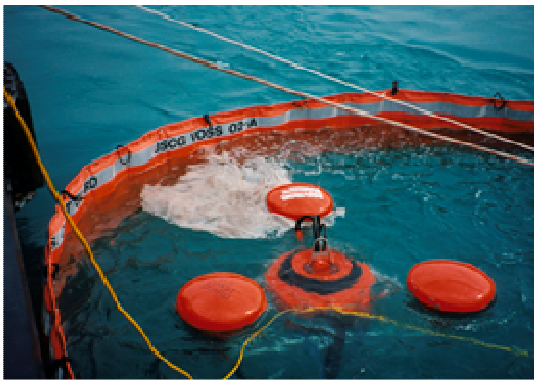
Absorbent (Pillows/Booms/Pads)

After the deployment of the containment boom it's time to collect the spill from the water surface, one way to do this is to use absorbent material in different forms.
The absorption pillows, booms and pads allow the easy collection of the material after the oil is absorbed, but for larger spills it is possible to use bags with granulated absorbent, allowing the absorption of larger quantities of oil.

Weir type skimmers



Rotary type skimmers



4.4 Air pollution

4.4.1 What is air pollution?

Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole.
Air pollution can further be classified into two sections:

- visible air pollution; and
- invisible air pollution.

Another way of looking at Air pollution could be any substance that holds the potential to hinder the atmosphere or the well- being of the living beings surviving in it. The sustainment of all things living is due to a combination of gases that collectively form the atmosphere; the imbalance caused by the increase or decrease of the percentage of these gases can be harmful for survival.

4.4.2 Causes of Air pollution

Burning of Fossil Fuels: Sulphur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one the major causes of air pollution. Pollution emitting from road, rail, aerial vehicles causes an immense amount of pollution. Maritime and inland transport ships also contribute to air pollution.
Carbon Monoxide caused by improper or incomplete combustion and generally emitted from vehicles is another major pollutant along with Nitrogen Oxides, that is produced from both natural and man -made processes.
Agricultural activities: Ammonia is a very common by-product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities has grown quite a lot. They emit harmful chemicals into the air and can also cause water pollution.
Exhaust from factories and industries: Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.
Mining operations: Mining is a process wherein minerals below the earth are extracted using large equipment. During the process dust and chemicals are released in the air causing massive air pollution.
Indoor air pollution: Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution.
Suspended particulate matter, popular by its acronym SPM, is another cause of pollution. Referring to the particles afloat in the air, SPM is usually caused by dust, combustion etc.

4.4.3 Effects of Air pollution

Respiratory and heart problems: The effects of Air pollution are alarming. They are known to create several respiratory and heart conditions along with Cancer, among other threats to the body.
Global warming: Another direct effect is the immediate alterations that the world is witnessing due to Global warming.
Acid Rain: Harmful gases like nitrogen oxides and sulphur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combines with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to human, animals and crops.
Eutrophication: Eutrophication is a condition where a high amount of nitrogen present in some pollutants gets developed on waterway's surface and turns itself into algae and adversely affects fish, plants and animal species.
Effect on Wildlife: Just like humans, animals also face some devastating effects of air pollution. Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat. The toxic pollutants deposit over the surface of the water and can also affect aquatic animals.
Depletion of Ozone layer: Ozone exists in earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere. As ozone layer will go thin, it will emit harmful rays back on earth and can cause skin and eye related problems. UV rays also have the capability to affect crops.

4.4.4 IWT impact on air pollution

IWT emission levels

Inland Waterway Transport (IWT) is an efficient, safe and environmentally friendly mode of transport. However, the previously undisputed competitive position of IWT in the field of emissions, in comparison to air, is increasingly being contested. The gap – regarding emissions to air – between road transport and IWT is rapidly becoming smaller. A major concern thereby, is the poor progress made on the emission of air pollutants with in particular, the emission of nitrogen oxides (NOx) and particulate matter (PM).

