Session 1
08:00 – 08:30
This area is a TRAINING ENVIRONMENT and therefore comes with risks!

Please be aware that you will come into contact with:
• Stairs
• Water
• Darkness
• Training equipment
• Other hazards!

This is an essential part of your training with us.

If you have ANY concerns, please see your instructor immediately!
Introduction

- Course Register
- All fit and well to take part
- Phones
- Safety
- Fire
- Toilets
- Refreshments
- Smoking
Safety Brief

- All Fit & Well?
- Injuries
- First Aid
- Assembly Point
- Jewellery
- Smoking

- Fire Kit
- Fire Unit
- Mess Area
Course Aims

- To provide training to IMO STCW standards Table A-VI/1. Section A-VI/1-2

**Fire Prevention & Firefighting**

- To enable delegates to work safely as part of a vessel’s firefighting crew
IMO STCW FP & FF Outcomes

The Learner:

- Understands and can minimize the risk of fire on board.  
  **OUTCOME 1**

- Knows the on board equipment, procedures and personal safety requirements in fire situations.  
  **OUTCOME 2**

- Is able to fight and extinguish fires.  
  **OUTCOME 3**
Course Objectives

At the end of this presentation you will be able to:

- Identify dangers of fire on board
- Identify good housekeeping principles
- Explain the conditions required for fires to start
- Describe how fire spreads and how to prevent it
- Describe flammability of materials
- Explain the classes of fire and correct extinguishing medium
- Describe methods used to extinguish fire
Course Objectives

At the end of this presentation you will be able to:

- Describe the basic principles of survival and personal safety on board
- Describe typical shipboard design features and equipment
- Identify fire and smoke detection systems and how they work
- Identify typical fixed firefighting systems
- Describe typical shipboard firefighting organisation
- Describe firefighting team organisation
IMO Guidance

ISM Code
INTERNATIONAL SAFETY MANAGEMENT CODE
with guidelines for its implementation
2014 EDITION

2015 edition – Amendment 1, October 2016
Session 2
08:30 – 09.30
Ship Fires

vessels sometimes have fires:
- Some small
- Some big
- Some catastrophic
- Danger to life
  - MCA & MAIB investigate and report
MAIB Fire Reports

- 2015 Arco Avon
- 2013 Cleopatra
- 2013 Corona Seaways
- 2013 Celtic carrier
- 2010 Yeoman Bontrup
- 2010 Carnival Splendor
MAIB Reports

Student Research & presentations

- 2015 Arco Avon
- 2013 Cleopatra
- 2013 Corona Seaways
- 2013 Celtic carrier
- 2010 Yeoman Bontrup
- 2010 Carnival Splendor
Arco Avon (Dredger)

- 18 August 2015
- 3rd Engineer mending fuel pipe under pressure
- Portable angle grinder
- Fire
- 3rd Engineer badly burned
- CO₂ activated
- 3rd Engineer died
29 September 2013
Sightseeing tour on the River Thames
28 passengers and 2 crew were forced to abandon the vehicle/Vessel
Recovered from the water without serious injury
4 December 2013

Fire on main deck of the ro-ro

On passage from Fredericia to Copenhagen

Crew established boundary cooling

Operated fixed CO\textsubscript{2} system

CO\textsubscript{2} was effective in controlling fire
Celtic Carrier

- 26 April 2013 fire in a crew cabin
- On passage from Gibraltar to Belfast
- Crew member consuming alcohol and smoking in bed
- Lit cigarette ignited foam seating
- Crew member discovered the fire and informed second officer
- Crew mustered and then attempted to contain and fight the fire
- Not extinguished until assisted by two fire-fighting teams from a Spanish ship
2 July 2010 major fire and explosion
Self-unloading (SUL) bulk carrier
Hot work on discharge hopper
Fire spread rapidly
Attempts made to extinguish fire, spread to the adjacent engine room
Crew evacuated ship
The fire spread into the steering gear compartment
Contained a wide variety of ship’s-use chemicals
Violent explosion followed tore the poop deck from the ship
Carnival Splendor
Carnival Splendor
Star Princess

- 23 March 2006
- On passage from Grand Cayman to Montego Bay
- 2690 passengers and 1123 crew
- Fire started on an external stateroom balcony on deck 10
- Caused by a discarded cigarette
- Spread rapidly along adjacent balconies and up to decks 11 & 12
- One passenger died as a result of smoke inhalation and 13 others were treated for the effects of the smoke
Common Factor?
Human Error!!!
SHIP SHAPE AND BRISTOL FASHION
Causes of Fire

• All Areas
  – Cargo/Stores - Cargo – Certain cargos can be dangerous under different conditions. Strict attention must be paid to packaging – Leaking or damaged packaging can allow cargo to leak or spill with potential to react with other cargoes
  – Paint – Static build up can cause ignition of solvents when pouring.

