

Mission capabilities. The ship shall be capable of simultaneous UNREP of two customer ships alongside at all speeds ranging from 12 to 16 knots. Underway cargo handling and UNREP shall be capable of being performed both day and night. The ship, without utilizing helicopters, shall be capable of performing continuous self-loading and self-unloading, day and night, alongside a pier and at anchor. Additional capabilities shall include:

- a. Stowage for the cargo specified herein.
- b. Handling equipment, staging areas, and other arrangements necessary to maintain the specified transfer rates to the receiving ship(s).
- c. Maintenance of the specified operational tempos (Appendix A) of cargo breakout, movement, and transfer.
- d. Stowage arrangements that permit rapid loading and unloading and cargo accessibility.

1.1.1 Description and quantity of cargo. Appendix B presents cargo load lists for different ship mission and design constraints. The ship shall be capable of stowing and efficiently loading and unloading, individually, each of the cargo loadouts described in Table I without reconfiguration of the ship. In addition, the ship shall be capable of stowing, loading, and unloading each of the three cargo loadouts described in Table II, individually, without reconfiguration of the ship

TABLE I. Cargo loadouts for stowage and transfer.

Loadout type	Dry cargo	Liquid cargo	Other cargo
Mixed Ammunition and Stores	Appendix B1	1700 m <sup>3</sup> F-76 Fuel 1200 m <sup>3</sup> F-44 Fuel 200 m <sup>3</sup> Potable Water	Specialty cargo
Stores	Appendix B2	2300 m <sup>3</sup> F-76 Fuel 600 m <sup>3</sup> F-44 Fuel 200 m <sup>3</sup> Potable Water	Specialty cargo except pyrotechnics, white phosphorus; fuzes, primers, and detonators; thermite; EOD and special warfare ordnance

TABLE II. Cargo loadouts for stowage.

Loadout type	Dry cargo	Liquid cargo	Other cargo
Weight limited	Appendix B3	2900 m <sup>3</sup> F-76 Fuel 200 m <sup>3</sup> Potable Water	Specialty cargo
Volume limited	Appendix B4	2900 m <sup>3</sup> F-44 Fuel 200 m <sup>3</sup> Potable Water	Specialty cargo
Maximum load	6675 metric tons (see 3.4.7)	2300 m <sup>3</sup> F-76 Fuel 600 m <sup>3</sup> F-44 Fuel 200 m <sup>3</sup> Potable Water	Specialty cargo

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In addition to the requirements specified in Tables I and II, the ship shall be capable of stowing a 7,930-mm long, 1,020-mm wide, 1,120-mm high weapons package weighing 4,300 kg in each cargo ordnance stowage area. The ship shall be configured to move this weapons package between each cargo ordnance stowage area, each cargo UNREP station, and pierside cargo loading areas. The lifting and handling points for the weapons package are provided in Figure 1.

