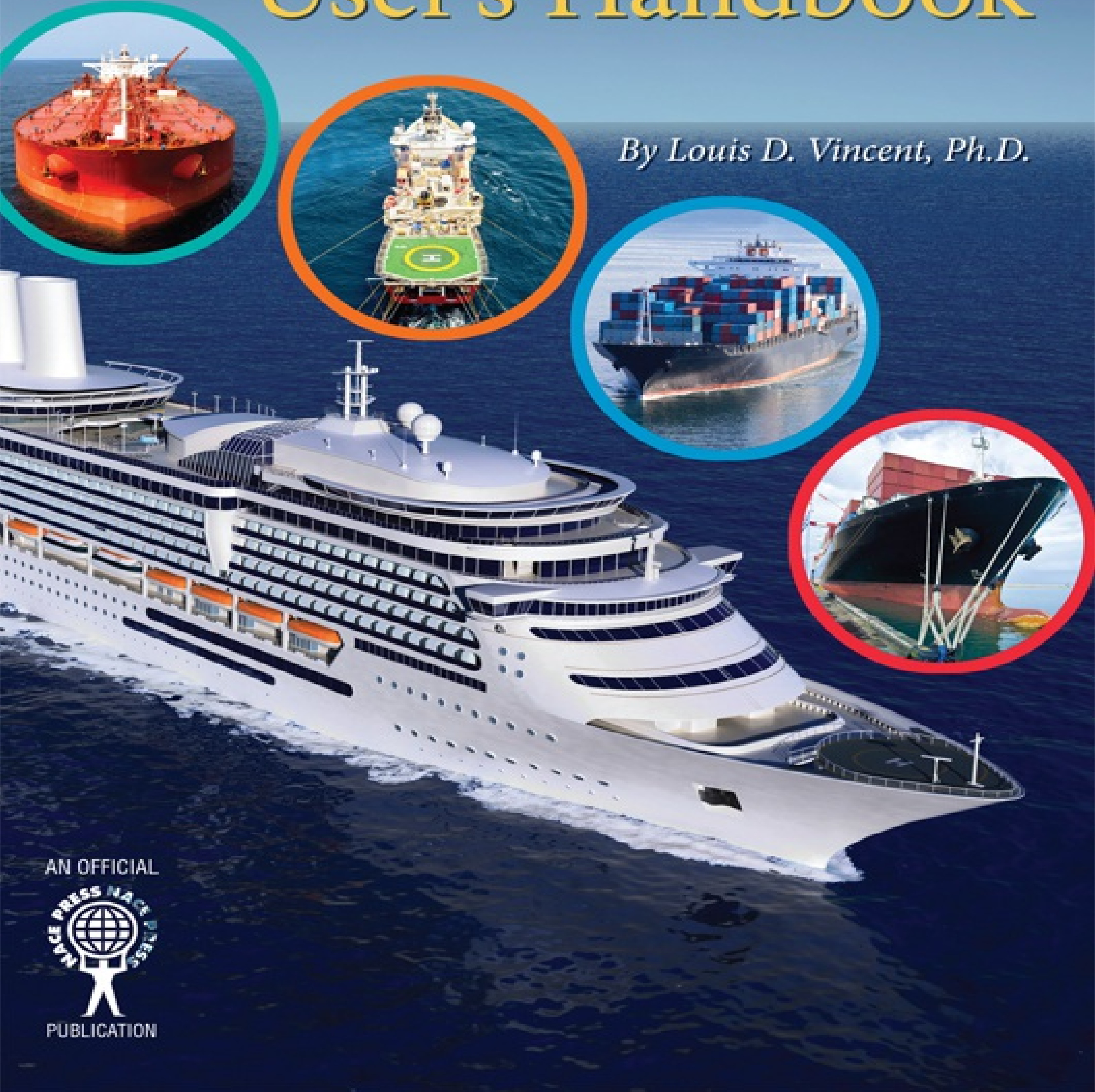
The Marine Coatings User's Handbook

By Louis D. Vincent, Ph.D.



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Contents

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CHAPTER 1

Painting in the Marine Environment

Mother Nature really does not like us humans to make changes to things she has created, such as the natural elements that make up the earth. This dislike is no better shown than when we attempt to put a man-made structure in a marine environment.

But build them we do—and in every shape, size, and type of material available, as well as for a variety of different uses. We can break down these structures into two different basic types: permanent and mobile. Although they all come from a basic floating platform concept, each is designed specifically for its intended use, which often makes it very difficult to paint compartments within the hull structure. For the purposes of this book, we consider only the mobile vessels as shown in the following pages. For each, we highlight the parts that are most difficult to paint and discuss typical coating systems for those areas at the end of this chapter. The following vessels are considered:

- Bulk cargo carriers (Figure 1.1) of various sizes (easily identified by their deck cranes for loading and unloading).
- Handysize—between 10,000 and 30,000 deadweight tons (dwt)
- Handymax—between 35,000 and 50,000 dwt
- Panamax—maximum size to transit the Panama Canal 50,000 dwt
- Capesize—between 80,000 and 150,000 dwt and trade around the Cape of Good Hope
- Container ships (Figure 1.2)—cargo ships that are specially built vessels second only to crude oil tankers and bulk carriers in size. Container ships are designed without any wasted space, with the capacity measured in twenty-foot equivalent units (TEUs) that they can carry, despite the fact that most containers today measure 40 to 48 ft (12 to 15 m) in length.
- Passenger ships (also known as cruise ships or cruise liners; Figure 1.3)— used exclusively for voyages from a base location to a holiday or vacation spot or spots. These are often referred to as the “Queens of the Seas.” One unique area that requires special care in these ships is the gray water tanks, which contain refuse from the galley and the dining areas on the ship. These can become quite toxic and are aggressive corrosively wherever there is a pinhole or holiday (discontinuity) in the coating system.
- Liquefied natural gas (LNG) ships (Figure 1.4)—These are specially designed ships that are capable of transporting liquefied natural gas (methane) at extremely cold temperatures (—260°F/—162°C). Not only must these ships have double hulls, but they also must be capable of isolating

- the LNG tanks from the ship structure; otherwise, the frigid temperatures can cause metal fatigue and structural failures. This usually involves expanded polyurethane foam between the tanks and the containment structure. To be able to support the weight of the tanks, as well as serve as insulators between the tanks and the support structure, closed cell foams with a density of 20 lb (9 kg) are commonly used.
- Crude oil tankers (Figure 1.5)—these ships are dedicated to the transport of huge volumes of crude oil from the world's production areas to the refining areas. Historically, they were designed with a single hull. After a series of environmental disasters due to hull ruptures, the class rules were changed to require double hulls—essentially, a tank within a tank—so that a puncture of the outer hull was less likely to also puncture the inner hull. All single-hulled tankers must be phased out of service by 2026, in accordance with the International Convention for the Prevention of Pollution from Ships, 1973 (Reference MARPOL 376). A detailed view of these double-skin compartments is shown later in Figure 1.11. Note that there is very little room for painters to work, making quality difficult to achieve.
- Crude oil tankers are classified as follows:
- Panamax—maximum size that can transit through the Panama Canal, which normally means an overall length of 965 ft (290 m), a beam of 106 ft (32.3 m), and a draft of 39.5 ft (12.04 m).
- Aframax—normally 80,000 to 119,000 dwt.
- Suezmax—maximum size that can transit through the Suez Canal, normally between 120,000 and 150,000 dwt.
- Very large crude carriers (VLCCs)—normally between 150,000 dwt and 320,000 dwt
- Ultra-large crude carriers (ULCCs) —in excess of 321,000 dwt, these are the largest movable man-made vessels. Currently, the largest is in excess of 564,000 dwt. These are so large that they often load and unload from deep-sea terminals because their draft and size prevent them from moving inland.
- Refined product carriers—smaller vessels designed to transport refined products, such as gasoline, jet fuel, and petroleum-based solvents. The tanks are much smaller than those on crude oil carriers, which makes them more difficult to prepare and coat. The coatings may be just inorganic zincs or may be several coats of high-performance epoxies.
- Chemical product carriers (Figure 1.6)—similar to refined product carriers but carry more highly complex chemicals, such as acids, caustics, reactive monomers, and alcohols. These are much more aggressive liquids than crude oil or refined oil; therefore, the coating systems must be very resistant to permeation of the cargo.
- Roll on/roll off ships (Figure 1.7)—these are basically huge floating garages in which vehicles of various sizes are driven directly into the massive cargo compartments and secured to the decks and bulkheads until they reach their delivery destinations, where the vehicles are driven off into parking lots at the port. These ships are easily distinguished both by their size and by how high they float. They are also easier to paint because of the large expanse of the internal compartments.
- General cargo ships (Figure 1.8)—historically, these were known as “break bulk cargo” ships because the cargo was at best palletized or boxed, but had to be loaded and unloaded manually. With the advent of container ships, general cargo ships are used mainly where port facilities do not have shore-based container cranes to do the loading and unloading; this basically limits their use to developing countries or poor third-world countries.

- Floating production, storage, and offloading (FPSO) vessels (Figure 1.9)—these were initially retrofits of existing VLCC ships to process oil or gas produced from a nearby platform and store it until it could be offloaded to a tanker or into a pipeline. A variation of this is the floating storage operation (FSO) vessel, which does not process the oil or gas; it only stores it prior to offloading to a tanker. Besides having the same painting difficulties encountered with crude oil tankers, these vessels have elaborate piping and processing systems that are as much as three levels high above the deck, making it very difficult to prepare the surfaces and paint.
- Drilling ships (Figure 1.10)—another offshoot of the oil and gas industry as it moved into waters too deep to operate from a platform fixed to the seabed is the drill ship, which is basically a VLCC-sized ship with a huge hole cut amidships, through which the normal drilling activities can be handled. These ships are every bit as difficult to paint as the FPSOs and FSOs, simply because of the dirty, oily, abrasive activities encountered while drilling for oil and gas.

FIGURE 1.1 Bulk cargo carrier.

FIGURE 1.2 Container ship.

FIGURE 1.3 Passenger ship.

FIGURE 1.4 LNG ship.

FIGURE 1.5 Crude oil tanker.

FIGURE 1.6 Chemical product carrier.

FIGURE 1.7 Roll on/roll off ship