• The Galley
  – Extract Hoods - Layers of grease can build up
  – Cooking Oil Fire - Overheated oil can auto ignite
  – Inattention - Ovens left on, cloths left on a hot plate
  – Electrical
    • Paint - Static build up can cause ignition of solvents when pouring.
Fire Prevention

What can you do to prevent a fire occurring?
Maintenance

- Maintenance schedule
- Check electrical systems
- Check fuel systems
- Extinguishers
- Fire detection
- Report faults and ensure they are rectified
- Stow equipment safely
Inspection

- Protect sources of heat
- Exhaust pipes
- Galley ranges
- Motors

Look for dangers
  - Overloaded power points
  - Oily rags in corners
  - Gas fittings tight
Proper Stowage

- Flammables
- Paints
- COSHH/MSDS
- Gas cylinders
- Tools
Triangle of Fire

- Chemical reaction between a combustible substance and oxygen giving off heat and light
Triangle of Fire

- Remove the fuel
Triangle of Fire

- Remove the **oxygen**
Triangle of Fire

- Remove the heat

LO 1.6
How Fires Start

Three ways to start a fire

- A source of ignition
  - a flame
  - spark
  - electrical (short circuit)

- Heating a flammable liquid above its Self Ignition Temperature (SIT)

- Spontaneous Combustion
Sources of Heat

- **Physical**
  - electrical/mechanical

- **Chemical**
  - chemical reaction

- **Biological**
  - organic bacteria
Flammable Liquids

- Flash Point
- Ignition Point
- Auto-Ignition / Self-Ignition Point
Flash Point

- Lowest temperature at which a spark or flame will ignite fuel vapours
- Flashpoint below 61°C (flammable)
- Flashpoint greater than 61°C (combustible)
- Hazard increases as the flashpoint decreases
Ignition (Fire) Point

- Lowest temperature a spark or flame will ignite vapours
- Continues to burn
- Produces vapours at a greater rate as the liquid heats up
Auto Ignition Temperature (Self Ignition)

- The lowest temperature at which it ignites without the application of a flame or other means of ignition
  e.g. a fat pan fire, oil spilling onto a hot exhaust
## Common ranges

<table>
<thead>
<tr>
<th>Common Combustible Gas LEL's and UEL's</th>
<th>LEL</th>
<th>UEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>2.15%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Acetylene</td>
<td>2.5%</td>
<td>100%</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.2%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Butadiene</td>
<td>1.1%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Ethane</td>
<td>3.0%</td>
<td>15.5%</td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>3.3%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Ethyl Ether</td>
<td>1.7%</td>
<td>36.0%</td>
</tr>
<tr>
<td>Ethylene</td>
<td>2.7%</td>
<td>36.0%</td>
</tr>
<tr>
<td>Hexane</td>
<td>1.1%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>4.0%</td>
<td>75.6%</td>
</tr>
<tr>
<td>IsoButane</td>
<td>1.8%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Isopropyl Alcohol (IPA)</td>
<td>2.0%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Methane</td>
<td>5.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Methanol</td>
<td>6.0%</td>
<td>36.0%</td>
</tr>
<tr>
<td>Pentane</td>
<td>1.5%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Propylene</td>
<td>2.0%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.2%</td>
<td>7.0%</td>
</tr>
</tbody>
</table>
## Comparison of Liquids

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Flashpoint</th>
<th>Auto Ignition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>- 30°C</td>
<td>600°C</td>
</tr>
<tr>
<td>Diesel</td>
<td>100°C</td>
<td>320°C</td>
</tr>
<tr>
<td>Lube Oil</td>
<td>210°C</td>
<td>260°C</td>
</tr>
<tr>
<td>Cooking Oil</td>
<td>315°C</td>
<td>330 - 360°C</td>
</tr>
</tbody>
</table>
Flammable Range (Gases)

- Mixture of Fuel & Oxygen
- Lower Flammable Limit
- Upper Flammable Limit
- Propane 2% - 10%
- Fuel Oil 0.7% - 5%
- Diesel 0.6% - 7.5%
- Acetylene 2.5% - 100%
Break
Session
09:45 – 10.45
Fire Development Curve

- Flashover
- Fully Developed
- Backdraft

Heat

Time

LO 1.5, 6, 7 & LO 3.1, 6
Flashovers & Backdraft

- Flashover

- Backdraft
How does fire spread?