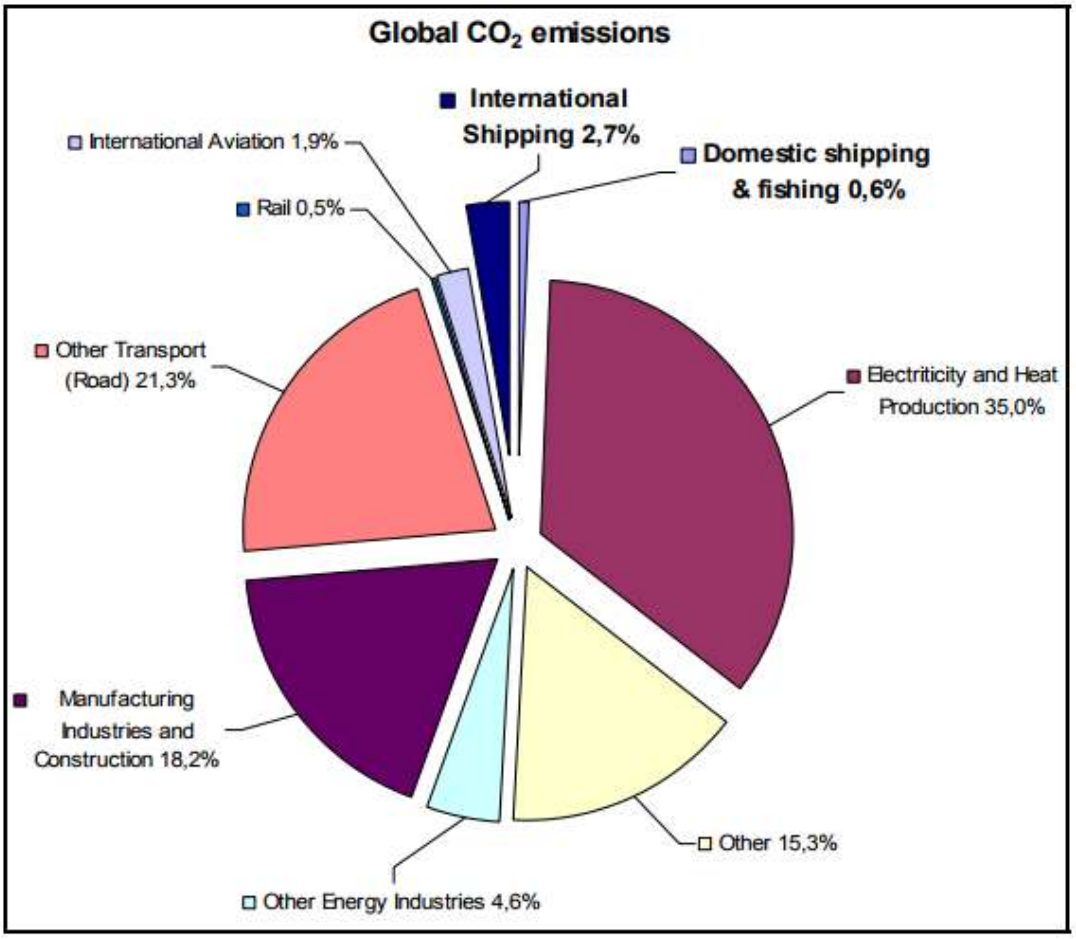
Therefore, addressing the emission levels of IWT is aimed at significantly reducing premature deaths caused by air pollution, whilst simultaneously resolving environmental impacts, such as acidification and associated losses in biodiversity.

In contrast to the road haulage sector the emission standards for new engines are much less stringent and the average lifetime of engines in inland vessels is very long. As a consequence, inland waterway transport already has higher air pollutant emission levels than road transport per tonne kilometre for certain vessel types. Without specific action this situation will further deteriorate in the future and the air pollutant emission will remain high for IWT.

Engines used in IWT have been subject to Stage IIIA emission requirements (Directive 97/68/EC on emissions from non-road mobile machinery engines) since 2007. Despite this measure the atmospheric pollution from inland shipping remains significant and with high concentration levels in certain harbours and cities. It should also be noted that around 9 out of 10 inland waterway vessels in the EU are registered in Belgium, the Netherlands, Germany and France, where the environmental impacts are more intense, due to a higher concentration of the population along waterways.

The Europe 2020 Strategy and the White Paper 2011 'Roadmap to a Single European Transport Area', sets out clear environmental objectives for the transport system. As an overall objective of the White Paper on Transport, the impact of transport on the environment should be lowered by reducing the dependency upon oil and thereby, cutting carbon emissions in transport by 60% by the year 2050. If current trends persist, IWT will not contribute sufficiently towards the achievement of the sustainability objectives of the White Paper on Transport.

