ELEMENTS OF SHIPBOARD SAFETY

Learner’s Guide

Maritime Studies
Elements of Shipboard Safety

Learner’s Guide
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Training Sector Services
Telephone: 08 6212 9789
Email: sectorcapability.ip@dtwd.wa.gov.au
Website: www.dtwd.wa.gov.au
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Authors and Consultants

Neil Bevis and Dave Hume

Australasian Maritime

Bernie Unwin
Martin Hall
Richard Dougal

Australian Transport Safety Bureau

Mike Squires

Central West College of TAFE

Steve Webster
Glenn Varley

Challenger TAFE

Chris Fenwick
Robin Gray
David Hume
Jean Menzies
Jim Powell
Kingsley Waterhouse

Defence Maritime Services

Robert Douglas

Department for Planning and Infrastructure

Jeff Hinnrichsen

Kimberly TAFE

Robert Tondut

Logistics Training Council

Silvio Ranieri

West Australian Fishing Industry Council Inc

Steve Hall

Note: Elements of Shipboard Safety also requires the completion of a Senior First Aid Certificate, conducted by an approved provider.

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# Contents

## Acknowledgements

1

## Section 1 – Occupational Safety & Health

<table>
<thead>
<tr>
<th>Introduction</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Safety training, musters and drills</td>
<td>2</td>
</tr>
<tr>
<td>2 Relevant maritime Acts and Regulations</td>
<td>2</td>
</tr>
<tr>
<td>3 Rights and responsibilities under OS&amp;H legislation</td>
<td>3</td>
</tr>
<tr>
<td>4 Hazards that exist on a coastal vessel</td>
<td>7</td>
</tr>
<tr>
<td>5 Personal protective equipment</td>
<td>8</td>
</tr>
<tr>
<td>6 Assessing and controlling risks</td>
<td>10</td>
</tr>
<tr>
<td>7 Confined spaces</td>
<td>21</td>
</tr>
<tr>
<td>8 Hot work</td>
<td>26</td>
</tr>
<tr>
<td>9 OS&amp;H signs and symbols</td>
<td>27</td>
</tr>
<tr>
<td>10 Conclusion</td>
<td>27</td>
</tr>
<tr>
<td>11 Self-test questions</td>
<td>29</td>
</tr>
</tbody>
</table>

## Section 2 – Emergencies and emergency procedures

<table>
<thead>
<tr>
<th>Introduction</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Types of emergencies</td>
<td>36</td>
</tr>
<tr>
<td>2 Incident reports</td>
<td>36</td>
</tr>
<tr>
<td>3 Damage control</td>
<td>39</td>
</tr>
<tr>
<td>4 Self-test questions</td>
<td>41</td>
</tr>
</tbody>
</table>

## Section 3 – Fire

<table>
<thead>
<tr>
<th>Introduction</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Relevant maritime Regulations</td>
<td>44</td>
</tr>
<tr>
<td>2 The chemistry of fire</td>
<td>45</td>
</tr>
<tr>
<td>3 Principles of fire prevention</td>
<td>47</td>
</tr>
<tr>
<td>4 Principles underlying the spread of fire</td>
<td>50</td>
</tr>
<tr>
<td>5 Classes of fire</td>
<td>51</td>
</tr>
<tr>
<td>6 Portable fire extinguishers</td>
<td>52</td>
</tr>
<tr>
<td>7 Firefighting equipment and appliances</td>
<td>54</td>
</tr>
<tr>
<td>8 Initial actions</td>
<td>57</td>
</tr>
</tbody>
</table>
MAR1142 Elements of Shipboard Safety

9 Firefighting techniques 58
10 Self-test questions 62

Section 4 – Survival 67

Introduction 67
1 Relevant maritime regulations 68
2 Emergency electronic and radio equipment 82
3 IMO safety signs and symbols 84
4 Survival 85
5 Principles of survival at sea 87
6 Self-test questions 93

Useful websites 99

Other sites of interest 100

Acronyms 100

Glossary of terms 102

Index 111
Section 1 – Occupational Safety & Health

A vessel is an industrial environment. It can be a dangerous place to work. However, it can be made safe by proper leadership and planning.

Safety is a journey, not a destination.

Introduction

Life at sea is perhaps the most enjoyable and rewarding career that anyone can embark upon. The sense of freedom and the open-air environment that is your office continues to lure both those just starting out in their working life and people with work experience on land who are seeking a ‘sea change’. Either way, the sometimes-romantic notions that people bring to the industry must be tempered by an understanding that the sea is an alien environment and therefore the level of training, safety awareness and vigilance required is substantially higher than that of a comparable land-based job.

Considering the extensive presence of vessels and humans at sea it is inevitable that there will be incidents and accidents leading to the loss of property, life and environmental damage. No two voyages are exactly the same. They usually involve different and often unexpected circumstances. But while research has shown that the frequency of accidents is declining, human error continues to be a dominant factor in a high proportion of those maritime accidents that do occur. Investigations reveal that common contributing factors are hazardous conditions, errors in judgement, unsafe work practices, and a failure to wear a personal flotation device (PFD) in circumstances where it would have saved life.

When working on deck there is the danger of equipment, with heavy metal blocks swinging around at head level while ropes and cables whip around at foot level. In the engine space there is moving machinery, electricity, heat and oily surfaces. Even in the accommodation area there are the dangers associated with general human activity. Combine these with the human factors of alcohol, general lack of fitness, incompetence and general disinterest and there is a reasonable scenario for accidents.

Working on board a vessel still involves all of the old skills and precautions of good seamanship, and many new ones as well.

Remember, knowledge alone is not everything. You must possess a complete devotion to your profession and your duties so that, even when acting outside the exercise of your actual functions, you will be always seeking to learn something new that is calculated to extend your knowledge, safety and ability.

It should be recognised that, if an emergency occurs on board a vessel at sea, you have to respond to that situation.
It goes without saying that the best way to survive an emergency situation is to prevent it from happening in the first place. Simply put, you would not need to use the lifesaving equipment if you knew how to handle a small fire with a portable fire extinguisher before it became a large fire. Similarly, you would not need to use the firefighting equipment if you followed safe working practices and prevented a fire starting in the first place.

The success of this course depends on your involvement and active participation. This course is only an introduction and it is vital that you continue to apply, throughout your seagoing career, the strategies taught and techniques demonstrated. This includes ongoing familiarity with the safety and emergency systems and practices that are in place on your vessel.

1 Safety training, musters and drills

In every circumstance it is the total and absolute responsibility of the skipper (master) to ensure that the crew of the vessel is familiar with the procedure for launching the vessel’s survival craft; that the survival craft is kept ready for launching at all times; that all crew members are instructed in and are familiar with firefighting procedures, and all crew members are familiar with the actions to take in the event of a collision. To achieve this, regular on-board safety training, musters and drills are required to be carried out in accordance with the marine legislation that applies in each particular state or territory. The timing of these activities will depend on the size of the vessel, its area of operation, the nature of its operation and its class of survey. Always refer to the legislation. The purpose of these activities is to maintain preparedness so that any response to an emergency situation is automatic, under control and team-oriented.

Participate, take notice and be involved.

2 Relevant maritime Acts and Regulations

Act: Sets out the laws and penalties.

Regulations: Spell out the specific requirements of an Act.

Codes of Practice: Provide practical advice on preventative strategies and methods of achieving the provisions of an Act and Regulations.

Guidance Notes: These are explanatory notes providing detailed information on how to achieve the above requirements.

There are various Acts and Regulations that govern the maritime industry. An Act is a legal document that basically sets out the laws and penalties, such as the Marine Act that is part of the legislative function of each Australian State and Territory.

A Regulation covers laws that are made under part of the parent Act and, therefore, is also a legal document. An example of a marine Regulation is the Commercial Vessels (Certificates of Competency and Safety Manning) Regulation.

There are also marine orders that are like Regulations (designated legislation), and there are marine notices that are safety guidelines covering particular issues.
There are also codes, which are guidelines on standards, but do not have the power of law until legally incorporated into the marine legislation of that country, state or territory. Examples of codes include the WAFIC OS&H Industry Code or the Ferry and Charter Boat Industry Code of Practice.

3 Rights and responsibilities under OS&H legislation

People can only do their job efficiently and safely if the conditions under which they have to live and perform their duties are such that everyone can work together as a team. This involves providing suitable living and working conditions, social interaction and confidence in each other, and the support of management.

Safety is not an activity in which a person participates only when being watched or supervised, nor does it simply revolve around posters, slogans, safety DVDs, meetings, inspections and investigations. While all of these things are important and contribute to safety, the most important thing is that safety is an attitude, a frame of mind. It is an awareness of one’s actions and how they relate to different surroundings and the different situations that arise every day.

Safety is knowing what is going on – knowing what can or might cause injury or damage. It is knowing how to prevent the possibility of injury or accident and to then act accordingly. It therefore requires intelligence and understanding coupled with the ability to use one’s natural instincts.

The OS&H legislation is designed to set out in detail the responsibilities of both the employer and the employee. The main cornerstones of these responsibilities are: consultation; the need to provide a safe workplace; to know how to resolve issues relating to safety and health; and the use of OS&H representatives in the workplace as well as formal committees.

However, you should always refer to the full version of the legislation when in doubt. In particular, take notice of the words ‘shall’ and ‘may’ as these are commonly used throughout most legislation.

For clarity, the word SHALL means MUST and the word MAY means SHOULD.

Responsibilities of the employer

Under OS&H legislation an employer shall, so far as is practicable, provide and maintain a working environment in which the employees are not exposed to hazard – that means, ‘provide a safe workplace’.
The following are some broad guidelines as to how this can best be achieved, by:

- providing safe systems of work
- providing information, instruction, training and supervision of its employees
- consulting and co-operating with its employees
- providing adequate personal protective clothing and equipment
- ensuring that the employees are not exposed to any hazards
- having a system of notification of workplace accidents to the OS&H authority.

**Responsibilities of the employee**

The employee must also contribute to his/her own safety and health, and the safety and health of others. Employees must take reasonable care for their own safety and health at work and avoid harming the safety and health of others.

To achieve this standard the employee must:

- Follow safety and health instructions.
- Use personal protective clothing and equipment.
- Take good care of, and maintain, equipment.
- Report hazards.
- Follow the correct hazard-reporting procedures.
- Report work-related injuries or harm to health.
- Cooperate with employers, with the common aim being to improve safety and health in the workplace.

**Duty of care**

*Everyone has a ‘duty of care’.* All persons are required to work in a safe manner and to not adversely affect the safety and health of others, either by action or omission. In short, safety and health is not an optional extra. Nor is it a hindrance that prevents you from working to your maximum potential or rate. Safety is an integral part of being a ‘good’, effective worker. Dead or injured workers are unproductive and not only an inconvenience to themselves but a financial cost and insurance penalty for the employer.

These are just a few of the most prominent requirements. Most OS&H legislation also provides for *penal provisions* (penalties) that can be applied to those persons, both employers and employees, who are found to be not complying with the legislation.

Remembering that the main purpose of any OS&H legislation is to *‘promote and improve standards for occupational safety & health’*, it should be recognised that penalties are generally only applied as a last resort, and are mainly only used to bring an action against an employer after there has clearly been a failure to provide a safe workplace and/or a significant injury has occurred. It then falls to the employer to demonstrate that all foreseeable precautions against the injury having occurred have been taken and/or a safe workplace has been provided.
The workplace

This means a place – whether or not an aircraft, ship, vehicle, building or other structure – where employees or self-employed persons work or are likely to be in the course of their work.

At sea the ‘workplace’ may also be your place of residence. This places a special onus on the employer to take into consideration not only your working conditions but also your living conditions as well as welfare, safety and health.

It also means that as employees we must work co-operatively with others, having a higher than usual regard for other people’s feelings and sensitivities. Personal relationships on a vessel can be intensified by the close and isolated confines of a vessel. It is not like a regular shore-side occupation where you can get away from the source of irritation. You are stuck with it for the duration of the voyage. On the other hand, this closeness can often develop a very strong sense of mateship that is often enduring.

Improvement notices

An improvement notice is a written direction issued by an OS&H inspector requiring a person to remedy (fix) an alleged breach of an OS&H Act or Regulation. An improvement notice states the reasons for the inspector issuing the notice and must include a reference to a specific Regulation or provision of the relevant legislation. An OS&H representative may also issue an improvement notice.

Provisional Improvement Notices (PINs)

A PIN is a notice issued to a person requiring them to address a safety and health concern in the workplace. The power to issue a PIN aims to improve the effectiveness of safety and health representatives. A PIN can only be issued by a qualified person.

Prohibition notices

A prohibition notice is a written direction issued by an OS&H inspector that prohibits any activity the inspector believes involves, or will involve, a risk of imminent and serious injury or harm to the health of a person. A prohibition notice states the reasons for the inspector issuing the notice and must include a reference to a specific Regulation or provision of the relevant legislation.

To ignore safety does not indicate bravery, only foolishness. To do things safely and correctly is the mark of a wise person, not a timid one.

There never has, and never will, be any job worth dying for.

For your own sake
WORK SAFE.

Everyone has a role to play and it is through cooperation that the most is achieved.
The collective mistake theory

There is something called the ‘collective mistake theory’, which means a series of individual links that could contribute to an accident. Therefore, what is necessary is to establish and maintain awareness in people of the potential for human factors to contribute to both triumph and disaster. Unless there is receptiveness to that concept, all legislation and legal instruments will fall on deaf ears.

Human error and fatigue

Human factors are increasingly being recognised as contributing to the success and/or failure of safety and efficiency in all areas of maritime operations. Fatigue is one of the more common human-related factors that can contribute to human error. Fatigue is generally categorised as being either acute or chronic.

*Acute fatigue* relates to the effects of a single work or duty period. On the other hand, *chronic fatigue* tends to occur when there is inadequate recovery time between multiple work or duty periods. While both situations are serious, chronic fatigue is considered to be more harmful because it is cumulative and gets worse over extended periods of time, especially during long periods at sea.

Some of the risk factors that have been identified through research as being likely to lead to fatigue in one form or another are:

- sleep quality and duration
- work schedules
- motion sickness
- poor diet and nutrition
- high stress situations
- exposure to environmental factors (heat and cold)
- rotating between day and night work and duty periods
- personal physical condition
- high workload.

Everyone has a responsibility to work safely and efficiently; therefore, everyone must contribute to ensuring that work and living schedules are properly structured and followed.

The safety induction

‘Induction’ is a term used to describe a planned procedure that is used to assist a new person when they join a vessel for the first time. It is designed to promote a positive attitude to safety and adjustment. The sooner a new person feels part of the vessel team, the quicker they will become an effective member of the crew. While most companies will have their own version of an induction checklist, they will usually follow the same format and include:

- safety procedures
- the ship and its surroundings
• the officers and crew
• the accommodation
• other essential information such as company rules, policies and procedures.

The skipper (master) is responsible for ensuring that an induction process is carried out so that a new crew person is properly informed of the vessel’s organisation and its operation.

This process must be formally documented and signed off by both the responsible person conducting the induction and the crew person receiving the induction. The skipper (master) must maintain this formal written and signed document on file for future reference and inspection.

You may also be expected to produce for verification any certification that is relevant to your position, such as marine qualifications, medical clearance, security clearance (only required in some cases), any safety training already undertaken and personal details such as next of kin or person to be notified in an emergency.

An induction must occur immediately upon joining a vessel.

4 Hazards that exist on a coastal vessel

There are numerous potential workplace hazards that can be found on board any vessel, regardless of its type, size and function. Some vessels, because of the nature of their work, such as fishing and trawling, and offshore rig supply and servicing, will probably have a greater hazard potential. Some of the most obvious ones are:

• moving heavy loads in an unsafe environment
• working around unsecured machinery and cargo or catch
• negotiating slippery deck surfaces, especially in heavy weather
• using welding and cutting equipment, particularly in restricted spaces
• handling sharp tools and other cutting implements
• using power tools
• working around, and on, moving and rotating machinery
• handling flammable liquids, and being exposed to fuel and vapours
• using lifting gear, cargo derricks, cranes, slings and nets
• poor housekeeping practices
• restricted spaces with hot pipes, valves and electricity
• refrigeration spaces
• working at heights, aloft and over the side
• working in confined and enclosed spaces
• setting and hauling fishing gear
• working in a dusty atmosphere
• painting in a restricted space.
A hazard is anything that has the potential to harm a person.  
A risk is the likelihood that a hazard will harm a person.  

These two terms are related but different. For example, when working on the open deck of a vessel at sea, the hazard is the possibility of being washed or falling over the side. While the risk of this happening varies depending on the sea conditions and the movement of the vessel, in short, a risk is a hazard multiplied by the exposure.

Risk = hazard x exposure

Hazard is anything that has the potential to harm a person. Risk is the likelihood that a hazard will harm a person. These two terms are related but different. For example, when working on the open deck of a vessel at sea, the hazard is the possibility of being washed or falling over the side. While the risk of this happening varies depending on the sea conditions and the movement of the vessel, in short, a risk is a hazard multiplied by the exposure.

Hierarchy of hazard control measures

This is a sequence of options which offer a number of ways to approach the control of hazards. It is a useful 'tool' as the order in which it is set out provides the types of control measures that give a better level of risk control. The hierarchy of control provides a better and more reliable control mechanism. The technique is to work down the list and implement the best measure possible for the particular situation.

The following example looks hypothetically at a heavy weather situation but the control measures equally apply to, say, a noisy job of the like of chipping and scraping. The steps are the same but the solutions would be different.

1. Eliminate the hazard (the most desirable option): If you eliminate the hazard you completely eliminate the associated risk. For example, if the vessel is encountering heavy weather with heavy seas coming on board, don’t plan any unnecessary work that requires persons to go out on the open deck.
2. Substitute the hazard with a lesser risk: Substitute something else that has less potential to cause harm or injury. Organise work that can be done inside the vessel.
3. Isolate the hazard or use engineering controls: Alter the ship’s course so that it rides more comfortably with less exposure to heavy seas.
4. Administrative: Constantly visually monitor everyone on board, especially if anyone has to go out on deck.
5. Personal protective equipment: When the risk of injury cannot be removed in any other way and someone has to go out on deck, personal protective equipment such as a life jacket (personal flotation device), thermal exposure suit, and safety lines need to be used.

5 Personal protective equipment

Employers have basic duties concerning the provision and use of personal protective equipment (PPE) at work. PPE can be defined as all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him/her against one or more risks to his/her health or safety, eg safety helmets, gloves, eye protection, high visibility clothing, safety footwear and safety harnesses.
The main requirement for PPE is that it is supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways. The main considerations relating to PPE are that it is:

- properly examined and assessed before use to ensure it is suitable
- maintained and stored properly
- provided with instructions on how to use it safely
- correctly used by employees.

To ensure the right type of PPE is chosen, first carefully consider the different hazards in the workplace. This will enable the correct assessment of which type/s of PPE are suitable against the hazard/s and the job to be done.

