MIL-HDBK-1025/3
30 April 1987
SUPERSEDING
NAVFAC DM-25.3
July 1981

MILITARY HANDBOOK

CARGO HANDLING FACILITIES

NO DELIVERABLE DATA REQUIRED BY THIS DOCUMENT

DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED

AREA FACR

THIS PAGE LEFT INTENTIONALLY BLANK

ABSTRACT

Basic criteria for cargo handling is presented for use by experienced engineers. The contents cover considerations for the handling of cargo between vessel and dock, vessel and shore, and for the handling of cargo in pier sheds.

THIS PAGE LEFT INTENTIONALLY BLANK

FOREWORD

This military handbook is one of a series developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFACENGCOM), other Government agencies, and the private sector. This handbook uses, to the maximum extent feasible, national professional society, association, and institute standards in accordance with NAVFACENGCOM policy. Deviations from these criteria in the planning, engineering, design, and construction of naval shore facilities cannot not be made without prior approval of NAVFACENGCOM Headquarters (Code 04).

Design cannot remain static any more than the naval functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged from within the Navy and from the private sector and should be furnished to Commander, Atlantic Division (Code 04A4), Naval Facilities Engineering Command, Norfolk, VA 23511-6287 telephone (804) 444-9970.

This handbook shall not be used as a reference document for procurement. Do not reference it in Military or Federal specifications or other procurement documents.

WATERFRONT CRITERIA MANUALS

Manual Number	Title	PA
DM-25.01	Piers and Wharves	L
DM-25.02	Dockside Utilities for Ship Service	L
MIL-HDBK-1025/3	Cargo Handling Facilities	L
DM-25.04	Seawalls, Bulkheads, and Quaywalls	L
DM-25.05	Ferry Terminals and Small Craft Berthing Facilities	L
25.06	General Criteria for Waterfront Construction	L

CARGO HANDLING FACILITIES

CONTENTS

FIGURES

TABLES

SECTION 1: INTRODUCTION

1.1 Scope. This handbook covers handling facilities and operations for the transfer of cargo from vessel to piers and wharves and from vessel to shore, and vice versa, and for the handling of cargo in pier sheds.

1.2 Cancellation. This publication, Cargo Handling Facilities, MIL-HDBK-1025/3, cancels and supersedes DM-25.3, Cargo Handling Facilities, dated July 1981.

1.3 Related Criteria. For related criteria, refer to NAVFAC sources itemized below.

Subject	Source
Piers and Wharves Mobile cranes, container cranes, and forklifts	NAVFAC DM-25.01
Weight Handling Equipment Characteristics and selection factors for cranes	NAVFAC DM-38.01
Pontoon System Manual	P-401
Primary Lightning Protection Design for Ordnance Handling Facilities - Crane on Pier and Wharf - Design Criteria	DD-1041109
Primary Lightning Protection Design for Ordnance Handling Facilities - Crane on Pier and Wharf - Examples No. 1 and No. 2	DD-1041110
Oil Spill Containment for Berthing Facilities	DD-1404371

1.4 General. Movement of cargo requires the basic material handling equipment necessary to load and discharge vessels. For planning ship-to-shore transfer of cargo, various factors such as working conditions, commodities, and materials to be handled must be considered. In general, determination of appropriate handling equipment shall consider:

a) Various commodities and materials to be handled;
b) Operations and processes and their sequencing;
c) Workload.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 2: GENERAL CARGO FACILITIES

2.1 Shipboard Equipment. Where vessels are berthed at piers or wharves, direct transfer of cargo between docks and vessels may be made using ship's gear either alone or in conjunction with dock-mounted equipment. Typical examples of transfer gear include:

2.1.1 Conventional Burtoning Gear. This system consists of a pair of ship's booms, each stepped at the foot of a king post, so that one boom is fixed over the ship's hatch and the other over the pier. Cargo falls, used to lift cargo, run either by hydraulic, electric, or steam-operated winches, and pass through the boom head by means of fairleads (heel blocks, lizards, and head blocks). They are then married together at a common point above the cargo hook (see Figure 1). Modifications of this gear are possible to meet special conditions. For maximum gear capacity, double up the system or use as a single boom. The capacity of burtoning tackle is generally 2 to 3 tons (1 814 to 2 722 kg) and occasionally 5 tons (4 536 kg). Also, see Saurbier, Charles L., Marine Cargo Operations, Chapter 6.

2.1.1.1 Advantages. Relatively simple in design, entails economical fuel costs, relatively simple maintenance requirements, and elimination of highly skilled operators.

2.1.1.2 Disadvantages. Requires maximum load limitation, lacks flexibility (fixed booms are deficient in spotting abilities), entails time loss on respotting and doubling up to achieve maximum capacity, danger involved in rigging the gear, and limited over-the-side reach.

2.1.2 Farrel Rig. This system is similar to the conventional burtoning gear except that the working guys are made fast to vang posts that are erected on deck. There are no midship guys, and the topping lift lead block assumes a position at or near the vessel's centerline. Efficiency is improved by providing winches for the topping lifts.

2.1.2.1 Advantages. Topping or lowering can be accomplished without lengthening or shortening the guys. It has greater spotting ability, ensures reduction of port time, is safer than conventional burtoning systems, and has pushbutton control over topping lifts.

2.1.2.2 Disadvantages. It has greater initial and maintenance costs due to the need for vang posts and topping lift winches. These disadvantages are minor.

2.1.3 Ebel Rig. This rig is similar to the farrel rig, but employs winches for both guying and topping. Vang posts are not used.

2.1.3.1 Advantages. Loads up to maximum boom capacities can be handled if doubling-up blocks are properly employed. Guying and topping are accomplished entirely with pushbutton control. If winches are provided with "joy stick" operated master switches, both motions can be controlled by one hand. Other advantages include greater spotting ability, increased safety, reduction of port time, and improvement in deck housekeeping.

