14. **Course Framework**

**Basic Training For Oil and Chemical Tanker**

1. **Aims**

This course provides training for officers and rating assigned specific duties and responsibilities related to cargo and cargo equipment on tankers. It comprises a familiarization training programme appropriate to their duties and responsibilities, including characteristics of tanker cargoes, their associated hazards, safety measures, pollution prevention, emergency operations, cargo equipment and operations. The course takes account of section A-V/1 of the STCW code.

Any of this training may be given on board or ashore. It should be supplemented by practical instruction on board and, where appropriate, in a suitable shore-based installation.

- Learning program safe keep in:
  - maritime training center's “Equator” office desk
  - maritime training center’s “Equator” library
  - maritime training center’s “Equator” quality system office
  - Georgia maritime agency

2. **Objective**

Provided they hold an appropriate certificate and are otherwise qualified in accordance with regulation V/1-1.2 of the international convention on standards of training, certification and watchkeeping for seafarers 1978, as amended in 2010, those successfully completing the course should be able to assume the duties and responsibilities related to cargo and cargo equipment, as specifically assigned to them.

3. **Entry standards**

The course is open to seafarers who are to be assigned specific duties and responsibilities related to cargo and cargo equipment on tankers, and who have completed an approved shore-based firefighting course in addition to the training required by regulation VI/1 as stipulated in STCW regulation V/1, paragraph 1. See the chart on page 6, which is also presented in teaching aid transparency in appendix 3.

The tanker familiarization course must be approved by the administration. Officers and ratings who are qualified in accordance with regulation V/1, paragraph 1, as appropriate, shall be issued with an appropriate certificate.

An existing certificate may be suitably endorsed by the issuing administration.

4. **Course intake limitations**

The number of trainees will not exceed 20 and practical training should be undertaken in small groups of not more than four.

5. **Staff requirements**

The instructor shall have appropriate training in instructional techniques and training methods (STCW Code section A-I/6, paragraph 7). It is recommended that all training and instruction is given by qualified personnel experienced in the handling and characteristics of oil/chemical/liquefied gas cargoes and the safety procedures involved.

Staff be recruited from deck and engineer officers of tankers, fleet superintendents and personnel in freight departments, cargo survey bureaux or laboratories, as appropriate.

<table>
<thead>
<tr>
<th>№</th>
<th>Name</th>
<th>Qualification/capacity</th>
<th>Required certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Besik beJandze</td>
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</tbody>
</table>

6. **Training facilities and equipment**

Ordinary classroom facilities and an overheard projector are sufficient for most of the course, and if possible a visit to a tanker should be arranged. When making use of audio-visual materials, the appropriate equipments must be available.

It is widely recognized that well-designed lessons and exercises can improve the effectiveness of training and shorten training times compared to training times compared to traditional methods.

The following equipment should be available for classroom demonstration:

- Complete set of personnel safety equipment, including breathing apparatus
- Set of suitable protective equipment
Resuscitator  
Filter-type respiratory protection for emergency escape  
Self-contained breathing apparatus for emergency escape  
Portable oxygen meter  
Portable combustible-gas detector  
Portable toxic-gas detector  
Chemical adsorption tubes for toxic-gas detector (for benzene, carbon monoxide, hydrogen sulphide)

Course outline and timetable

Minimum requirements for the training of officers and ratings on tankers (STCW chapter V, regulation V/1, paragraph 1)

<table>
<thead>
<tr>
<th>Course Outline</th>
<th>Approximate Time (hours)</th>
<th>Lectures, demonstrations and practical work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge, understanding and proficiency</td>
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<td></td>
</tr>
<tr>
<td>1. Introduction (STCW Code, section A-V/1, paragraph 2)</td>
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<tr>
<td>1.1 The course</td>
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<tr>
<td>1.2 Development of tankers, types, piping system, cargo pumps</td>
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<tr>
<td>1.3 Types of cargoes</td>
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<tr>
<td>1.4 Tanker terminology</td>
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</tr>
<tr>
<td>1.5 Rules and regulations</td>
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<tr>
<td>2. Characteristics of Cargoes (STCW Code, section A-V/1, paragraph 2)</td>
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<td>2.1 Basic Physics</td>
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<tr>
<td>2.2 Basic chemistry, chemical elements and groups,</td>
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</tr>
<tr>
<td>2.3 Physical properties of oil, chemicals and gases carried in bulk</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>3. Toxicity and Other Hazards (STCW Code, section A-V/1, paragraph 2/3/4)</td>
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<td>3.1 General concepts and effects of toxicity</td>
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<td>3.2 Fire hazards</td>
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<tr>
<td>3.3 Health hazards</td>
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<tr>
<td>3.4 Hazards to the environment</td>
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<td></td>
</tr>
<tr>
<td>3.5 Reactivity hazards</td>
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<tr>
<td>3.6 Corrosion hazards</td>
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<td></td>
<td></td>
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<tr>
<td>4. Hazard Control (STCW Code, section A-V/1, paragraph 5)</td>
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<td>4.1 Cargo Safety Data Sheets</td>
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<td>4.2 Methods of controlling hazards on tankers</td>
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<tr>
<td>5. Safety Equipment and Protection of personnel (STCW Code, section A-V/1, paragraph 6)</td>
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<td>5.1 Safety measuring instruments</td>
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<td>5.2 Specialized fire-extinguishing appliances</td>
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<tr>
<td>5.3 Breathing apparatus, tank evacuating, rescue and escape equipment</td>
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<td>5.4 Resuscitators</td>
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<tr>
<td>5.5 Safety Precautions and Measures</td>
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<td>6. Pollution Prevention (STCW Code, section A-V/1, paragraph 7)</td>
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<td>6.1 Causes of marine (air and water) pollution</td>
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<td>6.2 Prevention of marine pollution</td>
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<tr>
<td>6.3 Measures to be taken in the event of spillage</td>
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<tr>
<td>6.4 SOPEP</td>
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<td>6.5 Ship/shore liaison</td>
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### 7. Emergency Operations (STCW Code, section B-V/1, paragraph 13)

<table>
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<td>7.2 Organizational structure</td>
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<td>7.3 Alarms</td>
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<td>7.4 Emergency procedures</td>
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<td>7.5 First-aid treatment</td>
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### 8. Cargo Equipment (STCW Code, section B-V/1, paragraph 14)

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<th>Hours</th>
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<td>8.1 General Cargo-Handling equipment on board oil tankers</td>
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<td>8.2 General Cargo-Handling equipment on board chemical tanker</td>
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### 9. Cargo Operations (STCW Code, section B-V/1, paragraph 14/15)

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<td>9.1 General awareness of safe cargo operational procedures on tankers (if any)</td>
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<td>9.2 Assessment (list of cargo operation)</td>
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#### Course Timetable – example

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<th>4th period (1.5 hours)</th>
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<td>1.1 The course</td>
<td>1.3 Types of cargoes</td>
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<td>1.2 Development of</td>
<td>1.4 Tanker terminology</td>
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<td>1.3 Types of cargoes</td>
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<td>3.5 Reactivity hazards</td>
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<td>instruments</td>
<td>controlling hazards</td>
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<td>3</td>
<td>3.2 Fire hazards</td>
<td>3.3 Health hazards</td>
<td>4.2 Methods of</td>
<td>5.1 Safety measuring</td>
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<td>3.3 Health hazards</td>
<td>3.4 Hazards to the</td>
<td>controlling hazards</td>
<td>instruments</td>
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<td>4.2 Methods of</td>
<td>4.2 Methods of</td>
<td>5.5 Safety Precautions</td>
<td>1.1 Causes of marine</td>
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<td>and Measures</td>
<td>(air and water)</td>
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<td>5</td>
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<td>5.5 Safety Precautions</td>
<td>1.1 Causes of marine</td>
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<td>tank evacuating, rescue</td>
<td>tank evacuating, rescue</td>
<td>and Measures</td>
<td>(air and water)</td>
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<td>and escape equipment</td>
<td>and escape equipment</td>
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<td>pollution</td>
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<td>6</td>
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<td>6.3 Measures to be</td>
<td>6.5 Ship'shore liaison</td>
<td>6.5 Ship'shore liaison</td>
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<td>spillage</td>
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<tr>
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<td>1.3 Measures to be</td>
<td>6.4 SOPEP</td>
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<tr>
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<td>taken in the event of</td>
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<tr>
<td></td>
<td>spillage</td>
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<tr>
<td>7</td>
<td>7.2 Organizational</td>
<td>7.4 Emergency procedures</td>
<td>7.5 First-aid treatment</td>
<td></td>
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<tr>
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<td>1.3 Alarms</td>
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<td>7.4 Emergency procedures</td>
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<td>8</td>
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<td>8.2 General Cargo-</td>
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<tr>
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<td>Course outline</td>
<td>Approximate time</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>knowledge, understanding and proficiency</td>
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</tbody>
</table>

**Competence 1: Minimize the risk of fire**

<table>
<thead>
<tr>
<th>Course outline</th>
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</tr>
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<tbody>
<tr>
<td>1.1 Condition for fires</td>
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</tr>
<tr>
<td>1.2 Properties of flammable materials</td>
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</tr>
<tr>
<td><strong>Type and sources of ignition</strong></td>
<td></td>
</tr>
<tr>
<td>1.3 Fire prevention principles</td>
<td>0.25</td>
</tr>
<tr>
<td>Flammable materials commonly found on board</td>
<td>0.75</td>
</tr>
<tr>
<td>1.4 Spread of fire</td>
<td></td>
</tr>
<tr>
<td>1.5 Safe practice</td>
<td></td>
</tr>
<tr>
<td><strong>Need for constant vigilance</strong></td>
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<td>1.6 Need for constant vigilance</td>
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<tr>
<td>1.7 Patrol systems</td>
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<tr>
<td><strong>Fire hazards</strong></td>
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<td>1.8 Fire hazards</td>
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<td><strong>Sub-Total</strong></td>
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</table>

**Competence 2: Maintain a state of readiness to respond to emergency situations involving fires**

<table>
<thead>
<tr>
<th>Course outline</th>
<th>Approx. time</th>
</tr>
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<tbody>
<tr>
<td>Organization of shipboard fire fighting</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1 General emergency alarm</td>
<td></td>
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</tbody>
</table>
### Classification of fires and applicable extinguishing agents

<table>
<thead>
<tr>
<th>Section</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 Fire control plans and muster list</td>
<td></td>
</tr>
<tr>
<td>2.3 Communications</td>
<td></td>
</tr>
<tr>
<td>2.4 Personal safety procedures</td>
<td></td>
</tr>
<tr>
<td>2.5 Periodic shipboard drills</td>
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<tr>
<td>Location of fire-fighting appliances and emergency escape routes</td>
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</tr>
<tr>
<td>2.6 Ship construction arrangements</td>
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</tr>
<tr>
<td>2.7 Emergency fire pump (cargo ships)</td>
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</tr>
<tr>
<td>2.8 Chemical powder applicants</td>
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</tr>
<tr>
<td>2.9 Emergency escape routes</td>
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<tr>
<td>Fire spread in different parts of a ship</td>
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<tr>
<td>2.10 Fire spread</td>
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<tr>
<td>Fire and smoke detection measures on ships and automatic</td>
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</tr>
<tr>
<td>2.11 Fire and smoke detection system</td>
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</tr>
<tr>
<td>2.12 Automatic fire alarm</td>
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<tr>
<td>Classification of fires and applicable extinguishing agents</td>
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</tr>
<tr>
<td>2.13 Classification of fires and appropriate extinguishing system</td>
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#### Competence: 3 Fight and extinguish fires

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<tbody>
<tr>
<td>Selection of fire-fighting appliances and equipment</td>
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<tr>
<td>3.1 Fire hoses and nozzles</td>
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<tr>
<td>3.2 Mobile apparatus</td>
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<td>3.3 Portable fire extinguishers</td>
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<td>3.4 Fireman's outfit</td>
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<td>3.5 Fire blankets</td>
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<td>3.6 Knowledge of fire safety arrangements</td>
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<tr>
<td>3.7 Fire alarms and first actions</td>
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<tr>
<td>3.8 Fire fighting</td>
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<tr>
<td>3.9 Fire-fighting mediums</td>
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<td>3.10 Fire-fighting procedures</td>
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<tr>
<td>3.11 Small fires</td>
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<td>3.12 Extensive fires</td>
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<td>Precautions for and use of fixed installations</td>
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<td>3.13 General</td>
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<td>3.14 Smothering effect systems: carbon dioxide (CO2) and foams</td>
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<td>3.15 Inhibitor effect systems: powders</td>
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<td>3.16 Cooling effect systems: sprinklers, pressure spray</td>
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<tr>
<td>Use of breathing apparatus for fighting fires</td>
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<tr>
<td>3.17 Breathing apparatus</td>
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<tr>
<td>3.18 Drills in smoke-filled spaces</td>
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<tr>
<td>Use of breathing apparatus for effecting rescue</td>
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<td>3.19 Use of breathing apparatus</td>
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**Total**                                                                **15.0**
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<thead>
<tr>
<th>Period/Day</th>
<th>Course Timetable</th>
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<tbody>
<tr>
<td>1st period (1,5 hrs)</td>
<td>Competence 1: minimize the risk of fire</td>
</tr>
<tr>
<td>2 period (1,5 hrs)</td>
<td>Competence 1: minimize the risk of fire (continued)</td>
</tr>
<tr>
<td>3 period (1,5 hrs)</td>
<td>Competence 2: maintain a state of readiness to respond to emergency situations involving fires</td>
</tr>
<tr>
<td>4 period (1,5 hrs)</td>
<td>Competence 2: maintain a state of readiness to respond to emergency situations involving fires (continued)</td>
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</table>

**Day 1**
- Competence 1: minimize the risk of fire
- Competence 2: maintain a state of readiness to respond to emergency situations involving fires

**Day 2**
- Competence 3: fighting and extinguish fires
- Competence 3: fight and extinguish fires (continued)

**Day 3**
- Competence 3: Fight and extinguish fires
- Competence 3: Fight and extinguish fires (continued)

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**Meal break**
Scope

This course provides training for officers and ratings assigned specific duties and responsibilities related to cargo and cargo equipment on tankers. It comprises a familiarization training programme appropriate to their duties, including characteristics of tanker cargoes, their associated hazards, safety measures, pollution prevention, emergency operations, cargo equipment and operations. The course takes account of section A-V/1 of the STCW code adopted by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended in 1995, 2010. Any of this training may be given on board or shore. It should be supplemented by practical instruction on board and, where appropriate, in a suitable shore-based installation.

Learning program safe keep in:
- Maritime training center’s “EQUATOR” office desk
- Maritime training center’s “EQUATOR” quality office
- Maritime training center’s “EQUATOR” library
- Georgia Maritime Agency

1. Objective

Provided they hold an appropriate certificate and are otherwise qualified in accordance with regulation V/1-1.2 of the STCW 1978, as amended in 1995/2010, those successfully completing the course should be able to assume the duties and responsibilities related to cargo and cargo equipment, as specifically assigned them.

2. Entry standards

This course is open to seafarers who are to be assigned specific duties and responsibilities related to cargo and cargo equipment on tankers, and who have completed and approved shore-based fire-fighting course in addition to the training required by regulation VI/1 as stipulated in STCW regulation V/1, paragraph 1. The tanker familiarization course must be approved by Administration. Officers and ratings who are qualified in accordance with regulation V/1.

3. Course intake limitation

The number of trainees should not exceed 20, and practical training should be undertaken in small groups of not more than four.

- All trainees before starting courses to be noted:
  - contents of program
  - safe working
  - using instruction

4. Staff requirements

The instructor shall have appropriate training in instructional techniques and training methods (STCW code A/6, paragraph 7). It is recommended that all training and instruction is given by qualified personnel experienced in the handling and characteristics of oil/chemical/liquefied gas cargoes and safety procedures involved.

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Qualification/capacity</th>
<th>Required certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Besik Bejanidze</td>
<td>engineer-navigator, Deep sea captain, instructor</td>
<td>1. Training courses for instructors: model 1.02, 1.20, 1.23, 2.03.</td>
</tr>
</tbody>
</table>

5. Training facilities and equipment

Ordinary classroom facilities and an overhead projector are sufficient for most of the course, and if possible a visit to a tanker should be arranged. When making use of audio-visual materials, the appropriate equipments must be available.