### Hazards and types of personal protective equipment

<table>
<thead>
<tr>
<th>Person</th>
<th>Hazards</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td>Chemical or metal splash, dust, projectiles, gas and vapour, radiation</td>
<td>Safety spectacles, goggles, face shields, visors</td>
</tr>
<tr>
<td>Head</td>
<td>Impact from falling or flying objects, risk of head bumping, hair entanglement</td>
<td>Safety helmets, bump caps</td>
</tr>
<tr>
<td>Breathing</td>
<td>Dust, vapour, gas, oxygen-deficient atmospheres</td>
<td>Disposable filtering face piece or respirator, half or full face respirators, air-fed helmet, breathing apparatus</td>
</tr>
<tr>
<td>Body</td>
<td>Temperature extremes, adverse weather, chemical or metal splash, spray from pressure leaks or spray gun, impact or penetration, contaminated dust, excessive wear or entanglement of own clothing</td>
<td>Conventional or disposable overalls, boiler suits, specialist protective clothing, high visibility clothing and wet weather gear</td>
</tr>
</tbody>
</table>
### Person Hazards Options

<table>
<thead>
<tr>
<th>Person</th>
<th>Hazards</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands and arms</td>
<td>Abrasion, temperature extremes, cuts and punctures, impact, chemicals, skin infection, disease or contamination</td>
<td>Gloves, gauntlets, mitts, wristcuffs, armlets</td>
</tr>
<tr>
<td>Feet and legs</td>
<td>Wet, electrostatic build-up, slipping, cuts and punctures, falling objects, metal and chemical splash, abrasion</td>
<td>Safety boots and shoes with protective toe caps and penetration-resistant mid-sole, gaiters, leggings</td>
</tr>
<tr>
<td>Whole body</td>
<td>Sunburn, windburn and glare</td>
<td>Appropriate clothing, sunglasses, sunscreen</td>
</tr>
</tbody>
</table>

### 6 Assessing and controlling risks

There is a legal requirement under OS&H legislation to assess risks in the workplace so that a risk control plan can be put in place. A risk assessment is simply a careful examination of what, in the workplace, could cause harm to personnel, to weigh up if enough precautions have been taken or if more should be done to prevent any harm being done to anyone.

The standard steps in a risk assessment process are:

- identify the hazard/s
- decide what may be harmful and how it may be harmful
- evaluate the risk and decide on procedures
- record the findings and implement them
- review the assessment and update it if necessary.

In many instances on board a vessel, the risks are well known and the necessary control measures are already in place. However, it is still necessary to be sure by checking that all reasonable precautions have been taken to avoid injuring anyone.

Some of the most common useful tools are what are termed ‘toolbox meetings' and 'job safety analysis' meetings.

**Toolbox meeting prompts**

*The job:* Decide the objectives.

*Procedure:* Do you need a Job Safety Analysis or special permits?

*Responsibilities:* Who has it, what are they, how do they apply?

*Possible hazards:* To yourself, to others, to the environment.
Job procedures: Are there any existing company requirements?
Conflicting operations: Is there other work going on in the same area?
Precautions to take: Are there any particular precautions to consider?
Action to take if the job situation changes: If the weather changes or an unexpected problem arises.
Communications: Do you need radios or hand signals?
Safety equipment: What is required and is it available?
Safety clothing: What is required and is it available?

If you are in any doubt at any time during the job STOP THE JOB and ASK.

Job safety analysis (JSA)
For more complex tasks or those that are unfamiliar or unusual – or may be dangerous and involve groups of people who may not have worked together before as a team – a higher level of scrutiny and preparation is required. In order to be effective, it is essential to get together all the people involved in the task to meet, greet, and discuss the task and its objectives. This will include the steps in the task and how any hazards, once identified, are to be controlled or eliminated.

Stages of a Job Safety Analysis (JSA)
1. Break the task down into steps.
2. Identify the hazards or potential accidents in each step.
3. Develop solutions for each of these.
4. Keep a record of the JSA.
5. Review and update the JSA on completion of the job.

There are several variations on just how the JSA process works. Individual companies may refer to the same ‘safe working tool’ under a different name, but the process is fairly universal.

Often a company will have a standard JSA form with an appropriate checklist, with particular relevant hazards already identified. This can be quite useful, especially where the company has more than one vessel, and a completed JSA can become a standard resource for all of the worksites. It also provides an opportunity for the standard completed JSA to be constantly refined and improved with time, as what might be overlooked by one group will be picked up by another group.

If the vessel or worksite on which you are working does not have any of these tools, you can be proactive in making the workplace safer by introducing the JSA system.
General safety aspects

Quite a lot of situations with accident potential are those that are encountered within every job or task that is likely to be undertaken on board during normal daily operations. Some are categorised as having a ‘small-scale’ risk factor because they are dealt with on an everyday basis and have a familiar nature to them. Others, such as those that are dealt with only on occasions, are considered to have potential ‘large-scale’ risks with unexpected associated hazards that can have serious consequences.

In both cases, general safety precautions have to be taken at all times. Even those considered as having a small-scale risk can be highly dangerous simply because of the concept of the familiarity that is associated with the task and, therefore, familiarity with the hazards and risks.

Boarding

Safety begins at the point of joining the vessel; that is, at the gangway. The standard requirement is that there is a safe means of access and exit to and from the vessel. A gangway or brow is used for this purpose and is placed between the vessel and the wharf.

The gangway or brow must be securely lashed and have a safety net underneath it. It must also have hand ropes or solid railings along each side to prevent people from falling over the side of the gangway or brow.

Note: In small vessels, it may not always be practicable to provide arrangements such as those illustrated above. However, the legal requirement to have a safe means of access and exit still applies. This may involve an alternative method such as having a section of the deck painted with non-skid paint and a hand rail provided – or having a crew member in attendance to assist persons boarding and leaving through a section of removed handrail. In any event the system must be safe.
Always use the gangway. There have been many incidents where personnel have been killed or injured by using either incorrect or poorly maintained access. Always check the safety and stability of the gangway and its equipment before committing your weight to it. Where a gangway is provided it must be constantly watched, illuminated during the hours of darkness, and adjusted to account for the rise and fall of the tide and the movement of the vessel as it moves alongside the wharf.

**A lifebuoy should always be placed adjacent to the gangway for quick use in the event of an incident.**

**Incident**

An *incident* occurred in the Port of Townsville when the master of a small Danish vessel overbalanced while boarding, resulting in the gangway/brow tipping onto its side and spilling him into the water between the ship and the wharf. Although the chief engineer and a crew member jumped into the water in an attempt to save him, he was later found to have drowned.

Conclusions established during the *incident* investigation was that:

- the hand ropes on the gangway had not been tended and tensioned regularly by the deck watch as the vessel rose and fell with the tides
- the hand ropes being sufficiently slack to allow the Master’s centre of gravity to move outside the edge of the narrow gangway and for his weight to tip it over

The final (probably most telling) conclusion was that:

- had a safety net been rigged underneath the gangway, as required by the Port of Townsville by-laws during the weeks immediately preceding the *incident*, it may have prevented the master from falling into the water.


**Once on board**

Once you have safely boarded the vessel you should immediately report to the skipper (master). This is important for two reasons.

**Firstly**, as the skipper (master) is the person in charge of the workplace (the vessel), it is important that he/she is aware of who is on board the vessel in case of a shipboard emergency. In an emergency, it is vitally important that all persons are accounted for and emergency personnel need to know if they have to search for a missing person.

**Secondly**, it is important that you are immediately made familiar with the vessel safety procedures, emergency sound signals, and equipment and muster points. *An on-board emergency can occur at any time and it can happen without much warning.* When a vessel is in port immediately after arrival and/or preparing for departure there is a lot of activity that may include carrying out repairs and other forms of maintenance, handling cargo or catch, refuelling, taking on stores and water and carrying out crew changes.
With all this activity, the chances of an incident occurring are magnified and a minor incident can rapidly escalate into a disaster.

In an emergency it will be too late for you to be shown a safe area to muster, and to be given your emergency station and duties.

Berthing and unberthing operations

When mooring lines are under strain, all personnel in the vicinity should remain in a position of safety – that is, avoiding all recoil (snapback) zones. Immediate action should be taken to reduce the load should any part of the system appear to be under strain. Care is needed so that ropes or wires will not jam when they come under strain; if necessary, they can then be quickly slackened off.

A good example of this is in a recent case where an employer was found liable for injuries sustained by a deckhand who was injured by being caught in the bight of a rope. Although the injured person had handled mooring lines previously, this was the first time he had been required to handle the first mooring line ashore. As this mooring line is usually placed under considerable strain, often very quickly and without warning, the crewman was unprepared for the suddenness of the tension and his lower leg was caught in the bight of the line, severely injuring him.

The court found that even with ten days’ experience as a deckhand this was insufficient and that the employer should have ensured that the deckhand was properly supervised when undertaking this new responsibility, as it presented considerable additional risks to those previously encountered. The defence put forward by the employer that the person’s deck working time and the fact that he held a minimum qualification from a recognised Marine Regulating Authority was not enough to avoid prosecution.

Incident

During an unberthing operation, a stern rope being retrieved very rapidly swung and whipped as the eye of the rope neared the ship’s side. The eye of the mooring rope hit the second mate, who was leaning over the rail, and caught around his head and shoulders. The second mate was pulled over the ship’s side and into the water. When he was recovered from the water, he was dead.

Synthetic mooring lines

This type of mooring line is commonly used, and comes in a number of constructions and materials such as polyethylene, polypropylene, polyester and nylon. Most of these are sensitive to ultra-violet (UV) radiation and can deteriorate without showing any obvious signs. But the biggest danger is the dangerous phenomenon of recoil (snapback) potential when they break, much like a rubber band. They will take out anything in their path.
**Batteries**

Many of the things that we are familiar with in a normal land-based situation tend to present different consequences when introduced into the marine environment. While a normal 12-volt battery in a motor vehicle will pose the threat of electrical sparks, once we put this item of equipment into a marine environment several other hazards emerge.

One of the first things to notice is that marine batteries are usually made of a much stronger and heavier construction. This makes lifting the battery a manual handling hazard that may require more than one person. The other thing to notice is that most marine-approved batteries are not maintenance-free (as in a battery in a motor vehicle) and require to be physically topped up, resulting in direct exposure to the strong acids contained in the battery.

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**Battery handling means the wearing of protective gloves, safety glasses, an acid-proof apron and safety footwear.**

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**Hydrogen gas**

This is the gas that is produced when a battery is on charge. It is extremely explosive. In a vessel the battery has to be protected against the elements and, therefore, is usually stowed in a special enclosed battery locker. This locker must be properly vented at the top as H₂ is lighter than air, so that dangerous levels of hydrogen gas are dispersed to the outside atmosphere and not allowed to build up inside the locker and create a confined explosive atmosphere.

**Incident**

An incident occurred during a regular maintenance routine on a sail training vessel when one of the students was using a rotary grinder to remove rust from the door of the battery locker. A spark from the grinder being used by the student ignited the hydrogen air mixture causing an explosion within the battery locker. The student took the full force of the blast, which threw him through the vessel’s port side rail and thence overboard, resulting in his death.

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**Portable ladders**

The movement of a vessel at sea is a combination of pitching in a fore and aft direction with an up/down action, and rolling in a sideways direction. When using a ladder under these circumstances, special precautions have to be taken to counteract these normal ship movements. This means that a ladder must always be secured at the top and bottom to prevent it from moving with the motion of the vessel. The area around the ladder should always be roped off to prevent people entering the drop zone and if someone is required to be in the drop zone they must always wear an approved safety helmet.

**Note:** Even when in port and the vessel is not moving, a ladder should still always be secured at the top, with someone 'footing' it at the bottom. Always avoid overreaching. It is best to shift the ladder so that the work area is within easy reach and at no more
than arm’s-length.

**Working aloft**

Working aloft means anywhere that is above the deck. Because of the motion of a ship, particularly when it is rolling, the higher above the deck a person is the greater the radius of movement. It may sometimes be necessary in these circumstances to request the skipper (master) to temporarily alter course or reduce speed whilst working aloft so that the vessel rides better and the movement is reduced.

Whenever working on a ladder or higher above the deck (aloft) you should always ensure that you are properly secured with an approved safety harness, and any tools that you are using are lashed with a lanyard to prevent them falling.

**Carrying and lifting**

Carrying anything on board a vessel is considered to be more hazardous than carrying the same load when on land. Similarly, carrying a load while the vessel is moving in a seaway is more hazardous than when the vessel is in calm waters. This is because the action of carrying a load is magnified by the need to brace the feet, legs and body against and into the movement of the vessel. This creates an artificial force on all parts of the body that generates a greater strain. Also, the body is in an unusual position with the weight being carried acting to push the body over towards the direction the vessel is rolling or pitching, while you are mentally and physically trying to push against the movement of the vessel and remain upright.

(Reproduced with the permission of Challenger TAFE)

*Figure 1: carrying and lifting*
It is better to divide the weight to be carried into two loads instead of trying to carry it all at the same time.

When you lift something with a bent back you risk damaging your spine. This damage is cumulative (it adds up) and generally does not easily repair itself, if ever. Eventually, after a number of incorrect lifts (this could be as few as one or as many as hundreds) you will have probably done sufficient damage to your spinal disc to cause pain and possibly incapacitation.

The lift that actually causes back problems need not be an excessive weight. In some cases it has been reported that back pain has occurred while simply tying a shoelace, with the real cause that triggered the pain being a long history of bad carrying and lifting practices.

Liquid Petroleum Gas (LPG)
A normal item of equipment that has the potential to become a ‘bomb’ when incorrectly used and handled in the marine environment is the LPG cooking appliance and storage bottle. LPG is heavier than air and will accumulate around the bottom of a compartment. Because of the enclosed arrangement of a boat, ship or vessel for it to be able to maintain its ‘watertight integrity’, any leaking gas is unable to freely escape by ‘leaking out of the bottom of a compartment’. Therefore it has the perfect place to collect. A vessel will usually have a ‘gas sniffer’ arrangement installed in the bilges, and any gas bottle lockers must be capable of being vented at the bottom (where the gas will collect). This venting action must be such as to carry the gas overboard and above the waterline.

Gas bottles should be left turned off unless actually being used.

Extreme care must always be taken when handling this product.

Petrol vapour
Like LPG, petrol vapour is heavier than air and will collect in the lowest areas of a
compartment (usually the bilge) and form an explosive mixture. This is one of the reasons that diesel engines are often favoured over petrol in the marine industry. One of the danger periods when handling petrol is when taking it on as fuel to fill the fuel tanks.

**Refuelling**

When refuelling fixed tanks in the vessel, there are a number of precautions that should be taken:

- remove all unnecessary personnel from the vessel and the immediate area
- display ‘No Smoking’ signs and ensure that they are observed
- indicate that you are undertaking a refuelling operation by displaying the ‘B’ flag
- turn off the engines and any electrical equipment on the vessel
- measure the remaining space in the tank so that you can calculate the amount to be taken (this must be done before you start pumping)
- have spillage equipment ready at hand
- have a suitable type of portable fire extinguisher at hand
- block any deck scuppers so that, if there is an accidental spillage, it will be contained
- make sure that any breather pipes from the tank are open and clear
- always have the loading point manned at all times during the operation
- KEEP ALERT.

**Note:** If filling small portable containers to carry extra fuel, this should always be done outside the vessel and not on deck.

**Handling chemicals**

As a normal part of working there will always be the need to use a variety of chemicals, because they tend to enable us to complete tasks easier, quicker and more effectively. There are several thousand chemicals that are in use across all aspects of our daily life, with hundreds more being added to the total every year. Even more confusing is that different manufacturers may use similar chemicals and simply brand them with different names.

The effects on the human body of chemical exposure may not be felt until well after the chemical has been in use and long before it may have been withdrawn because of its effects. A good example of this is DDT, a highly effective pesticide in the 1950s and 1960s but later found to have serious, even fatal consequences, depending on the type and duration of exposure. Mercury is another example, and so is asbestos.

Chemicals can have a variety of effects from mild (with few long-term effects) to acute in which the effects are immediate and serious, to chronic (the ill effects do not show up immediately and it may take several years for the damage to become apparent).
With any chemical you must be sure that you know what you are dealing with.

Incident

A process worker in a coastal fishing cooperative was asked to clean aluminium racks with a cleaning agent. The worker proceeded without safety glasses, long gloves or an apron. After some time, the worker developed painful burns on the arms, legs, stomach, face and eye where the cleaning agent had made contact with exposed tissue. He was eventually hospitalised.

The worker was not aware the cleaning agent contained hydrofluoric acid. Without ready access to a Materials Safety Data Sheet (MSDS) or a register and without reading the label, neither the employer nor the worker had any way of recognising the hazard.

Without access to this information, the employer could not provide a safe system of work. In this case, consulting the register, label or MSDS would have identified the product as hazardous, and alerted users to the need to assess the risk of using it in the workplace.

(Reproduced courtesy of WorkSafe, Department of Commerce, Western Australia – www.worksafe.wa.gov.au)

Importance of the Materials Safety Data Sheet (MSDS)

Remember, your employer is legally obliged to provide you with this information, as is the manufacturer or supplier. The consequences of not bothering to use it and take the proper precautions may not become evident for many years, long after you have moved on and/or the employer at the time is no longer in business, making it difficult to seek proper compensation for yourself or your family.

It is a requirement under OS&H Legislation that an employer provides all necessary information to an employee in order for the employee to use a substance safely. This usually takes the form of a MSDS because it is a requirement that manufacturers must supply this document with all of their products.

The MSDS is designed to give, among other things, details of the:
  • contents data
  • known health effects
  • toxicity data
  • precautions for use
  • safe exposure limits
  • first aid information
  • storage information
  • other known associated hazards.
All MSDS documents that come with every product supplied to a vessel should be kept in a file and be readily accessible to everyone on board. Find the documentation and read it before using the product.

It should be assumed that all chemicals may cause injury, and therefore must be treated with respect and from an informed perspective. Regardless of the exposure limits you should always try to minimise your contact.

Whilst knowing all this it should always be remembered that if a chemical is listed as being hazardous, don’t take any chances. Wear proper protective clothing and a respirator.

Importance of danger tags and lock-out procedures

Deaths and injuries continue to occur when equipment that is being serviced, repaired or worked on is accidentally started by someone energising an electrical power system or when a fault occurs in the power system or when a piece of shipboard machinery is inadvertently re-started.

‘Danger tags’ are an essential part of a safety system that is designed to prevent accidents from happening. When the danger tag is applied it means the equipment or area of concern cannot be used or entered until the problem has been evaluated or fixed, or the hazard has been removed. The danger tag itself is to be attached to the item of equipment or area that is considered to be unsafe. It is a predominantly red tag with lettering or symbols in black and white.

A danger tag should always be associated with a hazard, incident or near-miss report.
form. Only a designated person can remove a danger tag and this can only be done when the unsafe condition is resolved. This decision must be made in conjunction and discussion with the person who placed the tag, or in their absence, a competent person who is fully able to evaluate the unsafe condition. After the danger tag has been removed the tag must be attached to the completed hazard/incident/near-miss report form and filed on board or forwarded to the company/owner for filing and registration.

![Caution Sign](image)

**Figure 3: caution signs**

*Each individual company should have in place structured lockout procedures and policies. Read them and follow them.*

To ensure that no one will turn on any electric, hydraulic, pneumatic or mechanical power, or a combination that activates machinery, lock out and tag the equipment. In other words disconnect the power and lock it out – and, before work is commenced on the machine or item of machinery, test all sources of power have been isolated. Remember:

- tags should be dated and signed
- locks should be accompanied by a corresponding tag to identify who locked out the plant.

‘Out of Service’ tags are used to identify equipment or machinery that has been taken out of service due to a fault, damage or malfunction. The tag should not be removed until the equipment is safe to be returned to service, or the reason for the tag no longer exists.