2.1.3.2 Disadvantages. Insignificant.

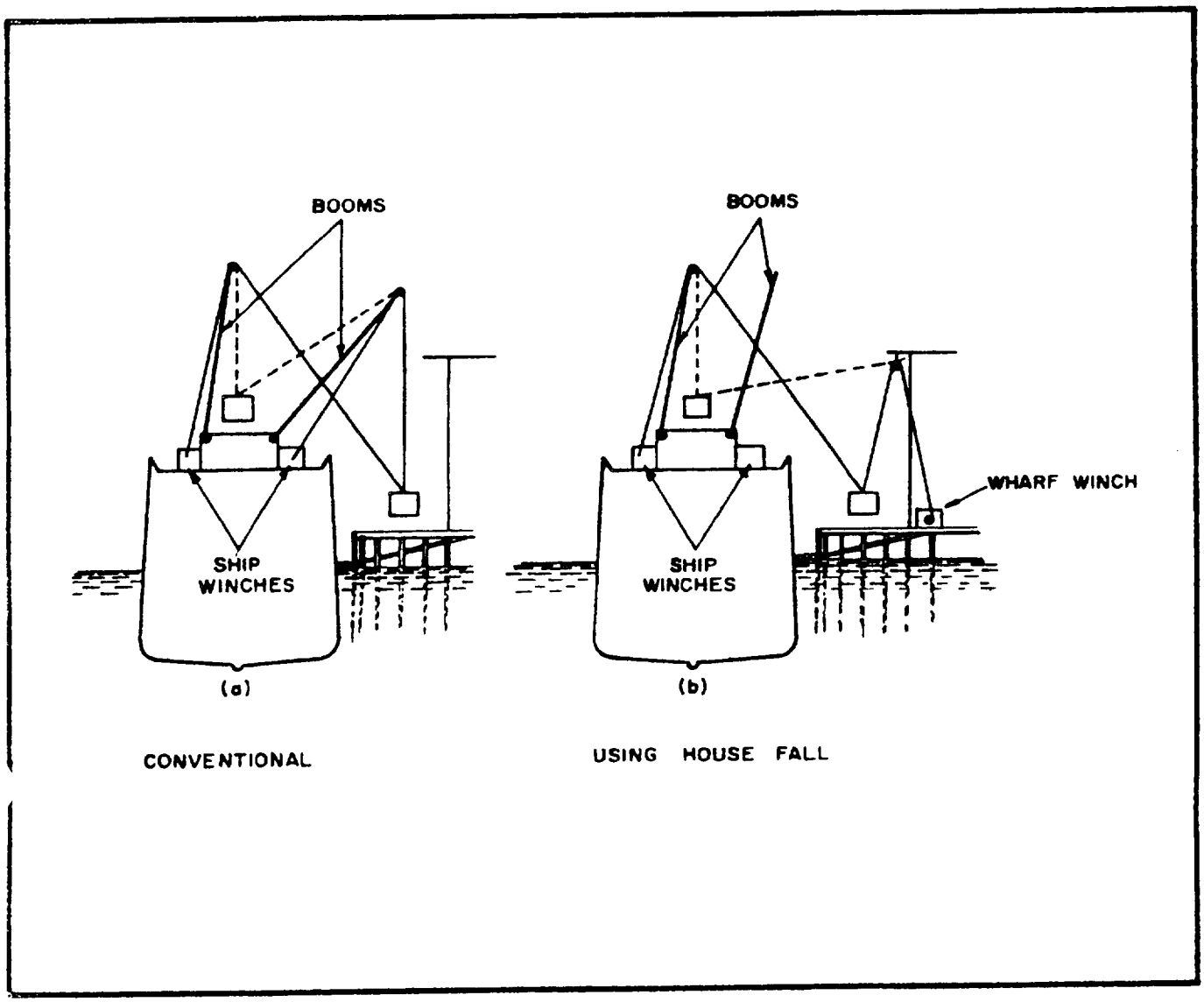


FIGURE 1
Burtoning System

Courtesy of Abbett, Robert W., American Civil Engineering Practice, John Wiley and Sons, Inc., New York, NY.

2.1.4 Jumbo Boom. In general, all U.S. cargo ships have one or more jumbo (heavy lift) booms located at strategic hatches on the vessel. These booms usually are stepped in a pedestal mounted along the centerline of the vessel. When not in use, they are collared aloft.

2.1.4.1 Advantages. There is greater over-the-side reach than with conventional burtoning gear, plus high capacity. When backstays are used, capacities up to 60 tons (54 431 kg) or more are common.

2.1.4.2 Disadvantages. More personnel are required to operate the system. Other disadvantages include slow operation, boom must be used as a swinging boom (slewing), readying gear from secured position is time consuming, limited maximum capacity, dangerous (when lowering heavy weights), and additional space is required to stow auxiliary gear when not in use.

2.1.5 Shipboard Crane. The shipboard crane is another means of handling cargo with ship's gear. It has been found, in certain trades, to be faster than the boom mast/king post rigs (see Saurbier, Charles L., Marine Cargo Operations).

2.1.6 Siporter. The siporter is a specialized means of handling cargo limited in quantity and of limited types. It consists of a set of booms (laterally slid into position) which extend out from the vessel's side just above the sideport. The booms support trolleys and hoisting blocks. When not in use, the booms are housed within vessel space. (See Saurbier, Charles L., Marine Cargo Operations, for additional information.)

2.1.7 House Fall. Certain piers (particularly those with narrow aprons or two-deck levels) are equipped with cargo masts which may be used in combination with the vessel's regular cargo handling gear. The usual method is to rig the ship's offshore boom and winch to manipulate the up-and-down fall, and the cargo mast and dock winch to manipulate the burtoning fall. The latter is referred to as the house fall (see Figure 1).

2.1.7.1 Advantages. These include increased over-the-side reach, an occasional lateral view of the entire width of the pier apron, and ability to work second deck levels by regular burtoning gear. Also, since the onshore boom is not employed, the danger of this boom contacting the pier terminal is eliminated.

2.1.7.2 Disadvantages. Assembly and disassembly are time consuming.

2.2 Shore-Based Equipment. Types of shore-based equipment are indicated below. The amount and type of equipment required will vary according to the volume of cargo handled. For characteristics and selection factors for cranes, see NAVFAC DM-38.01, Weight Handling Equipment.

2.2.1 Tracked Cranes. These cranes include rotating and nonrotating types which travel along a pier or wharf on tracks. Portal, tower, and locomotive cranes pick up and deposit cargo by vertical lifting and lowering of the hooks and rotation of the boom. Some portal tower cranes employ a level luffing feature. Gantry, semigantry, and cantilever gantry cranes utilize vertical movement of the hooks and horizontal translation of the hook by means of a trolley.

2.2.1.1 Advantages. Loads may be picked up or lowered at any loading point on the ship and deposited or picked up anywhere on the pier or wharf within the reach of the crane's boom or trolley. The crane can service heights above the decks of the ship not ordinarily reached by the ship's gear. In the case of heavy-lift cranes, maximum capacities often exceed those of the ship's jumbo booms. These cranes can be fitted with various attachments such as clamshells or grab buckets for handling bulk cargoes.

2.2.1.2 Disadvantages. Initial high cost, and mobility is limited to the areas covered by the tracks.

2.2.2 Mobile Cranes. This category includes rubber-tired truck cranes and crawler cranes. Portal type cranes have been adapted to operate on rubber tires in lieu of steel-wheeled assemblies for running on tracks. The normal lifting capacity range generally used at ports is between 50 and 140 tons (45 359 and 127 006 kg). Heavier capacity models are also available. The mobile truck crane is the prime mover of heavy cargo and repair parts for most naval vessels. (See NAVFAC DM-25.01, Piers and Wharves, for capacities, reaches, and imposed loads on piers and wharves.) Mobile cranes have virtually unlimited coverage on areas that are capable of supporting their loadings.