The following equipment should be available for classroom demonstration:
- Complete set of personnel safety equipment, including breathing apparatus
- Set of suitable protective equipment, including chemical and gas-tight suits
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

Tank evacuating equipment
Resuscitator
Filter-type respiratory protection for emergency escape
Self-contained breathing apparatus
Portable oxygen meters
Personal oxygen monitor
Portable combustible gas detector
Portable toxic-gas detector
Chemical absorption tubes for toxic-gas detector (for benzene, carbon monoxide, hydrogen sulphide)
Portable foam applicators

Detailed Teaching Syllabus
Basic Training For Oil and Chemical Tanker

1. Introduction

1.1 The course

I states the background for and the purpose of the course as:
- the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, as amended in (STCW), which contains mandatory minimum requirements for training and qualifications of masters, officers and ratings of tankers - this training is divided into two parts:
  level 1: a tanker familiarization course, or under an approved seagoing service, for officers and ratings assigned specific duties and responsibilities related to cargo or cargo equipment on tankers;
  level 2: a specialized training programme for masters, chief engineer officers, chief mates, second engineer officers and any person with immediate responsibility for loading, discharging and care in transit or handling of cargo on oil tanker, chemical tanker or gas tanker on which they serve
- this course covers the requirements for level 1 training required by STCW 1995, Reg. V/1(1.2)
.2 states that personnel on tankers should at least have attended an approved shore-based fire-fighting course and the training required by Reg. VI/1 of STCW 1995

1.2 Development of tankers

.1 lists important stages in the development of oil, chemical and liquefied gas tankers as outlined on pages 130-132 ibjsi of Appendix 2

1.3 Types of cargoes

Oil cargo
.1 states that "oil" means petroleum in any form, including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals)
.2 states that the list of oils includes the substances shown on page 143 [bjis2] of Appendix 2
.4 states that crude petroleum as discharged at the well head is a mixture of a large number of different hydrocarbon molecules
.5 states that "hydrocarbons" is the common name for substances composed of only the elements hydrogen and carbon
.6 states that the composition of petroleum depends on its source
.7 describes general arrangement of tankers which carry bulk cargoes of:
  - crude oil
  - petroleum products
  - bitumen
  - ore/oil
  - ore/bulk/oil
Chemical cargo

.8 states that:
- a chemical tanker is primarily designed for the carriage of dangerous chemicals in bulk
- these chemicals are listed in the IMO Bulk Chemical Codes
- in addition to the cargoes listed in the Codes, chemical tankers may carry a wide variety of other liquid products which would normally be considered to be unrelated to chemicals, such as:
  - fruit juice
  - water
  - molasses
  - animal and vegetable oils
  - clean petroleum products and lubricating oils

.9 explains that a chemical tanker may carry dangerous chemicals and all product tanker cargoes, but that a product tanker is limited to carry products and chemicals which are not identified in the Codes as dangerous.

.10 states that cargoes in chemical tankers may be divided into four groups as follows:
- petrochemicals
- alcohols and carbohydrates
- vegetable and animal oils and fats
- inorganic chemicals

.11 explains that petrochemicals are organic products derived wholly or partly from crude oil, natural gas or coal.

.12 lists examples of petrochemicals as:
- solvents
- aromatics
- intermediates or refined products

.13 explains that the group of alcohols and carbohydrates includes products which may be produced by fermentation, such as:
- liquor
- wine
- molasses

.14 explains that vegetable and animal oils and fats are products derived from seeds of plants and from the fat of animals, including fish.

.15 lists examples of vegetable and animal oils and fats as:
- soya bean oil
- cottonseed oil
- lard and lard oil
- beef and mutton tallow
- whale oil
- sardine oil
- cod oil

.16 explains that inorganic chemicals are products which are not of organic origin.

.17 lists examples of inorganic chemicals as:
- sulphuric acid
- phosphoric acid
- nitric acid
- caustic soda

.18 states that most cargoes in chemical tankers belong to the group "petrochemicals".

.19 states that chemical tankers may also carry petroleum products such as those normally carried in oil tankers.

.20 states that chemical tankers may be engaged in "dedicated" or "parcel" trades.

.21 explains that dedicated service usually means that the tanker is dedicated for a certain type of chemical, transporting the same type of cargo on each voyage.

.22 explains that a chemical tanker engaged in parcel service moves a variety of relatively small lots of chemicals between a number of ports.

Liquefied gas cargo

.23 states that, generally speaking, a liquefied gas is the liquid form of a substance which at ambient temperature and atmospheric pressure would be a gas.

.24 states that cargoes transported by gas tankers are listed in IMO's Gas Carrier Codes.

.25 explains that these cargoes can be divided into the following four groups:
- liquefied natural gas, LNG
- liquefied petroleum gas, LPG
- liquefied ethylene gas, LEG
- chemical gases and certain other substances.

.26 states that LNG is liquefied natural gas from which impurities are removed.
.27 states that the principal constituent of LNG is methane
.28 states that "liquefied petroleum gas" - LPG - is a common name for petroleum gases, mainly propane and butane
.29 states that LPG is produced from two sources:
- from crude oil processing in refineries, or as a by-product of chemical plants
- from natural gas streams or from crude oil at or close to production points (wells/platforms)
.30 states that liquefied ethylene gas - LEG - is produced by "cracking" of LPG
.31 states that chemical gases are a group of liquefied gases produced through a chemical process
.32 lists chlorine, ammonia and vinyl chloride monomer (VCM) as examples of chemical gases
.33 states that certain other substances in the "borderland" between liquefied gas and chemicals are carried on gas tankers
.34 lists acetaldehyde and propylene oxide as examples of such cargoes
.35 lists the two methods by which gas can be liquefied as:
- liquefaction by removal of heat
- liquefaction by pressurizing
.36 states that liquefaction of gas cargoes on ships - other than fully pressurized ships - is done by removal of heat
.37 states that the heat to be removed from the cargo is called "latent heat of condensation"

1.4 Tanker terminology
.1 explains commonly used terms and abbreviations on board tankers and in tanker terminals as listed in Appendix 1

1.5 Rules and regulations
.1 lists the most important of the rules governing tankers as:
- international rules and regulations
- national rules and regulations
- classification society rules
.2 states that transport of oil, liquid chemicals and liquefied gas by sea in bulk is internationally regulated - as regards safety and pollution aspects - through conventions adopted by the International Maritime Organization (IMO).

.3 explains that the convention requirements are supplemented by recommendations, specifications and codes adopted by IMO.

.4 states that the IMO conventions covering the carriage of oil, chemicals and liquefied gas in bulk are:
- the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended
- the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the 1978 Protocol (MARPOL 73/78), as amended
- the International Convention for Standards of Training, Certification and Watchkeeping, as amended

.5 states that all tankers of 500 gross tons and upwards must comply with the International Management Code for Safe Operation of Ships and for Pollution Prevention (ISM Code).

.6 states that the most important codes and standards covering the transport of chemicals are:
- the Bulk Chemical Codes (BCH and IBC Codes)
- Standards for Procedures and Arrangements (P & A Standards)

.7 states that the codes and standards covering design, construction and other safety measures for ships carrying liquefied gases in bulk are set out in the IMO's Gas Carrier Codes.

.8 lists examples of national rules.

.9 lists examples of classification society rules.

2 Characteristics of cargoes

2.1 Basic physics

.1 defines the following in simple terms:
- states of aggregation
- melting point and boiling point
- liquid density
- vapour density
- vapour pressure
- partial pressure
- viscosity
- pour-point
- diffusion

.2 describes briefly the structure of atoms and molecules.

.3 states that a negatively charged body has an excess of electrons.

.4 states that a positively charged body has a shortage of electrons.

.5 states that similarly charged bodies repel each other and oppositely charged bodies attract each other.

.6 describes induction and how the induction of an electrode may cause it to become charged.

.7 describes how a charged electrode may be discharged.

.8 States that a discharge releases energy which may cause a spark.

2.2 Basic chemistry, chemical elements and groups

.1 explains in simple terms:
- chemical symbols and structures
- "atomic number" and "atomic weight"
- the Periodic System and Periodic Table
- a hydrocarbon molecule
- chemical elements of acids and bases
- chemical reactions

.2 gives examples of chemical reactions.

.3 states the use of the Codes in relation to reactivity of cargoes.
A explains the meaning of the chemical data for a common cargo (as given in the ICS or other Cargo Data Sheets)

The hydrocarbon structure

states that:

- crude petroleum as discharged at the well head is a mixture of a large number of different hydrocarbon molecules
- the molecules are termed "light" or "heavy" according to the number of carbon atoms forming the molecule
- very light molecules such as methane, butane and propane tend to be gaseous under normal atmospheric conditions
- very heavy molecules such as asphalt and bitumen tend to be solid under normal atmospheric conditions
- intermediate molecules such as petrol (motor spirit) and diesel oil tend to be liquid under normal atmospheric conditions
- very light gaseous molecules such as methane are extracted at the well head
- the petroleum remaining after the removal of products such as methane is termed "crude oil"
- crude oil is a mixture of hydrocarbons which under normal atmospheric conditions are gaseous, liquid and solid
- in an oil refining process, termed "distillation", crude oil is split into a number of fractions

- each petroleum fraction has a range of physical properties specific to itself

2.3 Physical properties of oil, chemicals and gases carried in bulk

defines the following in simple terms and explains their practical significance in the tanker trade:

- flashpoint
- volatility
- saturated vapour pressure
- vapour pressure/temperature relationship
- influence of pressure on melting and boiling point
- flammability
- upper flammable/explosive limit
- lower flammable/explosive limit
- auto-ignition temperature
- spontaneous combustion
- reactivity
- toxicity
- corrosivity

states that there is need for taking cargo samples and for the chemical and physical analysis of cargoes

3 outlines the properties of oil, chemicals and gases carried in bulk, including:

- the determination of cargo temperature
- the determination of cargo density
- determination of colour of cargoes and use of a colour scale
- determination of flashpoint
- test for contamination by hydrocarbons
- test for contamination by chloride
3. Toxicity and other hazards

3.1 General concepts and effects of toxicity

Toxicity of cargoes in general

.1 states that most of the cargoes on tankers have some hazardous properties
.2 states that poisoning may occur orally, through inhalation or by skin contact
.3 states that poisoning may be acute or chronic
.4 states that exposure to oil, chemical or gas can have acute or chronic effects on a person’s health
.5 defines “acute” effect as effect of single exposure of short duration to relatively high concentration of vapour
.6 defines “chronic” effect as accumulative effect of prolonged exposures to relatively low concentrations of vapour over a long duration of time
.7 states that the vapour from some cargoes may have both acute and chronic effects, whilst others may have one or the other more prominent
.8 states what are systemic poisons and irritants
.9 states that the toxicity of a substance is difficult to measure and that it is therefore rated on the basis of studies performed on animals and extrapolated for the human body
.10 defines the terms and explains their significance:
- threshold limit value (TLV)
- odour threshold
.11 states that cargoes also may be harmful to the environment

3.2 Fire hazards

.1 lists the three essentials necessary for a fire to commence as: oxygen, flammable material (fuel), source of ignition
.2 states that when flammable vapour is mixed with oxygen (usually from the atmosphere) an explosive mixture may be produced
.3 states that the ability of petroleum to generate flammable vapour is a major factor for starting a fire
.4 describes the ability to vaporize as volatility
.5 states that volatility increases with temperature and reaches a maximum at the boiling temperature of the petroleum
.6 states that the concentration of hydrocarbon vapour present in air is used to define “flammable range”
.7 states that the working flammable range of a mixture of petroleum vapour and air can be taken to be from 1% to 10% by volume
.8 describes the flammability diagram
.9 states that the flashpoint of an oil indicates the lowest temperature at which the oil will give off sufficient hydrocarbon vapour to form a flammable gas mixture with air near the surface of the oil
.10 states that only the vapour from a flammable material will combine with oxygen to produce fire
.11 states that an explosive mixture may be produced when chemical cargo vapours are mixed with air
.12 states that corrosive liquids can become flammable and produce flammable gases when in contact with certain materials
.13 states that a mixture of vapour and air will only ignite and burn if its composition is within the “flammable range”
.14 states that within the flammable/explosive range, if a heat source is introduced, then it will result in a fire
.15 lists the sources of ignition as:
- direct heat
- mechanical sparks
- chemical energy
- electrical energy
- electrostatic discharge
.16 states that static electricity can arise when two dissimilar materials (solids, liquids or gases) come in contact and charge separation occurs at the interface
.17 states that static electricity can cause sparks capable of igniting flammable mixture
.18 lists causes of electrostatic charge generation as:
- flow of liquids through pipes or filters
- settling of solids or immiscible liquids through a liquid
- ejection of particles or droplets from a nozzle
- splashing or agitation of a liquid against a solid surface
- vigorous rubbing together and subsequent separation of certain synthetic polymers

.19 states that some tanker operations can give rise to electrostatic charge generation.

.20 lists examples of such tanker operations:
- that certain cargoes are accumulators of static electricity because of their low conductivity
- that the three essentials necessary for a fire to commence, stated in 3.2.1 above, may be represented by the sides of a triangle, and the complete triangle represents a fire or an explosion
- that the way to prevent a fire is to prevent the formation of such a triangle
- that the removal of any one side of the fire triangle will extinguish the fire
- that removal of the flammable material is usually not possible with petroleum in bulk
- that it is essential to keep ignition sources away from cargo areas, where flammable vapours are likely to be present

.27 states that it is essential to avoid the entry of flammable vapours into areas where ignition sources are present, such as living accommodation, engine-room, galley, etc.

.28 states that the use of inert gas in cargo tanks can reduce the oxygen content below that necessary to produce a flammable mixture.

.29 states that starving a gas fire by stopping the source of gas leak may be the most effective way to control a gas fire.

.30 states that covering the surface of a flammable material with a blanket of inert material will prevent oxygen from making contact with the vapours from the flammable material.

.31 states that water in sufficient quantity can provide cooling.

.32 states that, compared with oil and other hydrocarbons, some liquid chemicals have unusual properties with regard to fire-fighting procedures.

.33 lists cargo properties referred to under objective 3.2.32

3.3 Health hazards

Toxic effects

.1 lists the hazards to health of:
- skin contact with liquid petroleum
- ingestion (swallowing) of liquid petroleum
- inhalation (breathing) of liquid petroleum
- inhalation of petroleum vapour
- compounds of lead contained in the cargo

.2 describes the toxic effect on personnel of skin contact with and ingestion (swallowing) of petroleum liquid and inhalation (breathing) of petroleum vapour.

.3 states that skin contact with liquid petroleum causes irritation and dermatitis because of the removal of essential natural skin oils.

.4 states that ingestion of liquid petroleum into the stomach causes acute discomfort and nausea.

.5 states that if the liquid is inhaled into the lungs there is a serious risk of suffocation through interference with the normal oxygen/carbon dioxide transfer taking place during breathing.

.6 states that the liquid ingested will tend to vaporize and the vapour could be inhaled into the lungs.

.7 states that inhalation of petroleum vapour will produce narcosis, the main symptoms being headache/eye irritation and dizziness, with very high concentrations leading to paralysis, insensitivity and very possibly death.

.8 states that the vapours from some chemicals are toxic by inhalation.

.9 states that some chemicals or their vapours are toxic by absorption through the skin.

.10 states that effects of exposure involving dangerous chemicals are given in the ICS or other Cargo Data Sheets.

.11 states that the action to be taken in an emergency is indicated in the Data Sheets, in the form of "If this happens……..do this."

.12 states that when providing first aid, personnel should also be aware of the list of "don'ts", including:
- do not attend to victim unless it is safe to do so
- do not attempt to do more than necessary
- do not delay in summoning for help and informing the master
- do not enter the enclosed spaces unless you are a trained member of a rescue team acting upon instruction.
.13 states that all personnel should be familiar with the health data set out in the Data Sheets for the cargoes carried.

.14 states that cargo vapours in sufficient concentration will exclude oxygen and, even if not toxic, may cause asphyxiation.

**Oxygen deficiency**

.15 states that the oxygen content of air is 21% by volume.

.16 states that the oxygen content in enclosed spaces may become lower.

