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AUSTRALIAN NAVAL CLASSIFICATION AUTHORITY MANUAL (VOLUME 2)

DIVISION 3: SHIP RULES

CHAPTER 10: DANGEROUS GOODS (Explosive Ordnance)

PART 2: SOLUTIONS TO THE ANC RULES

This document is issued for use by Defence and Defence Industry personnel and is effective forthwith.

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AUSTRALIAN NAVAL CLASSIFICATION RULES

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Division 3: Ship Rules

Part 2: Solutions to the ANC Rules

Chapter 10: Dangerous Goods (Explosive Ordnance)

Contents

Solutions to the ANC Rules

Rule 0. Goals

0.1 Goal for this Chapter is contained in Part 1

Rule 1. General

1.1 The Naval Vessel Operator (NVO) shall present and justify a solution for demonstrating compliance to Part 1 of the ANC Rules. All decisions that affect compliance with the requirements of this chapter shall be recorded at all stages from concept to disposal, and these records shall be maintained throughout the life of the Naval Vessel.

Solutions

1.2 The Naval Vessel's safety management system shall include a section specific to Dangerous Goods, which addresses all Explosive Ordnance (EO) to be embarked. The scope of the section shall include as a minimum all the elements of this Chapter. It also shall demonstrate that:

1.2.1 risks associated with stowage and handling of EO are being managed to an acceptable level;

1.2.2 adequate records of munition carriage, incidents and stowage conditions; and

1.2.3 handling and stowage of EO is undertaken by suitably qualified and experienced persons in accordance with appropriate procedures.

Note: See Division 2 Chapter 01 *General Requirements* Rule 2 *Safety Management System* for the requirements relating to the Safety Management System

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1.3 The operating assumptions for the handling and stowage of EO shall be detailed in in the design information. The design information shall adequately record the as built and approved configuration of a Naval Vessel. Design information shall be updated following modification or change to operation.

1.4 EO shall be designated in accordance with the *UN Recommendations on the Transport of Dangerous Goods – Model Regulations*.

1.5 All EO embarked shall be provided with documentation which describes the hazards and risks associated with handling and stowage on-board a Naval Vessel as required by the IMDG Code Chapter 5.4. For Class I dangerous goods this shall include characterisation of the munition in accordance with STANAG 4439 *Policy for Introduction and Assessment of Insensitive Munitions (IM) for external threats*, STANAG 4239 *Electrostatic Discharge, Munitions Test Procedure for EMC* and STANAG 4375 *Safety Drop Munitions Test Procedure for drop height and underwater shock*.

1.6 The Competent Authority shall verify that adequate safety management processes are in place for training, incident reporting, munitions handling and emergency preparedness in relation to dangerous goods In Accordance With (IAW) Division 2 Chapter 01 *Core Design Rules*.

1.7 The design objectives of the EO Stowage and handling design are to:

1.7.1 stow the required EO to support a Naval Vessel's weapon system capability;

1.7.2 minimize the chances of EO being endangered by fire or being damaged;

1.7.3 ensure that EO is kept in a serviceable condition; and

1.7.4 provide physical security for EO.

1.8 A statement of EO Stowage and Designated Danger Area (DDA) requirements or equivalent document based on the OSI shall be developed, that includes (as a minimum):

1.8.1 The expected EO and material to be carried in an EO Stowage or DDA.

1.8.2 Identifying the items that can or are to be co-located and those that must be stored separately or separated.

1.8.3 Any special requirements for the storage of particular items shall be listed including environmental conditions and conductive deck coating requirements.

1.8.4 Construction materials requirement describing the permissible materials or required alternatives for EO Stowage structures.

1.8.5 EO Stowage and DDA labelling or signage requirements describing the required labels and their locations.

1.8.6 Fluid systems requirements describing the operating fluids and operating pressures of all fluid systems within the EO Stowage and DDA boundaries.

1.8.7 EO handling requirements describing the equipment and space required to enable the EO to be safely handled, maintained and stowed.

Rule 2. Layout and Services

2.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

2.2 The design and construction of stowage areas for Dangerous Goods (UN Class 1) items shall meet the requirements in this Chapter. The final arrangement for the stowage area for Dangerous Goods (UN Class 1) shall be approved by a Competent Authority.

Note: From hereon, Dangerous Goods (UN Class 1) shall be referred as Explosive Ordnance (EO) and related stowage areas as EO Stowages.

2.3 Where EO Stowages are located adjacent to high risk or high value compartments, mitigation shall be incorporated into the design. Where there is a risk of fire, an A60 boundary between auxiliary machinery spaces, exhausts, workshops and hangar and vehicle stores shall be used.

2.4 EO Stowages containing Hazard Classification 1.1 EO shall be located above the double bottom and between the collision bulkhead and aft peak bulkhead, below the waterline and separated by 20 m from each other.

Note: Consideration shall be given to locating EO Stowages inboard to minimise risk from external threats to a Naval Vessel.

2.5 Initiation systems (e.g. fuses and detonators) shall be separated from other EO in a Detonator Magazine.

2.6 EO Stowage areas shall provide for the prevention of condensation.

2.7 EO Stowage locations shall be determined based on System Safety Analysis as required by Division 2 Chapter 01 *Core Design Rules* Rule 03 *System Safety*. Supplementary requirements for stowage and use of EO in Naval Vessels are detailed in this Section.

2.8 The System Safety Analysis shall include consideration of EO Stowage location to adjacent compartments (See Rule 2.3 *Adjacent Compartments*) and the maritime environment (See Rule 12 *General Maritime Environment for Armament Systems*) and the following hazards:

2.8.1 Natural environment on EO contained within the EO Stowage (including the effects of solar radiation and heavy seas).

2.8.2 Naval Vessel vibration, fire and heat sources.

2.8.3 Weapon effects such as blast, fragmentation and debris.

2.8.4 Missile efflux.

2.8.5 Electromagnetic Environmental Effect (E3).

2.8.6 Significant Electro-static hazard.

2.8.7 Shock.

2.8.8 Extreme Threat Condition.

Adjacent Compartments

General Requirements

2.9 Adjacent compartments are those compartments that have a deck, deckhead or bulkhead in common with an EO Stowage. This also applies in part to compartments that have a contiguous (share a common border) connection to an EO Stowage because they diagonally about the EO Stowage. Such compartments are described as indirectly adjacent to an EO Stowage.

2.10 The location of the EO Stowage in respect with adjacent compartments have the potential to affect operational capability. The System Safety Analysis shall consider the adjacent compartments to minimise the risk and impact from an explosive incident.

2.11 Compartments adjacent to EO Stowages shall not contain high fire risk stores, equipment (including electrical items), processes or activities.

2.12 EO Stowages containing any type of explosive may be sited adjacent to the compartments listed below, provided adequate Fire Protection design solution is included IAW Chapter 06 *Fire Safety* Rule 8 *Containment of Fire*.

2.13 Auxiliary Machinery spaces including (not exhaustive):

2.13.1 refrigeration machinery compartments;

2.13.2 hydraulic compartments not using fire-resistant hydraulic fluid (e.g. OX40);

2.13.3 conversion machinery spaces;

2.13.4 emergency fire pump; and

2.13.5 air conditioning plant spaces (Air Treatment Unit (ATU) / Air Filtration Unit (AFU), etc.).

2.14 High Value Spaces including:

2.14.1 laundries;

2.14.2 workshops;

2.14.3 hangars;

2.14.4 vehicle decks and wells;

2.14.5 uptakes and downtakes;

2.14.6 acid stores; and

2.14.7 paint and flammable stores.

2.15 EO Stowages shall be protected from extremes of temperature originating from potential adjacent compartment fires, compartments containing heat sources and other environmental conditions external to the vessel, including solar radiation.

2.16 EO Stowages shall not be sited within compartments where the temperature normally exceeds 32ºC.

2.17 Access to integral magazines (magazines bounded by elements of the main hull structure) shall be from the open deck.

Note: Access to integral magazines shall not be permitted from any of the adjacent compartments defined above.

2.18 EO cook off temperatures shall be considered when designing thermal insulation systems, doors, hatches and cofferdams/ plenum chambers.

Note: Guidance on EO cook off temperatures can be sourced from the NVO or Competent Organisation.

2.19 Material with the approved fire resistant division rating shall be placed on the external surfaces of the EO Stowage boundaries to control the effects of an adjacent compartment fire, in accordance with Chapter 6 *Fire Safety*.

Note: The insulation shall be designed to prevent an increase in temperature within the EO Stowage that may cause the stored EO to function, burn, detonate or unacceptably degrade. EO characteristics shall be obtained from the NVO or Competent Organisation.

2.20 Where the arrangement of EO Stowage in relation with adjacent compartments is impracticable, EO Stowage shall be separated from the high-risk space by a minimum 600 mm wide cofferdam constructed of steel.

Note: Cofferdams shall not be designed or used for stowage purposes.

2.21 Where a battery compartment is sited adjacent to an EO Stowage, arrangements shall be put in place to prevent fluids from being able to penetrate the EO Stowage boundary.

2.22 Where a machinery space or engine exhaust uptake has been fitted adjacent to an EO Stowage boundary, a ventilated air space or FBI in accordance with Chapter 06 *Fire Safety* Rule 8 *Containment of Fire* shall be provided between the space or uptake and the boundary.

2.23 High fire risk equipment and electrical fitting shall not be fitted to the external surfaces of the EO Stowage boundaries.

Note: Where this is unavoidable, equipment and cabling shall be sited with an air gap of at least 60mm (tolerance of minus 10 mm) provided between the equipment and the boundary bulkhead.

2.24 Adjacent compartment bulkheads shall be marked in accordance with Rule 2.12 to indicate the presence of an EO Stowage on the other side.

2.25 Electrical cables passing through adjacent compartments, but not associated with equipment therein, shall be continuous (e.g. no junction boxes fitted) and suitably protected from mechanical damage.

Adjacent Compartment POL and Pressurised Systems.

2.26 The requirements for the design, manufacture, and installation of Petroleum, Oils and Lubricant (POL) and Pressurised Systems for ships are detailed in Chapter 04 *Engineering Systems* Rule 27 *Fuel and Lube Oil Systems* and Rule 28 *Hydraulic Systems*. Supplementary requirements for Adjacent Compartment in Naval Vessels are detailed in this Section.

2.27 EO Stowages shall not be sited adjacent to structural tanks containing POL Class I and II products.

2.28 Pressurised cylinder stowages shall not be sited where they may cause a risk to EO Stowages if the cylinders' fragment or explode.

2.29 No fuel or pressurised bottle stowage shall be within a 6 m radius of any Weapons Launcher or EO Stowage.

2.30 Pressurised gas bottles that serve EO Stowages (e.g. Rapid Reaction Spray System bottles) may be sited in adjacent compartments based on the outcome of the System Safety Analysis where risk control or mitigation measures are reduced.

2.31 Structural tanks containing any liquid with a flash point lower than 60ºC shall not be sited adjacent to an EO Stowage.

Note: The siting of tanks containing liquids with a flash point higher than 60ºC adjacent to EO Stowage shall be justified in the System Safety Analysis.

2.32 Fuel pump spaces shall be separated from EO Stowages by a minimum of 6 m.

2.33 Unsleeved or unruffled mechanical couplings containing pressurised flammable liquids shall not be positioned in an adjacent area or within direct line of sight of Small Magazines and Specific Magazines.

2.34 If it is essential to have a structural tank adjacent to an EO Stowage for operational reasons, consideration shall be given to the intended contents (e.g. water is preferable to diesel, which in turn is preferable to an AVCAT tank).

Detectors in Adjacent compartments

2.35 Adjacent Compartments (other than tanks or void spaces) shall be fitted with smoke and heat detectors in accordance with Chapter 06 *Fire Safety* Rule 7 *Detection and Alarm*. Additional Rules for adjacent compartments are detailed in this section.

2.36 Compartments adjacent to EO Stowages (except airlocks, weapon lift trunks, structural tanks and cofferdams) shall be fitted with fire detectors linked to:

2.36.1 audible and visual alarms in a Naval Vessel's Damage Control Centre (DCC) and control stations; and

2.36.2 gangway positions and other locations appropriate to the Naval Vessel's fire protection arrangements.

2.37 Smoke and Heat Detectors shall operate an alarm in either the Naval Vessel's DCC or control stations. In Minor Naval Vessels and Naval Support Vessels, including Auxiliary Oiler Replenishment (AOR), detectors shall also alarm on the weatherdeck.

2.38 Smoke and Heat Detectors shall be installed in adjacent compartments with access to EO Stowages or in compartments containing Ready Use (RU) Magazines.

2.39 In Naval Vessels where the DCC or control stations is not continually manned, additional alarms shall be fitted adjacent to the Officer of the Watch (OOW) position at sea, and adjacent to the Quarter Master's position in harbour.

2.40 In Naval Vessels not crewed by military personnel, additional Smoke and Heat Detector alarms should be centralised either in the Navigating Bridge area or at any other suitable control station with direct communication with the Navigation Bridge.

EO Stowage Emergency Escape Exits

2.41 A means of escape from the EO Stowage shall be provided in accordance with Chapter 07 *Escape, Evacuation and Rescue* Rule 16 *Escape Routes and Escape Exits*.

2.42 Where emergency escape hatches, doors or kick out panels are fitted to EO Stowages they shall be operable only from within the EO Stowage.

2.43 All electrical equipment, fittings and lighting along the escape route that are within the hazardous areas shall meet Rule 5 *Electrical Fittings*.

Hazardous Gas Detection System

2.44 EO Stowages containing EO that may release hazardous or noxious liquids or gases shall be provided with an appropriate detector connected to a local and remote alarm position.

EO Stowage Compatibility and Capacity

2.45 EO Stowages shall meet the requirements for mixing, segregation, and separation provided in IATG 01.50 Section 7 - *Storage of Compatibility Groups* and in accordance with DEOP 101 *Department of Defence Explosives Regulations* Section 4 *Storage and Handling of Explosives*. Supplementary requirements for stowage and use of EO in Naval Vessels are detailed in this section.

2.46 EO Stowages shall be designed to enable stowage of EO within its service packaging as specified in the OSI except in Loaded Launchers or Integrated Weapon Magazines or where the packaging significantly hampers the EO capability.

Note: A Competent Organisation shall be consulted to determine any additional protective measures required for the stowage of EO outside of its service packaging.

2.47 EO Stowages shall be designed to enable stowage, within its service packaging, of EO type and quantity specified in the OSI.

Note: Except in Loaded Launchers or Integrated Weapon Magazines or where the packaging significantly hampers the EO capability.

Note: A Competent Organisation shall be consulted to determine any additional protective measures required for the stowage of EO outside of its service packaging.

2.48 The designed capacity of EO Stowages shall be sufficient to stow the EO specified in the Operating and Support Intent (OSI).

2.49 Space and facilities shall be provided for routine maintenance checks of the EO Stowage and DDA structures and fittings to ensure the safe handling of EO in these spaces.

Identification of Stowage Capacity

2.50 Each Magazine, Small Magazine and RU Magazine shall be provided with a stowage for a contents board in a prominent position near to the access of each compartment. This allows the NVO to display the list of explosive items and non-explosive items approved for stowage on the non-explosive contents list.

2.51 A method of temporarily covering the Magazine contents board shall be available as required for security purposes.

Hazard Warning/Safety Signs & Notices

2.52 All common decks, deckheads, bulkheads, adjacent compartments and those within 25 mm of the EO Stowage boundaries (not on the weatherdeck) shall have an explosives warning sign affixed to their access door/hatch or external sides of the EO Stowage that states “EXPLOSIVES OTHER SIDE”.

2.53 Markings, signs and notices associated with EO shall be positioned so that they are not visible from positions external to the Naval Vessel.

2.54 Where EO Stowage doors open onto the weatherdeck, the deck in front of the access should be marked “DANGER EXPLOSIVES” in red text.

2.55 “OBSERVE ANTI-STATIC PRECAUTIONS” signs shall be fitted to positions where EO susceptible to ESD is required to be stowed or handled. The sign shall specify the electrostatic susceptible EO and the precautions to be followed when handling the subject EO including requirement to wear conductive footwear.

2.56 All pipes passing through EO Stowages and WPAs shall be identified with the correct colour coding and DC identification tape in accordance with Chapter 04 *Engineering Systems* Rule 6 *Pressure and Piping Systems*.

2.57 Other signs and Damage Control (DC) markings should have a Fire Division warning sign together with appropriate supplementary symbols. This aids the actions of personnel and permits common training for emergency and contingency arrangements.

Designated Danger Area (DDA)

2.58 DDAs shall meet the explosive stowage and handling requirements DEOP 101 *Department of Defence Explosives Regulations*. Supplementary requirements for stowage and use of EO in Naval Vessels are detailed in this Section.

Note: While considering this requirement, Chapter *10 Dangerous Goods* Part 1 Rule 2.12, Rule 4 *Fire Protection*, Rule 5 *Electrical Fitting* and Rule 7 *Security* shall be considered.

Note: EO embarked on-board a Naval Vessel, but not in its designated stowage location are considered as being located in a DDA. DDAs are compartments and spaces not fitted out specifically for the stowage of EO but in which there is likely to be an increased hazard to Naval Vessel safety due to their temporary presence.

2.59 The design of DDAs shall minimise the hazard from fire, flood, shock, vibration to EO.

2.60 DDAs shall not be located adjacent to High Risk or High Value areas on a Naval Vessel.

2.61 A Heating, Ventilation and Air Conditioning (HVAC) system shall be fitted where Weapon Lifts/Trunks can 'hold' EO for any significant period, or where the volume of the lift/trunk is such that access for maintenance or operation would require protracted time for 'safe to enter confined space' clearance.

2.62 DDAs shall be fitted with smoke and heat detectors as defined in the OSI.

2.63 If required, flash protection shall be achieved by a combination of flash tight, interlocked doors/hatches such that EO loads located in the supply route and handling area are flash protected from each other and external sources.

2.64 DDAs where EO is handled shall be fitted with locally operated fixed water-based fire suppression systems capable of manual operation, commensurate with the risk classification and type of Naval Vessel.

EO Stowage Hydraulic and Pneumatic Systems

2.65 High Pressure (HP) or Low Pressure (LP) air and Hydraulic systems serving EO Stowages shall comply with the requirements of Chapter 04 *Engineering Systems*. Supplementary requirements for Hydraulic and Pneumatic Systems used in EO Stowages on-board Naval Vessels are as detailed in this Section.

Note: Fire Prevention measures for Hydraulic and Pneumatic Systems shall be consistent with the MSC.1/Circular.1321 – *Guidelines for Measures to Prevent Fires in Engine-Rooms and Cargo Pump-Rooms* (11 June 2009).

2.66 Hydraulic and pneumatic systems serving EO Stowages shall be low-pressure systems only.

2.67 Non-flammable hydraulic fluid shall be used.

Note: Preference should be given to water based hydraulic fluid.

2.68 There shall be no fittings or system branches between the EO Stowage boundary and the isolation valve.

2.69 Pneumatic and hydraulic systems shall be positioned and shielded to protect EO and personnel from physical contact with heated equipment.

2.70 Hydraulic equipment shall be provided with suitable overspill preventative measures.

2.71 Hydraulic and pneumatic pressure lines, HP and LP air systems and exhaust pipes shall not be routed into or through Magazines and Small Magazines except when they serve equipment in the Magazine or Small Magazine.

2.72 Automatic hydraulic relief valves shall not be installed in Magazines and Small Magazines.

2.73 Automatic hydraulic relief valves shall not discharge into Magazines and Small Magazines.

2.74 Manually operated valves, used during maintenance to bleed air from hydraulic lines, are permitted in Magazines and Small Magazines.

2.75 Mechanical couplings in systems containing pressurised flammable liquids shall be sleeved or muffed to prevent mists forming from a failed coupling.

2.76 Where hydraulic, HP or LP air systems terminate within Magazines and Small Magazines all isolation valves within shall be lockable. Such systems shall be capable of being isolated from outside the Magazines and Small Magazines.

2.77 High-pressure fluid lines and pneumatic systems shall be suitably positioned/restrained to reduce vulnerability to damage to the system or EO and injury to personnel at normal operating positions.

2.78 Adequate access to EO Stowage hydraulic and pneumatic systems shall be provided for inspection and maintenance.

2.79 Air operated handling machinery may be used in Magazines and Small Magazines shall be designed to minimise the probability of feeding air into a fire.

Piping Systems

2.80 Piping systems in EO Stowages shall comply with the requirements defined in Chapter 04 *Engineering Systems* Rule 6 *Pressure and Piping Systems.* Supplementary requirements for Piping Systems used in EO Stowages on-board Naval Vessels are detailed in this Section.

2.81 Piping used within EO Stowages shall meet the strength, heat and corrosion resistance requirements defined by Rule 12 *General Maritime Environment (GME) for Armament Systems*.

2.82 Pipe work within EO Stowages shall be constructed of metal or other fireproof material.

Note: Plastic piping shall not be used in EO Stowages.

2.83 Piping shall not be routed through EO Stowages unless required for use in EO Stowages.

2.84 Pipes, other than those associated with EO Lifting and Handling Equipment (LHE) shall not terminate within EO Stowages.

2.85 Pipe systems permitted to pass through or terminate in EO Stowages shall be of one-piece construction or of a welded construction within the EO Stowages. Such pipework shall be fitted with anti-sabotage arrangements at the terminals to prevent the passage of foreign/bodies liquids into the pipe.

Note: Piping of fresh or salt water and drainage systems and piping systems installed in and servicing EO Stowages shall be routed through the EO Stowage.

Note: Routing of piping for other systems through the EO Stowage shall only be permitted if enclosed in a watertight trunk.

2.86 All piped or trunked systems serving EO Stowages shall have isolating valves immediately external to the EO Stowage boundary.

2.87 Pipes conveying engine exhaust gases, combustible liquids or flammable gases shall not be routed through EO Stowages.

Note: See Chapter 04 *Engineering Systems* Rule 6 *Pressure and Piping Systems* for the requirements relating to Piping Systems, including markings required for damage control.

Heating, Ventilation and Air Conditioning

HVAC General Requirements

2.88 The requirements for the design, manufacture and installation of air-conditioning and ventilation systems for Naval Vessels are detailed in Chapter 04 *Engineering Systems*. Supplementary requirements for HVAC Systems used in EO Stowages on-board Naval Vessels are detailed in this Section.

2.89 Independent air-conditioning/ventilation systems shall be installed in EO Stowages to maintain the explosive compositions of EO in a safe and serviceable condition, in addition to providing a safe and satisfactory environment for human occupants.

Note: Magazine HVAC systems shall be separated from other ventilation systems

2.90 The environment of EO Stowages shall be controlled to ensure the EO is remain safe and meets function and performance requirements within the naval operating environments (See Rule 12 *General Maritime Environment (GME) for Armament Systems*).

2.91 Air-conditioning and ventilation systems shall be designed to maintain:

2.91.1 temperature and humidity conditions required for EO to be carried, and

2.91.2 watertight integrity, flash/flame tightness, antisabotage and CBRN-D requirements of these Rules.

2.92 EO Stowages where walk in entry is not possible (e.g. RU Magazine, Detonator Magazine) shall not require a ventilation system.

2.93 Magazines shall be provided with forced ventilation fitted with flash/flame proof screens sufficient to maintain the temperature below the upper temperature extremes specified in DEOP 101 *Department of Defence Explosives Regulations*.

Note: Ambient environmental conditions for EO shall be obtained from the OSI and used to determine upper temperature limits likely to be encountered in the expected ambient environmental conditions.

Note: See Rule 12 *General Maritime Environment (GME)* for Armament Systems for requirements relating to calculating temperature and relative humidity condition for EO Stowages.

2.94 Magazine ventilation systems shall be separate from other Naval Vessel ventilation systems.

Note: Where damage control considerations allow, an air-conditioning/ventilation system may serve either a number of EO Stowages or an EO Stowage complex.

Note: A shared air-conditioning/ventilation system shall be configured so that EO Stowages exhaust direct to atmosphere (e.g. does not recirculate).

2.95 Magazines and Small Magazines shall not share a system providing ventilation to a compartment with a high fire risk.

2.96 An air-conditioning/ventilation system serving a number of EO Stowages or an EO Stowage complex shall serve the minimum number of compartments that meet the specification defined in the OSI.

Note: EO Stowages shall be the last compartment(s) served by a supply fan and exhaust shall be a natural exhaust or the EO Storage shall be nearest to the exhaust fan.

2.97 EO Stowages holding weapons containing hazardous or noxious liquids/gases shall be:

2.97.1 fitted with adequate ventilation to prevent the build-up of poisonous, flammable or explosive gasses;

2.97.2 fitted with ventilation and exhaust fans that ensure gasses are vented to atmosphere and not recirculated into the system or the rest of the Naval Vessel;

2.97.3 provided with a means of developing a positive pressure within that space to aid in the removal of toxic fumes;

2.97.4 provided with an appropriate hazardous or noxious liquids/gases fume detector connected to a local and remote alarm position as required for smoke and heat detectors; and

2.97.5 capable of being sealed to contain hazardous vapours.

2.98 EO Stowage areas shall not share drains or vents with compartments containing flammable liquids.

2.99 Ventilation intakes shall not be located where missile efflux, smoke or liquid fuel fumes (from a leaking weapon) can be drawn directly into a Naval Vessel.

2.100 Air from any source shall not be exhausted or re-circulated into compartments containing toxic liquids.

2.101 Self-contained air conditioner units fitted with compressors and chiller units incorporating fans shall be sited outside EO Stowages.

2.102 EO stowage areas shall provide for the prevention of condensation.

2.103 Flexible trunking shall be connected to the ventilation system/trunking outside the EO stowage to provide for installation of temporary cooling.

Note: Heating may be required when, in Arctic type conditions, the internal temperature of the EO Stowages may fall below 7°C. Any requirement will be derived from the OSI.

2.104 Direct electrical heating shall not be located in an EO Stowage.

HVAC Trunking

2.105 The requirements for the design, manufacture and installation of air-conditioning and ventilation systems for ships are detailed in Chapter 04 *Engineering Systems*. Supplementary requirements for EO Stowage and use of EO in Naval Vessels are detailed in this Section.

2.106 HVAC trunking shall be of an equivalent fire integrity standard as the EO Stowage and retain its structural integrity when subjected to fire for a period consistent with the Magazine/Small Magazine fire rating.