### 7 Confined spaces

Much has been written on this subject and yet, tragically, many seafarers’ families suffer loss due to death in enclosed and confined spaces. People die in confined
spaces because they either fail to recognise that the job being undertaken is in a confined space – or they simply fail to recognise that a hazard may even exist.

It is, therefore, of the utmost importance that the precautions applying to entry into confined spaces are understood by everyone on board.

**Australian Standard ® 2865, Safe Working in a Confined Space, requires that the employer, or the skipper or master as the employer’s representative, is to provide written approval in the form of an entry permit before work is carried out in a confined space.**

A confined space is usually defined as being an enclosed or partially enclosed space which:

- is not intended or designed primarily as a workplace
- is at atmospheric pressure during occupancy
- has a restricted means of entry and exit
- has an atmosphere containing potentially harmful levels of contaminant, an unsafe oxygen level, or is of a nature that could contribute to a person in the space being overwhelmed by an unsafe atmosphere.

**Any other space, enclosed or not, that has been isolated from the surrounding atmosphere for a period of time, must be considered as dangerous.**

This is a very broad definition and with good reason as the hazards that a confined space can present are varied and sometimes difficult to detect. For example, a tank that has not contained an actual hazardous substance (it may even have been a water tank) can still have an atmosphere that is considered to be hazardous because as steel (a construction material) rusts, it oxidises, effectively removing oxygen from the atmosphere in the tank leaving an oxygen-deficient space. The hazard of this situation exists if the possibility of oxygen deficiency is not recognised (because it is only a water tank), the tank is not thoroughly ventilated before entry, and the residual atmosphere tested prior to entry.

You cannot ‘smell’ a lack of oxygen. The first indication of oxygen deficiency may be when you start to feel strange and collapse. Then it is too late. If another person sees you become overcome and collapse there is the danger that he/she may enter the tank to assist you, only to become overcome and also collapse.
If not a lack of oxygen, it could be a build-up of carbon monoxide (CO), or carbon dioxide (CO₂) or hydrogen sulphide (H₂S), all of which are highly dangerous.

**Incident**

In a recent case two workers entered the ballast tank of a barge to determine if it could be outfitted with a bilge pump. When they passed out, a first aid attendant was called who subsequently entered the tank with a portable oxygen bottle and mask. The attendant was also overcome. The municipal fire department eventually removed the three victims but the first aid attendant died. When the ballast tank was tested it had only 13% oxygen and 58ppm of carbon monoxide. The normal oxygen level is 21% and 18% is considered to be the minimum level. ‘Materials like rusting steel, wood, as well as vegetable products, fish and many ores can use up the oxygen in a space without ventilation. When a person enters a space that does not contain an adequate supply of oxygen, they can pass out *before they realise something is wrong*. The human body determines the need to breathe from the level of carbon dioxide in the lungs. The body cannot detect a lack of oxygen. Toxic gases that may also be present may not have a detectable odour.

(Source: Ship Safety Bulletins 04/1994 and 04/2007, Transport Canada. Reproduced with the permission of the Minister of Public Works and Government Services Canada (2009)).

**Incident**

A recent incident in British Columbia highlights the risks of carbon monoxide poisoning. Four of eight people on a small passenger vessel suffered the effects of exposure to CO when fumes from a damaged rubber bellows surrounding the outside portion of the vessel’s inboard/outboard engine migrated forward over the transom and into the cabin. Although there were no fatalities, one victim continues to suffer severe impairment of motor skills and cognitive ability. The deaths by CO poisoning of four recreational boaters in Idaho highlighted the potential dangers of CO for operators of pleasure craft and non-pleasure craft alike.

(Source: Ship Safety Bulletins 04/1994 and 04/2007, Transport Canada. Reproduced with the permission of the Minister of Public Works and Government Services Canada (2009)).

**Incident**

In a recent case off a port in Western Australia eight crewmen died as a result of an explosion in a ballast tank from excessive paint thinners being used to assist spraying the tank. There were several problems that combined to cause this tragic accident.

One of the conclusions reached in the final ATSB Report found that the actual explosion resulted from the added 30% by volume of thinners that was added to make the paint easier to be sprayed. Unfortunately this created a highly explosive mixture that when used in an inadequately ventilated space posed a danger of explosion if ignited in any way.

It seems that there was no appreciation of the hazards posed, the equipment being used was inadequate for the job, the company had inadequate work procedures and the procedures that were in place were ignored by the ship’s officers who believed that they only applied to the oil tankers within the company’s fleet.
Entry permits for confined spaces

Entry permits are records which certify that specific precautions and procedures have been established before any person enters a confined space. The permit process provides a systematic method of verifying that all necessary checks have been carried out before the entry is authorised.

The essential components of an entry permit system include:

- *a written procedure*, which sets out how the system is to operate and clearly defines who may authorise particular jobs and who is responsible for specifying and implementing the necessary precautions
- *a form known as a ‘permit to work form’*, which becomes a written and signed statement, ensuring both the establishment of safe conditions for the work to commence and the maintenance of safe conditions for the duration of the work, including the provision of emergency arrangements
- *a method of informing the persons* carrying out the work of the exact identity, location, nature and extent of the job, the hazards involved and the precautions to be taken
- *a system* for ensuring the safe hand-back of the workplace after the job has been completed and, in the case of confined space entry, after the space is vacated.

*The entry permit must be signed by the skipper/master or delegated responsible person prior to entry.* The permit must state the period of its validity and be revalidated wherever it becomes evident that the duration of work will involve one of the following:

- change in personnel
- significant break in work continuity
- significant change in risk.

*Confined space entry checklist*

A checklist must always be completed by the responsible officer in charge and must always be approved and countersigned by the skipper (master). A separate checklist
should be completed for each and every entry operation and should include the following details, as a minimum:

- spaces to be entered
- reasons for entry
- entry and exit points
- results of atmosphere checks
- names of persons entering
- times of entry and expected duration
- method and frequency of communication
- name of the linkman (standby person)
- at least one compressed air breathing apparatus set positioned at the point of entry together with resuscitation unit and rescue equipment consisting of life-lines and harnesses
- coordinator on duty to sound the emergency alarm without delay if a problem occurs
- details of the ventilation method
- personal oxygen meters issued, if available.

It is essential that all people who entered (or may have entered) the confined space be accounted for on completion of the work.

Rescue

On no account should the stand-by person, or anyone else for that matter, attempt to enter a space before additional help has arrived, and no-one should enter any space or attempt to carry out a rescue without wearing breathing apparatus and a rescue harness.

All too often a casualty in an enclosed space has caused the linkman to rush into the space, often with fatal results, so that when the rescue party arrives they are confronted with two casualties and double the problems.

The skipper (master) or responsible officer should always ensure that the persons who have been given rescue duties and responsibilities are competent in the use of breathing apparatus and have been trained and drilled in enclosed space entry practices and procedures.
Note: While a statutory duty to practise emergency drills simulating the rescue of a person from a dangerous space may not apply to all vessels, such drills are certainly in the interests of shipboard safety. These drills can range from a ‘tabletop’ drill in which procedures are enacted and discussed, to a full-scale emergency drill to retrieve a dummy from a tank or compartment.

8 Hot work

Hot work is a term used to describe heat-producing operations such as welding, flame cutting and grinding. It presents two significant hazards:

1. open flames or flying sparks that can ignite flammable gases and vapours
2. hot work that of itself may produce toxic fumes and gases.

(Refer to Australian Standards ® 1674.1 and 1674.2.)

The skipper (master) is responsible for the safety of the vessel; therefore, no hot work should be carried out on board a vessel without permission in writing from the skipper (master) or other nominated responsible person. The permit-to-work system is the key to ensuring that safe hot work procedures are followed. The information that they should contain will depend on the job to be undertaken, but generally should include:

- the location and nature of the hot work
- the proposed time and duration of the work
- the limits of time for which the permit is valid
- the precautions that should be taken before the work starts, during the work, and on completion of the work
- the person in direct control of the work.

It is essential that all those involved in the work are aware that it does not follow that, once a permit to work is issued, the situation will remain safe.

If conditions change the permit to work should be withdrawn, the situation reviewed and, if appropriate, a new permit to work issued with the conditions amended as necessary.

Some of the necessary precautions that should be taken prior to commencing any hot work are:

- ensure that the area is free from flammable materials or residues of flammable materials and that it is gas-free
• ensure that the opposite side of any plating, such as a bulkhead or deck, to that on which the hot work is to be carried out is free from flammable materials or residues and is gas-free
• check that the area below the hot work is free from flammable materials and is gas-free
• check that no dangerous substances enter the area during the operation. These can be flammable, toxic, very hot or very cold
• check that the atmosphere is, and remains, safe to breathe. Provide adequate ventilation
• ensure that any personal protective clothing and equipment is provided and worn
• have the appropriate firefighting equipment available at the work site, together with a person trained in its use (this can be the person carrying out the hot work)
• make sure that, when work stops, any cylinders of flammable gas or oxygen or hoses and torches attached to them are not left inside an enclosed space
• make sure that there are no smouldering residues remaining after the work has been completed.

9 OS&H signs and symbols

Various signs and symbols are used throughout a vessel to indicate a range of situations from prohibition to hazards. There are thousands but the one thing that connects them all is that they are used because they are ‘non-linguistic’; that is, their meaning should be self-evident without having an associated language.

Exit signs, for example, are designed to give directions. They do this by having a symbol (an arrow or a person running) and a text. These signs are coloured white on a green background and they cannot be text alone. They must show a symbol and text.

Prohibition signs are commonly used through a workplace to indicate actions that should not be taken. Some common ones are ‘No Smoking’. They consist of a black-coloured symbol on a white background, enclosed in a red circle with a red slash through the symbol. They may also have text.

Warning signs are coloured black on a yellow background inside a black triangle and are usually placed at the entrance to areas that are considered to be in some way dangerous or contain a danger. They should always include a pictorial symbol.

Mandatory signs are blue on a white background with a white text and/or a white symbol. They are designed to draw attention to common things such ‘face protection must be worn’.

10 Conclusion

Making change
It is fine to conclude that an OS&H inspector can be accessed every time one is needed. This usually works well in a shore-based industry, but if an incident or safety issue occurs at sea the same availability does not apply and you have to deal with it. This sometimes leads to the philosophy of simply ‘running the risk’. This is not a good option as it is your safety that could be compromised and your safety is much too important to simply accept a dangerous condition and work around it. It is therefore important to understand the type of strategies that can be used to deal with difficult situations while still allowing you to function and do your job.

The reasons for having unsafe conditions range from the ‘cost of implementing improvement’ through to the attitude of ‘that’s the way it has always been done’, or ‘risks are part of the job’, or genuinely not seeing the risk. It would be highly unlikely that an employer would knowingly and willingly expose its employees to a risk that was considered to be dangerous. Often the problem is that employers may simply not be aware of the situation that is posing the risk because they have not been advised of it.

Understanding this, it makes sense that in order to address safety concerns, or to have them addressed you should try to follow a suitable model.

**Suggested model**

**Step 1:** *Avoid being angry.* Although shouting may make you feel better, most people don’t like it and simply become defensive. Instead, think before making the approach, make notes to support your case, avoid abuse and blame and make sure that you separate those issues that do not directly relate to the situation you are concerned with. Don’t confuse the issue.

**Step 2:** Ask other crew members how they feel about the situation. Perhaps you are not the only one concerned. *Obtain a consensus* and if many of the crew feel the same way about the situation then this will add strength to your point of view, but do not approach the skipper (master) as a ‘gang’ in an attempt to intimidate. The other problem that can result from the ‘gang’ approach is that there is little overall control with everyone wanting to have their say at the same time. The best approach is to elect or select one or two persons from the group to act as the group representatives.

**Step 3:** *Try to offer suggestions* on how best the improvements can be implemented with a minimum of disruption. Perhaps there is more than one solution. Work through a consensus that will arrive at an agreed solution. Offering solutions is being positive and removes the perception that you are simply being a whinger.

**Step 4:** If there is more than one concern then *prioritise* and concentrate on the most serious. Alternatively, choose the simplest to implement and work on the idea that as the skipper (master) sees things improving he/she is more likely to accept further suggestions.

**Step 5:** *Keep records and notes* of dates, times, what was said at the various meetings and who was present. Ensure that witnesses’ names are recorded. If you intend to make an individual approach, take an independent person with you to act as an umpire and prevent events from spiralling into confrontation and ill feeling. Remember that if you need to go beyond the workplace situation to find an acceptable solution – that is, you feel the need for an OS&H inspector to intervene – this will be able to be more effective if there is evidence of your attempts to resolve the situation. Additionally, if you are singled out and your
ongoing employment compromised, you will need this evidence if you are to obtain redress for possible unfair dismissal.

Step 6: If you believe that a certain action would endanger you, be prepared to say ‘NO’. At the end of the day you go to work so that you can improve the quality of your life and to support your family. If this is likely to be compromised then it is not worth it.

11 Self-test questions

The following questions are designed to allow you to check your understanding of Occupational Safety & Health.

1. What is the purpose of a Provisional Improvement Notice, and who has the authority to issue one?

2. Who on board a vessel is responsible for ensuring that safety training, musters and drills are carried out?

3. Are Guidance Notes considered to be legal documents or simply advisory?

4. List any ten (10) hazards that are likely to be encountered on board a working vessel.
5. What is meant by ‘duty of care’ and to whom does it apply?

6. What is meant by the abbreviation OS&H?

7. What are the five (5) stages of a Job Safety Analysis (JSA)?

8. What type of things would be most likely to be covered in a safety induction on joining a vessel for the first time?

9. What are four (4) dangers associated with carrying out any ‘hot work’ on board a vessel?
10. What are five (5) things that are detailed on an MSDS?

11. What are the dangers associated with hydrogen gas that is generated when an accumulator battery is on charge?

12. What are the differences between an Act and a Code of Practice?

13. If you were the standby person at a confined space and you noticed the person
inside the space suddenly collapse, what should you do?

14. What Personal Protective Equipment would be most suitable to use in each of the following situations?
   • to prevent dust penetrating the eyes?
   • to prevent dust entering the respiratory system?
   • to avoid the possibility of skin infection?
   • to protect the feet from possible damage?
   • to protect the head from impact strikes or bumps?

15. What is the purpose of a vessel’s gangway?

16. What is the purpose of a Confined Space Entry Permit?

17. What is the purpose of having properly organised safety training musters and drills on board a vessel?

18. Who is required by law to ensure that there is in place a proper system of notification of workplace accidents – the employer or the employee?
19. What is meant by the term recoil (snap-back) zone when referring to the use of mooring lines for berthing and unberthing a vessel?

20. What is one (1) item of personal safety equipment that should be used when working aloft?

21. Where should all copies of a Materials Safety Data Sheet (MSDS) be kept on board a vessel?

22. What safety features are associated with a vessel gangway?

23. What are ten (10) items that would most likely be covered by a Confined Space Entry Checklist
24. What special precautions should be taken when using a portable ladder on board a moving vessel?

__________________________________________

__________________________________________

25. What are the five (5) steps in a Risk Assessment process?

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26. What are six (6) precautions that should be taken before commencing a re-fuelling operation?

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27. What is the difference between acute fatigue and chronic fatigue?

__________________________________________

__________________________________________
Introduction

An emergency on board a vessel can be a terrifying experience. Most emergencies happen suddenly and it is this suddenness that creates an initial level of terror and general confusion. One minute everything is perfectly normal. The next minute there can be a situation involving completely different and unexpected circumstances that have to be dealt with in extremis. Suddenly a number of information sources have to be processed and assessed along with any alternatives. As a result, the immediate ‘overall awareness’ narrows and people have to rapidly refocus their thinking and look to their training to take over.

The chance of saving the day by uncoordinated spontaneous reaction is extremely remote, and the chance of catapulting yourself into deeper trouble is very high.

A simple example of how people react to stressful situations is to use the analogy of what happens when the engines suddenly stop and/or the ship suddenly starts to vibrate. If the engine suddenly stops it usually creates a shock reaction along the lines of ‘hey, the engines have stopped’. But if the ship suddenly starts vibrating for no obvious reason the shock reaction is usually ‘what on earth is happening’. The latter is a much greater stress reaction.

Dealing with emergencies can be complicated by the nature and extent of the emergency.
1 Types of emergencies

There are many ways in which an emergency can occur on a vessel. Examples are:

- collision with another vessel
- fire or explosion on board
- flooding of the vessel
- loss of steering control
- loss of motive power
- foundering
- grounding
- beaching a vessel
- person overboard
- person unconscious in a confined space
- rescue and evacuation of injured personnel
- severe weather conditions
- fishing gear caught on a submerged obstruction
- a shift of cargo causing the vessel to list or loll.

2 Incident reports

Collision

A collision occurred between a cargo ship (Handymariner) and a rock lobster fishing vessel (Lipari) off the West Australian coast. The Lipari left port (south of Fremantle) in the morning to check lobster pots set some 36 nautical miles offshore. The mate on watch on the Handymariner detected the Lipari on radar on a collision course and attempted to call the vessel but the marine radio on the Lipari was not working so the calls went unheard. The mate then attempted to warn the fishing boat by signal lamp and the ship’s whistle but still received no response. Lipari maintained a steady course and speed towards the ship. When collision was imminent the mate on the Handymariner altered the ship’s course to starboard. In the meantime, just before the two vessels collided, the skipper in the Lipari wheelhouse heard the ship’s whistle. He realised at that point that there was a ship dead ahead and so turned the vessel’s helm hard to port to try and avoid the collision. The Lipari struck the side of the Handymariner and was holed (the Lipari) on the starboard bow above the waterline.
Collision and sinking

The offshore supply vessel *Lady Ann* was manoeuvring alongside the drilling ship *Regional Endeavour*, off Exmouth Gulf WA, in order to transfer a mooring wire. Both vessels were underway at the time. Suddenly the *Lady Ann* sheered towards the *Regional Endeavour* and, despite the efforts of the Master, came into contact with the drilling ship resulting in a 60mm gash in the shell plating below the engine room floor plates. The master attempted to beach the vessel but the pumps were unable to cope with the inflow of water and the crew were taken off by another vessel (*Lady Sally*). The *Lady Ann* sank shortly after.

Grounding

The 34.5 metre passenger vessel *True North* with 38 people on board ran aground in the entrance passage to St George basin in Western Australia’s Kimberley region. The vessel remained aground for about an hour. It then floated clear of the rock on which it had grounded on the incoming tide and moved under its own power to an anchorage point. The vessel was beached and a full appraisal of the damage made. Temporary repairs were carried out while the vessel was beached, after which the vessel made its way under its own power to Darwin where repairs were finalised and the vessel was able to resume its cruise schedule.

Grounding and sinking

The offshore anchor handling and supply vessel *Boa Force* was engaged in deploying anchors from an offshore construction barge off Thevenard Island, 11 miles north west of Onslow, Western Australia. In the immediate area of the vessel’s operation there was a pipeline marked at regular intervals with temporary buoys and an unmarked sub-sea wellhead standing about three metres high in a general seabed depth of under eight metres of water. During manoeuvres to recover an anchor close to the wellhead, the *Boa Force* hit the wellhead and holed the engine room space. The crew were ordered to abandon ship and were picked up safely by a stand-by launch. The *Boa Force* sank to the seabed, partially supported by the wellhead.