.17 describes the reasons of oxygen deficiency in an enclosed space could be:
- an inert atmosphere
- displaced oxygen due to presence of cargo vapour
- combustion
- chemical reactions
- rusting
- drying paint

.18 states that in certain wind conditions vented gases may descend down, making the atmosphere on open deck harmful due to:
- presence of gases in harmful concentration
- oxygen deficiency

.19 states that if harmful conditions on deck exist, all non-essential work on deck should cease and only essential personnel should remain on deck, taking all appropriate precautions.

.20 describes the symptoms of the effect of oxygen deficiency as asphyxia.

.21 states that reliance should not be placed on symptoms for indicating an oxygen-deficient atmosphere.

.22 states that persons have varying susceptibility to oxygen deficiency but that all will suffer if the oxygen content drops below 16% by volume.

.23 states that if oxygen is less than 21% an atmosphere may be extremely dangerous unless it is known which gas has replaced the oxygen.

**Toxicity of inert gas**

.24 states that the main hazard associated with inert gas is its low oxygen content, but that it may also contain toxic gases.

.25 lists the main toxic constituents of inert gas.

### 3.4 Hazards to the environment

.1 defines "pollution" as inconvenience or damage, caused by human activities, to humans, animals, plants and to our environment as a whole, by spreading of hydrocarbons and chemical compounds to air, water or land.

.2 states that a major oil pollution can harm other industries like fishery, tourism, etc.

.3 states that crude oil tankers, product tankers and chemical tankers are chiefly responsible for marine pollution.

A states that cargoes in tankers may be harmful to the environment.

.5 states that most chemicals carried represent a pollution risk.

.6 explains hazards caused to the environment, covering the effect on human and marine life from the release of oil, chemicals or gases.

.7 explains the effect that the specific gravity and solubility of the cargo have on the hazards to the environment in the event of a spillage.

.8 explains the effect of the cargo vapour pressure and atmospheric conditions on the hazards to the environment.

.9 explains the dangers arising from a vapour cloud drift as potential fire and health hazards.

### 3.5 Reactivity hazards

.1 states that chemical cargo may react in a number of ways, such as:
- with itself (self reaction)
- with air
- with water
- with another cargo
- with other materials

.2 gives examples of each of the above reactions.

.3 states that reactivity data of chemicals are given in the ICS or other Cargo Data Sheets.

.4 states that polymerization is the formation of larger molecules as a result of self-reaction.
5.5 states the effects of temperature on the reactivity of cargoes and polymerization
6.6 states that the presence of impurities may act as catalysts on the reactivity of cargoes and polymerization
7.7 states that polymerization may, under some circumstances, be dangerous

3.6 Corrosion hazards
1.1 states that some cargoes may be corrosive to human tissue and to a ship's equipment and structure
2.2 states that instructions about the use of protective clothing should be observed
3.3 states that care should be taken to ensure that unsuitable materials are not introduced into the cargo system
4.4 states the effect of concentration and evolution of hydrogen on corrosion

Hazards from liquefied gas
1.1 states that liquefied gas cargoes are transported at or close to their boiling point
2.2 states that the boiling temperatures of these cargoes range from 162 °C for methane to 0 °C for butane
3.3 states that low temperatures can cause cold burns, which may damage skin and tissue when in direct contact with cold liquid or vapour
4.4 states that these low temperatures can cause brittle fracture if cold cargo comes in sudden contact with metals
5.5 states that liquefied gas cargoes give off vapour readily because they are boiling
6.6 states that cargo vapour can be flammable, toxic or both

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6.6 states that cargo vapour can be flammable, toxic or both
7.7 states that cargo vapour in sufficient concentration will exclude oxygen and may cause asphyxiation whether the vapour is toxic or not
8.8 states that an explosive mixture may be produced when most cargo vapours are mixed with air
9.9 states that the vapours from some liquefied gas cargoes are toxic by inhalation
1.10 states that some toxic gases carried in gas tankers can be absorbed into the body through the skin
11.11 states that some gases are caustic and can damage human tissue
1.12 states that some cargoes in liquefied gas tankers are reactive and may react in a number of ways
13.13 states that necessary information for each cargo on board must be available on cargo data sheets
14.14 states that all personnel on board should use the cargo data sheets to acquaint themselves with the characteristics of each cargo to be loaded

4. Hazard control

4.1 Cargo Safety

Data Sheets
1 states that information about cargoes to be handled is essential to the safety of the vessel and her crew
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.2 states that such information may be found on ICS or other Cargo Data Sheets for each product, which also include all necessary data for the safe handling and carriage of the cargo

.3 states that cargo information for most tanker cargoes is kept on board and available for all concerned

.4 states that the cargo will not be loaded unless sufficient information necessary for its safe handling and transportation is available

.5 states that the responsible officer will see to it that the necessary cargo information is posted on the notice board prior to cargo operations

.6 states that all personnel engaged in cargo operations should familiarize themselves with the cargoes by studying the ICS or other Cargo Data Sheets

.7 states that cargo information is fundamental in cargo planning lists reference books where cargo information may be found

**1.2 Methods of controlling hazards on tankers**

.1 states that all cargoes can be handled safely by showing the greatest care throughout operation and by following standing instructions at all times

.2 lists precautions taken to avoid health hazards, such as:
- strict control of entry into pump-rooms, cargo spaces and other enclosed spaces
- proper procedures to be followed before entry into enclosed spaces, including thorough ventilation of the spaces
- use of adequate protective clothing
- thorough cleansing of personal clothing after contact with cargo
- continuous monitoring of the atmosphere in working spaces for petroleum vapour and toxic gases

.3 states that there are strict procedures for ventilation and gas-freeing to ensure that fire and health hazards are minimized

.4 states that the mechanical ventilation arrangements in the pump-rooms have a capacity to ensure sufficient air movement through the space

.5 states that the construction of the cargo-tank ventilation system reduces the risk of cargo vapour in gas-safe areas, for example vapour from cargo tank is led by ventilation line to the cargo ventilation tower

.6 defines "gas-freeing" as the replacement of cargo vapours, inert gas or any other gases with air

.7 describes ventilating to a too-lean atmosphere as gas-freeing

.8 states that, before personnel enter any tank, the atmosphere must be checked for oxygen content, hydrocarbon content and, after carrying some cargoes, toxic gas content

.9 states that a cargo tank is gas-free only when oxygen content is 21% by volume and no vapours from cargo or toxic constituents of inert gas can be measured in values above the threshold limit value (TLV)

.10 explains that to avoid fire, reactivity and corrosion hazards, certain precautions are taken such as:

- inerting
- provision of anti-static measures
- water padding
- nitrogen padding
- segregation of cargoes
- separation of piping system
- use of inhibitors to prevent polymerization
- use of drying agents compatibility of materials
- suitability of materials and tank coatings

.11 defines "inert gas"

.12 states that inert gas is used in cargo tanks:

- to protect the cargo from polymerization, oxidation and humidity
- to replace air and thereby prevent fire and explosion

.13 states that inerting is done by replacing cargo vapours with an inert gas until the concentration of cargo vapours is lower than the LEL

.14 states that inert gas used on tankers is either nitrogen or inert gas produced in the ship's inert-gas plant

.15 states that the correct inerting procedure is ensured by regular checks of the tank atmosphere
.16 states that atmosphere checks are done by measuring the percentage of oxygen and cargo vapours through the sampling tubes.

.17 states that the atmosphere in an inerted tank or void space is safe with regard to fire hazard but dangerous with regard to health.

.18 states that to avoid electrostatic hazard:
- an important countermeasure is to bond all metal objects together
- bonding to earth is effectively accomplished by connecting all metal objects to the ship's structure
- the ship's hull is naturally earthed through the seawater.

.19 lists examples of objects which might be electrically insulated in hazardous situations and which must therefore be bonded.

.20 states that when a cargo tank is maintained in an inerted condition anti-static precautions are not normally necessary.

.21 lists anti-static measures to be taken if the tank is in non-inerted condition with regard to:
- safe flow rates procedures for ullaging, sampling and gauging
- anti-static additives to be taken when handling static accumulator oil with regard to:
  - initial flow rate
- anti-static additives.

.22 lists anti-static measures to be taken when handling static accumulator oil with regard to:
- initial flow rate
- anti-static additives.

.23 Defines. "padding" as the filling and maintaining of the cargo and associated piping system with an inert gas, other gas or vapour, or liquid, which separates the cargo from air.

.24 states that cargoes which present a major fire hazard are kept under a "padding" during the voyage.

.25 states the purpose of segregating the cargoes.

.26 states that to determine whether or not a cargo can be loaded adjacent to another cargo, the cargo compatibility chart is used.

.27 states that segregation and separation of cargoes and spaces are fundamental to the safety of the tanker, and that this is achieved by means such as cofferdams, void spaces, etc.

.28 states that segregated ballast tanks are tanks designated for ballast only.

.29 states that segregated ballast tanks are equipped with a pumping system that is independent of the cargo system, in order to avoid contamination by cargoes.

.30 explains, with the aid of a simple drawing, how cargo is routed from the manifold to tanks on a chemical tanker with separate lines for each tank.

.31 explains, with the aid of a simple drawing, how cargo is routed from tank to manifold on a chemical tanker with deepwell pumps and separate lines from each tank.

.32 explains the functions of inhibitors and catalysts.

.33 states that inhibitors added to a liquid cargo may not inhibit reactions of the cargo vapour in the ullage space.

.34 states that the atmosphere in cargo tanks, and, in some cases, the spaces surrounding cargo tanks, may require special attention, and that "cargo conditioning" also requires inerting, padding and drying conditions to be maintained.

.35 explains the purpose of drying agents.

.36 explains the monitoring techniques used for ensuring proper conditions in inerting, padding and drying.

.37 states that all materials used for construction of tanks and the associated piping, valves and pumps must be resistant to the cargoes carried, and dictated by the service temperature.

.38 states that mild steel is the normal material for the construction of a chemical tanker.

.39 states that mild steel is resistant to most chemicals, but that its propensity to rust makes it unsuitable for chemical cargoes.

.40 states that rust makes tank cleaning more difficult and may also contaminate the cargo.

.41 states that, in order to avoid cargo contamination and to obtain a smooth surface on tank structures, mild-steel cargo tanks on chemical tankers are always coated internally with paint that is resistant to groups of chemicals.
.42 states that no coating today is suitable for all cargoes shipped in chemical tankers, and that a "coating resistance list" must be strictly followed when a cargo is to be loaded in a coated tank.

.43 states that most chemical tankers have their cargo tank section divided into some coated tanks and some stainless-steel tanks.

.44 states that stainless steel may be "clad" or solid.

.45 explains that clad steel consists of a mild steel plate with a veneer of stainless steel of about 2 mm thickness.

.46 states that stainless steel is resistant to almost all chemicals.

.47 states that stainless steel is not "stainless" or corrosion-resistant unless it is handled properly.

.48 states that the steel manufacturer’s or the owner’s instructions for maintenance of stainless-steel tanks and piping must be strictly followed by ship's personnel.

5. Safety equipment and protection of personnel

5.1 Safety measuring instruments

.1 states that safety measuring instruments may be personal, portable, or fixed types.

.2 states that gas measurements are the only way to get correct information about the composition of the atmosphere in a tank.

.3 lists the different types of gas-measuring equipment common on board tankers.

.4 states that gas-measuring equipment for atmosphere evaluation is available on board.

.5 demonstrates use of:
  - portable oxygen meter
  - portable explosion meter
  - toxic gas meter (chemical absorption tubes)

.6 states that every gas tanker has a fixed gas-detection system.

.7 states that the fixed gas detector gives an automatically controlled protection against concentrations of flammable gas that are too high, and that it is thereby fundamental to the safety of the gas tanker.

5.2 Specialized fire-extinguishing appliances

.1 states that all seafarers are required to attend basic safety training in compliance with the provisions of STCW 95.

.2 states that personnel on board tankers should be familiar with fire prevention and fire fighting, including:
  - fire-fighting media normally used to fight and control fires, such as:
    - water in the form of a jet, a spray, and a fog
    - foam
    - halon
    - carbon dioxide gas
    - steam
    - dry powder
    - sand
  - the vital importance of applying the correct media to particular types of fire, including the different classes of fire
    - that water in the form of a wide-angle spray (diffuser nozzle) can be used to shield personnel from radiant heat
    - the three main methods of controlling a fire are:
      - removal of oxygen (smothering)
      - cooling (reduction of ignition source)
      - inhibition of the burning process
  - fire-fighting procedures and appliances used for fires involving electrical apparatus which:
    - has not been isolated from the electrical supply
    - is isolated from the electrical supply
  - fire-fighting procedures and appliances used for fires of liquids
  - basic fire-fighting procedures and appliances used for fires of liquefied gases
  - basic fire-fighting procedures and appliances used for fires involving dangerous cargoes are given in the ICS or other Cargo Data Sheets.
.10 demonstrates use of foam monitors

**1.3 Breathing apparatus, tank evacuating, rescue and escape equipment**

1 states that spaces not normally entered (e.g. double bottom tanks, cofferdams and pipe tunnels) are capable of being ventilated to ensure a safe environment when entry into these spaces is necessary

.2 defines "enclosed spaces" as tanks for cargo, bunkers, water, slops or ballast, pump-rooms, cofferdams, double bottoms or any similar enclosed compartment

- explains why spaces defined in objective 5.3.2 may be dangerous to enter
- states that no person should enter a tank or an enclosed space without permission from a responsible officer

.5 states that only a tank or space declared gas-free can be entered by personnel without breathing apparatus and protective clothing

.6 states that a gas-free tank or space may not be considered to remain gas-free unless regular measurements of the atmosphere prove so

.7 lists safety precautions when entering enclosed spaces

.8 lists precautions for entering cargo pump-rooms during cargo, ballast or tank-cleaning operations

.9 demonstrates use of:
- self-contained compressed-air breathing apparatus
- filter-type respiratory protection for emergency escape
- a complete set of safety equipment
- stretcher and tank evacuating equipment

10 states that pump-rooms have permanent arrangements for hoisting an injured person with a rescue line

**5.4 Protective clothing and equipment**

1 states that for the protection of personnel engaged in loading and discharging operations, there must be suitable protective clothing on board

.2 states that for entering gas-filled spaces there must be complete sets of safety equipment on board

.3 states that all equipment for personnel protection must be kept in clearly marked lockers

4 states that all personnel should wear protective clothing when involved in cargo operations

.5 states that on chemical and gas tankers, there must be respiratory and eye protection equipment for every person on board, for purposes of emergency escape

.6 demonstrates use of:
- protective clothing

.7 states that on chemical and gas tankers decontamination showers and eyewash must be available in certain locations on deck

.8 states that stretchers and medical first-aid equipment must be provided on board

**5.5 Resuscitators**

.1 lists the circumstances under which a resuscitator should be used

.2 demonstrates use of:

- resuscitator

**5.6 Safety precautions and measures**

*Tank atmosphere evaluation*

.1 lists circumstances when the atmosphere in cargo tanks and enclosed spaces must be tested as:
- prior to entry by personnel
- to establish that there is a gas-free condition prior to repair work, entry to a shipyard or dry-docking
- during inerting, gas-freeing and purging operations
- as a quality control before loading/changing cargo

.2 states that an evaluation is the only way to get correct information about the composition of the tank atmosphere

.3 lists the information essential to evaluation of the tank atmosphere as:
- the nature of the constituent gases
- flammability
- toxicity/oxygen deficiency
- reactivity

.4 states that the atmosphere in tanks or enclosed spaces must be considered dangerous unless proper checks prove otherwise

.5 explains the importance of taking measurements of the atmosphere at several positions within a tank

.6 states that before entry in enclosed spaces:
- oxygen content must be 21% by volume
- hydrocarbon content must be less than 1% LFL
- toxic gas concentration must be less than its TLV
.7 states that after tank washing, manual removal of residue may be necessary
.8 states that residue removal generates more hydrocarbon gas
.9 explains that gas-freeing operations must therefore be continuous
.10 states that adjacent bulkheads and pipelines may constitute additional sources of hydrocarbon gas
.11 states that the inert gas supply to the tank should be shut off
.12 states that a gas-free certificate is needed from a qualified chemist before contractor's work can be carried out
.13 states that an additional hot work permit is required for hot work
.14 states that such certificate and permit must be reissued every day that work is carried out, or such lesser period as the port authority stipulates