2.2.3 Container Cranes and Related Equipment. Most container vessels do not have shipboard cranes to handle containers, and onshore container cranes will usually be a requirement. The most common type is the tracked gantry crane designed specifically for container handling. Such cranes, which generally constitute a permanent installation, ride on fixed rails and can readily be spotted at any required lift location along the pier or wharf. They normally are available in lifting capacities ranging from 30 to 50 tons (27 216 to 45 359 kg). Some cranes are capable of lifting substantially more weight. Normally, one or more cranes working will unload and load a container ship with a normal cycle time of 3 to 4 minutes or 15 to 20 containers an hour per crane. Two cranes can unload an average size container ship in 18 to 20 hours. Container cranes may be fitted with various attachments, such as clamshells or grab buckets for handling bulk cargo, and hooks for breakbulk cargo. Other types of cranes also are used in container handling between vessels and shore. Typical examples are truck or crawler type mobile cranes fitted with container lifting spreaders. Such cranes are generally used on conventional piers and wharves which have not been equipped with container cranes. Figure 2 is a graphic summary of container handling systems. For details regarding container cranes, design criteria for containerized wharves and piers, and other related transfer equipment, refer to NAVFAC DM-25.01. Typical outside container dimensions appear in Table 1.

2.2.4 Conveyors. Conveyors are employed for handling bulk or relatively small packaged goods, but their limited maximum lifting capacity restricts their usage to relatively light cargoes. There are various accessory attachments and equipment which are selected for a specific cargo transfer that increases the efficiency of the handling operation. There is a wide variety of conveyors, including gravity, power, and air-driven types, that move cargo over a fixed inclined or horizontal route.

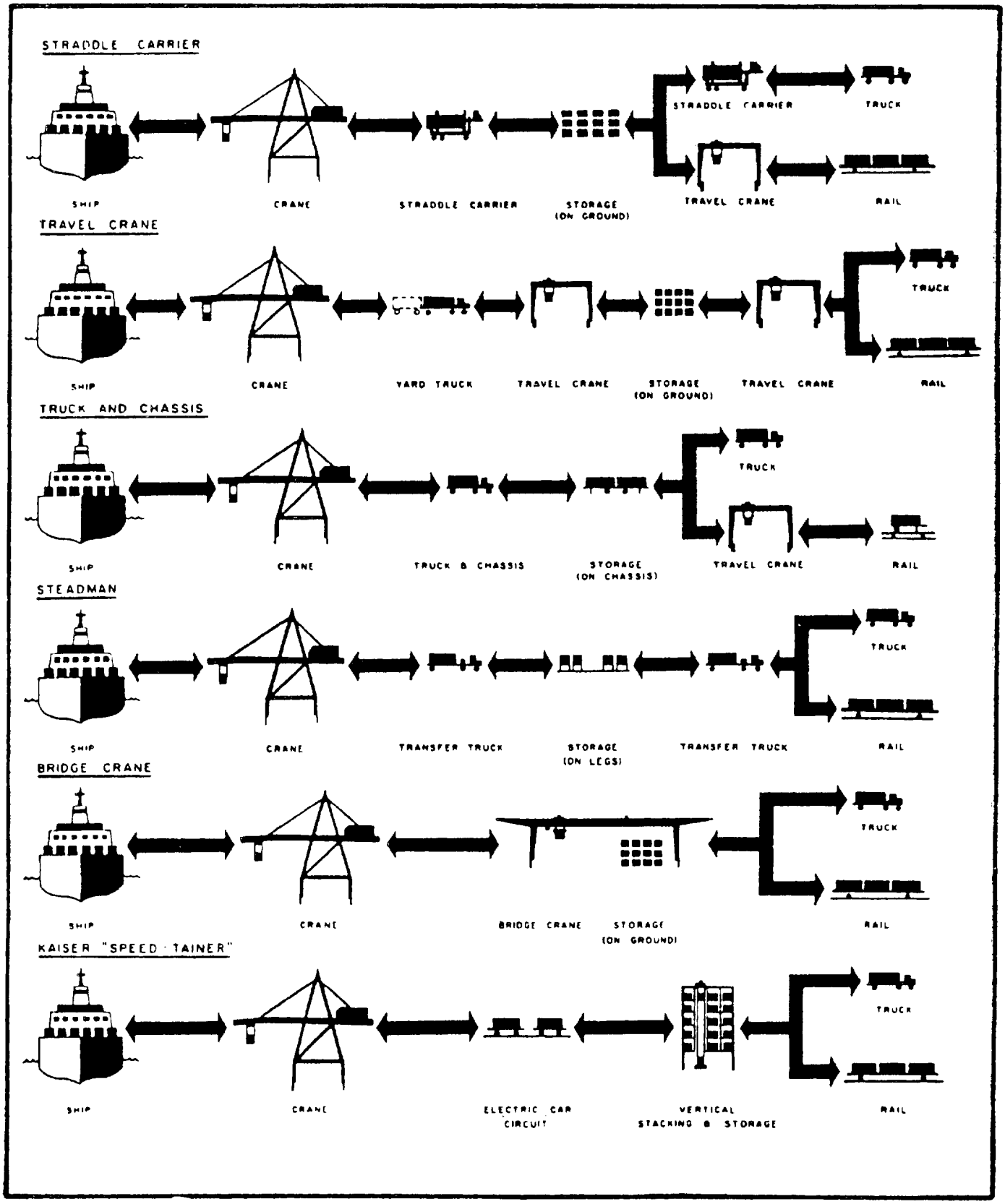


FIGURE 2
Graphic Summary of Container Handling Systems

Courtesy of Port Planning, Design, and Construction, The American Association of Port Authorities.

Table 1

Outside Container Dimensions[1]

Container Designations	Military Terminology	Reference Size	Length ft. in.	Dimensions Width ft. in.	Dimensions Height ft. in.	Maximum Gross Weight (Pounds)
1A		40-footer	40	8	8	67,200
1B		30-footer	29 - 11 1/4	8	8	56,000
1C	MILVAN	20-footer	19 - 10 1/2	8	8	44,800
1D		10-footer	9 - 9 3/4	8	8	22,400
1E	TRICON	---	6 - 5 1/2	8	8	15,700
1F	QUADCON	---	4 - 9 1/2	8	8	11,200
		24-footer[2]	24	8	8 - 6 1/2	56,000
		35-footer[2]	35	8	8 - 6	78,400
		CONEX[3]	6 - 3	8 - 9	6 - 10 1/2	8,960

1 Source: ISO 668 - 1976(E)

2 These containers are obsolete, used only by three U.S. shippers, and have not been permitted since January 1982.

3 These containers are obsolete and have not been manufactured since early 1950.

NOTE: Marine containers are now nonstandard and will be phased out as rapidly as possible.