Regulation (EU) 2016/1628 of the European Parliament and of the Council on requirements relating to gaseous and particulate pollutant emissions limits and type-approval for internal combustion engines for non-road mobile machinery will be implemented until 31 December 2021, when Member States shall the obligation to inform the Commission of the application of the EU type-approval procedures laid down in this Regulation.



4.5 Dangerous goods and environmental aspects

Dangerous goods include those substances and articles the carriage of which is prohibited by the ADN-European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways, or authorized only under the condition prescribe therein.

ADN-European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways

The classes of dangerous goods according to ADN are the following:

- Class 1- Explosive substances and articles;

- Class 2- Gases;
- Class 3- Flammable liquids;
- Class 4.1 – Flammable liquids, self-reactive substances, polymerizing substances and solid desensitized explosives;
- Class 4.2- Substances liable to spontaneous combustion;
- Class 4.3 – Substances which, in contact with water, emit flammable gases;
- Class 5.1- Oxidizing substances;
- Class 5.2 – Organic peroxides;
- Class 6.1 – Toxic substances;
- Class 7- Radioactive material;
- Class 8- Corrosive substances;
- Class 9- Miscellaneous dangerous substances and articles.

Criteria for substances hazardous to the aquatic environment

Environmentally hazardous substances include, inter alia, liquid or solid substances pollutant to the aquatic environment and solutions and mixtures of such substances (such as preparations and wastes). Substances means chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

The aquatic environment may be considered in terms of the aquatic organisms that live in the water, and the aquatic ecosystem of which they are part. The basis, therefore, of the identification of hazard is the aquatic toxicity of the substance or mixture, although this may be modified by further information on the degradation and bioaccumulation behaviour.

The basic elements for classification of environmentally hazardous substances (aquatic environment) are as follows:

- Acute aquatic toxicity;
- Chronic aquatic toxicity;
- Potential for actual bioaccumulation; and
- Degradation (biotic or abiotic) for organic chemicals.

Acute aquatic toxicity means the intrinsic property of a substance to be injurious to an organism in a short-term aquatic exposure to that substance.

Acute (short-term) hazard means the hazard of a chemical caused by its acute toxicity to an organism during short-term aquatic exposure to the chemical.

Chronic aquatic toxicity means the intrinsic property of a substance to cause adverse effects to aquatic organisms during aquatic exposures which are determined in relation to the life-cycle of the organism.

Long-term hazard means the hazard of a chemical caused by its chronic toxicity following long-term exposure in the aquatic environment.

Bioaccumulation means net result of uptake, transformation and elimination of a substance in an organism due to all routes of exposure (i.e. air, water, sediment/soil and food).

Degradation means the decomposition of organic molecules to smaller molecules and eventually to carbon dioxide, water and salts.

5.

POLLUTION PREVENTION

COMPETENCE

Take precautions to prevent pollution of the environment

5.1 General precautions to prevent pollution of the environment

Pollution prevention is any practice that reduces, eliminates, or prevents pollution at its source. Reducing the amount of pollution produced means less waste to control, treat, or dispose of. Less pollution means less hazards posed to public health and the environment.

Specific pollution prevention approaches

Pollution prevention approaches can be applied to all potential and actual pollution-generating activities, including those found in the energy, agriculture, federal, consumer and industrial sectors. Prevention practices are essential for preserving wetlands, groundwater sources and other critical ecosystems - areas in which we especially want to stop pollution before it begins.

In the energy sector, pollution prevention can reduce environmental damages from extraction, processing, transport and combustion of fuels. Pollution prevention approaches include:

- increasing efficiency in energy use;
- use of environmentally benign fuel sources.

In the agricultural sector, pollution prevention approaches include:

- reducing the use of water and chemical inputs;
- adoption of less environmentally harmful pesticides or cultivation of crop strains with natural resistance to pests; and
- protection of sensitive areas.

In the industrial sector, examples of pollution prevention practices include:

- modifying a production process to produce less waste;
- using non-toxic or less toxic chemicals as cleaners, degreasers and other maintenance chemicals;
- implementing water and energy conservation practices;
- reusing materials such as drums and pallets rather than disposing of them as waste.

Why is pollution prevention important?

Pollution prevention reduces both financial costs (waste management and clean up) and environmental costs (health problems and environmental damage). Pollution prevention protects the environment by conserving and protecting natural resources while strengthening economic growth through more efficient production in industry and less need for households, businesses and communities to handle waste.