2.107 HVAC trunking within the EO Stowage shall be watertight to the extent consistent with the watertight integrity of the Naval Vessel.

2.108 HVAC trunking outside the EO Stowage shall be watertight/gastight (to the same pressure as the compartment through which it passes) and keep out floodwater until the relevant Water Tight Butterfly Valve (WTBV) is closed.

Note: Gastight standards are acceptable for fittings and ventilation trunks between adjacent EO Stowages.

2.109 Where water tightness is not required for damage control purposes, the trunking shall be flash/flame tight as a minimum standard over its whole length from the boundary of the EO stowage to the flash/flame tight barrier or to the ATU.

2.110 Flash/flame tight barriers shall be fitted within the trunking as close as practicable to the EO stowage boundary.

Note: This may be in the air treatment unit compartment.

2.111 EO Stowages shall be served by dedicated ATU(s).

2.112 Aluminium shall not be used in HVAC trunking serving EO Stowages.

2.113 HVAC trunking shall be designed to prevent the passage of objects or fluids into the EO Stowage.

2.114 Inspection or access covers shall not be fitted in HVAC trunking outside and close to the magazine that it serves.

2.115 Supply ventilation ducts and the exhaust ventilation outlets to and from Magazine shall be fitted with:

2.115.1 Anti-sabotage protection covers for maintaining a watertight condition; and

2.115.2 Security grills/screens at ventilation intake and exhaust locations.

2.116 Trunking in the EO stowage shall not interfere with water spray or ammunition handling arrangements and meet with the requirements for fittings detailed in this Chapter.

2.117 On long trunking runs, removable sections of trunking secured by flanged joints shall be provided for cleaning purposes.

Note: In Naval Vessels designed to meet low magnetic signatures, trunking may be of a composite material, subject to approval by a Competent Authority and stated in the OSI.

Note: Smoke clearance trunking from other compartments may pass through an EO stowage provided it does not impair the EO stowage compartment's airtightness integrity.

2.118 Where a smoke clearance system is required for the EO Stowage, it shall be a dedicated system.

Note: A number of EO Stowages may be linked.

HVAC Isolation Arrangement

2.119 A central facility for 'crash-stop' of the ventilation shall be provided to switch off all EO Stowage supply and exhaust fans.

2.120 All ventilation openings providing direct connection with EO Stowages shall be capable of being made flame tight either by:

2.120.1 water tight valves installed in the supply and exhaust trunking at the EO Stowage boundary; or

2.120.2 automatic or hand operated fire baffles if watertight valves are not required for damage control purposes.

2.121 Trunking providing air to EO Stowages outside the RED RISK zone shall be fitted with flap valves at through bulkhead positions to prevent the passage of smoke and shall be operable locally.

2.122 Watertight valves and fire baffles shall be fitted in both supply and exhaust trunking and be operable locally external to the EO Stowage boundary and adjacent to the bulkhead to satisfy the watertight integrity and smoke boundary as identified by the Red Risk Zone.

2.123 Ventilation natural supply and exhaust terminals shall be fitted with a hinged watertight cover capable of being pinned or locked shut and provided with hold open arrangements.

HVAC Local and Remote Operating Valves

2.124 All EO Stowage ventilation watertight/gastight valves shall be capable of both local and remote operation. This is a mandatory requirement to enable the spread of smoke and toxic products to be controlled.

2.125 The operating positions shall be sited as follows:

2.125.1 Where the EO Stowage is located within the citadel, both the local and remote operating positions should be sited inside the citadel. The local operating position should be outside and adjacent to the EO Stowage boundary.

2.125.2 Where an EO Stowage is outside the citadel, operating positions may be either inside or outside the citadel.

2.125.3 Operating positions shall not be sited where the contents of the compartment may block access to them.

2.125.4 Remote operating positions shall be sited to allow operation of the valve without risk to personnel from any hazard in the EO Stowage or at the local operating position. This may be achieved by separating the remote operating position by one deck or a main watertight bulkhead from the local position.

2.125.5 Local and remote ventilation valve operating positions shall be sited in a readily accessible place with unrestricted access.

2.125.6 Local and remote ventilation valve operating positions shall not be located in compartments that are normally locked unless a key box containing the compartment key is provided at the compartment access.

Note: In Minor War Vessels and other minor craft where it is not practicable to meet the remote operating position requirements of this section, the remote position shall be sited on the weather deck clear of the EO Stowage boundary and housed in a lockable spray-proof cabinet.

Note: Where this is also not practicable, an alternative method may be to use a flush-deck operating fitting and place the operating key in a lockable box on adjacent structure.

2.126 Access to the remote operating position shall not require the local position to be passed en-route other than when exiting from the Magazine or Small Magazine.

2.127 Both local and remote ventilation valve operating positions shall be lockable and capable of accepting an approved padlock. A frangible key box and key shall be provided near the operating position.

2.128 Local and remote ventilation valve operating positions shall be able to operate the system with the other position still padlocked.

HVAC System Notices

2.129 A readily accessible notice of legible size identifying the EO Stowage compartments served by the ventilation system and its function (i.e. supply/exhaust/recirculation) shall be:

2.129.1 fixed or painted next to each valve with the notice indicating its normal system line-up position (e.g. Locked Open/Shut); and

2.129.2 provided at each valve operating position with the notice stating whether the position is the local or remote and its normal system line-up position.

Temperature and Humidity Monitoring

2.130 Magazines, Small Magazine and RU Magazines shall be monitored by the Naval Vessel's Integrated Control System (ICS) to record current ambient, past maximum and minimum temperatures and humidity.

2.131 Monitoring systems used within hazardous/explosive areas shall be intrinsically safe and approved for use by the relevant Competent Authority.

2.132 The monitoring display system shall be located in a prominent position near the access to each EO Stowage.

2.133 Magazines, Small Magazines, and RU Magazines without integrated monitoring system shall be fitted with:

2.133.1 A thermometer suitable for use as current ambient and past maximum and minimum temperatures.

2.133.2 A system for identifying and recording humidity.

Note: Electronic data loggers are preferred but max/min temperature thermometers or humidity indicators with a record card are acceptable.

2.134 The Competent Organisation shall be consulted and approve the type of thermometer or humidity indicator for use in the EO Stowage.

Rule 3. EO Stowage Structural Protection

3.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

3.2 The requirements for the structural protection for Naval Vessels are detailed in Chapter 02 *Structure*. Supplementary requirements for structural protection for EO Stowages on-board Naval Vessels are detailed in this section.

Note: Magazines, VLS Magazines, missile launchers, missile canisters, Small Magazines and Specific Magazines shall be collectively referred to as EO Stowages hereafter unless otherwise specified.

Design and Installation Requirements

3.3 Boundaries, penetrations and openings shall be designed to withstand the water pressure head associated with the requirements to flood the space in the event of an incident and the damage stability requirements defined in Chapter 03 *Buoyancy and Stability*.

3.4 EO Stowages containing Hazard Classification Division 1.1 EO shall be:

3.4.1 located in positions where surrounding compartments and passageways provide a protective buffer against external attack or impact;

3.4.2 located below the waterline and on or near the centreline;

3.4.3 separated by a distance of at least 20 m from each other;

3.4.4 separated in the vertical plane from accommodation spaces by at least one compartment;

3.4.5 separated in the horizontal plane from accommodation spaces by a permanent watertight bulkhead; and

3.4.6 designed such that the EO placement is at the greatest practicable distance from the accommodation bulkhead.

3.5 EO Stowages designated for the stowage of EO that produces smoke, fumes or toxic bi-products shall be sited such that the main access door/hatch opens onto the weatherdeck except EO Hazard Division 1.1.

3.6 In the event of EO functioning, EO Stowage openings shall vent combustion products directly to atmosphere external to a Naval Vessel at a position where such products would not interfere with Naval Vessel operations.

3.7 Tanks containing the following shall not be sited within an EO Stowage:

3.7.1 oils and fuels,

3.7.2 stores having a flashpoint less than 60°C,

3.7.3 solvents,

3.7.4 paints,

3.7.5 acids, and

3.7.6 oxidisers.

3.8 High-pressure vessels shall not be fitted in an EO Stowage unless required for the safe stowage and handling of EO or functioning of an associated weapons system.

3.9 Integral Magazines (magazines bounded by elements of the hull structure) shall not be located:

3.9.1 in close proximity to and never below accommodation spaces, and

3.9.2 in close proximity / adjacent to a control space, boiler room, engine room, galley, or other space presenting a fire hazard.

3.10 If it is necessary to construct an EO Stowage in proximity to these areas, a water-filled cofferdam of at least 600 mm shall be provided.

Note: Where weight considerations preclude a water fill, a cofferdam with an air gap of 1 m should be effective for lower Effective Net Explosive Quantity (ENEQ) events and allow access for maintenance.

Note: The fire resistance of bulkheads shall be in accordance with the requirements of Chapter 06 *Fire Safety* Rule 08 *Containment of Fire*.

Note: Depending on location, EO Stowages may require additional protection against defined ballistic threats.

3.11 EO Stowages shall be sited and designed so that ease of handling EO is facilitated.

Construction Requirements

3.12 EO Stowage Construction shall meet the requirements of Chapter 02 *Structure*. Supplementary requirements for EO Stowages on-board Naval Vessels are detailed in this Section.

3.13 The designed capacity of EO Stowages shall be sufficient to stow the EO designated in the OSI.

3.14 The integrity of EO Stowages shall not be compromised by an adjacent compartment fire.

3.15 EO Stowages shall remain intact following a fire of a magnitude that does not result in the EO cooking off.

3.16 EO Stowages shall be watertight and cater for:

3.16.1 the mass of the EO considering the vessel's movement, vibration etc.;

3.16.2 shock loads resulting from explosions external to the EO Stowage;

3.16.3 EO vulnerability to shock loading and electrostatic discharge;

3.16.4 human factor aspects associated with the design and use of the EO Stowage; and

3.16.5 natural and induced climatic conditions that Naval Vessel EO is likely to be exposed to.

3.17 The extend of design loads to apply to EO Stowages and boundary structures to protect against and control credible hazards, shall be assessed through a System Safety Analysis as required by Division 2 Chapter 01 *Core Design Rules* Rule 03 *System Safety*.

3.18 Magazine and Small Magazine boundaries (Deck, Deckhead and Bulkheads) shall be constructed from steel with a minimum 5 mm thickness of 250 MPa yield strength steel, except where a Threat Hazard Assessment (THA) identifies a thicker steel is required to protect the crew or equipment from blast and fragments hazards, due to EO initiation event within the magazines.

3.19 EO Stowage boundaries, including doors and hatches, decks and bulkheads shall be designed and constructed in accordance with the requirements of Chapter 02 *Structure* and shall:

3.19.1 Provide protection to EO from fire or flooding adjacent to the EO Stowage;

3.19.2 Withstand pressures from fire suppression systems;

3.19.3 Meet watertight standards for gastight standards;

3.19.4 Contain pressures associated with an inadvertent propellant burn but still allow pressure-venting arrangements to function as designed;

3.19.5 Protect EO against threats from weapon attack and effects of blast fragmentation on stored EO resulting from:

3.19.5.1 firing of own Naval Vessel's weapons (e.g. gun blast and missile efflux);

3.19.5.2 explosions internal and external to the EO Stowage,

3.19.5.3 underwater explosions external to the Naval Vessel's hull (shock), and

3.19.5.4 provide Protection against Electron Explosive Hazard (EEH).

Note: Aluminium or combustible material shall not be used for the construction of boundaries.

Flood and Pressure Protection

3.20 The requirements for the design, manufacture and installation of fire, flooding, and pressure protection are detailed in Chapter 06 *Fire Safety* Rule 08 *Containment of Fire*. Supplementary requirements for EO Stowages on-board Naval Vessels are detailed in this Section.

3.21 EO Stowage boundaries where the external surfaces are exposed to weather shall be fitted with fire resistance thermal insulation to reduce temperature variations.

Note: See Chapter 06 *Fire Safety* Rule 08 *Containment of Fire* for requirements relating to fire resistant insulation to reduce temperature variations.

3.22 Magazines and Small Magazines above the Red Risk Zone shall meet the minimum structural requirements to achieve the air pressure test.

3.23 Magazine and Small Magazine watertight integrity shall be proven by means of an air pressure test of least 0.1 bar [10kPa] (test pressure of 0.15 bar [15kPa]).

3.24 Indicator test plugs for testing flooding of compartment shall be fitted on surface Naval Vessels to all watertight compartments within the Red Risk Zone except for those containing liquid in bulk.

3.25 A liquid level switch that meets the requirements of Rule 05 *Electrical Fittings* shall be located where liquid normally accumulates. The actuation level shall be set approximately 50 mm above the deck.

Note: Depending on size and shape of EO Stowage, liquid level switches may be required to be located at the extremities (port, starboard, forward or aft) of the Magazines.

3.26 All liquid level switches installed in one compartment shall be connected in parallel to activate a single Incident Management System (IMS) flooding alarm.

3.27 Boundary structures shall provide a level of structural integrity to withstand initiation events of EO stowed in the magazine, in particular from Explosion Type III, Deflagration Type IV, Burning Type V reactions and propulsive burning reactions.

Automatic Air Escapes

3.28 A structural consequence analysis shall be undertaken to determine the need for Automatic Air Escapes (AAEs) and number of relief valves required and to ensure that the elastic design capability of the EO Stowage is not exceeded.

3.29 AAEs of sufficient capacity in order to prevent excessive pressure build up during total water flooding shall be provided for all EO Stowages fitted with spraying arrangements. Variations to this requirement are:

3.29.1 Individual magazines within a watertight EO Stowage, which are not themselves watertight, do not require individual AAE.

3.29.2 Weapon Preparation Areas do not require AAE.

3.30 AAEs shall operate at approximately 0.013 bar (1.38 kN/m^2) (0.2 psi).

3.31 AAEs shall terminate above the Red Risk Zone in suitable lobbies, passageways or weather decks to prevent pressurisation during operation of the spray system.

3.32 AAEs fitted to EO Stowages with flood systems shall not compromise the security of the stowage.

3.33 In EO Stowages where blast vent plates are fitted (e.g. Guided Weapons magazines), the AAE shall operate below the pressure required to lift the blast vent plates.

Note: The size of an AAE is too limited to act as an effective over-pressure vent to relieve the pressure caused by inadvertent initiation of EO propellant.

3.34 The position of an AAE within the EO Stowage and the terminating position shall be indicated by a red arrow and the words 'Air Escape' in red.

3.35 AAEs shall be readily accessible for periodic functional testing.

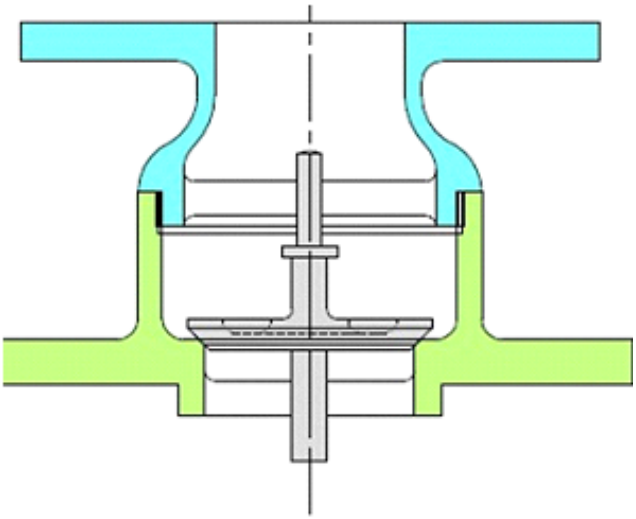

Figure 10.1: Example Automatic Air Escape

Access Doors and Hatches

3.36 The requirements for the design and construction of access doors and hatches for Naval Vessels are detailed in Chapter 03 *Structure* Rule 02 *Watertight Integrity*. Supplementary requirements for EO Stowage onboard Naval Vessels are detailed in this Section

3.37 Access doors and hatches to Magazines and Small Magazine shall be of steel and have the same strength as their surrounding magazine structure. See Construction Requirements section.

3.38 Access doors, hatches and their associated manholes to EO Stowages and the tops of any trunks or hoists that deliver direct into magazines shall be fitted with suitable approved securing arrangements. See Rule 07 *Security*.

3.39 Access doors and hatches to EO Stowages shall provide a watertight seal compatible with the intended application and of a type suitable for service under marine conditions.

3.40 Access doors and hatches shall be provided with door/hatch hold open arrangements.

Note: If multiple access doors are provided, each door shall be capable of being opened without having to open the other doors.

3.40.1 Access doors and hatches shall be fitted with a coaming to limit free surface water entering a magazine or small magazine. The height of the coaming shall not be less than the minimum Class requirement.

Note: Naval Vessel torpedo/air weapon magazines above the waterline do not require coamings to be fitted.

3.41 Access hatches shall be fitted with a removable barrier. Stanchions associated with barriers shall be removable and provided with a suitable outside stowage.

3.42 EO Stowage doors or hatches shall be marked in accordance with current Naval Vessel location and damage control requirements to indicate compartment designation.

3.43 The entry point to magazine drains shall be designed with a low lip (approximately 15mm to 25mm) to provide effective boundary cooling, but sufficiently small to avoid free surface issues.

Note: In a larger EO Stowage (e.g. greater than 10 m^2) a drain may be provided on each side to avoid the build-up of a significant volume of water in a list condition (port, starboard, forward or aft).

3.44 Doors and hatches in the blast route that open toward a Magazine or Small Magazine shall be fitted with a soft patch venting plate IAW Rule 3.52 *Overpressure Relief – Venting Plates*.

3.45 All doors and hatches providing a direct route from the Magazine or Small Magazine to atmosphere should open away from the magazines.

3.46 Hinges of doors/hatches that open outwards shall be welded or otherwise treated (e.g. fitted with locking dogs) to ensure they cannot be disassembled from outside the secure compartment to gain unauthorised access.

3.47 Where emergency escape hatches, doors or kick out panels are fitted to EO Stowages they shall be operable only from within the EO Stowage.

3.48 Doors and hatches shall be fitted with a door closer.

Note: Where the weight of the door or scuttle hatch exceeds 90 kg and 30 kg respectively, door closers are not required (other mitigations may be considered).

3.49 Where blast resistant doors are fitted, they shall have the same level of blast, fragmentation protection and fire resistance as the bulkhead within they are fitted.

3.50 “Out-to-in” fish eye viewing (f-e-v) devices shall be fitted at each access point to a Magazine or Small Magazine to allow an assessment of the magazines.

3.51 An “in-to-out” f-e-v shall be fitted to magazine doors that open directly into the hangar/flight deck to allow assessment of any fuel danger hazards and fitted with a note a notice stating:

"DO NOT OPEN DOOR IN FUEL DANGER STATE"

Note: The notice shall be BLACK text on a WHITE background and affixed to the inside of the door.

Overpressure Relief – Venting Plates

3.52 Over-pressure relief venting plates are designed to prevent the structure of a Magazine or Small Magazine being damaged by a credible incident involving the gas produced from the

ignition of propellants (Liquid or solid) or high explosives (Insensitive Munitions response of a type "IV" or "V" reaction).

Note: The venting plates are not designed to cater for overpressure (quasi-static over-pressure or quasi static pressure) caused by blast from detonation type reactions (Type I or II).

3.53 An assessment shall be undertaken to determine the number and size of the over-pressure vent plate(s), including the trunking volume and numbers of turns required to relieve the over-pressure to atmosphere.

Note: Guidance on calculating the minimum area of the vent (or vents) is provided at EN 14797 *Explosive venting devices*.

3.54 Over-pressure relief venting plates designed to function at 0.2 bar should be incorporated into the structure of magazine or small magazine where EO, ignited by a credible incident, produces a quasi-static over-pressure of 0.2 bar (20.4 kN/m^2) (3 psi) or more in their normal designated stowage position.

Note: Where the Magazine or Small Magazine is located within the Naval Vessel's citadel, the air pressure of the citadel shall be considered when designing the over-pressure vent plate function as it may exceed 0.2 bar.

3.55 Pressure venting arrangements and fittings shall:

3.55.1 be designed to meet the appropriate deck or bulkhead structural, pressure and water tight integrity requirements according to location;

3.55.2 ensure security is not compromised;

3.55.3 not function under pressures achievable by the ventilation system or pressures generated by partial compartment flooding;

3.55.4 limit the maximum overpressure applied to compartment boundaries to a level which does not produce significant structural damage and prevent plastic deformation of the compartment boundary in the event of a credible propellant burn incident;

3.55.5 be mechanically restrained with hinges or straps to limit the propulsion of the plates;

3.55.6 vent direct to atmosphere or via dedicated vent trunking fitted between the magazine area and atmosphere; and

3.55.7 ensure vented efflux from a missile motor burn does not create an unacceptable risk to Naval Vessel or crew survivability.

3.56 GW Magazines containing propellant shall:

3.56.1 be fitted with venting arrangements designed to prevent over pressurisation of the GW Magazine in the event of a propellant fire resulting from one missile motor burn; and

3.56.2 have venting arrangements designed to function immediately and provide continuous pressure relief when an over pressure of 20 kPa is reached.

3.57 The efficiency of a venting arrangement (post functioning) shall not be degraded by obstructions placed in the vent path.

3.58 If venting from a Magazine or Small Magazine space is via a vent trunk, the required scantlings for the vent trunk structure shall be calculated as for Magazine and Small Magazine boundary requirements.

3.59 Where the vent trunking includes an escape route, the arrangements for hatches shall prevent over-pressures from escaping into other internal compartments.

3.60 Doors and hatches in the venting route to atmosphere that do not open away from the Magazines or Small Magazines shall be fitted with a venting plate.

3.61 A warning sign 'BLAST VENT-DO NOT OBSTRUCT' shall be placed on the outside of the venting/blow out plates in red letters 50 mm high.

3.62 The venting plate boundary shall be signified by a continuous 50mm wide Red line.

3.63 The vent plate should also be marked with a descriptive sign 'Vent Plate'.

Inspection Access Plates

3.64 Inspection access plates shall be sited outside EO Stowages.

Note: Where design limitations dictate access is necessary, no more than one access plate per compartment to be inspected shall be sited in a Magazine or Small Magazine and it shall be clear of EO Stowage and associated fittings.

3.65 Inspection access plates shall be bolted in place and meet the construction requirements of its surrounding structure

Efflux Protection

3.66 Adequate protection shall be provided to prevent efflux from Vertical Launching System (VLS) Magazines and missile launchers/canisters burning through the EO Stowage boundaries, adjacent stowages and internal structures.

3.67 The efflux radius of an armament system, in particular missile systems, shall be measured or obtained from the system manufacturers and applied to the Naval Vessels upon which they are to be installed.

3.68 The efflux radius measurement shall be used to:

3.68.1 determine the level of protection from efflux for EO Stowage boundaries/structures and adjacent high value compartments; and

3.68.2 identify personnel safe distances.

3.69 External doors, hatches, hoists or other openings in the Naval Vessel's structure that may be subject to burning efflux emitted from a missile during or after launch shall:

3.69.1 be flameproof as well as flashtight when closed,

3.69.2 be coated with a suitable ablative coating, and

3.69.3 not be located where efflux, smoke and liquid fuel fumes from missile activation or damage can be directly ingested into the Naval Vessel.

3.70 Combustible material, including high-pressure cylinders shall not be stowed or used in positions upon which missile efflux is likely to impinge.

3.71 Efflux from missiles shall vent directly to atmosphere and shall not pass through adjacent compartments.

3.72 Fittings near VLS Magazines and missile launchers/canisters shall be designed and constructed so that they are not damaged or dislodged by missile efflux.

3.73 Personnel manning open gun mounts or stationed within 20 m of any missile launcher shall be provide with protection against missile efflux and debris.

Protection from Liquid Fuel Threats

3.74 Storage and Handling of weapons containing OTTO Fuel shall meet the requirements of DEOP 350.001.A0.01 *OTTO Fuel II Safety, Storage and Handling Instructions*. Supplementary requirements for EO Stowage onboard Naval Vessels are detailed in this Section.

3.75 EO Stowages containing liquid fuelled weapons shall be capable of being sealed to contain hazardous vapours.

3.76 Areas below stowage racks for EO containing OTTO Fuel shall be sealed to prevent fuel leaking into compartments below in the event of a damaged weapon.

3.77 EO Stowages containing liquid fuelled weapons shall be provided with a means of exhausting vapours direct to atmosphere external to the vessel to prevent build-up of toxic or flammable vapours in the event of a weapon leaking.

3.78 Appropriate vapour monitoring equipment shall be installed when liquid fuel weapons containing harmful substances are embarked.

3.79 The drains of EO Stowages containing liquid fuelled weapons shall discharge into a dedicated sump.

Protection from Blast, Fragment and Response to Attack on Ammunition Threats

3.80 A System Safety Analysis (including threat hazard analysis and vulnerability assessment) of the EO Stowage's ability to protect against ballistic and blast threats (including fragment and Response to ATTack on AMmunition (RATTAM) threats) shall be undertaken.

Note: See Division 2 Chapter 01 *Core Design Rules* Rule 03 *System Safety* for requirements relating to System Safety Analysis.

3.81 The requirement for protection shall be assessed in the configuration that will be used for stowage in Naval Vessels and against the possibility of mass detonation of EO within EO Stowages.

3.82 Protection shall be incorporated into Naval Vessels against ballistic and blast threats including fragment and RATTAM threats identified in the OSI. The level of protection shall minimise the potential of a response to susceptible EO, stowed in their permanent approved stowages SFARP.

Note: Where weatherdeck EO stowage is essential, measures shall be implemented to reduce the likelihood of occurrence of the most severe response of one explosive store to the RATTAM threat causing a sympathetic reaction in adjacent stores that is greater than burning (Type V) reaction.

3.83 Where the System Safety Analysis indicates the projectile hazards (including shrapnel and small arms fire) or blast hazards from the defined threat may enter or impact the EO Stowage then additional protection shall be provided.

Note: Mitigation techniques to reduce the Vulnerability of EO Stowages should include the use of insensitive explosive fillings, EO containers, physical barriers between warheads and the location and stacking of EO.

Protection from Flash

3.84 EO Stowage design shall cater for the effects of transient flame, pressure wave and electromagnetic radiation associated with an explosion.