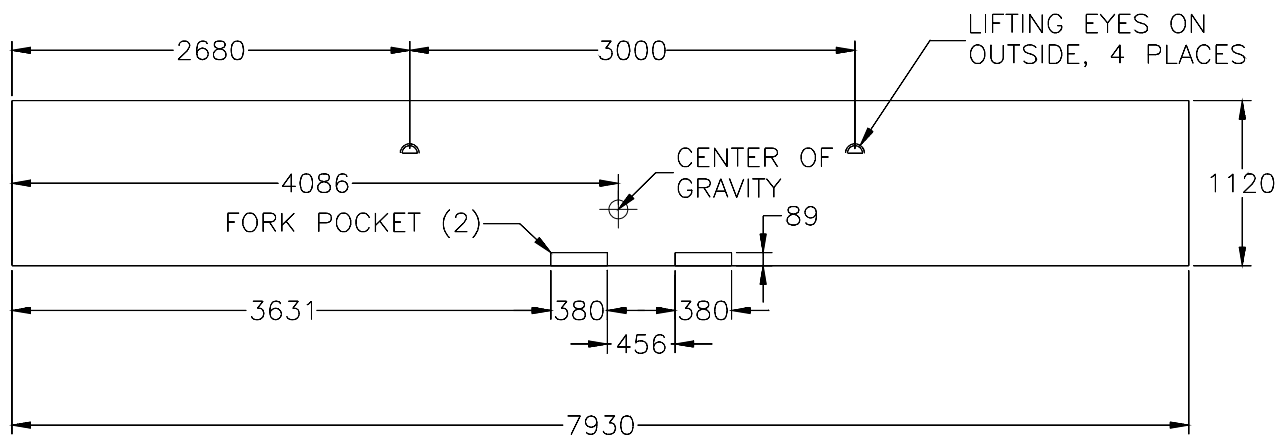


FIGURE 1. Weapons Package Lifting and Handling Points.

Note: Side view shown, dimensions are in millimeters, uniform deck load over footprint.

In addition to the requirements specified in Tables I and II, the ship shall be capable of stowing containers as shown in Figure 2 in at least one cargo ordnance stowage hold on all hold levels and in the outsized cargo space. Flush deck sockets capable of accommodating chain lashings and container twist locks shall be provided in the outsized cargo space. The sockets shall be arranged to allow stowage of the maximum number of the containers shown in Figure 2. Container twist lock securing devices need not be installed in the hold provided that the dunnage system is capable of securing the containers against ship motions. The ship shall be configured to move this container between each level of the selected cargo ordnance stowage hold, outsized cargo space, each cargo UNREP station, and pierside cargo loading areas using the notional MHE, defined in 3.5.3, handling the container by the fork pockets on the long side. If the arrangements do not permit handling the container in this fashion, other means of moving the container between the specified areas shall be provided. The dimensions and handling points for the container are provided in Figure 2.

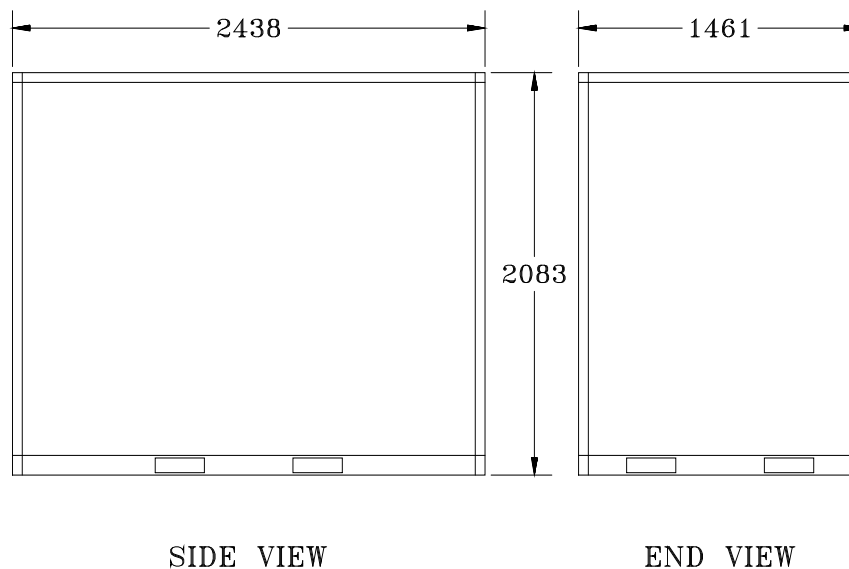


FIGURE 2. Container Dimensions and Handling Points.

Notes:

1. Dimensions are in millimeters
2. Maximum gross weight of 2,725 kg
3. Standard fork pockets on all four sides
4. ISO/ANSI corner fittings on all corners

### 1.1.2 Cargo stowage and handling requirements.

- a. **General.** – Means shall be provided to secure cargo from shifting, tipping, spilling, and other effects caused by ship motion and to protect cargo from direct sunlight, rain, temperature, humidity, sea spray, and other conditions that may cause degradation of the cargo. Materials and devices provided to secure and protect the cargo shall not loosen up under the effects of ship motion and vibration. Materials and devices provided to secure cargo

shall meet the allowable stresses of OP 4 section 5-3.1.2. Stowage shall be provided for materials and devices provided to secure and protect the cargo when they are not in use. Cargo spaces shall be clear of distributive systems except for those portions of systems that serve that specific cargo space. Physical protection shall be provided for items such as HVAC sensors and controls, fire fighting systems, and distributive systems in cargo and other spaces that could be damaged by the movement and stowage of cargo, MHE, and AHE. Deck surfaces in areas that MHE and AHE can operate, shall be free from obstructions, abrupt transitions and other irregularities, which would impede MHE and AHE operations. Items such as dunnage systems, tie-downs, doorsills and tracks, BERPs, and manholes, shall be flush or shall be fitted with suitable transitions and fillers to permit unimpeded MHE and AHE operations. These items shall not reduce clearances below the minimum requirements.