5.2 Safe Bunkering operations and procedures

Spillages and leakages during bunkering operations are a primary source of oil pollution. Experience has shown that many of the bunker overflows and spillages that do occur can be attributed to human error.

All bunkering operations should be carefully planned and executed in accordance with applicable regulations.

Personnel involved in the bunkering operation on board should have no other tasks and should remain at their workstations during topping-off. Generally, bunkering during cargo operations is not considered to be best practice owing to the need to avoid conflicts of interest for operational personnel. Spillages often occur when crew members are distracted by another task. Companies should require that all bunkering operations are controlled under procedures that are incorporated in a Safety Management System.

These procedures should ensure that the risks associated with the operation have been assessed and that controls are in place to mitigate these risks. The procedures should also address contingency arrangements in the event of a spill.

The Company should consider the following items when producing the procedures:

- determining that there is adequate space for the volume of bunkers to be loaded;
- establishing maximum loading volume for all tanks;
- controls for the setting of bunker system valves;
- determining loading rates for the start of loading, bulk loading and topping-off;
- special precautions when loading into double bottom tanks;
- arrangements of bunker tank ventilation;
- overflow arrangements;
- verification of gauging system operation and accuracy;
- alarm settings on overfill alarm units;
- bunker overfill protection (in general, the bunker overfill protection is an emergency stopping device only. It should not be used as a standard method of stopping bunkering);
- communication between the supplier and receiver must be established before bunkering can be undertaken, including communication procedures for the bunkering operation and emergency stop;
- manning requirements to execute the operation safely (including e.g. deck watch);

- monitoring of the bunkering operation and checking it conforms to the agreed procedure;
- changing over tanks during bunkering;
- containment arrangements and clean-up equipment to be available.

Once the procedure is produced, it should be implemented by use of a check-list (model from Appendix 5 – ISGINTT- International Safety Guide for Inland Navigation Tank-barges and Terminals).

Prior to commencing the operation, all pre-loading checks should be carried out and communication systems verified as working.

The loading rate should be checked regularly.

When changing over from one tank to another, care should be taken to ensure that an excessive back pressure is not put on the hose or loading lines.

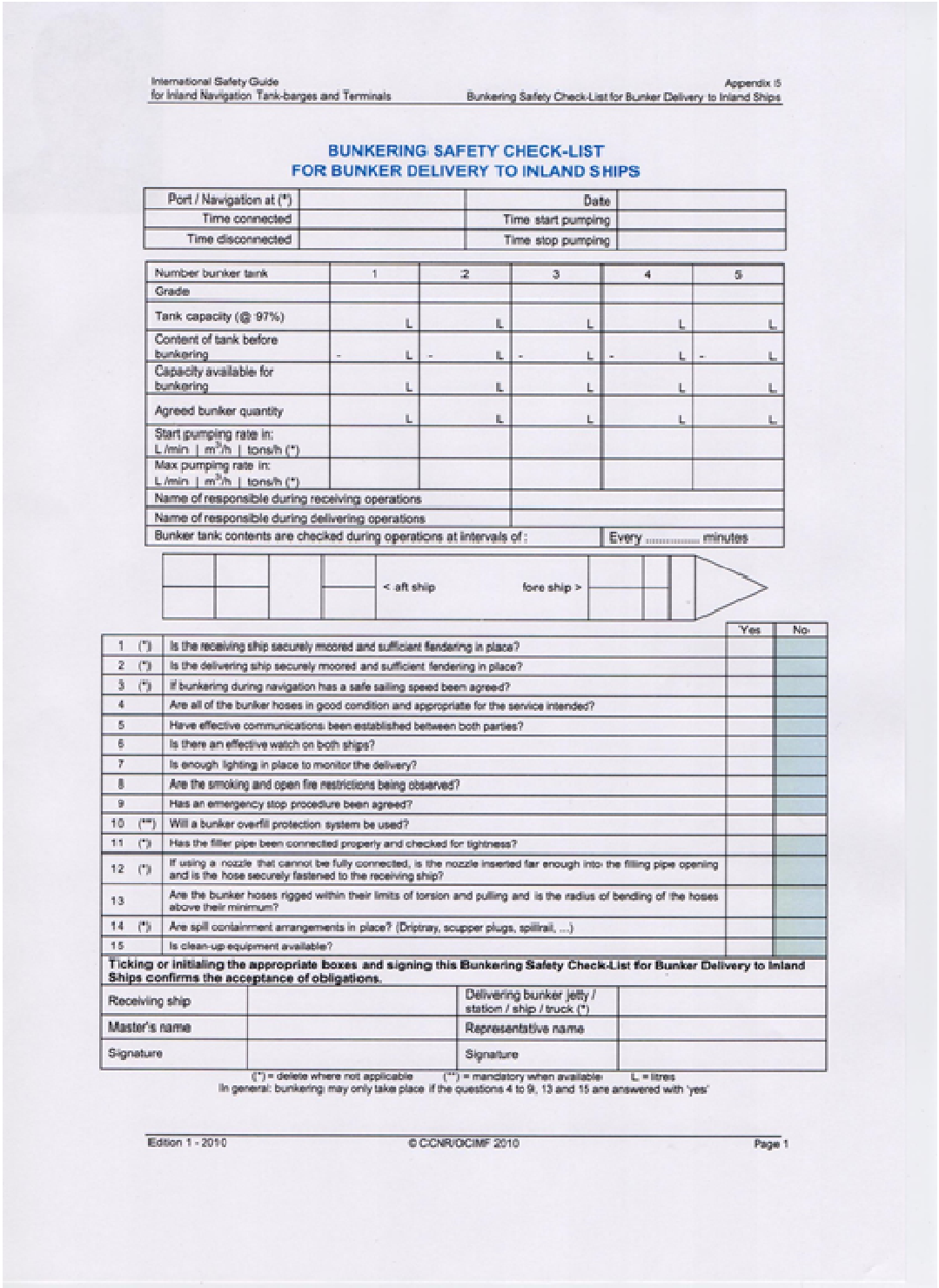
When topping-off tanks, the loading rate should be decreased to reduce the possibility of air locks in the tank causing mist carry over through the vents, and to minimise the risk of the supplier not stopping quickly enough.

