Guide for

Methanol and Ethanol Fueled Vessels

January 2022

GUIDE FOR

METHANOL AND ETHANOL FUELED VESSELS
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American Bureau of Shipping
Incorporated by Act of Legislature of
the State of New York 1862

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Foreword

Due to increased commitment from the International Maritime Organization (IMO) to reduce Green House Gas (GHG) emissions from shipping the use of Liquefied Natural Gas (LNG), methanol, ethane, Liquefied Petroleum Gas (LPG), hydrogen, ammonia and other gases or low-flashpoint fuels, including the e-fuels produced from non-fossil fuel sources, are expected to become more widely adopted by the marine industry as a substitute for conventional residual or distillate marine fuels. The increasing experience with methanol fueled commercial vessels, the relatively simple fuel arrangements for storage and distribution of methanol or ethanol, and the ability to produce from renewable and sustainable sources that can meet the IMO GHG reduction goals, is stimulating increased interest in these alcohol-based fuels. Accordingly, this Guide addresses the use of methyl/ethyl alcohols as marine fuels.

The ABS criteria to be applied to gas or other low flashpoint fueled ships are detailed in Part 5C, Chapter 13 of the ABS *Rules for Building and Classing Marine Vessels (Marine Vessel Rules*), which incorporates the IMO *International Code of Safety for Ships using Gases or Other Low Flashpoint Fuels* (IGF Code).

The IGF Code currently only includes detailed prescriptive requirements for natural gas (methane) applications. All other low flashpoint fuels or gases must demonstrate an equivalent level of safety by application of the Alternative Design methodology as specified in SOLAS Chapter II-1 regulation 55 and guidelines referenced by footnote MSC.1/Circ.1212, or associated guidelines MSC.1/Circ.1455.

However, where other prescriptive IMO requirements exist for particular gases or other low flashpoint fuels, either by regulation, or as interim guidelines, these may be applied in lieu of the Alternative Design criteria, subject to agreement by the vessel's flag Administration. IMO's adoption of MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel* in November 2020 established the goals, functional requirements and prescriptive requirements for application of methanol or ethanol as marine fuels.

Accordingly, this Guide has been developed to further support application of methanol or ethanol as fuel on ABS Classed vessels and incorporates the aforementioned IMO MSC.1/Circ.1621 Interim Guidelines.

Where the requirements of the Guide are proposed to be used for compliance with the IGF code and MSC.1/Circ.1621, such application is subject to approval by the vessel's flag Administration prior to issuance of relevant statutory certificates on behalf of the same flag Administration by ABS.

The applicable edition of the *Marine Vessel Rules* is to be used in conjunction with this Guide.

This Guide becomes effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of this Guide is the most current.

Also refer to the ABS Sustainability Whitepaper: *Methanol as Marine Fuel*, for supplemental information on methanol as a marine fuel.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.

GUIDE FOR

METHANOL AND ETHANOL FUELED VESSELS

CONTENTS

SECTION 1
Introduction

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*. Operational, training or national requirements are shown in *italics* and are not required for Classification and are shown for information only.

1 Scope

The international regulations pertaining to gas or other low flashpoint fueled ships other than those covered by the IGC Code are those included in the IMO *International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels* (IGF Code), which entered into force on 1 January 2017. The IGF Code has been incorporated along with ABS requirements into Part 5C, Chapter 13 of the ABS *Rules for Building and Classing Marine Vessels* (*Marine Vessel Rules*).

Currently the IGF Code only includes detailed prescriptive requirements for natural gas (methane) applications. All other low flashpoint fuels or gases must demonstrate an equivalent level of safety by application of the Alternative Design methodology as specified in the *International Convention for the Safety of Life at Sea* (SOLAS) Chapter II-1 regulation 55 and guidelines referenced by footnote MSC.1/Circ.1212 or associated guidelines MSC.1/Circ.1455.

However, where other prescriptive IMO requirements exist for particular gases or other low flashpoint fuels, either by regulation or as interim guidelines, these may be applied in lieu of the Alternative Design criteria, subject to agreement by the flag Administration. IMO's adoption of MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*, in November 2020 has now established the goals, functional requirements and prescriptive requirements for application of methanol or ethanol as marine fuels.

Accordingly, this Guide has been developed to provide guidance for the design, construction, and survey of vessels using methanol or ethanol as fuel. This guide focuses on systems and arrangements provided for the use of methanol or ethanol for propulsion and auxiliary systems and incorporates IMO's MSC.1/Circ.1621.

2 Objective

This Guide provides Classification criteria for the arrangements, construction, installation and survey of machinery, equipment and systems for vessels operating with methanol or ethanol as fuel in order to minimize risks to the vessel, crew and environment.

3 Classification Notations

3.1 Alternative Low Flashpoint Fueled Ship – Methanol or Ethanol

The **LFFS** notation is mandatory and will be assigned where a vessel is arranged to burn methanol or ethanol for propulsion and/or auxiliary purposes and is designed, constructed and tested in accordance with the requirements of this Guide. The **LFFS** notation will be assigned in association with the specific fuel and the following additional equipment notations (e.g. (**LFFS(DFD - Methanol)**, **LFFS(DFD - Ethanol)**)).

Commentary:

See also 5C-13-1/1 of the *Marine Vessel Rules* for additional details on ABS notations for IGF Code vessels.

End of Commentary

3.2 Dual Fuel Diesel Engine Power Plant

Where a dual fuel diesel engine power plant is installed, the **DFD** notation is mandatory and the unit is to be designed, constructed and tested in accordance with this Guide and the *Marine Vessel Rules*.

3.3 Single Fuel Engine Power Plant

Where a methyl/ethyl single fuel engine power plant is installed, the **SGF** notation is mandatory and the unit is to be designed, constructed and tested in accordance with this Guide and the *Marine Vessel Rules*.

4 Certification

ABS design review, survey, testing, and the issuance of reports or certificates constitute the certification of machinery, equipment and systems; see also 4-1-1/3 of the *Marine Vessel Rules*.

5 Flag Administration Approval

Where the conditions of the Guide are proposed to be used to comply with the IGF code and MSC.1/Circ.1621, such application is subject to approval by the vessel's flag Administration prior to issuance of relevant statutory certificates on behalf of the same flag Administration by ABS.

6 Format

This Guide is based on MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*, which are contained in their entirety and is required for classification.

The term “should be” is to be understood to read as “must be” or “is to be” or “are to be”. Unless otherwise specified, the term “Administration” as used in this guide is to be read as “Flag Administration” (See Subsection 1/5 of this Guide).

The numbering system reproduced herein follows the numbering contained in the aforementioned Interim Guidelines, except the numbering in the text referring to Interim Guidelines has been modified to reflect the numbering in this Guide.

The text contained in this Guide that comes from the Interim Guidelines is presented in *italics* “Times New Roman” typeface.

The parts of this Guide which are operational, training or national requirements are presented in *italics*. These parts are not required for Classification and are shown for information only.

The parts in this Guide which are Classification requirements are presented in non-italics “Times New Roman” typeface.

This Guide specifies only the unique requirements applicable to vessels using methanol or ethanol fuels, and is always to be used in association with the IGF Code, as incorporated in 5C-13 of the *Marine Vessel Rules*, and with other relevant Sections of the Rules.

Where this Guide includes cross references to Parts A-1, B-1 and C-1 of the IGF Code (5C-13-5 to 5C-13-18 of the *Marine Vessel Rules*), the terms "natural gas", "LNG" or "gas", as related to fuel, are to be understood as referring to methyl/ethyl alcohol for application of the requirements of this Guide.

Introduction

1) *The purpose of these Interim Guidelines is to provide an international standard for ships using methyl/ethyl alcohol as fuel.*

2) *The basic philosophy of these Interim Guidelines is to provide provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using methyl/ethyl alcohol as fuel to minimize the risk to the ship, its crew and the environment, having regard to the nature of the fuels involved.*

3) *Throughout the development of these Interim Guidelines it was recognized that the provisions therein must be based on sound naval architectural and engineering principles and the best understanding available of current operational experience, field data and research and development. These Interim Guidelines address all areas that need special consideration for the use of methyl/ethyl alcohol as fuel.*

4) *These Interim Guidelines follow the goal-based approach (MSC.1/Circ.1394/Rev.2) by specifying goals and functional requirements for each section forming the basis for the design, construction and operation of ships using methyl/ethyl alcohol as fuel.*

5) *The current version of these Interim Guidelines includes provisions to meet the functional requirements for methyl/ethyl alcohol as fuel.*

Commentary:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

End of Commentary

SECTION 2
General

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Application*

Unless expressly provided otherwise, these Interim Guidelines apply to ships to which part G of SOLAS chapter II-1 applies.

This guide is to be applied to both new construction and existing vessel conversions, regardless of size, including those of less than 500 tons gross tonnage, utilizing methanol or ethanol as fuel.

2 *Definitions*

For the purposes of these Interim Guidelines, the terms used have the meanings defined in the following paragraphs. Terms not defined have the same meaning as in SOLAS chapter II-2 and the IGF Code.

Commentary:

See also 5C-13-2/2 of the *Marine Vessel Rules* for IGF Code and additional ABS definitions.

End of Commentary

2.1

"Bunkering" means the transfer of fuel from land-based or floating facilities into ships' permanent tanks or connection of portable tanks to the fuel supply system.

2.2

"Fuel" means methyl/ethyl alcohol fuels, containing allowable additives or impurities, suitable for the safe operation on board ships, complying with an international standard.

Commentary:

Methyl/Ethyl alcohol means methanol or ethanol alcohol fuels.

End of Commentary

2.3

"Fuel tank" is any integral, independent or portable tank used for storage of fuel. The spaces around the fuel tank are defined as follows:

.1 "Fuel storage hold space" is the space enclosed by the ship's structure in which a fuel tank is situated. If tank connections are located in the fuel storage hold space, a fuel storage hold space should also be considered as tank connection space. Integral fuel tanks do not have a fuel storage hold space;

.2 "Cofferdam" is a structural space surrounding a fuel tank which provides an added layer of gas and liquid tightness protection against external fire, and toxic and flammable vapours between the fuel tank and other areas of the ship.; and

.3 "Tank connection space" is a space surrounding all tank connections and tank valves that is required for tanks with such connections in enclosed spaces.

2.4

"Fuel preparation space" means any space containing equipment for fuel preparation purposes, such as fuel pumps, fuel valve train, heat exchangers and filters.

2.5

"Gas freeing" is the process carried out to achieve a safe tank atmosphere. It includes two distinct operations:

.1 purging the hazardous tank atmosphere with an inert gas or other suitable medium (e.g. water) to dilute the hazardous vapour to a level where air can be safely introduced; and

.2 replacing the diluted inert atmosphere with air.

2.6

"Independent tanks" are self-supporting, do not form part of the ship's hull and are not essential to the hull strength.

2.7

"Integral tank" means a fuel-containment envelope tank which forms part of the ship's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the ship's hull.

2.8

"Portable tank" means an independent tank being able to be:

.1 easily connected and disconnected from ship systems; and

.2 easily removed from ship and installed on board ship.

2.9

"Single failure" is where loss of intended function occurs through one fault or action.

2.10

"Single fuel engine" means an engine capable of operating on a fuel defined as in 2/2.2 of this Guide only.

2.11 (ABS)

"Engine room" is a machinery space containing methanol or ethanol fueled engine(s).

Commentary:

See also IMO MSC/Circ.834 for the definition of engine room.

End of Commentary

2.12 (ABS)

"FVT" means Fuel Valve Train and refers to the consumer safety valve unit. For gas applications known as Gas Valve Unit (GVU) or Gas Valve Train (GVT) and is typically located in a dedicated space, enclosure or the fuel preparation room.

2.13 (ABS)

"Gas dispersion analysis" is the analysis of the dispersion behavior of gases using appropriate modeling techniques such as computational fluid dynamics (CFD) analysis.

2.14 (ABS)

"Inerting" refers to the process of providing a non-combustible environment by the addition of compatible gases, which may be carried in pressure vessels or produced on board the ship or supplied from an external source.

2.15 (ABS)

"Master Fuel Valve" is an automatic shut-off valve in the fuel supply line to each consumer and is located outside the machinery space of the consumer. This has the same functionality as "Master Valve", "Master Gas Valve" or "Master Gas Fuel Valve" defined under 5C-13-2/2.45 of the *Marine Vessel Rules*.

2.16 (ABS)

"Pressure tank" is a tank having a design pressure greater than 0.07 MPa gauge. A pressure tank is to be an independent tank and is to be of a configuration permitting the application of pressure vessel design criteria according to recognized standards.

3 *Alternative Design*

3.1

These Interim Guidelines contain functional requirements for all appliances and arrangements related to the usage of methyl/ethyl alcohol fuels.

3.2

Appliances and arrangements of methyl/ethyl alcohol fuel systems may deviate from those set out in these Interim Guidelines, provided such appliances and arrangements meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety to the relevant sections.

3.3

The equivalence of the alternative design should be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration should not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment or type thereof which is prescribed by these Interim Guidelines.

Commentary:

SOLAS regulation II-1/55.3 requires the alternative design engineering analysis to be prepared in accordance with MSC.1/Circ.1212, the '*Guidelines for Alternative Design Arrangements for SOLAS Chapters II-1 and III*'. See also MSC.1/Circ.1455, the '*Guidelines for Approval of Alternatives and Equivalents as Provided for in Various IMO Instruments*'.

End of Commentary

Equipment, components, and systems for which there are specific requirements in this Guide, or its associated references, may incorporate alternative arrangements or comply with the requirements of alternative recognized standards in lieu of the requirements in this Guide. However this is subject to such alternative arrangements or standards being determined by ABS as being not less effective than the overall safety and strength requirements of this Guide or associated references. Where applicable, requirements may be imposed by ABS in addition to those contained in the alternative arrangements or standards so that the intent of this Guide is met. In all cases, the equipment, component or system is subject to design review, survey during construction, tests and trials, as applicable, by ABS for purposes of verification of its compliance with the alternative arrangements or standards. The verification process is to be equivalent to that outlined in this Guide. See also 4-1-1/1.7 of the *Marine Vessel Rules*.