3.85 A System Safety Analysis shall be undertaken to identify susceptible munitions and appropriate measures taken to eliminate or minimise risks from credible incidents relating to flash in EO Stowages SFARP.

3.86 Flash protection shall be achieved by a combination of flash tight, interlocked doors/ hatches such that EO loads are flash protected from each other and external sources.

3.87 Doors, hatches and other openings with metal-to-metal facings shall be regarded as being flash-tight provided the flash path is not less than 25 mm in length and the clearance between faces does not exceed 0.25 mm per 25 mm of flash path.

Note: An EO Stowage watertight door or hatch is flash-tight.

Note: An example of a flash-tight barrier in Figure 10.2: Example of a Flash Tight Barrier.

3.88 EO Stowages shall be:

3.88.1 protected by a flash tight barrier at the exit of the Transfer Routes or as near to them as is practicable; and

3.88.2 fitted with access doors that are flash tight when closed.

3.89 Protection from flash shall not be required for EO Stowages and designated EO handling areas as follows:

3.89.1 40 mm EO ammunition and below where the potential for generation of a damaging flame front is reduced by the lower Net Explosive Quantity (NEQ) of the stores; and

3.89.2 EO stores containing propellant that are themselves inherently flash tight do not normally require protection.

3.90 EO Transfer Routes that enter the hangar from inside the Naval Vessel and openings in EO Stowages for secondary supply routes shall be flash tight when closed.

3.91 All openings to weapon lifts/hoists shall be fitted with a watertight door/shutter that is flash-tight when closed.

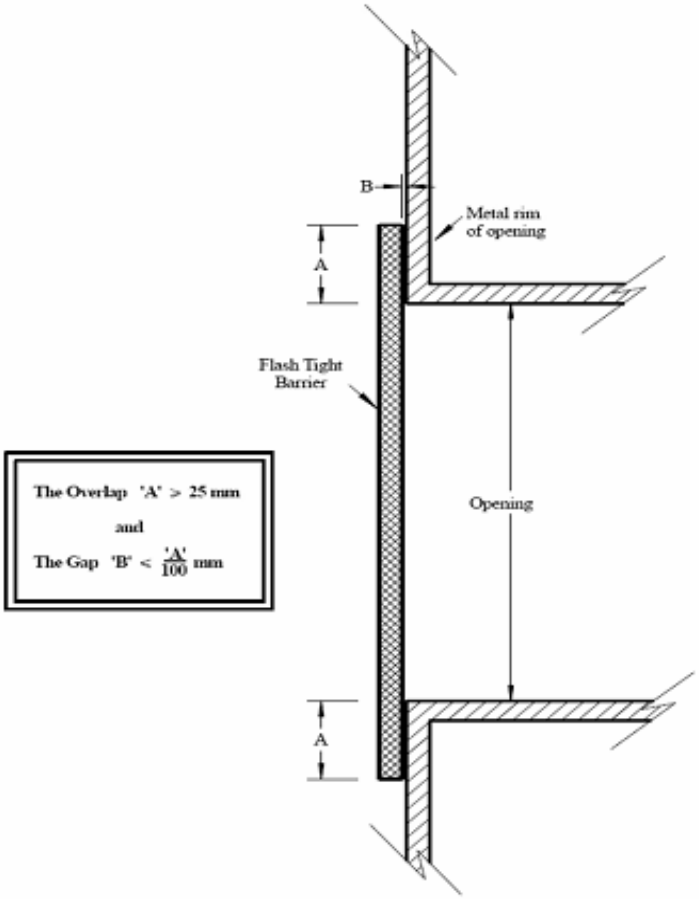

Figure 10.2: Example of a Flash Tight Barrier

Painting and Preservation

3.92 The requirements for the painting and preservation of Naval Vessel surfaces and fittings are detailed in Chapter 02 *Structure* Rule 06 *Preservation Systems*. Supplementary requirements for EO Stowages and DDA's are detailed in this Section.

Note: See Chapter 06 *Fire Protection* for requirements in relation to insulation and paint combustion.

3.93 Painting and Preservation of EO Stowages (includes racks, workbenches, desks, and bulkheads etc.) storing weapons containing OTTO Fuel shall meet the requirements of DEOP 350.001.A0.01 *OTTO Fuel II Safety, Storage and Handling Instructions*.

3.94 The external surfaces of Magazine boundaries shall be covered with fire resistance material or intumescent/fire resistant paint to control the effects of an adjacent compartment fire.

3.95 The interiors of EO Stowages shall be covered with fireproof thermal insulation or paint having non-flammable and/or intumescent properties.

3.96 Fireproof thermal insulation or intumescent/fire resistant paint shall be designed to prevent an increase in temperature within the EO Stowage that may cause the stored EO to function, burn, detonate or unacceptably degrade. Fire Insulation and paint shall be non-combustible and shall meet the requirements of Chapter 06 *Fire Protection*.

Note: Intumescent paint shall not be used on shock rated Naval Vessels.

3.97 EO Stowage shelves and racks constructed from aluminium (where approved for use) shall be left unpainted.

3.98 Magazine and Small Magazine deck covering material shall provide protection from incendive sparking (friction, impact and abrasion) and anti-slip.

3.99 Anti-slip deck covering shall be applied to all traffic working areas of Weapon Preparation Area (WPA) except where latex concrete or magnesite deck coatings are used.

3.100 Magazine and Small Magazine Flow-forge stowage system deck covering shall be non-slip.

3.101 Anti-slip deck coverings shall meet the requirements of MIL-PRF-24667 *Anti-Skid Safety Coating* or equivalent.

3.102 Paints containing aluminium greater than 10% shall not be used in EO Stowages.

3.103 The surface of conducting decks shall comply with the requirements of Rule 05 *Electrical Fitting*s where static electricity poses a hazard due to the operations being performed or an explosive atmosphere exists.

Note: Where there is a conducting deck requirement an antistatic precaution notice shall be displayed including the requirement for conductive footwear.

3.104 Areas below stowage racks for weapons containing OTTO Fuel shall be painted in accordance with DEOP 350.001.A0.01 *OTTO Fuel II Safety, Storage and Handling Instructions*.

3.105 Fire suppression system rubber hoses, fittings, spray heads and automatic sprinkling system control piping shall not be painted.

3.106 Manually operated spraying control valves shall be painted red.

Small and Specific Magazines

General Requirements

3.107 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules.

3.108 The relevant requirements for EO Stowages and DDAs given in this Chapter shall be applied to Small Magazines and Specific Magazines in addition to the requirements detailed in this Section.

3.109 Small Magazines and Specific Magazines shall be provided with flash protection and located to prevent damage by RATTAM type attack, gun blast and efflux from a rocket or missile at launch or in flight.

3.110 Shelves or divisions not forming the section boundaries shall be perforated to assist EO cooling.

3.111 Boundaries including doors, lids and hatches, shall be robust and constructed from steel that is not prone to warping, cracking or distortion under normal operating conditions and provide a watertight seal to the extent consistent with protecting EO from environmental conditions as detailed in the OSI.

Note: The natural and induced climatic conditions that EO detailed in the OSI are likely to be exposed to are detailed in Rule 12 *GME for Armament Systems*.

3.112 High fire risk equipment and electrical fittings shall not be fitted to the external surfaces of Small and Specific Magazine boundaries. If this is unavoidable then equipment and cabling shall be at least 50mm clear of the boundary.

3.113 When determining characteristics of the overall Small and Specific Magazine design environmental materials used for construction shall be assessed as part of the System Safety Analysis including:

3.113.1 The mass of the EO, taking into account vessel's movement, vibration etc.

3.113.2 Shock loads resulting from explosions external to the Small and Specific Magazine.

3.113.3 EO vulnerability to shock loading and electro static discharge; and, (See Rule 5 Electrical Fittings).

Note: In Naval Surface Vessels, the adjacent area for Small and RU Magazines is defined as being 2m all-round line of sight from the magazine boundaries.

3.114 Clips and closing arrangements shall not be distorted or able to rotate freely or spring open under the influence of Naval Vessel motion, vibration or shock as defined in Rule 12 *GME for Armament Systems*.

3.115 Small Magazines and Specific Magazines shall be divided into sections to allow separate storage in accordance with the UN Hazard Classification Code (HCC) system and each section shall be watertight and have its own watertight door.

3.116 A separate stowage outside the Small and Specific Magazine for Drill EO shall be provided.

Note: EO embarked in a Small or Specific Magazine on the upper deck may be at higher risk from bullet or fragmentation attack and so may need to meet a higher threat level for specific operations.

3.117 Small and Specific Magazines on the upper deck or in the superstructure shall be designed not to afford obvious targets for bullet attack.

3.118 Small and Specific Magazines fitted externally to Magazines shall be provided with a maximum/minimum thermometer and temperature and humidity record card.

3.119 Small and Specific Magazines shall be provided with physical protection against unauthorised access and sabotage with locking arrangements designed to prevent the possibility of entry by removing the hinge pins (see Rule 7 *Security* for Security Requirements).

3.120 Small and Specific Magazines shall not normally be sited in any of the compartments listed in Rule 2 *Adjacent Compartments*.

Small Magazines

Note: A Small Magazine is a self-contained magazine of such a shape or size that it does not permit “walk-in” and the contents are handled while standing outside. It is free standing or recessed into the Naval Vessel’s structure, but its boundaries are not part of the Vessel’s structure.

3.121 Where Small Magazines are located outside Magazines or Loaded Launchers and have a boundary within 25 mm or common with another compartment boundary, then adjacent compartment requirements in Rule 2 *Adjacent Compartments* shall be applied.

3.122 Small Magazines located in an EO Stowage shall be located so that 75 mm clearance is maintained between rear, sides, and undersides of the Small Magazine boundaries to permit effective cooling.

3.123 The applicable requirements detailed in Rule 3 *Structural Protection*, Rule 4 *Fire Protection*, and Rule 5 *Electrical Fittings* shall be applied in addition to the requirements detailed in this Section.

3.124 Cabling, waveguides and electrical equipment not associated with the safe storage or handling or operation of EO shall not be fitted to or pass through Small Magazines.

3.125 Appropriate measures shall be taken to permit the flooding of small magazines in the event of a fire (except where justified in the Safety Case and for magazines containing only HCC 1.4S munitions).

3.126 Small Magazines shall be fitted with local manually operated internal flooding arrangements, controlled by a single flood control valve except where:

3.126.1 They are installed in Magazines fitted with fire suppression systems; or

3.126.2 The EO Stowages contain HCC 1.4S EO, detonator, water activated EO or NAE beacons, bubble decoys and candle smoke white (shallow).

3.127 Drainage arrangements, not compromising the security of the Small Magazine and with suitable plugging arrangements that are removable from outside the magazine shall be fitted at the lowest point of a Small Magazine.

3.128 Drain facilities shall be identified by a notice, displayed in a prominent position, with the words 'DRAIN' in BLACK text on a WHITE background together with a BLACK arrow.

3.129 Small Magazines with flood systems shall be fitted with an air escape that is weather proof and does not compromise the security of the magazine (See Rule 07 *Security*).

3.130 A readily available first aid fire suppression appliance shall be located in close proximity to the Small Magazine and be located outside the adjacent area.

Specific Magazines

Note: Specific Magazines (includes RU Magazines and Detonator Magazines) are designed for the temporary stowage of small amounts of EO which have a reduced time at risk and slightly different requirements to Small Magazines.

3.131 Specific Magazines shall be free standing surrounded by an air gap and may be recessed into the Naval Vessel's structure.

Note: A RU Magazine does not normally have an 'adjacent compartment' because of this air gap.

3.132 Each Specific Magazine shall be considered a separate EO Stowage.

3.133 Specific Magazines shall be constructed of steel or any material meeting or exceeding the physical and chemical material properties of Stainless Steel 316 (316 SS).

3.134 Any material exposed to the environment shall be able to withstand conditions as defined in Rule 12 *GME for Armament Systems*.

Note: Other material may be accepted as identified in the construction materials requirement detailed in the OSI and approved by the Competent Authority.

Ready Use Magazines

Note: RU Magazines are normally located near the weapons system to facilitate resupply during action.

3.135 RU Magazines for SOLAS pyrotechnics and explosive stores for immediate use in all Naval Vessels shall be compliant with IMO regulations for SOLAS related EO, as adopted through Australian Maritime Safety Authority (AMSA) Marine Orders, as a minimum.

3.136 RU Magazines shall be constructed of steel or any material meeting or exceeding the physical and chemical material properties of 316 SS with a wall thickness of 3 mm and a minimum of 7 mm thick steel partitions.

3.137 Glass-Reinforced Plastic (GRP) or non-magnetic material may be used to construct RU Magazines to meet operational requirements as defined in the OSI and based on the results of a THA (See Rule 1 *Design Principles*).

3.138 The use of GRP or nonmagnetic material shall be approved by the relevant Competent Authority and as detailed in the OSI.

Note: The RU Magazine GRP carcass may be moulded with Radar Cross Section (RCS) attenuating material embedded onto or within the composite itself.

3.139 Temperature, humidity, radar cross section and the need for RATTAM protection shall be considered when choosing RU Magazine construction materials.

Note: Refer to environmental conditions defined in Rule 12 *GME for Armament Systems*.

3.140 RU Magazine boundaries including doors shall be robust and constructed from materials that are not prone to warping or distortion under normal operating conditions as defined in Rule 12 *GME for Armament Systems* and the OSI.

3.141 RU Magazines shall be designed so that the maximum contents of any one RU Magazine does not exceed 125 kg of propellant.

3.142 RU Magazines located on the weather deck and exposed to solar radiation shall be provided with sun shields on external boundaries.

Note: Sun shields shall be stood off 25mm from the RU Magazine boundaries and allow for air circulation.

Note: Due to the low thermal conductivity of GRP and similar materials, solar cladding may not be required depending on the design of the RU magazine.

3.143 RU Magazines shall be installed clear of structure, on all sides, to allow adequate cooling and Naval Vessel husbandry activities and located:

3.143.1 at least 4.5 m from oxygen generators, oxygen or oxidizer stowage or handling, flammable liquid stowage or handling, combustible liquid stowage or handling, or flammable gas stowage or handling; and

3.143.2 at least 600 mm from a fume-tight compartment containing oxygen generators, oxygen or oxidizer stowage or handling, flammable liquid stowage or handling, combustible liquid stowage or handling, or flammable gas stowage or handling.

3.144 RU Magazines located on a weather deck shall have a watertight enclosure to prevent munitions being exposed to salt mist.

3.145 RU Magazines on a weather deck shall be sited in a safe location surrounded by an air gap of at least 300 mm on all sides and where applicable protected from direct sunlight by fitting solar cladding over top and sides with an air gap of at least 25 mm air gap.

Note: RATTAM protection may be fitted in lieu of solar cladding subject to the air gap of 25 mm being maintained. The use of composite materials in the RU Magazine carcass may remove the requirement for solar cladding.

3.146 The provision of upper deck RU Magazines for the stowage of explosive stores/munitions shall be kept to a minimum to reduce Radar Cross Section (RCS) Naval Vessel vulnerability.

3.147 Where RU Magazines are located outside Magazines or Loaded Launchers and have a boundary within 25 mm or common with another compartment boundary then adjacent compartment requirements at Rule 2 *Adjacent Compartments* shall be applied.

Note: Where the RU Magazine contains small arms ammunition only or small quantities of pyrotechnics, then a single magazine type EO Stowage, without spray or flood arrangements, may suffice. Approval shall be sought from the Competent Authority.

3.148 RU Magazines shall not be welded directly to the deck.

3.149 A RU Magazine used for stowage of Aircraft Cartridge Actuated Devices (CADs) and Propellant Actuated Devices (PADs) shall be provided in close proximity to the aircraft maintenance area. A fire suppression system is not required.

3.150 RU Magazines provided for weather deck stowage of pyrotechnic and incendiary ammunition, such as parachute flares and thermobaric (TH) grenades, shall have manual jettison capability in case of a fire in the vicinity. Location of the manual jettison mechanism shall consider the safety of personnel undertaking the jettison operation.

Note: Un-sprinkled and non-jettison capable RU Magazines containing pyrotechnic and incendiary ammunition should be located at least 600 mm from another Magazine, RU Magazine, or Loaded Launcher located on weather decks.

3.151 The jettison mechanism shall be protected from damage and a positive locking device provided to prevent inadvertent actuation and the RU Magazine lid support arm shall be designed so that it does not contact the intended contents when the RU Magazine is closed.

Detonator Magazines

Note: Detonator Magazines are for the stowage of detonators separately from other explosives in a dedicated Magazine.

3.152 Detonators shall be stowed separately from other EO in dedicated EO Stowages that comply with the requirements detailed in this Chapter and the additional requirements of this Section.

3.153 Detonator Magazines shall be constructed from 3 mm thick steel with a minimum of 7 mm thick steel partitions and comply with the relevant requirements of Rule 3, Rule 5, Rule 6, and Rule 7 for Construction requirements and/or as detailed in the OSI.

3.154 Detonator Magazines shall not be installed on the weather decks.

3.155 Detonator Magazines may be installed in a Magazine (excluding GW Magazines) provided the total Net Explosive Quantity (NEQ) of the detonators shall not exceed 1 kg per Magazine.

3.156 Detonator Magazines shall not be sited in compartments:

3.156.1 Subject to temperatures above 32°C;

3.156.2 Subject to excessive vibration; or

3.156.3 Containing flammable liquids, solvents, mixed paints, acids in bulk, or any material liable to spontaneous combustion.

3.157 Where the total NEQ of the detonators to be embarked exceeds 1 kg, stowage shall either be provided by installing Detonator Magazines in a Magazine below the waterline, or in a number of dry secure approved EO Stowages.

3.158 Each Detonator Magazine shall be partitioned and, each partition shall hold no more than 0.25 kg NEQ.

3.159 Detonator Magazines shall be sited with a free air distance of at least 60 mm from the compartment boundary and should not be secured to the Naval Vessel's side.

Note: Where up to four (4) in number Detonator Magazines for Compatibility Group B class stores are located in the same compartment, they may be bolted together provided that an 8 mm (minimum) mild steel plate is fitted between each Detonator Magazine.

3.160 Detonator Magazines shall not be fitted with internal spray or flood systems.

3.161 Compartments containing Detonator Magazines shall be fitted with fire detection systems.

Small and Specific Magazine Finishes and Markings

3.162 Preparation and painting for all surfaces and fittings including pipe work and weather deck RU Magazine external surfaces shall be carried out in accordance with the relevant requirements of Rule 3 *Painting and Preservation*.

3.163 The relevant requirements detailed at Rule 2.52 *Hazard Warning/Safety Signs & Notices* shall be applied to Small and Specific Magazines in addition to the requirements detailed in this Section.

3.164 Upper deck Small and RU Magazines shall be surface finished with the colour of the Naval Vessel's side or adjacent superstructure.

3.165 All decks, deckheads and bulkheads within 25 mm of a Small or RU Magazine shall have a red letter on white background sign at least 400 mm x 250 mm in size, on the opposite side to that of the magazine, located in a clearly visible position, which states 'EXPLOSIVES OTHER SIDE".

Note: This sign is not required when it would be visible from outboard.

3.166 Warning notices shall be painted (approved pre-printed labels may be used) on Small and RU Magazines in 50 mm high 'RED' letters as follows:

3.166.1 Small and RU Magazine lettering to read 'DANGER EXPLOSIVES'.

3.166.2 RU Magazine lettering to read 'READY USE ONLY'.

3.166.3 For RU Magazines, a notice board marked 'DANGER EXPLOSIVES' is also to be provided for display when the magazine contains explosives.

3.167 Small and RU Magazines shall be clearly marked to identify their use with 10 mm permanent lettering that can withstand conditions as defined in Rule 12 *GME for Armament Systems*.

3.168 Internal Magazines (Magazines, Small Magazines, and Specific Magazines) shall be fitted with an explosives warning sign.

3.169 Detonator Magazines shall be painted RED with the word 'DETONATORS' painted in 20 mm high WHITE letters across the front of the Detonator Magazine.

Guided Weapons Magazines

3.170 The relevant requirements detailed in this Chapter shall be applied to GW Magazines in addition to the requirements detailed in this Section.

Note: For the purposes of this rule, GW Magazines are categorised as Integrated Missile Magazines, Non-Integrated Missile Magazines and Loaded Launchers.

Integrated Missile Magazines

Note: An Integrated Missile Magazine forms an integral part of the launch system and transfer of missile to launcher is automatically achieved. An example of an integrated system is the Vertical Launch System (VLS).

Note: Integrated systems do not include canisterised weapons (e.g. Naval Strike Missiles and Nulka) that are classified as loaded launchers.

3.171 Weapon delivery access hatches to an Integrated Missile Magazine shall be interlocked with the launch system to prevent efflux from entering the Magazine when a weapon is fired/launched.

3.172 A “DO NOT OBSTRUCT” notice shall be clearly displayed on automatic weapon delivery and discharge access hatches.

3.173 Fire detection and suppression systems shall be installed to prevent the ignition of adjacent missiles if the inadvertent firing of one missile is likely to cause an adjacent missile to fire.

Note: Integrated Missile Magazine Fire Detection and Suppression systems may incorporate automatic water deluge, water injection or efflux venting systems or a combination of such measures.

Non-Integrated Missile Magazines

Note: A Non-Integrated GW Magazine is an EO Stowage where the GW does not form an integral part of the launch system. GW may be stowed in these EO Stowages in or out of weapon shipping containers.

3.174 Non-Integrated GW Magazines shall be designed with a capability to stow weapons containing a shaped charge with their warheads facing a designated direction as advised by a Competent Organisation and detailed in the OSI.

Loaded Launchers

Note: A Loaded Launcher is an EO Stowage designed for the permanent stowage and launch of a missile or torpedo. Examples of loaded launchers are the Active Missile Decoy (AMD) launcher, canister Naval Strike Missiles and SVTT.

3.175 Loaded launchers and torpedoes containing OTTO Fuel II shall meet the requirements of DEOP 350.001.A0.01 *OTTO FUEL – Safety, Storage, and Handling Instructions.*

GW Pressure Venting and Efflux Protection

3.176 The relevant overpressure relief / venting plate requirements detailed in Rule 3 and Rule 6 for EO Stowages shall be applied to GW Magazines.

3.177 The relevant efflux protection requirements detailed in Rule 3 and Rule 6 for EO Stowages shall be applied to GW Magazines.

Cargo EO Stowage

Note: Cargo EO is defined as EO intended for delivery to other Naval Vessels or destinations, or both. Support operations may require Naval Vessels to carry commercial explosives as cargo for operational tasks.

Note: Any Naval Vessel carrying EO in a stowage not holding an EOS&H certificate or quantity of EO outside the warrant requires approval by the NVO.

Cargo EO Stowage General Requirements

3.178 The requirements of this Chapter shall be applied to Auxiliary vessel EO Stowages designated for the carriage of Cargo EO.

3.179 The relevant requirements detailed in Rule 2 *Layout and Services*, Rule 4 *Fire Protection,* Rule 6 *Stowage and Handling* and Rule 7 *Security* shall be applied to Cargo EO in addition to those detailed in this Section.

3.180 The requirements in the GW Magazines section covering Non-Integrated Missile Magazines shall be applied to Cargo EO if GW embarked.

3.181 The positioning and design capacity of Cargo EO Stowages shall be taken into account when designing cargo EO Stowage compartment including its impact on whether the Naval Vessel will be permitted to berth at wharves where public and property are exposed to risk from embarked EO.

3.182 Defence requirements for embarkation of non-RAN EO (e.g. Embarked Forces) shall be considered when designing Cargo EO Stowages.

3.183 Particular attention shall be paid to stores containing bagged propellant that are not intrinsically flashtight. Under these circumstances, flashtight design features shall be incorporated.

3.184 The design of bays, racks, shelves and securing mechanisms should provide stowage flexibility to allow for variations in Cargo EO types and packaging (See Rule 6 *EO Stowage and Non-Electrical Fittings*).

Cargo EO Handling

3.185 Handling systems relating to Cargo EO shall comply with the requirements of EO LHE (See Rule 1 *General*, Rule 2 *Layout and Services* and Rule 6 *Stowage and Handling*) and be capable of unrestricted operation in the conditions stated in in the OSI.

3.186 Handling systems and equipment consists of weapons elevators, overhead handling equipment, and mobile handling equipment as specified herein, and shall be provided in quantities for safely moving EO:

3.186.1 between the replenishment stations and Cargo EO Stowage compartments;

3.186.2 within the Cargo EO Stowage compartments; and

3.186.3 from Cargo EO Stowages to the assembly and checkout area.

3.187 The speed, capacity, and arrangement of equipment comprising these handling systems shall be based on the type of EO being handled and the replenishment and service cycle rates required.

3.188 Positive control requirements shall be applicable when EO is being handled vertically from one deck to another (as through a hatch, in a trunk, or in an elevator).

3.189 Slings, strongbacks, adapters, and fittings required for handling Cargo EO on pallets, cradles, and skids, and in containers shall be provided as detailed in the OSI.

3.190 Metal guards shall be provided up to a height of 1980 mm from the deck in the Cargo EO Stowage spaces and cargo EO handling areas to prevent damage to installed items protruding from bulkheads and stanchions from forklift truck operations.

3.191 The guards shall be removable where access to items being protected is necessary.

3.192 Electro-mechanical elevators shall be installed for the vertical movement of Cargo EO and EO components on pallets, cradles, and skids, and in containers.

3.193 Access to the elevator platform, platform size, and rated load capacity shall be as required by the configuration of the Cargo EO to be handled, the rate of flow desired, and the platform stowage arrangement.

3.194 Overhead monorail and bi-rail racks and bridge cranes shall be provided to facilitate handling of Cargo EO and EO components in EO Stowages and EO checkout areas.

3.195 Forklift trucks and pallet trucks shall be provided for the horizontal movement of Cargo EO and related components on pallets and cradles.

Cargo EO Stowage Markings

3.196 To indicate the maximum stack height, a 25 mm black line shall be clearly marked on each bulkhead 300 mm below the level of the spray heads and extend approximately one (1) m either side of the bulkhead centre line.