On completion of bunkering, all hoses and lines should be drained to the tank or, if applicable, back to the delivery bunker supplier, prior to disconnection. The practice of blowing lines with air into bunker tanks has a high risk of causing a spillage unless the tank is only part full and has sufficient ullage on completion of loading.

Responsibility and accountability for the safe conduct of bunker operations is shared jointly between the receiver and the supplier. Before the bunkering operation commences, the responsible personnel should:

- agree in writing the handling procedures, including the maximum transfer rates.
- agree in writing the action to be taken in the event of an emergency during transfer operations;
- complete and sign the Bunkering Safety Check-List for Bunker Delivery to Inland Ships.

The Check-List is primarily structured for loading bunkers from a barge, a jetty or when loading bulk lubricating oil or gas oil from a road tanker.



International Safety Guide for Inland Navigation Tank-barges and Terminals — Appendix I5 — Bunkering Safety Check-List for Bunker Delivery to Inland Ships

BUNKERING SAFETY CHECK-LIST
FOR BUNKER DELIVERY TO INLAND SHIPS

Port / Navigation at (*)		Date	
Time connected		Time start pumping	
Time disconnected		Time stop pumping	

Number bunker tank	1	2	3	4	5
Grade					
Tank capacity (@ 97%)	L	L	L	L	L
Content of tank before bunkering	- L	- L	- L	- L	- L
Capacity available for bunkering	L	L	L	L	L
Agreed bunker quantity	L	L	L	L	L
Start pumping rate in: L/min | m³/h | tons/h (*)					
Max pumping rate in: L/min | m³/h | tons/h (*)					
Name of responsible during receiving operations					
Name of responsible during delivering operations					
Bunker tank contents are checked during operations at intervals of :			Every ..... minutes		

< aft ship — fore ship >

		Yes	No
1 (*)	Is the receiving ship securely moored and sufficient fendering in place?		
2 (*)	Is the delivering ship securely moored and sufficient fendering in place?		
3 (*)	If bunkering during navigation has a safe sailing speed been agreed?		
4	Are all of the bunker hoses in good condition and appropriate for the service intended?		
5	Have effective communications been established between both parties?		
6	Is there an effective watch on both ships?		
7	Is enough lighting in place to monitor the delivery?		
8	Are the smoking and open fire restrictions being observed?		
9	Has an emergency stop procedure been agreed?		
10 (**)	Will a bunker overfill protection system be used?		
11 (*)	Has the filler pipe been connected properly and checked for tightness?		
12 (*)	If using a nozzle that cannot be fully connected, is the nozzle inserted far enough into the filling pipe opening and is the hose securely fastened to the receiving ship?		
13	Are the bunker hoses rigged within their limits of torsion and pulling and is the radius of bending of the hoses above their minimum?		
14 (*)	Are spill containment arrangements in place? (Driptray, scupper plugs, spillrail, ...)		
15	Is clean-up equipment available?		