Capsize at sea

A 16-metre landing barge *Keppel Trader* sailed from Darwin in the early hours of the morning, bound for the port of Wyndham. At a point during the voyage when the master was off watch he was awakened by the motion of the vessel and found that it was in rough seas. After several manoeuvres to try and make headway the barge suddenly developed a loll and appeared to be sinking by the stern. A few seconds later it rolled to port and capsized, settling in a stable upside down attitude. The Master was eventually rescued but the deckhand died.
Lost at sea

The 12.4 metre fishing vessel Tamara left Southport near Brisbane on a voyage to Noumea. Several days into the voyage the weather being experienced was westerly winds 20–25 knots and a fairly big following sea of between 4 to 6 metres. While in these conditions the skipper noticed that the engine was losing power and saw black smoke coming from the hatches on the work deck. He could see no fire and checked several spaces including the ice room and steering compartments. He returned to the wheelhouse and turned the vessel’s head into the sea. As the vessel turned a wave washed over the stern, trapping a large amount of water inside the bulwarks on the work deck. This water quickly flowed into the open steering hatch and through into the ice room and engine room. As water filled the after compartments the stern of the vessel sank lower in the water and the work deck became awash. Both the skipper and the deck hand, realising the vessel was now sinking, dived over the side, after first unsuccessfully attempting to grab the Emergency Position Indicating Radio Beacons (EPIRB), and climbed into the life raft that had floated to the surface as the vessel sank. After drifting for 14 days they were eventually rescued.

Fire and sinking

While on a voyage from Singapore to Cebu City in the Philippines the Australian registered fishing vessel Northern L caught fire. The six crew members were unable to fight the fire and abandoned the vessel, taking with them the EPIRB. Shortly after, explosions were heard coming from the vessel, which then sank. With the EPIRB activated the Australian MRCC was able to alert a vessel in the area and the survivors were quickly rescued.

Summary

These are just a few examples of some of the extremes that emergencies can involve. As each of these incidents shows, the emergency can be sudden and unexpected. In most of the cases quoted there was no loss of life while in one other there was. In some cases there was time to do something that actually enabled recovery from the situation, while in other cases there was no time for anything other than self-preservation.

Do not take any situation for granted. Treat an emergency for what it is, an emergency, and act accordingly.
3 Damage control

Damage control is based on the premise that the safety of the vessel depends on its maintaining its watertight integrity. Many vessels have been lost because no attempt or real effort has been made to contain the ship’s watertight integrity after an accident in which the hull of the vessel has been punctured, say, in the event of a collision or grounding.

The techniques that are available will depend on the nature, location and degree of the damage sustained in the emergency, and most importantly the equipment that is available to actually construct the control measure. It is often said that if a small vessel sustains a hole in the hull below the waterline, throw a mattress over the side in the vicinity of the hole and hope that it gets sucked into the hole and stems the flow of water. Another use of a mattress is for it to be pushed into the hole from inside the vessel and jammed into place. Both of these methods may be an expedient way to stem the flow of water but should only ever be considered as a temporary measure until a more substantial patch can be put in place. While this may seem to be a crude method (the use of a mattress) it has to be said that it does have possibilities, especially if nothing else is available.

But for more secure methods there are techniques that can be used with greater effect, such as shoring and the use of a cement box patch. However, each of these methods require specific materials that may not necessarily be available.

Shoring

Shoring is a way of supporting decks that have been weakened, or for strengthening bulkheads between flooded compartments. Shoring involves two phases:

- stopping or reducing the inflow of water
- bracing damaged or weakened structural members by transferring and spreading the pressure to other parts of the damaged area.

![Figure 4: shoring](image_url)
Cement box

The use of cement for repair work is generally limited to leak stopping. A cement box is a timber framework (in the shape of a box) that is built around the area of the leak to support the concrete while it is setting. The leak should first be stopped as much as possible to reduce the inflow of water. A drain system is then set up from the leak to the bilge where it can be pumped out. As soon as the drain is functioning satisfactorily, the cement is poured into the box. Once set the drain tube can be plugged. This method is not recommended for use on leaks in surfaces that are likely to move in a seaway.

Although all damage control is temporary, it must be strong enough to give the vessel a chance of getting into port or to a safe haven.

Protection of the marine environment

One important aspect in dealing with emergencies at sea or in port is coping with the damage to the coastal environment and inland waters from spilt material such as oil – and, in some cases, other toxic chemicals.

Marine-sourced pollution can occur in a number of ways: while bunkering; pumping bilges; shipping accidents; or indiscriminate disposal of plastics, garbage and sewage.

There are three levels (national, state and local) to consider when dealing with these types of marine pollution incidents in offshore, coastal and inland waters. At the national level, the Australian Maritime Safety Authority (AMSA) administers the National Plan to Combat Pollution of the Sea by Oil and Noxious Substances. This is known simply as the ‘National Plan’.

If there has been a pollution incident or the potential for pollution to occur that could affect a coastal area, the government agency of the coastal state concerned must be notified immediately. This should then be followed (in Australia) with a notification to the Australian Maritime Safety Authority (AMSA).
4 Self-test questions

The following questions are designed to allow you to check your understanding of emergencies and emergency procedures.

1. In the incident report on page 36, what was the significance of the marine radio not being operational on the vessel *Lipari*? Should it have been operational?

2. List any six (6) emergency situations that could arise on board a vessel at sea and/or in port.

3. In the incident report on page 38, what was the main cause for the actual flooding and sinking of the *Tamara*?

4. How is a cement box constructed for use in stopping a leak?
5. In the event of a marine pollution incident from your vessel in the vicinity of a coastal port, what are your reporting responsibilities?


6. What is the purpose of shoring?


7. What is meant by the phrase ‘to maintain the watertight integrity of the vessel’?


8. In two of the incident reports on page 37 (Lady Ann and Boa Force), both vessels sank after being holed in the area of the engine room. Why would being holed in the engine room space have such critical results? Could the results have been the same if the vessels had been holed in a small tank instead? Explain your answer.


Section 3 – Fire

While the focus of fire drills is typically on firefighting, the drill should also cover aspects in managing the control of smoke by training crew members to immediately report any progress of smoke. In vessels that carry passengers, the training should also include the management and evacuation of passengers from smoke-affected areas.

Introduction

Every year lives are lost and millions of dollars worth of damage is caused through fires on vessels. Human error is by far the most common cause of shipboard fires but it is not the only cause. Faulty equipment, dangerous cargo, leaking fuel, and collision are some of the others.

Fire is probably the most common, yet most preventable, emergency on board a vessel. There is no such thing as an insignificant fire. All fires have the potential to be catastrophic. Much will depend on the nature of the response.

The first few minutes of a fire are critical. Detection means using all of your senses, eyes, ears and nose (seeing, hearing and smelling). Research and actual experience has shown that a fire has the capacity for sudden exponential growth and can increase by up to 5 times in the first minute, 25 times in the second minute and 125 times in the third minute.

This unit is not designed to turn you into a professional firefighter. But at sea there is no fire department to call on and you have to become the firefighter. Therefore it is vital that you have an absolute familiarity with the equipment that you will have at your disposal, and how best to use that equipment in an emergency.

The first response to a fire can make the difference between a crisis and a catastrophe.
1 Relevant maritime Regulations

The Marine Act in each State and Territory requires all vessels to be properly surveyed and to carry the required firefighting appliances as set out in the conditions of survey. This equipment must be properly maintained. Regular musters, drills and training must also be carried out in accordance with the relevant state and territory Marine Act and Regulations.

A fire is an emergency situation. The general emergency alarm used in the maritime industry is seven short blasts followed by one long blast on the ship’s whistle. It is also to be made on the ship’s internal bells and an announcement made over the internal public address (PA) system (if fitted).

On hearing this alarm, everyone should put on warm clothing and a lifejacket and proceed immediately to their designated muster point. In the event that the muster point is itself a position of danger (due to the emergency), proceed to the alternative muster point.

It is important that everyone go to their muster point quickly, as a head count will be taken to establish if anyone is missing.

The fire-smothering system cannot be activated if it is believed that someone is in the space to be drenched.

During the induction process each crew person will be designated a role to undertake during an emergency. Pre-assigning responsibilities and alerting each person as to what will be expected of them will assist in speeding up the ‘size up’ aspect of the emergency and the planning process.

It could be an allocation to the fire party or the boundary cooling party, or responsibility for gathering any passengers into a safe area. Whatever the assignment, your safety and the safety of others will rely on every crew member knowing what to do and carrying out their duties quickly and calmly.

By displaying confidence you will be encouraging others, especially untrained passengers, to follow your instructions and allow the emergency to be handled efficiently.
2 The chemistry of fire

Fire is a chemical reaction where combustible material/s react with oxygen, generating heat and light. In more general terms it is when the three elements of a fire (heat, oxygen and fuel/material) react together. The fire triangle has always traditionally symbolised this.

However, further fire research in recent years has determined that a fourth element, a chemical chain reaction, was a necessary component of fire. This resulted in the fire triangle being changed to a fire tetrahedron to reflect the fourth side

![Figure 5: fire tetrahedron](image)

This means that all four elements must be present for fire to occur (fuel, heat, oxygen and a chemical chain reaction). Removal of any of these essential elements will result in the fire being extinguished.

The four elements

**Oxygen:** To sustain combustion. The atmosphere contains 21% oxygen. At this level a fire will be supported. Increasing the available oxygen through wind or ventilation will increase the spread and intensity of the fire. By reducing the amount of oxygen, the fire will commence to ‘starve’ and start to go out.

**Fuel:** Or a combustible material. Just about everything will burn, so anything can contribute to the start of a fire: oil, paper, wood, plastics, LPG, paint, fabrics, even metals.

**Heat:** To raise the material to its ignition temperature. With sufficient heat almost anything will burn. Most materials have two relevant temperatures. Firstly, the temperature at which they will ignite in the presence of a flame. Secondly, the temperature at which they will spontaneously burn.

**Chemical reaction:** An exothermic (a process or reaction that releases energy in the form of heat) chemical reaction in the material.
Ignition

To ignite a liquid there has to be gas above it. The liquid itself cannot burn, though the gas can when there is also oxygen and the temperature is sufficiently high. The lowest temperature at which this situation can occur is called the *flashpoint*.

However, it is possible that when the flashpoint is reached the combustion will cease after ignition. The reason for this is an incomplete mixing of the gas and air (oxygen). The *ignition temperature* is the lowest temperature at which combustion will continue after ignition. To sustain combustion after ignition there must be a sufficient amount of heat released in the process.

Combustion is also possible without ignition from an outside source. If enough heat is pumped into the fuel/material, the temperature may become so high that it will ignite spontaneously. The lowest temperature at which this can occur is called the *spontaneous combustion temperature*.

An *explosion* is generally defined as a very rapid release of high-pressure gas into the environment. The energy of this very rapid release is dissipated in the form of a shock wave and it is usually this shock wave that causes the damaging effects and is generally sufficient to knock a person down and/or cause structural damage.

Principles underlying the extinguishment of fire

There are three ways to extinguish a fire (break the fire tetrahedron).

*Remove the heat:* Cool the burning fuel/material to below its ignition point using a suitable fire-fighting medium.

*Remove the fuel/material:* Create boundary starvation by removing any combustible materials from adjacent areas. Turn off any gas or oil.

*Reduce the available oxygen:* Close off and seal the area – doors, fire flaps, fire dampers. Use a drenching agent.

By removing one or more of the above three elements, the fire should slow and go out.
3 Principles of fire prevention

On board a vessel at sea, the option of calling on professional firefighters is not available. The crew are the firefighters. But by far the best strategy is to prevent the fire from happening in the first place. There are ways in which this can be done, or at least go some way to reducing the possibility of a fire happening.

Consider the four elements of fire: fuel, heat, oxygen and the chemical reaction, and then look at the most likely places on board a vessel where these are found and where they are most likely to come into contact with each other:

- engine room and machinery spaces
- accommodation and living areas
- galley and cooking arrangements.

Engine room

Things to look for and be aware of in the engine room are hot surfaces and fuel leaks. Sources of fuel leakage can appear between flexible hoses, couplings, clogged filters, fractured pipes, loose flanges, and nuts and bolts. Most fuel oils will spontaneously ignite if they hit surfaces with temperatures above 250 °C. Take great care when pumping oil to the ready use tanks and avoid spillage or overflow. Switch off electrical sources when not in use. The engine room or machinery space is also an area where things tend to get a bit untidy. Avoid allowing flammable waste – or any other waste for that matter – to accumulate, particularly in bilge areas.

Incident – engine room

At about 0540 on 24 May, a fire started in the engine room of the general cargo ship Java Sea while it was berthed in Cairns. Initial attempts by the ship’s crew to fight the fire using a fire hose were unsuccessful and the decision was made to operate the engine room Halon 1301 fixed fire-extinguishing system. The release of the Halon 1301 proved ineffective. The fire was eventually extinguished by the Queensland Fire Service, using high expansion foam injected through a hole cut in the base of the funnel at poop deck level, directly above the seat of the fire.

There were no serious injuries as a result of the fire. However, the engine room and accommodation were significantly damaged by the fire and associated firefighting activities. The vessel had to be towed to Singapore for repairs.

The ATSB has found that the fire started when hot pressurised thermal oil, possibly in the form of a spray, came into contact with an un-lagged section of the thermal oil heater exhaust piping. The fire was further fuelled by the contents of oil storage tanks located near the seat of the fire.

The Australian Transport Safety Bureau investigation found that the fixed fire extinguishing system was ineffective in extinguishing the fire because the ship’s crew could not close the funnel casing ventilation dampers; the diesel generator was not shut down before the system was activated; and the oil tank quick-closing valves were not operated.
Accommodation

Things to look for in the *accommodation* and living spaces are materials stored too close to heat sources, equipment left running unnecessarily, cigarette smoking, clothing left near a heat source to dry, clothes dryers, overloading electrical circuits, loose papers and magazines and general untidy conditions.

**Incident – Accommodation**

A fire started in the vessel’s photography shop on the Ro-Ro passenger ferry *Spirit of Tasmania*. Two members of the fire party entered the shop using breathing apparatus. Initially they attempted to extinguish the fire with hand-held (portable) fire extinguishers but found that the fire kept re-igniting. Realising that the only option was to cool the area with a fire hose, they retreated from the shop and re-entered with a charged fire hose and extinguished the fire. Fire doors had to be closed to reduce the problem of smoke spreading throughout the ship’s accommodation.

**Galley**

Things to look for in the *galley* are overheated cooking oils and fats, grease fans and extractors that have not been maintained, spillages and other food waste that have not been cleaned up and cooking ranges that are not maintained.
Deep fat fires can be extremely dangerous.
If found at an early stage, cover the fryer with a metal lid or a fire blanket.
On no account should the fire be fought with a water-type portable fire extinguisher. This may cause a ‘boilover’ explosion that will spread the fire and possibly badly burn the firefighter.

Other things to look for overall are things that are likely to spontaneously combust such as oily rags and oil-impregnated overalls, chemicals stored incorrectly, incorrectly replaced fuses, and some particular cargoes.

You need to be vigilant and regularly arrange inspections of the vessel, particularly when on watch at night when others are resting or sleeping.
Hourly inspections of the engine room and machinery spaces, laundry areas, recreation rooms and accommodation can assist in preventing serious situations arising.
All fires start small. You may just be in time to prevent one from becoming serious.

Remember:
• fires can spread very quickly
• be safety conscious
• hold regular fire drills and learn where the safety equipment is kept and how to use it
• accidents involving fires can be avoided by practising good housekeeping
• clear away debris immediately
• gratings and ventilators should be cleaned regularly and oily rags and other flammable materials removed.
4 Principles underlying the spread of fire

To reduce the risk to persons, if there is a fire it is necessary to control or restrict the spread of the fire and/or the smoke. There are a number of ways in which heat, smoke and fire can spread. The most common of these are convection, conduction and radiation.

Convection means the upward movement of hotter, less dense gases. When a fire starts in an enclosed space such as a cabin, the smoke rising from the fire becomes trapped by the deck-head (ceiling) and then spreads in all directions to form an ever-deepening layer over the entire cabin. The smoke and heat will find their way through openings in horizontal surfaces which permit them to infiltrate into other compartments, allowing the smoke and fire to spread. In the meantime, the heat from the trapped fire in the cabin will cause the temperature to rise.

Conduction means the movement of heat through material. Some materials, such as steel, can absorb heat readily and transmit it to adjacent compartments where it can set fire to combustible items that are in contact with the heated steel.

Radiation means the transfer of heat through the atmosphere. Radiation transfers heat in the air in the same way as an electric bar heater heats a room. Any material close to the fire will absorb the heat until the item itself starts to smoulder and burn.

Some other ways in which a fire can spread are through flashover, backdraught, secret burning, the hidden fire, boilover, and an unconfined vapour cloud explosion.

Flashover is a heat-induced development of the fire loading in a compartment. It occurs when a smoke layer builds up at the ceiling of an enclosed cabin or compartment or an alleyway. When the door is opened, or the fire reaches the ceiling of a long alleyway, the smoke layer ignites and rolls along the ceiling as a rolling ball of flame.

Backdraught is a ventilation-induced ignition of fire gases following the entry of an air current (oxygen) into an area containing fuel 'rich' gases and an ignition source. It can result in an explosive fireball.

Secret burning is the accumulation of hot gases, remaining undetected until they ‘burn through’ and self-ventilate. This type of fire can jump several decks by spreading through air conditioning ducts.

The hidden fire can be as simple as a fire smouldering under a mattress, or inside a pile of rubbish bags. Once the mattress is lifted or the bags moved the fire comes to life.

Boilover occurs when water enters a hot liquid that is more than 100 °C. As the water instantly turns to steam it expands rapidly, causing the burning liquid to ‘boilover’ out of its container.

An unconfined vapour cloud is a cloud of flammable gas that travels through the atmosphere until it finds an ignition source to ignite it.
Restricting the spread of fire

If a fire can be prevented from spreading beyond the space in which it originated, it can usually be controlled and extinguished without extensive damage. Ways of doing this are:

- virtually surround the fire and attack on all six sides
- create boundary starvation by removing fuel from adjacent compartments
- create boundary cooling by applying water to all six sides
- remove oxygen by sealing the compartment
- evacuate, seal and drench the engine room
- apply water to an open fire to remove the ‘heat’
- turn the vessel to restrict the flow of smoke/fire over the ship
- shut down ventilation
- shut off fuel.

5 Classes of fire

Not all fires are the same. If the wrong type of fire extinguisher is used on the wrong class of fire it can make matters worse.

There are six different classes of fire, each classified according to the fuel or heat source it has, and by extension what methods will be necessary to contain or extinguish it.

Note: If the fire involves energised electrical equipment it is always classified as an ‘E’ class fire until the electrical circuit is disconnected and the power isolated. It then is reclassified according to the type of material that is burning.

Class A  Ordinary combustible or fibrous material such as wood, paper, clothing, some plastics, rubber

Class B  Flammable and combustible liquids such as petrol, kerosene, alcohol, oil and paint thinners

Class C  Flammable gasses such as LPG, butane, acetylene, hydrogen, natural gas and methane

Class D  Combustible metals such as potassium, sodium, lithium, aluminium, magnesium and metal swarf (shavings)

Class E  Electrically energised equipment such as computers, switchboards and power tools

Class F  Cooking oils and fats.
6 Portable fire extinguishers

A portable fire extinguisher is an active fire protection device used to extinguish or control small fires, often in immediate emergency situations.