4 Plans and Data to be Submitted

Plans, data and specifications are to be submitted as follows:

4.1 Ship Arrangements and Systems

For Section 5 of this Guide, plans and specifications covering the ship arrangements and systems listed below are to be submitted, and are, as applicable, to include:

i) Risk assessment as referenced by Subsection 4/2 of this Guide

ii) General arrangement

iii) Fuel storage arrangements

iv) Fuel supply system arrangements

v) Fuel bunkering station arrangements

vi) Hazardous area classification plan

vii) Vent mast and venting arrangements

viii) Operations and maintenance manuals (to be submitted for reference purposes only)

ix) Emergency response plan (to be submitted for reference purposes only)

x) Description of the control, monitoring and safety systems, including alarm and shutdown monitoring and cause and effect diagram (see Section 15 of this Guide)

4.2 Fuel Containment System

For Section 6 of this Guide, plans and specifications covering the fuel containment system listed below are to be submitted, and are, as applicable, to include:

i) General arrangement plans of the vessel showing the position of the fuel containment system and details of manholes and other openings in fuel tanks

ii) Plans of the hull structure in way of the fuel tanks, including the installation of attachments, accessories, internal reinforcements, saddles for support and tie-down devices

iii) Plans of the structure of the fuel containment system, including the installation of attachments, supports and attachment of accessories

For independent pressure fuel tanks, the standard or Code adopted for the construction and design is to be identified. Detailed construction drawings together with design calculations for the pressure boundary, tank support arrangement and analysis for the load distribution. Anti-collision, chocking arrangement and design calculations

iv) Specification of the tank materials and coatings, including attachments, valves, accessories, etc.

v) Design loads and structural analyses for the fuel storage tank(s) *vi)* Loading and unloading systems, venting systems, and gas-freeing systems, as well as a schematic diagram of the remote controlled valve system

vii) Details and installation of the safety valves and relevant calculations of their relieving capacity, including back pressure

viii) Details and installation of the various monitoring and control systems, including the devices for measuring the level of the fuel in the tanks

ix) Schematic diagram of the ventilation system indicating the vent pipe sizes and location of the openings

x) Details of the electrical equipment installed in the fuel containment area and of the electrical bonding of the fuel tanks and piping

xi) Diagram of inert-gas system or hold-space environmental-control system

xii) Diagram of gas and leak detection systems

xiii) Schematic-wiring diagrams

xiv) Details of all fuel and vapor handling equipment

xv) Details of fire extinguishing systems

xvi) Welding procedures, stress relieving and non-destructive testing plans

xvii) Construction details of submerged fuel pumps including materials specifications

xviii) Operating and maintenance instruction manuals – see fuel handling manual required by 17/2.3 of this Guide (submitted for reference purposes only)

4.3 Fuel Bunkering System

For Section 8 of this Guide, plans and specifications covering the fuel bunkering system listed below are to be submitted, and are, as applicable, to include:

i) General arrangement of the fuel bunkering system including location of the gas and leak detectors, electrical equipment and lighting

ii) Detailed drawings of the bunkering station, manifolds, valves, couplings and control stations

iii) Piping systems including details of piping and associated components, design pressures and temperatures

iv) Material specifications for manifolds, valves and associated components

v) Weld procedures, stress relieving and non-destructive testing plans

vi) Ventilation system

vii) Fixed gas and leak detection and alarm systems, and associated shut-off and shutdown systems

viii) Descriptions and schematic diagrams for control and monitoring system including set points for abnormal conditions

ix) Details of all electrical equipment in the bunkering and control stations

x) Arrangement of equipotential and bonding insulating flange

xi) Emergency shutdown (ESD) arrangements and ESD flow chart

xii) Operating and maintenance instruction manuals – see fuel handling manual required by 17/2.3 of this Guide (submitted for reference purposes only)

xiii) Testing procedures during sea/gas trials (submitted for survey verification only)

4.4 Fuel Supply System

For Section 9 of this Guide, plans and specifications covering the fuel supply system listed below are to be submitted, and are, as applicable, to include:

i) General arrangement of the fuel preparation room including location of the gas and leak detectors, electrical equipment and lighting

ii) Doors and other openings in fuel preparation rooms

iii) Ventilation systems

iv) Material specifications for pumps, piping, valves and associated fuel supply components

v) Fixed gas and leak detection and alarm systems, and associated shut-off and shutdown systems

vi) Fuel piping systems including details of piping and associated components, design pressures, temperatures, and fuel processing or treatment systems, where applicable

vii) Weld procedures, stress relieving and non-destructive testing plans

viii) Pressure vessels

ix) Descriptions and schematic diagrams for control and monitoring system including set points for abnormal conditions

x) Details of all electrical equipment in the fuel preparation room

xi) Electric bonding (earthing) arrangement

xii) Failure Modes and Effects Analysis (FMEA) to determine possible failures and their effects in the safe operation of the fuel supply system

xiii) Emergency shutdown arrangements

xiv) Operating and maintenance instruction manuals – see fuel handling manual required by 17/2.3 of this Guide (submitted for reference purposes only)

xv) Testing procedures during sea/gas trials (submitted for survey verification only)

4.5 Power Generation Prime Movers and Accessories

For Section 10 of this Guide, and in addition to the plans and particulars required by 4-2-1/1.5 of the *Marine Vessel Rules*, plans and specifications covering the power generation prime movers and accessories listed below are to be submitted, and are, as applicable, to include:

i) General arrangement of the engine room, including location of the gas and leak detectors, electrical equipment and lighting

ii) Ventilation systems

iii) Fixed gas and leak detection and alarm systems, and associated shut-off and shutdown systems

iv) Fuel specification(s)

v) Fuel piping systems including schematics for main and pilot fuel systems together with details of piping and associated components, design pressures and temperatures

vi) Descriptions and schematic diagrams for control and monitoring system including set points for abnormal conditions

vii) Details of the electrical equipment

viii) Electric bonding (earthing) arrangement

ix) Arrangement and details for crankcase protection

x) Failure Modes and Effects Analysis (FMEA) to determine possible failures and their effects in the safe operation of the engines for each engine type and fuel.

xi) Safety concept and/or risk analysis documentation

xii) Emergency shut down arrangements

xiii) Operating and maintenance instruction manuals (submitted for reference purposes only)

xiv) Testing procedures for shop test and sea trial (submitted for survey verification only)

SECTION 3
Goal and Functional Requirements

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of these Interim Guidelines is to provide for safe and environmentally friendly design, construction and operation of ships and in particular their installations of systems for propulsion machinery, auxiliary power generation machinery and/or other purpose machinery using methyl/ethyl alcohol as fuel.

2 Functional Requirements

2.1

The safety, reliability and dependability of the systems should be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.

2.2

The probability and consequences of fuel-related hazards should be limited to a minimum through arrangement and system design, such as ventilation, detection and safety actions. In the event of fuel leakage or failure of the risk reducing measures, necessary safety actions should be initiated.

2.3

The design philosophy should ensure that risk-reducing measures and safety actions for the fuel installation do not lead to an unacceptable loss of power.

2.4

Hazardous areas should be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the ship, persons on board and equipment.

2.5

Equipment installed in hazardous areas should be minimized to that required for operational purposes and should be suitably and appropriately certified.

2.6

Unintended accumulation of explosive, flammable or toxic vapour and liquid concentrations should be prevented.

2.7

System components should be protected against external damage.

2.8

Sources of ignition in hazardous areas should be minimized to reduce the probability of fire and explosions.

2.9

Safe and suitable fuel supply, storage and bunkering arrangements should be provided, capable of receiving and containing the fuel in the required state without leakage.

2.10

Piping systems, containment and overpressure relief arrangements that are of suitable design, material, construction and installation for their intended application should be provided.

2.11

Machinery, systems and components should be designed, constructed, installed, operated, maintained and protected to ensure safe and reliable operation.

2.12

Suitable control, alarm, monitoring and shutdown systems should be provided to ensure safe and reliable operation.

2.13

Fixed fuel vapour and/or leakage detection suitable for all spaces and areas concerned should be arranged.

2.14

Fire detection, protection and extinction measures appropriate to the hazards concerned should be provided.

2.15

Commissioning, trials and maintenance of fuel systems and fuel utilization machinery should satisfy the goal in terms of safety, availability and reliability.

2.16

The technical documentation should permit an assessment of the compliance of the system and its components with the applicable rules, guidelines, design standards used, and the principles related to safety, availability, maintainability and reliability.

2.17

A single failure in a technical system or component should not lead to an unsafe or unreliable situation.

2.18 (ABS)

Personnel Protective Equipment (PPE) and emergency treatment facilities, appropriate to the potential hazards (in particular toxicity), for operational and maintenance purposes, are to be provided.

SECTION 4
General Provisions

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to ensure that the necessary assessments of the risks involved are carried out in order to eliminate or mitigate any adverse effect on the persons on board, the environment or the ship.

2 Risk Assessment

2.1

A risk assessment should be conducted to ensure that risks arising from the use of methyl/ethyl alcohol fuels affecting persons on board, the environment, the structural strength, or the integrity of the ship are addressed. Consideration should be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

2.2

The risks should be analysed using acceptable and recognized risk analysis techniques. Loss of function, component damage, fire, explosion, toxicity and electric shock should, as a minimum, be considered. The analysis should ensure that risks are eliminated wherever possible. Risks which cannot be eliminated should be mitigated as necessary. Details of risks, and the means by which they are mitigated, should be documented to the satisfaction of the Administration.

Commentary:

See IACS Recommendation No.146, Risk Assessment as Required by the IGF Code. See also the ABS *Guidance Notes on Risk Assessment Applications for the Marine and Offshore Industries* for further guidance on risk assessment.

End of Commentary

2.3 (ABS)

In addition to the risks listed in 4/2.2 of this Guide, the risk assessment is to specifically consider, but not limited to, the items referenced by this Guide.

i) Mechanical protection of fuel preparation room/space – see 5/8.2 of this Guide

ii) Capacity of drip trays - see 5/10.2 of this Guide

iii) Required number of compressed air safety equipment sets – see 5/13.4 of this Guide *iv)* Arrangements of closed or semi-enclosed bunker stations – see 8/3.1.1 and 13/5 of this Guide

v) Causes and consequences of fuel supply release – see 9/3.2 of this Guide

vi) Required gas detection for ventilation inlets to accommodation spaces, machinery spaces, service spaces and control stations – see 15/7.1.8 of this Guide

vii) Gas detection system suitability for toxicity detection – see 15/7.4 of this Guide

2.4 (ABS)

The risk assessment plan developed and submitted to ABS for review is to contain, but not limited to:

i) Description of proposed function

ii) Quantitative or Qualitative risk assessment method(s) to be used and description if using a non-standard method

iii) Scope and objectives of the assessment

iv) Subject matter experts / participants / risk analysts, including their background and area of expertise

v) Proposed risk acceptance criteria or risk matrix

vi) Risk control and management measures

The risk control and management measures are to be maintained throughout the life of the vessel. Any modification is to be submitted to ABS.

Further guidance on submitting a risk assessment plan can be found in the ABS *Guide for Risk Evaluations for the Classification of Marine-Related Facilities*.

3 Limitation of Explosion Consequences

An explosion in any space containing any potential sources of release[(1)] and potential ignition sources should not:

(Note 1: Double wall fuel pipes are not considered as potential sources of release.)

.1 cause damage to or disrupt the proper functioning of equipment/systems located in any space other than that in which the incident occurs;

.2 damage the ship in such a way that flooding of water below the main deck or any progressive flooding occur;

.3 damage work areas or accommodation in such a way that persons who stay in such areas under normal operating conditions are injured;

.4 disrupt the proper functioning of control stations and switchboard rooms necessary for power distribution;

.5 damage life-saving equipment or associated launching arrangements;

.6 disrupt the proper functioning of fire-fighting equipment located outside the explosion-damaged space;

.7 affect other areas of the vessel in such a way that chain reactions involving, inter alia, cargo, gas and bunker oil may arise; or

.8 prevent persons' access to life-saving appliances (LSA) or impede escape routes.

SECTION **5**

Ship Design and Arrangement

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Goal*

The goal of this section is to provide for safe location, space arrangements and mechanical protection of power generation equipment, fuel storage system, fuel supply equipment and refuelling systems.

2 *Functional Requirements*

This section is related to functional requirements 3/2.1 to 3/2.7, 3/2.12, 3/2.14 and 3/2.16 of this Guide. In particular, the following applies:

.1 the fuel tank(s) should be located in such a way that the probability of the tank(s) being damaged following a collision or grounding is reduced to a minimum taking into account the safe operation of the ship and other hazards that may be relevant to the ship;

.2 fuel containment systems, fuel piping and other fuel release sources should be located and arranged such that released fuel, either as vapour or liquid, is led to safe locations;

.3 the access or other openings to spaces containing potential sources of fuel release should be arranged such that flammable, asphyxiating or toxic vapours or liquids cannot escape to spaces that are not designed for the presence of such substances;

.4 fuel piping should be protected against mechanical damage;

.5 the propulsion and fuel supply system should be designed such that safety actions after any fuel leakage do not lead to an unacceptable loss of power; and

.6 the probability of a fire or explosion in a machinery space as a result of a fuel release should be minimized in the design, with special attention to the risk of leakage from pumps, valves and connections.

3 *General Provisions*

3.1

Tanks containing fuel should not be located within accommodation spaces or machinery spaces of category A.

3.2

Integral fuel tanks should be surrounded by protective cofferdams, except on those surfaces bound by shell plating below the lowest possible waterline, other fuel tanks containing methyl/ethyl alcohol, or fuel preparation space.

3.2 (ABS)

The scantlings of the hull structure in way of integral tanks are to be in accordance with Part 5C, Chapter 2 of the *Marine Vessel Rules,* as modified by 5C-9-4/1.1 (ABS) of the *Marine Vessel Rules*.

3.3

The fuel containment system should be abaft of the collision bulkhead and forward of the aft peak bulkhead.

3.4

Fuel tanks located on open decks should be protected against mechanical damage.

3.4 (ABS)

Fuel tanks located on deck are not to be located less than 800 mm from the vessel's side.

3.5

Fuel tanks on open decks should be surrounded by coamings and spills should be collected in a dedicated holding tank.

3.6

Special consideration should be given to chemical tankers using methyl/ethyl alcohol cargoes as fuel.

4 Independent Fuel Tanks

4.1

Independent tanks may be accepted on open decks or in a fuel storage hold space.

4.2

Independent tanks should be fitted with:

.1 mechanical protection of the tanks depending on location and cargo operations;

.2 if located on an open deck, drip tray arrangements for leak containment and water spray systems for emergency cooling; and

.3 if located in a fuel storage hold space, the space should meet the provisions of Sections 11 and 13 of this Guide.

4.2 (ABS)

A tank connection space is required for tanks located in enclosed spaces and may be required for tanks on open deck. A tank connection space would be required for tanks on open deck where the restriction of hazardous areas is safety critical or is necessary to provide environmental protection for essential safety equipment related to the fuel system such as tank valves, safety valves and instrumentation.