3.197 The following sign in 50 mm high lettering shall be clearly displayed just above the line: ‘MAXIMUM STACK HEIGHT’.

3.198 The following sign in 50 mm high lettering shall be clearly displayed inside the EO Stowage at eye level on each bulkhead: Leave 100 mm clearance between Cargo and bulkhead.

Vehicle Deck EO Stowage

3.199 Vehicle decks of Naval Vessels shall have a fitted fire suppression system capable of dealing with liquid fuel fires, providing protection against ignition of EO carried on embarked vehicles.

3.200 The vehicle deck shall be divided athwartships by water formed fire curtains from spray pipes fitted to the bulkheads and deckheads.

Note: The number of fire curtains required will depend upon the volume of the vehicle deck and design advice shall be sought from the NVO.

Rule 4. Fire Protection

4.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

4.2 The requirements relating to the selection of an appropriate fire suppression and cooling systems and fire safety systems in Naval Vessels are detailed in Chapter 06 *Fire Safety*. Supplementary requirements for EO Stowages on-board Naval Vessels are detailed in this Section.

4.3 The level of fire safety shall be demonstrated through a EO Stowage related systems safety analysis as required by Division 2 Chapter 01 *Core Design Rules* Rule 3 *System Safety* to meet the fire safety objective of this chapter.

Note: Electrical fittings internal to the EO Stowage or DDA associated with fire detection and suppression systems shall comply with the requirements of Rule 5 *Electrical Fittings*.

Fire Detection, Monitoring and Control Systems

4.4 Naval Vessel Arrangements shall ensure the supply of services (e.g. electricity, water) to the EO Stowage's Fire Safety Management System and equivalent alternative arrangements are available in the event of the loss of critical services.

4.5 Where EO is stowed on the upper deck, Naval Vessel arrangements shall provide a dedicated fire management system.

4.6 Naval Vessel arrangements shall control over pressurisation of EO Stowages and DDAs during operation of fire detection and suppression systems.

4.7 Magazines and Small Magazines shall be fitted with a dedicated automatic fire detection and suppression system with the exception of:

4.7.1 those containing water activated stores;

4.7.2 Guided Weapon Magazines; and

4.7.3 Cargo Magazines.

4.8 The primary performance requirements for fire detection and suppression systems installed in Magazines, Small Magazines and DDAs shall:

4.8.1 Reliably detect the presence of excessive heat, fire or smoke stimuli.

4.8.2 Provide early warning alarms to provide for the activation of fire suppression systems in a time that prevents escalation of the event.

4.8.3 Provide rapid effective containment and cooling of an event within or outside such spaces as to:

4.8.3.1 prevent damage to the EO,

4.8.3.2 prevent EO initiation through 'cook off', and

4.8.3.3 reduce the risk of a manageable fire becoming untenable due to EO becoming involved.

4.9 Magazines (excluding Small and RU Magazines) containing water-activated stores shall be fitted with manually operated spraying arrangements and drains that can be locked in the open position.

Note: The spraying arrangement may be fed from a single section of the fire main.

4.10 In Naval Surface Vessels, flood valves for Small Magazines containing water-activated stores shall be fitted with arrangements to allow locking in the closed position.

4.11 Operating instructions for fire suppression and handling equipment shall be displayed at the operating positions.

4.12 Fire detection and suppression systems shall be capable of being functionally tested (without detriment to safety) on a periodic basis, with or without EO embarked.

4.13 The system control unit shall have facilities to enable:

4.13.1 self-test checks of the sensors to be carried out as part of the routine maintenance procedures, and

4.13.2 full functional tests of the system to be carried out.

4.14 The spray system shall be configured such that the spray heads themselves shall not be able to be activated during testing and the water flow from the downstream side of the operating control valve is checked and suitably discharged overboard.

4.15 A facility shall be provided to discharge the test water overboard.

4.16 The system shall be capable of isolation to facilitate maintenance of the flood-operating valve and fitted with a means of 'bleeding' off water retained within to ensure that water does not enter the EO Stowage or DDA after testing.

Fire Detectors

4.17 The requirements for the design and construction of detection systems are detailed in Chapter 06 *Fire Safety* and Rule 07 *Detectors and Alarms*. Supplementary requirements for EO Stowages on-board Naval Vessels are detailed in this Section.

4.18 Fire detection in EO Stowages shall incorporate at least two different types of detector (e.g. smoke, flame or heat) with either detector type triggering the system.

4.19 Detectors in EO Stowages shall operate individually – the system architecture shall not include combined detector loops.

Note: The actual number and arrangement of detectors is dependent upon the physical parameters of the Magazine and Small Magazine including the stowage configuration but shall be sufficient to monitor the entire compartment.

4.20 Automatic water fog/mist, spray, sprinkler or flood systems shall activate in response to at least two detectors - one smoke and one heat.

Note: Detection of smoke or heat alone should only result in alarms being activated.

4.21 Where EO Stowages are split into zones the detectors shall be distributed evenly amongst the zones.

4.22 Where heat and atmosphere detectors are linked to a control system that automatically initiates a water fog system or water spray system, the control system shall:

4.22.1 be located outside the EO Stowage;

4.22.2 be provided with interlocks and remote testing facilities that permit routine testing and maintenance to be carried out without hindering the operation of the system;

4.22.3 operate the water fog or spray system in the Magazine and Small Magazine in a time sufficient to prevent escalation of the event; and

4.22.4 incorporate automatic fault detection arrangements.

4.23 Fire and heat detectors shall be fitted to:

4.23.1 weapon hoists/trunks that can be entered by personnel,

4.23.2 weapon lifts,

4.23.3 WPAs, and

4.23.4 specific to type weapon facilities as defined in the OSI.

4.24 Where there is a potential fire risk, adjacent compartments shall be fitted with heat and atmosphere detection measures.

4.25 Automatic fire detection and suppression systems shall provide an immediate response.

4.26 Detectors in EO Stowages shall not be fitted with isolation switches.

4.27 Detection systems shall incorporate automatic fault detection arrangements.

4.28 Where the size of the EO Stowage requires the spray system to be configured into zones, the number of atmosphere detectors should be shared as equally as possible between each zone.

Note: a maximum of four (4) is recommended, such that a whole magazine is not “wetted” when a fire/heat source is confined to a small area.

Atmosphere/Smoke Detectors

4.29 The minimum number of Atmosphere/Smoke Detectors within an EO Stowage shall be determined on deckhead area based on the following:

4.29.1 Deckhead area <12 m^2. One sensor fitted that has demonstrated an ability to cover at least this area.

4.29.2 Deckhead area 12 m^2 to 25 m^2. Two sensors fitted then one extra detector for every additional 50 m^2 (or part thereof).

4.30 Atmosphere/Smoke detectors may be either:

4.30.1 Point detectors (optical and ionisation),

4.30.2 Beam detectors (optical),

4.30.3 Aspirated systems, and

4.30.4 Video recognition systems.

Heat Detectors

4.31 Heat detectors in EO Stowages shall be:

4.31.1 of low thermal inertia capable of sensing and responding to extremely steep temperature/time gradients of at least 25°C per second; and

4.31.2 capable of individually sensing and responding to heat stimuli (e.g. the system should not be configured with combined detector loops).

4.32 Heat detectors may be either:

4.32.1 Electronic Point Detectors,

4.32.2 Thermally Sensitive Devices (Such as sprinkler bulbs),

4.32.3 Linear Detectors, or

4.32.4 IR Video Systems.

4.33 Heat detectors shall provide a continuous readout of temperature that the system control unit can electronically process or be of the form where the device triggers or activates at a pre-set temperature.

Note: This is nominally 68°C +/-5°C or based on the specific reaction to various heating regimes by the EO being stowed.

4.34 The minimum number of point heat detectors shall be determined on deckhead area, based on the following:

4.34.1 The maximum spacing between sensors shall be 3 m.

4.34.2 The maximum distance between a sensor and bulkhead shall be half the sensor spacing.

4.35 Any single heat detector signal indicating 68°C or more shall activate audible/visible alarms, both locally and remotely in the DCC, or other locations appropriate to the Naval Vessel's protection organisation. The alarms shall operate independently of controls to activate the spray system.

4.36 The maximum distance between heat detectors shall not be greater than 9 m and distance from detectors to bulkhead shall not be more than 2 m.

Note: Where there is no adjacent compartment hazard, the 2 m distance from the bulkhead/Naval Vessel side may be relaxed.

4.37 The detectors shall be installed just below and distributed across the deckhead taking into account the layout of the Magazine, potential heat flow distribution and the relationship of its boundaries to the potential risk from the adjacent compartment/area.

Note: Consideration shall be given to the installation of detectors in Magazine that detect the rise in bulkhead temperature due to fire in an adjacent compartment.

4.38 The threshold value for heat detection devices shall be close to but no lower than 30ºC above the highest anticipated ambient temperature of the compartment.

Fire Alarm Requirements

4.39 The requirements for the design, manufacture and installation of fire alarms are detailed in Chapter 6 *Fire Protection* for requirements relating to Fire Alarms. Supplementary requirements for EO Stowage and use of EO in Naval Vessels are detailed in this Section.

4.40 Clearly identifiable visual and audible alarms shall immediately activate in the DCC and in other locations appropriate to the Naval Vessel's fire protection organisation's response to detector activation.

Note: In Minor War Vessels and support Vessels, including Auxiliary Oiler Replenishment (AOR), fire alarms shall also alarm on the weatherdeck.

4.41 The fire alarm in EO Stowages shall:

4.41.1 have a characteristic tone distinguishing it from a Naval Vessel's other alarm systems, and

4.41.2 operate independently of controls to activate the water fog or spray system.

4.42 An audible fire detection alarm shall be installed in the vicinity of Magazines and Small Magazines and fitted with a mute switch.

4.43 In Naval Vessels where the DCC or the Vessel's protection organisation is not continually manned, additional alarms shall be fitted adjacent to the Officer of the Watch (OOW) position at sea and adjacent to the gangway positions in harbour.

4.44 EO Stowage fire detection systems shall provide facilities to manually initiate the fire alarm from positions adjacent to all exits from the EO Stowages, the navigating bridge/control room and manned watch positions.

Monitoring and Control Requirements

4.45 The fire protection system shall operate when the temperature in the EO Stowage area reaches a threshold temperature defined in the OSI.

4.46 Fully automatic systems in EO Stowage Fire Detection and Suppression Systems shall be capable of manual operation.

4.47 The reaction time of fully automatic EO Stowage Fire Detection and Suppression Systems shall be appropriate to the carriage and use of EO and the consequences of an incident as defined by the OSI.

4.48 Remote control stations are to be separated by at least one deck or a main watertight bulkhead with independent power supply.

4.49 Detectors protecting the EO Stowage area shall be configured to raise the alarm in a continually manned space linked into the EO Stowage's fire protection arrangements.

4.50 EO Stowage Fire detection and suppression system elements to be monitored shall include:

4.50.1 system water pressure;

4.50.2 water flow alarm unit status;

4.50.3 low pressure indicators for any compressed gas storage cylinders associated with fire suppression systems;

4.50.4 detector visual and audible alarms; and

4.50.5 flood warning.

4.51 The status of each fire detection and suppression system shall be monitored and controlled from the DCC and other locations consistent with the Damage Control organisation requirements.

4.52 A water flow alarm unit shall be installed to provide an indication of spray system activation.

4.53 A float-operated valve shall be fitted that turns off the supply once a Small or RU Magazine is completely flooded.

4.54 The control system in EO Stowages should be provided with interlocks and remote testing facilities that permit routine testing and maintenance to be carried out without hindering the operation of the system.

Water Suppression

General Requirements

4.55 The requirements for the design, manufacture and installation of fire system are detailed in Chapter 6 *Fire Safety* for requirements relating to water suppression. Supplementary requirements for EO Stowage and use of EO in Naval Vessels are detailed in this Section.

4.56 Flow rates for water systems shall be appropriate to the quantity and type of EO embarked and account for both fire suppressant and cooling of EO and EO Stowage boundaries.

4.57 Where water spray systems are installed, they shall be arranged to provide 100% coverage of all EO Stowage areas as defined as the larger of the deck or deckhead area.

4.58 Water systems in EO Stowages are to be fitted with flow and pressure sensors configured to operate distinctive audible and visual alarms at the appropriate manned monitoring position.

4.59 Water suppression systems shall provide cooling for 30 minutes after end of the fire incident.

4.60 A Naval Vessel's fire main system shall have sufficient reserve capacity to meet the flow rates for EO Stowage flood, spray and missile deluge systems most demanding load case.

4.61 EO Stowages water suppression systems shall be fitted with:

4.61.1 sufficient drainage and pumping arrangements to ensure EO Stowages can be completely drained or pumped out; and

4.61.2 an effective water removal system to ensure that water can be drained or pumped out from stowage bins or lockers and from under false floors within EO Stowages.

4.62 A 3 mm hole shall be placed in a readily visible section of the lowest point of a horizontal run in the piping after the sprinkler flow alarm device.

Note: the horizontal run shall be lower than the flood connection point to the magazine and drain to a safe space or over the Naval Vessel's side.

4.63 Where water supply and control pipes to EO Stowages cannot be run below decks or within the Naval Vessel and contain static water they shall be insulated to guard against freezing or provided with some form of heating.

Spray Systems

4.64 The fire suppression system shall provide water to Magazines via water spray heads capable of protecting 9 m^2 of deck area from a maximum height of 2.4 m with a minimum delivery rate of 33 litres per minute per square metre of deckhead or magazine base.

Note: This rate is equivalent to that specified in magazine section of NAVSEA S9AA0-AB-GOS-010 - *General Specifications for Overhaul of Surface Ships* with deckhead heights of 2.4 m (8 feet) or less.

4.65 The distance between nozzles and bulkhead where boundary cooling is required to EO Stowages shall be assessed to ensure that bulkhead (up to the deckhead joint or red line defining the stack height) is fully covered.

Note: Boundary cooling of bulkheads is not required when the ‘boundary’ is the Naval Vessel’s side or a compartment/ tank containing water.

4.66 The underside of the nozzle shall be at least 300 mm and adjacent nozzles shall overlap at least 100 mm clear of the EO top level.

Note: Where the 300 mm clearance is not achievable, additional nozzles may be installed in lieu in order to provide the required spray coverage.

4.67 Two separate branch lines shall supply the sprinkler heads with each branch line supplied from a separate independent supply section of the fire main and individual controlled. These feeds shall enter the Magazine diagonally opposites.

Note: The requirements for two separate branch lines may not be applicable to Minor War Vessels, where endorsed by the Competent Authority.

4.68 Each spray system within an EO Stowage shall have a facility that temporarily cross connect (e.g. jumper hose) to another section of the fire main in emergency conditions and facilitate the conduct of maintenance on the fire main.

4.69 Spray systems (including fog/mist systems) installed in EO Stowages shall have a facility provided with an alternative supply of water downstream of the main spray system control valve.

Spray Systems Local and Remote Control

4.70 Each Magazine spray system shall be provided with local and remote control points to enable manual activation of the spray control valve.

4.71 A control point shall be installed in a readily accessible position outside the Magazine in an access lobby or passageway.

4.72 Each spray system shall be provided with a remote control panel sited on the weather deck to enable manual activation of the spray control valve.

4.73 The activation of the spray control valve from the local and remote control panel shall be by key operated switch.

4.74 The remote control panel shall be protected in a lockable watertight metal cabinet or by an anti-tamper device with the key stowed in a breakable glass fronted key box, sited adjacent to the cabinet and control panel.

4.75 All controls shall be clearly marked on the outside of each cabinet and the instructions for operating the controls shall be clearly indicated inside the cabinet.

4.76 Pneumatic spray control valves complete with actuator, air bottle and manual operating lever shall be suitably protected in a lockable cabinet.

Note: The cabinet and contents shall not be installed in any compartment that is capable of being locked.

Upper Deck Launcher Spray Systems

4.77 A manual spray system shall be fitted to upper deck launchers loaded with torpedoes or guided weapons magazines containing water activated stores.

Note: This includes magazines housing small quantity of explosive stores (e.g. pyrotechnics, marker float signal, smoke generators, etc.).

Note: The system fitted to upper deck launchers is normally dry, consisting of open-ended spray heads fed from the fire main.

4.78 The spray control valve shall be:

4.78.1 fitted in the seawater branch close to the magazine access, and

4.78.2 capable of both local and remote operation.

4.79 The remote operating position shall be separated by one (1) deck or a main watertight bulkhead from the local position.

4.80 Each operating position shall be capable of independent operation.

4.81 Upper deck launchers shall:

4.81.1 be provided with sufficient nozzles to ensure that all parts of the launcher are completely drenched with water at an appropriate flow rate from the sea water main, and

4.81.2 have the spray valve installed in the supply branch near the launcher, but inside the Naval Vessel's structure.

4.82 For flushing and draining purposes, a 65 mm instantaneous hose connection with a 40 mm bore locked shut ball valve shall be fitted on a short branch between the spray shut-off valve and the strainer.

Water Fog and Water Mist Systems

4.83 The design and installation of Water Fog and Water Mist system performance shall be based on full scale trials and/or modelling data using representative fire loads, compartment volumes and stowage arrangements.

4.84 Magazine Water Fog Systems shall achieve a minimum pressure of one (1) bar at the nozzle furthest from the supply.

4.85 Where EO is stowed on more than one level in the magazine, each level shall be provided with pipework and nozzles fed from a common supply.

4.86 Water fog systems shall have a multi orifice that produces a high local fog density and a single orifice that produces a lower fog density.

4.87 Single orifice water fog nozzles shall cover the upper and lower EO Stowages, multi orifice water fog nozzles and uppermost forward and uppermost aft spray positions shall form a line running athwartships.

4.88 The distance between Water Fog or Mist System nozzles shall be a maximum of 600 mm athwartships and 1500 mm fore and aft.

4.89 Water Fog or Water Mist System nozzles shall be no less than 100 mm above the top of embarked EO and no less than 50 mm clear of obstructions.

4.90 Water Fog or Mist Systems shall be capable of local and remote operation.

Spray System Sign/Notice Requirements

4.91 Each spray control/isolating valve and operating position for all spray systems shall have a clearly visible adjacent sign which identifies the Magazine being served, and its normal system line-up position.

4.92 Signs at manual spray control operating positions are also to include whether it is the 'local' or 'remote' operating position.

4.93 System isolating valves are to have a clearly visible sign adjacent to it that identifies the magazine being served and its normal state (e.g. open or shut).

Flooding and Drainage Requirements

4.94 Each Magazine with sprinkling, water injection, deluge or flooding systems shall be fitted with sufficient drainage arrangements to ensure Magazines can be completely drained or pumped out within 30 minutes.

4.95 Additional arrangements shall be made to ensure that water can be drained or pumped out from stowage bins or Magazines and from under false floors within Magazines.

4.96 To maintain Magazine integrity, dedicated drainage piping shall be provided for each stowage, and drains shall not be:

4.96.1 led into lower compartments and bilges, sump tanks or drains common with other compartments; or

4.96.2 shared with drains likely to contain flammable liquids.

4.97 Magazine water removal systems shall be effective when the platform is listing to the anticipated operating environment detailed in the OSI and have a capacity equal to or greater than the flow rate of the Magazine spray system or flood system.

4.98 Water removal system drains shall be installed with positive closing arrangements with a remote lockable opening and closing arrangement immediately adjacent to the Magazine.

4.99 Water removal system drain valves shall be labelled to:

4.99.1 identify their function; and

4.99.2 indicate whether they are open or closed.

4.100 Drainage arrangements, which may be subject to contamination from the Magazine's contents, should be separate from all other drainage systems. Such systems should be able to contain the contents or discharge directly overboard.

Note: See Chapter 14 *Environmental Protection* for requirement relating to Environmental Protection and Drainage.

4.101 Removable gratings or grills shall be installed to the EO Stowage water removal system to prevent blockages.

4.102 Water seals shall be installed if open drains present a hazard to a Magazine and/or Naval Vessel CBRN-D integrity and a potential for flammable vapours entering the drainage system may be present.

4.103 EO Stowages containing White Phosphorus (WP) munitions (Compatibility Group H) munitions shall be arranged such that either the:

4.103.1 whole EO Stowage can be flooded to above the level of the stowages; or

4.103.2 WP natures are provided with a container (bath, tank or bin) that can be separately manually flooded in the event of an adjacent fire or of damage or potential damage to the munitions.

4.104 Flood sensors should be fitted in EO Stowages where a pressurized fluid system (other than the EO Stowage spray system) passes through or serves the Magazine.

Note: Small and Specific Magazines (RU and Detonator Magazines) do not normally require flood sensors.

4.105 A flood detection system shall be installed in each EO Stowage fitted with a water suppression system. This system shall activate prior to the flood depth reaching 60 mm.

4.106 Magazine drains shall be normally locked open.

Note: Where EO carrying liquid fuel are present in a Magazine, it may be considered more appropriate that the drain is normally locked shut. This will depend upon the free surface presented by a Magazine or EO area and operating environment restrictions considered in the design of arrangements.

4.107 If internal flood/deluge systems have not been installed in a loaded launcher, then the launcher shall be sprayed externally from a fixed manually operated fire suppression system controlled from a protected position outside the adjacent area.

4.108 Internal flood/deluge systems shall supply water to the external surfaces of the loaded launcher at a minimum rate of 33 litres per minute per square metre of launcher external surface area.

EO Stowage Water Suppression Valve Requirements

4.109 Flood and spray activation control valve or devices shall be installed in a protected position and screened from the Magazine by a deck or water tight bulkhead:

4.109.1 at least 3 m from the Magazine, or

4.109.2 greater than 5 m away from the Magazine in an unprotected position.

4.110 A minimum of two spray control valves shall be installed in the system as follows:

4.110.1 The primary valve shall be taken directly from the salt water main and be capable of local operation in close proximity to the Magazine and hydraulic, pneumatic or electrical operation from the DCC.

4.110.2 The secondary valve shall be fitted to a secondary branch and be capable of manual operation locally and from a remote position consistent with the damage control arrangements for the Naval Vessel.

4.111 OPEN and SHUT conditions of water suppression system operating and isolation valves shall be visually apparent at the valve.

4.112 Valve positions shall be chosen to provide the maximum protection against failure from action damage.

4.113 All control valve/devices and isolation valves shall be installed in close proximity outside the Magazine they serve.

4.114 Spray systems shall be provided with isolation valves to facilitate maintenance and the operation of redundant features.

Note: Manual activation control arrangements for control and isolation valves for Magazines in close proximity should be grouped to allow for ease of operation under battle conditions.

4.115 Valve and control device locations shall be chosen to provide the maximum protection against failure from action damage.

4.116 The flood valve for EO Stowages containing water-activated stores shall be fitted with arrangements to allow locking in the closed position.

4.117 A suitable facility (e.g. pressure gauge) shall be fitted in the branch pipe immediately downstream of the flood-isolating valve.

4.118 If valve handles are removable then a dedicated secure stowage shall be provided adjacent to the valve to hold the handle.

4.119 Locking arrangements shall be fitted to all activation switches, activation pushbuttons, spray valves, isolation valves, flooding valves, drain valves and cocks in the normal operating position to prevent tampering with the exception of activation valves/devices and isolation valves when housed in a lockable cabinet.

4.120 Activation valves/devices and isolation valves located in passageways, accommodation spaces or other areas where personnel congregate shall be provided with protective devices to prevent tampering.

4.121 The system shall be capable of isolation to facilitate maintenance of the flood-operating valve and fitted with a means of 'bleeding' off water retained within to ensure that water does not enter the EO Stowage or DDA after testing.

4.122 Flood/spray activation valves/devices and isolating valves shall have a clearly visible sign in WHITE text on a RED background adjacent to it that identifies the:

4.122.1 EO Stowage served;

4.122.2 position/location;

4.122.3 purpose/function of the valve/device;

4.122.4 normally OPEN and CLOSED conditions;

4.122.5 the normal system valve line-up position, e.g. "locked closed" to identify valve function; and

4.122.6 activation and reset instructions for the system.

Additional Suppression

4.123 First aid fire extinguishers shall be provided appropriate to the content of the EO Stowage.

4.124 In addition to the installed spray system, a means of effectively boundary cooling bulkheads from within the Magazine and Small Magazine shall be provided.

4.125 An adequate number of Multipurpose Extinguishers (MPE) or 9.1 litre aqueous film forming foams (AFFF) Extinguishers shall be installed inside and the immediate areas outside Magazine and Small Magazines.

4.126 If it is difficult to remove EO from a supply route, WPA or handling system below decks in the event of the EO being threatened by fire, a fixed fire suppression system capable of manual operation shall be installed. This system shall be locally operated from a protected position and provide adequate cooling to the EO.

4.127 GW hoist trunks and GW preparation areas designed to be used in wartime for the stowage of missiles shall be fitted with automatic fire detection and suppression arrangements as for Magazines.

4.128 Fire hydrants shall be located in the vicinity of EO dump points on weather decks.

4.129 Additional fire extinguishers shall be readily available if electrical or hydraulic equipment increases the risk of fire.

Rule 5. Electrical Fittings

5.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

5.2 The requirements for the design, manufacture and installation of Naval Vessel electrical fittings and equipment are detailed in Chapter 04 *Engineering Systems* for general spaces. Supplementary requirements for EO Stowages and DDAs on-board Naval Vessels are detailed in this Section.

5.3 All electrical equipment & fittings for the stowage of dangerous goods shall comply with the principles of SOLAS Chapter II-2 Regulation 19.3.2 specifically relating to sources of ignition.

5.4 A safety assessment shall determine whether additional protection techniques are required (refer AS/NZS 60079 *Design, selection, and installation of electrical equipment in hazardous areas* series of standards).

5.5 Electrical equipment & fittings in EO Stowages shall be watertight with Ingress Protection of IP56 as defined by IEC 60529: *Degrees of protection provided by enclosures (IP Code)* and fit for purpose in the marine environment and constructed from materials that are consistent with the proposed operating environment, threat and survivability studies.

5.6 Electrical equipment & fittings shall be designed and position to not interfere with the operation of blast pressure venting arrangements, lighting, ventilation, fire and smoke detection and suppression equipment.

5.7 Where compliance with safety standards is achieved through the use of environmental isolation, containment shall be secure to prevent accidental opening

5.8 Power outlets in EO Stowage areas shall be of socket type only and designed to contain any arcing on make/break.

5.9 Safety related switching shall not involve intermediate software control and shall be fitted with manual override.

5.10 Failure of safety related electrical items shall be detected rapidly and fail safe.

5.11 Emergency stop or safety related shut-down shall be fitted with a lock-out to prevent re-start without an intentional command.