The four most common type of portable fire extinguisher to be found on a vessel are:

- water
- foam
- dry chemical powder
- carbon dioxide.

Portable fire extinguishers are distinguished by their labels and colouring. Most portable fire extinguishers will also have a pictograph label indicating which type of fuels the extinguisher is designed to fight.

**Water** extinguishers come in an *all-red coloured canister*, filled with about \( \frac{1}{3} \) tap water and then pressurised with air. When this type of extinguisher is activated a stream of water is forced out of the nozzle. This type of extinguisher is designed to remove ‘heat’ from the burning material. They are effective only on Class A fires. They are not considered effective on Class B and C fires and are highly dangerous if used on electrically energised equipment or cooking oils and fats. Being water, the clean up process afterwards is relatively easy.

![Figure 6: fire extinguisher (water-based)](image)

**Foam** extinguishers contain a solution of Aqueous Film Forming Foam (AFFF) foam concentrate and water and are most effective against fires involving flammable and combustible liquids. They are recognised by a *blue band around the top section of a (red) canister*. The foam forms a blanket over the surface of a burning liquid cutting off the air supply to the fire, and is suitable for fighting Class A and B fires and, with limited effectiveness, on class F fires. They are not considered effective for use on class C fires and can be dangerous if used on electrically charged equipment.
Dry chemical powder extinguishers are filled with a fine powder and pressurised. When activated they extinguish the fire by coating the surface of fuel with a thin layer of powder to separate the fuel from the oxygen in the surrounding air. The powder also interrupts the chemical reaction of fire. They are recognised by a white band around the top of a (red) canister. They are very effective on most types of fires.

It is important to read the labels on this type of extinguisher.

Some are labelled A B (E), indicating that they are considered suitable for class A, B, C and E fires but are not considered effective on class F fires.

Some are labelled B (E) indicating that they are designed to be used on class B, C and E fires and may be used with limited effectiveness on class F fires, but are not considered effective for class A fires.
Carbon dioxide extinguishers are filled with a nonflammable carbon dioxide gas under extreme pressure. They extinguish the fire by displacing the air and thus removing the oxygen. They also provide some cooling of the fire. They are recognised by a black band around the top of a (red) canister and they also have a wide nozzle shield (horn) on the end of the flexible discharge hose. They are suitable for class E fires, and have a limited effectiveness on class A, B and F fires. Because of the nature of the gas that propels the liquid there is the possibility the ‘horn’ will become extremely cold, and ice may form. This can cause frostbite to the hand if the extinguisher is not held properly during its activation.

![Figure 9: fire extinguisher (carbon dioxide-based)](image)

Other types of portable fire extinguishers are available such as wet chemical (red canister with an oatmeal-coloured band) and vaporising liquid (red canister with a canary yellow-coloured band) but these are not necessarily approved for marine use.

Portable fire extinguishers should be located (placed) near to where they are most likely to be used but not so close that a fire will prevent someone reaching it. On board a vessel these locations are determined when the vessel is being built and surveyed. All portable fire extinguishers must be maintained in accordance with the manufacturer’s instructions and the survey requirements of the Marine Regulating Authority.

### 7 Firefighting equipment and appliances

#### Emergency shut-off systems

Valves on fuel tanks must be able to be shut off from outside the engine room in case of a fire. Fuel transfer pumps and ventilation fans must also be able to be stopped from outside the engine room.

> *Everyone should know where these are located and how they are operated.*
Emergency fire pump

An emergency fire pump is to be carried so that it is available to be brought into operation when a single casualty, such as fire or switchboard failure, renders the main fire pump/s in the engine room inoperable.

Everyone should know how to start and stop this emergency fire pump.

Fire hoses and hydrants

Fires will generally have to be fought with something more powerful than a portable fire extinguisher. A fire hose is designed to operate through a hydrant and with a nozzle. Care should be taken on how to adjust the nozzle settings (from a full 90° water shield to a straight jet).

A straight jet of water can spread a fire.
It also creates a lot of steam when used against red hot metal (and this will usually be superheated steam).
It also uses a lot of water, which, if not pumped out can accumulate and affect the stability of the vessel.

Fire, smoke and flame detection systems

There are two methods of fire detection: manual and automatic.

Manual means:
- conducting regular rounds during both working and non-working hours
- being alert
- observing running machinery for any abnormal noise, vibration or temperatures.

Automatic means:
- smoke detectors placed in different parts of the vessel
- heat detectors placed in appropriate parts of the vessel
- flame sensors placed where best suited
- a fire alarm central control panel.
Fire blanket
These are made of a fireproof material (woven fibreglass) and are usually best placed in the galley area. They are excellent for rapid smothering of a small oil fire, such as one in a saucepan or cooking pot. They can also be used as a protective coat to escape a burning area. Wrap the fire blanket over your upper body, crouch down below the smoke and make for an exit or escape route. Wrapping a person whose clothing is burning in the fire blanket will rapidly extinguish the flames.

Fire axe
These may be the only means of getting access into a cabin, or for breaking out of a burning space. Check their locations.

Sand buckets
Old technology but they can still be found on some vessels. This can be effective for smothering a small fire and for soaking up a fuel spill.

Breathing apparatus
This is highly specialised equipment and not carried on all vessels. But if it is carried on board a vessel it should only be used by those crew persons who have been trained in its use.
8 Initial actions

As often as not the first indication of a fire is when an individual discovers it.

**SOUND THE ALARM IMMEDIATELY!**

Once an alarm has been activated, the circumstances of the situation will then dictate the action to take. For the individual at the scene of the fire this usually results in that person being faced with the dilemma of whether to tackle the fire, which may by now be getting quite large, or to withdraw and wait for others to arrive. As a general rule, in a small fire the fastest initial actions may be to attack the fire with a portable fire extinguisher. In a large fire, the most effective action may be to seal the space to reduce the oxygen and minimise the spread of smoke, and then follow the shipboard fire procedures so that more people and equipment can be properly brought to bear in a coordinated way.

Each situation is different and without hindsight it is a matter of judgement that has to be made by the individual and made at that particular time.

Cautions

If you decide to attempt to fight a fire with a portable fire extinguisher, as either the first person to discover it or while waiting for further assistance to arrive, there are a few rules to consider.

*Ensure that you have a clear escape path behind you at all times.* Always position yourself with an exit or means of escape at your back before attempting to use a portable fire extinguisher to fight a fire. If something unexpected were to suddenly happen you would need to get out of the area quickly and not become trapped.

*Never attempt to fight a fire with a portable fire extinguisher if you don’t know what is burning.* It may be an explosive or have toxic smoke or you may have the wrong fire extinguisher.

*If the fire starts to spread rapidly and all you have is a portable fire extinguisher,* shut the compartment door and evacuate the area. A portable fire extinguisher is only of any use on small fires.

*If the fire is producing large amounts of smoke* that you would have to inhale in order to fight the fire, it is best not to try. Any form of fire will produce some amounts of carbon monoxide. When synthetic materials such as carpets and padding are involved, they can produce highly toxic and poisonous gases such as hydrogen cyanide. Many of these toxins can be fatal even in very small amounts.
9 Firefighting techniques

Every vessel must have in place a properly constructed and organised plan for emergency procedures. Each individual must be allocated duties and responsibilities as part of the plan, with muster points and sound signals clearly promulgated.

Leadership is the responsibility of everyone, but the skipper (master) is the person in overall command and control.

Sound the alarm

When sounding the alarm, make sure to identify the location of the fire. This is important as the location may indicate the need to shut down certain fuel, ventilation or electrical systems. It may also indicate what doors or hatches need to be closed to isolate the fire.

A delay in sounding the alarm could result in a small fire becoming a big one.

Staging, command and control locations

These locations should be established in a smoke-free area and as near as possible to the fire but not where it will be endangered by the fire.

All equipment (other than that in immediate use) that is needed to support the firefighting effort should be brought to this staging area in readiness for use.

Size up the situation

Evaluate the nature and extent of the fire including the class of fire:

• what materials are burning?
• what is the best extinguishing agent to use?
• what is the most appropriate method of attack?
• how can the fire be kept from spreading?
• what manpower do you have?
Hidden fires

If flames can be seen, the location of the fire is obvious. However, if only smoke is evident the fire may be hidden behind a bulkhead or a door.

Before a compartment or bulkhead door is opened to check for fire, the door should be carefully examined. Discoloured or blistered paint indicates that the fire is directly behind the door. Smoke puffing from cracks or seals is also an indicator of the fire. The bulkhead door should be touched with the back of the hand. If it is hotter than normal it is most likely hiding the fire.

A fire burning in a closed compartment consumes oxygen within that space. Opening the door will feed additional oxygen to the fire and the fire will grow in size and with explosive force. Anyone standing in its path will be severely burned.

Do not open a door hiding a fire until help and a charged fire hose are at hand.

Cool the door with water and have everyone stand clear.

Communications

Intercom, hand-held radios or individual messengers should be used to establish and maintain communications with the fire team.

Keep the communication brief but make it clear and concise.

Attacking the fire

The attack should be commenced as soon as possible so as to gain immediate control and minimise or prevent its spread. The attack will need to be either direct or indirect, depending on the fire situation.

A direct attack involves advancing immediately to the fire area and applying the extinguishing agent directly into the seat of the fire. However, if heat and smoke make it impossible to locate or reach the seat of the fire, the indirect attack needs to be considered.
In an indirect attack it may be possible to make a small opening in the fire space and insert a fire hose nozzle, injecting the water as a spray. In this way the heat (if the fire is hot enough) will convert the water spray to steam and this acts as a smothering agent. The other method is to seal and flood the space with a smothering agent, first making sure that no one is still in the space to be flooded.

**Ventilation**

Most fire casualties result from asphyxiation by combustion gases or lack of oxygen or both. Ventilation can be used to release combustion products trapped within the vessel. But if used in a fire it should only be used in a direct attack.

*In an indirect attack, the area must be kept sealed and airtight to keep oxygen out and the extinguishing agent in.*

**Preventing the fire from spreading**

If a fire can be prevented from spreading beyond the space in which it originated, it can usually be controlled and extinguished without extensive damage. To do this the fire must be surrounded on six sides. Firefighters with hose lines or portable extinguishers must be positioned to cover the flanks and the spaces above and below the fire.

*The possibility of the fire travelling through the ventilation system must be considered.*

**Dewatering**

Free water inside the vessel can impair its stability. Every effort must be made to ensure that large accumulations of water are not allowed to build up, especially in large compartments. Try to achieve maximum cooling with minimum quantities of water (water spray rather than solid jet).

*As soon as water is introduced for extinguishment, dewatering procedures should commence.*

**When the fire is out**

Before a fire can be considered as being 'out' certain important steps must be taken:

- Conduct a muster to account for all personnel.
• Make a thorough examination of the fire area, including any potential paths of fire spread.
• Ensure all smoke and combustion gases have been ventilated out.
• Post a fire watch in case of re-ignition.
• Examine all parts of the vessel to identify any damage that may have resulted from the fire. (High temperatures can cause decks, bulkheads and other structural members to buckle or warp or otherwise become structurally unsound.)
• Continue any dewatering procedures until the stability, list or trim of the vessel is satisfactory.

**Things to remember in a fire**

A standard and useful acronym is RECEO.

Rescue: The first priority in an incident is to effect the rescue of a casualty, but without unduly endangering the safety of the rescuers and without escalating the injuries to the casualty. If a clean rescue is not possible until further action is taken to minimise the risks, the casualty then becomes part of the exposure list that has to be dealt with.

Exposure: It is important that, prior to commencing firefighting operations, all relevant and obvious risks of exposure to danger have been considered. This may mean that some surfaces will first have to be cooled or starved before attacking the main fire. Exposures should be dealt with in order of importance, the most important being protection of life. Others are adjacent risks and structural integrity.

Control: At any incident, only one person should be in overall control. After Rescue and Exposure have been dealt with, the situation must be controlled and managed by the fire team leader. This person must formulate the plan of attack and get the fire party to respond to his/her commands. This plan must also take into account ways of containing the fire to prevent its spread.

Extinguish: Only now attempt to fight the fire.

Overview: Once all fires have been extinguished, an overview of the situation should commence. This will include any necessary cooling down of hot spots and making sure that re-ignition does not occur. It also involves checking the equipment and making sure that it is still in a serviceable condition and returned to its correct stowage.

A follow-up debrief of all involved should be conducted to determine things like the cause of the fire, response times and actions. Did the plan work? Was the equipment sufficient and functioning?
10 Self-test questions

The following questions are designed to allow you to check your understanding of fire.

1. How can fire spread through the process of convection?

2. What type of portable fire extinguisher is colour-coded red with a horizontal white band?

3. What are at least two (2) precautions that should be taken before attempting to attack a fire using a portable fire extinguisher?

4. What is the sound signal to indicate an emergency?

5. What are the four (4) elements of a fire tetrahedron?

6. What does the label A B (E) mean?

7. What is meant by ‘flashpoint’?
8. What are the three (3) ways to extinguish a fire?

9. List at least six (6) locations on a vessel where fire is most likely to occur.

10. What does ‘boundary starvation’ mean?

11. What actions should be taken when hearing the emergency signal?

12. What are the dangers associated with a fire in the engine room?

13. How can fire spread through the process of conduction?
14. What is a class ‘A’ fire?

15. What are the dangers with using water to extinguish a burning fat fire?

16. What are the dangers associated with the phenomenon of ‘backdraught’ in a fire?

17. List at least six (6) ways of restricting the spread of fire.

18. What is a class ‘D’ fire?

19. How can fire spread through the process of radiation?
20. What colour is a water fire extinguisher?

21. What class of fires can a foam fire extinguisher be used on?

22. What is meant by ‘spontaneous combustion temperature’?

23. What are the dangers to the vessel when using a lot of water to extinguish a fire?

24. What is the first primary action that should be taken by a person who discovers a fire?

25. What is meant by ‘ignition temperature’?

26. What is involved in a ‘direct attack’ method of fighting a fire?
27. What are the dangers associated with the phenomenon of ‘secret burning’?


28. What does ‘boundary cooling’ mean?


29. What are the dangers associated with a fire in the accommodation area?


30. What actions should be taken after any fire has been extinguished?


Section 4 – Survival

Introduction
Safety at sea is a primary concern of everyone involved in the seagoing industry. This includes the vessel owner, the designer, the builder, the regulating authority and of course the seafarer. Nationally and internationally there are bodies such as the National Maritime Safety Committee (NMSC) and the International Maritime Organisation (IMO) that set standards for safety at sea. But despite all of this and the efforts that are made to preserve life at sea, emergency situations will continue to be a daily possibility that seafarers have to prepare for. Collisions, grounding, fire, heavy weather, machinery failure, explosions and sinking continue to pose a threat to vessels and people.

Incident
On the afternoon of 14 October 2005, the six-metre Department of Immigration and Multicultural and Indigenous Affairs (DIMIA) vessel Malu Sara was returning from Saibai Island at the northern extreme of the Torres Strait to its home community on Badu Island. During the midafternoon, the skipper reported that he was lost in reduced visibility. There were five people on board: two male DIMIA crew, two adult females and a four-year-old girl.

There was no suggestion of panic or distress. With the onset of darkness, at about 1915 on 14 October the Thursday Island Police took over coordination of the search for Malu Sara. The skipper was instructed to activate the boat’s emergency position indicating radio beacon (EPIRB) and the boat’s position was eventually established. Later the skipper reported he was close to an island and could see a shore light. It appeared that Malu Sara was in a sheltered position. At 0215, the skipper again made contact by satellite telephone and reported that the boat was taking on water and sinking.
Despite an extensive search over six days, involving the Queensland Police Service and the Australian Maritime Safety Authority’s Rescue Coordination Centre, no trace of the boat was found. The body of one of the females on board was recovered by Indonesian fishermen near Deendar Reef about 50 nautical miles west of Malu Sara’s last known position and handed to Indonesian authorities. The body was subsequently repatriated to Australia for burial.

The Investigation Report covers key aspects of the tragedy including the seaworthiness of Malu Sara, the equipment it carried, fatigue and decision-making and regulatory oversight.


1 Relevant maritime regulations

All vessels have to be designed, built, equipped, manned and surveyed to approved standards. The appropriate Marine Regulating Authority Acts and Regulations such as the Emergency Procedures and Safety of Navigation Regulation and International Conventions such as the Safety of Life at Sea (SOLAS) Convention determine these approved standards.

Mandatory musters and drills have the objective of developing a trained and organised response to situations which may unexpectedly threaten life at sea. It is important that they be carried out realistically, approaching as closely as possible to actual emergency conditions and in accordance with the scheduled periods.

The emergency muster list should describe each individual crew person’s muster station, survival craft station, emergency duties, and all emergency signals and what action to take on hearing these signals.

The timing of emergency drills, especially the abandon ship drill, should be such that crew persons who may not have been available to participate in one drill can participate in the next.

Musters and drills

Emergency musters and drills are ways of exercising the crew readiness to react in an emergency. A muster is a gathering of crew and passengers at the designated or alternate muster point. It is here that a roll call of the crew will be undertaken. Members of the crew will be questioned in their roles and duties. Passengers will be shown how to properly don their life jacket and use its fittings and attachments.

A drill is when a muster is carried out, and then parts of the lifesaving (or firefighting) equipment are exercised by the crew. This could be launching, boarding and recovering one of the survival craft or conducting a mock firefighting exercise.
The whole purpose of musters and drills is to familiarise everyone with their stations and duties in an emergency, and with the operation of the emergency equipment.

Depending on the size of the vessel and the number of crew, the schedule of musters and drills will be variable. Whatever the case, every vessel must have in place an emergency procedures process that conforms to the relevant legislation covering that particular vessel. A detailed emergency stations list is required to be displayed at convenient locations throughout the vessel.

Everyone must attend musters and drills and it is a requirement for the skipper (master) to keep an accurate record of the event in the vessel logbook or vessel record book.

Emergency signals

Apart from the general emergency signal of seven short blasts followed by one long blast on the whistle or siren (which means go to the emergency muster point) there is also a requirement for two further signals to be in place. They are as follows:

The prepare to abandon ship signal consisting of one short blast followed by one long blast at least three times in succession made on the vessel’s whistle or siren and repeated on the ship’s internal bells and announced over the public address system (if fitted).

This signal is used to advise the crew that the ship is about to be abandoned and they should commence preparing the survival craft for launching.

The final signal is to order the abandonment of the vessel (abandon ship) and means GO NOW. There is no standard signal for this and it is to be decided by the skipper (master) and promulgated on the vessel's emergency station list that is displayed throughout the ship. Like all of the other signals it must be made on the vessel's whistle or siren, repeated on the internal bells and announced over the PA system (if fitted).
The abandon ship signal and the order to abandon ship can only be given by the skipper (master) or the senior surviving officer.

Equipment requirements

The amount and type of emergency lifesaving equipment required to be carried on a vessel will depend on its size and area of operations. These will be decided on by the regulating and survey authority and listed on the Certificate of Survey. Some examples are:

- life jackets and/or PFDs
- lifebuoys
- inflatable life rafts
- lifeboats
- distress signals (pyrotechnics)
- EPIRB
- Search and Rescue Transponder (SART)
- first aid box
- Very High Frequency (VHF) hand-held radio
- Survival at Sea Manual (AMSA).

Life jackets and Personal Flotation Devices (PFDs)

While the terms 'life jacket' and 'personal flotation device' are common to each other they should not be standardised as totally meaning the same thing. The term PFD can refer to a number of items of safety equipment required to be carried by a vessel. On the other hand, a 'life jacket' only has one meaning.