4.3

Independent fuel tanks should be secured to the ship's structure. The arrangement for supporting and fixing the tanks should be designed for the maximum expected static, dynamic inclinations and accidental *loads as well as the maximum expected values of acceleration, taking into account the ship characteristics and the position of the tanks.*

4.4 (ABS)

The hull structure in way of independent fuel tanks is to be in accordance with 5C-9-1/11.3 of the *Marine Vessel Rules*.

5 *Portable Tanks*

5.1

Portable fuel tanks should be located in dedicated areas fitted with:

.1 mechanical protection of the tanks depending on location and cargo operations;

.2 if located on an open deck, drip tray arrangements for leak containment and water spray systems for emergency cooling; and

.3 if located in a fuel storage hold space, the space should meet the provisions of Sections 11 and 13 of this Guide.

5.1 (ABS)

A tank connection space is required for tanks located in enclosed spaces and may be required for tanks on open deck. A tank connection space would be required for tanks on open deck where the restriction of hazardous areas is safety critical or is necessary to provide environmental protection for essential safety equipment related to the fuel system such as tank valves, safety valves and instrumentation.

5.2

Portable fuel tanks should be secured to the deck while connected to the ship systems. The arrangement for supporting and fixing the tanks should be designed for the maximum expected static and dynamic inclinations, as well as the maximum expected values of acceleration, taking into account the ship characteristics and the position of the tanks.

5.3

Consideration should be given to the ship's strength and the effect of the portable fuel tanks on the ship's stability.

5.4

Connections to the ship's fuel piping systems should be made by means of approved flexible hoses suitable for methyl/ethyl alcohol or other suitable means designed to provide sufficient flexibility.

5.5

Arrangements should be provided to limit the quantity of fuel spilled in case of inadvertent disconnection or rupture of the non-permanent connections.

5.6

The pressure relief system of portable tanks should be connected to a fixed venting system.

5.7

Control and monitoring systems for portable fuel tanks should be integrated in the ship's control and monitoring system. A safety system for portable fuel tanks should be integrated in the ship's safety system (e.g. shutdown systems for tank valves, leak/vapour detection systems).

5.8

Safe access to tank connections for the purpose of inspection and maintenance should be ensured.

5.9

When connected to the ship's fuel piping system:

.1 each portable tank should be capable of being isolated at any time;

.2 isolation of one tank should not impair the availability of the remaining portable tanks; and

.3 the tank should not exceed its filling limits.

6 Provisions for Machinery Space

6.1

A single failure within the fuel system should not lead to a release of fuel into the machinery space.

6.2

All fuel piping within machinery space boundaries should be enclosed in gas and liquid tight enclosures in accordance with 9/4 of this Guide.

7 Provisions for Location and Protection of Fuel Piping

7.1

Fuel pipes should not be located less than 800 mm from the ship's side.

7.2

Fuel piping should not be led directly through accommodation spaces, service spaces, electrical equipment rooms or control stations as defined in the SOLAS Convention.

7.2 Interpretation of 7.2 (ABS)

Fuel piping in this context also includes fuel vent piping from tank pressure relief valves, block and bleed valves and relief valves or vent lines from other fuel supply system components and fuel consumers.

7.3

Fuel pipes led through ro-ro spaces, special category spaces and on open decks should be protected against mechanical damage.

7.4

Fuel piping should comply with the following:

.1 Fuel piping that passes through enclosed spaces in the ship should be enclosed in a pipe or duct that is gas and liquid tight towards the surrounding spaces with the fuel contained in the inner pipe. Such double walled piping is not required in cofferdams surrounding fuel tanks, fuel preparation spaces or spaces containing independent fuel tanks as the boundaries for these spaces will serve as a second barrier.

.2 All fuel pipes should be self-draining to suitable fuel or collecting tanks in normal condition of trim and list of the ship. Alternative arrangements for draining the piping may be accepted by the Administration.

8 Provisions for Fuel Preparation Spaces Design

Fuel preparation spaces should be located outside machinery spaces of category A.

8.1 (ABS)

Fuel preparation spaces are to be separated by gastight bulkheads and decks from other spaces.

8.2 (ABS)

When located on deck, fuel preparation spaces are to be protected against mechanical damage where vessel cargo handling operations increase the risk of mechanical impact damage.

8.3 (ABS)

Fuel preparation spaces are to contain only the equipment essential for fuel conditioning, preparation and supply, together with necessary safety equipment such as fire and gas detection, low oxygen level detection system, fire-fighting equipment, and bilge equipment.

9 Provisions for Bilge Systems

9.1

Bilge systems installed in areas where methyl/ethyl alcohol can be present should be segregated from the bilge system of spaces where methyl alcohol or ethyl alcohol cannot be present.

9.2

One or more holding tanks for collecting drainage and any possible leakage of methyl/ethyl alcohol from fuel pumps, valves or from double walled inner pipes located in enclosed spaces should be provided. Means should be provided for safely transferring contaminated liquids to onshore reception facilities.

9.3

The bilge system serving the fuel preparation space should be operable from outside the fuel preparation space.

10 Provisions for Drip Trays

10.1

Drip trays should be fitted where leakage and spill may occur, in particular, in way of single wall pipe connections.

10.2

Each tray should have a sufficient capacity to ensure that the maximum amount of spill according to the risk assessment can be handled.

10.2 (ABS)

The drip trays located below the tank connections and other sources of vapor release from tanks located on deck are to be located not less than 3 m from entrances, services spaces, cargo spaces, air inlets and openings to accommodation spaces, machinery spaces and control stations.

10.3

Each drip tray should be provided with means to safely drain spills or transfer spills to a dedicated holding tank. Means for preventing backflow from the tank should be provided.

10.4

Drip trays for leakage of less than 10 litres may be provided with means for manual emptying.

10.5

The holding tank should be equipped with a level indicator and alarm, and should be inerted at all times during normal operation.

11 Provisions for Arrangement of Entrances and Other Openings in Enclosed Spaces

11.1

Direct access should not be permitted from a non-hazardous area to a hazardous area. Where such openings are necessary for operational reasons, an airlock which complies with the provisions of Subsection 5/12 of this Guide should be provided.

11.2

Fuel preparation spaces should have independent access direct from open deck. Where a separate access from open deck is not practicable, an airlock complying with Subsection 5/12 of this Guide should be provided.

11.3

Fuel tanks and surrounding cofferdams should have suitable access from the open deck, where practicable, for gas freeing, cleaning, maintenance and inspection.

11.4

Without direct access to open deck, an entry space to fuel tanks or surrounding cofferdams should be provided and comply with the following:

.1 be fitted with an independent mechanical extraction ventilation system, providing a minimum of six air changes per hour; a low oxygen alarm and a gas detection alarm should be fitted;

.2 have sufficient open area around the fuel tank hatch for efficient evacuation and rescue operation;

.3 not be an accommodation space, service space, control station or machinery space of category A; and

.4 a cargo space may be accepted as an entry space, depending upon the type of cargo, if the area is cleared of cargo and no cargo operation is undertaken during entry to the space.

11.5

The area around independent fuel tanks should be sufficient to carry out evacuation and rescue operations.

11.6

For safe access, horizontal hatches or openings to or within fuel tanks or surrounding cofferdams should have a minimum clear opening of 600 mm x 600 mm that also facilitates the hoisting of an injured person from the bottom of the tank/cofferdam. For access through vertical openings providing main passage through the length and breadth within fuel tanks and cofferdams, the minimum clear opening should not be less than 600 mm x 800 mm at a height of not more than 600 mm from bottom plating unless gratings or footholds are provided. Smaller openings may be accepted provided evacuation of an injured person from the bottom of the tank/cofferdam can be demonstrated.

12 Provisions for Airlocks

12.1

An airlock is a space enclosed by gastight bulkheads with two gastight doors spaced at least 1.5 m and not more than 2.5 m apart. Unless subject to the requirements of the International Convention on Load Lines, *the door sill should not be less than 300 mm in height. The doors should be self-closing without any hold-back arrangements.*

12.2

Airlocks should be mechanically ventilated at an overpressure relative to the adjacent hazardous area or space.

12.3

Airlocks should have a simple geometrical form. They should provide for free and easy passage and should have a deck area not less than 1.5 m^2*. Airlocks should not be used for other purposes, for instance as storerooms.*

12.4

An audible and visual alarm system to give a warning on both sides of the airlock should be provided to indicate if more than one door is moved from the closed position.

12.5

For non-hazardous spaces with access from hazardous spaces below deck where the access is protected by an airlock, upon loss of underpressure in the hazardous space access to the space should be restricted until the ventilation has been reinstated. Audible and visual alarms should be given at a manned location to indicate both loss of pressure and opening of the airlock doors when pressure is lost.

12.6

Essential equipment required for safety should not be de-energized and should be of a certified safe type. This may include lighting, fire detection, gas detection, public address and general alarms systems.

12.7

Electrical equipment which is not of the certified safe type for propulsion, power generation, manoeuvring, anchoring and mooring equipment as well as the emergency fire pumps should not be located in spaces to be protected by airlocks.

13 Personnel Safety and PPE (ABS)

13.1

Suitable protective equipment consisting of large aprons, appropriate gloves with long sleeves, suitable footwear, coveralls of chemical-resistant material, and tight-fitting goggles or face shield, or both, to a recognized national or international standard is to be provided for protection of crew members engaged in normal bunkering or fuel system maintenance and operations.

13.2

Personal protective and safety equipment required in this section is to be kept in suitable, clearly marked lockers in readily accessible locations.

13.3

The compressed air breathing apparatus is to be inspected at least once a month by a responsible officer and the inspection logged in the ship's records. This equipment is to also be inspected and tested by a competent person at least once a year.

13.4

Sufficient, but not less than three complete sets of safety equipment are to be provided in addition to the required firefighter's outfits. Each set is to provide adequate personal protection to permit entry and work in a gas-filled space for at least 20 minutes.

13.5

Each complete set of safety equipment is to consist of:

i) one self-contained positive pressure air-breathing apparatus incorporating full face mask not using stored oxygen, and having a capacity of at least 1,200 ℓ (liters) of free air. Each set is to be compatible with the required firefighter's outfits.

ii) protective gas tight clothing, boots and gloves to a recognized standard.

iii) steel-cored rescue line with belt.

iv) explosion-proof lamp.

13.6

An adequate supply of compressed air is to be provided and is to consist either of:

i) at least one fully charged spare air bottle for each breathing apparatus required by 5/13.4 of this Guide;

ii) an air compressor of adequate capacity capable of continuous operation, suitable for the supply of high-pressure air of breathable quality; and

iii) a charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus required by 5/13.4 of this Guide.

13.7

Eyewash and decontamination safety showers are to be provided, the location and number of these eyewash stations and safety showers are to be derived from the detailed installation arrangements. As a minimum, the following stations are to be provided:

i) In the vicinity of the fuel preparation room(s), fuel transfer or treatment pump locations. If there are multiple fuel transfer or treatment pump locations on the same deck then one eyewash and safety shower station may be considered acceptable provided that the station is easily accessible from all such pump locations on the same deck.

ii) An eyewash station and safety shower is to be provided in the vicinity of a fuel bunkering station on-deck. If the bunkering connections are located on both port and starboard sides, then consideration is to be given to providing two eyewash stations and safety showers, one on each side.

iii) An eyewash station and safety shower is to be provided in the vicinity of any part of the fuel system where there is the potential for a person to come into contact with methanol/ethanol (e.g., openings such as filling/drainage or system connections/components that require periodic maintenance).

iv) The eyewash stations and decontamination showers are to be operable in all ambient conditions.

Commentary:

For vessels of unrestricted service, ambient temperature as indicated in 4-1-1/9 TABLE 8 of the *Marine Vessel Rules* is to be considered in the selection and installation of machinery, equipment and appliances. For ships of restricted or special service, the ambient temperature appropriate to the special nature is to be considered.

End of Commentary

13.8

The ship is to be provided with at least two sets of portable gas detectors that meet an accepted national or international standard and are suitable for toxicity.

Fuel Containment System

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to provide for a fuel containment system where the risk to the ship, its crew and to the environment is minimized to a level that is at least equivalent to a conventional oil-fuelled ship.

2 Functional Requirements

2.1

This section refers to functional requirements 3/2.1, 3/2.2, 3/2.5, and 3/2.8 to 3/2.16 of this Guide.

2.2

The fuel tanks should be designed such that a leakage from the fuel tank or its connections does not endanger the ship, persons on board or the environment. Potential dangers to be avoided include:

.1 flammable fuels spreading to locations with ignition sources;

.2 toxicity potential and risk of oxygen deficiency or other negative impacts on crew health due to fuels and inert gases;

.3 restriction of access to muster stations, escape routes or LSAs; and

.4 reduction in availability of LSAs.

2.3

The fuel containment system and the fuel supply system should be designed such that safety actions after any leakage, irrespective of in liquid or vapour phase, do not lead to an unacceptable loss of power.

2.4

If portable tanks are used for fuel storage, the design of the fuel containment system should be equivalent to permanent installed tanks as described in this section.

3 Provisions for Fuel Tanks Venting and Gas Freeing System

3.1

The fuel tanks should be fitted with a controlled tank venting system.

3.2

A fixed piping system should be arranged to enable each fuel tank to be safely gas freed, and to be safely filled with fuel from a gas-free condition.

3.3

The formation of gas pockets during the gas freeing operation should be avoided by considering the arrangement of internal tank structure and location of gas freeing inlets and outlets.

3.4

Pressure and vacuum relief valves should be fitted to each fuel tank to limit the pressure or vacuum in the fuel tank. The tank venting system may consist of individual vents from each fuel tank or the vents from each individual fuel tank may be connected to a common header. Design and arrangement should prevent flame propagation into the fuel containment system. If pressure relief valves (PRVs) of the high velocity type are fitted to the end of the vent pipes, they should be certified for endurance burning in accordance with MSC/Circ.677. If PRVs are fitted in the vent line, the vent outlet should be fitted with a flame arrestor certified for endurance burning in accordance with MSC/Circ.677.

3.5

Shut-off valves should not be arranged either upstream or downstream of the PRVs. Bypass valves may be provided. For temporary tank segregation purposes (maintenance) shut-off valves in common vent lines may be accepted if a secondary independent over/underpressure protection is provided to all tanks as per 6/3.7 of this Guide.

3.6

The fuel tank-controlled venting system should be designed with redundancy for the relief of full flow overpressure and/or vacuum. Pressure sensors fitted in each fuel tank, and connected to an alarm system, may be accepted in lieu of the secondary redundancy requirement for pressure relief. The opening pressure of the PRVs should not be lower than 0.007 MPa below atmospheric pressure.

3.7

PRVs should vent to a safe location on open deck and should be of a type which allows the functioning of the valve to be easily checked.