2.2.4.1 Skids and Chutes. In spiral chutes, packages move by force of gravity and, by centrifugal force, tend to move to the outside of the spiral. A disadvantage is that cargo bundles moved from a deck on to a sloping runway reach a point where they topple over. This can cause tall packages to fall forward. Skids and chutes are capable of handling a wide range of articles. Spiral chutes require no power, entail low maintenance costs, make economical use of space, and permit selective discharge at different elevations.

2.2.4.2 Roller Conveyor. This device requires a grade ranging from 3 to 7 percent to permit free rolling. The elevation changes are usually 5 to 10 feet (1.5 to 3.0 m) per stage. Roller and wheel conveyors are relatively inexpensive and light compared to other devices. Manually-loaded package conveyors are limited to articles which one person can carry unaided (up to 100 pounds (45 kg)). Roller conveyors with capacities as high as 10 tons (9 072 kg) are available. The speed of individual rollers is usually about 250 rpm.

2.2.4.3 Belt Conveyor. Many articles moved over a fixed route are carried on some form of powered, endless belt. In general, articles that can be transported on wheels or rollers will ride well on a belt. Standardized conveyor elements for particular requirements and units which can be rearranged or added if there are changes in operating conditions are readily available manufactured items. Few material handling operations require more careful measuring than that needed in floor-to-floor conveyor-line planning.

2.2.4.4 Chain Conveyor. This device pulls or pushes cargo by direct contact. The entire length of the endless chain is actuated by a single source of power. Typical load ranges are between 75 and 600 pounds (34 and 272 kg) and typical speed is 30 fpm (9 m/min). Compared to belt conveyors, drag chain conveyors permit greater flexibility in the path of travel and are relatively simple to operate.

2.2.4.5 Screw Conveyor. This device consists of a spiral member that winds around a circular shaft. Material is advanced by the action of the helical screw as it turns. It is a relatively inexpensive means of conveying pulverized or granular materials. In standard lengths, sections are coupled together.

2.2.4.6 Pneumatic Tubes. These devices (pressure and suction types) are employed to convey light, free-flowing materials by means of moving columns of air. These tubes have been used for handling such items as grain and powdered substances.

2.3 Special Equipment. The devices described below are used to lift and move loads through the air along fixed paths and over limited areas.

2.3.1 Aerial Tramway. Aerial tramways transport materials and passengers from loading point to discharge point by means of overhead steel cables and ropes supported by one or more spans. Movement is intermittent over a fixed path. Effectiveness depends on the types of loads handled.

2.3.2 Aerial Ropeways. Aerial ropeways may be employed where ships must transfer relatively lightweight cargo at open roadsteads (see Figure 3). They have also been used with advantage, during and after wars, in harbors where piers and wharves have been destroyed through enemy action.

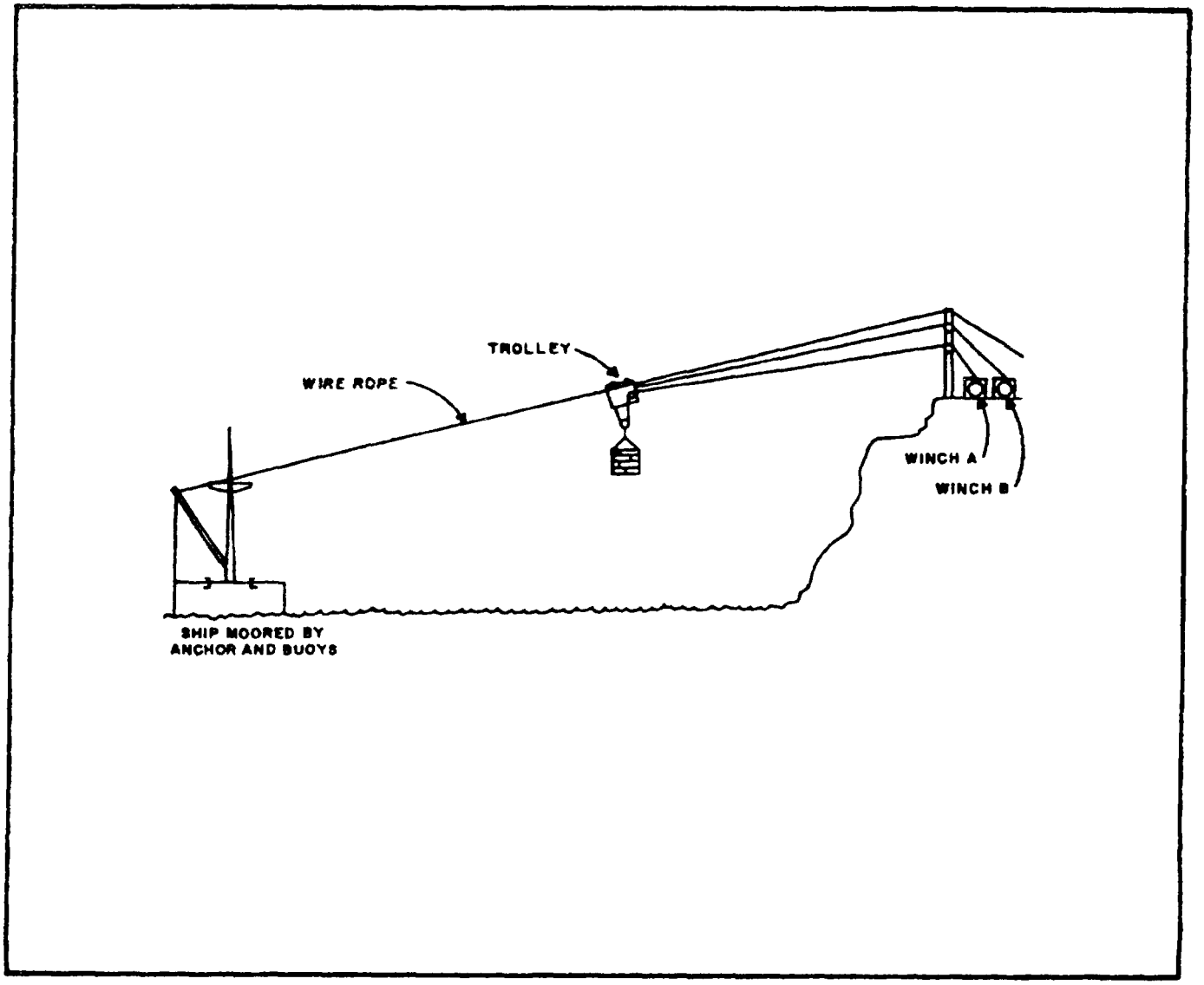


FIGURE 3
Aerial Ropeway

Courtesy of Saurbier, Charles L., Marine Cargo Operations, John Wiley and Sons, Inc., New York, NY.