For example, a lifebuoy which can be thrown is referred to as a PFD, as are certain types of 'vest' that are worn when working on an exposed deck or in work involving small boat activities. In general terms, a PFD is a sort of new generation life jacket that is used for boating activities rather than commercial seagoing purposes.

For large seagoing merchant ships it is normal to use the term 'life jacket' as this is what is used in the legislation covering vessels of that size. These life jackets have to be SOLAS (Safety of Life at Sea) type and be approved by the national marine regulating authority (in Australia, this is the Australian Maritime Safety Authority – AMSA). They must carry the manufacturer's name or means of identification; the manufacturer’s model identification, serial number and year of manufacture. They must also show the intended body mass range for which they are approved, approval information including the administration which approved it; and for 'inflatable life jackets' a label for registering the ‘date of service’ and the text ‘annual servicing required’. They must also be of a standard colour (orange), fitted with a plastic whistle and a water-activated light, securing tapes, and strips of retro-reflective tape.
Smaller seagoing vessels with limited operational areas are required to carry ‘coastal life jackets’ and they need to be approved by the State Regulating Authority. They must show the manufacturer’s name or other means of identification, the words ‘Life jacket’, and have instructions for donning. They must also be of a standard colour (orange), fitted with a plastic whistle and a water-activated light, securing tapes, and strips of retro-reflective tape.

Recreational-type vessels usually carry PFDs. They are usually categorised as PFD Type 1 or Type 2 or Type 3.

*(For more information about the characteristics and standards of each type of PFD refer to the National Maritime Safety Committee website www.nmsc.gov.au/pfd)*

Whatever they are called, a life jacket or a PFD is useless unless it is worn.

For commercial vessel purposes there must be one (1) life jacket for every person the vessel is certified to carry (stowed in the individual’s cabin) with an extra supply stowed in working areas such as the navigation bridge, forecastle and engine room for use by persons in an emergency who may not be able to get to their cabin in time to retrieve their own.

There should be instructional posters throughout the vessel on how to correctly put on and wear a life jacket.

*In passenger vessels there should be two sizes of life jacket, one for adults and one for children.*

*Figure 11: PFD*
Lifebuoys

These must be of an approved type, size and colour, marked with the name and port of registry of the vessel, and fitted with a line around the outer edge and strips of retro-reflective tape.

The survey requirements for the vessel will determine how many are to be carried but it is generally accepted that every vessel will carry at least one on each side of the vessel fitted with a length of line not less than 27.5 metres. Some lifebuoys are also fitted with a smoke float, or a water-activated light or, in some cases, fitted with both a smoke float and a water-activated light.

![Figure 12: lifebuoy](image)

Survival craft

Survival craft in the form of life rafts and lifeboats are placed on board a vessel as a means of saving life in an emergency. The number of rafts and/or boats to be carried is calculated on the basis of the carrying capacity of the survival craft and the number of persons the vessel is certified to carry.

All survival craft are to be surveyed periodically in accordance with the relevant State or Territory or Commonwealth marine legislation.

Inflatable life rafts

In many vessels inflatable life rafts are the primary and only source of survival craft. The regulating survey authority will decide on the number to carry and their location, and they must be of an approved type. Life rafts come in a variety of sizes.

They are packed inside a fibreglass container and stowed in a cradle on the deck, although in larger passenger-carrying vessels they may also be stowed in a ‘stack’ in an angled ramp. They are secured in the cradle or angled ramp by a firm strap so that they are not washed over the side. This securing strap is itself secured to a hydrostatic release mechanism. The fibreglass container has to be marked with details of the manufacturer, the number of persons it is certified to carry, the date of last survey, the type of survival pack it has included, and the length of the launching painter line.
One of the advantages of an inflatable life raft is that it is portable; that is, it can be carried to a more convenient or safer position for launching if there is a problem at the launch site where it is stowed.

Figure 13: container storing inflatable life rafts

Hydrostatic release mechanism

This is designed to allow the life raft to float free from a sinking vessel. It is activated by water pressure at a depth of between 1.5 and 4 metres, and in so doing it releases the securing strap. The shipboard end of the inflation painter line remains secure to the ship and, as the raft floats to the surface due to its buoyancy, the painter line is withdrawn from inside the life raft container, until on reaching its maximum length it triggers the gas bottle to inflate the raft on the surface.

As the vessel continues to sink, the painter line becomes tight (with the sinking vessel at one end and the inflated life raft at the other end) but as the shipboard end of the painter is fitted with a ‘weak link’ arrangement, this will break free and allow the raft to remain on the surface.

Figure 14: hydrostatic release mechanism
Life raft construction

A standard inflatable life raft consists of two inflatable chambers on top of which is a highly visible coloured exposure cover. The exposure cover is fitted with strips of retro-reflective tapes, a water-collecting gutter and a strobe light and is marked with the name of the manufacturer, the vessel, and the number of persons it is certified to carry. The exposure cover has openings at each end for boarding, with flaps that can be either closed (to preserve heat) or left open (for cooling and ventilation).

The top inflatable chamber is fitted with a ‘becketed’ (looped) line around the outside and a boarding ladder arrangement is rigged at the openings. One end of the launching painter line is connected to this chamber so that the inflated raft can remain attached to the vessel to assist in boarding.

The underside of the bottom chamber is fitted with strips of retro-reflective tape, a righting line (for use if the life raft inflates upside down), several large water pockets to assist in stabilising the raft, and the inflating gas bottle in a pocket. The painter is connected to this gas bottle for activation and inflation.

The inside of the life raft has an inflatable floor and a pocket at the entrance in which a knife is located for cutting the painter line. It also has an emergency equipment pack and a battery-operated small internal light.

Note: The usual routine at a muster and drill is to discuss the launching of the life raft without actually doing it (it would then need to be repacked). The general requirement, however, is to engage a manufacturer to visit the vessel in port with a life raft and demonstrate the actual inflation and launching process. Depending on the local legislation, this will normally be carried out at intervals of six months.
Emergency equipment pack

There are various types of emergency equipment packs such as SOLAS ‘A’, SOLAS ‘B’, or SOLAS ‘B+’. While the contents vary slightly, the main equipment is common to them all and is made up of the following.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Purpose and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bailer</td>
<td>To remove as much water as possible from inside the raft.</td>
</tr>
<tr>
<td>Chemi-luminescent lights</td>
<td>For use inside the raft to enable survival instructions and other important information to be read.</td>
</tr>
<tr>
<td>Doses of anti-seasickness medicine</td>
<td>To prevent the onset of seasickness. <em>Must be taken immediately on boarding the raft.</em></td>
</tr>
<tr>
<td>Daylight signalling mirror with instructions</td>
<td>For attracting attention by using the reflection of the sun.</td>
</tr>
<tr>
<td>Drinking vessel (graduated and rustproof)</td>
<td>For measuring and issuing water rations.</td>
</tr>
<tr>
<td>EPIRB</td>
<td>A battery-operated distress alerting beacon.</td>
</tr>
<tr>
<td>Food rations</td>
<td>The daily ration is 125 grams of high-energy food supplement.</td>
</tr>
<tr>
<td>First aid outfit in a waterproof case capable of being closed tightly</td>
<td>Mainly dressings and adhesive tapes for treatment of minor injuries. <em>Narcotic drugs such as morphine are not included in this pack.</em></td>
</tr>
<tr>
<td>Fishing tackle including a line on a hand reel with sinker and hook fitted, plus a selection of 6 spare hooks and a coloured lure/spinner</td>
<td>For supplementing food rations. Fish, if caught, should preferably be left to dry and only consumed when heavy rain enables extra drinking water to be obtained.</td>
</tr>
</tbody>
</table>
### Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Purpose and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand flares</td>
<td>For attracting attention.</td>
</tr>
<tr>
<td>Instructions for immediate action</td>
<td>Explains the steps to take immediately after boarding the raft.</td>
</tr>
<tr>
<td>Knife of the non-folding type having a buoyant handle and lanyard attached and stowed in a pocket on the exterior side of the canopy near the point at which the painter line is attached to the raft.</td>
<td>For cutting the painter line.</td>
</tr>
<tr>
<td>Lifesaving signals on a waterproof card or in a waterproof container</td>
<td>Signals to be used for attracting the attention of aircraft or shore landing parties.</td>
</tr>
<tr>
<td>Manually operated bellows or pump</td>
<td>For inflating the floor or buoyancy chambers.</td>
</tr>
<tr>
<td>Paddles (buoyant)</td>
<td>For assisting to clear away from the sinking ship.</td>
</tr>
<tr>
<td>Rescue quoit (buoyant) attached to not less than 30 metres of buoyant line</td>
<td>To assist in the recovery of persons from the water. It can be thrown to them and used to drag them to the raft. Or, if a swimmer is sent into the water to assist, it can be used as a rescue line attached to the swimmer.</td>
</tr>
<tr>
<td>Rocket parachute flares</td>
<td>For attracting attention.</td>
</tr>
<tr>
<td>Radar reflector</td>
<td>Used to enhance the echo strength of a survival craft.</td>
</tr>
<tr>
<td>SART</td>
<td>Battery-operated locating device.</td>
</tr>
<tr>
<td>Repair kit for punctures</td>
<td>For minor repairs to the rubber tubing. Consists of cone shapes with a screw thread. They come in various sizes.</td>
</tr>
</tbody>
</table>
### Equipment and Purpose

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Purpose and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke floats</td>
<td>Attracting attention during daylight.</td>
</tr>
<tr>
<td>Sea anchor of adequate size, fitted with a shock-resistant hawser</td>
<td>To hold the raft in position and reduce drift. Also to assist in stabilising the raft.</td>
</tr>
<tr>
<td>Seasickness bags</td>
<td>To enable hygiene to be maintained inside the raft.</td>
</tr>
<tr>
<td>Waterproof torch with batteries</td>
<td>For on-board illumination and signalling.</td>
</tr>
<tr>
<td>Water rations</td>
<td>An amount of 1.5 litres for each person the survival craft is certified to carry.</td>
</tr>
</tbody>
</table>

### Lifeboats

While all vessels will carry a life raft/s, most vessels will also carry lifeboats. They are heavily constructed, big enough to carry large numbers of persons and are fitted in fixed positions with mechanical launching arrangements. Most common are those lifeboats that are categorised as being ‘fully enclosed’.

All lifeboats must be of an approved construction, of a highly visible colour, fitted with strips of retro-reflective tapes and looped lines around the outside, with the name and/or call sign of the vessel clearly marked.

If a lifeboat is carried it must be swung out and suspended by its davits, lowered to the water, crewed and then taken away from the vessel at the appropriate legislated training intervals.

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**Care must be taken during a full lifeboat drill.**

*During a drill the lifeboat must be launched without the crew, lowered to the water and then boarded by the crew using a rope-boarding ladder. The crew should be removed via the same ladder before the lifeboat is retrieved.*

*Particular care must be taken when retrieving the lifeboat to ensure that the ‘on-load/off-load’ mechanism (if fitted) is properly connected to the lifting hooks.*
Incident

A seaman from the Antigua and Barbuda flag cargo ship Waddens was seriously injured when a lifeboat fell about six metres while being recovered from the water in Cairns Harbour on 14 February 1999.

The probable cause of the lifeboat's fall was accidental movement of the lever on the release mechanism, according to a report issued by the Australian Transport Safety Bureau (ATSB). The report found that the hoisting hooks had opened, releasing the boat after an exercise in the harbour.

The incident is one of many accidents involving lifeboats with on-load release gear failing while being recovered. On-load release equipment permits a lifeboat to be released when there is weight on the hooks connecting the boat to the fore and aft falls.

While the actual sequence of events was not determined, the report states it was probable that the lever for the release mechanism was in the correct position while the boat was being hoisted, but was unsecured.

According to the report, the most likely explanation for the accident is that a crew member dislodged the lever while he was stowing a rope in the boat.

The report identifies poor ergonomic design in the siting of the lever, adjacent to the engine controls; a common factor in similar lifeboat accidents. The report addresses issues of maintenance of the release mechanism and the fact that records of such maintenance did not exist.

Australia has raised the issue of the safety of on-load release mechanisms for lifeboats at the International Marine Organisation (IMO) and the ATSB is submitting a paper, at the request of the Flag State Implementation Subcommittee, correlating similar accidents from a number of countries.
Distress signals (pyrotechnics)
All vessels must carry a range of pyrotechnic distress signals (over and above those carried in the life raft and lifeboat emergency pack) to be used in the event of an emergency. The actual number of each type will depend on the survey requirements for that particular vessel and its area of operation, but in general most vessels will carry a number of:

- rocket star parachute flares
- red hand-held flares
- orange smoke distress signals.

These should be stowed on board the vessel in a waterproof container and kept in a convenient place so that they are readily available for rapid use.

The usual life of pyrotechnics is three years.

Red star parachute distress flare
These can be used effectively during both the hours of daylight and darkness, with a visible range of up to 10 nautical miles (15 km) by day and up to 27 nautical miles (40 km) by night.

It is generally recommended that this type of distress signal is best used to attract attention over long distances and should be fired vertically or at an angle of 45º if there is a low cloud base. If the wind is strong, the aim should be slightly downwind.

Figure 17: red star parachute distress flare

Red hand-held distress flare
These are most effective during the hours of darkness, with a visible range of around 6 nautical miles (10 km) on a clear, dark night. They can also be used during the day. The best method of firing one of this type is to hold it out from the body and point it downwind.
This type should only be used when a potential rescue vessel or aircraft is in line-of-sight, so as to pinpoint the position.

Orange smoke distress signal

These are best for daylight use and have a visible range, by day, of about 2.5 nautical miles (4 km). They are used to pinpoint the position of the survival craft or survivor and therefore should only be used when a potential search vessel or aircraft is in line-of-sight.

Note: It should be noted that while smoke floats are best for daylight use, most dedicated search and rescue aircraft and some types of vessels are fitted with FLIR (Forward Looking Infra Red) and this may provide them with the ability to detect smoke by virtue of its heat release, during darkness.

It is an offence for any person to use or activate a distress pyrotechnic device except in cases of emergency or where the vessel is in distress and requires assistance.

Always read the instructions before activating a pyrotechnic.
Signal flags
Most vessel survey requirements list (as part of the miscellaneous equipment to be carried) the two flags N and C. When flown together with N upper and C lower, they indicate the International Signal of Distress.

![Signal flags](image)

Figure 20: signal flags

Line-throwing apparatus
Some medium-size vessels may also carry a line-throwing apparatus that should be capable of throwing the line over a distance of 230 metres and is suitable for sending a line to another vessel or to the shore to prepare for the rescue or retrieval of survivors or survival craft.

![Line-throwing apparatus](image)

Figure 21: line-throwing apparatus

All survival equipment and appliances should be well maintained.

Offences
A person must not, without reasonable excuse, engage in conduct resulting in any damage to an appliance or item of equipment stored in or belonging to any appliance.

A person must not, without reasonable excuse, engage in conduct resulting in the alteration or defacement of any label or marking on an appliance or an item of equipment stored in or belonging to a life-saving appliance.
2 Emergency electronic and radio equipment

The EPIRB (Emergency Position Indicating Radio Beacon) and the SART (Search and Rescue Transponder) are two of the most important types of rescue equipment you will need.

*The EPIRB is a distress-alerting device* that transmits information as regards the vessel’s identity to a constellation of polar orbiting satellites. This information is then relayed to a Rescue Coordination Centre (RCC) via a LUT (Local User Terminal) so that its position can be established, and search and rescue procedures can be initiated. It is designed to float free from the vessel if time does not permit it to be activated and/or carried into the survival craft.

The standard EPIRB operates in the 406 MHz band and has a detection radius of about three nautical miles around the EPIRB. It should be attached to the survival craft and allowed to float in the water clear of the survival craft.

*Note:* The older type analogue EPIRB operating in the 121.5-243 MHz bands ceased being monitored by satellite on 1 February 2009.

While the EPIRB is unquestionably an essential and vital item of equipment for the purposes of distress-alerting from a survival craft, the marine Very High Frequency (VHF) and Medium Frequency (MF)/High Frequency (HF) radio is still required to be carried on a seagoing vessel as it enables much valuable extraneous information to be sent and received, at all times, not just in an emergency.

While all persons holding a marine certificate of competency are required to hold a Marine Radio Operators Certificate of Proficiency (MROCP) or (MROVHFCP), it is desirable that everyone who serves on board hold one.

Courses are available at all approved marine training colleges and through other organisations. Check with the regulating authority or Registered Training Organisation (RTO) in your State.
The SART is a locating device and should be taken with you when abandoning the vessel. By activating the SART and positioning it on the outside of the survival craft and about 1 metre above the surface of the water, a passing ship or searching aircraft will be able to detect it by a particular signal (a series of dots in a radial line) that is displayed on 3 cm radar. The normal range of detection of a SART is about 6 nautical miles.

Hand-held VHF radios

Most vessels carry one or more hand-held radios that can be used for a number of purposes, not the least being in an emergency, and are especially useful for communicating between survival craft. They can also be used for communication between the vessel and survival craft during a practice drill. When not being used, these should be kept in a battery charger socket on board the vessel.
First aid pack

The first aid container that is carried in the emergency pack of a survival craft can be supplemented by the first aid pack that is carried on board the vessel. Take this into the survival craft with you.

3  IMO safety signs and symbols

Planning for emergencies, and possibly evacuation and abandonment, is a necessary requirement that involves, amongst other things, giving due importance to an awareness of the identification of the usual signage that is used on board a vessel to indicate important locations and other features. Colours and symbols are used on signs as a way of providing ever-present information and warnings, essential to on-board safety.

*Signs and symbols are non-linguistic and are designed to be visually recognised.*

![Safety signs and symbols](image)

*Figure 25: safety signs and symbols*
4 Survival

When the Estonian ferry the *Estonia* foundered and sank in the Baltic Sea in 1994, of the 938 persons on board most were trapped inside the sinking ship and perished. While as many as 200 were able to get clear of the ship and into the water, only about half of them were to survive.

The ocean is a hostile environment and nature is a cruel master. Once adrift in a survival craft there are many hazards. The following list is indicative of some of those hazards:

**Exposure**

The ability to survive extremes in temperature (hot and cold) is limited. Death can occur by exposure to these extremes and this is especially so when in a weakened condition after the abandonment of a vessel.

**Cold shock**

When a person enters the water, particularly cold water, he/she is exposed to the ‘gasp response’ known as cold shock characterised by an immediate loss of breathing control, incapacitation and a high risk of drowning or sudden death from cardiovascular failure. This effect is increasingly fatal as the water temperature decreases. Cold shock usually sets in before the advent of hypothermia.

**Hypothermia**

This is a process where the body loses heat to the environment (water and air) faster than it can produce heat. This lowers the body’s core (brain, heart, lungs) temperature with accompanying decrease in bodily functions that are critical for survival. Hypothermia takes time; the rate at which it occurs is proportional to the coldness of the water temperature and the person’s insulation (clothing).

The signs of hypothermia should always be looked for, not just in an emergency but even when working in bitterly cold conditions. The normal signs include shivering; confusion or sleepiness; slurred speech or shallow breathing; weak pulse or low blood pressure; stiffness in the arms or legs, or poor control over body movements.