3.8

The fuel tank vent system should be sized to permit bunkering at a design loading rate without over-pressurizing the fuel tank.

3.9

The fuel tank vent system should be connected to the highest point of each tank and vent lines should be self-draining under all normal operating conditions.

3.9 (ABS)

The stainless steel piping of the fuel tank vent system is to be in accordance with 5C-9-8/2.5.2 of the *Marine Vessel Rules*.

4 Inerting and Atmospheric Control within Fuel Storage System

4.1

All fuel tanks should be inerted at all times during normal operation.

4.2

Cofferdams should be arranged either for purging or filling with water through a non-permanent connection. Emptying the cofferdams should be done by a separate drainage system, e.g. bilge ejector.

4.3

The system should be designed to eliminate the possibility of a flammable mixture atmosphere existing in the fuel tank during any part of the atmosphere change operation, gas freeing or inerting by utilizing an inerting medium.

4.4

To prevent the return of flammable liquid and vapour to the inert gas system, the inert gas supply line should be fitted with two shutoff valves in series with a venting valve in between (double block and bleed valves). In addition, a closable non-return valve should be installed between the double block and bleed arrangement and the fuel system. These valves should be located inside hazardous spaces.

4.5

Where the connections to the inert gas piping systems are non-permanent, two non-return valves may substitute the valves required in 6/4.4 of this Guide.

4.6

Blanking arrangements should be fitted in the inert gas supply line to individual tanks. The position of the blanking arrangements should be immediately obvious to personnel entering the tank. Blanking should be via removable spool piece.

4.7

Fuel tank vent outlets should be situated normally not less than 3 m above the deck or gangway if located within 4 m from such gangways. The vent outlets are also to be arranged at a distance of at least 10 m from the nearest air intake or opening to accommodation and service spaces and ignition sources. The vapour discharge should be directed upwards in the form of unimpeded jets.

4.8

Vapour outlets from fuel tanks should be provided with devices tested and type approved to prevent the passage of flame into the tank. Due attention should be paid in the design and position of the PRVs with respect to blocking and due to ice during adverse weather conditions. Provision for inspection and cleaning should be arranged.

4.9

The arrangements for gas freeing and ventilation of fuel tanks should be such as to minimize the hazards due to the dispersal of flammable vapours to the atmosphere and to flammable gas mixture in the tanks. The ventilation system for fuel tanks should be exclusively for ventilating and gas freeing purposes. Connection between fuel tank and fuel preparation space ventilation will not be accepted.

4.10

Gas freeing operations should be carried out such that vapour is initially discharged in one of the following ways:

.1 through outlets at least 3 m above the deck level with a vertical efflux velocity of at least 30 m/s maintained during the gas freeing operation;

.2 through outlets at least 3 m above the deck level with a vertical efflux velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame; or

.3 through outlets underwater.

4.11

In designing a gas freeing system in conformity with 6/3.2 of this Guide due consideration should be given to the following:

.1 materials of construction of system;

.2 time to gas free;

.3 flow characteristics of fans to be used;

.4 the pressure losses created by ducting, piping, fuel tank inlets and outlets;

.5 the pressure achievable in the fan driving medium (e.g. water or compressed air); and

.6 the densities of the fuel vapour/air mixture.

5 Inert Gas Availability On Board

5.1

Inert gas should be available permanently on board in order to achieve at least one trip from port to port considering maximum consumption of fuel expected and maximum length of trip expected, and to keep tanks inerted during 2 weeks in harbour with minimum port consumption.

5.1 (ABS)

Where inert gas is also stored for fire-fighting purposes, it is to be carried in separate containers and is not to be used for fuel gas services.

5.2

A production plant and/or adequate storage capacities might be used to achieve the availability target defined in 6/5.1 of this Guide.

5.3

Fluid used for inerting should not modify the characteristics of the fuel.

5.4

The production plant, if fitted, should be capable of producing inert gas with oxygen content at no time greater than 5% by volume. A continuous-reading oxygen content meter should be fitted to the inert gas supply from the equipment and should be fitted with an alarm set at a maximum of 5% oxygen content by volume. The system should be designed to ensure that if the oxygen content exceeds 5% by volume, the inert gas should be automatically vented to atmosphere.

5.5

The system should be able to maintain an atmosphere with an oxygen content not exceeding 8% by volume in any part of any fuel tank.

5.6

An inert gas system should have pressure controls and monitoring arrangements appropriate to the fuel containment system.

5.7

Where a nitrogen generator or nitrogen storage facilities are installed in a separate compartment outside of the engine-room, the separate compartment should be fitted with an independent mechanical extraction ventilation system, providing a minimum of six air changes per hour. If the oxygen content is below 19% in the separate compartment, an alarm should be given. A minimum of two oxygen sensors should be provided in each space. Visual and audible alarms should be placed at each entrance to the inert gas room.

5.7 (ABS)

Where an inert gas generator or inert gas storage facilities are installed in the engine room, see 5C-13-6/14.5 (ABS) of the *Marine Vessel Rules*.

5.8

Nitrogen pipes should only be led through well ventilated spaces. Nitrogen pipes in enclosed spaces should:

.1 have only a minimum of flange connections as needed for fitting of valves and be fully welded; and

.2 be as short as possible.

5.8 (ABS)

Inert gas piping is not to pass through accommodation spaces, service spaces or control stations.

5.9

Notwithstanding the provisions of Subsection 6/5 of this Guide, inert gas utilized for gas freeing of tanks may be provided externally to the ship.

SECTION 7

Material and General Pipe Design

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to ensure the safe handling of fuel, under all operating conditions, to minimize the risk to the ship, personnel and to the environment, having regard to the nature of the products involved.

2 Functional Requirements

This section relates to functional requirements 3/2.1, 3/2.6, 3/2.8, 3/2.9 and 3/2.10 of this Guide. In particular, all materials used should be suitable for the fuel under the maximum working pressure and temperature.

3 Provisions for General Pipe Design

3.1

The design pressure for any section of the fuel piping system is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on any relief valve on the system.

3.2

The wall thickness of pipes made of steel should not be less than:

$$t = (t_0 + b + c)/(1 - a/100)\ mm$$

where:

t_0 *= theoretical thickness, mm*

$t_0 = PD / (2Ke + P)$ *mm*

P = system design pressure, but not less than the design pressure given in 7/3.1 of this Guide, MPa

D = outside pipe diameter

K = allowable stress N/mm^2 *(see 7/3.3 of this Guide)*

e = efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with recognized standards. In other cases, an efficiency factor less than 1.0, in accordance with recognized standards, may be required depending upon the manufacturing process

b = allowance for bending (mm). The value for b should be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, b should not be less than: $b = Dt_0 / 2.5r$ *where: r = mean radius of the bend (mm)*

c = corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping should be increased over that required by the other design provisions

a = negative manufacturing tolerance for thickness (%)

3.3

For pipes made of steel the allowable stress K to be considered in the formula for t_0 *in 7/3.2 is the lower of the following values:*

R_m/A or R_e/B

where:

R_m *= specified minimum tensile strength at ambient temperature (N/mm²)*

R_e *= specified minimum yield stress at ambient temperature (N/mm²). If stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies*

The values of A and B should be at least A = 2.7 and B = 1.8

3.4

Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to superimposed loads, the wall thickness should be increased over that required by 7/3.2 of this Guide or, if this is impracticable or would cause excessive local stresses, these loads should be reduced, protected against or eliminated by other design methods. Such superimposed loads may be due to supports, ship deflections, liquid pressure surge during transfer operations, the weight of suspended valves, reaction to loading arm connections or otherwise.

3.5

For pipes made of materials other than steel, the allowable stress should be considered by the Administration.

3.6

High pressure fuel piping systems(2) should have sufficient constructive and fatigue strength. This should be confirmed by carrying out stress analysis and taking into account:

.1 stresses due to the weight of the piping system;

.2 acceleration loads when significant; and

.3 internal pressure and loads induced by hog and sag of the ship.

(Note 2: Whether a fuel system should be considered as a high-pressure system for the purpose of these Guidelines depends on the design and arrangement of the specific system. Accordingly, the stress analysis should be waived or done to the satisfaction of the Administration.)

3.7

Fuel pipes and all the other piping needed for safe and reliable operation and maintenance should be colour marked in accordance with a standard at least equivalent to those acceptable to the Administration.

3.8

All fuel piping and independent fuel tanks should be electrically bonded to the ship's hull. Electrical conductivity should be maintained across all joints and fittings. Electrical resistance between piping and the hull should be maximum 10^6 Ohm.

3.9

Piping other than fuel supply piping and cabling may be arranged in the double wall piping or duct provided that it does not create a source of ignition or compromise the integrity of the double pipe or duct. The double wall piping or duct should only contain piping or cabling necessary for operational purposes.

3.10

Filling lines to fuel tanks should be arranged to minimize the possibility for static electricity, e.g. by reducing the free fall into the fuel tank to a minimum.

3.11

The arrangement and installation of fuel piping should provide the necessary flexibility to maintain the integrity of the piping system in the actual service situations, taking potential for fatigue into account. Expansion bellows should not be used.

3.12 *Piping Fabrication and Joining Details*

3.12.1

The inner piping, where a protective duct is required, is to be full penetration butt-welded and fully radiographed. Flange connections in this piping are to only be permitted within the tank connection space and fuel preparation space or similar;

.1 during the use of the fuel piping, all doors, ports and other openings on the corresponding superstructure or deckhouse side should normally be kept closed; and

.2 the annular space in the double walled fuel piping should be segregated at the engine-room bulkhead; this implies that there should be no common ducting between the engine-room and other spaces.

3.12.2

Piping for fuel should be joined by welding except:

.1 for approved connections to shut-off valve and expansion joints, if fitted; and

.2 for other exceptional cases specifically approved by the Administration.

3.12.3

The following direct connections of pipe length without flanges may be considered:

.1 butt-welded joints with complete penetrations at the root;

.2 slip-on welded joints with sleeves and related welding having dimensions in accordance with recognized standards should only be used in pipes having an external diameter of 50 mm or less; the possibility for corrosion is to be considered; and

.3 screwed connections, in accordance with recognized standards, should only be used for piping with an external diameter of 25 mm or less.

3.12.4

Welding, post-weld heat treatment, radiographic testing, dye penetrating testing, pressure testing, leakage testing and non-destructive testing should be performed in accordance with recognized standards. Butt welding should be subject to 100% non-destructive testing, while sleeve welds should be subject to at least 10% liquid penetrant testing (PT) or magnetic particle testing (MT).

3.12.5

Where flanges are used, they should be of the welded-neck or slip-on type. Socket welds are not to be used in nominal sizes above 50 mm.

3.12.5 (ABS)

Design calculations, materials, dimensions and gasket data are to be submitted for non-standard flanges.

3.12.6

Expansion of piping should normally be allowed for by the provision of expansion loops or bends in the fuel piping system. Use of expansion joints used in high pressure[3] fuel systems should be approved by the Administration. Slip joints should not be used.

(Note 3: Whether a fuel system should be considered as a high-pressure system for the purpose of these Guidelines depends on the design and arrangement of the specific system.)

3.12.7

Other connections: Piping connections should be joined in accordance with 7/3.12.2 of this Guide, but for other exceptional cases the Administration may consider alternative arrangements.

4 Provisions for Materials

Due consideration should be taken with respect to the corrosive nature of fuel when selecting materials.

4.1 (ABS)

Materials in general are to comply with the requirements of the ABS *Rules for Materials and Welding (Part 2)*.

4.2 (ABS)

Materials for fuel containment, fuel piping, process pressure vessels are to additionally be in accordance with 5C-9-6 of the *Marine Vessel Rules*.

Where stainless steel is specified, it is to be an austenitic or duplex type, except austenitic steel is not to be used where the methanol contains water which may contain chlorides.

4.3 (ABS)

Where coatings are proposed for fuel storage tanks, the coating is to be corrosion resistant and compatible with the fuel. Coating application to be in accordance with the manufacturer's recommendations.

4.4 (ABS)

In addition, the following materials of construction for fuel tanks and associated pipelines, valves, fittings and other items of equipment normally in direct contact with the methanol liquid or vapor are not to be used:

- Galvanized steel, aluminum, lead, nickel, magnesium or alloys of these materials

4.5

Components of butyl rubber or nitrile materials likely to be exposed to methanol are not to be used. Subject to review and agreement by ABS, certain rubber and plastic materials may be considered for methyl/ethyl alcohol service provided they meet design criteria, are suitable at the service temperatures, aging properties are established as appropriate for the design life, and sufficient corrosion data and environmental cracking/damage susceptibility data exists.

SECTION 8
Bunkering

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to provide for suitable systems on board the ship to ensure that bunkering can be conducted without causing danger to persons, the environment or the ship.

2 Functional Requirements

2.1

This section relates to functional requirements 3/2.1 to 3/2.11, 3/2.13 to 3/2.15 and 3/2.16 of this Guide. In particular, the following applies:

2.2

The piping system for transfer of fuel to the fuel tank should be designed such that any leakage from the piping system cannot cause danger to the persons on board, the environment or the ship.

3 Provisions for Bunkering Station

3 General (ABS)

See Subsection 5/13 of this Guide for PPE requirements.

3.1 General Provisions

3.1.1

The bunkering station should be located on open deck so that sufficient natural ventilation is provided. Closed or semi-enclosed bunkering stations should be subject to special consideration with respect to provisions for mechanical ventilation. The Administration may require special risk assessment.

3.1.1 Interpretation of 3.1.1 (ABS)

The special consideration is to include, but is not restricted to, the following design features:

i) Segregation towards other areas on the ship

ii) Hazardous area plans for the ship

iii) Requirements for forced ventilation *iv)* Requirements for leakage detection (e.g., gas and leakage detection)

v) Safety actions related to leakage detection

vi) Access to bunkering station from non-hazardous areas through airlocks

vii) Monitoring of bunkering station by direct line of sight or by CCTV

3.1.2

Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations should not face the bunkering station.

3.1.3

Closed or semi-enclosed bunkering stations should be surrounded by gas and liquid-tight boundaries against enclosed spaces.

3.1.4

Bunkering lines should not be led directly through accommodation, control stations or service spaces. Bunkering lines passing through non-hazardous areas in enclosed spaces should be double walled or located in gastight ducts.

3.1.5

Arrangements should be made for safe management of fuel spills. Coamings and/or drip trays should be provided below the bunkering connections together with a means of safely collecting and storing spills. This could be a drain to a dedicated holding tank equipped with a level indicator and alarm. Where coamings or drip trays are subject to rainwater, provision should be made to drain rainwater overboard.