5.12 Electrical fittings shall be capable of being isolated from the electrical main from outside the EO Stowage.

Note: Electrical equipment fitted in high value compartments shall be sited at least 3 m from the contiguous connection with any diagonally abutting EO Stowages. If this distance cannot be achieved, FBI in accordance with Chapter 06 *Fire Safety* Rule 08 *Containment of Fire* shall be fitted or seek guidance from ANC Authority or Competent Organisation.

5.13 Electrical fittings susceptible to damage during Magazine or DDA operations shall be suitably strengthened, guarded or repositioned to avoid damage.

5.14 The temperature of electrical items (or any other item) shall not exceed levels likely to lead to the ignition of gases or vapours or risk elevation of the temperature of EO above safe levels.

5.15 The maximum surface temperature for Electrical equipment & fittings in EO Stowage shall be 135°C (Temperature Classification T4) in accordance with IEC 60079-0: *Explosive atmospheres* - Part 0: *Equipment - General requirements.*

5.16 Electrical equipment and fittings in EO Stowages and DDAs shall be protected against ignition of the gases encountered in the compartment and certified for the Classification of the Hazardous Area determined from Division 2 Chapter 01 *General Requirements* Rule 07 *Hazardous Areas*.

5.17 Electrical equipment and fittings within the EO Stowage area shall not create an unsafe electrical environment when the fire fighting system is activated.

5.18 Electrical fittings, including cabling, shall be at least 50 mm clear of the boundary to assist boundary cooling and to facilitate Naval Vessel structural maintenance

5.19 Electrical fittings shall be capable of being isolated from the electrical main from outside the EO Stowage.

5.20 Arrangements for electrical items shall be such that their maintenance or repair shall not create an incident.

5.21 Direct installation of electrical equipment & fittings to any of the EO Stowage boundaries shall be avoided.

Cabling and Waveguides

5.22 Cables not associated with EO Stowage or WPA equipment shall not run through these compartments.

5.23 All associated and non-associated (due to overriding Naval Vessel design constraints) cabling routed through EO Stowages and WPAs shall be of unbroken length, without splices or coupling connectors, and be provided with mechanical protection to prevent:

5.23.1 damage by accidental impact, and

5.23.2 anything being suspended from them.

Note: Plastic conduit or troughs shall not be used in EO Stowages.

5.24 Cabling in EO Stowages shall be:

5.24.1 routed away from EO Stowages as far as is practicable;

5.24.2 arranged to prevent lightning or other external RF event from discharging into EO Stowage area;

5.24.3 joint and termination free if passing through the EO Stowage area;

5.24.4 fitted with glands at the EO Stowage area boundaries that control fire transition across the boundary;

5.24.5 capable of total isolation unless there is no termination or junction within the EO Stowage area;

5.24.6 separated, screened, sheathed or protected where necessary to prevent contamination or false signals; and

5.24.7 not attached directly to the EO Stowage area boundary except for lighting and low power cables (e.g. alarms).

5.25 Electrical cables passing through adjacent compartments, but not associated with equipment therein, shall be continuous (e.g. no junction boxes fitted) and suitably protected from mechanical damage.

5.26 Cables carrying greater than 440 volts shall not be permitted in a EO Stowage area containing Class 1 items or attached to its boundaries.

5.27 Combat and weapon firing circuits that must pass through EO Stowages shall be enclosed and protected in steel conduit.

5.28 Combat and weapon firing circuits in adjacent compartments shall be fitted in accordance with the requirements for EO Stowages.

5.29 Waveguides shall be not routed through an EO Stowage.

5.30 Degaussing cables shall be not routed through a EO Stowage. If not practicable, then equipment installed in EO Stowage shall withstand the expected magnetic field strength in accordance with Rule 12 *Generic Maritime Environment for Armament Systems*.

5.31 Penetration, conduit and cable glands on EO Stowage boundaries shall be sealed and meet the requirement of AS/NZS 60079: *Explosive atmospheres (IEC 60079).*

Junction Boxes and Electrical Cabinets

5.32 Junction Boxes and Electrical Cabinets shall be:

5.32.1 installed only to service EO Stowages and WPA equipment;

5.32.2 fitted external to EO Stowages and WPAs; and

5.32.3 robust and, if fixed to a bulkhead, constructed from steel.

5.33 EO Stowage and WPA associated electrical equipment shall be supplied from dedicated junction boxes and electrical cabinets.

5.34 All connections between test equipment and electrical equipment shall be incapable of being made or broken when the equipment is live.

EO Stowage and Weapons Preparation Area (WPA) Lighting

5.35 The requirements for the design, manufacture and installation of Naval Vessel lighting are detailed in Chapter 04 *Engineering Systems* Rule 14 *Lighting*. Supplementary requirements for EO Stowages and WPAs onboard Naval Vessels are detailed in this section.

5.36 Construction of lighting systems shall be of a certified safe type appropriate to the type of dangerous goods and be suitable for the maritime environment.

5.37 Fixed and portable lighting shall be provided in Magazines and Small Magazines to support inspection and operation under normal and fault conditions.

5.38 Portable lighting and light switches shall be readily accessible at the entrance to Magazines and Small Magazines and be safe for use in hazardous environments.

Note: Portable lighting installed in EO Stowages shall be assessed and approved by a Competent Authority.

5.39 Lighting in EO Stowages and WPAs shall be of the flameproof type, protected and sufficient to allow reading of markings on bulkheads and containers stowed within.

5.40 EO Stowages of walk-in proportions including Magazines, Small Magazines and WPAs shall be provided with emergency lighting.

5.41 Relay-operated lighting shall not be installed unless it meets the requirements approved by the Competent Authority.

5.42 Lighting circuits shall be isolated using clearly identified multi pole switches located directly outside the main access to the Magazines, Small Magazines, or WPAs.

5.43 Isolating switches for lighting circuits shall be painted golden yellow.

5.44 Lighting fixtures in EO Stowages and WPAs shall be either fluorescent, or Light Emitting Diode (LED), provided they are watertight and have mechanical protection to prevent damage from accidental impact and anything being suspended from them.

Note: Fluorescent lighting shall not be installed in Magazines or Small Magazines.

5.45 The emergency lighting stowage box shall be sited adjacent to the access on the outside for inboard EO Stowages and WPAs and the inside for weather deck EO Stowages and WPAs.

Note: The stowage box shall be off from the bulkhead to allow boundary cooling.

Electrical Earthing and Bonding

5.46 All EO containing Electro-explosive devices (EEDs) present a hazard when exposed to the Vessel's RF environment. Antistatic and conductive decking controls shall be implemented to meet the electromagnetic environmental conditions specified in the OSI and DEOP 115 *Defence Electro-Explosive Hazards Manual*. Supplementary requirements for EO on-board Naval Vessels are detailed in this Section.

5.47 As part of the System Safety Analysis, Environmental Effects Management (E3) shall be considered to identify the following:

5.47.1 Naval Vessel EO that is susceptible to inadvertent initiation, malfunction or dudding when exposed to the Navy electromagnetic environment including EO in the packaged and unpackaged state; and during handling, assembly, test, preparation and following action damage, etc.

5.47.2 Static and conducting deck requirements for EO Stowages and WPAs within the Naval Vessel where EO with vulnerable EEDs are stowed and/or handled.

5.47.3 The potential consequences of unauthorised or incorrect handling or processing in areas without conducting decks.

5.47.4 The potential for loss of mission capability in the event of action damage to conducting deck areas.

5.47.5 The potential effects of a lightning strike on the Naval Vessel with respect to any damage or effect on equipment in or associated with the EO Stowages.

Note: See Chapter 01 *Integrated Platform Survivability* Rule 15 *Susceptibility Reduction* for requirements relating to Electromagnetic radiation and electrostatic susceptibility.

5.47.6 EO Stowages and WPAs shall be designed or sited to ensure that EO maximum safe power density figures are not exceeded and boundary arrangements shall prevent external RF conditions from creating an unsafe internal electrical environment.

5.47.7 Magnetic field (both static and transitory) shall be controlled through shielding or location to be within safe limits.

5.48 Every sub-assembly within EO Stowages and WPAs including those subject to withdrawal or removal, built on metal chassis, drawers, or frameworks, and housed in a metal cabinet or console shall be bonded to the main outer enclosure of the Magazine or enclosure. This includes:

5.48.1 ventilation trunking,

5.48.2 junction boxes,

5.48.3 ventilation trunking, junction boxes, electrical cabinets on resilient mounts,

5.48.4 protective metal guards for electrical equipment,

5.48.5 cabling,

5.48.6 permanently mounted light fittings, and

5.48.7 steel electrical conduit that shall be electrically continuous.

Note: In addition to the solutions provided in this chapter, supplementary information on earthing of all equipment (electrical and non-electrical items) is provided in Chapter 4 *Engineering Systems* Rule 15 *Electrical Protection Arrangements.*

Static Control Requirements

5.49 Protection Arrangements for requirements relating to Earth bonding and the control of static electricity are detailed at Chapter 04 *Engineering Systems* Rule 15 *Electrical Protection*. Supplementary requirements for the handling and stowage of EO on-board Naval Vessels are detailed in this Section.

5.50 EO susceptible to electrostatic discharge shall be stowed and handled in an environment that is not conducive to charge build-up.

Note: The EO Competent Authority shall identify when EO is vulnerable to ESD. EO Stowages and WPAs shall be protected from electromagnetic radiation unless the explosive store in itself is adequately protected from radiation.

5.51 Personnel earthing arrangements shall be installed where EO susceptible to static discharge is handled or where preparation of susceptible EO is conducted.

5.52 A handhold consisting of bare, bright metal shall be installed and maintained adjacent to the Magazine door/hatch to provide a good path to earth.

5.53 Grounding (earthing) points should be available for equipment, tools and EO in EO workshops, to prevent a difference of electrical potential between operators and the material that they must handle.

5.54 Where bonding straps are required for the control of static electricity, they are to be robust, that is, having a cross-sectional area of at least 10 mm^2, and are to comply with the Earthing requirements of these Rules.

5.55 Where a piping system is required to be electrically conductive for the control of static electricity, continuity be maintained across the joints and fittings and the system shall be earthed. The resistance per unit length of the pipe, bends, elbows, fabricated branch pieces, etc., is not to exceed 0.1 MΩ/m. The resistance to earth from any point in the piping system is not to exceed one (1) MΩ.

Conducting Deck Requirements

5.56 Conducting decks shall be provided where the Competent Authority specified that static control precautions in stowage, preparation/test or handling areas are required for vulnerable EO.

5.57 For new construction and major repairs to existing EO Stowages, the following shall be implemented:

5.57.1 WPAs/Combined Assembly/Test Areas: Conductive or anti-static flooring depending on the sensitivities of the EED being handled.

5.57.2 EO Workshops: Conductive or anti-static flooring as required by the equipment or EO compositions being handled.

5.58 Naval Vessels carrying EO requiring static control precautions shall have a separate area with a conducting deck or conducting earthed mat of sufficient size to allow any assembly/disassembly task or examination of any stores with damaged or broken packaging. The remaining area of the deck space should be coated with the standard paint scheme for decks.

5.59 Conductive decks and footwear shall be used in areas where handling of Electrically Initiated Devices (EIDs) with resistivity in the range 50 kΩ to 50 MΩ is undertaken.

5.60 Metal benches for carrying out EID operations requiring precautions against electrostatic effects shall be clearly bonded to ground.

5.61 The resistance to earth of the conducting deck shall be less than 50 kΩ to be effective.

5.62 Decks in EO Stowages and WPAs shall be either metal sprayed or painted with a conductive coating as detailed in the OSI. No top coatings shall be applied over the metal spray.

Note: Specific instructions regarding the appropriate paint scheme and the management of dangers to both personnel and the Naval Vessel may be obtained from the NVO or the Competent Organisation.

5.63 Where there is a conducting deck requirement a “static control precautions notice” shall be prominently displayed in EO Stowages and WPAs.

5.64 EO Stowages and WPAs (including areas where the preparation, test, assembly or examination of EO is carried out) requiring a conducting deck shall have a static monitoring device installed immediately adjacent to their access.

5.65 Shielded zones shall be clearly marked and rooms containing electrostatic sensitive devices shall have signs for ESD protected area. Signboards shall be posted at access points and at cable penetrations into other shielded zones.

Rule 6. Stowage and Handling

6.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following must be considered.

Solutions

6.2 Appropriate EO Stowages and fittings shall be provided to safely stow the required quantities of EO as defined in the Naval Vessel Armament Statement requirements and/or the OSI.

6.3 Layout of stowage, configuration and orientation of EO Stowages shall be optimised for both protection and operability to prevent initiation, sympathetic reaction and reduce risk SFARP.

EO Stowage and Non-Electrical Fittings

6.4 The requirements relating to material selection are detailed in Division 2 Chapter 1 *General Requirements* Rule 5 *Material Selection*. Supplementary requirements for EO Stowages on-board Naval Vessels are detailed in this Section.

6.5 Stowage shelves, racks and associated fittings shall maintain structural integrity in the event of a "credible fire". They shall generally be made of steel, rather than a lower melting point metal and be capable of withstanding fire or heat generated by a "credible fire" or EO incident.

Note: Fittings should not add to the possible fuel load of a fire within the magazine.

6.6 Details of EO characteristics including dimensions, packaging, and weights shall be taken into account when designing bays, racks, shelving, fittings and battens.

6.7 EO stowage non-electrical fittings including bays, racks, shelving, fittings and battens design shall ensure safe and secure stowage of the required quantities of EO for the environment and operating conditions as specified in the OSI.

6.8 EO Stowage shelves, racks, and associated fittings shall:

6.8.1 provide ease of access and secure stowage for EO that prevents damage to EO through normal handling,

6.8.2 provide sufficient space for stowage of empty EO containers especially where EO transferred to WPAs,

6.8.3 provide a layout configuration that considers the effects from an initiation event and how they affect adjacent EO, stowages or structures,

6.8.4 be free of projections that may cause an obstruction, damage stores or hazard to personnel during EO handling, storage or maintenance operations,

6.8.5 not interfere with the efficient operation of pressure venting arrangements, lighting, ventilation equipment or fire detection and suppression equipment and water discharge,

6.8.6 be fitted with protective arrangements where they are prone to damage,

6.8.7 not cause a tier or part of a tier to topple when restraint has been removed to gain access to other stores, and

6.8.8 minimise noise and rattles that may contribute to the acoustic noise signature of the Naval Vessel when subjected to forces expected from the defined environmental conditions detailed in the OSI.

Note: See Rule 5 *Electrical Fittings* for requirements relating to Earthing and EEH Control of stowage and non-electrical fittings.

6.9 Equipment or fittings unrelated to the stowage and handling of EO should not be installed within EO Stowages.

6.10 Where different types of EO are to be embarked then separate bays, shelves and bins within stowages shall be considered to allow ease of access to different EO types.

6.11 Permitted contents of EO Stowages including special-to-type designated stowage positions shall be identified and the safe stowage capacity suitably marked and clearly displayed inside the EO Stowage.

6.12 A tally shall be placed over each bay or bin containing projectiles to allow for the recording of the number and nature of the projectiles contained within and EO Stowage.

6.13 All stowage and handling equipment including portable fittings and battens, EO packaging, arisings, and protective covers shall be restrained to prevent "jumping out" under shock conditions when in use and in stowage position when not required for use.

6.14 EO Stowages shall be designed to:

6.14.1 provide 75 mm spacing between the stowages and the EO Stowage boundary for effective boundary cooling;

6.14.2 ensure EO Stowages comply with UN Hazard Classification Code;

6.14.3 ensure sufficient aisle space is provided so it is at least 50 mm greater than the length of the ammunition to allow manual access if required to breakout the ammunition;

6.14.4 provide easy access for the safe handling of the EO with the doors open;

6.14.5 ensure EO is restrained in three axes for all automated stowage and handling systems; and

6.14.6 stow EO off the EO Stowage bottom on a raised platform or shelving to facilitate cooling, reduce the potential for corrosion and assist Naval Vessel husbandry.

Note: The distance between the tops of EO Stowages and sprinkler heads shall not be less than 300 mm.

Note: Where shelves are an integral part of the EO Stowage they shall be constructed with an upstand and provided with drainage holes.

6.15 Where EO Stowage racks are fitted, identification letters shall be painted in BLACK over each bay in Magazines and the tiers are to be numbered commencing with the lowest tier to enable the different EO rack and location within the rack to be uniquely identified.

6.16 Each EO Stowage shall be fitted with a label plate or cardholder showing the nature of the contents and the maximum number of boxes/munitions.

6.17 EO Stowage racks shall be marked with a BLACK line to denote the maximum permissible height of EO. The line shall take into account the spray head clearances.

6.18 Where flow forge arrangements are fitted, provision shall be made for removable to provide access above and under the grid for the purpose of maintenance and cleaning.

6.19 EO Stowage supports shall not be affixed to the hull plating.

6.20 Secure stowages for non-explosive Flight In Air Materials (FIAM) shall be located outside the Magazine. FIAM stowed in Magazines shall have non-flammable lockers with adjustable stowages provided.

Racks, Shelving, and Fittings

6.21 Shelves or bins shall have a drainage hole to prevent accumulation of liquids and allow self-draining of water from fire suppression systems to drain evenly to lower levels to ensure boxes on lower shelves are also wetted thoroughly to cool EO.

6.22 EO Stowages cupboards and drawers shall be constructed from steel and fitted with locks and label plates or cardholders.

6.23 A means of retention shall be provided to hold EO Stowage Battens securely in position with the upper end of a vertical batten or stanchion allowed to move 50mm vertically in either the up or down direction without becoming disengaged.

6.24 Horizontal division battens shall be fitted so that the removal of a vertical batten does not allow EO to fall.

6.25 Designated EO Stowages shall be provided for portable battens if there is a requirement to remove them from the normal stowage position.

6.26 Battens that are not interchangeable shall be labelled to identify the batten and its corresponding stowage position.

6.27 Precautions shall be taken to ensure that portable battens do not rattle when placed in their stowage position.

6.28 Portable battens used to restrain the EO in stowage shall:

6.29 be provided with a tally that indicates the Safe Working Load (SWL); and

6.30 not be stressed greater than 80% of their yield strength or deflect greater than 1/240 times its length in order to prevent the ammunition from becoming disengaged from its stowage systems during storm conditions.

EO Stowage (Compatibility Group H)

6.31 EO containing White Phosphorus (WP) (Compatibility Group H) in EO Stowage shall be stored separately (segregated) from other EO and not exposed to the sun.

6.32 EO containing WP (Group H) shall be stowed in an EO Stowage where either the:

6.32.1 whole EO Stowage can be flooded to above the level of the stowages and its packaging and container until removed / disposed of; or

6.32.2 EO Stowage includes a tank of water suitable for the immersion of the whole of the largest Group H EO package to enable a 'leaker' to be immersed quickly if found.

Note: The tank shall be removable and fitted with a drainage fitting.

6.33 The safety precautions and treatment for WP shall be posted near authorized stowage locations when stowing WP loaded munitions as mission load, cargo or landing force ammunition allowance.

EO Transfer Routes

6.34 The System Safety Assessment Threat Hazard Analysis shall consider the following when designing Naval Vessel EO Transfer routes:

6.34.1 The safety of EO embarkation within the Naval Vessel through evaluation of EO handling embarkation, EO Transfer Routes, stowage and supply arrangements.

6.34.2 The likely usage of the area for the EO and evaluation of the time at risk.

6.34.3 The potential:

6.34.3.1 hazards in the vicinity of EO in the DDA,

6.34.3.2 consequences of unauthorised or incorrect EO handling, and

6.34.3.3 loss of mission capability in the event of action damage to EO handling arrangements.

General Requirements

6.35 EO Transfer Routes shall be designed to enable the unhindered efficient movement of EO from the embarkation point to its permanent stowage, and, where required, to its ready use stowage or point of use, with a minimum workforce. This includes providing adequate clearance within passageways, lifts, doorways and in deck head height.

6.36 Communications facilities shall be provided between manned stations or sections on EO Transfer/assault routes (e.g. all stations on lifts, weapon parks to EO Stowages and EO Stowages to assault assembly point or missile/gun control compartment to embarkation hatch/hoists position.

Note: See Chapter 08 *Safety Communications* Rule 6 *Internal Communications* and Rule 8 *Portable Communications* for requirements relating to communications facilities on EO Transfer Routes.

6.37 EO Transfer Routes shall:

6.37.1 be free from obstruction;

6.37.2 afford protection to the dangerous goods;

6.37.3 maintain the environmental conditions in accordance with the safety requirements of the EO stowed and handled on-board Naval Vessels; and

6.37.4 prevent access by unauthorised personnel during transfer activities.

Note: Loading, unloading, movement and stowage arrangements along the EO Transfer Routes shall be tested, verified and approved by a Competent Authority prior to finalisation of the EO Transfer Routes.

6.38 EO Transfer Routes shall be well clear of shore cables, and under no circumstances are the routes to pass within 6 m of unguarded cables.

Note: This restriction does not apply when the EO Transfer Routes and cables are separated by a bulkhead or deck.

6.39 EO Transfer Route shall be designed to:

6.39.1 Reduce the number of obstacles, projections, and hazards dangerous to EO to a minimum;

6.39.2 Expose the minimum quantities of EO to personnel, consistent with the operation being carried out;

6.39.3 Reduce the need to handle EO to a minimum and ensure the transfer is carried out safely and expediently;

6.39.4 Consider the effects of a Naval Vessel's movement on EO handling at sea; and

6.39.5 Ensure that any EO susceptible to RF or electrostatic discharge shall be stowed and handled in an environment that is not conducive to charge build-up.

6.40 EO Transfer Routes shall:

6.40.1 facilitate all likely traffic, including the use of any Lifting and Handling Equipment, such as trolleys/skids, or forklifts which may be required by personnel using the route; and

6.40.2 ensure that adequate clearance is provided to allow standard commercial pallets and NATO pallets without the need to be broken down.

6.41 Doors and passageways within the EO Transfer Route shall be of dimensions to allow for the movement of EO LHE, including handling trolleys/skids.

6.42 Where sloping ladders are an integral part of the EO Transfer Route they shall be capable of being either struck down or incorporating chutes.

6.43 Cruets shall be provided to avoid damage to cases, packages, Ammunition Container Assembly (ACAs), etc. when lowered or raised through hatches.

6.44 Facility for temporary rigging between decks, guide wires and spreader bars shall be fitted.

6.45 Primary and Secondary EO Transfer Routes shall be provided to enable EO to be moved efficiently from the embarkation point to its EO Stowage or point if use.

6.46 Both Primary and Secondary EO Transfer Routes shall be as direct as possible, while minimising risk.

6.47 EO Transfer Routes shall be sheltered as far as practicable, from the climatic, physical and electromagnetic environment.

Primary EO Transfer Routes

6.48 Equipment dedicated to other operational requirements (e.g. aircraft lifts), shall not be used on the Primary EO Transfer Route.

6.49 The Primary EO Transfer Route shall not interfere with other important Naval Vessel operations (e.g. aircraft movement).

Note: The primary EO Transfer route may include a dedicated hoist, lift or make use of hatches and doors provided for normal ship access.

Secondary EO Transfer Routes

Note: The Secondary EO Transfer Route shall provide an alternative route (not utilising the same mechanical handling equipment as the Primary EO Transfer Route) in the event of equipment failure or damage to the Naval Vessel.

6.50 So far as practicable, the Secondary EO Transfer Route shall not be common with the Primary EO Transfer Route.

6.51 Apart from vertical launch missiles, GW in canisters and large decoys (above 100mm in diameter) replenished only in harbour, a Secondary EO Transfer Route shall be provided from the embarkation point to the dedicated permanent stowage or launcher.

6.52 The following principles shall apply to Secondary EO Transfer Routes:

6.52.1 Equipment dedicated to other purposes (e.g. aircraft or stores lifts) may be used; and

6.52.2 Maximum possible use of mechanical handling aids shall be made.

Assault Routes

6.53 Assault Routes and related procedures shall be provided for routes of transit of Embarked Forces (EF) EO and movement by armed parties through the Naval Vessel to the point of issue, disembarkation and embarkation.

Millers Flap

6.54 Millers' flaps (See Figure 10.3: Example Miller Flap) shall be provided at the following positions on EO Transfer Routes:

6.54.1 at hatches below which the vertical drop height is in excess of 6 m; and

6.54.2 to provide a platform for use when transferring EO into and out of a cruet employing guide wires.

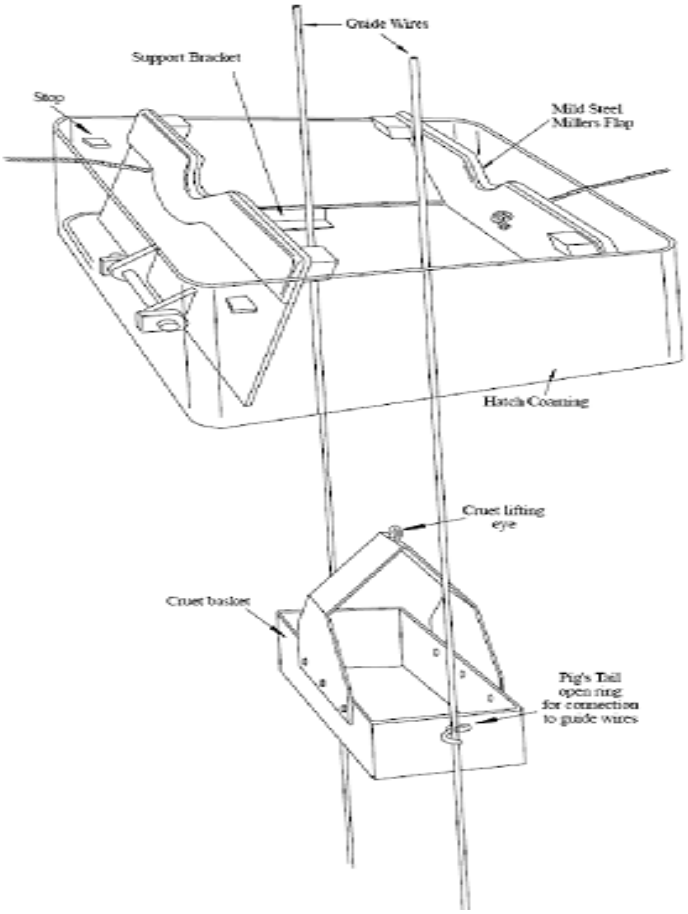

Figure 10.3: Example Millers Flap

6.55 Whilst being strong enough to resist the impact of the heaviest load that may be moved up or down through the hatch (including the cruet), millers' flaps shall be constructed to be as light as possible.