**Accommodation**
.15 states that the accommodation is located outside the cargo area
- states that superstructures for accommodation are designed to minimize the possibility of entry of cargo vapour and that this design feature should not be impaired in any way
- states that no entrances, air inlets or openings to the accommodation are facing the cargo area
- states that accommodation portholes and windows facing the cargo area, and those within a certain distance from the cargo area, are of the non-opening type
- states that all doors, portholes or windows in accommodation should be kept closed during cargo operations
- states that mechanical ventilation and air-conditioning units supply air to accommodation spaces
.21 states that all ventilation systems should be stopped or operated on closed cycle if there is any possibility of cargo vapour being drawn into accommodation spaces
.22 states that air intakes for accommodation and for engine room are subject to requirements with respect to minimum distance from ventilation outlets of gas-dangerous spaces
.23 states that access to accommodation or to the engine-room is subject to requirements with respect to the minimum distance from the forward bulkhead of the accommodation
.24 states that for the safety barrier concept to be successful it is essential that the ship's staff follow the safe operational practices

**Precautions against fire**
.25 lists precautions against fire as:
- prohibiting smoking except in designated spaces
- absolute prohibition of smoking in calm weather
- prohibiting any form of naked light
- prohibiting non-safety matches and gas lighters
- prohibiting matches and lighters outside accommodation
- requiring the use of approved types of safety matches under strictly controlled conditions
- requiring the use of only approved types of fixed electrical equipment
- permitting only galley equipment of an approved design to be used
- prohibiting the use of battery-powered personal equipment exercising close control over the condition and use of tools and equipment requiring all electrical lighting, motors, portable lamps, torches and other equipment to be of an approved type
- stopping all cargo operations if an electrical storm is imminent or taking place
- maintaining overpressure in accommodation
- keeping accommodation doors and windows closed
- maintaining overpressure in gas-safe spaces inside cargo areas
- keeping close control and ensuring safe conditions if hot work, hammering, chipping or sandblasting is to be carried out
- keeping the bonding in hoses and line systems mechanically and electrically sound
- avoiding spills of flammable liquid and releases of cargo vapour
- that two sides of the triangle are normally removed on board gas tankers for safe operation in tanks and on decks
- that oxygen and ignition sources must be eliminated in cargo tanks where flammable material is present in the form of cargo vapours
- that cargo vapours and ignition sources must be eliminated on deck and in other gas-dangerous zones where oxygen is present
.26 lists dangers from:
- accumulations of oily rags, waste and other flammable material
- cathodic protection units becoming detached and falling into cargo spaces with the possibility of spark generation
- the use of aluminium paints on areas of rust, thereby generating heat
- the generation of static electricity, and electrical discharge
- thereby, from:
  - flow of petroleum (non-conductor) through metal pipelines (conductor)
  - concentration of static at oil free-surface during loading
  - water washing of cargo tanks
  - lowering sampling or ullaging equipment into a tank
  - water slugs from a high-capacity tank-washing machine
  - surging of ballast water

.27 states that:
- an important countermeasure to prevent electrostatic hazards is to bond all metal objects together
- on ships, bonding to earth is effectively accomplished by connecting all metal objects to the ship's structure
- the ship's hull is naturally earthed through the seawater

6 Pollution prevention

6.1 Causes of marine (air and water) pollution
.1 states that marine pollution at sea can occur as a result of:
- strandings and collisions
- lightening operations
- normal operations such as tank washing and line flushing
- deballasting
- thermal expansion of oil in tanks and piping
 .2 states that marine pollution in port can occur as a result of:
- leaking hoses and loading arms
- overflow from tanks
- equipment failure
- procedural failures, e.g. improperly set sea valves

6.2 Prevention of marine pollution
.1 states that the International Maritime Organization is the international body responsible for controlling marine pollution
 .2 states that IMO achieves this by adopting the International Convention for the Prevention of Pollution from Ships, commonly known as "MARPOL"
 .3 states that Annex I of the MARPOL Convention contains regulations for control of pollution by oil
 .4 states that Annex II of the MARPOL Convention contains regulations for control of pollution by noxious liquid cargoes carried in bulk or tank washings from such cargoes
.5 states that, to prevent hazards to the environment, the following should be observed

Oil tankers
.6 states that for oil tankers at sea:
- there are requirements for the discharge of oil into the sea which must be observed
- in order to comply with these requirements, LOT procedures must be observed during deballasting, decanting and tank cleaning operations
most crude carriers must:
• crude oil wash their cargo tanks to minimize oily wastes;
• have segregated ballast tanks; or
• have dedicated clean ballast tanks

.7 states that for oil tankers in port:
- ship movements alongside must be restricted by adjusting moorings
- all pipelines, joints and valves must be kept under observation whilst handling cargo
- catchment trays must be fitted or placed at vulnerable points (hose connections, for example)
- strict control must be exercised whilst loading to prevent tanks overflowing
- all scuppers must be closed to prevent a discharge of oil from the deck overboard
- all valves and blanks must be checked prior to cargo operations
- valves not used should be secured if possible
- sea valves not in use should be closed by double valves or blanked off
- if oil is spilt, cargo operations must be stopped and warnings given to all involved

Chemical tankers

.8 states that for chemical tankers at sea and in port:
- for the purpose of discharging slops containing cargo residues into the sea, Annex II divides noxious cargoes on
chemical tankers into four categories
- these categories are A, B, C and D, and a cargo of category A represents the most dangerous pollutant and a cargo of
category D the least dangerous
- all operations on board involving cargo, ballast and bunkers should be done in accordance with the applicable pollution
Regulations
- carrying out operations in accordance with the ship's Procedures and Arrangements (P and A) Manual ensures that
pollution regulations are complied with
- care should be taken to avoid cargo spillage during cargo transfer, ballasting or tank-cleaning operations
- pollution-prevention procedures during the operations include keeping a watch on:
• levels in cargo, slop or ballast tanks
• cargo or ballast hoses or hard arms
• spill pans and scuppers
• alarms and instrumentation
• co-ordination of operation signals
- personnel on watch should be present at all times during operations and regularly carry out the inspections on the
pollution-prevention procedures

Liquefied gas tankers

.9 state that for liquefied gas tankers at sea and in port:
- all operations on board involving cargo, ballast and bunkers should be done in accordance with the applicable pollution
regulations
- during cargo-transfer operations, care should be taken to avoid release of cargo liquid and/or vapours
- the preparation for cargo transfer includes procedures to be followed to prevent pollution of air and of water
- these procedures include:
• inspection of cargo hoses, loading arms, valves and gaskets
• inspection of cargo system and instrumentation
• inspection of flanges, valves, connections and tank hatches for tightness
- personnel on watch should be present at all times during cargo-transfer operations, and should regularly carry out the inspections mentioned above

.10 states that, where required, all events should be recorded in the Oil/Cargo Record Book

**Air pollution**

.11 states that air pollution may be caused by inert gas, hydrocarbon gas or any other cargo vapour finding their way into the atmosphere because of:
- the breathing or venting of loaded tanks
- purging or gas-freeing operations
- loading or ballasting cargo tanks

.12 states that hydrocarbon vapour collects above the surface of the oil
.13 states that the vapour/air mixture is displaced during loading, ballasting, gas-freeing and tank-washing operations
.14 states that hydrocarbon gas, chemical gas and inert gas may be considered air pollutants
.15 states that no measures are usually taken against air pollution at sea, apart from the necessary safety precautions:
- have good communication
- have the best possible co-operation between ship and terminal
.16 states that some ports have regulations restricting air pollution from tankers
.17 states that certain displacement and containment measures can be taken to restrict air pollution
.18 specifies the manner in which the emissions of volatile organic compounds (VOCs) from tankers are to be regulated in ports
and terminals
.19 outlines, briefly, the provisions for the control of VOC emissions from tankers
 .20 states that some terminals have a vapour emission control system
 .21 describes, in simple terms, the fundamental concept of a vapour control system

**6.3 Measures to be taken in the event of spillage**

1 states the measures to be taken in the event of spillage, including the need to:
- immediately report all relevant information to the appropriate officials when a spill is detected or when a malfunction has occurred which poses a risk of a spill;
- promptly notify shore-based response personnel;
- and properly implement shipboard spill-containment procedures

**6.4 SOPEP**

.1 states that, as per the MARPOL Convention, most tankers shall carry a Shipboard Oil Pollution Emergency Plan (SOPEP)
.2 states in brief that the concept of the plan is to assist personnel in dealing with an unexpected discharge of oil
 .3 states that the SOPEP consists of at least:
- the procedure to be followed to report an oil pollution incident
- the list of authority or persons to be contacted in an event of an oil pollution incident
- description of action to be taken by persons on board to control the discharge of oil
- the procedures and point of contact on the ship for coordinating shipboard action with national and local authority

**6.5 Ship/shore liaison**

.1 states that for safe conditions alongside a terminal it is necessary to:
- comply with safety regulations
- have good communication
- have the best possible co-operation between ship and terminal
.2 lists safety precautions and procedures for personnel on watch prior to and during cargo transfer with regard to:
- communication
- cargo information
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

- ship information/terminal information
- moorings
- emergency towing-off wires
- gangways or accommodation ladders
- fire-fighting equipment
- lighting
- unauthorized persons
- persons smoking, drunk or drugged signs and notices craft alongside
- scuppers
- weather precautions
- connection/disconnection of hoses for cargo, slop or ballast
- safety equipment and protective clothing
- doors and portholes
- designated smoking places

.3 states that a ship/shore safety checklist should be completed jointly by a ship’s officer and a shore representative to ensure the safety of both ship and terminal

7. Emergency operations

7.1 Emergency measures

.1 states that planning and preparation are essential for dealing successfully with emergencies and lists the information which should be readily available as:

- type of cargo and its disposition
- location of other hazardous substances
- general arrangement plan of the ship
- stability information
- location of fire-fighting equipment and instructions for its use

.2 states that, in an emergency, important actions to take would include:

- giving audible and visual warnings that an emergency exists by means of:
  - bells, whistles, klaxons or other audible devices
  - flashing lights
- advising the command centre of the location and nature of the emergency
- stopping any cargo-related operations, closing valves and openings in tanks
- removing any craft alongside

.3 states that personnel in the vicinity of the emergency should take appropriate action to try and control the incident until the emergency team can take over

.4 states that all crew members should know the location of all safety equipment, such as:

- breathing apparatus
- protective clothing
- approved portable electric lights
- instruments for measuring oxygen and other gases
- first-aid kits
- tank evacuation equipment
- fire-fighting equipment with instructions for its use

.5 states that all equipment which may be needed in an emergency must be maintained in good order and always be ready for use, and lists important items as:

- fire-fighting equipment
- breathing apparatus
- protective clothing
- alarm systems
- communication systems
- arrangement plans

.6 states that towing hawsers should be prepared, hung offside over bow and stern ready for use

.7 states that a plan for dealing with an outbreak of fire or an explosion must be prepared and all crew members briefed on its operation
7.2 Organizational structure

.1 states that the planning for and the implementation of an emergency procedure require an emergency organization.

.2 states that the basic structure of the emergency organization should consist of four elements:
- emergency command centre (with an alternate emergency position identified for use if the normal command centre cannot be occupied)
- emergency party
- back-up emergency party
- engineers group or technical team

.3 states the need to identify a senior officer as being in control during the emergency, with another senior officer identified as his deputy.

.4 states the general composition and the task of the emergency command centre.

.5 states the general composition and the task of the emergency party.

.6 states the general composition and the task of the back-up emergency party.

.7 states the general composition and the task of the engineers group.

.8 states that all personnel on board should know their place in the emergency organization and their duty in case an emergency procedure is being initiated.

.9 states the need for realistic drills to be undertaken periodically.

7.3 Alarms

.1 states that a fire alarm signal or general alarm signals are given in case of:
- fire
- collision
- grounding
- man overboard
- cargo hose burst
- major cargo spillage or escape of vapour
- every other emergency situation which calls for emergency actions.

.2 states that other alarm signals are given in case of:
- high concentration of toxic or flammable vapours
- unacceptable condition in cargo tanks or cargo systems
- unacceptable conditions in auxiliary cargo systems
- system failure in cargo plant and auxiliary systems
- system failure in engine-room or machinery spaces
- a CO2 discharge in engine-room or pump-rooms
- a high level of oxygen in inert gas
- high level of oil residues in overboard discharge.

.3 states that the ship’s muster list and emergency instructions specify details of the emergency alarm signals.

.4 states that all personnel on board should be able to identify the different alarm signals.

.5 states that all crew members should be familiar with the emergency plan and act according to the plan when the alarm is raised.

.6 states that any person who discovers an emergency should raise the alarm and pass on relevant information as quickly as possible.
7.4 Emergency procedures

.1 states that the ship’s muster list and emergency instructions specify action to be taken by each crew member and officer in case of an emergency.

.2 states that all personnel should be familiar with the emergency instructions and act according to the instructions when the alarm is raised.

.3 states that a vessel’s safety plan and fire control plan specify details and location of all equipment for emergency use.

.4 states that all personnel should know the location of emergency equipment and be familiar with its use.

.5 states that it is essential that personnel are properly trained for emergency operations.

.6 states that all equipment which may be used in an emergency must be maintained in good order and be ready for use at all times.

.7 lists basic emergency actions to be taken in case of:
- Fire
- Collision
- Grounding
- Cargo hose burst
- Accident involving personnel

.8 states that the correct emergency procedures for accidents involving dangerous chemicals are given in the ICS or other Cargo Data Sheets.

7.5 First-aid treatment

.1 states that first-aid procedures for accidents involving dangerous chemicals are given in the ICS or other Cargo Data Sheets.

.2 states that all personnel should be familiar with the first-aid procedure set out in the Data Sheets for the cargoes carried.

.3 states that medical advice should be sought in the event of an accident.

.4 states that the emergency showers should be used immediately in the event of spillage of cargo liquid in eyes or on skin.

.5 states that the correct treatment for most cargoes is to flush with water for at least 15 minutes and to remove the affected clothing.

.6 states that for symptoms of vapour exposure the treatment for most cargoes is:
- to remove the victim to fresh air
- to give artificial resuscitation if breathing has stopped or is weak/irregular

.7 states that if frostbite has occurred this should be treated by immersion in lukewarm water.

.8 states that antidotes for cargoes carried are available on board.

.9 states that all personnel should be instructed and trained in the technique of mouth-to-mouth resuscitation and basic first-aid treatment.

8 Cargo equipment

8.1 General cargo-handling equipment on board oil tankers

.1 states that for this section the training should preferably be carried out on board.

.2 states that this section complements on-board training.