3.1.6

Showers and eye wash stations for emergency usage are to be located in close proximity to areas where the possibility for accidental contact with fuel exists. The emergency showers and eye wash stations are to be operable under all ambient conditions.

Commentary:

See also 5/13.7 (ABS) of this Guide for requirements for eyewash and decontamination safety showers.

End of Commentary

3.2 *Ships' Bunker Hoses*

3.2.1

Bunker hoses carried on board are to be suitable for methyl/ethyl alcohol. Each type of bunker hose, complete with end-fittings, should be prototype-tested at a normal ambient temperature, with 200 pressure cycles from zero to at least twice the specified maximum working pressure. After this cycle pressure test has been carried out, the prototype test should demonstrate a bursting pressure of at least 5 times its specified maximum working pressure at the upper and lower extreme service temperature. Hoses used for prototype testing should not be used for bunker service.

3.2.2

Before being placed in service, each new length of bunker hose produced should be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure, but not more than two fifths of its bursting pressure. The hose should be stencilled, or otherwise marked, with the date of testing, its specified maximum working pressure and, if used in services other than ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure should not be less than 1 MPa gauge.

3.2.3

Means should be provided for draining any fuel from the bunkering hoses upon completion of operation.

3.2.4

Where fuel hoses are carried on board, arrangements should be made for safe storage of the hoses. Hoses should be stored on the open deck or in a storage room with an independent mechanical extraction ventilation system, providing a minimum of six air changes per hour.

4 Provisions for Manifold

The bunkering manifold should be designed to withstand the external loads during bunkering. The connections at the bunkering station should be of dry-disconnect type equipped with additional safety dry break-away coupling/self-sealing quick release. The couplings should be of a standard type.

4.1 (ABS)

Arrangements are to be provided for the installation of a break-away coupling or emergency release system. These are to be designed to prevent damage and spark generation and to minimize release of fuel when activated. The release system is to incorporate suitable means to prevent accidental operation and is to be of the fail-release type. It is recognized that these features may well be within the scope of the bunker supplier (bunkering vessel, truck or shore side facility).

4.2 (ABS)

Filters/strainers are to be fitted to prevent the transfer of foreign objects.

4.3 (ABS)

Connections for methyl/ethyl vapor return lines are to be provided.

5 Provisions for Bunkering System

5.1

Means should be provided for draining any fuel from the bunkering lines upon completion of operation.

5.2

Bunkering lines should be arranged for inerting and gas freeing. When not engaged in bunkering, the bunkering lines should be free of gas, unless the consequences of not gas freeing is evaluated and approved.

5.3

A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source should be fitted.

5.3 (ABS)

An ESD system arranged to shut down the bunkering valve(s), in accordance with the parameters denoted in 15/Table 15.1 and 15/Table 15.3 of this Guide, is to be operational during bunker operations to enable a safe shut down in the event of an emergency during bunker delivery.

5.4

In the bunkering line, as close to the connection point as possible, there should be a manually operated stop valve and a remotely operated shutdown valve arranged in series. Alternatively, a combined manually operated and remote shutdown valve may be provided. It should be possible to operate this remotely operated valve from the bunkering control station.

5.4 (ABS)

The remote operated valve is to be of the fail closed type (closed on loss of actuating power), be capable of local manual closure and is to have a positive indication of the actual valve position.

5.5

Where bunkering lines are arranged with a cross-over, suitable isolation arrangements should be provided to ensure that fuel cannot be transferred inadvertently to the ship side not in use for bunkering.

6 Gas Detection (ABS)

Enclosed or semi enclosed bunker stations and ducts around fuel bunker pipes are to be fitted with permanently installed gas detectors in accordance with Subsection 15/7 of this Guide.

Monitoring and safety system functions are to be provided in accordance with Section 15 and 15/Table 15.1 and 15/Table 15.3 of this Guide.

SECTION 9

Fuel Supply to Consumers

Note:

Text in *italics* comes from MSC.1/Circ.1621, *the Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to ensure safe and reliable distribution of fuel to the consumers.

2 Functional Requirements

2.1

This section is related to functional requirements 3/2.1, 3/2.2, 3/2.3, 3/2.4, 3/2.5, 3/2.6, 3/2.8, 3/2.9, 3/2.10, 3/2.11 and 3/2.13 to 3/2.17 of this Guide.

3 General Provisions for Fuel Supply System

3.1

The fuel piping system should be separate from all other piping systems.

3.2

The fuel supply system should be arranged such that the consequences of any release of fuel will be minimized, while providing safe access for operation and inspection. The causes and consequences of release of fuel should be subject to special consideration within the risk assessment in Subsection 4/2 of this Guide.

3.3

The piping system for fuel transfer to the consumers should be designed in a way that a failure of one barrier cannot lead to a leak from the piping system into the surrounding area causing danger to the persons on board, the environment or the ship.

3.4

Fuel lines should be installed and protected so as to minimize the risk of injury to persons on board in case of leakage.

4 Provisions for Fuel Distribution

4.1

The outer pipe or duct should be gas and liquid tight.

4.2

The annular space between inner and outer pipe should have mechanical ventilation of underpressure type with a capacity of minimum 30 air changes per hour and be ventilated to open air. Appropriate means for detecting leakage into the annular space should be provided. The double wall enclosure should be connected to a suitable draining tank allowing the collection and the detection of any possible leakage.

4.3

Inerting of the annular space might be accepted as an alternative to ventilation. Appropriate means of detecting leakage into the annular space should be provided. Suitable alarms should be provided to indicate a loss of inert gas pressure between the pipes.

4.4

The outer pipe in the double walled fuel pipes should be dimensioned for a design pressure not less than the maximum working pressure of the fuel pipes. As an alternative the calculated maximum built-up pressure in the duct in the case of an inner pipe rupture may be used for dimensioning of the duct.

5 Redundancy of Fuel Supply

Propulsion and power generation arrangements, together with fuel supply systems, should be arranged so that a failure in fuel supply does not lead to an unacceptable loss of power.

5.1 (ABS)

The propulsion and auxiliary arrangements and fuel supply systems are to be arranged so that in the case of emergency shutdown of the fuel supply the propulsion and maneuvering capability, together with power for essential services, can be maintained. Under such a condition, the remaining power is to be sufficient to provide for a speed of at least 7 knots or half of the design speed, whichever is the lesser.

Dual fuel engine installations are considered to meet this redundancy of fuel supply by their inherent provision of independent conventional fuel oil and methyl/ethyl alcohol fuel systems.

6 Safety Functions of the Fuel Supply System

6.1

All fuel piping should be arranged for gas freeing and inerting.

6.2

Fuel tank inlet and outlet valves should be as close to the tank as possible. Valves required to be operated under normal operation, such as when fuel is supplied to consumers or during bunkering, should be remotely operated if not easily accessible.

6.2 (ABS)

Fuel tank valves, whether accessible or not, are to be automatically operated in accordance with the safety actions of 15/Table 15.1 of this Guide. Such remote valves are to be of the fail closed type (closed on loss of actuating power) are to be capable of local manual closure and have positive indication of the actual valve position.

6.3

The main fuel supply line to each consumer or set of consumers should be equipped with an automatically operated master fuel valve. The master fuel valve(s) should be situated in the part of the piping that is outside the machinery space containing methyl/ethyl alcohol-fuelled consumer(s). The master fuel valve(s) should automatically shut off the fuel supply in accordance with 15/2.2 and 15/Table 15.1 of this Guide.

6.3 Interpretation of 6.3 (ABS)

If the master fuel valve is located in an enclosed space such as a fuel preparation room, that space is to be protected against fuel leakage by another automatic shutdown valve arranged for closure in the event that gas or leakage is detected within the enclosed space or, as applicable, loss of ventilation for the duct or casing of the double wall fuel piping occurs. That additional automatic shutdown valve may be the fuel tank outlet valve required by 9/6.2 of this Guide. If the fuel preparation room is adjacent to the fuel tank, the valve may be fitted on the tank bulkhead on the fuel preparation side, as per 9/6.8.

6.4

Means of manual emergency shutdown of fuel supply to the consumers or set of consumers should be provided on the primary and secondary escape routes from the consumer compartment, at a location outside consumer space, outside the fuel preparation space and at the bridge. The activation device should be arranged as a physical button, duly marked and protected against inadvertent operation and operable under emergency lighting.

6.5

The fuel supply line to each consumer should be provided with a remotely operated shut-off valve.

6.5 Interpretation of 6.5 (ABS)

The remote operated shut-off valve required by 9/6.5 of this Guide may be used for normal shutdown of the fuel supply to the consumer.

6.6

There should be one manually operated shutdown valve in the fuel line to each consumer to ensure safe isolation during maintenance.

6.7

Valves should be of the fail-safe type.

6.8

When pipes penetrate the fuel tank below the top of the tank a remotely operated shut-off valve should be fitted to the fuel tank bulkhead. When the fuel tank is adjacent to a fuel preparation space, the valve may be fitted on the tank bulkhead on the fuel preparation space side.

7 Provisions for Fuel Preparation Spaces and Pumps

7.1

Any fuel preparation space should not be located within a machinery space of category A, should be gas and liquid tight to surrounding enclosed spaces and vented to open air.

7.2

Hydraulically powered pumps that are submerged in fuel tanks should be arranged with double barriers preventing the hydraulic system serving the pumps from being directly exposed to methyl/ethyl alcohol. The double barrier should be arranged for detection and drainage of eventual methyl/ethyl alcohol leakage.

7.3

All pumps in the fuel system should be protected against running dry (i.e. protected against operation in the absence of fuel or service fluid). All pumps which are capable of developing a pressure exceeding the design pressure of the system should be provided with relief valves. Each relief valve should be in closed circuit, i.e. arranged to discharge back to the piping upstream of the suction side of the pump and to effectively limit the pump discharge pressure to the design pressure of the system.

8 Pressure Vessels (ABS)

8.1

Pressure vessels used to store or treat fuel supply liquids or vapors are to be designed, constructed and certified in accordance with Section 4-4-1 of the *Marine Vessel Rules*.

SECTION **10**

Power Generation Including Propulsion and Other Energy Converters

Note:

Text in *italics* comes from MSC.1/Circ.1621, *the Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

Commentary:

The requirements specified in this section are additional to all other relevant requirements of the *Marine Vessel Rules*.

End of Commentary

1 Goal

To provide safe and reliable delivery of mechanical, electrical or thermal energy.

2 Functional Requirements

2.1

This section is related to functional requirements 3/2.1, 3/2.11 and 3/2.13 to 3/2.17 of this Guide. In particular, the following applies:

.1 the exhaust system should be designed to prevent any accumulation of unburnt fuel; and

.2 each fuel consumer should have a separate exhaust system.

2.2

One single failure in the fuel system should not lead to an unacceptable loss of power.

3 General

3.1

All engine components and engine-related systems should be designed in such a way that fire and explosion risks are minimized.

3.2

Engine components containing methyl/ethyl alcohol fuel should be effectively sealed to prevent leakage of fuel into the machinery space.

3.3

For engines where the space below the piston is in direct communication with the crankcase, a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase should be carried out and reflected in the safety concept of the engine.

3.4

A means should be provided to monitor and detect poor combustion or misfiring. In the event that it is detected, continued operation may be allowed, provided that the fuel supply to the concerned cylinder is shut off and provided that the operation of the engine with one cylinder cut-off is acceptable with respect to torsional vibrations.

3.5 (ABS)

Internal combustion engines intended to burn methyl/ethyl alcohol fuels are to be designed, tested and certified in accordance with Sections 4-2-1, 5C-8-16 and 5C-13-10, as applicable, of the *Marine Vessel Rules*.

The fuel specification(s) required by the engine is to be declared by the manufacturer and detailed in the operation and maintenance manuals.

3.6 (ABS)

Engine air inlet manifolds and crankcases and to be arranged in accordance with 5C-13-10/3.1.12 and 5C-13-10/3.1.13 of the *Marine Vessel Rules*.

3.7 (ABS)

A Failure Modes and Effects Analysis (FMEA) is to be carried out by the engine manufacturer in order to determine necessary additional safeguards to address the hazards associated with the use of methyl/ethyl alcohol fuel. This requirement is in addition to, but may be by revision of, the FMEA required by 4-2-1/ TABLE 1 of the *Marine Vessel Rules*.

The analysis is to identify all plausible scenarios of fuel leakage and the resulting hazards. Then the analysis is to identify necessary means to mitigate the identified hazards.

As given by footnote 5 to 4-2-1/TABLE 1 of the *Marine Vessel Rules,* where engines rely on hydraulic, pneumatic or electronic control of fuel injection and/or valves, a failure mode and effects analysis (FMEA) is to be submitted to demonstrate that failure of the control system will not result in the operation of the engine being degraded beyond acceptable performance criteria for the engine. The FMEA reports required will not be explicitly approved by ABS and are to be submitted to ABS for review.

Commentary:

See also IACS Recommendation No.138, *Recommendation for the FMEA process for diesel engine control systems*.

End of Commentary

3.8 (ABS)

Where the master fuel valve and/or remote fuel shut-off valve required by 9/6.3 and 9/6.5 of this Guide are incorporated into a dedicated Fuel Valve Train (FVT), this must be located in a space outside the consumer machinery space. Such FVT units may be located in the fuel preparation space.

Commentary:

For FVT room and enclosure requirements see 5C-13-10/3.1.15 of the *Marine Vessel Rules*.

End of Commentary

4 *Provision for Dual-Fuel Engines*

4.1

In case of shut-off of the methyl/ethyl alcohol supply, the engines should be capable of continuous operation by oil fuel only without interruption.

4.2

An automatic system should be fitted to change over from methyl/ethyl alcohol fuel operation to oil fuel operation with minimum fluctuation of the engine power. Acceptable reliability should be demonstrated through testing. In the case of unstable operation on engines when methyl/ethyl alcohol firing, the engine should automatically change to oil fuel mode. There should also be the possibility for manual changeover.

4.2 Interpretation of 4.2 (ABS)

Changeover to and from methyl/ethyl alcohol fuel operation is only to be possible at a power level and under conditions where changeover can be achieved with acceptable reliability and safety.

4.3

In case of an emergency stop or a normal stop, the methyl/ethyl alcohol fuel should be automatically shut off not later than the pilot oil fuel. It should not be possible to shut off the pilot oil fuel without first or simultaneously closing the fuel supply to each cylinder or to the complete engine.

4.4 (ABS)

Type testing and shop testing are to be as specified in Section 4-2-1 of the *Marine Vessel Rules*. Dual fuel engines are to be so tested for both fuel modes. Tests performed are to demonstrate smooth changeover from methyl/ethyl alcohol fuel to oil mode and from oil to methyl/ethyl alcohol fuel mode at the test load points. The rapid (emergency) changeover testing is only required from methyl/ethyl alcohol fuel to oil mode. The engine manufacturer is to specify the lowest permissible operating speeds for both oil and methyl/ethyl alcohol fuel modes, and these speeds are to be demonstrated during the type tests.