The intra-ship material handling system shall permit the temporary stowage and movement of cargo at sea and in port. Clearance from fixed overhead obstructions to the top of stowed cargo shall be not less than 150 mm. Stowage shall be provided for MHE, AHE, tools, and accessories of the replenishment systems in locations convenient for their use. Cargo transfer and handling equipment and arrangements shall permit packaged cargo units to be moved from their stowage spaces to each CONREP or VERTREP location and to each self loading and unloading area by not less than two means and two different routes (for example, two elevators per hold). Within each stowage space, two means of moving packaged cargo units from each stowage location shall be provided (for example, two fork lift trucks). For cargo ordnance, food, HULL, and stores cargo spaces (including the cargo spare parts space since it shall be suitable for non-refrigerated food, HULL, and stores cargo), the second means of movement, as a minimum, shall provide cargo flow equal to the flow possible using a forklift truck and an elevator. Cargo stowage spaces shall be provided with two accesses for cargo movement. Only one access for cargo movement needs to be provided for cargo stowage spaces less than 800m<sup>3</sup>. Only one route needs to be provided to accommodate outsized cargo. Clearance in cargo routes shall permit unrestricted movement of the largest cargo to be handled on that route without the removal of fixed or portable objects. MHE routes and cargo handling passageways between cargo stowage areas, pre-staging areas, CONREP transfer stations, the VERTREP transfer station, cargo strike-up and strike-down equipment, and MHE workshop(s) shall be sized to accommodate the following clearances from the MHE and load carried:

1. 300 mm to fixed overhead obstruction.
2. 600 mm to fixed lateral obstruction.
3. 1000 mm to moving obstruction.

In no case shall the MHE routes and cargo handling passageways have a clear height less than 2.5 m. Cargo ordnance handling passageways shall have a minimum clear width of 3.7 m. Doorways along MHE routes shall be sized to accommodate a minimum of 300 mm of clearance between all parts of the doorway, and the MHE and load carried. Unless otherwise specified herein, cargo spaces shall be provided with:

1. Lockable access.

2. Heating and air conditioning in accordance with 3.5.2 and a minimum replenishment air change rate of 0.5 changes per hour based on gross space volume.
3. Cargo segregation meeting IMO-200E and 210E and NAVSEA OP 4 requirements. Hazard categories are specified herein.

Control and monitoring of cargo space air conditioning, ventilation, and refrigeration shall be provided both remotely in the EOS and locally. Remote control of heating of chilled and frozen cargo stowage spaces operating in stores mode shall not be required. The MCCS shall alarm at user defined temperatures for each cargo space and at user defined temperatures and pressures for each cargo air conditioning and refrigeration plant. A separate high and low recording thermometer shall be provided in each cargo space.