Oil cargo containment and handling

Tank arrangements

.3 describes the general tank arrangements; including:
- Cargo tanks
- Pump-rooms
- Segregated ballast tanks
- Slop tanks
- Cofferdams
- peak tanks
- deep tanks

**Piping arrangements**

4 describes the piping arrangements, including:
- internal piping in tanks and pump-rooms
- external piping (deck lines)
- crossovers
- by-passes
- ring-main systems

**Pump types**

5 describes the operating principles of the following pump types:
- reciprocating positive-displacement pumps
- rotary positive-displacement "screw" and screw-type pumps
- rotary positive-displacement lobe- and vane-type pumps
- roto-dynamic (centrifugal) pumps
- educators

**Pump characteristics**

6 states suitability of the pump types listed above for cargo handling in terms of:
- maintaining flow at inlet under low heads
- start-up procedures

**Draining and stripping**

7 lists the reasons for draining and stripping tanks, lines and pumps, and states the pumps suitable for this purpose in terms of:
- maintenance of flow at inlet under low head conditions
- ability to "self prime"
- wear on moving parts when flow is intermittent or fluctuating

**Measurement of cargo level**

8 explains how the level of cargo in the tank can be determined by sounding or by measuring ullage and lists the various devices used for this as:
- flexible steel or alloy tapes
- float indicators
- pneumatic gauges
- hydraulic gauges
- electrical capacitance gauges
- sonic gauges
- radar gauges
- multi-function unit

**Cargo heating**

9 states that:
- a particular viscosity range is required for storage and handling and that this is maintained by controlling the temperature of the oil
- the methods of heating the cargo are the use of:
  - steam supplied to coils or other forms of extended heating surface, for normal petroleum cargoes
  - a mineral oil heating fluid supplied to heating apparatus for special (heavy) petroleum cargoes
- leakage in heat-exchanger pipes or matrix units will permit oil to contaminate the condensate system in steam heating systems or water to contaminate the oil cargo
- dangers exist in heating heavy cargoes (such as bitumen) if water is present in the cargo
- steel heating coils suffer serious corrosive attack from crude oil cargoes
- oil vaporization increases with a rise in temperature

**8.2 General cargo-handling equipment on board chemical tankers**

1 states that for this section the training should preferably be carried out on board
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.2 states that this section complements on-board training

**Ship types and arrangements**

**Tankers for chemicals**

.3 states that:
- the design of a chemical tanker is based on the design of a conventional oil tanker
- a tanker carrying chemicals may be referred to as a "chemical tanker", a "parcel tanker", a "product tanker" or a combination of these designations
- a chemical tanker is a tanker designed for the carriage of dangerous chemicals as identified by the IMO Chemical Codes
- tanks, ballast tanks and cofferdams
- a product tanker is a tanker primarily designed for transport of petroleum products such as naphtha, gasoline, kerosene, white spirit, lubricating oils, etc.
- a chemical tanker may carry dangerous chemicals and all product tanker cargoes, but that a product tanker is limited to carry products and chemicals which are not identified in the Codes as dangerous
- a parcel tanker is a tanker (normally for chemicals) with a great number of individual cargo tanks, which enables the vessel to carry a great variety of small cargo "parcels" on each voyage
- a product tanker has fewer and bigger cargo tanks than a chemical/parcel tanker and less sophisticated tank materials and coatings

.4 explains, with the aid of a simple drawing, how the tank section in a chemical tanker may be divided into cargo tanks, slop tanks, ballast tanks and cofferdams

.5 states that:
- the cargo-tank area is that part of the ship which contains cargo tanks, slop tanks and pump-rooms and includes cofferdams, void spaces and deck spaces adjacent to and above all such spaces
- the cargo tanks and slop tanks are segregated from other parts of the ship
- segregation is achieved by means of cofferdams, void spaces, cargo pump-rooms, other pump-rooms, empty tanks or fuel-oil tanks
- gas-dangerous spaces and zones are spaces and zones within the cargo area which are likely to contain cargo vapours and which are not equipped with approved arrangements to ensure that their atmosphere is maintained in a safe condition at all times
- a gas-safe space is a space other than a gas-dangerous space, and identifies, on a drawing, the gas-dangerous areas and the gas-safe areas
- a cargo control room is normally placed aft of the cargo area
- cargo-handling systems are, with few exceptions, completely separated from accommodation spaces, machinery spaces and other gas-safe spaces
- when cargo-handling systems are located outside the cargo area, operational and constructional precautions are taken to prevent cargo or cargo vapour flowing to a gas-safe area. The construction of the cargo-tank ventilation system reduces the risk of cargo vapour in gas-safe areas
- air intakes for accommodation and for the engine-room are subject to requirements with respect to minimum distance from ventilation outlets of gas-dangerous spaces. Access to accommodation or to the engine-room is subject to requirements with respect to the minimum distance from the forward bulkhead of the accommodation
- chemical tankers may have cargo pump-rooms located on or below the main deck, sometimes both
- the cargo pump-rooms contain cargo pumps and cargo pipelines
- pump-rooms have permanent arrangements for hoisting an injured person with a rescue line
- the mechanical ventilation arrangements in the pump-rooms have a capacity to ensure sufficient air movement through the space
- spaces not normally entered (e.g. double bottoms, cofferdams and pipe tunnels) are capable of being ventilated to ensure a safe environment when entry into these spaces is necessary
access to spaces in the cargo area should be sufficiently large to allow a person wearing a self-contained breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also to enable the hoisting of an injured person from the bottom of the space

- segregation and separation of cargoes and spaces are fundamental to the safety of the chemical tanker

**Survival capability and tank location**

.6 states that:
- the Bulk Chemical Codes divide chemical tankers into three ship types, Type 1, Type 2 and Type 3, which reflect the hazard rating of the cargoes to be carried
- a Type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazards and that Type 2 and Type 3 are for products of progressively lesser hazards
- a Type 1 ship is required for highly hazardous cargoes such as dodecylphenol and phosphorus
- the most common chemical tanker cargoes require Type 2 or Type 3 ships
- the background for the IMO grouping of ship types is the ship's capability to survive damage caused by collision or stranding, in combination with the location of the cargo tank in relation to such damage
- the term "overall hazard" includes both safety hazard and pollution hazard

**Cargo equipment and instrumentation Tanks, piping and hoses**

.7 lists tanks in the cargo area, such as:
- cargo tanks
- slop tanks
- segregated ballast tanks

.8 explains, with the aid of a simple drawing, how the tanks mentioned above may be located in a chemical tanker

.9 states that:
- some chemical tankers have small additional cargo tanks located on deck
- slop tanks are tanks designated or used for tank washings and cargo residues
- cargo tanks may also be used as slop tanks and vice versa
- segregated ballast tanks are tanks designated for ballast only
- segregated ballast tanks are equipped with a pumping system that is independent of the cargo system, in order to avoid contamination by cargoes
- cargo tanks may also be used for ballast
- some commonly fixed piping arrangements in a cargo tank are:
  - discharge line
  - cargo ventilation line
  - drop line
  - the main purpose of the discharge line is to lead the cargo from the cargo tank to the manifold by means of a cargo pump
  - the drop line is mainly used to fill the cargo tank
  - the main purpose of the ventilation line is to lead vapour from the cargo tank to the cargo ventilation tower
  - the flow of cargo vapour may be regulated by a pressure/vacuum relief valve in the ventilation line
  - the vent outlets are arranged to prevent the entry of water into the cargo tanks and, at the same time, to direct the vapour discharge upwards
  - the vent outlets are provided with flame screens or high-velocity devices

there are several types of valves used in cargo-handling systems on chemical tankers
- chemical tankers are provided with cargo hoses the cargo hose constitutes a weak part of the cargo-handling system and that incorrect handling of the hose will increase the danger of fire, health hazard and pollution

.10 describes, with the aid of a simple drawing, a cargo-unloading arrangement

.11 describes, with the aid of a drawing, a simple cargo-loading arrangement

.12 describes correct handling, storage and inspection of the ship's cargo hoses

**Constructional materials and coatings**

(Note: for this section, objective 8.2.13 is a repeat of objectives 4.2.37 to 4.2.48)

.13 states that:
- all materials used for construction of tanks and the associated piping, valves and pumps must be resistant to the cargoes carried and dictated by the service temperature
- mild steel is the normal material for the construction of a chemical tanker
- mild steel is resistant to most chemicals, but that its propensity to rust makes it unsuitable for chemical cargoes
- rust makes tank cleaning more difficult and may also contaminate the cargo
- in order to avoid cargo contamination and to obtain a smooth surface on tank structures, mild-steel cargo tanks on chemical tankers are always coated internally with paint that is resistant to groups of chemicals
no coating today is suitable for all cargoes shipped in chemical tankers, and that a "coating resistance list" must be strictly followed when a cargo is to be loaded in a coated tank
- most chemical tankers have their cargo-tank section divided into some coated tanks and some stainless-steel tanks
- stainless steel may be "clad" or solid
- clad steel consists of a mild steel plate with a veneer of stainless steel of about 2 mm thickness
- stainless steel is resistant to almost all chemicals
- stainless steel is not "stainless" or corrosion-resistant unless it is handled properly
- the steel manufacturer's or the owner's instructions for maintenance of stainless-steel tanks and piping must be strictly followed by ship's personnel

**Pumps and eductors**

.14 states that:
- the main cargo pumps fitted aboard chemical tankers are mainly of the centrifugal type
- these pumps may be of the deepwell type in the cargo tanks or placed in a pump-room
- screw pumps and piston pumps are used also in some unloading systems
- the cargo-pumping systems on chemical tankers are designed to minimize cargo remnants after discharge
- in addition to the main unloading pumps, there are arrangements for alternative unloading
- alternative unloading may be done by means of portable cargo pumps or eductors

.15 describes generally:
- an unloading system consisting of submerged cargo pumps
- an unloading system consisting of pumps placed in pump-rooms
- the safe handling of a centrifugal pump

**Cargo heating systems**

.16 states that:
- some cargoes have to be heated by the ship's cargo heating system
- the main reason for heating a cargo is:
  - to keep the viscosity below a certain level during unloading
- the heating medium may be steam, water or thermal oils
- means are provided to ensure that cargo does not enter boilers or the engine-room through leakages in cargo heating coils

.17 describes, with the aid of a drawing, a cargo heating system:
- using heating coils fitted inside the cargo tank
- using a heat exchanger placed outside the cargo tank

**Tank-washing and slop-retaining systems**

.18 states that:
- mixtures of water and cargo from tank-washing operations are called "slops"
- tanks which contain this sort of mixture are called "slop tanks"
- slop tanks should be placed inside the cargo area
- slops may be stored in slop tanks or in cargo tanks
- slops from different cargoes may be incompatible

.19 describes, with the aid of a drawing, a tank-washing and slop-retaining system

**Inert-gas systems**

.20 defines "inert gas"

.21 states that:
- inert gas is used in cargo tanks
  * to protect the cargo from polymerization, oxidation and humidity
  * to replace air and thereby prevent fire and explosion
- the inert gas produced by an oil-burning inert-gas generator is composed of:
  * approximately 0.5% oxygen
  * approximately 84% nitrogen
  * approximately 15% carbon dioxide
  * approximately 0.5% carbon monoxide, oxides of nitrogen and sulphur dioxide nitrogen
- is delivered on board in pressurized bottles or in liquid form
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

• may be produced on board by distillation of liquid air
• may be produced on board by separation of air
• may be produced on board by combustion of ammonia
• may be produced on board by removing CO2 from inert gas
  - some terminals deliver inert gas or nitrogen through the loading line and purge the cargo tanks prior to loading the product
  - .22 describes generally an inert-gas generator system

Instrumentation
.23 states that:
  - all electrical equipment installed or used in gas-dangerous areas is approved for operation in flammable atmospheres
  - each cargo tank is provided with means for indicating the temperature and a predetermined high level of the cargo
  - the liquid level in cargo tanks may be measured by means of an open, a restricted or a closed device
  - the Bulk Chemical Codes define limitations of the measuring devices with regard to the types of cargo carried
  - the type of gauging device that may be used is related to the construction of the device and the amount of vapour to which its user is exposed
  - an open gauging device is used to measure products of moderate toxicity and where the vapours have approx imately the same flammable limits as petroleum vapours
  - restricted gauging device is used to measure products that are relatively toxic and volatile, but where skin contact is not poisonous
  - a closed gauging device is required for the most hazardous cargoes

8.3 General cargo-handling equipment on board liquefied gas tankers
1 states that for this section the training should preferably be carried out on board
.2 states that this section complements on board training

Cargo containment systems
Independent tanks
.3 states that independent tanks are completely self-supporting and neither form part of the ship's hull nor contribute to hull strength
there are three different types of independent tanks for gas carriers: types A, B and C
.4 describes generally:
  - a self-supporting prismatic tank (type A)
  - a self-supporting spherical tank (type B)
  - a self-supporting cylindrical tank (type C) Membrane tanks
.5 states that membrane tanks are not self-supporting, like the independent tanks, but are supported through the insulation by the hull of the ship
.6 describes generally the design of a membrane tank Semi-membrane tanks
.7 states that semi-membrane tanks are not self-supporting in loaded condition
.8 describes generally a semi-membrane tank

Integral tanks
.9 states that
.2.2 integral tanks form a structural part of the ship's hull, and are affected in the same manner and by the same loads which stress the hull structure
.2.3 these tanks are not normally allowed for cargoes of which the temperature is below 10 °C
.10 describes generally an integral tank

Internal insulation tanks
.11 states that:
internal insulation tanks are not self-supporting, consisting instead of thermal insulation materials which contribute to the cargo containment, and are supported by the structure of the adjacent inner hull or of an independent tank the inner surface of the insulation is exposed to the cargo

**The liquefied gas tanker Gas tanker types**

.12 states that:
- liquefied gas tankers can be grouped into five different categories according to the cargo carried, as follows:
  - LPG ships
  - LEG ships
  - LNG ships
  - Chlorine ships
  - LEG/LPG/chemical ships
- liquefied gas tankers can be grouped into three different categories according to carriage condition, such as
  - fully pressurized ships
  - semi-pressurized ships
  - fully refrigerated ships
.13 describes generally:
- LPG ships
- LEG ships
- LNG ships
- Chlorine ships
- LEG/LPG/chemical ships

**Layout of a general gas tanker**

.14 states that:
- the cargo area is segregated from other parts of the ship
- cargo-handling systems are completely separated from accommodation spaces, machinery spaces and other gas-safe spaces fundamental to the safety of the gas tanker
- gas-dangerous spaces and zones are spaces and zones within the cargo area which are not equipped with approved arrangements to ensure that their atmosphere is maintained in a safe condition at all times and which are, therefore, likely to contain cargo vapours
- a gas-safe space is a space other than a gas-dangerous space
- air intakes for accommodation and engine-room have to be at a minimum distance from ventilation outlets from gas-dangerous spaces
- access to accommodation or engine-room has to be at a minimum distance from the forward division of the accommodation
- access from a gas-dangerous zone on the open weather deck to a gas-safe space is arranged through an airlock
- the airlock doors should be self-closing, and there must not be any hook or other device by which they could be held open
- an audible and visual alarm system gives a warning on both sides of the airlock when one door is moved from the closed position
- gas-safe spaces within the cargo area have positive-pressure ventilation
- when this overpressure is lost, all electrical equipment that is not of a certified safe type should be de-energized
- use of segregation, separation and airlocks are fundamental to the safety of the gas tanker
Survival capability and tank location

.15 states that:
- the IMO Codes divide gas tankers into four categories, ship types 1G, 2G, 2PG and 3G, which reflect the hazard rating of the cargoes to be carried
- a type 1G ship is a gas tanker intended for the carriage of products considered to present the greatest overall hazards, and types 2G, 2PG and 3G are intended for products of progressively lesser hazards
- type 1G ships are required for highly hazardous cargoes such as chlorine
- the most common cargoes, such as LNG, LPG and ethylene, must be carried in type 2G or type 2PG ships
- type 3G ships are only permitted to carry nitrogen and refrigerant gases
- the background for IMO's grouping of ship types is the ship's capability to survive damage caused by collision or grounding and the capability of tanks to contain the cargo after sustaining such damage.