5 *Provision for Single Fuel Engines*

In case of a normal stop or an emergency shutdown, the methyl/ethyl alcohol fuel supply should be shut off not later than the ignition source. It should not be possible to shut off the ignition source without first or simultaneously closing the fuel supply to each cylinder or to the complete engine.

6 Main and Auxiliary Boilers (ABS)

6.1

Dual fuel main and auxiliary boilers are to be arranged in accordance with this Guide and 5C-13-10/4 of the *Marine Vessel Rules*.

7 Fuel Cells

7.1

Fuel cells are to be arranged in accordance with this Guide and the ABS *Guide for Fuel Cell Power Systems for Marine and Offshore Applications*.

SECTION 11
Fire Safety

Note:

Text in *italics* comes from MSC.1/Circ.1621, *the Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Goal*

The goal of this section is to provide fire protection, detection and fighting for all systems related to storing, handling, transfer and use of methyl/ethyl alcohol as fuel.

2 *Functional Requirements*

This section is related to functional requirements 3/2.1, 3/2.2, 3/2.4, 3/2.5, 3/2.12, 3/2.14 and 3/2.16 of this Guide.

3 *General Provisions*

The provisions in this section are additional to those given in SOLAS chapter II-2.

4 *Provisions for Fire Protection*

4.1

For the purposes of fire protection, fuel preparation spaces should be regarded as machinery space of category A. Should the space have boundaries towards other machinery spaces of category A, accommodation, control station or cargo areas, these boundaries should not be less than A-60.

4.1 Interpretation of 4.1 (ABS)

Fire protection in 11/4.1 means structural fire protection, not including means of escape.

4.2

Any boundary of accommodation up to navigation bridge windows, service spaces, control stations, machinery spaces and escape routes, facing fuel tanks on open deck should have A-60 fire integrity.

4.3

For fire integrity, the fuel tank boundaries should be separated from the machinery spaces of category A and other rooms with high fire risks by a cofferdam of at least 600 mm, with insulation of not less than A-60 class.

4.3 Interpretation of 4.3 (ABS)

The following "other rooms with high fire risk" are as a minimum to be considered, but not be restricted to:

i) cargo spaces except cargo tanks for liquids with flashpoint above 60°C and except cargo spaces exempted in accordance with SOLAS regulations II-2/10.7.1.2 or II-2/10.7.1.4 (see 4-7-2/7.1.3 of the *Marine Vessel Rules*)

ii) vehicle, ro-ro and special category spaces

iii) service spaces (high risk): galleys, pantries containing cooking appliances, saunas, paint lockers and storerooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids and workshops other than those forming part of the machinery space, as provided in SOLAS regulations II-2/9.2.2.4, II-2/9.2.3.3 and II-2/9.2.4

iv) accommodation spaces of greater fire risk: saunas, sale shops, barber shops and beauty parlours and public spaces containing furniture and furnishing of other than restricted fire risk and having deck area of 50 m^2 or more, as provided in SOLAS regulation II-2/9.2.2.3

4.4

The bunkering station should be separated by A-60 class divisions towards machinery spaces of category A, accommodation, control stations and high fire risk spaces, except for spaces such as tanks, voids, auxiliary machinery spaces of little or no fire risk, sanitary and similar spaces where the insulation standard may be reduced to class A-0.

5 Provision for Fire Main

When the fuel storage tank is located on the open deck, isolating valves should be fitted in the fire main in order to isolate damaged sections of the fire main. Isolation of a section of fire main should not deprive the fire line ahead of the isolated section from the supply of water.

6 Provision for Fire Fighting

6.1

Where fuel tanks were located on open deck, there should be a fixed fire-fighting system of alcohol-resistant foam type, as set out in chapter 17 of the IBC Code and, where appropriate, chapter 14 of the FSS Code.

6.2

The alcohol-resistant foam type fire-fighting system should cover the area below the fuel tank where a spill of fuel could be expected to spread.

6.3

The bunker station should have a fixed fire-extinguishing system of alcohol resistant foam type and a portable dry chemical powder extinguisher or an equivalent extinguisher, located near the entrance of the bunkering station.

6.4

Where fuel tanks are located on open deck, there should be a fixed water spray system for diluting eventual spills, cooling and fire prevention. The system should cover exposed parts of the fuel tank.

6.4 (ABS)

The fixed water spray system is to be arranged in accordance with 5C-13-11/5 of the *Marine Vessel Rules*.

6.5

A fixed fire detection and fire alarm system complying with Fire Safety System Code should be provided for all compartments containing the methyl/ethyl alcohol fuel system.

6.6

Suitable detectors should be selected based on the fire characteristics of the fuel. Smoke detectors should be used in combination with detectors which can more effectively detect methyl/ethyl alcohol fires.

6.7

Means to ease detection and recognition of methyl/ethyl alcohol fires in machinery spaces should be provided for fire patrols and for fire-fighting purposes, such as portable heat-detection devices.

7 Provision for Fire Extinguishing of Engine Room and Fuel Preparation Space

7.1

Machinery space and fuel preparation space where methyl/ethyl alcohol-fuelled engines or fuel pumps are arranged should be protected by an approved fixed fire-extinguishing system in accordance with SOLAS regulation II-2/10 and the FSS Code. In addition, the fire-extinguishing medium used should be suitable for the extinguishing of methyl/ethyl alcohol fires.

7.2

An approved alcohol-resistant foam system covering the tank top and bilge area under the floor plates should be arranged for machinery space category A and fuel preparation space containing methyl/ethyl alcohol.

SECTION 12

Explosion Prevention and Area Classification

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Goal*

The goal of this section is to provide for the prevention of explosions and for the limitation of effects of a fire and explosion.

2 *Functional Requirements*

2.1

This section is related to functional requirements 3/2.1, 3/2.2, 3/2.3, 3/2.4, 3/2.5, 3/2.6, 3/2.8 and 3/2.11 to 3/2.17 of this Guide. The probability of explosions should be reduced to a minimum by:

.1 reducing the number of sources of ignition;

.2 reducing the probability of formation of ignitable mixtures; and

.3 using certified safe type electrical equipment suitable for the hazardous zone where the use of electrical equipment in hazardous areas is unavoidable.

3 *General Provisions*

3.1

Hazardous areas on open deck and other spaces not addressed in this section should be analysed and classified based on a recognized standard.[4] The electrical equipment fitted within hazardous areas should be according to the same standard.

(Note 4: Refer to IEC standard 60092-502:1999, part 4.4: Tankers carrying flammable liquefied gases, as applicable.)

3.2

All hazardous areas should be inaccessible to passengers and unauthorized crew at all times.

4 Area Classification

4.1

Area classification is a method of analysing and classifying the areas where explosive gas atmospheres may occur. The object of the classification is to allow the selection of electrical apparatus able to be operated safely in these areas.

4.2

In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2, according to 12/5 of this Guide. In cases where the prescriptive provisions in 12/5 of this Guide are deemed to be inappropriate, area classification according to IEC 60079-10-1:2015 should be applied with special consideration by the Administration.

4.3

Ventilation ducts should have the same area classification as the ventilated space.

5 Hazardous Area Zones

5.1 Hazardous Area Zone 0

This zone includes, but is not limited to, the interiors of methyl/ethyl fuel tanks, any pipework for pressure-relief or other venting systems for fuel tanks, pipes and equipment containing methyl/ethyl fuel.

5.2 Hazardous Area Zone 1

This zone includes, but is not limited to:

.1 cofferdams and other protective spaces surrounding the fuel tanks;

.2 fuel preparation spaces;

.3 areas on open deck, or semi-enclosed spaces on deck, within 3 m of any methyl/ethyl fuel tank outlet, gas or vapour outlet, bunker manifold valve, other methyl/ethyl fuel valve, methyl/ethyl fuel pipe flange, methyl/ethyl fuel preparation space ventilation outlets;

.4 areas on open deck or semi-enclosed spaces on deck in the vicinity of the fuel tank P/V outlets, within a vertical cylinder of unlimited height and 6 m radius centred upon the centre of the outlet and within a hemisphere of 6 m radius below the outlet;

.5 areas on open deck or semi-enclosed spaces on deck, within 1.5 m of fuel preparation space entrances, fuel preparation space ventilation inlets and other openings into zone 1 spaces;

.6 areas on the open deck within spillage coamings surrounding methyl/ethyl fuel bunker manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck;

.7 enclosed or semi-enclosed spaces in which pipes containing methyl/ethyl fuel are located, e.g. ducts around methyl/ethyl fuel pipes, semi-enclosed bunkering stations; and

.7 (ABS) and including spaces or enclosures containing Fuel Valve Train (FVT) equipment.

.8 a space protected by an airlock is considered as a non-hazardous area during normal operation, but will require equipment to operate following loss of differential pressure between the protected space and the hazardous area to be certified as suitable for zone 1.

5.3 Hazardous Area Zone 2

This zone includes, but is not limited to:

.1 areas 4 m beyond the cylinder and 4 m beyond the sphere defined in 12/5.2.4 of this Guide;

.2 areas within 1.5 m surrounding other open or semi-enclosed spaces of zone 1 defined in 12/5.2.5 of this Guide; and

.3 airlocks.

SECTION 13
Ventilation

Note:

Text in *italics* comes from MSC.1/Circ.1621, *the Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Goal*

The goal of this section is to provide for the ventilation required for safe working conditions for personnel and the safe operation of machinery and equipment where methyl/ethyl alcohol is used as fuel.

2 *Functional Requirements*

This section is related to functional requirements 3/2.1, 3/2.2, 3/2.4, 3/2.6 and 3/2.11 to 3/2.17 of this Guide.

3 *Provisions - General*

3.1

Ventilation inlets and outlets for spaces required to be fitted with mechanical ventilation should be located such that according to the International Convention on Load Lines they will not be required to have closing appliances.

3.2

Any ducting used for the ventilation of hazardous spaces should be separate from that used for the ventilation of non-hazardous spaces. The ventilation should function at all temperatures and environmental conditions the ship will be operating in.

3.3

Electric motors for ventilation fans should not be located in ventilation ducts for hazardous spaces unless the motors are certified for the same hazard zone as the space served.

3.4

Design of ventilation fans serving spaces where vapours from fuels may be present should fulfil the following:

.1 ventilation fans should not produce a source of vapour ignition in either the ventilated space or the ventilation system associated with the space; ventilation fans and fan ducts, in way of fans only, should be of non-sparking construction defined as:

.1 impellers or housings of non-metallic material, due regard being paid to the elimination of static electricity;

.2 impellers and housings of non-ferrous metals;

.3 impellers and housings of austenitic stainless steel;

.4 impellers of aluminum alloys or magnesium alloys and a ferrous (including austenitic stainless steel) housing on which a ring of suitable thickness of non-ferrous materials is fitted in way of the impeller, due regard being paid to static electricity and corrosion between ring and housing; or

.5 any combination of ferrous (including austenitic stainless steel) impellers and housings with not less than 13 mm tip design clearance;

.2 in no case should the radial air gap between the impeller and the casing be less than 0.1 of the diameter of the impeller shaft in way of the bearing but not less than 2 mm; the gap need not be more than 13 mm; and

.3 any combination of an aluminum or magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and should not be used in these places.

3.5

Ventilation systems required to avoid any vapour accumulation should consist of independent fans, each of sufficient capacity, unless otherwise specified in these Interim Guidelines. The ventilation system should be of a mechanical exhaust type, with extraction inlets located such as to avoid accumulation of vapour from leaked methyl/ethyl alcohol in the space.

3.5 (ABS)

The ventilation arrangements are to take account of the evaporation rate and density of any methyl/ethyl leakages.

Commentary:

See also 15/7.2 (ABS) of this Guide for gas detector location and prevailing ventilation airflow requirements.

End of Commentary

3.6

Air inlets for hazardous enclosed spaces should be taken from areas that, in the absence of the considered inlet, would be non-hazardous. Air inlets for non-hazardous enclosed spaces should be taken from non-hazardous areas at least 1.5 m away from the boundaries of any hazardous area. Where the inlet duct passes through a more hazardous space, the duct should be gastight and have over-pressure relative to this space.

3.7

Air outlets from non-hazardous spaces should be located outside hazardous areas.

3.8

Air outlets from hazardous enclosed spaces should be located in an open area that, in the absence of the considered outlet, would be of the same or lesser hazard than the ventilated space.

3.9

The required capacity of the ventilation plant is normally based on the total volume of the room. An increase in required ventilation capacity may be necessary for rooms having a complicated form.

3.10

Non-hazardous spaces with entry openings to a hazardous area should be arranged with an airlock and be maintained at overpressure relative to the external hazardous area. The overpressure ventilation should be arranged according to the following:

.1 during initial start-up or after loss of overpressure ventilation, before energizing any electrical installations not certified safe for the space in the absence of pressurization, it should be required to:

.1 proceed with purging (at least five air changes) or confirm by measurements that the space is non-hazardous; and

.2 pressurize the space;

.2 operation of the overpressure ventilation should be monitored and in the event of failure of the overpressure ventilation:

.1 an audible and visual alarm should be given at a manned location; and

.2 if overpressure cannot be immediately restored, automatic or programmed, disconnection of electrical installations according to a recognized standard[5] should be required

(Note 5: Refer to IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features, table 5.)

3.11

Non-hazardous spaces with entry openings to a hazardous enclosed space should be arranged with an airlock and the hazardous space should be maintained at underpressure relative to the non-hazardous space. Operation of the extraction ventilation in the hazardous space should be monitored and in the event of failure of the extraction ventilation:

.1 an audible and visual alarm should be given at a manned location; and

.2 if underpressure cannot be immediately restored, automatic or programmed, disconnection of electrical installations according to recognized standards in the non-hazardous space should be required.

3.12

Double bottoms, cofferdams, duct keels, pipe tunnels, hold spaces and other spaces where methyl/ethyl fuel may accumulate should be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary.

4 *Provisions for Fuel Preparation Spaces*

4.1

Fuel preparation spaces should be provided with an effective mechanical forced ventilation system of extraction type. During normal operation the ventilation should be at least 30 air changes per hour.

4.2

The number and power of the ventilation fans should be such that the capacity is not reduced by more than 50% if a fan with a separate circuit from the main switchboard or emergency switchboard or a group of fans with common circuit from the main switchboard or emergency switchboard is inoperable.