6.56 The design shall allow safe and effective installation and operation by personnel during EO movements.

Transfer Route Documentation

6.57 Embarkation, striking down and course of EO Transfer Routes (including Assault Routes) drawings for all EO listed in the Armament Statement and/or OSI shall be provided for each Naval Vessel.

6.58 EO Transfer Route drawings shall detail the routes and all handling equipment necessary for the movement of EO throughout the Naval Vessel.

Note: This includes Assault Routes and procedures for Embarked Forces (EF) EO.

6.59 The top-level drawing shall be a master general arrangement containing a schematic of all EO Transfer Routes.

6.60 Individual Primary and Secondary Route drawings, indicating the route to EO Stowages or a group of EO Stowages (on the same deck and within the same watertight subdivision) shall be identified on schematic drawings referenced from the master drawing including:

6.60.1 Locations of ammunition hoists, conveyors, elevators, strike down hatches, and other pertinent items.

6.60.2 Locations of motors, control panels, switches, and control stations for ammunition hoists, powered conveyors, and elevators.

6.60.3 The operating speeds of all power operating handling equipment.

6.61 Separate tabulated sheets, broken down into sub routes, shall be provided to identify the following:

6.61.1 Sub-routes (e.g. along deck or through a line of hatches).

6.61.2 Handling method employed (e.g. 2-man lift or hoist).

6.61.3 Equipment to be cleared before use (e.g. ladders in way of hatches).

6.61.4 Equipment items to be used or rigged (e.g. rails, hoists or cruet), annotated with route drawing and rigging warrant references.

6.61.5 Details of any special precautions.

6.62 Where special to type equipment is required, details should be shown on separate sheets of the individual route drawing.

6.63 Common equipment and EO LHE shall be specified on sub-sheets of the master route schematic indicated above.

6.64 EO Transfer LHE system assembly drawings shall be provided.

Weapon Preparation Area (WPA)

6.65 WPAs are DDAs specified for weapon preparation and transit positions where EO may be held for a short period and includes RAS dump points and temporary holding areas.

6.66 Where mechanical handling is specified, lashing points for restraining shall be provided in the WPAs.

Note: WPAs may be provided and large Naval Vessels where re-palletisation is required for examination of damaged packages or where significant numbers of packages/ammunition containers are refilled from part used or damaged boxes.

Weapon Systems Areas

6.67 The EO safety requirements for the design, construction and fitting of naval weapon system areas including mounts are detailed in Chapter 13 *Combat Systems Engineering Systems* Rule 7 *Armament System Safety*.

RAS(L) and RAS(A) Areas

6.68 RAS - Liquid (RAS-L) and RAS - Ammunition (RAS-A) positions shall be separated as far as practicable.

Note: Best practise should achieve at least 18 m separation between RAS-L and RAS-A positions.

6.69 EO Transfer Routes shall be separated by at least 18 m from fuelling/pumping points unless Naval Vessel structure or other agreed mitigation is in place to prevent the escalation on of any accident/incident between routes.

EO Lifting and Handling Equipment (LHE)

LHE General Requirements

6.70 EO Lifting and Handling Equipment (LHE) shall meet the requirements of DEOP 101 *Department of Defence Explosives Regulations* - Regulation 4.6 Procedure 2 - *Handling Equipment and Mechanical Aids including Vehicles for use with Explosive Ordnance and associated equipment*. Supplementary requirements for LHE used in the stowage and handling and use of EO in Naval Vessels are detailed in this Section.

Note: The System Safety Analysis shall include consideration of EO LHE with a Naval Vessel's layout, general maritime environment requirements and the EO being lifted or handled.

6.71 EO LHE shall be provided for safe transfer and handling of EO in the most efficient manner from the receiving stations to the EO Stowage, within the EO Stowage, and from the EO Stowage to the DDA.

Note: Instructions and procedures form an essential part of the “safe system of work” to meet the requirements of the Safety Management System and the *WHS Act.*

6.72 EO LHE shall be designed to fail safe, and be capable of:

6.72.1 satisfactory operation with rated load, for the specified duty cycle, under environmental and equipment specified operating condition;

6.72.2 holding the rated load and maintaining its static position under equipment specified holding conditions;

6.72.3 ensuring the load is always under positive control within its design limits and operational environment and will not slide or topple;

6.72.4 operating in sea states and manoeuvers mandated by OSI without the loss of oil or hydraulic fluid; and

6.72.5 raising or lowering the load by a secondary means in the event of a power failure.

Note: Naval Vessel motion prediction programs are acceptable to derive both the lateral and vertical accelerations at which the handling equipment has to operate and survive for design purposes.

6.73 EO LHE shall be designed to prevent damage to the load if the equipment strikes a stop at maximum operating speed.

6.74 Secondary Transfer Routes LHE shall have the capability for strike-down and strike-up of EO should failure of the primary handling system preclude its use.

Note: The term fail safe shall not be applied to static components, to members and static parts of mechanisms, or to hydraulic cylinders and air cylinders.

6.75 Naval Vessel design shall ensure that adequate clearance is provided within passageways, lifts, doorways and in deckhead height so that standard sizes of commercially available LHE can operate within the Naval Vessel environment, thereby minimising through life costs of procuring and maintaining the LHE.

6.76 Prior to new LHE being introduced or existing equipment modified, the following shall be provided to the Competent Organisation or NVO:

6.76.1 Evidence that the inspection and testing requirements have been successfully undertaken and recorded.

6.76.2 Operating instructions/procedures or manuals.

6.76.3 Maintenance manuals including detail & assembly drawings of the equipment and components, schedules, routines.

6.76.4 Special tools.

6.76.5 Guarantees and warranties if called up in the procurement specifications.

6.76.6 Information as to the availability of spares.

6.77 All new or modified EO LHE shall be subject to inspection, tests and approved by a Competent Authority.

6.78 EO LHE shall be tested and certified for use with the EO taking account of sea states in which the handling system is expected to operate.

6.79 LHE operating within the confines of one deck level shall be provided with lateral restraining features, such as telescopic guides, with the following exceptions:

6.79.1 where handling operations will not be performed in excess of a 10-degrees roll or list on Naval Vessels and 3-degrees roll or pitch on tenders; or

6.79.2 where specified due to significant loss of stowage density; or

6.79.3 where equipment portability is an overriding consideration; or

6.79.4 where the system has been designed for personnel to prevent swaying of the weapon load.

6.80 LHE shall be provided with a secure rattle free stowage position with suitable restraint arrangements to restraint the LHE for the operating conditions as specified in the OSI.

6.81 Safety guards shall be fitted on any moving parts associated with EO LHE that present a possible hazard to the EO or personnel.

Note: LHE for EO shall comply with the electrical requirements in Rule 5 *Electrical Fittings*

6.82 LHE shall be fitted with restraints for securing EO when subjected to shock and vibration conditions as specified in Rule 12 *Generic Maritime Environment* (GME).

6.83 LHE operating noise levels shall be within the noise levels specified in Chapter 12 *Habitability* Rule 3 *Noise and Vibration*.

6.84 Ramps with anti-slip surfaces shall be provided for Magazine entrances and EO Transfer Route doors where wheeled access is required.

6.85 The gradient of ramps shall not exceed 1:6 or such lesser gradient required to prevent 'bottoming' of EO trolleys or skids as they cross its peak.

6.86 LHE integration design shall ensure:

6.86.1 there is adequate clearance within passageways, lifts, doorways, hatches and in deckhead height so that the equipment can safely operate within the Naval Vessel environment; and

6.86.2 risk is minimised to personnel injury and damage to EO, equipment, and Naval Vessel under the operating and environmental conditions for the equipment.

6.87 Ramps shall be secured and rattle free when not in use.

6.88 All LHE approved for use with EO shall have a tally plate or tag reading “AUTHORISED FOR HANDLING EXPLOSIVE ORDNANCE” affixed next to that Equipment's SWL/Test tally plate.

6.89 The Equipment's SWL/Test tally plate shall include description of the LHE Equipment, EO Rated Capacity, SWL Capacity, EO/HCC Allowed, EO/HCC Prohibited, Current Test Date and Next Test Date. An example is provided in Figure 10.4: Example Appliance Test Plate.

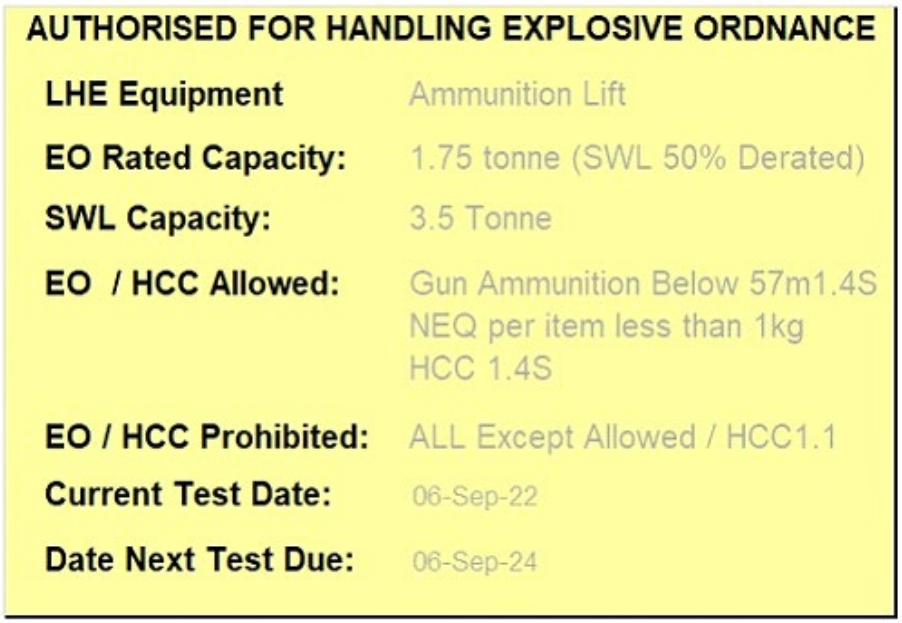

Figure 10.4: Example Appliance Test Plate

6.90 EO Lifting and Handling Equipment shall have an EO rated capacity no greater than 50% of the Safe Working Load (SWL) limit unless that equipment is specifically designed for use with EO or a safety argument has been accepted by the Competent Authority.

Note: Evidence from the manufacturer/supplier shall be provided stating the LEH is specifically designed for EO, and has a Factor of Safety of least 8.

6.91 Under the LHE operating conditions, the combined stresses, acting both individually and concurrently, in the load bearing structural and mechanical components of the equipment shall not exceed:

6.91.1 Thirty-five percent (35%) of the yield strength of the material used, calculated on the basis of operating design load.

6.91.2 Seventy percent (70%) of the minimum yield strength of the material used in the load bearing mechanical and structural components.

6.92 LHE, especially portable equipment, shall be the minimum weight consistent with the service required and be constructed to facilitate easy installation and removal.

6.93 Where relief valves associated with EO LHE are installed in EO Stowages, such valves shall:

6.93.1 not form an oil mist when operating, and

6.93.2 have an associated audible or visual warning of operation.

Mobile LHE

6.94 Mobile LHE shall consider the EO Transfer Route and the Naval Vessel's environment to ensure adequate clearance is provided within passageways, lifts, doorways, and between deck and deckhead height so that procured equipment can operate within the Naval Vessel's environment. This includes:

6.94.1 allowance for deckhead structure and services, and

6.94.2 provision of facilities to enable clearance of ramps.

Note: Mobile LHE includes pallet trucks, forklift trucks, hand trucks, trolley hoists, and roller conveyors.

6.95 Mobile LHE used to handle EO shall be equipped with electrically conductive grounding straps, or electrically conductive tires and wheels, to bleed off static charges.

Powered LHE

6.96 Powered LHE shall be designed so that under extreme loading conditions (for example, impact, load test, drive motor stall torque, or limits of load limiting devices) the combined stresses shall not exceed 70% of the minimum yield strength of the material used in the load bearing mechanical and structural components.

Note: In general, diesel powered LHE vehicles can climb up to a 30-degrees incline and electrically powered LHE vehicles can climb a 10-degrees) incline.

6.97 Powered LHE (except for drive trains powered by hydraulic cylinders or air cylinders) shall be provided with a mechanical brake in the drive train that is automatically engaged when the drive train power actuating control is in the "OFF" position.

6.98 Powered LHE powered by hydraulic and air cylinders shall use holding valves.

6.99 Positive traversing and braking features (such as rack and pinion, sprocket and chain, or hydraulic cylinders) shall be provided for powered traversing handling equipment that does not rely on deck friction for driving or braking.

6.100 Powered LHE shall be provided with a non-overhauling feature to prevent the load from overcoming the operating power source when the mechanical brake is disengaged.

6.101 Powered LHE shall be provided with means for manual operation, at reduced speed, in the event of power or control failure.

Note: This excludes forklift trucks, wire rope elevators and specially exempted equipment.

6.102 Traversing hoists and bridge cranes in the unloaded condition shall be secured for the maximum dynamic forces produced by motion of the Naval Vessel as specified in the OSI.

6.103 Powered LHE shall have an alternative means of raising or lowering the load if there is a power or control failure and the load should remain secure and under control in the event of a power failure.

6.104 Powered LHE shall be "power up" and "power down" and the load shall not be disconnected from the drive device at any time during normal operations.

Track Guided LHE

6.105 All track guided LHE in the unloaded condition shall be secured for the maximum dynamic forces produced by motion of a Naval Vessel.

6.106 LHE shall provide self-aligning features such as floating, funnelling, or camming action. The degree of self-alignment required shall be determined by the system design.

6.107 Alignment features shall allow for maximum cumulative tolerances from the required load centre position and axis. Where more than one type of motion applies, and more than one corrective feature is necessary, the tolerances are additive.

6.108 Overhead monorail or bi-rail track systems and trolley hoists shall be provided (where specified) for transporting EO or weapons that cannot be manhandled.

6.109 The tracks shall consist of I-beam sections for a monorail system, and shall include portable sections, hinged sections, switches, and turntables, as required.

6.110 Where several sections of portable monorails interface and are clamped to overhead supports, their interfaces shall be provided with keying devices to prevent track separation. These keying devices shall not interfere with horizontal hoist movement.

6.111 The radius of curvature of the monorails shall not be less than specified in the reference specifications for the trolley hoists that the tracks will support.

6.112 Monorail tracks shall be installed as high as possible in the overhead.

Safety Stops

6.113 LHE shall be designed to include positive mechanical stops at the extreme limits of the LHE range of travel and cushioned to prevent damage to the EO if impacted at the maximum operating speed.

6.114 On manually controlled powered systems, the bumpers shall prevent damage, based on the maximum speed obtained by one piece of equipment.

6.115 On automatic or semi-automatic powered systems, the bumpers shall prevent damage based on the maximum speed obtained by both pieces of equipment added together.

6.116 Where positive stops are not practical or the EO could be damaged if the handling device contacts the positive stop, then a limit device shall be provided to slow/stop movement of the drive before the maximum travel limit is reached.

6.117 Where positive stops are not practical, and a limit device malfunction could cause a catastrophic failure to the handling device or damage to the EO, a secondary limit device shall be installed.

Note: Where a limit device malfunction would cause a catastrophic failure to the handling device or damage to the EO then a secondary limit device shall be provided.

6.118 LHE on tracks, such as bridge cranes, monorail hoists, and bi-rail track systems, shall have a positive mechanical stop at each extreme limit of the equipment's range of travel.

6.119 Automatic safety stops shall be provided at other locations, where required, to prevent the equipment from accidentally moving off an open section of track.

6.120 Where two pieces LHE operate on the same track or rail, one or both shall be provided with a bumper type of device to prevent damage in the event of a collision.

6.121 Manual LHE that traverses shall have a brake that automatically stops and holds the equipment in position when a brake handle or control is released.

Note: Track clamps may be used as a deadman brake.

EO Lifts and Elevators

6.122 The performance requirements prescribed in Part 1 for Lift and Elevator for handling EO shall be met through the application of Chapter 05 *Seamanship Systems* Rule 15 *Lifting and Hoisting Appliances*. Supplementary requirements for Lifts and Elevators using in handing and stowage of EO on-board Naval Vessels are detailed in this Section.

6.123 Access into Naval Vessel Magazines through auxiliary weapon lifts, hoist trunks, or doors shall be prevented by means of an approved securing device secured from the inside the magazine (e.g. by pinning the door in the closed position).

6.124 Interlocks shall be provided so that only the door/shutter at the level at which the lift/hoist is stopped can be opened.

6.125 Magazine lift/hoist doors at each level shall be interlocked.

6.126 Where there is more than one access to the lift/hoist from separate compartments at the same level of which at least one is a magazine, interlocks shall be provided to ensure only one of the doors/shutters at that level can be opened at any point in time.

6.127 Where an EO Stowage is serviced by two lift systems, the requirement for interlocks to prevent access doors/shutters on the same level being opened at the same time shall be assessed and the risks eliminated or minimised SFARP.

Lift and Elevator Markings

6.128 Safety margins shall be painted on ordnance elevator platforms to ensure that loads do not overhang the platform prior to closing doors or hatches as detailed in the following Figure 10.5: Elevator Safety Margin.

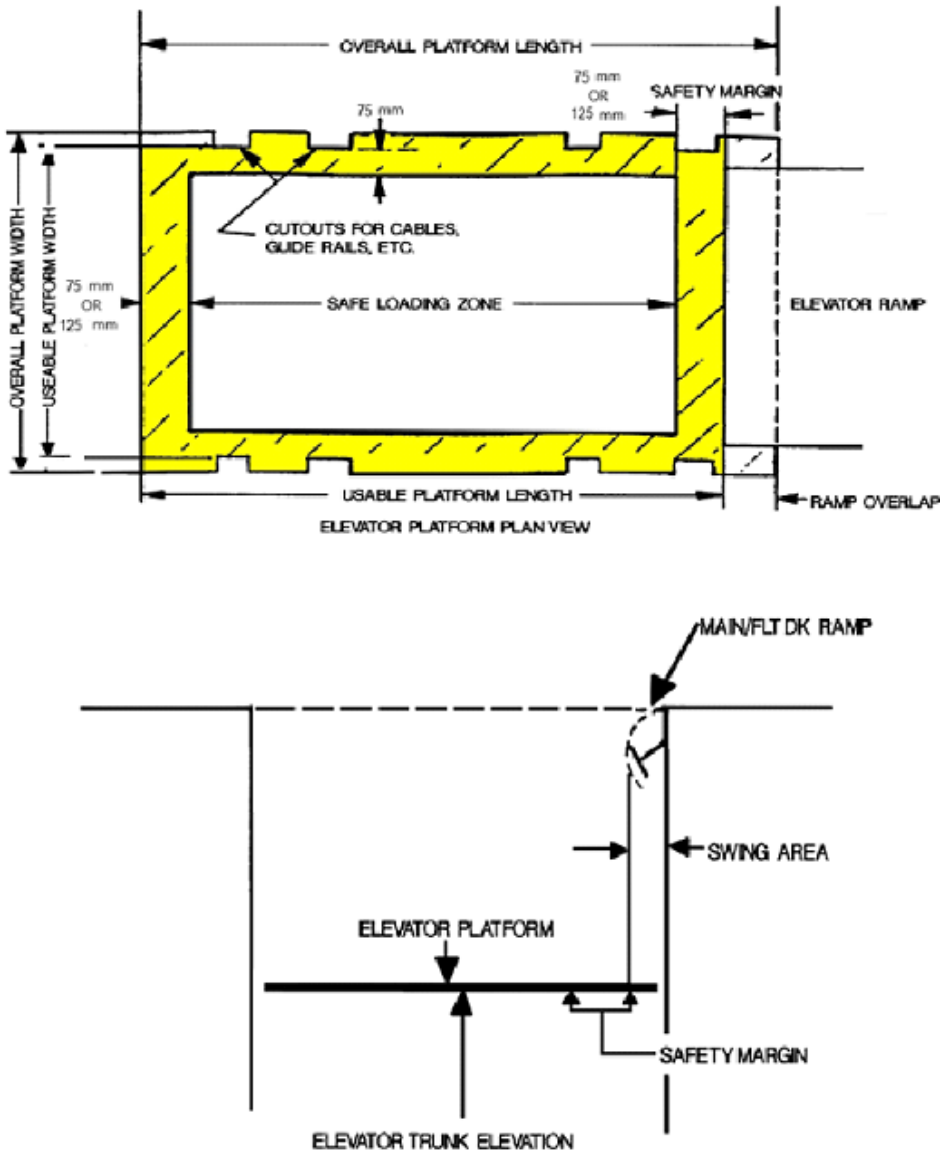

Figure 10.5: Elevator Safety Margin

6.129 The safety margin shall be painted solid yellow and extend from the platform edges 75 mm.

6.130 Where a ramp extends onto the platform, the margin shall extend a minimum of 75 mm beyond the maximum inboard extension of the ramp except as detailed below.

6.131 Where wheeled handling equipment are used for the transfer of ammunition and explosives, the elevator platform end edges and ramps shall have a painted safety margin of 125 mm with a 75 mm margin on the side edges.

6.132 EO lift and elevator flush deck hatches shall have a red and yellow striped safety margin painted around the hatch opening as shown in Figure 10.6: EO Flush Deck Hatch Marking.

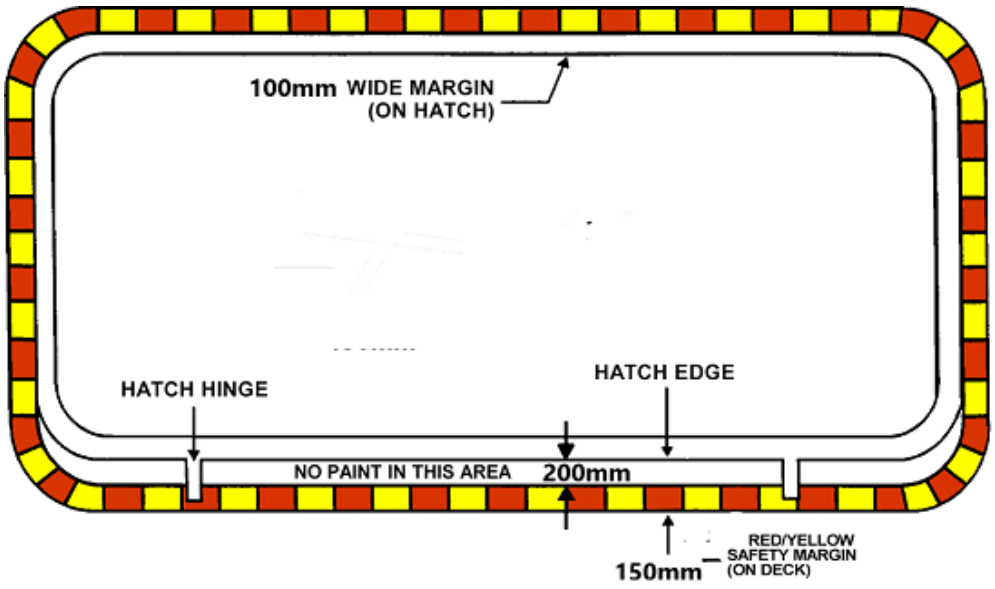

Figure 10.6: EO Flush Deck Hatch Marking

LHE Fittings & Accessories

6.133 Sheaves blocks for lifting purposes shall comply with AS 2089 - *Sheave Blocks for lifting purposes* or equivalent as approved by Competent Authority.

6.134 Shank hooks and large eye hooks shall comply with AS 3777 - *Shank hooks and large eye hooks*.

6.135 Cordage used for moving EO should be manufactured from natural fibres (NFC) or fabricated fibres (MMFC) in accordance with AS 4142.1 *Fibre Ropes - Care and safe usage*.

6.136 The lower purchase block or whip end of all appliances used for handling EO shall be fitted with a safety device (e.g. closed hook).

6.137 Hoists utilising wire rope shall have at least 2-1/2-full turns of wire rope remaining on the drum and standing end attached to the drum when the hoist is extended to its lowest position.

6.138 Hoists shall be provided with all required adapters necessary to perform EO handling operations.

6.139 Steel Wire Rope shall comply with AS 3569 *Steel wire ropes*.

6.140 Steel Wire Rope installations shall be designed to ensure that differences in elongations between loaded and unloaded conditions do not cause deleterious effects on limit switch operations and lift/elevator platform alignment.

6.141 The size of wire rope and chain shall be determined by the method described in AS 3569 *Steel wire ropes – Product specification*, based on the maximum total stress acting on the rope.

6.142 The safety factor of wire ropes and chains; and fittings and connecting parts used in load chain (link and roller) and wire rope applications; shall be a minimum of five (5), based on the ratio of the certified minimum breaking strength to the operating design load for wire rope, chain, or related fittings.

6.143 The safety factor of fittings and connecting parts used in load chain (link and roller) and wire rope applications shall be a minimum of five (5), based on the ratio of the yield strength to the operating design load.

6.144 In handling equipment-utilising load bearing wire rope or load chain, stresses shall not exceed 20% (percent) of the breaking strength of the load bearing wire rope, or 20% (percent) of the breaking load of the load chain.

6.145 Load bearing wire rope sections that require padded coatings or covers for weapon protection shall have the coatings or covers transparent or removable to permit visual inspection of the section.

6.146 Securing points for laden EO handling trolleys/skids at designated Weapon Parks (DDAs) or WPAs shall be provided, and shall have:

6.146.1 their load rating clearly identified, and

6.146.2 the securing points shall be routinely inspected for wear, corrosion or degradation that might otherwise affect their load rating.