Cargo equipment and instrumentation

.16 describes generally the cargo piping arrangement

.17 states that:
- the construction materials in tanks, piping and equipment containing cargo liquid and vapour should be resistant to the cargo
- the resistance to the cargo is dictated by the minimum service temperature and the compatibility with the cargo carried
- all connections and personnel access to a cargo tank have to be arranged through the cargo tank dome area
- commonly found fixed piping arrangements in a cargo tank are:
  - sample tubes
  - vapour line
  - condensate line
  - stripping line/puddle heat line
  - discharge line
  - liquid line
  - upper purge line/spray line
  - ventilation line
- there are usually three sample tubes at different levels in the cargo tank
- the monitoring of tank atmosphere and cargo sampling can be done through the sample tubes
- the main purpose of the vapour line is to lead the boil-off to the reliquefaction plant or to the shore via the crossover
- the main purpose of the condensate line is to lead reliquefied gas from the reliquefaction plant to the cargo tank
- the stripping line is used for removal of remaining liquid cargo from the pump sump by means of pressure
- the purpose of the puddle heat line is to lead heated cargo vapour from the cargo compressor to the pump sump for vaporizing the remnants of a liquid cargo
- the main purpose of the discharge line is to lead the liquid cargo from the cargo tank to the crossover by means of the cargo pump
- the main purpose of the liquid line is to lead the liquid cargo from shore to the cargo tank via the crossover
- the purpose of the upper purge line is to lead different types of ventilation gases into or from the cargo tank
- the main purpose of the spray line is to spray liquid cargo into the tank during cool-down of the cargo tank
- the main purpose of the ventilation line is to lead vapour from the cargo tank safety relief valve to the vent outlet
- a cargo tank should have shutoff valves located as close to the tank as practicable for all liquid and vapour connections, with the exception of pressure-relief valves and liquid level gauging devices
- IMO establishes rules for place, type and number of valves in a cargo piping system
- the IMO regulations require remotely operated emergency shutdown valves in the cargo piping system Pressure-relief and vacuum-protection system

.18 describes generally the pressure-relief piping system

.19 states that:
- all cargo tanks should be provided with a pressure-relief system
- IMO has established rules for vacuum protection of cargo tanks
- all equipment and piping which may be isolated when full of liquid should be provided with a pressure-relief valve
- the pressure-relief and vacuum-protection system gives an automatically controlled protection against too high or too low pressure within the cargo-handling system
Pumps and unloading systems

.20 describes generally the unloading system

.21 states that:
- the main cargo pumps fitted aboard liquefied gas tankers are of the centrifugal type
- these cargo pumps are either submerged or deepwell pumps
- on fully pressurized gas tankers the cargo pumps may be mounted on deck in addition to the main unloading pumps there are arrangements for alternative unloading
- alternative unloading can be done by means of vapour pressure, replaceable pump or eductor

.22 describes generally:
- the operating principle of a centrifugal pump
- safe centrifugal pump handling

Cargo heaters and cargo vaporizers

.23 states that:
- when discharging refrigerated cargoes into pressurized shore tanks it is frequently necessary to heat the cargo in a cargo heater because the shore tanks and piping materials are not designed for low temperatures
- seawater is commonly used as a heating medium for the cargo heater
- it is necessary to run the booster pump when discharging to a pressurized shore tank
- a vaporizer is used to maintain the pressure in the cargo tank during discharging
- seawater and steam are each commonly used as the heating medium for vaporizers

Reliquefaction systems and control of boil-off

.24 states that:
- heat is always transferred from a warmer area to a relatively cooler area
- the temperature of the cargo will increase as long as the cargo is relatively cooler than the environment
- when the temperature of the cargo increases, the pressure in the cargo tank increases
- because of the transmission of heat to the cargo, means must be provided to control the vapour pressure in the cargo tanks
- the methods of controlling vapour pressure in cargo tanks include:
  - leading the cargo boil-off to the ship's boiler, gas turbine or main engine to be used as fuel
  - leading the cargo boil-off to the ship's reliquefaction plant, where the vapour is liquefied
  - cooling the liquid cargo in a heat exchanger
  - cooling the shell of the cargo tank and thereby the cargo
.25 describes generally:
- a simplified vapour-handling system for LI4G boil-off
- a simplified single-stage direct reliquefaction cycle
- a simplified cascade reliquefaction cycle
- a simplified indirect reliquefaction cycle

Cargo compressors

26 describes generally:
- the operating principle of a reciprocating compressor
- the operating principle of a screw compressor

27 states that the reciprocating and screw compressors used on board gas carriers are commonly of the oil-free type

Inert-gas system

.29 defines "inert gas"

.30 states that:
- inert gas is used in cargo tanks and hold spaces to replace air, thereby preventing fire and explosion
- inert gas is commonly produced on gas tankers by an oil-burning gas generator
- inert gas produced by an oil-burning gas generator is composed of
Basic Training For Oil and Chemical Tanker  
Model Course – 1.01

- approximately 0.5% oxygen  
- approximately 84% nitrogen  
- approximately 15% carbon dioxide  
- approximately 0.5% carbon monoxide, oxides of nitrogen and sulphur dioxide

.31 describes generally an inert-gas generator system

**Instrumentation**

.32 states that:
- all electrical equipment installed or used in gas-dangerous spaces or zones should be approved for operation in a flammable atmosphere  
- each cargo tank is provided with means for indicating level, pressure and temperature of the cargo  
- the liquid level in cargo tanks is commonly measured by means of float gauges  
- each cargo tank is fitted with high-level alarms  
- the purpose of high-level alarms is to prevent overflow of cargo tanks  
- that every gas tanker has a fixed gas-detection system  
- the fixed gas-detection system's alarm is activated when  
- the vapour concentration reaches 30% of the Lower Explosive Limit (LEL)

.33 describes generally:
- a float gauge  
- a simplified fixed gas-detection system

**9 Cargo operations**

**9.1 General awareness of safe cargo operational procedures on tankers**

.1 states that for this section the training should preferably be carried out on board  
.2 states that this section complements on-board training

**For oil tankers**

**Loading**  
.3 explains need for compliance with all safety requirements  
.4 states:  
- that the control valves are operated during loading according to planned sequence of filling tanks  
- that the quantity of cargo is checked by measuring ullages  
- that the venting of tanks into the atmosphere is controlled as necessary  
- that events during operations are recorded  
.5 explains how and when samples are taken  

**Loaded voyage**

.6 explains how and when vapour pressures are checked and logged (non-IGS vessel)  
.7 states:  
- that cargo vapour may be vented to control pressure
how the temperature of the cargo is controlled

**Discharging**

8 explains the need for compliance with all safety requirements

.9 states:
- that the control valves are operated during discharging according to planned sequence of emptying tanks
- why and how tanks are vented
- that ballast is loaded as required by the discharging plan

.10 outlines draining and stripping procedures

**Ballast voyage**

11 explains the need for ballasting

.12 states:
- that a number of tanks are allocated for ballast
- the considerations for allocating the amount of ballast
- that some tankers have tanks solely designated for ballast, served by a dedicated ballast system
- such tanks are defined as segregated ballast tanks
- that additional ballast is carried in cargo tanks if the segregated ballast capacity is insufficient
- that such ballast is put in dirty cargo tanks
- that such ballast is heavily contaminated with oil

.13 explains:
- why the ship may have only clean or segregated ballast on board upon arrival in the loading port
- the operations for changing ballast
- how the slop tank is filled with an oily water mixture
- the need to decant the contents of the slop tank
- the decanting procedure in general terms
- that the remainder of the slop tank may be utilized for the carriage of cargo
- the process of changing ballast, decanting the contents of slop tanks and loading slop tanks as the load-on-top procedure (LOT)

**Tank cleaning**

14 lists the reasons for tank cleaning

.15 states that:
- tank washing machines are used
- there are portable and fixed tank washing machines
- tanks may be cleaned with water or crude oil
- on the ballast voyage, only water is used, sometimes mixed with chemicals
- hot or cold water may be used
- the tank washing system incorporates a water heater
- tank washing should preferably be carried out in a non-explosive atmosphere
- this may be an inert or, alternatively, too lean or too rich atmosphere
- if an inert-gas system (IGS) is fitted and operating, tank washing should take place in an inert atmosphere
- if an IGS is not fitted, tank washing should preferably take place in a too lean atmosphere

.16 explains:
- too rich and too lean atmospheres
- ventilating to a too lean atmosphere as gas-freeing
- that gas-freeing should be continued during tank washing
that tank washing water is transferred to the slop tank

- the working of tank washing machines
- the use of the slop tank in the open-cycle mode
- the use of the slop tank in the recirculation mode
- line flushing

Crude oil washing (COW)

Use of inert gas

Purging and gas-freeing

- gas-freeing is usually done by mechanical means such means may be portable fans or a fixed system the IGS may be used for gas-freeing
- gas-freeing is the replacement of hydrocarbon vapours or inert gas by air
- hydrocarbon vapours remain inside a cargo tank after cargo discharge
- the hydrocarbon vapours are mixed with inert gas on a ship fitted with an IGS or with air in a ship not so fitted
- in an inerted cargo tank there is no explosive atmosphere
- care must be taken that the tank atmosphere does not come within flammable range during gas-freeing operations
- soot particles in inert gas create an additional ignition hazard in an explosive tank atmosphere
- gas-freeing a non-inerted tank will bring the tank atmosphere within the explosive range for some time
- oil tankers should be supplied with meters to check oxygen content, hydrocarbon content and toxic gas content
- meters are available showing percentage lower flammable limit (LFL) by volume
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.2 explains how purging a tank with inert gas will prevent the development of an explosive atmosphere in a cargo tank.

**Tank cleaning and gas-freeing for repairs**

.3 states that:
- procedures for tank cleaning, purging and gas-freeing must be carried out
- before personnel enter any tank, the atmosphere must be checked for oxygen content, hydrocarbon content and, after carrying some cargoes, toxic gas content
- oxygen content must be 21% by volume
- hydrocarbon content must be less than 1% LFL
- after tank washing, manual removal of residue may be necessary
- residue removal generates more hydrocarbon gas
- gas-freeing operations must therefore be continuous
- adjacent bulkheads and pipelines may constitute additional sources of hydrocarbon gas
- the inert gas supply to the tank should be shut off
- a gas-free certificate is needed from a qualified chemist before contractor’s work can be carried out
- an additional hot work permit is required for hot work
- that such certificate and permit must be reissued every day that work is carried out, or such lesser period as the port authority stipulates

**For chemical tankers**

**Cargo information**

(Note: for this section, objectives 9.1.24 and 9.1.25 are a repeat of objectives 4.1.1 to 4.1.8)

.24 states that:
- information about cargoes to be handled is essential to the safety of the vessel and her crew.
- such information may be found on ICS or other Cargo Data Sheets for each product, which also include all necessary data for the safe handling and carriage of the cargo
- cargo information for most tanker cargoes is kept on board and available for all concerned
- the cargo will not be loaded unless sufficient information necessary for its safe handling and transportation is available
- the responsible officer will see to it that the necessary cargo information is posted on the notice board prior to cargo operations
- all personnel engaged in cargo operations should familiarize themselves with the cargoes by studying the ICS or other Cargo Data Sheets
- cargo information is fundamental to cargo planning
.25 lists reference books where cargo information may be found

**Cargo planning**

.26 states that:
- cargo operations are always preplanned
- the main purpose of planning cargo operations is to ensure safe and efficient operation cargo operations on chemical tankers may involve simultaneous loading, unloading and tank cleaning
- the planning of these operations is done in co-operation between the vessel and a shore-based operating team
- cargo preplanning is based on cargo information, port information and thorough knowledge of the ship and its cargo systems
.27 lists points to be taken into account during the planning of cargo operations as:
- rules and regulations
- seamanship
- safety
- port rotation for loading
- ballasting and deballasting
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

- draught and stability
- cargo properties (flammability, toxicity, reactivity)
- suitability of coatings
- cargo maintenance during voyage
  - port rotation for unloading
  - tank cleaning procedures slop retaining and disposal

Loading

.28 states that:
- all personnel must follow standing instructions at all times whether or not the cargo to be loaded is dangerous
- personnel on watch or involved in the loading operation should wear appropriate protective clothing, as indicated in the ICS or other Cargo Data Sheets, when handling dangerous cargoes
- cargoes are stowed according to a stowage plan that was prepared before loading began
- prior to loading, cargo tanks are inspected for cleanliness and suitability for cargo according to the stowage plan
- prior to the loading of cargoes which present a major fire hazard, tanks are purged with nitrogen to remove air so that the atmosphere above the cargo will be non-flammable
- such cargoes are kept under a nitrogen "padding" during the voyage

.29 explains, with the aid of a simple drawing:
- how cargo is routed from the manifold to tanks on a chemical tanker with a pump-room
- how cargo is routed from the manifold to tanks on a chemical tanker with separate lines for each tank
- how cargo vapour is removed from the tanks during loading
- a "closed-circuit" loading operation

.30 states that:
- cargoes giving off vapours which present a major health hazard are loaded in a "closed circuit", requiring a vapour-return line
- in order to check for impurities, cargo samples are taken from lines and tanks during loading
- a vessel’s trim, list and stability may be adjusted, if necessary, during loading by filling or emptying ballast tanks
- all events during cargo operations are recorded

.31 lists procedures and duties for personnel on watch during the loading operation

Unloading

.32 states that:
- all personnel must follow standing instructions at all times during unloading, whether or not the cargo is considered dangerous
- personnel on watch or involved in the unloading operation should wear appropriate protective clothing, as indicated in the ICS or other Cargo Data Sheets, when handling dangerous cargoes
- cargoes are unloaded according to a planned sequence of emptying tanks
- prior to unloading, cargo samples from each tank and from cargo lines are analysed to check if a product has been contaminated on board during passage

.33 explains, with the aid of a simple drawing:
- how cargo is routed from tank to manifold on a chemical tanker with a pump-room
- how cargo is routed from the tank to manifold on a chemical tanker with deepwell pumps and separate lines for each tank
- the functioning of the cargo-tank venting system during unloading

.34 states that:
- in tanks containing cargoes that present a major fire hazard, inert gas or nitrogen is used to maintain a positive
tank pressure during unloading in order to avoid air entering the tank
- a vessel's trim, list and stability may be adjusted, as necessary, during unloading by filling or emptying ballast
tanks

.35 lists procedures and duties for personnel on watch during unloading operations

**Tank cleaning and gas-freeing**

36 lists reasons for tank cleaning as:
- rules and regulations
- the prevention of contamination of the cargo to be loaded
- the prevention of contaminated ballast

- maintenance of cargo tanks and equipment

.37 states that:
- tank-washing machines are used
- tank-washing machines may be fixed or portable
- tank-cleaning equipment must be properly earthed to avoid accumulation of static electricity
- personnel involved in tank-cleaning operations may be exposed to cargo vapours and should, if necessary, use
equipment for personal protection
- different cargoes require different tank-cleaning procedures
- cleaning may be done with hot or cold seawater or with fresh water, or by ventilation only
- water cannot be used for tank cleaning before or after some cargoes
- in some cases, detergents are added to the washing water in some cases, solvents are used for tank cleaning

.38 describes:
- the working of a tank-washing machine
  - how the electric bonding of tank-cleaning hoses may be checked
- a safe procedure for the connection and disconnection of tank-cleaning equipment

39 lists phases in a tank-cleaning operation as:
- pre-wash
- main wash
- fresh water rinse
- gas-freeing
- drying
- inspection/testing

.40 explains, with the aid of a simple drawing, the cycle in a tank-washing system from the seawater inlet to the slop
tank

.41 states that:
- the purpose of gas-freeing is to replace cargo vapours, inert gas or any other gases with air
- gas-freeing may be done by fixed or portable fans driven by air, steam, water or hydraulic fluid
- the gas-freeing operation is verified by regular checks of the tank atmosphere
- the tank atmosphere is checked by measuring the percentage of oxygen and the ppm values of cargo
  vapours or of toxic constituents of inert gas
- a cargo tank is gas-free only when the oxygen content is 21% by volume and no vapours from cargo or toxic
  constituents of inert gas can be measured in values above the threshold limit value (TLV)

**Slops and slops disposal**

.42 defines "slops" as tank washings or any residue/water mixtures from pump-room bilges, engine-room bilges or slop
tanks

.43 states that:
- modern chemical tankers are fitted with tanks for the storage of slops
- cargo tanks may also be used to contain slops
- in general, the discharge of slops into the sea is prohibited unless certain conditions are satisfied
  - slops from certain noxious chemicals have to be discharged to shore facilities
- all slop-handling operations on chemical tankers are recorded in the Cargo Record Book

.44 identifies international regulations covering:
- the discharge of slops
- the discharge of slops containing noxious chemicals
For liquefied gas tankers

Tank environmental control

.45 explains that environmental control within cargo tanks and hold spaces is achieved by means of piping systems provided for this purpose.

.46 explains that when a gas tanker is to change cargo, the following procedures for environmental control in cargo tanks are normally carried out:
- warming up
- inerting
- gas-freeing/aerating
- purging
- cooling down

.47 states that sampling tubes, pressure sensors and temperature sensors are provided in the tanks to ensure that procedures are correctly carried out.