Symptoms of hypothermia are:

- Shivering is typically the first sign and symptom of hypothermia. It eventually becomes uncontrollable. However, with severe hypothermia, shivering stops. Therefore one of the key indicators that a victim has moved from mild/moderate hypothermia to severe hypothermia is that he/she is no longer shivering.

- Behaviour changes – like complaining, difficulty in speaking, and uncoordinated movements. Victims will struggle to perform simple tasks. With severe hypothermia, behaviour changes from erratic to apathetic to unresponsive. Uncharacteristic behaviour like inappropriate excitement or lethargy, poor judgement, and poor decision-making is common.

- Cold, pale and blue-grey skin due to constricting blood vessels becomes obvious. The victim may lapse into a coma, with dilated pupils making it difficult to determine if the victim is dead or alive.
It is understood that cold water kills by cold shock, drowning and advanced hypothermia. Unless death occurs at any point, the final result occurs in three continuous phases:

- an initial cold shock response
- a short-term immersion and loss of performance
- a long-term immersion with the onset of hypothermia.

**Dehydration**

Dehydration is a condition that occurs when a person loses more fluids than he/she takes in. When a person becomes dehydrated it means the amount of water in the body has dropped below the level needed for normal body function. Thirst is usually the first indicator of dehydration. Other symptoms are feeling dizzy and light-headed, having a dry mouth and producing less urine or urine that is dark-coloured. As the condition progresses, a person will start to feel much sicker as more of the body organs become affected.

**Note:** Maintaining the body’s water balance is a primary requirement for survival. Drinking salt water will increase thirst and shorten survival time. Under conditions of lack of water intake, urine is too toxic to drink. Drinking alcohol as a substitute for water in a survival situation is suicidal, as it will promote heat loss through the skin and water loss through the kidneys.

**Drink no water on the first day. This has the effect of causing the body to activate its own water saving mechanisms. Thereafter, spread the consumption of drinking water to small sips throughout the day.**

**Starvation**

Starvation is caused by a severe reduction in the intake of food (vitamins, nutrients and energy). This usually manifests itself in the loss of substantial fat and body mass. The person will suffer both psychological as well as physiological effects.

**Injuries**

The very act of having to abandon a sinking vessel carries with it the increased danger of sustaining an injury in the process. Considering the state of shock that the survivor is already in, any further debilitation will only work to reduce their ability to withstand the confinement and privations of a survival craft and a survival situation.
Loss of the will to live
It takes a lot of strength to withstand a traumatic experience. People can very quickly lose the emotional and psychological ability to fight against the urge to give up. The longer the time involved, the more rapid the decline is likely to be. They see it as a release from the struggle to survive.

Seasickness
Seasickness can be life threatening. It is unpleasant and causes dehydration which in severe cases can lead to death. It may disappear within a few days as the brain learns to compensate for the movement of the survival craft.

5 Principles of survival at sea
In an emergency people become stressed and confused. Their ability to receive, understand and absorb information is greatly reduced. They are distracted and their ability to follow anything but the simplest of instructions is limited. Your survival will depend on your will to live and your ability to adapt and cope with many hazards that you face.

When faced with wind, rain and extremes of heat or cold a person must be able to keep these hazards from becoming a serious threat to life by taking precautionary measures as soon as possible and by using all available resources to support themselves physically, emotionally and psychologically.

Preparation for abandonment
Personal preparation for abandonment involves making sure that you are suitably prepared in every respect to meet the trauma and the conditions that you are about to be exposed to. Cover yourself with sufficiently warm clothing and a hat, so as to be properly protected while still being comfortable. Above all else, you must wear a life jacket and/or PFD.

What to take with you
While it is a natural reaction to take things that are important to you personally, this must be avoided. It is a survival situation and only those things that are best likely to assist in surviving should be considered. Some suggestions are:

- extra fresh water (a few plastic bottles full)
- a few packets of sweet biscuits
- a blanket and towel
- the ship’s first aid kit
- the SART
- hand-held radios
- flashlight
- the ship’s pyrotechnics.
Launching a life raft

The manual launching procedure is relatively simple:

- remove the securing strap on the cradle or ramp
- ensure that the painter line is securely made fast to a strong point on the ship
- make sure the water is clear over the side
- make sure the launching area is clear of any discharge outlets
- double-check that the painter line is firmly secured
- pull out a short length of the painter line
- double-check it is clear over the side
- throw the raft into the water or, in the case of a ramp/rack stowage, hinge down the ramp securing plate and allow the raft to roll into the sea
- once the canister has stopped rolling in the water, pull out the remaining painter line and firmly tug on it to fire the CO₂ gas bottle
- the life raft will inflate in about 60 seconds.

Boarding a life raft

Boarding a life raft from the water, without help, is difficult. You should attempt to board the life raft dry if possible. It may be possible to climb down a boarding ladder and enter the life raft that way. Alternatively, you may have to jump from the deck or the boarding ladder and try to land in the life raft entrance or on the canopy. This can be a very difficult procedure and may result in injury to yourself or others inside the life raft. It should only be attempted from a low height. The most common practice is to jump into the water as close as possible to the life raft and swim to the entrance. Once at the entrance, use the ladder to pull the top half of your body over the top chamber. Then drag yourself the rest of the way. Once in the raft, assist others to board.

Upturned life raft

It is not uncommon to find that the life raft, after inflation, will have ended up in the capsized position and will require turning to an upright position before boarding can commence. This can be done by climbing onto the bottom of the raft at the position of the gas cylinder, and standing with feet braced against the gas cylinder and with the righting line held firmly, lean back and use body weight to bring the raft into the right-side-up position. This process can be made easier by first facing the upturned raft into the wind.

However, if the canopy and inside of the life raft are full of water, it may need more than one person to carry out the above manoeuvre.
After a raft is boarded

One of the most important things to do at this point is to issue the *seasickness pills*. Seasickness is not only unpleasant but can cause dehydration which can become life threatening within days.

There are many signs and symptoms of dehydration but for those in a survival craft the most obvious ones include:

- thirst
- dry mouth
- dry tongue
- dry skin
- cracked lips
- dark-coloured urine
- decrease or absence of urine output
- fatigue and weakness
- dizziness
- increased confusion.

*Issue the seasickness medication.*

Because of floating debris, oil, and other dangers in the immediate vicinity of the ship, you should attempt to get the raft clear of the immediate area. Once clear of the danger zone, efforts should be made to keep the raft in the area where the ship was abandoned and the distress call was activated. A sea anchor should be streamed to assist in this consideration.

It is important to stay near the vessel after it has been abandoned for several reasons:

- if the vessel continues to remain afloat it may be possible to eventually reboard it.
- if it remains afloat, searching aircraft or vessels will be more likely to see a vessel than a person or life raft in the water.

Check for other survivors and survival craft. Activate the EPIRB, attend to the sick or injured, allocate duties, settle down and do not issue any food or water rations for the first 24 hours except to those who are sick or injured, or with special needs. Look for signs of hypothermia.
At this point it is important to develop a hierarchy and allocate duties. These include:

- make one or more persons responsible for attending to the sick and injured
- make one or more persons responsible for water and rations
- make one or more persons responsible for other items in the emergency pack
- make one or more persons responsible for maintaining the dryness and hygiene inside the raft
- form everyone into watches for lookout duties in addition to the above duties
- ensure everyone is given time for adequate rest, even if this is only to assist in reducing stress
- spread the duties evenly.

**Crash abandonment**

The other extreme to a ‘controlled abandonment’ is a sudden disaster with no time for preparation of self or survival craft, or even the giving of clear orders. This is the case of a rapidly sinking ship and ‘every person for themselves’ with the only choice of a means of escape being jumping directly into the sea.

**Incident**

On 25 August, 1969, the Australian coastal ship ‘Noongah’ (1465 gross tonnes) carrying a complement of 26 persons, foundered off Smoky Cape. There were only five survivors. The Court of Marine Inquiry revealed the final hour of the disaster as follows.

‘At about 0345 am the radio officer was called on duty and told to radio the ship’s position and seek assistance…at 0355 the man at the wheel was relieved and he went below to call all hands to standby. The SOS was sent at 0352, 0423, and 0437, the last one advising SOS Noongah ship being abandoned. Station closing. An ‘abandon ship’ whistle was sounded but before it finished the vessel went under. A wall of water came over the bridge, the vessel shuddered and went down by the head rapidly’.

If possible, in the event of a ‘crash abandonment’ you should prepare yourself as best you can and jump from the lowest deck possible and from the bow or stern so that you are immediately clear of the ship’s superstructure should the ship roll either way when sinking.

Swim clear of the ship to avoid downward eddies and buoyant objects that can break the surface as dangerous missiles. Look for life jackets and/or PFDs and life rafts that should have floated free, and be ready to get to them quickly before they drift or are blown away.
Jumping into the water

While you should always endeavour to enter the life raft in a controlled fashion and avoid getting wet, this is not always possible and the situation may arise when you will have to jump directly into the water. This can result in injury especially if your life jacket and/or PFD is not properly secured. The recommended technique is to:

- firmly secure your life jacket and/or PFD
- hold the top of the life jacket and/or PFD with one hand
- cross the other arm over this arm and use your hand to block off your nose and mouth
- check that it is clear below
- keep your feet together
- step off the platform on which you are standing (do not jump as this may cause you to overbalance and land awkwardly in the water).

Afloat in the water

While afloat in the water do not attempt to swim unless it is to get clear of the vessel or to reach a nearby survival craft or fellow survivor, or a floating platform on which you can support yourself. Unnecessary swimming will push out any warm water between your body and the layers of clothing, thereby increasing the rate of body heat loss.

Once in the water, and after getting clear of the vessel, it is most important to remain as still as possible in the water no matter how uncomfortable it may be. The body loses heat many times faster in water than in air, especially if you are moving vigorously.

HELP and HUDDLE techniques

One technique that can be used to assist in reducing the loss of body heat is the ‘Heat Escape Lessening Posture’ (HELP). It involves tucking your legs in front of you with your knees tight against your stomach. Your upper arms should be held tightly against your sides and the forearms folded against the front of your chest.

It may be necessary to relax this position from time to time as cramp may take hold but avoid treading water or swimming and avoid any ‘drown proofing’ postures that involve putting your head into or under the water as these actions will result in a rapid loss of body heat, mainly from the head.
If possible, form a group with other survivors in the water. Apart from there being safety in numbers, a group is more likely to be seen and more likely to maintain morale. By using this *huddle technique* it will also assist in slowing any loss of body heat.

*Figure 26: afloat in water – HELP technique*

*(Adapted with the permission of Captain John Lynch)*

*Figure 27: HUDDLE technique*

*(Adapted with the permission of Captain John Lynch)*
6 Self-test questions

The following questions are designed to allow you to check your understanding of survival.

1. What is the difference between a muster and a drill?

2. What fittings are there on a life jacket?

3. What information is shown on the container of a life raft?

4. What information is shown on the Emergency Muster List?

5. What does the ‘prepare to abandon ship’ signal consist of?

6. What is the purpose of a SART?

7. What action would you take on hearing the ‘prepare to abandon ship’ signal?
8. List at least six (6) items of emergency survival equipment to be carried.

________________________________________________________________________

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9. Where are life jackets/PFDs stowed?

________________________________________________________________________

10. What is the length of line to be secured to a standard lifebuoy?

________________________________________________________________________

11. What is the purpose of a hydrostatic release mechanism on a stowed life raft?

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________________________________________________________________________

12. List at least fifteen (15) items of equipment found in a life raft survival pack.

________________________________________________________________________

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________________________________________________________________________
13. What type of pyrotechnic would you use to attract the attention of a passing ship?

14. What type of pyrotechnic would you use to attract the attention of an overflying aircraft?

15. What do the signal flags \( \text{N} \) mean?

16. What does the ‘abandon ship’ signal consist of?

17. How do you right an upturned life raft?

18. What type of shipboard equipment can receive the signal from a SART?

19. What are at least four (4) threats to survivors at sea?
20. What is the difference between the effects of cold shock and hypothermia?


21. How would you prepare yourself for abandoning ship?


22. What type of things would you take into a survival craft if time permits?


23. How do you launch an inflatable life raft?


24. How do you jump into the water wearing a life jacket and/or PFD?


25. What is the use of the HELP and HUDDLE positions?


26. What are the objectives of mandatory shipboard emergency musters and drills?
27. What actions would you take on hearing the abandon ship signal?


28. What is the purpose of an EPIRB?


Remember: the granting of any certificate, is merely the first stage. You must then be able to demonstrate your continuing ability to do the job to the highest standard.
Useful websites

Australian Bureau of Meteorology  www.bom.gov.au
Australian Maritime Safety Authority  www.amsa.gov.au
Australian Transport Safety Bureau  www.atsb.com.au
Australasian Maritime Institute  www.ami.edu.au
Central West TAFE  www.centralwest.wa.edu.au
Challenger TAFE  www.challengertafe.wa.edu.au
Defence Maritime Services  www.defencemaritimeservices.com
Department for Planning & Infrastructure  www.dpi.wa.gov.au
Department of Planning and Infrastructure – Marine Safety – NT  www.marinesafety.nt.gov.au
Kimberley TAFE  www.kimberley.tafe.wa.edu.au
Marine and Safety Tasmania  www.mast.tas.gov.au
Marine Safety Queensland  www.msq.qld.gov.au
Marine Safety Victoria  www.marinesafety.vic.gov.au
National Marine Safety Committee Inc  www.nmsc.gov.au
NSW Maritime  www.maritime.nsw.gov.au
The Cancer Council Australia  www.cancer.org.au
West Australian Fishing Industry Council  www.wafic.com.au
WorkSafe Australia  www.worksafe.com.au
Other sites of interest

www.gcaptain.com
www.marinebuzz.com
www.mca.gov.uk
www.navis.gr
www.nepia.com
www.ukpandi.com

Acronyms

AMSA  Australian Maritime Safety Authority
ATSB  Australian Transport Safety Bureau
AUSREP  Australian Ship Reporting (System)
AUSSAR  Australian Search and Rescue (System)
BOM  Bureau of Meteorology
COXSWAIN  Certificate of Competency
DMS  Defence Maritime Services
DPI  Department for Planning and Infrastructure
EPIRB  Emergency Position Indicating Radio Beacon
ESS  Elements of Shipboard Safety (a course)
FLIR  Forward Looking Infra Red
FPFF  Fire Prevention and Fire Fighting (a course)
GBR  Great Barrier Reef
GBRNP  Great Barrier Reef National Park
Glossary of terms

**Abandon ship**
To abandon ship is to leave the vessel, usually in an emergency situation after all efforts to save the vessel or keep it afloat have been exhausted and it is time to launch the survival craft or directly enter the water, depending on the situation. The decision to order the ship to be abandoned can only be given by the skipper/master of the vessel or in the event of his/her incapacity, by the senior surviving officer.

**Abandon ship signal**
A signal that is made in an emergency and given in the most effective manner to indicate to everyone on board that the ship is now to be abandoned and gives authority to those in charge of survival craft to launch them as soon as they are ready. The signal is defined by the skipper/master and stated on each of the muster lists that are located throughout the vessel. This order and signal can only be given by the skipper/master of the vessel, or the senior surviving officer.

**Acute fatigue**
Fatigue is the state of feeling very tired, weary or sleepy resulting from insufficient sleep, prolonged mental or physical work, or extended periods of stress or anxiety. Boring or repetitive tasks can intensify feelings of fatigue. Acute fatigue results from short-term sleep loss or from short periods of heavy physical or mental work. The effects of acute fatigue are usually of short duration and can usually be reversed by adequate sleep and relaxation.

**AMSA**
The Australian Maritime Safety Authority (AMSA) is an agency of the Australian Commonwealth Government whose charter it is to promote and enhance safety in the Australian maritime industry, including protection of the marine environment and search and rescue.

**ATSB**
The Australian Transport Safety Bureau (ATSB) is an independent agency within the Australian Commonwealth Government whose role and function is to contribute to safety within all areas of transport by independently investigating, analysing and openly reporting on transport safety matters. Within the ATSB is a unit dedicated to maritime safety. This is the Marine Investigation Unit (MIU) and its role and function is to investigate and report on the circumstances and causes of accidents in the maritime industry.
**Australian Standards**

A standard is a published document which sets out specifications and procedures designed to ensure that a material, product, method or service is fit for the purpose it is to be used for and that it consistently performs to the way in which it was intended. Australian Standards are developed by a vast number of technical committees to produce a document for a specific item or service, setting out all of the parameters that relate to the safety and safe use of that item or service.

**Backdraught**

It is defined as being an ‘explosive surge of fire produced by the sudden mixing of air with other combustible materials’. Some materials such as plastics and other synthetics do not burn cleanly but generate a lot of smoke and unburnt material, most of which gathers at ceiling level in a room or compartment. If a door to the room or compartment is opened to allow entry for the firefighting team, this could cause a rapid ignition of the material creating a wave of flame that explodes outwards from the fire space, not only endangering the lives of the firefighting team but also rapidly spreading the fire.

**Bailer**

This is an item of equipment that is carried in the survival craft emergency pack, primarily for the use of removing water from within the survival craft. It is inevitable that when entering a survival craft in an emergency, considerable quantities of water will be brought in with each survivor. It is vital that the survival craft be dried out as quickly as possible, especially in cold weather. The primary means of removing the water is by using the bailer. The bailer also has other potential uses such as catching and storing fresh water from rain and for holding and disposing of human waste. The survival craft bailer must be buoyant.

**Ballast tank**

A compartment on a vessel that is used to hold water and can be filled and emptied in order to adjust and manage the condition and behaviour of the vessel, such as its draft, freeboard, trim, list and stability. Most vessels have several ballast tanks for this purpose. Some vessels also use ballast tanks to hold low-grade liquid cargoes.

**Beaching**

Beaching is a method of intentionally running a vessel ashore or aground, usually to prevent it from sinking, although some craft (landing barges) are meant to be beached as part of their normal operations, such as loading and discharging mobile cargo. Much preparation and many precautions have to be put in place before beaching and when getting off the beach.
**Bellows pump**

This is a small, manually operated pump that is a part of the equipment found in a life raft emergency equipment pack. While a life raft is supposed to fully inflate via its gas bottle at launching, things sometimes go wrong and full inflation does not result, requiring the flotation chambers to be topped up using the bellows pump. However, it is more likely that the most likely use of the bellows pump is to top up the flotation chamber due to slow leaks that may have developed during or after entering the life raft. It is also most likely to be used for inflating the floor of the raft to compensate for temperature differences between day and night. It is also worth remembering that life rafts breathe. If the temperature is high during the day, the sun’s rays combine to heat the gas in the chambers causing some of the gas to be released via the life raft relief valve. Then, when it cools in the night, the gas compresses causing the flotation chambers to be left less than fully inflated and soft. The pump is then used to top up the chambers until fully inflated.

**Bilge**

The bilge is a gutter arrangement running longitudinally along the lowest part on both sides of the inside of a vessel. A bilge is always located on each side of the engine room space as an area where waste liquids can accumulate so as to be pumped out and over the side. The engine room bilge must be fitted with a bilge level alarm to warn when the contents of the bilge have reached a critical level. Care has to be taken when the contents of the bilge includes an oily water mixture.

**Boilover**

One of the hazards of using water on a burning oil fire is ‘boilover’, which is the expulsion of the burning liquid from the open top of a tank (or even a saucepan) in a full surface fire. The cause of boilover is the transfer of heat from the burning liquid to the cooler layer of water below. As the ‘hot zone’ moves down through the liquid and reaches the water, the water will start to boil vigorously causing a sudden overflow of the burning liquid at the surface. This can have a disastrous effect, endangering firefighters and spreading the fire.