LHE Interlocks, Alarms and Controls

6.147 EO LHE shall be provided with mechanical, electrical, hydraulic, and pneumatic controls and interlocks, to ensure safe operation of the equipment, to prevent damage to the equipment and the weapon, and to prevent injury to personnel in any handling sequence or series of motions.

6.148 Interlocks and controls shall be provided for automatic or semi-automatic powered equipment and shall be arranged so that operation of any control, or combination of controls, in other than normal sequence, shall not operate the equipment or cause injury to personnel or damage to any component.

6.149 Interlocks shall be provided to prevent power operation when manual drives are engaged.

6.150 Controls shall provide for smooth acceleration and deceleration of the weapon and LHE between extreme travel limits.

6.151 Controls shall permit alignment of LHE and positioning of EO and weapons to within the specified tolerance.

6.152 Controls shall be equipped with manual overrides to permit completion of a handling operation in the event of failure of the control system.

6.153 Vertical handling equipment doors in trunks shall be fitted with interlocks to prevent movement while the doors are open and to prevent the opening of doors on floors other than the one at which the lift has stopped.

6.154 All elevator doors shall be provided with an electrical interlock to prevent elevator platform movement unless every door is closed and a mechanical interlock to prevent opening a door unless the platform is at that particular level.

6.155 Elevator doors and hatches that are powered shall be under positive control at all times and shall have deadman type controls.

6.156 Open trunk elevators shall have an alarm [minimum 90dB(A)] installed that sounds whenever the elevator platform is in motion.

6.157 Portable or automatic rail guards shall be provided for personnel and forklift truck protection around elevator trunks for the following conditions:

6.157.1 Personnel guard rails shall be installed around flush hatches and around elevator doors whose operation is not interlocked with the elevator movements.

6.157.2 Forklift truck guardrails shall be installed around flush or low-profile hatches and elevator doors whose operation is not interlocked with the elevator movements.

6.158 Hatches over vertical handling equipment shall be interlocked to prevent equipment operation that would cause door, equipment, elevator platform, weapon or EO collision.

6.159 Warning lights shall be provided to indicate unsafe equipment and system operation.

6.160 Power-operated weapon loading doors or hatches (except those operated under the operator's direct control and full visual observation of full range of door or hatch operating limits) shall be provided with an audible warning signal to indicate that the doors or hatches are in motion.

6.161 The alarm shall be initiated at least 3 seconds before movement of the door or hatch.

6.162 Automatic operating hatches internal to elevator trunks shall not be provided with an audible warning signal.

Note: Audible sound pressure for alarms shall be at least 15dB(A) above ambient noise levels in accordance ISO 7731 *Ergonomics danger signals for public and work areas - Auditory danger signals*.

6.163 Alarm circuits and components shall be integrated with the associated handling equipment.

6.164 The handling system shall provide mechanical methods for visually determining proper position alignment for critical drive train system stop positions.

6.165 Powered traversing handling equipment that does not operate under the direct control or visibility of an operator (such as automatic or semi-automatic equipment) shall have an automatic power cut-off device at each extreme limit of the equipment's horizontal range of travel.

6.166 Powered vertical handling equipment shall have an automatic cut-off device at the upper extreme limit of the equipment's vertical range of travel.

6.167 Powered handling equipment that could drive EO or weapon against a fixed object, such as structure, a chock or container, shall have an automatic cut-off device to stop travel before the weapon could be damaged.

Note: This excludes hand, pallet and fork trucks, dollies and skids.

LHE Documentation

Note: Instructions and procedures form an essential part of the 'safe system of work' to meet the requirements of the Safety Management System and WHS Act.

6.168 Maintenance and operating manuals and general arrangement drawings for EO LHE shall be provided and include:

6.168.1 method for transporting EO between replenishment stations, Magazines, check out rooms, launchers, torpedo tubes, and aircraft as applicable;

6.168.2 all related interfacing slings, adapters and dollies; and

6.168.3 the operating speeds of all powered LHE.

6.169 EO LHE shall be specified in the weapons/drill handbooks, rigging warrants, lifting equipment registers and EO Stowage and Handling (EOS&H) Certificate.

Rule 7. Security

7.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

7.2 The Naval Vessel's security arrangements shall be agreed by a Competent Organisation and demonstrated through design review and physical testing.

Note: See Division 2 Chapter 01 *General Requirements* Rule 17 *Physical Security* for requirements relating to general security which are also applicable to EO

7.3 Physical Security for all EO Stowages shall comply with the requirements of the Defence Security Principles Framework (DSPF), Australian Security Intelligence Organisation (ASIO) Technical Notes or equivalent. Supplementary requirements provided below tailored for a Naval Vessel's operational environment.

Physical Security Requirements for EO Stowage on Naval Vessels.

7.4 EO Stowage doors and hatches shall be designed to prevent the possibility of entry through the removal of hinge pins, or locking arrangements or the use of tamper proof hardware.

7.5 EO Stowage access doors shall be structural, steel, outward opening and with minimum of three hinges.

7.6 Hinges of doors/hatches that open outwards shall be welded or otherwise treated (e.g. fitted with locking dogs) to ensure they cannot be disassembled from outside the EO Stowage.

7.7 Pad-eyes, hasp and staples shall be designed to resist high-level physical attack and approved by a Competent Authority.

7.8 Where emergency escape hatches, doors or kick out panels are fitted to EO Stowages, they shall be operable only from within the EO Stowage.

7.9 Embarkation hatches of EO Stowages shall be provided with arrangements on the inside to prevent unauthorized entry (e.g. a sliding bolt arrangement).

7.10 Access to the EO Stowage should be through a single access steel door.

7.11 If a Naval Vessel is fitted with a Door Positioning System (DPS), the Access Door shall be fitted with a door position sensor that alerts the Vessel's DPS when opened.

7.12 All Security Hardware in EO Stowages shall be secured with NVO Security Construction and Equipment Committee (SCEC) approved padlocks and covering devices available from SCEC endorsed Locksmiths.

Note: A list of approved products and locksmiths can be found on Govdex website (www.govdex.gov.au).

7.13 Keys to EO Stowages shall not be slaved to a master key or keyed alike to any other compartment or EO Stowage.

Rule 8. Incident Reporting

8.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

8.2 An incident reporting system shall ensure clear procedures for the identification and reporting of incidents are in place and communicated in such a manner that all personnel directly or indirectly involved with the carriage and use of dangerous goods understand their responsibilities.

8.3 EO incident reporting shall meet the requirements of DEOP 101 *Department of Defence Explosives Regulations* Regulation 1.3 *Explosive Ordnance Incidents*.

8.4 The incident reporting system shall be compatible with, and comply with the *Defence Safety Manual* Section 2 – *Governance and Due Diligence.*

Rule 9. Not Used

Rule 10. Use of Dangerous Goods

10.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

10.2 The use of EO shall meet the requirements of DEOP 101 *Department of Defence Explosives Regulations*. Supplementary requirements for stowage and use of EO in Naval Vessels are detailed in this Section.

10.3 Naval Vessel Arrangements shall control the safety risk associated with use of EO.

10.4 All planned activities involving the use of EO shall be identified with a safe system of work defined for each activity.

10.5 Emergency procedures and any other safety arrangements shall be verified before activation.

10.6 Personnel involved with the activation shall be aware of their safety responsibilities.

10.7 Safety protection measures shall be in place for personnel and material and equipment.

10.8 The interface between the Naval Vessel and off board system shall be managed to provide a safe environment to manage the dangerous good.

10.9 A system shall be in place to identify and categorise all EO carried by embarked persons.

10.10 Stowage plans shall be in place to manage the risk associated with EO carried by embarked persons.

10.11 Additional arrangements may be necessary to assure the safety of EO involved in tests, trials and experiments.

10.12 Approved procedures shall be available for all activities involving removal of EO from their dedicated stowage that clearly identify the action and define a safe system of work.

10.13 Breakdown and make-up of transportation packaging shall:

10.13.1 be undertaken by approved personnel;

10.13.2 follow procedures approved for the Naval Vessel and operation;

10.13.3 occur only when the Naval Vessel Arrangements are functioning correctly;

10.13.4 be scheduled to reduce risk to personnel as far as possible;

10.13.5 be carried out efficiently to minimise time at risk;

10.13.6 expose minimum EO as possible to risk consistent with efficiency and scheduling; and

10.13.7 use an approved standard for packaging.

10.14 When Dangerous Goods have been discharged, all compartments and spaces shall be adequately ventilated to ensure that no explosive atmosphere exists. No source of ignition shall be introduced until the atmosphere is deemed to be benign.

Rule 11. Emergency Procedures

11.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

11.2 EO Emergency Procedures shall meet the requirements of DEOP 101 *Department of Defence Explosives Regulations*. Supplementary requirements for EO Stowage and use of EO in Naval Vessels are detailed in this Section.

11.3 A formal risk assessment methodology shall be used to identify foreseeable emergency situations and shall be compatible with the *Defence Safety Manual* Section 2 *Governance and Due Diligence*.

11.4 Emergency arrangements to control or mitigate the consequences of an emergency situation shall consider:

11.4.1 the emergency organisation;

11.4.2 emergency procedures and plans;

11.4.3 supporting safety information;

11.4.4 training requirement;

11.4.5 the involvement of other emergency services; and

11.4.6 testing.

Rule 12. Generic Maritime Environment (GME) for Armament Systems

12.1 The NVO shall present and justify a Solution for demonstrating compliance to Part 1 of the ANC Rules. In the presentation and justification of a solution, the following shall be considered.

Solutions

12.2 The Generic Maritime Environment (GME) requirements for EO Stowage and use of EO in Naval Vessels are detailed in this Section.

12.3 The GME performance requirements or standards detailed in this document or equivalent alternative standards approved by the Competent Authority shall be applied to acquisition, maintenance and repair contracts that specify the requirements for components of the Armament System (e.g. weapon systems, EOS&H systems and EO) installed or embarked for carriage and/or use in Naval Vessels.

12.4 The GME Environment details of the environmental parameters to be considered when acquiring Naval Vessels fitted with Armament Systems and/or EO to be embarked on-board Naval Vessels. The requirements for the Armament Systems and EO to be acquired for integration into Naval Vessels shall be detailed in the OSI.

12.5 During the acquisition and integration process, the Naval Vessel Armament System shall be mapped against the GME. Any risks or gaps in original equipment manufacturer (OEM) documentation recorded in the form - Maritime Environment Assessment Statement (MEAS) in Part 3 of this Chapter.

Note: The process shall be performed for each EO configuration to be acquired and/or integrated into Naval Vessels.

Natural and Induced Climatic Environment Requirements

12.6 A System Safety Analysis including a Threat Hazard Assessment shall be undertaken to determine applicability for any upper deck weapon where the EO is exposed and for weapon launch canisters and vertical launch systems.

Note: The results of testing against the Natural and Induced Climatic Environments as detailed in the following paragraphs shall be recorded in the form - Maritime Environment Assessment Statement (MEAS) in Part 3 of this Chapter, and as required by the OSI.

Temperature and Humidity Performance Requirement

12.7 Armament Systems and EO shall be safe and meet function and performance requirements in the range of temperature and humidity conditions likely to be experienced in the Naval Vessel stowage and operating environments.

12.8 The Naval Vessel shall provide EO Stowage conditions consistent with the range of temperature and humidity conditions for different shipboard stowage locations, as provided (see Table 10.1) or provide protective measures that minimises exposure.

Table 10.1: Generic Temperature and Humidity Conditions

GENERIC TEMPERATURE AND HUMIDITY CONDITIONS		
EO / Location	Temperature (°C)	Relative Humidity (%)
Upper Deck	-33 to 71	100 to 8
Ready Use (RU) Magazine /Container	-33 to +49	100 to 8
Magazine/WSC	+15 to +32	70 to 30
Hold	+15 to +40	85 to 30
Submarine Torpedo Tube/SSE	-2 to +36	N/A

Note: The temperature and humidity ranges have been taken from the maritime categories M1, M2 and M3, and the land categories with the exception of C3 and C4 which Naval Vessels could not conceivably experience (See Def Stan 00-35 Pt 4 *Natural Environments*). All other land based climatic categories have been considered for the situation of a Naval Vessel in port

Note: The extreme hot land Category (A1) has been considered, as it is feasible that Naval Vessels could experience these conditions in port in places such as the northern Persian Gulf and the Red Sea (See Def Stan 00-35 Pt 4 *Natural Environments*).

Note: The two applicable climatic categories for Naval Vessels are M1 (Marine Hot) and M2 (Marine Intermediate) as defined in Def Stan 00-35 Pt 4 *Natural Environments*.

Note: Figures are derived from extreme operating climatic regions defined in AECTP 230 *Climatic Conditions* and Def Stan 00-35 Pt 4 *Natural Environments* and should include the effects of solar heating.

12.9 Climatic categories temperature and humidity detailed in AECTP 230 *Climatic Conditions* and Def Stan 00-35 Pt 4 *Natural Environments* shall be used when assessing the climatic conditions Naval Vessels may be exposed to when operating globally.

12.10 EO Stowage compartments designed for the long-term storage of EO shall maintain temperature and humidity requirements below and detailed in the Table 10.1: Generic Temperature and Humidity Conditions.

Note: The maximum may be relaxed to +35ºC for EO not containing propellant.

Note: The minimum is +15ºC for compartments manned during platform action stations.

Note: Unmanned compartments may have minimum of +7ºC.

12.11 **Upper Deck Stowage.** EO exposed on the upper deck for significant lengths of time (>30minutes) and exposed to solar heating (e.g. EO a loaded launcher or in a munitions dump) shall remain safe and meet function and performance requirements when exposed to the temperature and humidity requirements in Table 10.1: Generic Temperature and Humidity Conditions.

Note: Figures are derived from extreme operating climatic regions defined in AECTP 230 *Climatic Conditions* and Def Stan 00-35 Pt 4 *Natural Environments* and should include the effects of solar heating.

Note: Amplifying remarks may be found in AECTP 230 *Climatic Conditions*.

Note: Fresh Air Ventilated EO Stowage temperature extremes likely to be experienced are +1ºC to +55ºC, at Upper Deck RH level.

12.12 **Magazine and Small Magazine**. EO stowed in a Magazines and Small Magazines shall remain safe and meet function and performance requirements when exposed to temperature and humidity requirements in Table 10.1: Generic Temperature and Humidity Conditions, and the requirements of Rule 06 *Stowage and Handling*.

12.13 **RU Magazine.** EO stowed in a RU Magazine shall remain safe and meet the function and performance requirements when exposed to temperature and humidity requirements in Table 10.1: Generic Temperature and Humidity Conditions.

Note: The Maximum temperature experienced by EO stowed in RU magazines may be reduced through the use of solar reflective panels.

Note: Underwater Naval Vessel torpedo tube/stores ejector temperature is based on the immersion of the store in water, with stated temperature extremes.

Note: Temperature extremes of -2ºC (Minus 2ºC) to +42ºC (Plus 42ºC) are possible during EO Transfer activities.

12.14 **Test Procedures.** Temperature and Humidity testing shall be undertaken in accordance with DefStan 00-35 Pt 3 *Environmental Test Methods* Ch.3-02 *Test Checklist 2 (CL2*) f*or upper deck tests internal locations - land storage test*.

12.15 The torpedo tube/SSE temperature test shall be conducted as part of the Immersion test (See DefStan 00-35 Pt 3 *Environmental Test Methods* Ch.3-29 *Test CL29)* at a maximum water temperature of +35ºC.

Note: Hold conditions are not normally utilised for tests, as normal land storage environment tests are more severe.

Spray

12.16 EO shall remain safe and meet function and performance requirements following spray loading consistent with the performance parameters listed below.

12.17 The Naval Vessel shall provide an EO Stowage and Handling environment that is consistent with the performance parameters listed below or provide protective measures as necessary that minimises exposure.

12.18 At a minimum, test procedures shall satisfy either:

12.18.1 MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests;

12.18.2 AECTP 300 Climatic Environmental Tests Method 310; or

12.18.3 DefStan 00-35 Pt 3 Environmental Test Method Ch.3-28 Test CL28.

Pre-Wetting and Wash Down

Note: Pre-wetting/wash down systems supplied by water from the high pressure sea water (HPSW) System provide continuous coverage by a moving film of water on exposed surfaces of the weatherdeck (including associated equipment and superstructure surfaces).

12.19 Armament Systems and EO shall be designed to be safe and meet function and performance requirements when subjected to a spray intensity of 0.8 mm/min at a temperature of +24°C.

12.20 **Test Procedures.** Test Procedures shall at a minimum satisfy Def Stan 00-35 Pt 3 *Environmental Test Method* Ch 3-27 *Test CL27* Sec 3 (See Def Stan 08-144 *Material Requirements for the NBC Defence of Surface Ships*).

Flooding and Immersion

12.21 EO in Magazines, cargo holds and floodable Small and RU Magazines safe and shall meet function and performance during accidental or intentional intermittent immersion in water to depths detailed in the OSI.

12.22 The Naval Vessel shall provide an EO Stowage environment that is consistent with the performance parameters listed below or provide protective measures that minimises exposure.

12.23 **Test Procedures**. At a minimum, armament system equipment required to operate during accidental or intentional intermittent immersion in water shall satisfy DefStan 00-35 Pt 3 *Environmental Test Methods* Ch.3-29 Test CL29 Severity Depth 150 mm and/or AECTP 300 *Climatic Environmental Tests Method 307*.

Green Seas Loading

12.24 Armament Systems and EO Stowages installed in areas subject to green sea loading shall be designed to withstand loads specified in Def Stan 00-35 Pt 5 *Mechanical Environment* Ch 2-04 Clause 2.2.1.

Note: If, due to exceptional circumstances, the requirements above cannot be met, the armament system is to be either shielded to deflect green seas, or totally enclosed within covers or screens that, if used to protect missile launchers, can be easily and quickly removed when the launcher is required to operate. This solution shall only be considered following consultation with the relevant Competent Organisation.

Note: Supporting information on sea states and wind speed is contained in Lloyd's *Register Rules and Regulations for the Classification of Naval Ships* Vol 1 Pt 5 Ch 2 Sec 1.

Note: Statistical information on ocean waves can be found in Lloyd's Register *Rules and Regulations for the Classification of Naval Ships* Vol 1 Pt 5 Ch 2 Sec 2.

12.25 **Test Procedures.** As there is no practicable test other than exposure to severe weather in an OPEVAL, assessment shall be carried out by a simulation or structural analysis of the exposed weapon mounting, canister or silo.

12.26 Green Seas Loading of a Naval Vessel shall be tested to maximum severity of 70 kPa for 350 ms, transient 140 kPa for 15 ms.

Ice Accumulation

12.27 Armament systems including EO shall remain safe and meet function and performance requirements in conditions of ice accumulation consistent with the performance parameters listed below or be provided with protection.

. Note: This is required for EO that are necessarily exposed on the upper deck. It does not normally apply to EO stowed in upper deck RU Magazines or EO loaded into weapons.

12.28 The Naval Vessel shall provide an EO Stowage and Handling environment that is consistent with the performance parameters listed below or provide ice accumulation protection measures that minimises exposure.

12.29 **Test Procedures.** Testing shall, as a minimum, satisfy Def Stan 00 35 Pt 3 *Environmental Test Methods* Ch 3-10 Test CL10 - *Ice Accumulation Test* and/or AECTP 300 *Climatic Environmental Tests Method 311 Icing*. The following requirements shall apply:

12.29.1 De-icing facilities, if fitted, should be capable of shedding 25 mm of ice per hour.

12.29.2 Ice Accumulation. Maximum rate experienced shall be taken as 25 mm/hour.

12.29.3 Loading. Maximum shall be taken as up to 120 kg/m^2.

Hail

12.30 Armament system equipment and EO shall be designed to remain safe and meet function and performance requirements when exposed to hail (may occur twice a month) as detailed in the OSI and the performance parameters in Table 10.2 or be provided with protection.

12.31 Naval Vessels shall provide an EO Stowage and Handling environment that minimises exposure to the parameters listed in Table 10.2 or provide protective measures that minimises exposure.

Table 10.2: Hail Severity Requirements

Hailstone Diameter	6 mm to 25 mm
Striking Velocity	14 m/s to 25 m/s
Duration	7 min

12.32 **Test Procedures.** If testing is required, details of a test procedure can be found in Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch 3-19 Test CL19.

Note: This test is normally applied for aircraft in flight but may be utilised for Naval Vessels.

Rain

12.33 Naval Vessels shall provide an EO Stowage and Handling environment that minimises exposure to the rainfall intensity parameters listed below or provide protective measures that minimises exposure.

12.34 Armament system equipment and EO shall be designed to operate without degradation in performance when subjected to either of the rainfall intensities defined in the OSI or Def Stan 00-35 Pt 3 Ch 3-27 *Test CL27 Sec 2*.

12.35 **Test Procedures.** At a minimum, test procedures shall satisfy Def Stan 00-35 Pt 3 Environmental Test Methods Ch 3-27 *Test CL27* Sec 3.

Lightning

Note: A lightning strike can produce an electrical current of 200 kA with a rise time of one microsecond. Whilst operating in the tropics the probability of lightning striking a Naval Vessel due to the field concentration presented by the Vessel's structure may well be higher than a figure of once per 30 years.

12.36 Armament system equipment and EO shall be designed to remain safe and suitable for service when exposed to lightning as detailed in the OSI or be provided with protection.

12.37 Naval Vessels shall provide an environment that minimises exposure of Armament system equipment and EO to the effects of Lightning.

12.38 In order to minimise the risk of damage to Naval Vessels, including the electrical installation, lightning conductors shall be fitted in accordance with Lloyd's Register Rules and Regulations for the Classification of Naval Ships Vol 2 Pt 10 Ch 1 Sec 1.

12.39 The effects of lightning on equipment installed in exposed positions shall be discounted providing the equipment is electrically bonded to the supporting superstructure in accordance with Chapter 04 *Engineering Systems* Rule 10, Rule 13, Rule 14 and Rule 15.

12.40 **Test Procedures.** There is no specific test for lightning strike. EO shall be designed to meet the following requirements:

12.40.1 **Packaged Near Lightning Strike**. EO is to remain safe and meet functional and performance requirements.

12.40.2 **Unpackaged Direct Strike**. EO is to remain at least safe for disposal.

12.40.3 **Unpackaged Nearby Strike**. EO is to remain safe and meet functional and performance requirements.

12.40.4 **Packaged Direct**. EO shall remain safe and meet functional and performance requirements.

Thermal Shock

Note: Thermal shock, or rapid rates of change of temperature, induces high rates of expansion and contraction, resulting in thermal stress and fracture of materials, deformation of structural components, failure of bonded joints, degraded performance of seals and malfunction of armament system equipment.

12.41 EO shall remain safe and meet function and performance requirements after thermal shock caused by rapid rate of change of temperature conditions. These include EO transiting to or from a temperature-controlled stowage (such as a Magazine) and subjected to extreme hot or cold temperatures on the upper deck prior to firing and during EO Transfer.

12.42 Naval Vessels shall provide an EO Stowage and Handling environment that minimises exposure to Thermal Shock.

Note: Temperature conditions are defined in the Table 10.1: Generic Temperature and Humidity Conditions.

12.43 **Test Procedures.** Test procedures shall at a minimum satisfy Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch 3-14 *Test* CL-14 *Thermal Shock and Rapid Rate of Change of Temperature.*

12.44 Appropriate temperature levels, heating or cooling rates and the number of cycles shall be determined using the guidance in AECTP 300 *Climatic Environmental Tests Method 304 Air-To-Air Thermal Shock*, Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch 3-14.

Air Pressure (Above Atmosphere)

12.45 EO shall remain safe and meet function and performance requirements in and following conditions of air pressure experienced in surface Naval Vessel citadels, or within Underwater Naval Vessel pressure hulls, consistent with the performance parameters listed.

12.46 Naval Vessels shall provide a pressure environment that does not exceed the figures shown in Table 10.3: Generic Pressure Severities and the performance parameters of the following references.

Table 10.3: Generic Pressure Severities

PRESSURE SEVERITIES	
Platform	Pressure
Surface Ship – Internal	1140 mbar
External	1060 mbar
Internal to Submarine	Max 1300 mBar Min 872 mBar

12.47 Naval Surface Vessel pressure limits shall be sourced from AECTP 200 *Environmental Condition Leaflet 238 Deployment of Ships* and Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch 3-15 *Test CL-15 Air Pressure (Above Standard Atmospheric).*

Note: The pressure limits are based on a maximum of 80 mbar above ambient experienced in a maritime Naval Vessel's citadel.

12.48 Naval Underwater Vessel specific levels shall be sourced from the class design authority as higher levels of overpressure may be experienced during EO launch evolutions.

12.49 **Test Procedures.** Test procedures shall satisfy AECTP 200 Environmental Condition Leaflet 238 Deployment of Ships that provides guidance on pressure experienced by Surface and Underwater Naval Vessels [see Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch 3-15 *Test CL-15 Air Pressure (Above Standard Atmospheric*)].

Solar Radiation

12.50 Armament System equipment and EO shall be designed to remain safe and meet function and performance requirement when exposed during their lifecycle to a maximum thermal emission from solar radiation that is equivalent to a heat flux of 1120 W/m^2 acting for a period of 4 hours and consistent with the performance parameters detailed below

Note: This will cause a temperature rise in the order of 20°C to 30°C on the exposed surfaces of equipment dependent upon the surface finish.

12.51 Naval Vessels shall provide an EO Stowage and Handling environment that minimises exposure consistent with the performance parameters detailed below.

12.52 **Test Procedures.** Test procedures shall satisfy the requirements of Def Stan 00-35, Part 3, Ch. 3-03, Test CL3, Sect. 4, Procedure 'D', 'E', 'F', or 'G' as applicable. The test is applicable to equipment that is used in the open and fully exposed to solar radiation and may be used for testing samples of material whose reaction to solar radiation is unknown.

12.53 The maximum exposure is thermal emission from solar radiation equivalent to a heat flux of 1120 W/m^2 acting for a period of 4 hours.

Chemical and Biological Environment

12.54 A System Safety Analysis including a Threat Hazard Assessment shall be undertaken to determine the chemical and biological environment contamination and severity level to be applied.

Note: The results of testing against the Chemical and Biological Environments as detailed in the following paragraphs shall be recorded in the Maritime Environment Assessment Statement (MEAS) form in Part 3 of this Chapter, and as required in the OSI.