2.3.2.1 Advantages. These ropeways may be adapted to a wide range of topographical conditions. Vessels anchor and moor to buoys off the ropeway terminal.

2.3.2.2 Disadvantages. Unable to handle heavy loads. Assembly and disassembly are time consuming.

2.3.3 Over-the-Beach Highline Transfer. This device is a tensioned highline supporting a self-propelled trolley which runs from an offshore platform to an onshore terminal point. Loads are transferred from cargo ships to the platform and thence via highline to the beach. The self-propelled trolley can travel approximately 1,300 fpm (396 m/min) along the highline.

2.3.4 Helicopters. Used to unload containers and other large pieces.

2.3.5 Lighter-Than-Air-Devices. Controlled balloons used to unload containers and other large pieces.

2.3.6 Hydrofoils. Used to transport light cargo loads.

2.4. Floating Equipment.

2.4.1 Floating Cranes. There are barge-mounted cranes (some self-propelled) serving a wide variety of uses. Lifting capacities range from a few to 500 tons (453 600 kg) and more.

2.4.1.1 Advantages. High capacity and elimination of "breaking out" the ship's jumbo boom for heavy lifts.

2.4.1.2 Disadvantages. High cost of renting the equipment, which may not be readily available.

2.4.2 Pontoon Causeway. This device provides the final bridge from ship-to-shore. When used in conjunction with LST's, it provides a simple, rapid, and effective means of unloading. It is deficient in severe tidal ranges and extensive mud flats. (For further details, see P-401, Pontoon System Manual.)

2.4.3 Bow Ramp Causeway. This is used successfully by LST's with bow ramps for direct vessel-to-beach transfer of vehicles and material.

2.4.4 Pontoon Wharf. This type of cargo receiver is made of two pontoon bridge sections extending from shore abutments and connected to a floating barge section. The pontoons, consisting of steelplate buoyant boxes, are of the Navy Lightered Pontoon type. When used with other pontoons, they form a floating wharf. Many configurations are possible. The pontoons and barge are held in place by spud moorings (loop guides and piles) or, alternatively, by a system of bottom anchors and lines. For further details, see NAVFAC DM-25.01 and P-401.

2.4.5 Self-Propelled Causeway. Pontoons with power are carried by the vessel, allowing it to operate its own ferry and provide ship-to-shore transfer. The cargo can either be rolled on/rolled off or lifted on/lifted off. A string of causeways can safely transmit surf zones and flat beach gradients. With the addition of a winch and A-frame, the self-propelled

causeway section is transformed into a side-loadable tug. Each standard causeway section can carry a load of 105 tons (95 254 kg) of cargo with a resulting draft of 4 feet (1.2 m). For further details, see NCEL Technical Note 1625, Container Offloading and Transfer System (COTS).

2.4.6 Elevated Causeway. Pontoon module sections are jointed to create an elevated causeway. This eliminates surf-induced motion and breakup and provides a solid platform for a container handling crane to lift containers from landing craft and barges. The system is derived from LST-delivered causeways. Pontoons can be elevated in 5- to 7-foot (1.5 to 2.1 m) surf conditions at an overall rate of 2 hours per section. It eliminates the slow transportability of the DeLong pier (see paragraph below titled "Portable Piers (Spud Barge)") and the linking of the DeLong to the shore. For further details, see Technical Note 1625.

2.4.7 BARC. This is the U.S. Army's Barge Amphibious Resupply Cargo (BARC) vehicle. It is 62 feet (19 m) long, 27 feet (8 m) wide, and 16 feet (5 m) high, and has a normal payload of 60 tons (54 430 kg). It may be used in cargo handling only when beach conditions are most favorable.

2.4.8 Portable Piers (Spud Barge). These are floating barges which can be brought to the site and rapidly installed to form a fixed pier for cargo offloading. They jack themselves out of the water by means of large cylindrical piles. One disadvantage is the slow speed of towing to the site. An example is the DeLong pier which has been widely used in over-the-beach operations.

SECTION 3: BULK CARGO FACILITIES

3.1 Bulk Cargoes. Bulk cargoes are frequently stored in piles on the ground where they are exposed to the elements. Characteristics of the materials must be considered when planning for stockpiling. Dock or upland areas must be adequate to accommodate such stockpiles, which may be 60 to 80 feet (18 to 24 m) high for ore and 20 to 30 feet (6 to 9 m) high for coal.

3.1.1 Elevated Storage. Bins, bunkers, silos, and sheds may be utilized when land areas near the waterfront are inadequate to provide sufficient ground space for open storage or where the commodity must be stored under cover.

3.1.2 Coal Handling Facilities. The tilting system, unloading bridges, and towers normally used in coal handling are listed below.

3.1.2.1 Tilting System. Coal loading is usually accomplished by tilting a car's load into a hopper and discharging it by gravity into the vessel.

3.1.2.2 Unloading Bridges. These commonly used bridges span the coal storage pile and cantilever over the vessel. Trolley grab buckets are provided for recovering coal from the hold and dumping it into the stockpile or into hopper cars.

3.1.2.3 Unloading Towers. Coal is recovered from the hold by the use of grab buckets and dumped into hoppers in the towers. It is then conveyed by gravity to railroad cars or to a conveyor linked to the stockpile.

3.1.3 Oil Terminals. Equipment requirements are limited to storage tanks, hoses, hose-handling facilities (such as hose towers and fuel arms), and oil spillage containment and cleanup equipment.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 4: OTHER TRANSFER SYSTEMS AND SCHEMES

4.1 Lash System. This is a system whereby oceangoing motherships transport cargo-carrying barges of uniform dimensions. The barges are lifted on or off the mothership at the stern by a specially designed heavy lift traveling crane which is an integral part of the ship's equipment. The barges are towed between the mothership and shoreside facilities.

4.2 Seabee System. This system also consists of motherships transporting cargo barges of uniform sizes. Barges are carried two abreast on three levels. The barges are moved both fore and aft on deck by a powered transporter. Access from the water to each deck level is accomplished at the stern where a 2,000-ton (1 814 000 kg) capacity elevator handles the barges vertically. The elevator can handle two fully loaded barges simultaneously. Overhead clearance below deck is 18 feet (5.5 m).

4.3 Lighter System. Cargoes are transferred by ship's gear from vessel to lighter. This system is generally used when vessels are moored offshore or in harbors or where cargoes are brought to a berth by water rather than land transport. There is a wide range of lighter sizes and capacities.

4.4 Roll-On/Roll-Off. Packaged cargo units (containers, trailers, or freight cars), as well as a wide variety of equipment and other items capable of wheeled or tracked movement, are rolled on or off vessels especially constructed for this purpose. Where permanent piers or wharves are not available, floating platforms and ramps can provide for interface between roll-on/roll-off vessels and pontoon causeways. Cargo can be rapidly loaded and unloaded by such vessels. This system is gaining increasing use of ocean transport, due principally to its capability of accommodating efficiently virtually all types of lading that can be moved on wheels. These include high and wide, heavy lift, and out-of-gauge cargoes which would require time-consuming and complicated handling on other vessel types.