Heat is passed from one object to another by various methods:

- Radiation
- Convection
- Conduction
Fire Growth & Fire Spread
Actions in a Fire Emergency

**F** ind Locate & Identify the fire

**I** nform The bridge & raise the alarm

**R** estrict Close vents/dampers/fuel lines

**E** xtinguish or Escape or Evacuate
Shipboard Fire Signs

LO 2.1
Extinguishing Fires
Classes of Fire (Fuel)

- There are various types of fuel:
  - Class A - Solids
  - Class B - Liquids
  - Class C - Gasses
  - Class D - Metals
  - Class F - Fats

- Different fuels have different extinguishing methods
- Solids
- Extinguishing medium?
  - Water
  - Foam
  - Dry Powder
- Hazards?
  - Products of combustion
  - Steam
  - Liable to re-ignite

*How does each extinguisher work?*
- Liquids or Liquefiable solids
- Extinguishing medium?
- Foam
- Dry Powder
- CO$_2$
- Hazards?
- Reduced visibility
- Products of combustion
- Foam applied incorrectly may result in a “Boil-over”
- Gases or liquefiable gases
  - Butane
  - Propane
  - Hydrogen
- Extinguishing medium?
- Isolate the supply
- Dry Powder
- High levels of radiated heat
- Possibilities of a “BLEVE”

(Boiling Liquid Expanding Vapour Explosion)
- Metals
- Reactive metals such as:
  - Aluminium
  - Magnesium
- Ending in “ium”
- Extinguishing medium?
- Specialist Dry Powder
- Hazards?
- Explosive in contact with water
- Chemicals react with heat
- Creates crust
- Porridge like consistency
- “Saponification”
- Permeates fat

‘Fry Fighter’
Electrical Fires

- There is no Class “E”
- Electricity is only the source of energy
- Turn off power
- Deal with type of fire involved
- In enclosed cabinet use CO₂ extinguisher
Fire Blanket

LO 3.4, 7
Extinguisher Colour Codes

- WATER
- FOAM
- DRY POWDER
- CO2
- WET CHEMICAL
- M2/M2 POWDER
<table>
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<tr>
<td>FOAM</td>
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<td>X</td>
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<td>✓</td>
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<tr>
<td>DRY POWDER</td>
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<td>X</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>WET CHEMICAL</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>MWL3 POWDER</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
</tbody>
</table>
Shipboard Fire Signs

LO 3.4
Fixed Installations

- Equipment required to be installed in a ship or incorporated in its design to either detect a fire, attack a fire, or to prevent fire spread.

- Detailed in:
  - SOLAS (Fire Appliance Regulations)
  - IMO Fire Safety Systems Code (FSS Code)
  - Merchant Shipping (Fire Regulations) 2008 & (SI 2008 No.2924)
  - LY3 (Large Yacht Code)

LO 2.2,3,5
Automatic Fire Detection

- Prevent or minimise the risk from fire
- The main types are
  - Smoke
  - Heat
  - Flame
- Type fitted depends on risk
- Most vessels are zoned
- Be familiar with your Alarm System
- Know the fire alarm sound
Detectors

- Single Point
- Smoke
- Heat
- Flame
Fixed fire fighting systems

- Many vessels have fixed fire fighting systems

- Common fixed systems
  - Sprinklers
  - Water Mist/High Fog Water Mist
  - High expansion foam
  - CO₂
  - Other Inert gasses
Fire Main

- Fire pump (Main) & emergency pump outside Machinery space
- Isolation valve for main machinery space
- Hydrants
- Number and position so that two jets from different hydrants can reach any part of the ship
International Ship to Shore connections

Requirements on the International Shore Connection

SOLAS Ch. II-2, Part C, Regulation 10.2 – Water supply systems

2.1.7 International shore connection

2.1.7.1 Ships of 500 gross tonnage and upwards shall be provided with at least one international shore connection complying with the Fire Safety Systems Code.
Sprinklers