4.2 (ABS)

The number and power of the ventilation fans for fuel preparation rooms is to be such that if one fan or a group of fans with common circuit from the main switchboard or emergency switchboard are out of service, the capacity of the remaining ventilation fan(s) is not to be less than 100% of the total required.

4.3

Ventilation systems for fuel preparation spaces and other fuel handling spaces should be in operation when pumps or other fuel treatment equipment are working.

5 Provisions for Bunkering Station

Bunkering stations that are not located on open deck should be suitably ventilated to ensure that any vapour being released during bunkering operations will be removed outside. If the natural ventilation is not sufficient, the bunkering stations should be subject to special consideration with respect to provisions for mechanical ventilation. The Administration may require special risk assessment.

6 Provisions for Ducts and Double Wall pipes

6.1

Ducts and double wall pipes containing fuel piping fitted with a mechanical ventilation system of the extraction type should be provided with a ventilation capacity of at least 30 air changes per hour.

6.1 (ABS)

The ventilation is always to be in operation when there is fuel in the fuel supply piping.

6.2

The ventilation system for double wall piping and ducts should be independent of all other ventilation systems.

6.3

The ventilation inlet for the double wall piping or duct should always be located in a non-hazardous area, in open air, away from ignition sources. The inlet opening should be fitted with a suitable wire mesh guard and protected from ingress of water.

6.4 (ABS)

The ventilation outlet for the double wall piping or duct is to be covered by a protective screen and placed in a position where no flammable mixture may be ignited.

SECTION 14
Electrical Installations

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 *Goal*

The goal of this section is to provide for electrical installations that minimize the risk of ignition in the presence of a flammable atmosphere.

2 *Functional Requirements*

This section is related to functional requirements 3/2.1, 3/2.2, 3/2.3, 3/2.5, 3/2.8, 3/2.11, 3/2.13 and 3/2.15 to 3/2.17 of this Guide.

3 *Provisions - General*

3.1

Electrical installations should comply with a recognized standard[6] at least equivalent to those acceptable to the Organization.

(Note 6: Refer to IEC 60092:2018 series standards, as applicable.)

3.2

Electrical equipment or wiring should not be installed in hazardous areas unless essential for operational purposes or safety enhancement.

3.3

Where electrical equipment is installed in hazardous areas as provided in 14/3.2 of this Guide, it should be selected, installed and maintained in accordance with IEC standards or other standards at least equivalent to those acceptable to the Organization.

3.3 (ABS)

Electrical equipment installed in hazardous areas is to be rated gas group IIA and temperature class T1.

Commentary:

Refer also to Section 5C-9-17 of the *Marine Vessel Rules* for Methyl Alcohol.

End of Commentary

3.4

The lighting system in hazardous areas should be divided between at least two branch circuits. All switches and protective devices should interrupt all poles or phases and should be located in a non-hazardous area.

3.5

The onboard installation of the electrical equipment units should be such as to ensure the safe bonding to the hull of the units themselves.

SECTION 15

Control, Monitoring and Safety Systems

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*.

1 Goal

The goal of this section is to provide for the arrangement of control, monitoring and safety systems that support an efficient and safe operation of the fuel installations as covered in the other sections of these Interim Guidelines.

2 Functional Requirements

This section is related to functional requirements in 3/2.1, 3/2.2, 3/2.3, 3/2.9 to 3/2.11, 3/2.13, 3/2.14 and 3/2.17 of this Guide. In particular, the following applies:

2.1

the control, monitoring and safety systems of the methyl/ethyl alcohol installations should be arranged such that there is not an unacceptable loss of power in the event of a single failure;

2.2

a fuel safety system should be arranged to close down the fuel supply system automatically, upon failure in systems as described in 15/Table 15.1 and upon other fault conditions which may develop too fast for manual intervention;

2.3

the safety functions should be arranged in a dedicated fuel safety system that is independent of the fuel control system in order to avoid possible common cause failures; this includes power supplies and input and output signal;

2.4

the safety systems including the field instrumentation should be arranged to avoid spurious shutdown, e.g. as a result of a faulty vapour detector or a wire break in a sensor loop; and

2.5

where two fuel supply systems are required to meet the provisions, each system should be fitted with its own set of independent fuel control and safety systems.

3 General Provisions

3.1

Suitable instrumentation devices should be fitted to allow a local and a remote reading of essential parameters to ensure safe management of the whole fuel equipment including bunkering.

3.2

Liquid leakage detection should be installed in the protective cofferdams surrounding the fuel tanks, in all ducts around fuel pipes, in fuel preparation spaces, and in other enclosed spaces containing single walled fuel piping or other fuel equipment.

3.3

The annular space in a double walled piping system should be monitored for leakages and the monitoring system should be connected to an alarm system. Any leakage detected should lead to shutdown of the affected fuel supply line in accordance with 15/Table 15.1 of this Guide.

3.4

At least one bilge well with a level indicator should be provided for each enclosed space, where an independent storage tank without a protective cofferdam is located. A high-level bilge alarm should be provided. The leakage detection system should trigger an alarm and the safety functions in accordance with 15/Table 15.1 of this Guide.

3.4 Interpretation of 3.4 (ABS)

The "level indicator" required by 15/3.4 of this Guide is understood to be required for the purposes of indicating alarm and triggering shutdown actions; a level switch (float switch) is an instrument example considered to meet this requirement.

3.5

For tanks not permanently installed in the vessel, a monitoring system equivalent to that provided for permanent installed tanks should be provided.

4 Provisions for Bunkering and Fuel Tank Monitoring

4.1 Level Indicators for Fuel Tanks

Each fuel tank should be fitted with closed level gauging devices, arranged to ensure a level reading is always obtainable and unless any necessary maintenance can be carried out while the fuel tank is in service, two devices should be installed.

4.2 Overflow Control

4.2.1

Each fuel tank should be fitted with a visual and audible high-level alarm. This should be able to be function tested from the outside of the tank and can be common with the level gauging system (configured as an alarm on the gauging transmitter), but should be independent of the high-high-level alarm.

4.2.2

An additional sensor (high-high-level) operating independently of the high liquid level alarm should automatically actuate a shut-off valve to avoid excessive liquid pressure in the bunkering line and prevent the tank from becoming liquid full.

4.2.3

The high and high-high-level alarm for the fuel tanks should be visual and audible at the location at which gas freeing by water filling of the fuel tanks is controlled, given that water filling is the preferred method for gas freeing.

5 Provisions for Bunkering Control

5.1

Bunkering control should be from a safe remote location. At this safe remote location:

.1 tank level should be capable of being monitored;

.2 the remote-control valves required by 8/5.4 of this Guide should be capable of being operated from this location; closing of the bunkering shutdown valve should be possible from the control location for bunkering and from another safe location; and

5.1.2 Interpretation of 5.1.2 (ABS)

The remote-control valves are understood to be the valves required by 8/5.4 of this Guide and which are activated by the ESD shutdown system which is in communication via the ship-shore link required by 8/5.3 of this Guide.

.3 overfill alarms and automatic shutdown should also be indicated at this location.

5.2

If the ventilation in the ducting enclosure or annular spaces of the double walled bunkering lines stops, an audible and visual alarm should be activated at the bunkering control location.

5.3

If fuel leakage is detected in ducting enclosure or the annular spaces of the double walled bunkering lines, an audible and visual alarm and emergency shutdown of the bunkering valve should automatically be activated.

5.3 Interpretation of 5.3 (ABS)

The “bunkering valve” is the remote-control valve required by 8/5.4 of this Guide.

5.4 (ABS)

Where bunkering lines are enclosed in ventilated double pipes or ducts, the ventilation is to always be in operation during bunkering operations.

5.5 (ABS)

i) The bunkering control system is to incorporate an emergency shutdown facility to stop bunker flow in the event of an emergency. The design of the ESD system is to avoid the potential generation of surge pressures within bunker transfer pipe work.

ii) The ESD is to be activated by the manual and automatic inputs listed in Section 15, Table 15.1 and Table 15.3 of this Guide.

iii) A functional flow chart of the bunkering control system and ESD functions are to be provided in the fuel bunkering control station and on the bridge.

iv) The ESD function is to operate the remote valve required by 8/5.4 of this Guide.

v) As a minimum, the ESD action is to be capable of manual operation by a single control on the bridge, the safe control position required by 15/5.1 of this Guide and at least two strategic positions around the bunker manifold area.

6 Provisions for Engine Monitoring

In addition to the instrumentation provided in accordance with SOLAS chapter II-1, part C, indicators should be fitted on the navigation bridge, the engine control room and the manoeuvring platform for:

.1 operation of methyl/ethyl alcohol fuel engines; and

.2 operation and mode of operation of the engine in the case of dual fuel engines.

6.1 Engine Control and Monitoring Systems (ABS)

i) Where additional features such as hydraulic control circuits or sealing systems form part of the systems for safe operation of the engine, the loss of actuating power in these systems is to cause automatic shutdown of the methyl/ethyl fuel supply system.

Where these systems incorporate external high pressure piping of flammable liquids then these are to be protected with a jacketed piping system capable of containing leakage from the high pressure pipe and arranged for leakage collection and alarm in accordance with 4-6-5/3.3.7(a) of the *Marine Vessel Rules*.

ii) Unless the FMEA proves otherwise, the monitoring and safety system functions for the engines are to be provided in accordance with Section 15, Table 15.1 and Table 15.2 of this Guide.

iii) The alarms required by Section 15, Table 15.2 are to be provided at the engine control station. In addition, a summary alarm is to be provided at the navigation bridge.

7 Provisions for Gas Detection

7.1

Permanently installed gas detectors should be fitted in:

.1 all ventilated annular spaces of the double walled pipes:

.2 machinery spaces containing fuel equipment or consumers;

.3 fuel preparation spaces;

.4 other enclosed spaces containing fuel piping or other fuel equipment without ducting;

.5 other enclosed or semi-enclosed spaces where fuel vapours may accumulate;

.6 cofferdams and fuel storage hold spaces surrounding fuel tanks;

.7 airlocks; and

.8 ventilation inlets to accommodation and machinery spaces, if required, based on the risk assessment required in 4/2 of this Guide.

7.1 Interpretation of 7.1 (ABS)

The risk assessment is also to consider the need for gas detectors at the ventilation inlets to service spaces, control stations and other manned spaces.

7.2

The number and placement of detectors in each space should be considered taking into account the size, layout and ventilation of the space. Gas dispersal analysis or a physical smoke test should be used to find the best arrangement.

7.2 (ABS)

Placement of the detectors is critical to the effectiveness of the gas detection system. The exact location of the gas detectors is to be determined taking into consideration the sensitivity of the gas detectors under the prevailing airflow. Arrangements will be subject to approval for each application based upon the gas dispersion analysis or the physical smoke test.

7.3

Fuel vapour detection equipment should be designed, installed and tested in accordance with a recognized standard.[7]

(Note 7: Refer to IEC 60079-29-1:2016 – Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable gases.)

7.4

An audible and visible alarm should be activated at a fuel vapour concentration of 20% of the lower explosion limit (LEL). The safety system should be activated at 40% of LEL at two detectors. Special consideration should be given to toxicity in the design process of the detection system.

7.5

For ventilated ducts and annular spaces around fuel pipes in the machinery spaces containing methyl/ethyl alcohol-fuelled engines, the alarm limit should be set to 20% of LEL. The safety system should be activated at 40% of LEL at two detectors.

7.6

Audible and visible alarms from the fuel vapour detection equipment should be located on the navigation bridge, in the continuously manned central control station, safety centre and at the control location for bunkering as well as locally.

7.7

Fuel vapour detection required by this section should be continuous without delay.

7.8 (ABS)

Gas detection systems are to be of the self-monitoring type and suitable for both flammability and toxicity.

Commentary:

The National Institute for Occupational Safety and Health (NIOSH) indicates the Immediately Dangerous to Life and Health Concentration (IDLH) for methyl alcohol is 6,000 ppm, which is approximately 10% of LEL. Therefore, detectors based on flammability may be suitable for toxicity detection range.

End of Commentary

7.9 (ABS)

In the event that a system fault is detected by the self-monitoring functions, the output of the detection system is to be automatically disconnected such that the detector fault will not cause false emergency shutdown.

Commentary:

See also 15/7.11 (ABS) of this Guide. The gas detection systems is always to be in operation during normal operation of the methyl/ethyl fuel systems.

End of Commentary

7.10 (ABS)

The gas detection equipment is to be designed so that it may be readily tested.

7.11 (ABS)

The gas detection system is always to be in operation when there is fuel in the piping, during normal operation and while purging prior to maintenance works.

8 *Provisions for Fire Detection*

Fire detection in machinery space containing methyl/ethyl alcohol engines and fuel storage hold spaces should give audible and visual alarms on the navigation bridge and in a continuously manned central control station or safety centre as well as locally.

9 *Provisions for Ventilation*

Any loss of the required ventilating capacity should give an audible and visual alarm on the navigation bridge, and in a continuously manned central control station or safety centre as well as locally.

9 Interpretation of 9 (ABS)

Acceptable means to confirm that the ventilation system has the required ventilating capacity in operation are, but not limited to:

i) Monitoring of the ventilation electric motor or fan operation combined with underpressure indication;

or

ii) Monitoring of the ventilation electric motor or fan operation combined with ventilation flow indication;

or

iii) Monitoring of ventilation flow rate to indicate that the required air flow rate is established.

10 *Provisions on Safety Functions of Fuel Supply Systems*

10.1

If the fuel supply is shut off due to activation of an automatic valve, the fuel supply should not be opened until the reason for the disconnection is ascertained and the necessary precautions taken. A readily visible notice giving instruction to this effect should be placed at the operating station for the shut-off valves in the fuel supply lines.

10.2

If a fuel leak leading to a fuel supply shutdown occurs, the fuel supply should not be operated until the leak has been found and dealt with. Instructions to this effect should be placed in a prominent position in the machinery space.

10.3

A caution placard or signboard should be permanently fitted in the machinery space containing methyl/ethyl-fuelled engines stating that heavy lifting, implying danger of damage to the fuel pipes, should not be done when the engine(s) is running on methyl/ethyl.

10.3 (ABS)

The requirement of 15/10.3 of this Guide also applies to machinery spaces and fuel preparation rooms containing other consumers or fuel preparation equipment.

10.4

Pumps and fuel supply should be arranged for manual remote emergency stop from the following locations as applicable:

.1 navigation bridge;

.2 cargo control room;

.3 onboard safety centre;

.4 engine control room;

.5 fire control station; and

.6 adjacent to the exit of fuel preparation spaces.

10.5 (ABS)

Monitoring and safety system functions are to be provided in accordance with Section 15, Table 15.1, Table 15.2 (ABS) and Table 15.3 (ABS) of this Guide.