4.4.1 Military Roll-On/Roll-Off Vessel Requirements. Military support vessels such as the newer LST's are equipped with in-line bow and/or stern ramps. For LST bow ramp configuration and vessel characteristics, see SRD No. 845-2497341, Booklet of General Plans for the LST 1179. Such vessels, when alongside piers or wharves, often combine lift-on/lift-off operations using shore cranes with roll-on/roll-off activities. When berthed at piers or wharves, these vessels require a protruding shore ramp to enable interface with the pier or wharf and load or discharge roll-on/roll-off cargo. Ramp configuration and characteristic requirements vary from one support vessel type to another. Particular requirements of these vessels must be taken into account in the design of ramps to ensure effective roll-on/roll-off cargo operations.

4.4.2 Commercial Roll-On/Roll-Off Vessel Requirements. Some roll-on/roll-off ships (primarily European vessels) are self-sustaining, requiring only a stable platform to which their ramps can be lowered for transfer of cargo. Such vessels range in size from shallow draft coastal types to long-range ships of greater than 30,000 dwt (deadweight tons) (10 480 kg). While stern ramps predominate, some designs incorporate bow and side ramps. An increasing number of the newer vessels have quarter ramps or slewing ramps

which facilitate the vessel's capability to adapt to a wide variety of berthing conditions. Roll-on/roll-off vessels having quarter or slewing ramps can berth alongside most conventional cargo piers with no special adaptation needed to the facilities, provided there is sufficient apron width and pier deck loading capacity to permit the ramp to be landed and roll-on/roll-off cargo to be moved on and off the vessel. Both quarter and slewing type ramps are designed to hinge out at an angle from the vessel to the pier when in the lowered cargo handling position. In the case of roll-on/roll-off vessels having only in-line stern or bow ramps, some form of protruding ramp or platform is necessary at conventional piers or wharves. Criteria for standardization of ramp configurations are contained in Arvidson, L., Report of the IAPH Sub-Committee on Standardization of RO/RO Ramps and in Abbott, B., Report from ICHCA on RO/RO Ramp Standardization. It should be anticipated that commercial roll-on/roll-off vessels may be chartered to transport amphibious follow-on and resupply cargo. In this connection, plan for authorized new pier construction or major pier modification at ports that are now or might become emergency ports of embarkation listed in Table 2.

4.4.3 Additional Information. For further details see Technical Note 1625, Container Offloading and Transfer System (COTS).

4.5 Crane on Deck (COD). This principle consists of placing a mobile crane on deck. It is an expeditious way of making the vessels self-sustaining when conventional gantries or other cranes are unavailable. For further information, see Technical Note 1625.

4.6 Monorail Wharf. This system will permit monorail cars carrying 10-ton (9072 kg) loads on each trip to discharge cargo from three to five ships simultaneously at a rate of approximately 600 tons (544 310 kg) per hour. There are three major system elements: ship mooring facilities, monorail ship-to-shore transport facilities, and shore facilities. Ships to be loaded or unloaded are moored alongside suitable dolphins placed to act as fenders protecting the monorail structure and to hold the ship in position. Under suitable weather conditions, ships may be moored in position without dolphins if proper use of buoys and anchors is made. Mooring platforms should be approximately 16 feet (5 m) wide and 50 feet (15.2 m) long and should support 40 tons (36 300 kg) of cargo. Cargo handling is limited only by the ship's ability to place the cargo on the loading platforms.

4.7 Tip-Off. Cargo is stowed on brackets on the side of the ship and arranged so that it can be released and tipped off into the water.

4.8 Float-Off. This principle is relatively simple. The ship, ballasting down, floats preloaded boats (LVT's, LCM's, etc.) which proceed to the beach. Typical of this class of vessels are LSD's, LPD's, and LPH's.

4.9 Hull Ports. Hull ports are openings in the side of the ship which are normally equipped with watertight doors. Hull ports offer a means of unloading directly from one level of the cargo space and reduce vertical cargo travel from the unloading level to the water line, landing craft, or pier.

TABLE 2

NAVY AND MARINE CORPS PORTS OF EMBARKATION FOR AMPHIBIOUS OPERATIONS

Facility	Closest Port		Commercial/Military Alternate Port	
	Location	Distance (mi.)	Location	Distance (mi.)
NAVAL CONSTRUCTION BATTALION CENTERS (NCBC)				
Gulfport, MS	Gulfport, MS	0	New Orleans, LA	90
			Mobile, AL	75
Davisville, RI	Narragansett Bay, RI	0	Providence, RI	20
Port Hueneme, CA	Port Hueneme, CA	0	Long Beach, CA	80
			Los Angeles, CA	80
			Coronado/San Diego, CA	180
MARINE CORPS BASES				
Camp Lejeune, NC	Morehead City, NC	35	Little Creek/Portsmouth/ Norfolk, VA	210
Camp Pendleton, CA	Coronado/San Diego, CA	40	Los Angeles, CA	75
			Long Beach, CA	75
			Port Hueneme, CA	140
MARINE CORPS AIR STATIONS				
Cherry Point, NC	Morehead City, NC	15	Little Creek/Portsmouth/ Norfolk, VA	190
El Toro, CA	Long Beach, CA	40	North Island/San Diego, CA	85
			Port Hueneme, CA	100

Source: NCEL estimates based on NAVSO P-2471, Official Table of Distances, and Rand McNally Road Atlas of U.S., 1977.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 5: SHED TRANSFER EQUIPMENT

5.1 Hand Trucks. Hand trucks are used for movement of packages too heavy for manual handling or for increasing the unit load of small packages. There are two types of hand trucks: two-wheel trucks, suitable for loads up to 600 pounds (272 kg), and four-wheel platform trucks.

5.2 Motorized Trucks. Motorized trucks are normally used for cargo transferred directly from the vessel out of the pier complex. Use of tractor-trailer combinations for towing platform trucks is common.

5.3 Forklift Trucks. Forklift trucks are useful for handling cargo in the shed or on the pier or wharf. Recommended aisle widths are listed below:

Forklift Capacity (lbs/kg)	Aisle Width (ft/m)
2,000/ 907	10/3
4,000/1 814	12/3.7
6,000/2 721	14/4.3
8,000/3 628	18/5.5
10,000/4 536	20/6

For wheel loads and dimensions of forklifts, see NAVFAC DM-25.01, Piers and Wharves. In addition, heavy-duty forklifts weighing 40 to 45 tons (36 288 to 40 823 kg) with lifting capacities of 20 tons (18 140 kg) or more are frequently used in roll-on/roll-off cargo operations.