- b. **Cargo ordnance.** – The ship shall have provisions for stowage of cargo ammunition in cargo ordnance holds in accordance with NAVSEA OP 4 as modified by Appendix N and regulatory body requirements. The ship shall be equipped to permit intra-ship movement and handling of cargo ordnance in accordance with NAVSEA OP 4 as modified by Appendix N and regulatory body requirements. Each cargo ordnance hold and associated handling systems shall be capable of stowage and handling of any cargo ammunition item listed in Appendix B. Each cargo ordnance hold shall be provided with provisions for physical security and means for sensing and recording temperature.
- c. **Liquid cargo.** – Ship's fuel shall be segregated from cargo fuel. The liquid cargo fuel handling and stowage systems shall permit the ready conversion, including tank cleaning, to alternatively stow F-76 or F-44. The ship shall be able to transfer F-44 and potable water between the respective ship's service stowage and cargo stowage tanks at a rate of not less than 950 liters per minute. The ship shall be able to transfer F-76 between the ship's service stowage and cargo stowage tanks at a rate of not less than 5675 liters per minute. Cargo fuel stowage shall be divided into at least two tanks of approximately equal volume for each product (F-76 and F-44). The system shall be provided with a means of stripping the cargo tanks of water via a dedicated stripping system. Tank strippings shall be discharged to the cargo fuel slop tank. The cargo fuel slop tank shall be provided with a means for determining fuel/water liquid level interface. A means shall be provided for processing of contaminated F-44 cargo fuel. The system shall be sized to process an entire cargo tank of F-44 cargo within a 48 hour period via suction connections to the tank stripping system and discharge connections to the cargo tank fill and transfer mains. Water and contaminants from the system shall be directed to the Oil Pollution Abatement System. The cargo fuel slop tank shall have a connection to the Oil Pollution Abatement System. Cargo fuel stowage shall be provided with an inert gas distribution piping system meeting the requirements of SOLAS II-2, regulation 62. Space and weight reservations shall be provided to accommodate future installation of an inert gas generator meeting the requirements of SOLAS II-2, regulation 62. If the vapor emission control system is connected to the inert gas system, the instruction manual required by SOLAS II-2, regulation 62.21 shall include procedures relating to vapor collection operations. The cargo potable water system shall be provided with means to maintain the potable water to USPHS potable water standards using a bromination system. The bromination system, supplies, and support shall allow the cargo potable water to be stored in the tanks for 180 days.

- d. **Outsized cargo.** – The ship shall have the capability to stow, handle, and UNREP outsized cargo as identified in Appendix B. The outsized cargo stowage area shall not block the normal cargo handling routes, accommodation ladders, or the ship's self loading areas, or interfere with CONREP or VERTREP operations. A grid of flush deck sockets shall be provided for securing outsized cargo. These sockets shall not interfere with the pattern of sockets required for stowage of the containers specified in 3.2.1. The sockets provided for stowage of containers may form part of this grid. Wire rope or chain lashings shall be provided for securing outsized cargo. This stowage area shall be near the aft solid cargo sending stations and shall have a minimum clear height of 3 m. Space ventilation shall provide a minimum air change rate of 2 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C.
- e. **Food, High Usage Load List (HULL), and stores cargo.** – Food, HULL, and stores cargo pallet dimensions vary significantly. The ship shall be capable of handling and stowing the full range of pallet sizes in each food, HULL, and stores cargo stowage space. In addition to the pallet dimension listed in the appendices, food, HULL, and stores cargo pallets range from 1000 to 1950 mm in length, 850 to 1250 mm in width, and 700 to 2050 mm in height. Food, HULL, and stores cargo pallets vary in length and width as much as  $\pm 25$  mm from one pallet to the next of the same cargo. Heights vary by as much as  $\pm 250$  mm from one pallet to the next of the same cargo. Stowage and handling systems for food, HULL, and stores cargo shall meet the following:
  - 1. **Non-refrigerated food, HULL, and stores cargo stowage.** – Air conditioned spaces shall be provided for non-refrigerated food, HULL, and stores cargo stowage.
  - 2. **Chilled and frozen food cargo stowage.** – Chilled and frozen cargo stowage spaces shall have the capability to be individually used at either chill or freeze temperatures. The cargo refrigeration plant shall be designed to handle at least 70 percent, based on volume, of the chilled and frozen cargo stowage spaces at chill temperature and the remaining volume at freeze temperature. In addition, the cargo refrigeration plant shall be designed to handle at least 70 percent, based on volume, of the chilled and frozen cargo stowage spaces at freeze temperature and the remaining volume at chill temperature. Chilled and frozen spaces may be designated multi-purpose stowage spaces in accordance with 3.2.2h. Cargo refrigeration systems shall be in accordance with 3.5.16. During cargo movement operations, chilled and frozen pallets shall not spend more than 20 minutes outside of chilled and frozen spaces.
- f. **Flammable liquids.** – A space shall be provided for the stowage of palletized flammable liquids. Space ventilation shall provide a minimum air change rate of 15 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C.
- g. **Specialty cargo.** – Dedicated stowage space shall be provided for specialty cargo as listed below. Powered handling equipment; such as MHE and powered bridge cranes; shall be provided and have access to stow and remove cargo in these dedicated spaces without man-handling the cargo. Where cargo can be stacked higher than a single pallet, powered means, such as fork trucks, shall be provided and have access to stack and unstack the cargo. Volumes listed are molded volumes. Hazard categories are based on IMDG hazard codes.