Warming up

.48 states that:
- the warming up of cargo tanks is necessary for the following reasons:
  - vaporizing of liquid cargo residues in pump sump after discharging/stripping
  - warming up of tank’s shell prior to inerting and gas-freeing/aerating in order to avoid condensation and the formation of ice
- warming up is done by drawing cold vapour from the top of cargo tanks to the compressors, where the vapour is heated by compression and led back to the pump sump or to the bottom of the tanks
- during the warming-up procedure the temperature and pressure readings must be kept under observation

Inerting

(Note: for this section, some of the objectives on inerting are a repeat of other objectives mentioned earlier)

.49 states that:
- the purpose of inerting is primarily to prevent flammable vapour/air mixtures in tanks and piping
- inerting is done by replacing cargo vapours with an inert gas until the concentration of cargo vapours is lower than the LEL
- inert gas used on gas tankers is either nitrogen or inert gas produced in the ship’s inert-gas plant
- the correct inerting procedure is ensured by regular checks of the tank atmosphere
- atmosphere checks are done by measuring the percentage of oxygen and cargo vapours through the sampling tubes
- the atmosphere in an inerted tank or void space is safe with regard to fire hazard but dangerous with regard to health

Gas-freeing/aerating

.50 states that:
- the purpose of gas-freeing or aerating is to replace residues of inert gas and cargo vapour with air
- gas-freeing is done by introducing air into the inerted tanks and piping
- correct gas-freeing operations are verified by regular checks of the tank atmosphere
- atmosphere checks are done by measuring percentage of oxygen content and values of ppm of vapours from cargo or inert gas
- an atmosphere in tanks or void spaces is gas-free only when the oxygen content is 21% by volume and when no vapours from cargoes or inert gas can be measured in values above their TLV

Purging
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.51 states that
- the purpose of purging is to prepare cargo tanks and piping to receive cargo
- purging is done to reduce oxygen content and humidity in a tank by introducing nitrogen or inert gas
  from the ship’s inert-gas plant
- in some cases, purging with cargo vapours from the cargo to be loaded is also required after purging with
  inert gas or nitrogen
- regular checks of the tank atmosphere are carried out during the purging operation
- atmosphere checks are done by measuring percentage of oxygen and by reading the dewpoint temperature

Cooling down

52 states that:
- the reason for cooling down cargo tanks and piping prior to loading is to prevent undue thermal stresses
- cool-down is done by introducing cargo liquid slowly into the tank via the cooling-down line or the spray-line system
- the liquid cargo will tend to vaporize when introduced into a warmer tank, thus taking heat from the tank atmosphere and the tank shell
- the correct cool-down operation is verified by temperature readings which are made possible by temperature sensors installed in tanks and/or the tank shell
- the cooling down is completed when the temperature of the tank atmosphere and shell is acceptably low in relation to the temperature of the cargo to be loaded

13. Fire Prevention and Fire Fighting

Course Framework

1. Aims
The course aims to provide the training for candidates in fire prevention and fighting in accordance
with section A-VI/1 of the STCW code.

2. Objectives
This syllabus covers the requirements of the STCW Convention Chapter VI, Section A-VI/1, paragraph 2 and table
A-VI/1-2. On meeting the minimum standard of competence in fire prevention and fire fighting, a trainee will be
competent to take appropriate measures for the safety of personnel and of the ship and to use fire appliances correctly. The trainee will also have a knowledge of fire prevention.

3. Entry standards
The course is open to all seafarers and prospective seafarers and should be completed prior to employment on a sea-going ship. All trainees must be certified by a doctor to be in good health.

4. Course certificate
On successful completion of the course and demonstration of competence, a document may be issued certifying that the
holder has met the standard of competence specified in Table A-VI/1-2 of STCW. A certificate may be issued only by centres approved by the Administration.

5. Course intake limitations
The maximum number of trainees attending each session will depend on the availability of instructors, equipment and
facilities availability for conducting the training. Any practical training should be undertaken in small groups of not more
than six trainees per instructor.

5. Staff requirements
The instructor shall have appropriate training in instructional techniques and training methods (STCW Code A-I/7
par.7.) in addition, all training and instruction should be given by qualified personnel; the senior instructor, having
considerable experience in fire safety and fire-fighting techniques, should have a good knowledge of ships, including
stability considerations. All assistant instructors should have practical knowledge of fire fighting and should be familiar
with ships.
7. Training facilities and equipment

Ordinary classroom facilities and an overhead projector are sufficient for the theoretical part of the course. When making use of audiovisual material such as videos or slides, make sure the appropriate equipment is available. In addition, a demonstration table measuring 3 m by 1 m would be advantageous. Separate rooms, equipped with a table and chairs, will also be needed to accommodate three or four groups of trainees during case studies and other group assignments. For the practical part of the course it would be advantageous if the training facilities of a local or port fire brigade could be used. Alternatively, the following structure and equipment are required:

- building for smoke and fire drills, or a similar facility (see figure A on page 7)
- room with work bench area for inspection and maintenance of breathing apparatus
- 2 steel fire trays (approximately 1 m x 1 m x 0.3 m)
- 2 fire hydrants with 2 outlets each, or a similar water supply from open water and a fire pump
- a large supply of carbonaceous and hydrocarbon fuels (wood, diesel and lubricating oils, etc.) for the fire trays
- 2 dummies, for search and rescue procedures
- 2 fire hoses (65 mm diameter)
- 2 fire nozzles (1 standard, 1 jet spray)
- mechanical foam branches
- 1 generator of high-expansion foam and foam compound
- 1 water extinguishers (9 litre)
- 2 foam extinguishers (9 litre)
- 2 carbon dioxide extinguishers (5 kilogram)
- 1 dry powder extinguishers (10 kilogram)
- refills for extinguishers
- 10 sets of protective clothing, overalls, gloves, fire-boots, helmets and rainproof clothing
- 2 sets of self-contained breathing apparatus, complete with spare cylinders, spare parts and maintenance tools
- smoke generator
- smoke helmets with air pump
- a shower at the site
- 1 stretcher
- 1 first-aid kit
- 1 resuscitation kit with oxygen/suction unit
- 2 sets of fire-protective clothing
- 2 helmets with visor and neck protection
- 2 fire axes
- different types of detectors used on board ships
- indication of escape routes in the mock-up

12

Fire Prevention and Fire Fighting

Course Outline

<table>
<thead>
<tr>
<th>Course Outline</th>
<th>Approximate Time (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge, understanding and proficiency</td>
<td>Lectures, demonstrations and practical work</td>
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</tbody>
</table>
Introduction, safety and principles 0.5

**Competence 1:** Minimize the risk of fire

<table>
<thead>
<tr>
<th>Course Outline</th>
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<tbody>
<tr>
<td>Knowledge, understanding and proficiency</td>
<td>Lectures, demonstrations and practical work</td>
</tr>
<tr>
<td>Concept and application of the triangle to fire and explosion</td>
<td>0.5</td>
</tr>
<tr>
<td>1.1 conditions for fires</td>
<td>0.5</td>
</tr>
<tr>
<td>1.2 properties of flammable materials</td>
<td>0.5</td>
</tr>
<tr>
<td>Types and sources of ignition</td>
<td>0.25</td>
</tr>
<tr>
<td>1.3 fire prevention principles</td>
<td>0.25</td>
</tr>
<tr>
<td>Flammable materials commonly found on board</td>
<td>0.75</td>
</tr>
<tr>
<td>1.4 spread of fire</td>
<td>0.75</td>
</tr>
<tr>
<td>1.5 Safe practices</td>
<td>0.75</td>
</tr>
<tr>
<td>Need for constant vigilance</td>
<td>0.5</td>
</tr>
<tr>
<td>1.6 need for constant vigilance</td>
<td>0.5</td>
</tr>
<tr>
<td>1.7 Patrol systems</td>
<td>0.5</td>
</tr>
<tr>
<td>Fire hazards</td>
<td>0.5</td>
</tr>
<tr>
<td>1.8 Fire hazards</td>
<td>0.5</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>2.5</td>
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</tbody>
</table>

**Competence 2:** Minimize a state of readiness to respond to emergency situations involving fires

<table>
<thead>
<tr>
<th>Course Outline</th>
<th>Approximate Time (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge, understanding and proficiency</td>
<td>Lectures, demonstrations and practical work</td>
</tr>
<tr>
<td>Organization of shipboard fire fighting</td>
<td>1.0</td>
</tr>
<tr>
<td>2.1 General emergency alarm</td>
<td>1.0</td>
</tr>
<tr>
<td>2.2 Fire control plans and muster list</td>
<td>1.0</td>
</tr>
<tr>
<td>2.3 communications</td>
<td>1.0</td>
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<tr>
<td>2.4 Personnel safety procedures</td>
<td>1.0</td>
</tr>
<tr>
<td>2.5 Periodic shipboard drills</td>
<td>1.0</td>
</tr>
<tr>
<td>Location of fire-fighting appliances and emergency escape routes</td>
<td>0.75</td>
</tr>
<tr>
<td>2.6 Ship construction arrangements</td>
<td>0.75</td>
</tr>
<tr>
<td>2.7 Emergency fire pump (cargo ships)</td>
<td>0.75</td>
</tr>
<tr>
<td>2.8 Chemical powder applicants</td>
<td>0.75</td>
</tr>
<tr>
<td>2.9 Emergency escape routes</td>
<td>0.75</td>
</tr>
<tr>
<td>Fire spread in different parts of a ship</td>
<td>0.25</td>
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<tr>
<td>2.10 Fire spread</td>
<td>0.25</td>
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<tr>
<td>Fire and smoke detection measures on ships and automatic alarm systems</td>
<td>0.75</td>
</tr>
<tr>
<td>2.11 Fire and smoke detection systems</td>
<td>0.75</td>
</tr>
<tr>
<td>2.12 Automatic fire alarm</td>
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</tr>
<tr>
<td>Classification of fires and applicable extinguishing agents</td>
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<tr>
<td>2.13 Classification of fires and appropriate extinguishing agents</td>
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</tbody>
</table>

**Competence 3:** Fight and extinguish fires
# Basic Training For Oil and Chemical Tanker
## Model Course – 1.01

<table>
<thead>
<tr>
<th>Course Outline</th>
<th>Approximate Time (Hours)</th>
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<tbody>
<tr>
<td><strong>Knowledge, understanding and proficiency</strong></td>
<td>Lectures, demonstrations and practical work</td>
</tr>
<tr>
<td><strong>Selection of fire-fighting appliances and equipment</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Fire hoses and nozzies</td>
<td></td>
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<tr>
<td>3.2 Mobile apparatus</td>
<td></td>
</tr>
<tr>
<td>3.3 Portable fire extinguishers</td>
<td></td>
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<tr>
<td>3.4 Fireman’s outfit</td>
<td></td>
</tr>
<tr>
<td>3.5 Fire blankets</td>
<td></td>
</tr>
<tr>
<td>3.6 Knowledge of fire safety arrangements</td>
<td></td>
</tr>
<tr>
<td>3.7 Fire alarms and first actions</td>
<td></td>
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<tr>
<td>3.8 Fire fighting</td>
<td></td>
</tr>
<tr>
<td>3.9 Fire-Fighting mediums</td>
<td></td>
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<tr>
<td>3.10 Fire-fighting procedures</td>
<td></td>
</tr>
<tr>
<td>3.11 Small fires</td>
<td></td>
</tr>
<tr>
<td>3.12 Extensive fires</td>
<td>5.0</td>
</tr>
<tr>
<td><strong>Precautions for and use of fixed installations</strong></td>
<td></td>
</tr>
<tr>
<td>3.13 General</td>
<td></td>
</tr>
<tr>
<td>3.14 Smothering effect systems: carbon dioxide (CO2) and foams</td>
<td></td>
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<tr>
<td>3.15 Inhibitor effect systems: powders</td>
<td></td>
</tr>
<tr>
<td>3.16 Cooling effect systems: sprinklers, pressure spray</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Use of breathing apparatus for fighting fires</strong></td>
<td></td>
</tr>
<tr>
<td>3.17 Breathing apparatus</td>
<td>2.5</td>
</tr>
<tr>
<td>3.18 Drills in smoke-filled spaces</td>
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<tr>
<td><strong>Use of breathing apparatus for effecting rescues</strong></td>
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<td>3.19 Use of breathing apparatus</td>
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<tr>
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</table>
Detailed Teaching Syllabus

Proficiency in Fast Rescue Boats

Learning objectives

Competence 1: Minimize the risk of fire (3 hours)

Competence 2: Maintain a state of readiness to respond to emergency situations involving fire (3 Table A-VI/1 -2 hours)

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

Objectives are:

1. Initial actions on becoming aware of an emergency conform with accepted practices and procedures

2. Action taken on identifying muster signals is appropriate to the indicated emergency and complies with established procedures

Competence 3: Fight and extinguish fires (9 hours)

Fire-fighting equipment and its location on board:
- fixed installations
- firefighters' outfits
- personal equipment
- fire-fighting appliances and equipment
- fire-fighting methods
- fire-fighting agents
- fire-fighting procedures
- use of breathing apparatus for fighting fires and effecting rescues

Objectives are:

2.4 Use various types of portable fire extinguishers
Use self-contained breathing apparatus

2.5 Extinguish smaller fires, e.g. electrical fires, oil fires, propane fires

2.6 Extinguish extensive fires with water, using jet and spray nozzles

2.7 Extinguish fires with foam, powder or any other suitable chemical agent

2.8 Enter and pass through, with lifeline but without breathing apparatus, a compartment into which high-expansion foam has been injected

2.9 Fight fire in smoke-filled enclosed spaces wearing self-contained breathing apparatus
2.10 Extinguish fire with water fog or any other suitable fire-fighting agent in an accommodation room or simulated engine-room with fire and heavy smoke.

2.11 Extinguish oil fire with fog applicator and spray nozzles, dry chemical powder or foam applicators.

2.12 Effect a rescue in a smoke-filled space wearing breathing apparatus.

1. lists the main aims of the course as:
- knows what to do if:
- fire or smoke is detected, or
- the fire alarm is sounded
- raise the alarm and have basic knowledge of the use of the portable fire extinguishers
- close and open the fire-, weather- and water-tight doors fitted in the ship other than those for hull openings
- minimize the risk of fire and maintain a state of readiness to respond to emergency situations involving fire
- fight and extinguish fires

2 states the safety rules laid down by the chief instructor which must be adhered to during the course, including during the practice of drills.

3 lists the principles of survival in relation to fire as:
- regular training and drills
- preparedness for any fire emergency
- knowledge of actions to be taken when called to fire stations
- knowledge of escape routes
- knowledge of dangers of smoke and toxic fumes

**Competence 1: Minimize the risk of fire (2.5 hours)**

**Concept and application of the fire triangle m - section to fire and explosion** (0.5 hour)

**Conditions for fires**

1. lists conditions required for fire to occur as:
- the presence of material which acts as a fuel
- a source of ignition, e.g. chemical, biological or physical
- the presence of oxygen

2 sketches how these three conditions can be represented as a triangle (the fire triangle) - concepts to prevent and extinguish fires

3 sketches how the addition of a fourth condition, the "chain reaction", leads to the concept of the "fire tetrahedron", which represents a continuously burning fire

**1.2 Properties of flammable materials**

1 defines:
- flammability
- ignition point
- burning temperature
- burning speed
- thermal value
- lower flammable limit (LFL)
- upper flammable limit (UFL)
- flammable range
- flashpoint
- auto-ignition

2 gives one example of how static electricity can occur

3 explains reactivity

explains ignition sources

**Types and sources of ignition** (0.25 hour)

**1.3 Fire prevention principles**

1 gives examples of how a fire can be prevented from spreading by reducing or blocking:
- conduction
- radiation
- convection currents

.2 explains that removing any one element of fire triangle can prevent or extinguish a fire

**Flammable materials commonly found on board (0.75 hour)**

### 1.14 Spread of fire

.1 defines:
- conduction
- radiation
- convection currents

.2 states that spread of fire occurs as a result of equalization in temperature between fire and surroundings via:
- conduction
- radiation
- convection currents

.3 lists examples of each method of propagation

.4 lists four phases of fire development as:
- ignition (incipient)
- developing (surface fire)
- absolute fire (fire in depth in solids)
- **burning out**

.5 states the temperature of a normal fire and the temperature in burning metals

### 1.15 Safe practices

.1 lists general safety procedures, including:
- no smoking in hazardous areas
- cleanliness
- good housekeeping
- ability to recognize fire hazards and to take the necessary steps to prevent fires

.2 for the engine-room, lists measures for reducing fire hazards, which include:
- ensuring insulation and lagging are kept in good condition
- eliminating oil leaks and preventing accumulation of oil
- taking proper fire precautions when welding or burning is being carried out
- checking that caps and cocks for sounding pipes to oil tanks are closed
- maintaining a clean engine-room, removing oil-soaked rags

.3 for the galley, lists measures for reducing fire hazards, which include:
- keeping extraction fan and flue-gas duct clean
- ensuring cooking oils do not spill on top of the stove or overheat in electrical cooking pans
- keeping electrical installations well maintained