5.4 Conveyors. See Section 2.

5.5 Straddle Carriers. Straddle carriers (see Figure 4) are used for handling lumber, pipe, rails, steel shapes, containers, and similar materials. The carriers may also be adapted for lifting multiple-pallet loads. For wheel loads for a straddle carrier, see NAVFAC DM-25.01.

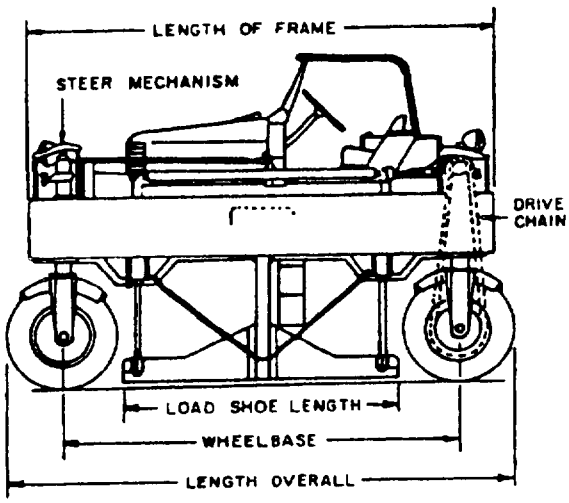
5.6 Crane Trucks. These are smaller types of mobile truck cranes which are used primarily in sheds. They are also used in narrow areas where they can pick up net slings or pallet sling loads that are bulky, complex shapes.

5.7 Overhead Traveling Cranes. Overhead traveling cranes are commonly used to handle cargo in transit sheds. These normally traverse one or more entire bays of the shed (see NAVFAC DM-38.01, Weight Handling Equipment, for criteria).

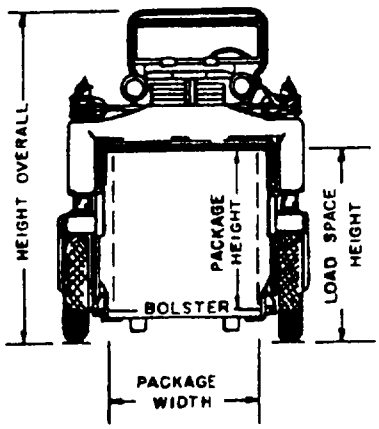
5.8 Monorails. Monorails keep the floor clear of vehicles and other obstructions. They are suitable where a single type cargo is to be conveyed over a fixed route. Monorails may extend beyond the sheds to the aprons. The principal disadvantage of a monorail system is its inflexibility.

5.9 Additional Shed Equipment.

5.9.1 Pallets. Pallets are used to place unit loads and transfer them to another point. The standard pallet measures 40 by 48 inches (1020 by 1220 mm) and has access on all four sides to accommodate forklift truck fingers.



SIDE VIEW



FRONT VIEW

FIGURE 4
Straddle Carrier

Courtesy of Haynes, D. Oliphant, Materials Handling Equipment, Chilton Company, Philadelphia, PA.

5.9.2 Pallet Dolly. This dolly has two fixed and two swivel casters. A unit load is assembled on a pallet resting on the dolly and the dolly is pushed to its destination.

5.9.3 Hand Pallet Truck. Hand pallet trucks are used to pick up, transport, and set down pallets. They are usually hydraulically controlled.

5.9.4 Hand Truck and Pries. These combine wheel and lever action in moving materials. Hand trucks and pries can be designed to carry cases, barrels, drums, kegs, bags, bales, and cylinders. Rubber-tire wheels are best for smooth operation.

5.9.5 Side Dump and End Dump. Trucks ride on or off tracks, generally pulled by a tractor. They are designed to handle dry materials when loading is done manually.

5.9.6 Mobile Dock Board. This is a lightweight ramp used to connect a tailgate of a truck to a loading platform so that cargo can easily be loaded from shed to truck.

5.9.7 Cargotainer. A wire-mesh container used to hold small parts for transport to various areas.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 6: ORDNANCE AND HAZARDOUS CARGO

6.1 Facilities and Handling. Ammunition and explosives are handled at facilities specifically designated for that purpose. Such facilities usually consist of finger piers and wharves equipped to handle truck, rail, and lighter shipments in transfer to and from oceangoing vessels. Shipments entering the facilities are first checked and inspected on onshore receiving stations which may be separated from the pier by as much as 2 or more miles. Shipments are moved from the receiving stations to the pier and loaded directly aboard ship. Lighters are received alongside vessels at the pier and loading is accomplished directly from lighter to vessel. Loading and transporter equipment at the facilities is electrically powered and must be equipped with explosion-proof motors. Shipments are loaded onto or discharged from vessels with electric shore-based cranes or with ship's gear. An example of an ammunition and explosives handling facility is the Navy Pier at Earle, New Jersey. This deep water pier, which extends approximately 2 miles from shore into Sandy Hook Bay, is equipped for rail and truck movements and can handle breakbulk, unitized, and containerized shipments.

6.1.1 FAST System. Fast Automatic Shuttle Transfer (FAST) is a mechanized transfer system designed primarily for, but not limited to, transferring guided missiles from the hold of a supply ship to the magazine of a combatant ship. It combines high transfer rates (900 fpm (274 m/min)) with maximum safety for personnel and missiles (either Terrier, Tartar, or Talos). The significant features of the system include mechanized handling from the hold, structural M-frame in lieu of boom/king post, highline tensioned by hydraulic rams, automatic, tensioned in-haul/out-haul winches, rig passed and tended by the sending ship, and sliding block for raising and lowering the load.

6.2 Specific Information. For specific information on ammunition and explosives handling and storage, refer to the sources listed below:

NAVSEASYSCOM

OP-5, Ammunition and Explosives Ashore

OP-3221, Shiploading and Dunnaging of Military Explosives Cargo Aboard Merchant-Type Ships

General Services Administration, Code of Federal Regulations (CFR), Title 46, Shipping, Transportation or Stowage of Explosives or Other Dangerous Articles or Substances, and Combustible Liquids Onboard Vessels

Joint Nuclear Weapons Publications System, Special Weapons Ordnance Publication (SWOP)

100-1, Supply Management of Nuclear Weapons Materiel

45-51 Series Transportation of Nuclear Weapons Materiel

THIS PAGE LEFT INTENTIONALLY BLANK

REFERENCES

Booklet of General Plans for the LST 1179, SRD-845-2497341

Container Offloading and Transfer System (COTS), Technical Note 1625, March 1982, Naval Civil Engineering Laboratory (NCEL) (Code L08A), Port Hueneme, CA 93043-5003

Joint Nuclear Weapons Publications System, Special Weapons Ordnance Publications (SWOP). Available from Officer in Charge, Naval Ordnance Station, Indian Head Detachment, Army Ammunition Depot, McAlister, OK 74501.