1. **Pyrotechnics.** – A minimum of 68 m<sup>3</sup> of dedicated stowage for pyrotechnics (hazard category 4.2G) shall be provided. Full load allowance shall be 18 metric tons. The stowage space shall be in accordance with NAVSEA OP 4 as modified by Appendix N. This space shall have a dedicated HVAC intake, exhaust, and air handling system. 5
2. **White phosphorus.** – A minimum of 83 m<sup>3</sup> of dedicated stowage for white phosphorus (hazard category 1.2H) shall be provided. Full load allowance shall be 22 metric tons. The stowage space shall be in accordance with NAVSEA OP 4 as modified by Appendix N. A locker for white phosphorous protective clothing and equipment such as face shields, heavy leather or rubber gloves, rubber aprons, and self-contained breathing apparatus (SCBA) shall be provided in the vicinity of the white phosphorous stowage space. 5
3. **Fuzes, primers, and detonators.** – A minimum of 45 m<sup>3</sup> of dedicated stowage for fuzes, primers, and detonators (hazard category 1.1B) shall be provided. Full load allowance shall be 11 metric tons. The stowage space shall be in accordance with NAVSEA OP 4 as modified by Appendix N. The stowage space shall be magazine stowage “type C” in accordance with IMO-200E and 210E. 5
4. **Medical supplies.** – A minimum of 51 m<sup>3</sup> of dedicated medical supply stowage shall be provided. Full load allowance shall be 11 metric tons. The space shall contain a safe locker for drugs, refrigerated lockable storage with temperature alarm for drugs that alarms visually and audibly outside the space, and a corrosion- and acid-resistant lined container for stowing medical acid. Sixty percent of the usable volume shall be provided with modular drawer stowage cabinets. The remaining 40 percent of the usable space shall be provided with racks measuring approximately 760 mm wide by 990 mm deep by 2310 mm high, with five shelves.
5. **Plywood and lumber.** – A minimum of 37 m<sup>3</sup> of dedicated plywood and lumber stowage space shall be provided. Full load allowance shall be 3 metric tons. The usable space shall be provided with means for securing, handling, and stowing standard plywood sheets or 4-m-long lumber on six-high divided shelves. The standard plywood sheets shall be 1220 mm by 2440 mm (4 feet by 8 feet) sheets of varying thickness. The plywood and lumber shall be stowed with uniform support so it does not deform in storage. Space ventilation shall provide a minimum air change rate of 2 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C.
6. **Plate and sheet metal and pipe and bar stock.** – Dedicated space shall be provided for stowage of plate and sheet metal and pipe and bar stock. Space ventilation shall provide a minimum air change rate of 2 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C. A minimum of 44 m<sup>3</sup> of plate and sheet metal stowage space shall be provided. Full load allowance shall be 28 metric tons. The usable space shall be provided with means for securing, handling, and stowing metal plates or sheets as long as 3 m in length. Vertically stowed plates shall be mechanically secured to preclude shifting due to ship motions or presenting a hazard to personnel while removing a plate for issue. Horizontally stowed plates shall be provided with a sufficient number of shelves to accommodate each size as an individual stack. 10  
A minimum of 71 m<sup>3</sup> of pipe and bar stock stowage space shall be provided. Full load allowance shall be 45 metric tons. Forty percent of the usable space shall be provided 10

with means for securing, handling, and stowing 3-m-long stock. The remaining 60 percent of the space shall be provided with means for securing, handling, and stowing 4-m-long stock.