Salt Corrosion

12.55 Armament system equipment and EO shall be designed to withstand the development of corrosion due to exposure to a salt-laden atmosphere during their lifecycle consistent with the performance parameters detailed below.

12.56 Naval Vessels shall provide an EO Stowage and Handling environment that does not exceed the figures shown in the performance parameters in this section.

12.57 EO and related upper deck EO Stowages shall be designed to withstand the development of corrosion due to exposure to a salt-laden atmosphere this Chapter.

12.58 Exposed EO and associated equipment shall withstand without damage or degradation of performance occasional wettings or sprays of salt water, consistent with the performance parameters detailed in this document.

12.59 Salt corrosion risk shall be applicable to EO exposed for a significant period (> 30 minutes) before firing or held in upper deck weapon parks or dumps.

12.60 Upper deck RU Magazines shall provide a watertight enclosure to prevent EO being exposed to salt mist.

Note: Salt in the form of Sodium Chloride is present in sea spray, sea mist etc. Salt water may be taken as having 3.5% salinity.

Note: The maximum accumulation rate of Sodium Chloride deposited at sea is approximately 1g/m²/day.

Note: Further guidance on corrosion prevention is included in Def Stan 21-05 *Code of Practice for Protective Finishes*.

12.61 **Test Procedures.** Test procedures shall satisfy AECTP 300 *Climatic Environmental Tests Method 309 Salt Fog* and/or Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch.4-02 *Test CN2 Corrosive Atmosphere*.

Note: The test shall also be applicable for weapon launch canisters and exposed parts of vertical launch systems.

Mould Growth

Note: Mould growth generally occurs in an environment where the relative humidity exceeds 65% and the temperature remains within the range 0ºC to 50ºC. The most rapid mould growth develops when the relative humidity is above 95% with the temperature between +20ºC and +35ºC and the atmosphere is stagnant.

12.62 Armament Systems and EO shall remain safe and meet function and performance requirement in conditions likely to promote mould growth. They shall be designed to withstand, without damage or degradation of performance, exposure to a mould growth environment for a period of 28 days, consistent with the performance parameters detailed below.

12.63 Naval Vessels shall provide an EO Stowage and Handling environment that does not promote mould growth and does exceed the performance parameters of the references detailed below.

12.64 EO that is unboxed and stowed in Small Magazines or RU Magazines on the upper deck shall require ongoing testing.

Note: Ventilation in Magazines and RU Magazines, and desiccant control of boxed EO, provides mitigation against internal mould growth and mould occurring on exposed EO.

12.65 Appropriate components and finishes shall be used to prevent mould growth (See Chapter 02 *Structure* Rule 06 *Preservation Systems* and Def Stan 21-05 *Code of Practice for Protective Finishes*).

12.66 **Test Procedures.** Test Procedures shall at a minimum conform to AECTP 300 Method 308 *Mould Growth* and/or Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch.4-01 *Test CN1 Mould Growth*.

Note: EO Stores generally undertake mould growth test as part of land based clearance.

Caustic Environment

12.67 Armament Systems shall remain safe and meet function and performance requirements in conditions where they may be subject to environmental pollution (by battery electrolytes, volatile fluids, missile efflux, etc.) that could result in damage or degradation.

12.68 Naval Vessels shall provide an EO Stowage and Handling environment that minimises exposure to caustic environments.

Note: This requirement can normally be met through the appropriate use of materials, components and finishes as detailed in this Chapter and Def Stan 21-05 *Code of Practice for Protective Finishes*.

12.69 **Test Procedures.** Test Procedures shall satisfy AECTP 300 *Climatic Environmental Tests Method 319 Acidic Atmosphere* and/or Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch. 4-02 *Test CN2* and *CN3 Corrosive Atmosphere*.

Fluid Contamination

Note: This requirement is not applicable to EO or materiel intended to have continuous contact with a specific fluid or fluids in order to carry out its function when in service.

12.70 Armament Systems and EO shall remain safe and meet function and performance requirements in conditions where the EO may be subject to contamination by fluids that could result in damage or degradation of performance and be consistent with the parameters detailed in following Sections.

12.71 Naval Vessels shall provide an environment that minimises the exposure of Armament Systems and EO to fluid contamination.

Note: This requirement can normally be met by the correct choice of materials, components and finishes (See Division 3 *Ship Rules*, Ch.2 Rule 6 *Preservations Systems* and Def Stan 21-05 *Code of Practice for Protective Finishes*).

12.72 **Test Procedures.** As a minimum, test procedures shall satisfy the requirements of AECTP 300 *Climatic Environmental Tests Method 314 Contamination by Fluids* and/or Def Stan 00-35 Pt 3 *Environmental Test Methods* Ch.4-04 Test CN4 *Contamination by Fluids*.

Mechanical Environment

12.73 A System Safety Analysis including a Threat Hazard Assessment shall be undertaken for each Naval Vessel to establish the actual mechanical environment threat levels that require to be considered relative to that Naval Vessel.

Note: It is likely that threat levels will vary widely between classes of Naval Vessel.

Note: This includes an assessment to determine the worst case for shock. This is generally the deepest stowage position in a Naval Vessel.

Note: The results of testing against the Mechanical Environments as detailed in the following paragraphs shall be recorded in the Maritime Environment Assessment Statement (MEAS) form in Part 3 of this Chapter, and as required in the OSI.

Naval Vessel Motion

12.74 Armament Systems and EO shall remain safe and meet function and performance requirements in conditions where they may be subject to Naval Vessel motions defined in the OSI and consistent with the performance parameters detailed in following Sections.

Note: The difference between the roll and pitch requirements will only be significant where stowage orientation is fixed and known. In most situations, the roll requirement shall be considered for all orientations of the EO.

12.75 At a minimum, EO in weapon systems shall be able to operate at a list/tilt of 15-degrees in any direction.

12.76 At a minimum, EO in weapon systems shall be able to survive a permanent list of 30-degrees without leakage of fluids or other degradation and shall be capable of design performance when conditions return to less than 15-degrees or the normal (See AECTP 400 *Mechanical Environment Tests Method 418 Motion Platform*).

Note: Recommended figures for general design purposes for Underwater Vessels may be found in Def Stan 08-123 *Requirements for Design and Testing of Equipment to Meet Environmental Conditions* Table 35.1 and Table 35.2.

12.77 Equipment in all Naval Surface Vessels shall be designed for unstabilised conditions. For Naval Vessels in which stabilised equipment is involved, then the figures actually used will be detailed in the OSI.

Note: Demonstration of this capability may be scheduled to form part of the OPEVAL in the First of Class Sea Trials.

12.78 **Test Procedures.** Test procedures shall satisfy requirements of AECTP 400 *Mechanical Environment Tests Method 418* and/or AECTP 200 *Environmental Condition Leaflet 248/1, 248/2* (See DefStan 00-35 Part 5 Ch.2.04 *Mechanical Aspects of Sea Transportation*) and meet the following requirements:

12.78.1 Tilt/List of up to 30-degrees without leakage of fluids or other degradation.

12.78.2 Safe to operate at up to 15-degrees tilt in any direction.

12.78.3 Roll of 30-degrees with a period of 8 seconds may be experienced.

12.78.4 Pitch of 7-degrees with a period of 6 seconds may be experienced.

12.79 Additional inertial acceleration experienced in the following planes and severities (See Def Stan 08-123 *Requirements for Design and Testing of Equipment to Meet Environmental Conditions*):

12.79.1 Upwards and Downwards 2.0G.

12.79.2 Lateral 0.8G.

12.79.3 Forward 1.0G.

12.79.4 Aft 1.0G.

Vertical Drop

12.80 EO shall not react energetically greater than the performance parameters given in the references when dropped from height as defined below and shall remain at least safe for disposal.

Note: The maximum drop height standard for EO is nominally 12 m.

Note: The 12 m standard includes a factor of safety for the lifting device, usually taken to be one-third (1/3) of the lifting height. This may be modified by detailed consideration of the requirements of the Crane Specifications. Thus, the standard corresponds to a height of deck above the waterline of nominally 9 m.

Note: EO to be embarked/disembarked in/from larger Naval Vessels may have to be lifted to heights from the jetty or lighter to the receiving point that are significant higher than 12 m.

12.81 The height of a lift shall take into account the height of the deck and wharf above water line, and any obstruction shall be cleared en-route (e.g. fixed guardrails, antennae, etc.).

12.82 The NVO shall provide the actual drop height requirements. Further information on susceptibility to initiation from vertical drops may be sought from the Competent Organisation.

12.83 **Test Procedures.** EO dropped onto a rigid flat surface or onto a solid spigot shall not react energetically and remain safe for disposal. Solid Spigot requirement are detailed in Def Stan 00-35 Part 3 *Environmental Test Methods* Ch.2-05 Test M5 - *Impact (Vertical and Horizontal) Test*. Rigid Flat Surface requirement are detailed in STANAG 4375 *Safety Drop, Munition Test Procedure*.

12.84 EO shall meet the following drop test requirements:

12.84.1 **Packaged Drop 25 m**. EO shall remain safe for disposal following a 25 m packaged drop.

12.84.2 **Packaged Drop 12 m**. EO shall remain safe for disposal following a 12 m packaged drop.

12.84.3 **Packaged Drop 4 m**. EO shall remain safe and meet function and performance requirement following a 4 m packaged drop.

12.84.4 **Unpackaged 1.5 m Drop**. EO shall remain safe and meet function and performance requirements following a 1.5 m drop

Vibration

12.85 EO shall remain safe and meet function and performance requirements during and following continuous exposure to vibration levels normally experienced in Naval Vessels consistent with the performance parameters detailed in the following paragraphs.

12.86 Naval Vessels shall provide an EO Stowage and Handling environment that does not exceed those consistent with the performance parameters detailed in the following paragraphs.

12.87 AECTP 400 Method 401 Ed D Annex A, Sec A-5 contains guidance on the vibration environment experienced by materiel deployed or installed in Surface and Underwater Naval Vessels and shall be consulted when assessing the vibration response of the EO in question.

Note: Additional guidance on the vibration environment in Naval Vessels is detailed in Def Stan 00-35 Part 5 Sec 9 Ch.9-01 *Mechanical Aspects of Deployment on Surface Ships and Submarines*.

Note: The vibration levels referenced in the above documents shall be taken as indicative and generic.

12.88 **Test Procedures.** Test procedures shall satisfy Def Stan 00-35 Part 3 *Environmental Test Methods* and/or AECTP 400 *Mechanical Vibration Tests*. Naval Vessel test procedures and severities should be applied as follows:

12.88.1 **Surface Naval Vessels - Mine Sweeper Size and Above.** Test severities for Naval Vessels of minesweeper size and above are detailed in Def Stan 00-35 Part 3 *Environmental Test Methods* Sec 2 Ch. 2-01 Annex A-5 A27 and/or AECTP 400 *Mechanical Vibration Tests* Annex A, Figure A-34 and A-35.

12.88.2 **Smaller Naval Vessels.** Test severities for smaller Naval Vessels are detailed in DefStan 00-35 Pt 3 Ch.2-01 Test M1 *General Purpose Vibration Tests* Annex A-5 and/or AECTP 400 *Mechanical Vibration Tests* Annex A, Figure A-36 and A-37.

12.88.3 **Underwater Naval Vessels**. Test severities for Underwater Naval Vessels are detailed at DefStan 00-35 Pt 3 *Environmental Test Methods* Ch.2-01, Test M1 *General Purpose Vibration Tests* Annex A-5; and/or AECTP 400 *Mechanical Vibration* Annex A, Fig A-38.

Underwater Shock (Non-Contact)

12.89 EO shall remain safe and meet function and performance requirements following shock from a non-contact underwater explosion to the levels defined in the performance parameters detailed in following sections.

Note: Underwater shock in this context is the effect of a non-contact underwater explosion on EO in a Naval Vessel.

12.90 Naval Vessels shall provide an EO Stowage environment that does not exceed the levels defined in the performance parameters.

12.91 Particular shock levels shall be defined for individual Naval Vessels and take into consideration guidance contained in Chapter 01 *Integrated Platform Survivability*.

12.92 Vulnerability to underwater shock shall be mitigated by shock mounting for the EO within its packaging or shock mounting of the packaging and/or the Unit Load relative to the Naval Vessel.

12.93 Where EO is provided with shock mounting then the shock test shall be performed with the EO mounted as specified in the installation specification using its shock mount(s).

12.94 **Test procedures** shall satisfy Chapter 01 *Integrated Platform Survivability*. Calculation of the shock imparted to the equipment. Guidelines are also detailed in:

12.94.1 Def Stan 00-35 Pt 5 Chapter 12-06 *Specific Considerations for the Selection of Underwater Shock Tests for OME*,

12.94.2 STANAG 4137 *Standard Underwater Explosion Test for Operational Surface Ships and Crafts*, and

12.94.3 AECTP 400 *Mechanical Environment Tests Method 403 Shock Testing*.

12.95 The shock level appropriate for the Embarked Forces Magazines in an LHD type Naval Vessel shall be used for default values:

12.95.1 Safe and Serviceable: 31g (Flight Deck),

12.95.2 Safe for Disposal level: 70g (Deck 8G Magazine), or

12.95.3 180 g (Deck 9G Magazine).

12.96 In case of doubt, guidance from the appropriate Competent Organisation shall be sought to provide the Shock Grade Level or value for a given Magazine position.

Response to Attack on Ammunition Environment

12.97 A System Safety Analysis including a Threat Hazard Assessment shall be undertaken to establish the actual Response to ATTack on AMmunition (RATTAM) environment threat levels to be considered relative a Naval Vessel.

Note: It is likely that threat levels will vary widely between classes of Naval Vessel.

Note: The results of testing against the RATTAM Environment as detailed in the following paragraphs shall be recorded in the form Maritime Environment Assessment Statement (MEAS) in Part 3 of this Chapter, and as required in the OSI.

Bullet Attack

12.98 EO response to bullet attack shall not exceed that defined in the performance parameters of the references detailed in following Sections.

12.99 Naval Vessels shall provide an EO Stowage environment that provides protection from bullet attack.

Note: If the EO Stowage or Magazine is positioned below the waterline, then it is assumed that no further protection is required for the bullet attack threat.

Note: Specific Naval Vessels may require higher levels of RATTAM protection. This will be specified OSI or by the relevant Competent Organisation.

Note: Rule 3 *Structural Requirements* provides guidance on ballistic protection requirements for Naval Vessels.

12.100 **Test Procedures.** Test procedures shall be undertaken as detailed in STANAG 4241 *Bullet Impact, Munition Test Procedures*.

12.101 If the result of the test is an EO response greater than Type V, and/or a propulsive reaction then additional RATTAM precautions shall be required in accordance with blast, fragmentation and RATTAM Protection as detailed in Rule 3 *Structural Requirements*.

Note: This acceptance criterion is higher than the acceptance criteria defined in STANAG 4241. This is required to meet the IM Goals specified in STANAG 4439 (NATO AOP 039) *Policy for Introduction and Assessment of Insensitive Munitions*.

Fragment Impact/Attack

12.102 EO response to Fragment Impact/Attack shall not exceed that defined in the performance parameters listed and in the references detailed within this section.

12.103 Naval Vessels shall provide an EO Stowage environment that provides protection from Fragment Impact/Attack**.**

Note: Specific Naval Vessels or specific operational areas may require higher levels of ballistic protection. This shall be specified in the OSI or by the Competent Organisation.

Note: Rule 3 *Structural Requirements* provides guidance on ballistic protection requirements for Naval Vessels.

Note: The levels of fragment threat in the naval environment may exceed that defined in STANAG 4439 (NATO AOP 039) *Policy for Introduction and Assessment of Insensitive Munition*s. Therefore, it is likely that threat levels will vary widely between classes of Naval Vessel.

12.104 Test Procedures. Test procedures shall satisfy STANAG 4496 (NATO AOP 4496) *Fragment Impact, Munitions Test Procedure*.

12.105 EO Response shall be Type V or less in accordance with STANAG 4439 (NATO AOP 039) *Policy for Introduction and Assessment of Insensitive Munitions Table 1*.

Sympathetic Reaction

12.106 EO sympathetic reaction shall not exceed that defined in the performance parameters of the references detailed within this section.

12.107 Naval Vessels shall provide measures to reduce the likelihood and effects of a sympathetic reaction to levels consistent with the performance parameters of the references detailed in the following sections.

12.108 **Test Procedures.** Test procedures shall satisfy STANAG 4396 *Sympathetic Reaction, Munition Test Procedures* and/or STANAG 4439 (NATO AOP 039) *Policy for Introduction, Assessment and Testing for Insensitive Munitions*.

12.109 The reaction of the acceptor EO shall be at least one order of response less than the donor munition, but should be no greater than a Type III response (See STANAG 4396 *Sympathetic Reaction, Munition Test Procedure*) so that the reaction is diminished and no unlimited "chain reaction" can occur

Note: If the maximum response to other credible accidents is less than Type I or Type II (detonation/partial detonation, e.g. Type III) the reaction of the acceptor shall be Type IV or less and so on. Where the donor reaction is a Type V then the acceptor should also exhibit no worse than a Type V reaction.

Electromagnetic Environment (EME)

Note: The results of testing against the Electromagnetic Environment as detailed in the following paragraphs shall be recorded in the Maritime Environment Assessment Statement (MEAS) form in Part 3 of this Chapter, and as required in the OSI.

Radio Frequency (RF) Electromagnetic Radiation

12.110 EO shall remain safe and meet function and performance requirements when exposed to the Maritime RF Environment consistent with the parameters defined in the references detailed below.

12.111 Naval Vessels shall provide an EO Stowage environment that provides protection consistent with the Maritime RF Environment parameters detailed below.

12.112 An assessment shall be required of the RF environment for all EO stowed or handled on the upper deck.

12.113 Where installed equipment is not constructed to this GME then reference shall be made to appropriate levels for that equipment.

Note: Where the container is a steel container affording an effective RF sealed box from the upper deck RF environment then there is no requirement for RF testing.

Note: Well-used ISO containers may not provide an effective Faraday cage and so any EO to be stowed in these conditions shall be tested or assessed before embarkation.

Note: Chapter 13 *Combat Systems* details the minimum requirements for function, performance, integration, test and evaluation of RF Systems for selection, design and construction on-board Naval Vessels.

12.114 **Test Procedure.** It is assumed that all EF EO will be on the upper deck of a Naval Vessel in a weapon dump/park at some stage of the MTDS. The default requirement for all EF EO is that they shall be tested against the full Naval Vessel RF environment.

12.115 EO shall be assessed against the maritime RF environment detailed in the OSI using AECTP 500 *Electrical Electromagnetic Environmental Tests and Verification Category 508* and/or MIL-STD-464C *Electromagnetic Environmental Effects Requirements for Systems*.

Note: US Hazardous Effects of Radiation on Ordnance (HERO) tests do not necessarily simulate the characteristics of RAN systems, but are suitable with appropriate restrictions. Further guidance should be sought from the NVO or Competent Organisation.

Electromagnetic Radiation

12.116 EO shall remain safe and meet function and performance requirements when exposed to the Maritime Electromagnetic Environment (degaussing coil fields and deperming) consistent with the performance parameters detailed below.

12.117 Naval Vessels shall provide an EO Stowage environment that provides protection consistent with the Maritime Electromagnetic Environment parameters detailed below.

12.118 An assessment shall be undertaken to determine how close the EO Stowages are to the nearest degaussing coil or deperming cable. The DC magnetic field environment that is present on Naval Vessels is summarised in Def Stan 08-123 *Requirements for Design and Testing of Equipment to Meet Environmental Conditions.*

Note: The levels quoted for degaussing systems will only exist relatively close to the degaussing cables. If a system is known to be sited some distance from the cables (e.g. > 3 m), advice should be sought on the levels to be used.

Note: If a system is very close to a degaussing cable (within 0.3 m), considerably greater field strengths may exist and further advice shall be sought from the NVO or Competent Authority.

12.119 **Test Procedures.** The requirements covering degaussing /deperming of Naval Vessels is detailed in Def Stan 59-411 Pt 2 Sec 2 *The Electric, Magnetic and Electromagnetic Environment* Ch.7.4 *Degaussing / Deperming of Navy Vessels*. Typical field parameters are as follows:

12.119.1 **Degaussing Coil Fields**. Maximum strength of 1600 A/m and rate of change 1600 A/m/s. Requirements are detailed in Def Stan 08-123 *Requirements for Design and Testing of Equipments to Meet Environmental Conditions DS 38*.

12.119.2 **Deperming**. Normal level Maximum field strength of 3200 A/m and a rate of change 1600 A/m/s. Level for Safety Critical Systems. Max Field Strength 4800 A/m and rate of change 1600 A/m/s.

Note: Levels cited above may be potentially prejudicial to the safety of weapons in Naval Vessel. The NVO or relevant Competent Organisation shall be contacted for clarification.

Electrostatic Discharge (ESD)

12.120 EO shall remain safe and meet function and performance requirements when exposed to Electrostatic Discharge (ESD) consistent with the performance parameters defined within the references detailed below.

12.121 Naval Vessels shall provide an EO Stowage environment that provides protection from ESD.

12.122 **Test Procedures.** EO shall be assessed against the ESD parameters detailed in AECTP 500 *Electrical Electromagnetic Environmental Tests and Verification* and/or Def Stan 59-411 Pt 2 Sec 6 *Electrostatic Charging, Discharge and Precipitation Static*.

12.123 EO shall be tested against the ESD parameters detailed Def Stan 59-411 Pt 3 Sec 7.13 DCS10 *Electro Static Discharge (ESD*).

Armament System Integration Threats

12.124 A System Safety Analysis including a Threat Hazard Assessment shall be undertaken to identify armament system integration threats to a Naval Vessel and/or its EO.

Note: The results of testing against Armament System Integration Threats as detailed in the following paragraphs shall be recorded in the Maritime Environment Assessment Statement (MEAS) form in Part 3 of this Chapter, and as required in the OSI.

Gun Muzzle Blast

12.125 Equipment and EO on/in launchers/canisters including fittings/equipment in close proximity to gun (muzzle) blast shall withstand the effects of such blast without damage or degradation of performance consistent with the performance parameters detailed below.

12.126 Naval Vessels shall provide an EO Stowage and Handling environment that provides protection from Gun Muzzle Blast.

12.127 Where exposed EO, whether on/in launchers/canisters or other containers, in a muzzle blast area, they shall be allowed the appropriate safe distances determined using the performance parameters of the references below.

12.128 A model of the gun muzzle blast shall be produced to enable appropriate design to allow for the effects of gun muzzle blast.

Note: Exposure to gun blast will be dependent on specific physical configurations of weapons and EO handling areas.

12.129 Any canistered EO or the exposed components of a vertical launch system shall be assessed for compatibility issues if these are within the footprint of the gun blast.

12.130 Containers on the Upper Deck shall not be positioned where significant gun blast is likely to be experienced.

Note: Advice on design to avoid gun blast damage is detailed in MIL-STD-1399A Section 072.2 *Blast Environment, Gun Muzzle*.

12.131 **Test procedures.** Test procedures shall be undertaken as detailed in AECTP 400 *Mechanical Environment Tests Method 405 Gun Fire* and/or MIL-STD-1399A Section 072.2 *Blast Environment, Gun Muzzle.*

Missile Efflux

12.132 Equipment and EO on launchers and fittings/equipment adjacent to launchers shall be designed to withstand the effects of weapon efflux (thermal, corrosive and pressure effects; and temperature, pressure and scouring) without damage or degradation of performance consistent with the performance parameters detailed in following sections.

12.133 Protection against the effects of missile efflux shall be achieved through design and by choice of materials, components and finishes in:

12.133.1 Def Stan 21-05 *Code of Practice for Protective Finishes* (See Def Stan 08-107 *General Requirements for the Design of Electrotechnical and Naval Weapon Equipment*), and/or

12.133.2 Def Stan 08-123 *Requirements for Design and Testing of Equipments to Meet Environmental Conditions Data Sheet 44*

Note: Safe distances shall be derived from MIL-STD-1399A Section 072.1 *Blast Environment Missile Exhaust*.

12.134 **Test Procedures.** The efflux effects produced by EO such as thermal, corrosive, toxic, scouring and pressure shall be assessed and recorded in the MEAS form in Part 3 of this Chapter to support the safe integration of the EO/system into the Naval Vessel.

12.135 Spot check tests of efflux impingement shall be conducted at Installation Test Firing (ITF) in follow-on Naval Vessels of the class.

Fuel Fire (Fast Heating)

12.136 EO response to a Fuel Fire (Fast Heating) shall not to exceed that defined in the performance parameters detailed below.

12.137 Naval Vessels shall provide measures to reduce the possible effects of a fuel fire.

Note: The hazard of liquid fuel fire is assumed to be present for all embarked EO at some or at all times.

12.138 Where the response to the Liquid Fuel Fire Test is Type V or greater within 5 minutes, additional operational limitations shall be recommended by the Competent Organisation for VERTREP and for stowage adjacent to motor transport or fuelling points.

12.139 **Test Procedures.** Test procedures shall satisfy STANAG 4240 *Liquid Fuel/External Fire, Munition Test Procedure*s.

12.140 Response shall be Type V or less in accordance with STANAG 4439 (NATO AOP 039) *Policy for Introduction, Assessment and Testing for Insensitive Munitions*.

Slow Heating (Slow Cook-Off)

12.141 EO response to Slow Heating (Slow Cook-Off) shall not exceed that defined in the performance parameters detailed below.

12.142 Naval Vessels shall provide measures to reduce the possible effects of slow heating/slow cook-off consistent with the performance parameters with the references detailed in following sections.

12.143 **Test Procedures.** Test procedures shall satisfy STANAG 4382 *Slow Heating Test for Munitions*.

12.144 EO response shall be Type V or less in accordance with STANAG 4439 (NATO AOP 039) *Policy for Introduction, Assessment and Testing for Insensitive Munitions*.

Note: Evidence from the STANAG 4382 *Slow Heating Test for Munitions* test, when compared with the STANAG 4240 *Liquid Fuel/External Fire, Munition Test Procedures* test, may be used in assessment of the likely reaction of EO to heating stimulus at other heating rates.

Note: A higher order response can occur following slow heating rates, as the explosive filling of the EO may have been heated through to a greater depth, potentially sensitising the explosive composition,