**Boundary cooling**

Boundary cooling means surrounding the fire and spraying water on all six sides, cooling the heat content, thus reducing its effects. Surrounding a fire from all six sides is the most effective way of controlling it rather than attacking it from one side only, which only has the effect of pushing it from one area to another.

**Boundary starvation**

The spread of a fire through a vessel will depend in part on the amount of continuous draughts of oxygen travelling throughout the vessel. By closing all mechanical ventilation the oxygen supply will be effectively reduced, starving the fire and reducing its spread.
Breathing apparatus

Breathing apparatus is an item of the equipment used by a firefighter when required to enter areas that may be filled with smoke or other hazardous gases. It can also be used for entering a confined space. It is made up of a tank or cylinder containing compressed air, a mask that covers the whole face, a gauge to indicate the amount of pressure in the tank/cylinder and a warning alarm to indicate when the pressure in the tank/cylinder has reached a low level.

Brow gangway

A narrow horizontal bridge with handrails and a cleated surface to prevent slipping. It is used when a vessel is moored to a wharf or alongside another vessel where the two levels are at nearly the same height.

Carbon dioxide

Carbon Dioxide (CO₂) is an odourless, colourless gas, mainly found in the air but becomes highly dangerous when released in a confined or unventilated space where it can lower the concentration of oxygen to a level that can be fatal to humans.

Carbon monoxide

Carbon Monoxide (CO) is an odourless, colourless and toxic gas that is found in the fumes from generators and other gasoline-powered equipment, among other things. Because it cannot be seen, tasted or smelt the fumes can kill before the person even becomes aware that he/she is being affected by it. If these fumes enter a confined space, the level can build up very quickly and be rapidly overpowering.

Chemi-luminescent light

A ‘light-stick’ found in the survival craft emergency pack. It works on the interaction of two chemicals to produce light rather than by using a heat source. To activate the light source, the light stick has to be shaken and then bent but not broken in half. The two chemicals inter-react and a yellow/greenish light is produced, sufficient to read with.

Cold shock

This is the body’s reaction to the shock of cold water that can trigger involuntary rapid breathing that can result in water being inhaled. It also causes the blood capillaries under the skin to suddenly constrict resulting in a sudden and rapid rise in blood pressure and heart rate. Both of these can cause unconsciousness and cardiac arrest.

Collision

A structural impact between two ships or one ship and some other object, such as a wharf, pier or bridge, etc. Ship collisions are extremely serious as they can result in loss of life or property and damage to the marine environment.

Combustion

The process of burning.

Conduction

The transfer of heat (thermal energy) from a region of higher temperature to one of lower temperature, through a medium in direct physical contact with both sources of temperature, such as a ship bulkhead between compartments.
Confined spaces Working in a confined space is potentially one of the most dangerous of all workplace hazards. Over the years, many seafarers and other maritime workers have lost their lives or suffered serious harm and debilitating sickness as a result of working in shipboard tanks and other shipboard confined spaces.

Convection As a heat source becomes less dense it rises, transferring the heat in convection current. A shipboard fire can be easily spread across several decks through this process.

Damage control Survivability is defined as the capacity of a vessel to absorb damage but still maintain its watertight integrity. Damage control means actions that need to be taken to effect temporary repairs sufficient for the vessel to reach safety. Shipboard drills in damage control are carried out at regular intervals on board ships.

Danger tags Tags can be attached to plant or equipment in the workplace as a warning that they cannot be operated. Danger tags are used to control risks from situations where equipment is undergoing maintenance, is under repair or is being tested. Their purpose in these situations is to ensure that the equipment is not operated so that lives are not endangered and/or the item of equipment damaged.

Dehydration An excessive loss of water from the body. In a survival situation such as a period of time in a survival craft where only limited amounts of fresh water are rationed and the body is exposed to weather conditions, especially extreme temperatures, this condition can become life threatening.

Dewatering Dewatering means using systems that will enable loose water to be drained or pumped out of internal ship spaces. When loose water is present inside a vessel, such as in an emergency firefighting situation where many fire hoses are being sprayed on the fire, the accumulation of loose water, unless controlled and quickly removed will affect the stability and trim of the vessel and may even lead to its unintentional capsize.

Emergency drill An emergency drill is an emergency and evacuation exercise. In the event of a shipboard emergency whether at sea or in port, the primary importance is that all crew and passengers (if carried) are evacuated, calmly, safely and efficiently. The drill is designed to test and evaluate the crew and passenger response. It also ensures that all crew are aware of how to respond, their duties and responsibilities, and how to operate the emergency equipment.

Emergency fire pump An independently driven pump that is located external to the engine room and from which a fire hose can be pressurised and used for shipboard firefighting in an emergency.
**Emergency signals**

Shipboard emergency signals are used to communicate alerts to crew and passengers. These signals, when made by sound signal (ship’s whistle and internal bells), are commonly used to indicate emergency, prepare to abandon ship, and abandon ship. Other emergency signals when made over the marine band radio network are more commonly used to announce mayday, urgency, and safety.

**Emergency stations list**

An emergency station and duty must be allocated to all crew members. This information is presented on a formal emergency stations list that is then permanently exhibited at suitable conspicuous locations throughout the ship, including the wheelhouse and accommodation.

**Entry permit**

This is a written or pro-forma printed document that is completed by a responsible supervisor (the ship’s master, chief engineer, or supervising deck or engineer officer) to allow and control entry into a space. Entry permits are records which certify that specific precautions and procedures have been established before any person is allowed to enter a controlled space (confined space, enclosed space, restricted space, etc). It provides a systematic method of verifying that all necessary checks on safety, atmosphere, hazards, risks and all safety equipment and clothing (including breathing apparatus and intrinsically safe lights or lighting) are in place. Under all circumstances when an entry permit is in force there must be a person on standby at the point of entry.

**EPIRB**

An emergency distress-alerting beacon that can be activated either manually or automatically. Once activated it transmits a distress signal to a worldwide network of satellites. The signal is then relayed back to ground stations where it is sent to a national search and rescue centre for analysis and commencement of search and rescue operations.

**Fire blanket**

This is an item of shipboard firefighting equipment usually found in the galley and mess room. It is basically a sheet of fire-resistant materials that can be used rapidly to cover a small fire, particularly one involving burning fat or oil in a pan, or it can also be used to wrap around a person whose clothing is on fire. In both cases, the desired result and purpose of the fire blanket is to cut off the source of oxygen supply to the fire.

**Fire watch**

After a fire has been extinguished there is always the danger of re-ignition, or the fire may have spread to another area and is still yet undetected. A fire watch is a duty routine to cover all areas of the ship as a way of establishing that the fire is no longer a danger. A fire watch may also be initiated after a false fire alarm has activated but without any cause being determined.

**FLIR**

Forward Looking Infra Red (FLIR) is a device that detects infrared (IR) radiation. It is mainly used in search and rescue (S&R) operations where it can detect warm objects (humans in a survival craft) against a cold background (water).
**Flooding**

Flooding is when, through whatever reason (collision damage or leaking), water enters the internal compartments of a vessel. It is extremely dangerous and could result in the vessel capsizing and sinking if it is not stopped and pumped out.

**Hypothermia**

It is a condition where the body becomes dangerously cold. It can be caused by a brief exposure to extreme cold or prolonged exposure to mild cold. It develops in stages, with each stage becoming progressively more damaging to the body and its organs. Untreated hypothermia, especially in the later stages, is very serious and can and usually does result in death.

**IMO**

The International Maritime Organisation (IMO) is a specialised agency of the United Nations (UN). Its main task is to develop and maintain a comprehensive regulatory framework for shipping worldwide. Its overall remit to the maritime industry includes safety, legal matters, matters of environmental protection, technical co-operation, maritime security and the general efficiency and safety of the maritime industry.

**Integrated rating**

Historically, in the Australian Merchant Marine seagoing ratings (seamen) were divided into two distinct categories, with each belonging to a separate department (deck and engine room). In recent years those two roles have been integrated with all ratings now being involved in the work associated with both deck and engine room.

**Lockout system**

This is a system that uses a lock or multiple locks to render an item of machinery or equipment inoperable or to isolate an energy source so that it can be safely worked on. The purpose of the latter of the two is to establish a total ‘zero energy’. This is where all sources of energy including electrical, pneumatic, hydraulic, mechanical and stored energy are totally isolated so that they pose no danger to persons working on or around the machinery or equipment being worked on.

**Marine Orders**

A body of delegated legislation made in Australia by the AMSA pursuant to the Navigation Act

**Marine radio**

A marine radio transceiver is a vital item of safety equipment to be carried on board a vessel. It enables the users to receive important navigation and weather warnings while also enabling contact with shore stations and vessels close by. It is used for general communications as well as in an emergency and during search and rescue operations. It uses rechargeable batteries that can be charged and discharged many times. To be able to legally operate a marine radio the operator must hold the appropriate qualification, either a Marine Radio Operators Certificate of Proficiency (MROCP) or a Marine Radio Operators VHF Certificate of Proficiency (MROVHFCP).

**Master**

The legal title accorded to the captain of a ship. The term Captain is used as courtesy title, not a legal term.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSDS</td>
<td>Materials Safety Data Sheet (MSDS) is an important document containing important information about hazardous substances. It provides employers, employees, and others with the necessary information needed to safely manage the risks of hazardous substances. All products whether classified as hazardous or not must be accompanied by a MSDS.</td>
</tr>
<tr>
<td>Muster point</td>
<td>A known location on board a vessel where persons are to gather in the event of an emergency situation.</td>
</tr>
<tr>
<td>NMSC</td>
<td>The National Marine Safety Committee (NMSC) is an Australian inter-governmental (Commonwealth, States and Territories) agency that works to produce guidelines and standards designed to achieve uniform safety legislation and procedures for the whole of the maritime industry in Australia.</td>
</tr>
<tr>
<td>Out of Service tag</td>
<td>The use of tags in the workplace is to serve as a warning that the plant or equipment to which the tag is attached cannot be operated. Out of Service tags are placed on plant or equipment that is out of service for repair, alteration, commissioning or decommissioning.</td>
</tr>
<tr>
<td>Painter line</td>
<td>A line that is used to activate the gas bottle on a life raft and to hold the life raft in position near the vessel for it to be boarded in an emergency situation. The same type of line is used on a lifeboat but only to hold it alongside the vessel for boarding on abandonment (a lifeboat is not inflated by a gas bottle as is a life raft).</td>
</tr>
<tr>
<td>Penal provisions</td>
<td>Penalties applied for a breach of the law.</td>
</tr>
<tr>
<td>Recoil zone</td>
<td>This term is usually applied to the use of mooring lines and refers to the areas where a mooring line under strain would pose a danger should the line break and 'snapback' with extreme force.</td>
</tr>
<tr>
<td>SART</td>
<td>Search and Rescue Transponder (SART) is a battery-operated locating device that is activated once in the survival craft after abandonment of the ship. It transmits a signal that can be received on radar (3 cm radar) and shows the location of the survival craft to the radar observer.</td>
</tr>
<tr>
<td>SAS Manual</td>
<td>Survival at Sea Manual (SAS Manual) is a handbook of procedures that are designed to assist survivors in a survival craft while awaiting rescue.</td>
</tr>
<tr>
<td>Sea anchor</td>
<td>An item of emergency equipment that is designed to hold the survival craft into the sea (waves) and to maintain its position relative to the sinking vessel. It also acts to reduce the drift of the survival craft so that it does not move too far away from the area of distress, in this way serving to assist the search and rescue vessels or aircraft.</td>
</tr>
</tbody>
</table>
**Seasickness**

A form of motion sickness caused by the movement of a vessel on the water. It is characterised by nausea and can also result in feelings of vertigo (giddiness). It can range from mild to severe, and in most cases is debilitating. It can be dangerous if constant vomiting causes dehydration.

**Skipper**

The same as the ship's master but usually associated with small vessels, especially with fishing vessels, rather than large commercial trading vessels.

**SOLAS**

The Safety of Life at Sea (SOLAS) Convention is one of the most important international treaties relating to the safety of merchant ships.

**Watertight integrity**

A vessel is designed and constructed in such a way that the outer shell of the vessel acts as a skin preventing water from entering the internal areas of the vessel. But ships are also designed to be functionally operational such as carrying cargo or catching and storing seafood products. The result is that necessary ‘holes’ are built into the structure of vessels such as cargo holds, portholes, stern and side opening doors and stern tubes for the propeller shaft. All of these openings must be structurally sealed so that the vessel can function but still prevent water from entering the ship. A ship is also compartmentalised into watertight sections, sealed by watertight doors as a further contribution to assisting in maintaining the watertight integrity of the vessel should it be damaged.

**Working aloft**

All vessels have some external structures such as masts, radar towers, funnels, and even cargo that will at some time require a crewperson to climb. This is what ‘working aloft’ means – having to climb some external structure that requires the person to reach an exposed elevated position above the deck level. When working aloft, it is essential that properly deployed safety measures and procedures are constantly observed. This mainly means using a suitable, approved safety harness and having a responsible person in attendance. A responsible person should also be advised of the work situation to be undertaken and an official ‘permit to work’ completed.
# Index

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act</td>
<td>2, 44, 68</td>
</tr>
<tr>
<td>Aloft</td>
<td>7, 16</td>
</tr>
<tr>
<td>Australian Standards</td>
<td>26</td>
</tr>
<tr>
<td>Backdraught</td>
<td>50</td>
</tr>
<tr>
<td>Batteries</td>
<td>15, 77</td>
</tr>
<tr>
<td>Berthing</td>
<td>14</td>
</tr>
<tr>
<td>Boilerover</td>
<td>50</td>
</tr>
<tr>
<td>Breathing Apparatus</td>
<td>9, 56</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>22, 23, 52, 54</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>22, 23, 57</td>
</tr>
<tr>
<td>Cement Box</td>
<td>39, 40</td>
</tr>
<tr>
<td>Checklist</td>
<td>6, 11, 24</td>
</tr>
<tr>
<td>Chemical Reaction</td>
<td>45, 47, 53</td>
</tr>
<tr>
<td>Chemicals</td>
<td>8, 10, 18, 20, 40, 49</td>
</tr>
<tr>
<td>Chemistry of Fire</td>
<td>45</td>
</tr>
<tr>
<td>Classes of Fire</td>
<td>51</td>
</tr>
<tr>
<td>Code of Practice</td>
<td>3</td>
</tr>
<tr>
<td>Cold Shock</td>
<td>85, 86</td>
</tr>
<tr>
<td>Communications</td>
<td>11, 59</td>
</tr>
<tr>
<td>Conduction</td>
<td>50</td>
</tr>
<tr>
<td>Confined Space</td>
<td>21, 22, 24, 25, 36</td>
</tr>
<tr>
<td>Convection</td>
<td>50</td>
</tr>
<tr>
<td>Crash Abandonment</td>
<td>90</td>
</tr>
<tr>
<td>Damage Control</td>
<td>39, 40</td>
</tr>
<tr>
<td>Danger Tags</td>
<td>20</td>
</tr>
<tr>
<td>Dehydration</td>
<td>86, 87, 89</td>
</tr>
<tr>
<td>Dewatering</td>
<td>60, 61</td>
</tr>
<tr>
<td>Duty of Care</td>
<td>4</td>
</tr>
<tr>
<td>Emergency Equipment Pack</td>
<td>74, 75</td>
</tr>
<tr>
<td>Emergency Fire Pump</td>
<td>55</td>
</tr>
<tr>
<td>Entry Permit</td>
<td>22, 23, 24</td>
</tr>
<tr>
<td>EPIRB</td>
<td>38, 67, 70, 75, 82, 89</td>
</tr>
<tr>
<td>Explosion</td>
<td>8, 15, 23, 36, 38, 46, 49, 50, 67</td>
</tr>
<tr>
<td>Exposure</td>
<td>6, 8, 15, 18, 19, 20, 23, 61, 74, 78, 85</td>
</tr>
<tr>
<td>Fatigue</td>
<td>6, 68, 89</td>
</tr>
<tr>
<td>Fire Blanket</td>
<td>49, 56</td>
</tr>
<tr>
<td>Fire Prevention</td>
<td>46, 47</td>
</tr>
<tr>
<td>Fire Tetrahedron</td>
<td>45, 46</td>
</tr>
<tr>
<td>Flashover</td>
<td>50</td>
</tr>
<tr>
<td>FLIR</td>
<td>80</td>
</tr>
</tbody>
</table>
Heat Escape Lessening Position (HELP) ................................................................. 91
Hot Work ........................................................................................................ 26, 27
Hydrogen Gas ................................................................................................. 15
Hydrostatic Release Mechanism ................................................................. 72, 73
Hypothermia ................................................................................................ 85, 86, 89
Induction ........................................................................................................ 6, 7, 44
Job Safety Analysis (JSA) ............................................................................. 10, 11, 23
Ladders ........................................................................................................... 15
Life jacket ....................................................................................................... 70, 71, 87, 90, 91
Line Throwing Apparatus ............................................................................. 81
LPG ............................................................................................................... 17, 45, 51
Marine Environment ..................................................................................... 15, 17, 40
Master ........................................................................................................ 2, 7, 13, 16, 22, 24, 25, 26, 28, 37, 58, 69, 70, 85
Materials Safety Data Sheet ........................................................................ 19
Mooring Lines ............................................................................................... 14
National Plan .................................................................................................. 40
Out of Service Tags ........................................................................................ 21
Personal Flotation Device (PFD) ................................................................. 1, 8, 70, 71, 87, 90, 91
Personal Protective Equipment ................................................................. 8, 9
Portable Fire Extinguishers ....................................................................... 48, 52, 54
Prohibition Notice .......................................................................................... 5
Provisional Improvement Notice (PIN) ..................................................... 5
Pyrotechnics ................................................................................................. 70, 79, 87
Radiation ...................................................................................................... 50
RECEO ........................................................................................................... 61
Regulation .................................................................................................... 2, 5, 44, 68
Search and Rescue Transponder (SART) ............................................... 70, 76, 82, 83, 87
Seasickness .................................................................................................. 75, 77, 87, 89
Shoring ......................................................................................................... 39
Signal Flags ................................................................................................ 81
Survival Craft ............................................................................................... 2, 68, 69, 72, 76, 77, 80–91
Vapour ........................................................................................................... 7, 9, 17, 26, 50
Very High Frequency (VHF) .................................................................... 70, 82, 83
Workplace .................................................................................................. 3, 4, 5, 7, 9, 10, 11, 13, 19, 22, 24, 27, 28, 32
ELEMENTS OF SHIPBOARD SAFETY

Learner’s Guide

DESCRIPTION
This Learner’s Guide relates to a variety of qualifications from the TDM07 Training Package. It is intended for learners working towards the Elements of Shipboard Safety Certificate. The guide is designed for learners undertaking any combination of the Units of Competency listed below.

CATEGORY
Maritime Studies

TRAINING PACKAGE
TDM07 – Maritime Training Package

UNITS OF COMPETENCY
• TDMMF1107B Survive at sea in the event of vessel abandonment
• TDMMF5407A Observe safety and emergency procedures on a coastal vessel
• TDMMF5507A Fight and extinguish fires on board a coastal vessel
• SFISHIP212B Take emergency action on board a vessel
• SFICORE106A Meet workplace OHS requirements

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