7. **Not Used.**

8. **US Mail.** – A minimum of 48 m<sup>3</sup> of dedicated stowage space shall be provided for palletized US Mail cargo. Full load allowance shall be 3 metric tons. The mail stowage area shall be near the VERTREP area. Space ventilation shall provide a minimum air change rate of 2 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C.

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9. **Spare parts.** – A minimum of 3,350 m<sup>3</sup> of dedicated space shall be provided for spare parts stowage. This space shall be located and outfitted such that with removal of the racks, cabinets, and bins required by this section, the space is suitable for stowage of non-refrigerated food, HULL, and stores cargo as a minimum. Full load allowance shall be 985 metric tons.

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Fifty percent of the usable space shall be provided with modular drawer stowage cabinets with modular drawer stowage shelf cabinets mounted above for binable items. Twenty percent of the usable space shall be provided with racks measuring approximately 1100 mm wide by 910 mm deep by 2310 mm high with three shelves. The remaining 30 percent of the usable volume shall be provided with modular drawer stowage cabinets. Modular drawer storage cabinets shall incorporate a quick acting latching mechanism to secure drawers in the closed and open position. Storage shelves and drawers shall each be individually identified.

T-AKE 10 and follow:

Thirty percent of the usable space shall be provided with modular drawer stowage cabinets with modular drawer stowage shelf cabinets mounted above for binable items. Fifty percent of the usable space shall be provided for segregated bulk. Twenty percent of the usable space shall be provided with racks measuring approximately 1100 mm wide by 910 mm deep by 2310 mm high with three shelves.

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10. **Hazardous material, medical waste, and solid waste.** – A minimum of 150 m<sup>3</sup> of dedicated space shall be provided for the stowage of fleet hazardous material, medical waste in approved containers, and solid waste. Full load allowance shall be 0 metric tons with an end of deployment allowance of 118 metric tons. Space ventilation shall provide a minimum air change rate of 15 changes per hour based on gross volume. Temperature shall be automatically maintained between 5 degrees C and 37 degrees C.
11. **Oxidizing agents.** – A minimum of 44 m<sup>3</sup> of dedicated stowage for oxidizing agents (hazard category 5.1) shall be provided. Full load allowance shall be 1.1 metric tons.
12. **Thermite.** – A minimum of 0.25 m<sup>3</sup> of dedicated space shall be provided for thermite ordnance (hazard category 1.3G). Full load allowance shall be 75 kg. This space shall be in a jettisonable locker in accordance with NAVSEA OP 4 as modified by Appendix N.
13. **EOD and special warfare ordnance.** – A minimum of two 35 m<sup>3</sup> dedicated storage spaces shall be provided for EOD and special warfare ordnance. These spaces shall

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meet the requirements for hazard class 1 cargo ordnance and shall be “separated from” other hazard class 1 cargo ordnance in accordance with IMDG code. Full load allowance shall be 14.5 metric tons in each space. This stowage space shall be in accordance with NAVSEA OP 4 as modified by Appendix N.