TABLE 15.1
Monitoring of Methyl/Ethyl Alcohol Supply System to Engines

Parameter	*Alarm*	*Automatic shutdown of tank valve (valve(s) referred to in 9/6.2)*	*Automatic shutdown of master fuel valve (valve(s) referred to in 9/6.3)*	*Automatic shutdown of bunkering valve*	*Comments*
High-level fuel tank	*X*			*X*	*See 15/4.2.1*
High-high-level fuel tank	*X*			*X*	*See 15/4.2.2 and 15/5.1*
Loss of ventilation in the annular space in the bunkering line	*X*			*X*	*See 15/5.2*
Gas detection in the annular space in the bunkering line	*X*			*X*	*See 15/5.3*
Loss of ventilation in ventilated areas	*X*				*See 15/9*
Manual shutdown				*X*	*See 15/5.1*
Liquid methyl/ethyl alcohol detection in the annular space of the double walled bunkering line	*X*			*X*	*See 15/5.3*
Vapour detection in ducts around fuel pipes	*X*				*See 15/7.1.1*

Parameter	*Alarm*	*Automatic shutdown of tank valve (valve(s) referred to in 9/6.2)*	*Automatic shutdown of master fuel valve (valve(s) referred to in 9/6.3)*	*Automatic shutdown of bunkering valve*	*Comments*
Vapour detection in cofferdams surrounding fuel tanks. One detector giving 20% of LEL	*X*				*See 15/7.5*
Vapour detection in air locks	*X*				*See 15/7.1.7*
Vapour detection in cofferdams surrounding fuel tanks. Two detectors giving 40% of LEL, (1)	*X*	*X*		*X*	*See 15/7.1.6*
Vapour detection in ducts around double walled pipes, 20% of LEL	*X*				*See 15/7.7* (ABS) See 15/7.1.1 and 15/7.5
Vapour detection in ducts around double walled pipes, 40% of LEL, (1)	*X*	*X*	*X* (ABS)(2)		*See 15/7.7. Two gas detectors to give min. 40% of LEL before shutdown* (ABS) See 15/7.1.1 and 15/7.5
Liquid leak detection in annular space of double walled pipes	*X*	*X*	*X* (ABS)(2)		*See 15/3.3* (ABS) See 15/3.2
Liquid leak detection in engine-room (3)	*X*	*X*	(ABS) X (2)		*See 15/3.2* (ABS) See 15/7.1.2
Liquid leak detection in fuel preparation space	*X*	*X*			*See 15/3.2*
Liquid leakage detection in protective cofferdams surrounding fuel tanks	*X*				*See 15/3.2*
(ABS)					
High oxygen concentration in inert gas supply at 3% O_2	*X*				See 6/5.4
High oxygen concentration in inert gas supply at 5% O_2	X (4)				See 6/5.4
Low oxygen concentration below 19% O_2 in nitrogen generator or storage compartment	X				See 6/5.7
Bilge well high level (5)	X	X		X	See 15/3.4

Parameter	*Alarm*	*Automatic shutdown of tank valve (valve(s) referred to in 9/6.2)*	*Automatic shutdown of master fuel valve (valve(s) referred to in 9/6.3)*	*Automatic shutdown of bunkering valve*	*Comments*
Gas detection in fuel preparation space at 5% LEL	X				See 15/7.4
Gas detection in fuel preparation space at 10% LEL	X	X	X (2)		See 15/7.4
Gas detection in machinery space (engine-room) containing gas consumer at 5% LEL	X				See 15/7.4
Gas detection in machinery space (engine-room) containing gas consumer at 10% LEL	X		X (2)		See 15/7.4

(ABS)
Notes:

1 Two independent gas detectors located close to each other are required for redundancy reasons. If the gas detector is of self-monitoring type the installation of a single gas detector can be permitted.

2 If the fuel is supplied to more than one engine, or group of engines, or supplied to engines in more than one machinery space, and the different supply lines are completely separated and fitted with individual master fuel valves, only the master fuel valve (and associated tank valve) on the supply line leading to where the leak has been detected is to close.
The remote operated shut-off valve to each consumer required by 9/6.5 of this Guide is also to close upon closure of the master fuel valve for the affected consumer(s).

3 The requirement for liquid leakage detection in engine room is not directly prescribed by 15/3.2 of this Guide. Gas detection for machinery spaces containing consumers is required by 15/7.1.2 of this Guide. See also 3/2.13 of this Guide.

4 If the oxygen content exceeds 5% by volume, the inert gas should be automatically vented to atmosphere.

5 For enclosed spaces with independent fuel storage tank and no cofferdam.

TABLE 15.2 (ABS)
Monitoring and Safety System Functions for Engines

Parameter	*Alarm*	*Automatic Activation of the Remote Shut-Off Valve (valve(s) referred to in 9/6.5)*	*Automatic Switching Over to Oil Fuel Mode (1)*	*Automatic Engine Slow-down/Shutdown*
Fuel supply system – malfunction	X	X	X	
Pilot oil fuel injection or spark ignition systems –malfunction	X	X	X	
Exhaust gas after each cylinder, temperature – high	X	X	X	

Parameter	*Alarm*	*Automatic Activation of the Remote Shut-Off Valve (valve(s) referred to in 9/6.5)*	*Automatic Switching Over to Oil Fuel Mode* (1)	*Automatic Engine Slow-down/Shutdown*
Exhaust gas after each cylinder, deviation from average, temperature – high	X	X	X	
Cylinder pressure or ignition – failure, including misfire and knocking	X	X	X	
Oil mist in crankcase, mist concentration	X	X		X (2)
Engine stops – any cause	X	X		
Failure of the control-actuating medium of the remote shut-off valve(s) or engine fuel valves	X	X	X	
Failure of the fuel valve oil sealing system, as applicable	X	X	X	

Notes:

1 Dual Fuel engines only.

2 Auto slow down for slow speed engines and auto shutdown for medium and high speed engines.

TABLE 15.3 (ABS)
Monitoring and Safety System Functions for Fuel Bunkering System

Parameter	*Alarm*	*Automatic Shutdown of the Manifold ESD Valves* (1)
Gas detection at enclosed or semi enclosed bunker station above 5% LEL	X	
Gas detection at enclosed or semi enclosed bunker station above 10% LEL	X	X
Fire detection in tank connection space or fuel preparation rooms	X	X
Gas detection in ducting around bunkering lines above 20% LEL	X	
Gas detection in ducting around bunkering lines above 40% LEL	X	X
High pressure in the fuel tank	X	X
Manual ESD shutdowns	X	X
Manual or automatic ESD signal from bunker supplier	X	X
Loss of ESD valve motive power (2)	X	X

Notes:

1 ESD signal and automatic activation of the ESD valves on the bunker receiving ship to activate automatic shutdown of the ESD valves and supply pumps at the bunker supplier.

2 Manifold ESD valves are to be of fail closed type as per 8/5.4 (ABS) of this Guide.

SECTION 16

Training, Drills and Emergency Exercises

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*. Operational, training or national requirements which are shown in this section are not required for Classification and are shown for information only.

1

The goal of this section is to ensure that seafarers on board ships to which these Interim Guidelines apply are adequately qualified, trained and experienced.

2

Methyl/ethyl alcohol fuel-related drills and exercises should be incorporated into the schedule for periodical drills.

3

Such drills and exercises related to methyl/ethyl alcohol fuels could include for example:

.1 tabletop exercise;

.2 review of fuelling procedures based on the fuel handling manual required by 17/2.3 of this Guide;

.3 responses to potential contingencies;

.4 tests of equipment intended for contingency response; and

.5 reviews that assigned seafarers are trained to perform assigned duties during fuelling, operation and contingency response.

4

The response and safety system for hazards and accident control should be reviewed and tested.

5

The company should ensure that seafarers on board ships using methyl/ethyl alcohol fuels should have completed training to attain the abilities that are appropriate to the capacity to be filled, and duties and responsibilities to be taken up.

6

The master, officers, ratings and other personnel on ships using methyl/ethyl alcohol fuels should be trained and qualified in accordance with regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code, taking into account the specific hazards of the methyl/ethyl alcohol used as fuel.

SECTION **17**

Operation

Note:

Text in *italics* comes from MSC.1/Circ.1621, the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel*. Operational, training or national requirements which are shown in this section are not required for Classification and are shown for information only.

1 *Goal*

The goal of this section is to ensure that operational procedures for the loading, storage, operation, maintenance and inspection of systems for methyl/ethyl alcohol fuels minimize the risk to personnel, the ship and the environment, and are consistent with practices for a conventional oil-fuelled ship whilst taking into account the nature of these fuels.

2 *Functional Requirements*

This section relates to the functional provisions 3/2.1 to 3/2.3, 3/2.9, 3/2.11, 3/2.14, 3/2.15 and 3/2.16 of this Guide. In particular, the following applies:

2.1

a copy of these Interim Guidelines, or national regulations incorporating the provisions of the same, should be on board every ship covered by these Interim Guidelines;

2.2

maintenance procedures and information for all methanol/ethanol related installations should be available on board;

2.3

the ship should be provided with operational procedures including a suitably detailed fuel handling manual, such that trained qualified personnel can safely operate the fuel bunkering, storage and transfer systems; and

2.4

the ship should be provided with suitable emergency procedures.

3 *Provisions for Maintenance*

3.1

Maintenance and repair procedures should include considerations with respect to the fuel containment system and adjacent spaces. Special consideration should be given to the toxicity of fuel.

3.2

The procedures and information should include maintenance of electrical equipment that is installed in explosion hazardous spaces and areas. The inspection and maintenance of electrical installations in explosion hazardous spaces should be performed in accordance with recognized standards.

3.3 Operating and Maintenance Instruction Manuals (ABS)

The manuals are to include, but not be limited to, the regular test and maintenance procedures for the gas and leak detection systems, safety shut-off systems and the integrity of backup systems together with details of required personal protective equipment and the occupational health hazards relevant to the use of methyl/ethyl alcohol fuels. The maintenance procedures are to specify who is qualified to carry out maintenance.

Operating and maintenance manuals are to be submitted for reference purposes only.

4 *Provisions for Bunkering Operations*

4.1 *Responsibilities*

4.1.1

Before any bunkering operation commences, the master of the receiving ship or their representative and the representative of the bunkering source (persons in charge (PIC)) should:

.1 agree in writing the transfer procedure including the maximum transfer rate at all stages and volume to be transferred;

.2 agree in writing action to be taken in an emergency; and

.3 complete and sign the bunker safety checklist.

4.1.2

Upon completion of bunkering operations, the ship PIC should receive and sign documentation containing a description of the product and the quantity delivered.

4.2 *Overview of Control, Automation and Safety Systems*

4.2.1

The fuel handling manual required by 17/2.3 of this Guide should include but not be limited to:

.1 overall operation of the ship from dry dock to dry dock, including procedures for bunker loading and, where appropriate, discharging, sampling, inerting and gas freeing;

.2 operation of inert gas systems;

.3 fire-fighting and emergency procedures: operation and maintenance of fire-fighting systems and use of extinguishing agents;

.4 specific fuel properties and special equipment needed for the safe handling of the particular fuel;

.5 fixed and portable gas detection operation and maintenance of equipment;

.6 emergency shutdown systems, where fitted; and

.7 a description of the procedural actions to take in an emergency situation, such as leakage, fire or poisoning.

.8 (ABS) emergency ship-to-ship transfer procedure, if applicable.

.9 (ABS) any limitation to personnel engaged in bunkering operation.

.10 (ABS) identification of appropriate personal protective equipment.

4.2.2

A fuel system schematic/piping and instrumentation diagram (P&ID) should be reproduced and permanently displayed in the ship's bunker control station and at the bunker station.

4.3 *Pre-bunkering Verification*

4.3.1

Prior to conducting bunkering operations, pre-bunkering verification including, but not limited to, the following should be carried out and documented in the bunker safety checklist:

.1 all communications methods, including ship shore link (SSL), if fitted;

.2 operation of fixed fire detection equipment;

.3 operation of portable gas detection equipment;

.4 readiness of fixed and portable fire-fighting systems and appliances;

.5 operation of remote-controlled valves; and

.6 inspection of hoses and couplings.

4.3.2

Documentation of successful verification should be indicated by the mutually agreed and executed bunkering safety checklist signed by both PICs.

4.4 *Ship Bunkering Source Communications*

4.4.1

Communications should be maintained between the ship PIC and the bunkering source PIC at all times during the bunkering operation. In the event that communications cannot be maintained, bunkering should stop and not resume until communications are restored.

4.4.2

Communication devices used in bunkering should comply with recognized standards for such devices acceptable to the Administration.

4.4.3

PICs should have direct and immediate communication with all personnel involved in the bunkering operation.

4.4.4

The SSL or equivalent means to a bunkering source provided for automatic ESD communications should be compatible with the receiving ship and the delivering facility ESD system.[8]

(Note 8: Refer to ISO 28460:2010, Petroleum and natural gas industries – installation and equipment for liquefied natural gas – Ship-to-shore interface and port operations.)

4.5 *Electrical Bonding*

Consideration should be given to the electrical insulation between ship and shore.

SECTION 18

Survey, Manufacture, Workmanship and Testing

1 General

1.1

Materials in general are to comply with the requirements of the ABS *Rules for Materials and Welding* (*Part 2*).

1.2

As per Subsection 7/4 of this Guide, due consideration is to be given to the corrosive nature of the fuel when selecting materials.

2 Survey During Construction

2.1

Fuel piping fabrication and joining details are to be in accordance with 7/3.12 of this Guide.

2.2

The manufacture, testing, inspection and documentation is to be in accordance with Part 2 and 5C-13-16/8 of the *Marine Vessel Rules*, as applicable.

3 Survey After Construction

3.1 Annual Survey

For annual survey, the survey is to include applicable requirements in 7-6-2/1.7 and 7-6-2/1.9 of the *Marine Vessel Rules*.

Additionally, the annual survey is to include:

i) Functional testing of alarms for monitoring and safety functions with reference to 15/Table 15.1, Table 15.2, Table 15.3 of this Guide and applicable FMEAs.

ii) Testing of portable gas detectors for methanol/ethanol.

iii) Examination of ventilation intakes including gas detection system for methanol/ethanol, as applicable.

iv) Examination of all other personnel safety and PPE specific to methanol/ethanol.

3.2 Intermediate Surveys

In addition to Subparagraph 3.1 above, for intermediate surveys, the survey is to include the testing detailed in 7-3-2/3.18 of the *Marine Vessel Rules.*

3.3 Special Periodical Surveys

In addition to Subparagraph 3.2 above, for special surveys, the survey is to include applicable requirements in 7-6-2/3.7 of the *Marine Vessel Rules.*