Ticking or initialling the appropriate boxes and signing this Bunkering Safety Check-List for Bunker Delivery to Inland Ships confirms the acceptance of obligations.

Receiving ship		Delivering bunker jetty / station / ship / truck (*)	
Master's name		Representative name	
Signature		Signature	

(*) = delete where not applicable (**) = mandatory when available L = litres
In general: bunkering may only take place if the questions 4 to 9, 13 and 15 are answered with 'yes'

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Bunkering Safety Check-list

5.3 Prevention of further damage after a collision accident by vessels

It is important while navigating vessel the crew members understand practical procedures to avoid collision guided by boatmaster standing orders. These procedures are only indicative, not exhaustive in nature and one must always be guided by practices of good seamanship. Call attention of other vessels that are in adjacent waters by turning on deck lights, putting up the lights or shaped objects to show not under command, using VHF, and other possible means.

Upon collision with another vessel, "Go Astern" as early as possible to limit the damage and to avoid further contact. But if the bow of the vessel has penetrated into the side shell of the other vessel, reverse the engine only after an initial damage assessment as one of the vessels may suddenly lose her buoyancy and sink, or cause/increase oil pollution.

Damage survey and measures against flooding

Survey the degree of damages of the hull by sounding all compartments likely to be affected by the collision. Limit any flooding by using available means on board.

If the leakage is small, wooden plugs, blankets, tarpaulin, cement boxes or the like can be used to reduce the flooding rate.

An increase in draft due to flooding can cause flooding through openings that are usually above waterlines, to which serious attention must be given.

If high rate flooding is likely to cause the vessel to sink, an intentional stranding should be considered.

In case of a leakage in the fore peak tank, proceed with reduced speed so that excessive pressure on the collision bulkhead is kept to a minimum, and move the vessel to safer waters . Ballast aft tanks if possible to regain freeboard forward.

Salvage contract and evacuation

Follow the Company's instructions to conclude a salvage contract, for which communication must be established between the Company and the vessel as soon as possible after the accident.

When there is imminent danger, where is absolutely no time to wait for the Company's decision, however, the Boatmaster may request salvage using his professional judgment.

If danger is imminent to human lives on board the vessel, every effort should be done to evacuate everyone from the vessel.

Cargo Leakage into Double Hull Tanks

If a cargo leak is discovered, the first step should be to check the atmosphere in the double hull or double bottom tank to establish the cargo content.

It should also be borne in mind that the hazards associated with cargo leakage may also relate to the cargo's toxicity, corrosiveness or other properties and additional measurements may have to be performed to confirm safe conditions for entry.

If a leakage is discovered, the tanker's captain should immediately contact the Company for consultation. It is strongly recommended that operators develop guidelines, taking into account the tank structure and any limitations of the available atmosphere monitoring system, which could assist the tanker's personnel to select the appropriate method of rendering the atmosphere safe. The guidelines should also include the process for contacting authorities and/or the tanker's Classification Society.

Filling or partially filling the double hull or double bottom tank with ballast in order to render the atmosphere safe and/or stop any further leakage of cargo into the tank must take into account prevailing stress, trim, stability and load line factors. It must also be borne in mind that all ballast loaded into a tank after a leak has been found, and all tank washings associated with cleaning the tank, will be classed as 'polluted ballast' and must be processed in accordance with legislation. This means that they must be transferred directly to a cargo or slop tank for further processing. The spool piece used to connect the ballast system to the cargo system should be clearly identified and it should not be used for any other purpose.

If the quantity of cargo leaking into the space is determined to be pumpable, it should be transferred to another cargo tank via the emergency ballast/cargo spool piece connection, if available (see above), or other emergency transfer method, in order to minimise contamination of the space and to facilitate subsequent cleaning and gas freeing operations.

6.