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- h. **Multi-purpose stowage space.** – Where dedicated dry cargo stowage space is not specifically required, a stowage space may be designated as “multi-purpose” provided it meets the stowage requirements of all of the cargoes to be stowed in that space. No reconfiguration of the space, other than turning valves and switches, shall be required to “convert” the space to an alternative purpose. The ship’s own crew shall be able to “convert” all of the “multi-purpose” spaces within a two day period without industrial assistance. Dry cargo stores (all cargo types except ammunition and inert weapons components) shall not be stowed in the same space at the same time as ammunition or inert weapons components.
- i. **Pre-staging areas.** – Pre-staging areas shall be provided as a way of leveling personnel workload involved in cargo breakout, strike-up, and inventory control. Pre-staging areas shall be located on the transfer deck. These areas shall not be used to satisfy cargo loadout requirements. To ensure the preservation of the cargo, the following requirements shall apply:
  - 1. Pre-staging areas for freeze cargo shall be automatically maintained at a temperature of not greater than minus 23 degrees C.
  - 2. Pre-staging areas for chill cargo shall be automatically maintained at a temperature of not greater than 2 degrees C and not less than 0.5 degrees C.
  - 3. Enclosed pre-staging areas for other cargo shall be automatically maintained between 5 degrees C and 37 degrees C. Space ventilation shall provide a minimum air change rate of 2 changes per hour based on gross volume. Ventilation shall be capable of being secured during UNREP operations without securing air conditioning and ventilation for other spaces.
  - 4. Decks in areas used for pre-staging shall be provided with a grid of flush deck sockets suitable for rigging temporary lashing or dunnage.
- j. **Cargo movement systems.**
  - 1. **Material handling equipment (MHE).** MHE is free roaming equipment, both powered and manual, under the direct control of an operator, such as forklift trucks, side-loading lift trucks, and pallet trucks. Internal combustion powered MHE shall not be used for cargo movement in enclosed areas other than the transfer deck. The mix and number of MHE is dependent upon the Contractor’s design approach and shall support the cargo flow rate requirements specified herein. The mix and number of MHE shall include allowances for MHE maintenance, equipment casualties, run time, refueling time, and recharging time as appropriate. While at sea, the ship shall have the capability for MHE to move (without disassembly) between cargo holds, CONREP stations, VERTREP stations, MHE workshop(s), and any other areas that the MHE may operate. MHE shall be provided with stowage out of the weather. A means shall be provided to secure MHE against the effects of ship motions in MHE stowage areas, MHE maintenance facilities,

cargo stowage and prestaging areas, and other areas common to MHE operations. MHE shall be provided with permanently affixed lifting and tie down provisions. MIL-STD-209J may be used as guidance for lifting and tie down provisions. Each type of MHE shall be procured through one of the following methods.

- a) Conventional shipboard-approved MHE; such as conventional forklifts, reach and tier forklifts, pallet trucks, side-loading lift trucks, and warehouse tractors in accordance with NAVSEA SW023-AH-WHM-010; purchased from the Government.
  - b) Conventional forklifts, reach and tier forklifts, pallet trucks, and side-loading lift trucks meeting the operational and function requirements of the Contractor's design, in accordance with ASME B56.1. MHE shall have all-wheel braking systems with a dedicated independent operating system. Tire loads shall not exceed the tire load limits specified in the Tire and Rim Association Yearbook. MHE shall be protected against unsafe transmission operation, such as sudden changes in speed or direction. MHE shall have FAILSAFE operation. MHE shall operate on deck surfaces and inclines on the ship when the surface is wet including the ship motions when operating in accordance with Table XII. MHE shall withstand the corrosive effects of a saline atmosphere. MHE shall be provided with a means of towing or being towed that is compatible with current Navy MHE. MHE shall be provided with two means of dissipating static charges, such as two static conductive tires or two grounding straps. Powered MHE shall be certified EE or DS in accordance with NFPA 505.
  - c) Non-conventional MHE (MHE not in accordance with NAVSEA SW023-AH-WHM-010 or ASME B56.1) in accordance with Appendix I.
2. **Ancillary handling equipment (AHE).** AHE is equipment used in conjunction with MHE and cargo and ordnance handling systems for intra-ship and inter-ship cargo and ordnance handling, such as slings, beams, strongbacks, adapters, carriers, bands, dollies, and cargo nets. Ordnance handling equipment (OHE) is a subset of AHE for handling ordnance. Conventional AHE shall be in accordance with NAVSEA OP 2173. Non-conventional (new design) AHE shall be in accordance with Appendix I. AHE shall be provided with stowage out of the weather.
  3. **Cargo and ordnance handling systems.** Cargo and ordnance handling systems are fixed automatic, semi-automatic, or manually controlled devices used for cargo and ordnance movement, such as elevators, cranes, automated pallet stowage and retrieval systems, and monorails. Cargo and ordnance handling systems shall be designed to and shall perform their rated function in accordance with Table XII. Load bearing structural and mechanical components shall have working load stresses, not greater than 35 percent of the yield point of the material, and overload stresses such as test loads and impact loads, not greater than 70 percent of the yield point of the material. Handling systems shall maintain positive control of the load. Handling systems shall incorporate FAILSAFE operation. Cargo booms shall not be provided. The following requirements for specific handling equipment shall also apply:

- a) **Cranes.** – Cranes shall be dynamically rated at the conditions specified in Table XII and shall be in accordance with API 2c and the ABS Guide for Certification of Cranes. Cranes provided for movement of cargo and the item described below shall meet the requirements of OP 4. Cranes shall be provided with a boom angle and load indicating device with a digital readout which sounds an alarm and lights a warning light when the load exceeds the crane rating. The controls for the crane shall permit the operator to have full visibility of the lifted load from the pier or barge to the deck.