- Linked to alarm system
- Activate at pre-determined temperature
- Restrict spread of fire
- Limit water damage
Water Mist System

- At rest < 25 bar
- Rises to 140 bar in 30 seconds
- Nitrogen cylinders or pump
- Pressurise the system
- Engine room systems can be
  - Operated locally
  - By detectors

No need to evacuate, shut down engine or ventilate
Deluge System

- Dry pipe system
- Open sprinkler heads
- Zoned system
- Large quantities of water
- Manual activation
CO2 Systems

- Equal to 30% of largest cargo space
- Equal to 35% of machinery space
- 50% discharged in 1 min
- 85% discharged in 2 min
- Two separate actions required to release CO$_2$
Engine Room Release Actions

- Decision made to release
- Space evacuated and report for muster
- Distinctive audible warning on opening cabinet
  - Ventilation secured
  - Exhaust dampers closed
  - Fuel shut-off activated
- Positive confirmation of muster
- Release CO$_2$
Engine Room - Post Release

- Ensure CO₂ fully released
- Continue boundary cooling and monitor
- Assess through remote means
- Temperature must be less than the S.I.T. of any flammables
- Only then open compartment
Halon replacements

- **FM 200** - Heptafluoropropane Gas
- **Novec 1230** - Fluorinated ketone
- **NAF S125, Halotron 11B, FE13**
Inert gases

- **Argonite**
  - 50% Nitrogen
  - 50% Argon

- **Inergen**
  - 50% Nitrogen
  - 40% Argon
  - 8% CO2
High Expansion Foam (Hi-Ex)

- Space filled in 10 minutes
- Over 500 m³ a flap should be open to allow gases to escape to avoid back pressure
- Sufficient to fill the largest space five times
Hazards of Hi-Ex

- Claustrophobia
- Loss of vision
- Reduction in light penetration
- Muffling of sounds
- Transmission of heat is reduced
- Thermal imaging cameras are ineffective
- Very difficult to locate casualties
**Structural & Thermal Protection**

- **CLASS A (0), (30), (60)**
  - No passage of flame or smoke for 1 hour

- **CLASS B (15), (30)**
  - No passage of flame or smoke for ½ hour

- **CLASS C**
  - Non combustible
  - No requirement to retard smoke or flame
A Class Bulkheads (0)

- Resist flame and smoke for 60 minutes
- No thermal insulation
A Class Bulkheads (30)

- Resist flame and smoke for 60 minutes
- Thermal insulation for 30 minutes

31 mins
>140°C
>180°C
61 mins
A Class Bulkheads (60)

- Resist flame and smoke for 60 minutes
- Thermal insulation for 60 minutes

61 mins

>140°C

>180°C
‘A’ class divisions, bulkheads or decks made of steel or equivalent.

‘B’ class divisions made of non combustible materials.
Fire Plans & Drills

- Plans must be in accordance with regulations
- Accessible in Bridge and fire equipment store
- Either English or French
- Separate set stowed in watertight container outside bridge/opposite gangway
Fire Control Plan

- Plans must contain:
- Ship layout and division, control points
- Fixed and portable fire appliances
- Fire fighting personnel
- PPE equipment & fire detection systems
- Alarms type and sound
- Means of access and escape
Signage

LO 2.4
Drills & Emergency Procedures

- Masters responsibility for complying and updating Muster Lists or Station Bills

- Musters should take place at the commencement of each voyage
Drills & Emergency Procedures

- One fire or abandon ship drill each month
- Within **24 hours** of leaving port
- Copies of drills and emergency procedures
  - Bridge
  - Engine Control Room
  - Crew Accommodation
Drills & Emergency Procedures

- Drills should be realistic
- Crews should train in:
  - Closing of all openings e.g. scuttles, ventilation shafts, fire doors
  - Operation of fixed systems
- Crew not allocated to fire party
  - familiar with the location and operation of fire extinguishers
  - Use of fire hoses and Emergency equipment

LO 2.1,4
Escape

- Maintain your means of escape
- Keep all doors, companion ways, hatches, corridors free of all obstructions
- Check, test & maintain all emergency exits and openings
Finally

- Your vessel is your home and it is very vulnerable to FIRE
- Know your vessel and its safety plans

Fire prevention is everybody’s business
Any Questions?
Practical Session
Day One
11:30 – 12:30
FIRE EXTINGUISHERS