REDUCING FUEL CONSUMPTION AND EMISSIONS IN IWT

COMPETENCE

Use resources efficiently

6.1 Measures for reducing fuel consumption and emissions in IWT

Emissions reduction measures in inland shipping can be categorized into three main groups:

- Technical measures: measures related to the propulsion system, vessel design and vessel equipment, exhaust after treatment, engine internal measures, use of alternative fuel/energy (LNG, electricity, hydrogen, biofuel);
- Operational measures: measures related to speed reduction, smart steaming, journey planning, on board information systems, optimal maintenance;
- Traffic and transport management: measures related to the organization of the logical chain, to the interface between inland waterway vessels and other transport modes, to the interface of inland vessels and infrastructure (locks, terminals in inland seaports etc.)

6.2 Research and development needs in support of greening the IWT fleet

Emission reductions in IWT depend on further R&D, in particular to adopt existing technologies to the specific context and to lower the cost of deployment. The following non-exclusive list of topics has been identified as requiring further R&D efforts:

- Clean technology needs to be developed for using LNG as mono-fuel as well as dual-fuel in the IWT context, and/or gas-electric applications, in order to further reduce fuel costs and to reduce the engine-out performance as regards NOx and PM;
- Stage V diesel engines development has started by using a combination of techniques that have been developed for smaller engines but are currently still considered experimental for large engines;
- Research on technical solutions to prevent or reduce methane emissions, for instance by using pressure LNG technologies or methane slip catalysts;
- Capacity building of systems integrators that provide Stage IV and V engines by integrating components from various suppliers;
- Technologies and procedures for monitoring compliance with emission standard.

7.

WASTE COLLECTION AND DISPOSAL

COMPETENCE

Dispose of waste in an environmentally friendly fashion

7.1 Applicable regulations concerning waste

7.1.1 CEVNI – European Code for Inland Waterways

On board collection and processing of waste

The Boatmaster shall ensure the separate collection on board of oily and greasy waste occurring during the operation of the vessel in receptacles provided for the purpose and the collection of bilge water in the engine room bilges. The receptacles shall be stored on board in such a way that any leakage of the contents may be noticed in time and easily prevented.

The Boatmaster shall ensure the separate collection on board and delivery to a reception facility of the waste such as household refuse, sludge, slops and other special waste. If possible, household refuse shall be deposited separately according to the following categories: paper, glass, other recyclable materials and other refuse.

7.1.2 Convention on collection, deposit and reception of waste produced during Navigation on the Rhine and Inland Waterway

Inland waterway transport is deemed to be the most environmentally friendly mode of transport. The treatment of waste that inevitably occurs during the operation of vessels is of particular concern for river operators.

As the management and the disposal of waste is a matter that is being regulated in a land-based context and taken into account through appropriate procedures and infrastructure on a national level, some rules for the various parties concerned by inland waterway transport had to be established in view of the necessary interface. These rules envisage to:

- encourage the prevention of waste generation;
- canalise the disposal to the dedicated waste reception facilities along the waterway network;
- ensure adequate funding in view of the “polluter-pays principle”;
- facilitate compliance with the prohibitions of discharge of the waste into surface water.

7.1.3 Recommendations relating to the organization of the collection of waste from vessels navigating on the Danube

Vessels are prohibited from throwing, pouring or dropping or flowing in the waters of the Danube, objects, substances and products of a nature to cause an obstruction or danger to navigation or pollute water.

Waste on board must be stored and unloaded in reception facilities at ports or other points for reception ship waste.

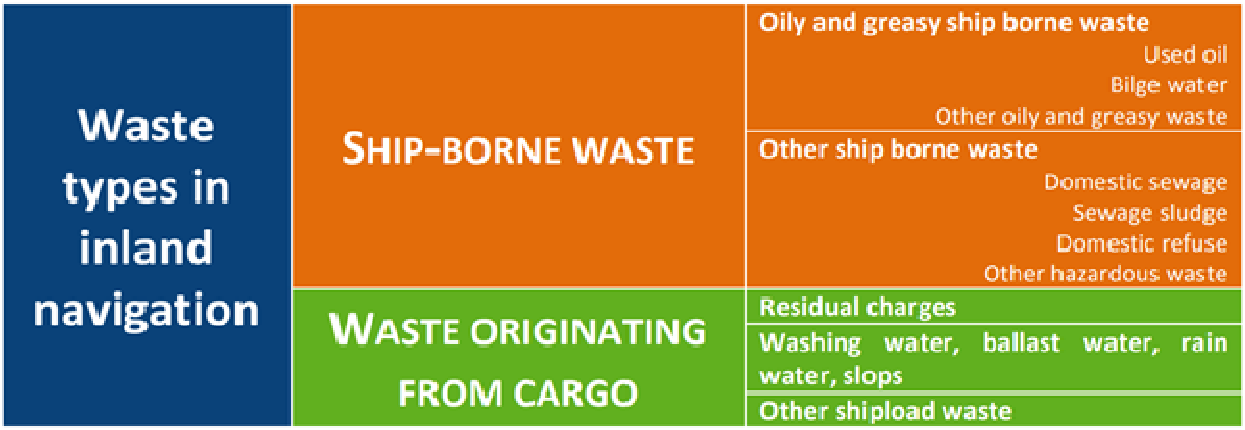
The discharge of bilge water into the waterway is forbidden to vessels. Water bilges must be unloaded at reception facilities approved.