At least one crane on each side shall be provided that is capable of transporting a 13.5 meter tall, 1.1 meter square, 5 metric ton item object (cargo package with associated lifting gear) from an area on the ship to a point such that the bottom of the object is 10 m above the Tropical Load line and 18 meters outboard of the maximum breadth on that side of the ship. The ship shall be provided with a means and route to move each cargo type, including the weapons package, to this area(s). The area(s) shall be large enough to permit righting the object from horizontal to vertical. This requirement may be satisfied by a single crane capable of transporting the object to the same points on both the port and starboard sides of the ship. These cranes shall be capable of lowering the hook from the specified destination points to the waterline. These requirements shall be met in the conditions specified for loading and unloading cargo and stores alongside a pier in accordance with Table XII.

- b) **Elevators and other fixed cargo movement devices not covered elsewhere in this section (if used).** – All access closures to the device platform shall be interlocked to prevent opening when the platform is not at the proper position required for the load to be handled through that closure. The device shall be interlocked to prevent operation unless the access closure is fully closed. Cargo elevators shall be non-operator riding. Traction drive vertical lifts shall meet the requirements of ASME A17.1. Where rated loads or dimensions of traction drive vertical lifts exceed those delineated in ASME A17.1, the vertical lift shall retain the equivalent strength, rigidity, and safety feature performance. If Navy standard cargo elevators are provided, the elevators shall be in accordance with Appendix G. Navy standard cargo elevator platform dimensions may be adjusted to suit the weapons package and other cargo item requirements provided that the modified platform design retains the same strength and rigidity characteristics. Navy standard cargo elevator controls may be replaced with programmable logic controllers (PLCs) that provide the same control functions. If PLCs are used, the control system logic for safe and reliable operation shall be based on either a fault tree analysis in accordance with IEC 61025, or a ladder logic diagram based on the operating logic and required safeties identified on drawing, NAVSEA No. 53711-573-6723832, Elevator Hybrid Relay Controller – No Hatch. If the weight capacity of Navy standard cargo elevators is increased or the design is modified in some other fashion, the elevator shall meet the requirements of Appendix I. Other fixed cargo movement devices shall meet the requirements of Appendix I. Skipbox hoists and single wire platform lifts shall be limited to 907 kg or less.

- c) **Trunks.** – Trunks used to enclose vertical handling equipment shall be provided with fumetight doors or powered hatches at each cargo opening. Hinged doors shall be powered if the door width exceeds 1070 mm. Vertical handling equipment shall be interlocked to prevent operation until the doors are closed. Doors or a fixed (nonmoving) means shall be provided to prevent fully loaded MHE and AHE from falling into trunks when struck at speeds of 3.2 kilometers per hour or less. Personnel, MHE, and AHE shall be prevented from falling into open hatchways.

If trunks are not used to enclose vertical handling equipment, the following requirements apply. Barriers or other means shall be provided to prevent personnel from falling into the opening when the lifting device is not present at the deck level. Vertical handling equipment shall be interlocked to prevent operation until the barrier is secured in place. Means shall be provided to prevent fully loaded MHE and AHE from falling into lifting device openings when struck at speeds of 3.2 kilometers per hour or less. Means shall be provided to completely close off each cargo opening to minimize the spread of fire and prevent unauthorized access to the hold.

- d) **Automated pallet stowage and retrieval systems.** – All automated pallet stowage and retrieval systems shall meet the requirements for ⚡APLUS classification under Part 6, chapter 2, section 4, subsection 5 of the ABS Rules for Building and Classing Steel Vessels. Features critical to safety and reliability shall be provided based upon a fault tree analysis. Automated pallet stowage and retrieval systems provided for use with ordnance shall also be in accordance with Appendix I.