.4 for the accommodation areas, lists measures for reducing fire hazards, which include:
- no smoking in bed
- no unauthorized electrical fittings
- no emptying of ashtrays into wastepaper bins without ensuring all cigarette ends are extinguished

.5 for cargo spaces, lists measures for reducing fire hazards, which include:
- ensuring hatches are correctly cleaned
- ensuring cargo is stowed and ventilated in accordance with the rules
- prohibition of smoking during cargo-working periods
- securing of cargo
- inerting the atmosphere in cargo compartments when required

.6 ensures hold/cargo compartment lights are switched off and cargo clusters disconnected, removed and stored away after use and before closing of hatches
The need for constant vigilance (0.5 hour)

1.6 Need for constant vigilance

.1 states that prevention is by far the best method of combatting a fire and this can be achieved by:
- constant vigilance
- preparedness
- fire patrol
- proper watchkeeping
- maintenance of equipment

1.7 Patrol systems

.1 states that on ships having more than 36 passengers an efficient patrol system must be maintained

.2 lists the duties of the patrol

.3 states that a fire patrol system is also advisable on other types of ships

Fire hazards (0.5 hour)

1.8 Fire hazards

.1 lists fire hazards in the engine-room, including:
- combustible liquids - fuel and lubricating oils
- oil leaks and oil-soaked insulation
- hot surfaces, e.g. exhaust pipes, engine parts overheating
- defects in lagging
- hot work, e.g. welding, cutting by oxy-acetylene torch
- auto-ignition, e.g. oil dripping on hot surface

.2 lists hazards in galley, including:
- combustible liquids, e.g. cooking oil, hot fat
- hot surfaces, e.g. ovens, frying pans, flues
- defective electrical connections

.3 lists hazards in accommodation, including:
- combustible materials, e.g. furnishings, personal effects
- matches and cigarette smoking
- defective electrical connections

.4 lists hazards from cargoes, including:
- self-heating cargo and spontaneous combustion
- oxidizing cargoes and organic peroxides
- compressed flammable gas
- pyrophoric cargoes
- explosives

.5 lists hazards from smokers and cigarettes, including:
- temperature of a burning cigarette, which is about 500°C
- carelessness with cigarettes and matches, setting fire to bedclothes, wastepaper bin contents and furnishings

Competence 2: Maintain a state of readiness to respond to emergency situations involving fires (3.0 hour)

Organization of shipboard fire fighting (1.0 hour)

1.1 General emergency alarm

.1 describes this signal as consisting of seven or more short blasts followed by one long blast on the ship's whistle and bells or klaxons or equivalent sounding elsewhere in the ship

.2 describes the purpose of the special alarm operated from the navigating bridge to summon the crew to fire stations
.3 lists other possible fire alarms as:
- \( \text{CO}_2 \)
- pump room
- manually operated
- UMS fire-detection system

1.2 Fire control plans and muster list
.1 describes the fire control plans and where they are located .2 describes the muster list
.3 gives examples of the duties of individual crew members

1.3 Communications
.1 describes the methods of communication used during a fire emergency as:
- messengers
- telephones
- walkie-talkies
- ship-to-shore VHF
- public address system

2.4 Personnel safety procedures
.1 describes how a fire-fighting team is made up and states who is in charge
.2 states that the fire zone may not be entered unless orders to do so have been given by the person in charge
.3 states the need to be familiar with the area of the fire zone and with escape routes
.4 states the need to be properly equipped to enter the fire zone, especially if the lights have failed and the space is full of smoke
.5 states how one should be dressed
.6 lists what equipment is required, including:
- breathing apparatus
- hand lantern
- axe
- fireproof lifeline with fittings
.7 explains the use of the lifeline for signalling
.8 states the need to be flexible in filling vacancies of key personnel in the fire parties

2.5 Periodic shipboard drills
.1 states the purpose of these drills
.2 describes typical exercises for use during fire drills as:
- extinguishing a fire in a deep fryer
- entering a closed room on fire
- extinguishing a major deck fire
- rescuing an unconscious person from a smoke-filled space

Location of fire-fighting appliances and emergency escape routes (0.75 hour)
2.6 Ship construction arrangements
.1 lists the basic principles
.2 states the location of emergency escape routes and how escape routes are protected
.3 describes class A, B and C/F divisions
.4 lists the means for gas-freeing tanks
.5 describes the purpose of and the means for inerting cargo spaces
.6 explains briefly the fire prevention arrangements required in cargo spaces
2.7 Emergency fire pump (cargo ships)

.1 states the number of acceptable jets of water which the emergency fire pump must be capable of supplying

.2 states the requirements for the location of this pump

.3 states the circumstances under which the emergency fire pump is used

2.8 Chemical powder application

.1 describes a typical fixed powder apparatus with each container holding 250 kg of powder

.2 explains how this equipment is used for best results

2.9 Emergency escape routes

.1 states the emergency escape routes from machinery space to accommodation space, main deck and boat deck

.2 states the emergency escape routes from accommodation space to main deck and boat deck

.3 states the emergency escape routes from cargo pump room to accommodation space, main deck and boat deck

.4 states emergency escape routes from cargo spaces and main deck leading to boat deck

.5 explains that escape routes are well marked showing arrow and symbols

.6 states that escape routes are provided with an emergency lighting system

.7 states that the emergency escape routes are used in reverse direction for access to the fire spot

2.10 Fire spread in different parts of a ship

.1 explains that a fire in machinery space shall be contained in the machinery space itself and shall not spread to accommodation as accommodation is separated from machinery space by structural and thermal protection boundaries

.2 states that a fire in cargo pump room shall be contained in the cargo pump room itself and shall not spread to accommodation as accommodation is separated from cargo pump room by structural and thermal protection boundaries

.3 states that all A-60 doors separating machinery space and cargo pump room shall be shut in case of fire in respective spaces

.4 states that all ventilation flaps shall be shut in case of fire in machinery space and cargo space

.5 states that accommodation fire shall be contained in accommodation itself and shall not be allowed to spread in machinery space and cargo pump room by similar arrangements as stated above

.6 states that accommodation fires originating in galley, laundry, linen locker, common public spaces, living spaces shall be contained in the space of origin of fire and shall not be allowed to spread to other parts of accommodation by using thermal protection and ventilation flaps/draught stops

.7 states that the fire in any cargo hold shall be contained in the affected cargo itself by shutting hatch covers, ventilator flaps and cooling boundary bulk heads

.8 states that fires in isolated spaces such as wheel house, radio room, chart room, forepeak area, i.e. paint locker etc. and steering gear compartment shall be contained in the space of origin itself by shutting doors, ventilator flaps and using the fixed installation and other fire-fighting appliances where provided

ships and automatic alarm systems (0.75 hours)
and smoke detection systems
construction of an automatic fire detection system

Fire spread in different parts of a ship (0.25 hour)

2.10 Fire spread

.1 explains that a fire in machinery space shall be contained in the machinery space itself and shall not spread to accommodation as accommodation is separated from machinery space by structural and thermal protection boundaries
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.2 states that a fire in cargo pump room shall be contained in the cargo pump room itself and shall not spread to accommodation as accommodation is separated from cargo pump room by structural and thermal protection boundaries.
.3 states that all A-60 doors separating machinery space and cargo pump room shall be shut in case of fire in respective spaces.
.4 states that all ventilation flaps shall be shut in case of fire in machinery space and cargo space.
.5 states that accommodation fire shall be contained in accommodation itself and shall not be allowed to spread in machinery space and cargo pump room by similar arrangements as stated above.
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**Ships and automatic alarm systems (0.75 hour)**

2.11 Fire and smoke detection systems
.1 describes the construction of an automatic fire detection system
.2 states the main types of automatic fire detectors
.3 lists the alarms or actions which may be activated by a detector
.4 states the benefit of an automatic sprinkler system in regard to fire detection in passenger and crew accommodation.

2.12 Automatic fire alarm

2.1 describes the operation of an automatic fire alarm.
.2 describes a system which has fire zones and states where such a system may be installed in a ship.

**Classification of fires and applicable extinguishing agents (0.25 hour)**

2.13 Classification of fires and appropriate

2.1 describes the classification of fires as:
- class A fires: involving carbonaceous solid materials of organic nature, e.g. wood, cloth, paper, rubber etc.
- class B fires: involving flammable liquid or liquefiable solids, e.g. oils, greases, tars, paints etc.
- class C fires: involving gases, e.g. cooking gas, welding gas
- class D fires: involving metals, e.g. magnesium, sodium and potassium

.2 describes the extinguishing agents for various classes of fire as:
- class A: water spray, water jet, flooding, CO2
- class B: foam, CO2, dry powder
- class C: dry powder, CO2
- class D: special dry powders

.3 states that electrical fires turn into any of these classes of fire, i.e. A, B, C or D once the circuit is turned off and dry chemical or CO2 portable extinguishers are recommended.
Competence 3: Fight and extinguish fires (9 hours)

**Selection of fire-fighting appliances and equipment** (5 hours)

### 3.1 Fire hoses and nozzles

1. States briefly the regulations concerning fire hoses and nozzles
2. Explains how hoses are joined together and connected to fire hydrants
3. Explains how a nozzle can be adjusted to produce a concentrated jet, a spray or a mist, and for which purpose each is used
4. Explains correct maintenance and storage of hoses and nozzles

### 3.2 Mobile apparatus

1. Lists the types of mobile apparatus available, including:
   - Carbon dioxide cylinders
   - Powder containers with propellant gas
   - Foam-making equipment
2. Describes areas where these are usually deployed

### 3.3 Portable fire extinguishers

1. Lists the different types of portable extinguishers as:
   - Water
   - Foam
   - Powder
   - Carbon dioxide
   - AFFF
2. Describes the operational principle of each type of extinguisher
3. States for which class of fire each type is suitable
4. States the normal capacity of each type of portable extinguisher
5. Explains the procedures for having empty extinguishers recharged

### 3.4 Fireman’s outfit

1. Lists the constituents of a fireman’s outfit in three sections as:
   - Personal equipment
   - Breathing apparatus
   - Fireproof lifeline with snap hook and harness
2. Lists the two main types of breathing apparatus which may be used
3. Lists their relative advantages and disadvantages
4. States the requirements for the lifeline
5. Lists the constituents of personal equipment as:
   - Fire suit
   - Gloves and shoes (non conducting)
   - Hard helmet
   - Safety lamp
   - Fire axe

### 3.5 Fire blankets

1. Describes a fire blanket
Basic Training For Oil and Chemical Tanker
Model Course – 1.01

.2 demonstrates how to use it
.3 states where fire blankets are normally located

3.6 Knowledge of fire safety arrangements
.1 states:
- the location and use of fire alarms
- the location and use of emergency controls

.2 states the necessity of knowing how fire-fighting equipment works
.3 states the necessity of being aware of potential fire hazards

3.7 Fire alarms and first actions
.1 states as actions on discovering a fire:
- activate the alarm
- inform control station
- restrict
- try to extinguish the fire

3.8 Fire fighting

1. explains the factors to be considered in deciding on fire-fighting methods:
- accessibility of the location of the fire
- personnel present at the location of the fire
- reactions with the cargo/burning material

equipment and fire-fighting agents appropriate to the fire

2 explains the reasons for a re-flash watch

3.9 Fire-fighting mediums
.1 lists the fire-fighting agents or mediums as:
- water in the form of solid jet, spray, fog or flooding
- foam as high, medium and low expansion
- carbon dioxide
- steam
- dry chemical powders

3.10 Fire-fighting procedures
.1 states that when the fire alarm is given, fire procedures and emergency stations procedures are put into effect:
- crew assembles at the designated fire stations as given in muster list
- the fire parties assemble, on orders from the bridge, and carry out their tasks aimed at containing the fire and extinguishing it
- the pumps are started to supply extinguishing water
- the master decides the most appropriate method for fighting the fire

.2 states that the master controls the fire-fighting operations from the bridge
.3 states that when fire is extinguished, a fire watch is kept
.4 states that an investigation into the cause of fire is initiated by master to avoid recurrence
.5 states that if fire is in port, the shore authorities are informed immediately

3.11 Small fires
.1 demonstrates the correct use of portable fire extinguishers suited, respectively, for the following types of fire:
- materials, e.g. wood
- oil
- fat
- plastics
- propane
- electrical

.2 demonstrates how to extinguish fires using a hose with water jet and spray nozzles and with foam applicator
3.12 Extensive fires

.1 demonstrates the extinguishing of extensive fires of various types, including an oil fire, using as appropriate:
- water (jet, spray and fog application)
- foams, including aqueous-film-forming type (AFFF)
- powder, dry and wet
- CO₂

.2 using a lifeline but without breathing apparatus, demonstrates entering and passing through a compartment into which high expansion foam has been injected

Precautions for and use of fixed installations (1 hour)

3.13 General

.1 lists the general requirements for a fixed system, including the following:
- the medium used must not produce toxic gases
- the quantity of the medium must be adequate for the spaces which are to be protected
- the piping system must have control valves
- the release of a gas medium must not be automatic
- the order to release the medium must be given by the master or a senior officer

.2 lists typical fixed systems as:
- carbon dioxide
- sprinkler (wet and dry risers)
- foam (low expansion)
- foam (high expansion)
- fire mains, hydrants
- emergency generators, fire and bilge pumps
- pressure water spray in special category spaces
- chemical powder applicants

3.14 Smothering effect systems: carbon dioxide (CO₂) and foams

.1 explains how CO₂ smothers a fire
.2 states the advantages and dangers of CO₂
.3 states the actions to be taken when the CO₂ alarm sounds
.4 states in which spaces CO₂ is used
.5 explains the action of foam on a fire
.6 describes the actions to be taken before CO₂ or foam is released into the fire zone
.7 describes the different types of foam

3.15 Inhibitor effect systems: powders

.1 states on which types of fire powders are used

3.16 Cooling effect systems: sprinklers, pressure spray Sprinklers

.1 explains how a sprinkler system works

.2 states in which spaces the sprinkler system is used
.3 defines the special category spaces in which manually operated pressure water spray systems are normally used. Fire hydrants
.4 states the reason for fitting a shut-off valve to serve each hose
.5 states the reason for fitting isolating and cross-over valves on the fire main
.6 describes an international shore connection, giving the principal dimensions, and states its purpose
.7 describes how it is connected

Use of breathing apparatus for fighting fires (2.5 hours)

3.17 Breathing apparatus

.1 describes a self-contained compressed air operated breathing apparatus (CABA)
.2 demonstrates the correct way to fit the face mask of a CABA and to check that it is airtight
.3 lists the checks which must be made on a CABA before it is used and after it has been strapped on

.4 demonstrates the correct breathing technique to give a low air consumption for a particular exertion when using a CABA
.5 explains the reasons for not remaining in a toxic atmosphere until the CABA air bottles are empty
.6 explains that the pressure gauge is read at frequent intervals during use and action which must be taken when the warning signal is given on a CABA that air pressure is low
.7 describes a breathing apparatus having a smoke helmet, air pump, air line and fittings

3.18 Drills in smoke-filled spaces
.1 demonstrates how to check and use the following breathing apparatus:
- smoke helmet type with air pump and hose
- compressed air operated breathing apparatus (CABA)
.2 demonstrates entering a small room using CABA when the room is filled with non-toxic artificial smoke
.3 demonstrates the use of the lifeline as a signal line in a smoke-filled space while wearing CABA
.4 takes part in team exercise communicating with other team members while wearing CABA
.5 demonstrates the use of various types of portable fire extinguishers on fires in a smoke-filled space while wearing CABA
.6 demonstrates extinguishing an extensive fire when wearing CABA in smoke-filled enclosed spaces, including an accommodation room or simulated engine-room, and using as appropriate:
- water (jet, spray or fog)
- foam
- powder

Use of breathing apparatus for effecting rescues (0.5 hour)

3.19 Use of breathing apparatus
.1 demonstrates how to search for persons (using dummies) in a smoke-filled space while wearing CABA
.2 use of breathing apparatus for rescue of casualties:
- takes a practical demonstration wearing CABA, consisting of two persons in a team, enters into the mock-up, carries out search for casualties and brings dummy casualty, after locating the casualty, to safer place on open deck for medical first aid
- carries out the exercise in same place in a dark compartment
- carries out the exercise in same place in a smoke-filled compartment
- also carries out the same exercise by carrying a spare CABA for the use of casualty during rescue operation