Garbage should be collected and put back, if possible after have sorted according to whether of waste paper, glass (white, coloured), materials synthetic materials, metals and other wastes, including food waste.

Boatmasters and any other person mentioned in these Recommendations should also observe local rules on the collection of ship waste that is issued by the competent authorities competent authorities and Special River Administrations for their sectors of river and port basins.

Reception areas must be equipped:

- a waste collection vessel serving areas of the Danube; and/or
- of a stationary-floating or coastal reception installation, for the receipt of vessel waste;
- unloading and discharge pipe discharge connections bilge water and household slops meeting the European Standard EN 1305.



Ship-borne waste management

7.2 Waste generated in inland navigation collection and disposal

In the absence of harmonised development plans, Danube riparian countries began constructing a ship-borne waste management system on their own. Certain developments have taken place everywhere. The most advanced waste management systems are in place in highest-traffic Germany and Romania. On-board waste, primarily hazardous (oily and greasy) materials, can generally be deposited at ports and bunkering stations, with other types of waste being collected mostly at ports. In addition to the stationary facilities, there are also mobile collection vessels operating in the port areas in most countries.

Bilge water, waste oils and other (solid) oily and greasy ship wastes can be categorised under oily and greasy ship wastes. Their characteristic feature is that they are hazardous wastes with a high hazard potential. Therefore, special attention has to be paid to proper collection and treatment processes and conditions that are taken into account in regulations on both national and supranational level. However, these regulations can be seen as a basis for the development and implementation of waste reception facilities.

Bilge water is oil contaminated water from the bilge of vessels. It is generated by cleaning procedures or leakages of the body shell and gets contaminated with oil, gas oil or grease. The oil content of bilge water averages 14.3 % (push boats: 16.7 %), the fluctuation range varies from 5 % and 15 %. The amount of bilge water generated is influenced by the age, construction, equipment and maintenance of the vessels as well as the demanded engine activity, which itself depends on several other factors (upstream or downstream way, cargo load, etc.). For the Danube region, approximations were made in the late 1990s, stating that the average quantity for cargo vessels in the Danube region would be about 4.2 m^3/ship/service due to the high age of the fleet. For passenger vessels, floating cranes and other type of working units 2.1 m^3/service, for pleasure boats and motor yachts 0.05 m^3/ship/service were stated. Based on the assumption that all vessels included in Danube Commissions statistics were in operation, the total amount of generated bilge water in the Danube Region was about 15,000 m^3/year .

Waste oils are used oil or other unusable oil from engines, gear or hydraulics. They are produced sporadically, especially at times of oil changes for engines and aggregates. In Germany, the average amount of waste oils, collected by (mobile) bilge water collection vessels together with bilge water, ranges between 100 and 125 litres per ship and service. If the whole amount of oil is changed, the amount can be up to 500 litres in twin-engine vessels.

Other (solid) oily and greasy wastes are used filters (used oil and air filters), used rags (polluted floor clothes and cleaning rags), containers (empty, polluted bins) and packaging materials. In Germany the amount of other oily and greasy ship wastes collected average between 10 and 20 kg/ship service.

8. REFERENCE DOCUMENTS

- CEVNI – European Code for Navigation on Inland Waterways- fourth revised edition 2009;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, UNEP and Basel Convention, 2014;
- Convention on Co-operation for the Protection and Sustainable Use of the River Danube, ICPDR, 1994;
- Belgrade Convention 1948 – Convention regarding the Regime of Navigation on the Danube;
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- Contribution to impact assessment of measures for reducing emissions of inland navigation- Panteia Research to Progress, 2013;
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