100-1	Supply Management of Nuclear Weapons Materiel
45-51 Series	Transportation of Nuclear Weapons Materiel

Marine Cargo Operations, Saurbier, Charles L., John Wiley and Sons, Inc., New York, NY.

Naval Facilities Engineering Command (NAVFAC) Design Manuals (DM), and P-Publications (P) available from the U.S. Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

DM-25.01	Piers and Wharves
DM-38.01	Weight Handling Equipment
P-401	Pontoon System Manual

Naval Facilities Engineering Command (NAVFAC) Definitive Designs (DD)

DD-1041109	Primary Lightning Protection Design for Ordnance Handling Facilities - Crane on Pier and Wharf - Design Criteria
DD-1041110	Primary Lightning Protection Design for Ordnance Handling Facilities - Crane on Pier and Wharf - Examples No. 1 and No. 2
DD-1404371	Oil Spill Containment for Berthing Facilities

Copies of DD's can be obtained from any of the following NAVFAC Field Division offices:

Commander (Code 406)
Atlantic Division
Naval Facilities Engineering Command
Building N26
Norfolk, VA 23511
Telephone: (804) 444-9906

Commanding Officer (Code 406)
Chesapeake Division
Naval Facilities Engineering Command
Washington Navy Yard, Building 212
Washington, DC 20374
Telephone: (202) 433-3314

Commanding Officer (Code 406)
Northern Division
Naval Facilities Engineering Command
Bldg. 77 Low. U.S. Naval Base
Philadelphia, PA 19112
Telephone: (215) 897-6090

Commander (Code 406)
Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, HI 96860
Telephone: (808) 471-8436

Commanding Officer (Code 406)
Southern Division
Naval Facilities Engineering Command
P.O. Box 10068
Charleston, SC 29411
Telephone: (803) 743-4214

Commander (Code 406)
Western Division
Naval Facilities Engineering Command
P.O. Box 727
San Bruno, CA 94066
Telephone: (415) 877-7111

Naval Sea Systems Command, National Center 3, Washington, DC 20362. Available from Naval Publications and Forms Center (NPFC), 5801 Tabor Avenue, Philadelphia, PA 19120.

OP-5 (undated)	Ammunition and Explosives Ashore (NPFC Stock No. 0630-LP-000-2131)
OP-3221 (Dec. 1, 1972 & Vol. 1, Sep. 1, 1976)	Shiploading and Dunnaging of Military Explosives Cargo Aboard Merchant-Type Ships (NPFC Stock No. 0631-LP-341-4002)

Official Table of Distances, Office of the Secretary of the Navy (NAVSO) P-2471 Supervisor of Shipbuilding Conversion and Repair, 495 Summer St., Boston, Massachusetts 02210. Copies can be obtained from the Commanding Officer, Naval Publication and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

Proceedings of the International Conference on Marine Transport, London, 21-22 June 1977.

Abbott, B., Report from ICHCA on RO/RO Ramp Standardization, pg. 147-148.

Arvidson, L., Report of the IAPH Sub-Committee on Standardization of RO/RO Ramps, pg. 137-145.

Road Atlas of the United States, Rand McNally Corporation, P.O. Box 7600, Chicago, IL 60680

Transportation or Stowage of Explosive or Other Dangerous Articles or Substances, and Combustible Liquids Onboard Vessels, Code of Federal Regulations (CFR), Title 46, Shipping, General Services Administration. Copies available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402

THIS PAGE LEFT INTENTIONALLY BLANK

GLOSSARY

Blocks. A wood or metal case enclosing one or more sheaves, and fitted with a hook, eye, or strap by which it may be attached to an object and used to change the motion or direction of the object.

Draft. Depth of vessel hull below the water line.

Fairlead. Pulley for change of direction or guide of a line.

Hatch. A deck opening over the cargo hold of a ship.

King Post. A short, strong tubular mast that supports cargo booms.

Lighter. Small vessel used for transfer of cargo from ship to dock (or vice versa) in shallow water harbors.

Lizard. A rope with a thimble or block spliced into one or both of the ends used as a fairlead in handling a ship's rigging.

Pier. A dock that is built from the shore out into the harbor and used for berthing and mooring vessels.

Ship's Boom. A long spar attached to the base of a mast or king post. Use as a derrick to handle cargo.

Vang Post. Posts holding vang ropes.

Vang Ropes. Either of two ropes extending from the peak of a boom to steady it when the boom is not cradled.

Wharf. A dock, oriented approximately parallel to shore and used for berthing or mooring vessels.

THIS PAGE LEFT INTENTIONALLY BLANK

KEYWORD INDEX

CARGO HANDLING FACILITIES -- SHORE-BASED EQUIPMENT
MIL-HDBK-1025/3 S2
-- SPECIAL EQUIPMENT
MIL-HDBK-1025/3 S2
-- STRADDLE CONVEYOR
MIL-HDBK-1025/3 S5
-- TIP OFF
MIL-HDBK-1025/3 S4

COAL HANDLING FACILITIES -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

CONVEYORS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

CRANES ON DECK -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

CRANE TRUCKS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

ELEVATED STORAGE -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S3

FLOATING EQUIPMENT -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S2

FLOAT OFF -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

GENERAL CARGO FACILITIES -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S2

HAND TRUCKS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

HULL PORT -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

LASH SYSTEM -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

LIGHTER SYSTEM -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

MONORAILS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

MONORAIL WHARF -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

MOTORIZED TRUCKS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

OIL TERMINALS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S3

OTHER TRANSFER SYSTEMS -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

ORDNANCE AND HAZARDOUS CARGO -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

OVERHEAD TRAVELING CRANES -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S5

ROLL-ON/ROLL-OFF -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

SEABEE SYSTEM -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S4

SHIP-BASED EQUIPMENT -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S2

SHORE-BASED EQUIPMENT -- CARGO HANDLING FACILITIES
MIL-HDBK-1025/3 S2

SPECIAL EQUIPMENT	-- CARGO HANDLING FACILITIES MIL-HDBK-1025/3 S2
STRADDLE CONVEYOR	-- CARGO HANDLING FACILITIES MIL-HDBK-1025/3 S5
TIP OFF	-- CARGO HANDLING FACILITIES MIL-HDBK-1025/3 S4

CUSTODIAN:

NAVY - YD

PREPARING ACTIVITY
NAVY - YD

PROJECT NO. FACR-0180

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 12503 WASHINGTON D C

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

Commander
Atlantic Division
Naval Facilities Engineering Command
Code 04A4
Norfolk, VA 23311-6287

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-HDBK-1025/3	CARGO HANDLING FACILITIES

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ EFD/PWO
- ☐ AE
- ☐ CONTRACTOR
- ☐ DICC/ROICC
- ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.

NAVFAC Overprint